DRAINAGE REPORT

7550 N Hummingbird Ln
Paradise Valley, Arizona

LDG PROJECT #1801024

Prepared for:
LDL Family Trust
8502 N 59th Place
Paradise Valley, AZ 85253

Submitted to:
Town of Paradise Valley
Engineering Department
6401 E Lincoln Dr.
Paradise Valley, Arizona 85253

Prepared by:
Land Development Group, LLC
8808 N Central Ave., Ste 288
Phoenix, Arizona 85020
Contact: Nick Prodanov, PE, PMP
P: 602 889 1984

REGISTERED PROFESSIONAL ENGINEER (CIVIL)
CERTIFICATE NO.
41005
NICKOLA
J.
PRODANOV
Date Signed 8/31/18
ARIZONA, U.S.A.
EXPIRES 06/30/2019

August 31, 2018

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APPENDICES

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1. INTRODUCTION

This drainage report and related civil engineering design have been developed in accordance with the current Maricopa County and Town of Paradise Valley drainage ordinances, standards, manuals and policies. It provides engineering analysis and assessment of the current and proposed drainage conditions that affect parcel 169-04-007, located at 7550 N Hummingbird Ln, Paradise Valley, AZ 85253 and also being Lot 38, mummy mountain park, according to the plat of record in the office of the county recorder of Maricopa county, Arizona, recorded in book 57 of maps, page 1, MCR, which is a portion of the SW ¼ of the NW ¼ of the NE ¼ of Section 8, Township 2 North, Range 4 East of the Gila and Salt River Base and Meridian, Maricopa County, Arizona. Refer to Appendix A-1 – Vicinity Map.

The project site is located within a residential subdivision Mummy Mountain Park and it is zoned R-43 (Hillside). The property is currently disturbed with an abandoned house, spilled slopes for the building pad and access driveway. The lot is sparsely vegetated and is approximately 4.922 acres. The site is surrounded by large residential lots and Hummingbird Ln on the easterly side. The proposed project will consist of a single-family residence, garages and access driveway to Hummingbird Ln.

A field survey and site inspections were conducted in March, 2018 to collect important information regarding the existing topographic characteristics, existing drainage conditions, to verify and confirm the extent of the tributary areas, local disturbances to the historic flows, and location and condition of the existing storm drainage structures. A topographic map was developed with a one-foot contour interval for the site and the adjacent street. Invert elevations of the existing culverts were picked up to facilitate the hydraulic calculations. The elevation contours and survey spot elevations are tied to the GDACS monuments and are based on the Town of Paradise Valley vertical datum (NAVD 88).

Aerial and topographic maps were collected from the Maricopa County GIS and USGS web sites to facilitate further and clearly delineate the limits of each drainage tributary area contributing runoff the subject property and conveyance corridors. Maricopa County, FCDMC and USGS maps, aerial photography and surveyed topographic map for the site were reviewed and used to establish the tributary areas within the watershed basin.

The analysis presented herein focuses on evaluating existing and proposed drainage conditions, as well as stormwater runoff resulting from a statistical evaluation of storm events of particular frequency, up to and including 100-year event as required by the Governing Agency. A storm event exceeding the 100-year will probably cause or create the risk of a greater storm impact than is presented and addressed herein.

2. DESCRIPTION OF EXISTING DRAINAGE CONDITIONS AND CHARACTERISTICS

The hillside is covered with native desert vegetation, disturbed by the previous residence constructed on the property. The overall terrain is sloping southeasterly at an average slope of 22%

where the building pad is located. Several distinctive flow lines were observed on site and on the historic maps. Concentrated flows come from the hill above and are diverted around the existing building pad with a build up swale and berm. The flows converge with offsite runoff coming from the southerly property. The flows continue in northeasterly direction, through an existing 24" storm drain pipe under the driveway until they reach the ultimate outfall near the northeast property corner at elevation of 1432.

Proposed improvements on the grading and drainage plan provides for safe conveyance of the off-site flows to the ultimate outfall without adversely impacting the drainage conditions of the adjacent properties. On-lot post development runoff generated by 100-yr, 2-hr storm is retained on-site through dry well.

The southeasterly property line fronts the right of way of Hummingbird Ln, which is an asphalt paved street with typical crown cross section and has longitudinal slope of 1.7%, sloping northerly.

Soils in the watershed are indicated in the NRCS report as:
26.7% of *Pinamt gravelly loam, 3 to 5 percent slopes;* 73.3% of Rock land. Soils in the watershed fall under Hydrologic Group (for the project site), which is classified as: "*Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a very slow rate of water transmission*". The above data was used to adjust the runoff coefficient values of the hydrologic model.

