Drainage Reports

Abbreveated Water & Sewer Need Reports

Water Study

Wastewater Study

Stormwater Waiver Application

PRELIMINARY DRAINAGE REPORT

ALTA OSBORN Apartment Homes

3220 N. Scottsdale Road
Scottsdale, AZ

Prepared For:

WOOD PARTNERS

8777 E. Via De Ventura
Scottsdale, AZ 85258
Phone: 480.607.0622

Plan # _____
Case # 42-DR-2016
Q-S # _____
☑ Accepted
☐ Corrections
N. Baronas 11-8-16
Reviewed By Date

Prepared by:

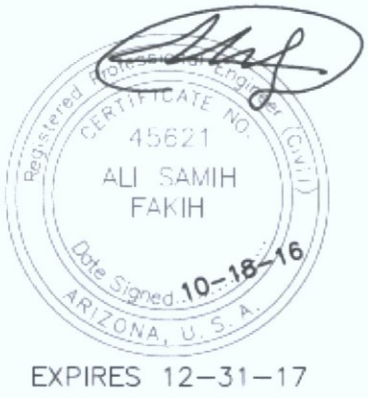
Registered Professional Engineer (Civil)
CERTIFICATE NO.
45621
ALI SAMIH
FAKIH
Date Signed 10-18-16
ARIZONA, U.S.A.

EXPIRES 12-31-17

Sustainability Engineering Group
8280 E. Gelding Drive, Suite 101
Scottsdale, AZ 85260
480.588.7226 www.azSEG.com

Project Number: 160410
Submittal Date: August 30, 2016 (DRB)
Revision Date: October 18, 2016

Case No.: 42-DR-2016 **Plan Check No.: TBD**



EXPIRES 12-31-17

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1. INTRODUCTION

This 90% Preliminary Drainage Report is being provided in conjunction with a Development Review submittal, Case Number 218-PA-2016. This report represents the storm water analysis for the proposed disturbed area (redevelopment) for a proposed residential apartment project, being a redevelopment of the land formerly occupied by ONYX car dealership. The purpose of this report is to provide the hydrologic and hydraulic analyses, required by the City of Scottsdale, to support the proposed site plan for said development. This report includes discussions and calculations defining the storm water management concepts for collection, conveyance, and detention systems necessary to comply with the drainage requirements of the City of Scottsdale and Maricopa County. Preparation of this report has been done in accordance with the requirements of the City of Scottsdale Design Standards & Policies Manual (DS&PM) 2010 [1], and the Drainage Design Manuals for Maricopa County, Arizona, Volumes I[2] and Volume II[3].

2. LOCATION AND PROJECT DESCRIPTION

2.1 LOCATION:

The project property consists of a parcel of land located on the west side of Scottsdale Road, across from the Drinkwater Boulevard intersection. It is further bound by 71st Street to the west, developed commercial property to the north, and a mobile home park to the south. It is located in a portion of Section 27, Township 2 North, Range 4 East of the Gila and Salt River Base and Meridian, Maricopa County,

- Arizona Parcel ID numbers APN: 130-16-006A
- Street address is 3220 N. Scottsdale Road
- The legal description is:

Lot three (3), Block twenty-nine (29), Security Acres Amended, according to the plat of record in the office of the County Recorder of Maricopa County, Arizona in Book 8 of Maps, page 59.

Except the east 22 feet thereof, and

Except the east 5 feet of the west 30 feet conveyed to the City of Scottsdale in instrument recorded June 7, 1983, document no. 83-217883.

Refer to **FIGURE 1 - Vicinity Map** for the project's location with respect to major cross streets.

2.2 EXISTING AND PROPOSED DEVELOPMENTS SURROUNDING THE SITE:

Existing site context related to surrounding developments is as follows:

- North: To the north, east half is US Egg zoned D/OC-2 PBD DO and the west half is zoned D/DMU-2 PBD DO. The west half, and land north of Angus Drive is in the process of being developed into 365 +/- unit multi-family project known as Agua Apartments.
- West: The west side is bound by 71ST Street with the Security Acres (AMD) subdivision directly across, zoned R-5.
- South: The south is an existing mobile home park zoned C-3 with