Computations have been performed to estimate the 100-year design peak discharges from the sub-basins that contribute offsite flows to the site. Computer program DDMS provided by the Flood Control District of Maricopa County was utilized to generate the hydrology model and to estimate the 100-year peak discharges. Since the total drainage area of the watershed is less than 160 acres, the Rational Method has been used in accordance with the Flood Control District of Maricopa County (FCDMC) Drainage Design Manual Volume I – Hydrology. FCDMC Drainage Design Management System software was utilized for calculating the Rational Method parameters and the peak discharges of each contributing area. Precipitation data was derived from the NOAA Atlas 14, Volume 1, Version 4.

Based on the observed field evidence and research of collected aerial maps, currently there is one drainage area that contributes offsite flows to the subject property. Detailed hydrologic and hydraulic analysis and modeling were performed in accordance with procedures presented in the Drainage Design Manual of Maricopa County, Volumes 1 & 2 to determine the 100-year storm design peak discharges for the contributing areas in the watershed and to design the swale sections that will safely convey the estimated peak flows. The swale was analyzed in a typical cross section for flow hydraulics using the estimated 100-year peak discharges, the existing topography and the proposed grading design. The watershed is 6.78 acres and generates 48.6 cfs during 100-year storm event. See Drainage Map - Appendix A-2.

3. FEMA FLOOD ZONE CLASSIFICATION

Site is located in FEMA Flood Zone "X" according to Flood Insurance Rate Map (FIRM) #: 04013C, Panel 1765 of 4425, Suffix L, dated October 16th, 2013, as published by FEMA. The FIRM Panel defines Zone "X" as follows: "*Areas determined to be outside the 0.2% annual chance floodplain"*.

See Appendix A-3 for FEMA Flood Insurance Rate Map exhibit.

4. PROPOSED DRAINAGE PLAN

The proposed single-family residence is located in the lower southeasterly half of the lot. Drainage swale lined with riprap is proposed to safely route the off-site flows coming from mountain around the home and to convey it downstream following the historic flows. The finish floor elevation of the main residence is set at 1472.00.

New 36" storm drain culvert is proposed under the new driveway. Existing driveway will be removed and the area will be restored back to the historic grades and natural mountain conditions. The driveway layout was revised to reduce its slope and the existing flow diversions. At each point of discharge, special rock outlet structures are proposed as energy dissipaters. Rock outlet structures will be installed with harvested from the site large boulders. This will significantly reduce the drainage impact to the downstream properties.

Retention calculations were performed for this site to determine the required on-lot storm water retention from the 100-year, 2-hour storm event, in accordance with the Town of Paradise Valley requirements. New storm drain system is proposed to handle to on-site runoff from the new roof and hardscape areas. The system will be connected with new drywell for slow dissipation or bleed off.

New drainage easements are proposed to cover the alignment of the offsite flows that run through the site.

Summary printouts of the drainage calculations are enclosed in Appendix A-7.

5. CONCLUSIONS AND RECOMMENDATIONS

Grading and Drainage plan has been designed in conformance with the recommendations and results presented in this report as well as the Town of Paradise Valley, Maricopa County, Arizona State and Federal requirements and standards.

Regular inspections and maintenance of the wall openings and subsurface drainage systems after every major storm must be performed. Any obstructions of flow need to be promptly cleared out in order to keep the performance of the storm drain system functioning as designed. It is the Owner's

responsibility to inspect and properly maintain all drainage structures, retaining walls, swales and storm drains.

Off-site flows shall be allowed to pass through the site and to exit the property in a manner similar to the existing conditions. Grading around the residence shall provide for positive drainage away from the structures as shown on the Grading and Drainage plan.

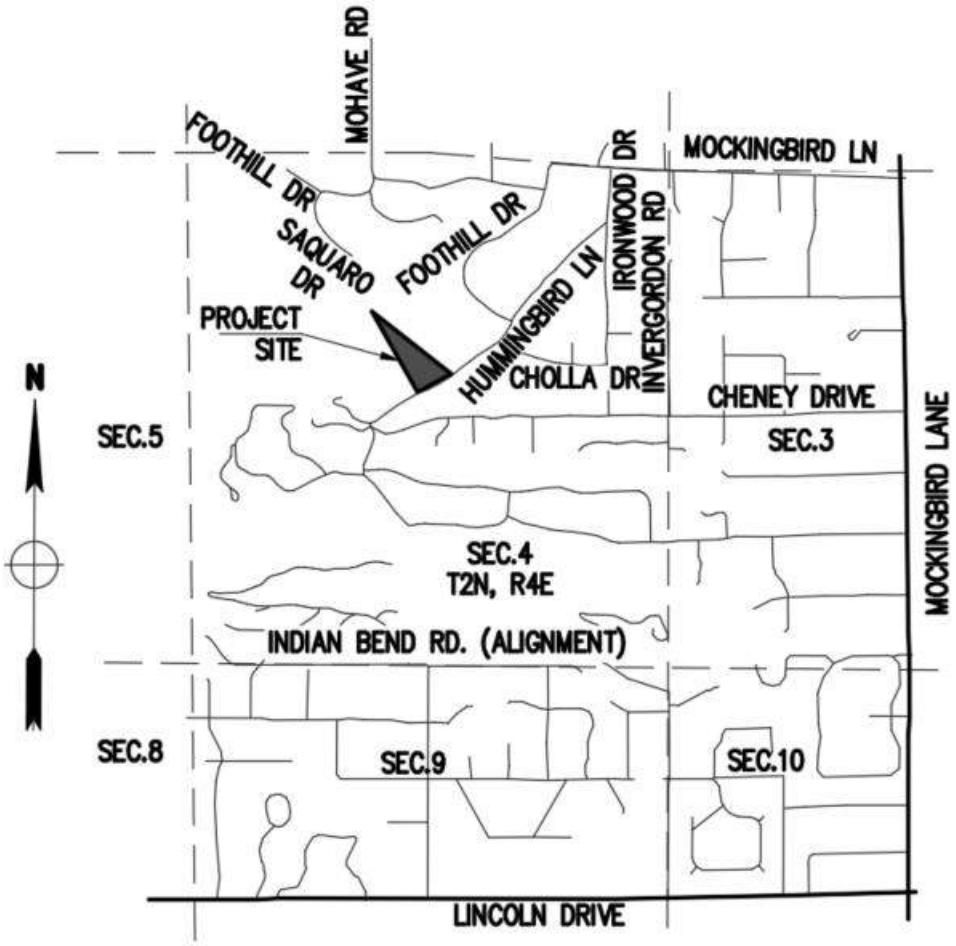
A Drainage Easement and Maintenance Agreement for Drainage Easement Area will be required for this project. Storm Water Pollution Prevention Plan and AZDEQ Notice of Intent will be required as a part of the building permitting process. All specified BMPs shall be installed on site, inspected and approved by the Town prior to commencing any grading activities.

In conclusion, the project site has the potential to collect, convey and discharge runoff safely and effectively with no adverse impact to downstream properties. The proposed improvements do not impact drainage conditions of neighboring lots and will not result in changes to the existing drainage patterns or magnitudes downstream.

6. REFERENCES

- Drainage Design Manual for Maricopa County, Arizona – Volume I Hydrology, Flood Control District of Maricopa County 2009
- Drainage Design Manual for Maricopa County, Arizona – Volume II Hydraulics, Flood Control District of Maricopa County, 2009
- Drainage Policies and Standards Manual for Maricopa County, Arizona, Flood Control District of Maricopa County, 2007
- Town of Paradise Valley Storm Drainage Design Manual

APPENDIX A-1
Vicinity Map

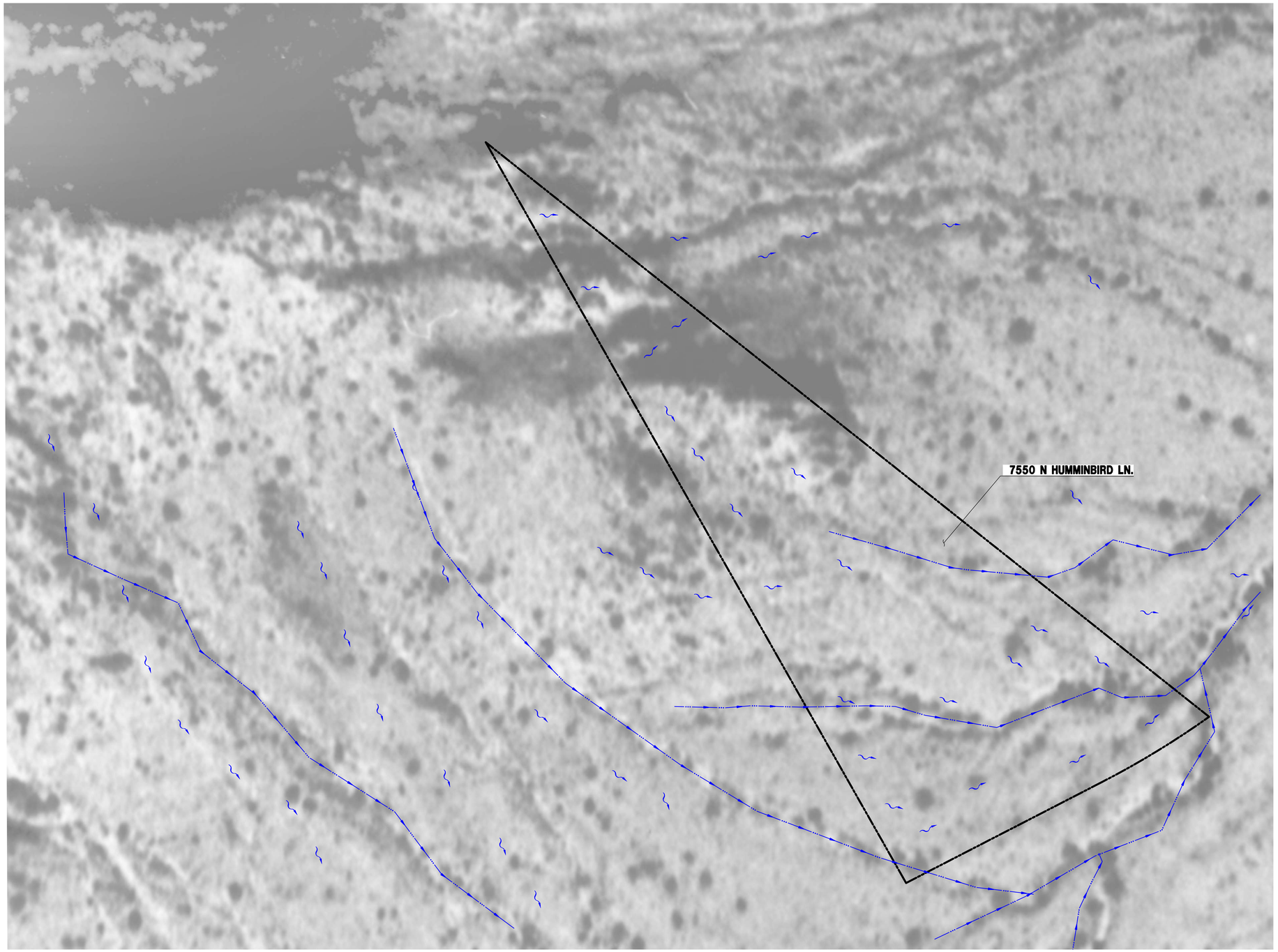


VICINITY MAP
NTS

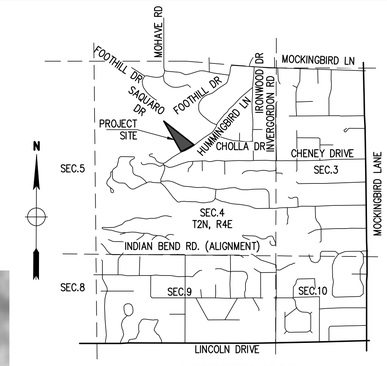
APPENDIX A-2
Drainage Maps

DRAINAGE MAP HISTORIC CONDITIONS
7550 N HUMMINGBIRD LN., PARADISE VALLEY, AZ 85253
LOT 38 - MUMMY MOUNTAIN PARK

A SUBDIVISION PLAT RECORDED IN BOOK 57 OF MAPS, PAGE 1, MCR.,
LOCATED IN A PORTION OF THE N 1/2 OF SECTION 4, T.2N, R.4E
OF THE GILA & SALT RIVER BASE AND MERIDIAN, MARICOPA COUNTY, ARIZONA



1949 AERIAL MAP



VICINITY MAP
NTS

OWNER
LDL FAMILY TRUST
8502 N 59TH PLACE
PARADISE VALLEY, AZ 85253

SITE DATA
APN: 169-04-007
ADDRESS: 7550 N HUMMINGBIRD LN., PARADISE VALLEY, AZ 85253
ZONING: R-43
LOT AREA: 214,384 S.F (4.922 AC.)
CONSTRUCTION YEAR: 1963
COP Q.S. 24-41 & 24-42

LEGAL DESCRIPTION
LOT 38, MUMMY MOUNTAIN PARK, ACCORDING TO THE PLAT OF RECORD IN THE OFFICE OF THE COUNTY RECORDER OF MARICOPA COUNTY, ARIZONA, RECORDED IN BOOK 57 OF MAPS, PAGE 1.

BASIS OF BEARINGS
THE MONUMENT LINE OF HUMMINGBIRD LANE, THE BEARING OF WHICH IS S62°44'00"E.

BENCHMARK
BRASS CAP FLUSH AT THE INTERSECTION OF MOCKINGBIRD LANE AND INDIAN BEND ROAD HAVING AN ELEVATION OF 1316.44, TOWN OF PARADISE VALLEY (NAVD 88) DATUM, GDACS# 24526-1.

LEGEND
- DRAINAGE FLOW
- EL:1432 — SPOT ELEVATION
- TRIBUTARY AREA BOUNDARY
- FLOW LINE
- PIPE/CULVERT

FLOOD INSURANCE RATE MAP (FIRM) DATA

COMMUNITY #	PANEL #	SUFFIX	BASE FLOOD ELEVATION
040049	1765 OF 4425	L	N/A
MAP #	PANEL DATE	ZONE	
04013C	10/16/2013	X*	

*AREAS DETERMINED TO BE OUTSIDE THE 0.2% ANNUAL CHANCE FLOODPLAIN

N

60' 30' 0 60'
SCALE 1" = 60'

REVISIONS:	DATE:	SCALE: 1"=60'	DATE: 03/27/18
		DESIGNED BY: NP	JOB: 1801024
		DRAWN BY: ZA	VERSION: 1.1
		CHECKED BY: NP	PLOT DATE: 03/27/18

DRAINAGE MAP HISTORIC CONDITIONS

LOT 38 - MUMMY MOUNTAIN PARK 7550 N HUMMINGBIRD LN., PARADISE VALLEY, AZ 85253

P. 602 889 1984 | F. 602 445 9482
8808 N. CENTRAL AVE., SUITE 288
PHOENIX, AZ 85020
PHOENIX@LDGENG.COM
Land DEVELOPMENT GROUP

REGISTERED PROFESSIONAL ENGINEER (CIVIL)
CERTIFICATE NO. 41005
NICKOLA J. PRODANOV
Date Signed 03/27/18
ARIZONA, U.S.A.
Expires 06/30/2019

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LOT 38 - MUMMY MOUNTAIN PARK

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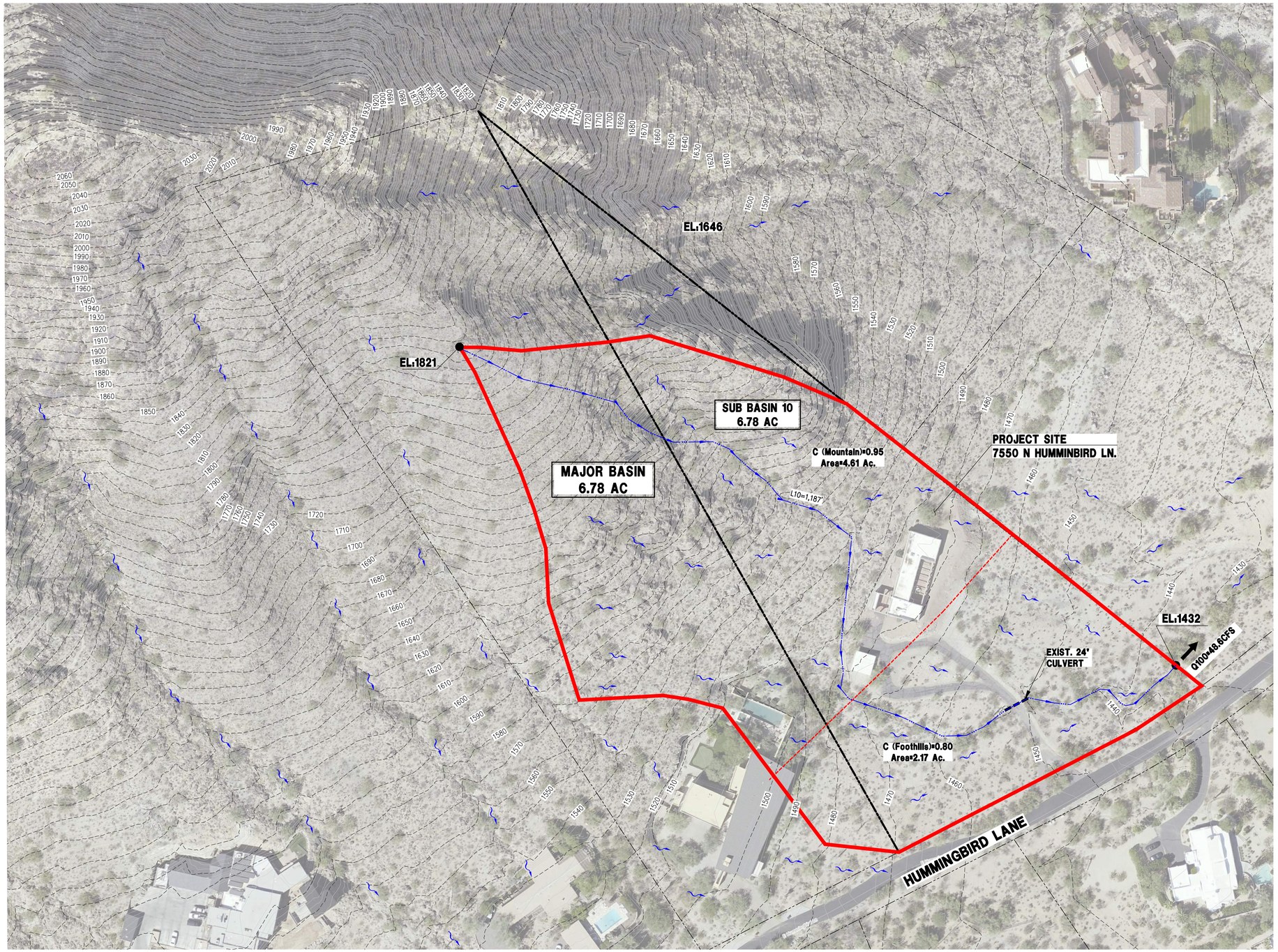
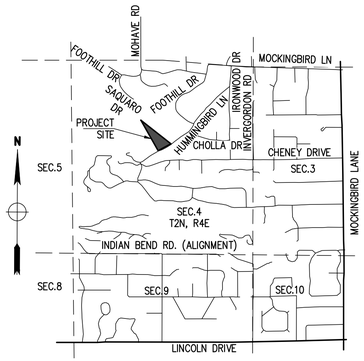
LOCATED IN A PORTION OF THE N 1/2 OF SECTION 4, T.2N, R.4E
OF THE GILA & SALT RIVER BASE AND MERIDIAN, MARICOPA COUNTY, ARIZONA





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LEGEND
- DRAINAGE FLOW
- EL.1432 — SPOT ELEVATION
- TRIBUTARY AREA BOUNDARY
- FLOW LINE
- PIPE/CULVERT

FLOOD INSURANCE RATE MAP (FIRM) DATA

COMMUNITY # 040049	PANEL # 1765 OF 4425	SUFFIX L	BASE FLOOD ELEVATION N/A
MAP # 04013C	PANEL DATE 10/16/2013	ZONE X*	

*AREAS DETERMINED TO BE OUTSIDE THE 0.2% ANNUAL CHANCE FLOODPLAIN

N

60' 30' 0 60'
SCALE 1" = 60'

2016 AERIAL MAP

REVISIONS:	DATE:	SCALE: 1"=60'	DATE: 03/27/18
		DESIGNED BY: NP	JOB: 1801024
		DRAWN BY: ZA	VERSION: 1.1
		CHECKED BY: NP	PLOT DATE: 03/27/18

DRAINAGE MAP CURRENT CONDITIONS

LOT 38 - MUMMY MOUNTAIN PARK
7550 N HUMMINGBIRD LN., PARADISE VALLEY, AZ 85253

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APPENDIX A-3
FEMA FIRM Exhibit

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 1765L

FIRM

FLOOD INSURANCE RATE MAP

MARICOPA COUNTY, ARIZONA

AND INCORPORATED AREAS

PANEL 1765 OF 4425

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
MARICOPA COUNTY	040037	1765	L
PARADISE VALLEY, TOWN OF	040049	1765	L
PHOENIX, CITY OF	040051	1765	L
SCOTTSDALE, CITY OF	045012	1765	L

Notice: This map was reissued on July 31, 2015 to make a correction. This version replaces any previous versions. See the Notice-to-User Letter that accompanied this correction for details.

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
04013C1765L

MAP REVISED
OCTOBER 16, 2013

Federal Emergency Management Agency


24503-1
24504-3M
24505-1M
24514-3
24515-1M
T. 3 N.
T. 2 N.
PROECT SITE
E FOOTHILL DR
N SAGUARO DR
N FOOTHILL DR
HUMMINGBIRD LN
E CHOLLA DR
IRONWOOD DR
N INVERGORDON RD
E BRONCO DR
E STALLION
N 64TH PL
N 65TH ST
N 66TH ST
N 58TH PL
N 61ST ST
QUARTZ MOUNTAIN RD
E HUMMINGBIRD LN
CATESBY RD
E UPPER GLEN RD
E GLEN DR
N 55TH ST
N 59TH
N 64TH PL
3
SE VALLEY

APPENDIX A-4
Aerial Map Exhibit


PROJECT SITE
24" CMP

APPENDIX A-5
FCDMC Floodplain Viewer

Floodplain Viewer

Parcel

Flood Zone

Not Within 100-Year Floodplain

A

AE

AH

AO

Regulatory Floodway

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

Unofficial Document
This document cannot be used for floodplain determinations. Current studies, erosion setbacks and other factors may also affect the floodplain status of the property. The information shown for pending floodplains are the best technical information available at this time to determine the 1% chance flood and are subject to change.

N

1:4,920 1 inch = 410 feet

0 0.04 0.08 0.16 mi

APPENDIX A-6
Soils Map and Data

Hydrologic Soil Group—Eastern Maricopa and Northern Pinal Counties Area, Arizona

Map Scale: 1:2,040 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 30 60 120 180

Feet: 0 50 100 200 300

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 12N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Eastern Maricopa and Northern Pinal Counties Area, Arizona
Survey Area Data: Version 10, Sep 11, 2017

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Oct 31, 2014—Dec 7, 2014

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
PvC	Pinamt very gravelly loam, 3 to 5 percent slopes	C	1.9	26.7%
Ro	Rock land		5.1	73.3%
Totals for Area of Interest			**7.0**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

APPENDIX A-7
Drainage Calculations

Project

Reference	1801024
Title	7550 N Hummingbird Ln
Location	7550 N Hummingbird Ln, Paradise Valley, AZ 85253
Agency	Town of Paradise Valley

Project Defaults

Model	Rational
Land Use Agency	FCDMC
Rainfall	NOAA14
Roads Agency	PHOENIX
Inlets Agency	PHOENIX

Comments

ID	Method	Duration	2 Yr	5 Yr	10 Yr	25 Yr	50 Yr	100 Yr
DEFAULT	NOAA14	5 MIN	0.273	0.368	0.442	0.540	0.616	0.693
	NOAA14	10 MIN	0.415	0.561	0.672	0.822	0.937	1.055
	NOAA14	15 MIN	0.515	0.695	0.834	1.019	1.161	1.308
	NOAA14	30 MIN	0.693	0.936	1.122	1.373	1.564	1.761
	NOAA14	1 HOUR	0.858	1.158	1.389	1.699	1.936	2.179
	NOAA14	2 HOUR	0.992	1.318	1.572	1.915	2.176	2.449
	NOAA14	3 HOUR	1.059	1.384	1.642	2.002	2.289	2.587
	NOAA14	6 HOUR	1.249	1.591	1.864	2.240	2.535	2.841
	NOAA14	12 HOUR	1.435	1.807	2.100	2.497	2.803	3.118
	NOAA14	24 HOUR	1.699	2.202	2.605	3.172	3.627	4.105

Town of Paradise Valley
Drainage Design Management System
LAND USE
Project Reference: 1801024

Sub Basin	Land Use Code	Area (acres)	Area (%)	Kb	Runoff Coefficient C						Description
					2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	
Major Basin ID: 01											
10	730	4.61	68.7	0.175	0.80*	0.80*	0.80*	0.88*	0.95*	0.95*	Passive Open Space (Includes mountain preserves and washes)
	730	2.10	31.3	0.175	0.55*	0.55*	0.65*	0.70*	0.75*	0.80*	Passive Open Space (Includes mountain preserves and washes)
		6.710	**100.0**								

* Non default value

ID	Sub Basin Data							Sub Basin Hydrology Summary					
	Area (acres)	Length (ft)	USGE	DSGE	Slope (ft/mi)	Kb		2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
Major Basin ID: 01													
10	6.8	1,187	1,821.00	1,432.00	1,730.3	0.175	Q (cfs)	12.9	18.6	24.1	33.2	42.0	48.6
							C	0.72	0.72	0.75	0.82	0.89	0.90
							CA (ac)	4.88	4.88	5.09	5.56	6.03	6.10
							Volume (ac-ft)	0.2111	0.2634	0.3146	0.3968	0.4711	0.5183
							Tc (min)	9	8	7	7	6	6
							i (in/hr)	2.64	3.81	4.73	5.97	6.96	7.96

* Non default value

Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Friday, Aug 31 2018

Swale

Trapezoidal

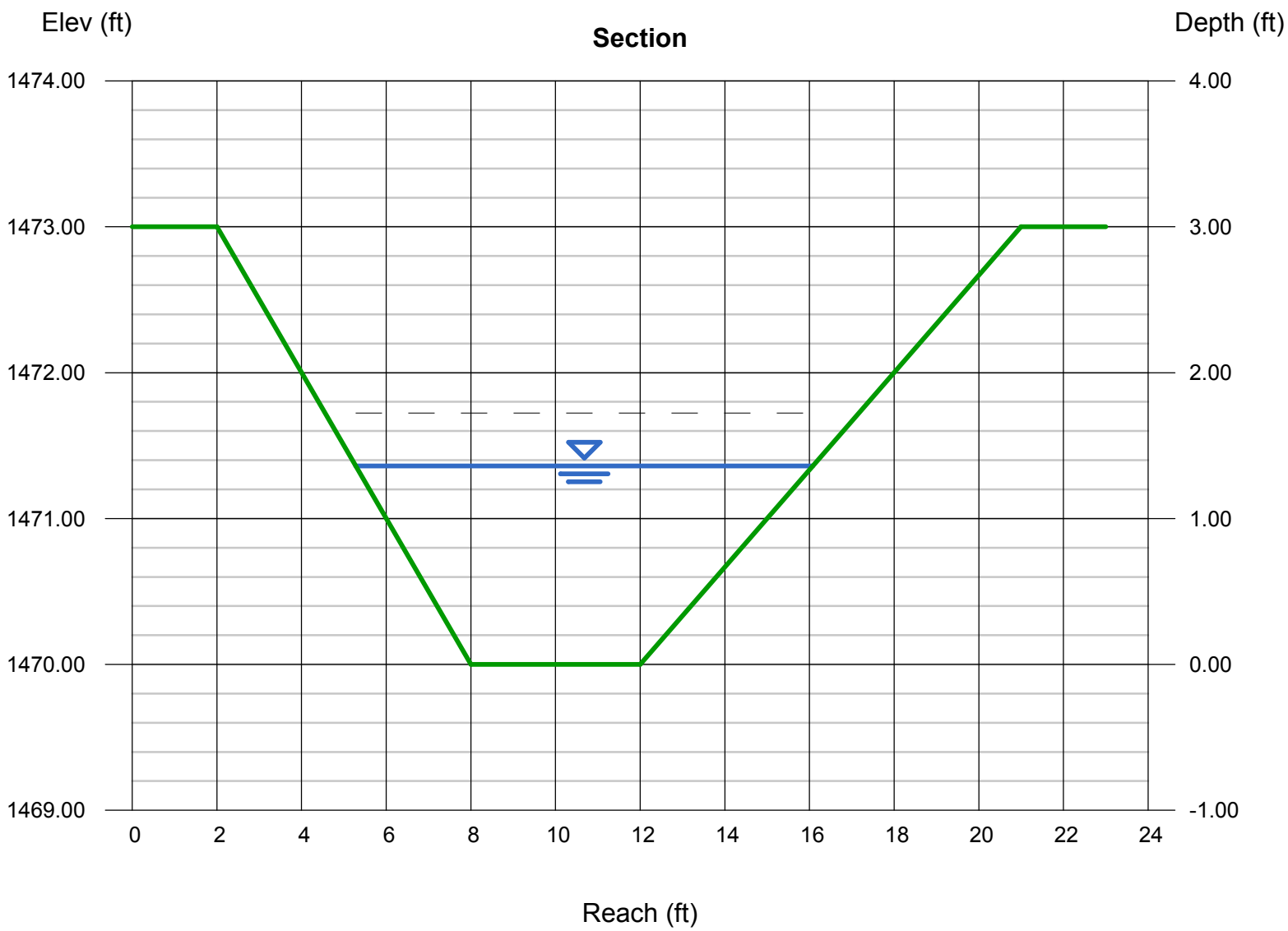
Bottom Width (ft)	=	4.00
Side Slopes (z:1)	=	2.00, 3.00
Total Depth (ft)	=	3.00
Invert Elev (ft)	=	1470.00
Slope (%)	=	2.00
N-Value	=	0.040

Calculations

Compute by:		Known Q
Known Q (cfs)	=	48.60

Highlighted

Depth (ft)	=	1.36
Q (cfs)	=	48.60
Area (sqft)	=	10.06
Velocity (ft/s)	=	4.83
Wetted Perim (ft)	=	11.34
Crit Depth, Yc (ft)	=	1.28
Top Width (ft)	=	10.80
EGL (ft)	=	1.72



PIPE CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

August 31, 2018

PROGRAM INPUT DATA

DESCRIPTION	VALUE
Culvert Diameter (ft).....	3.0
FHWA Chart Number.....	2
FHWA Scale Number (Type of Culvert Entrance).....	1
Manning's Roughness Coefficient (n-value).....	0.012
Entrance Loss Coefficient of Culvert Opening.....	0.5
Culvert Length (ft).....	23.5
Invert Elevation at Downstream end of Culvert (ft).....	1,452.2
Invert Elevation at Upstream end of Culvert (ft).....	1,453.0
Culvert Slope (ft/ft).....	0.034
Starting Flow Rate (cfs).....	5.0
Incremental Flow Rate (cfs).....	5.0
Ending Flow Rate (cfs).....	55.0
Starting Tailwater Depth (ft).....	0.0
Incremental Tailwater Depth (ft).....	1.0
Ending Tailwater Depth (ft).....	10.0

COMPUTATION RESULTS

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
5.0	0.0	0.9	0.0	0.4	0.7	0.4	9.04
10.0	1.0	1.33	0.0	0.56	1.0	0.56	11.09
15.0	2.0	1.68	0.0	0.68	1.24	0.68	12.48
20.0	3.0	2.0	2.4	0.79	1.44	3.0	2.83
25.0	4.0	2.31	3.52	0.88	1.61	3.0	3.54
30.0	5.0	2.6	4.66	0.97	1.77	3.0	4.24
35.0	6.0	2.89	5.83	1.05	1.92	3.0	4.95
40.0	7.0	3.19	7.02	1.13	2.06	3.0	5.66
45.0	8.0	3.59	8.24	1.2	2.19	3.0	6.37
50.0	9.0	3.92	9.48	1.27	2.3	3.0	7.07
55.0	10.0	4.31	10.75	1.34	2.41	3.0	7.78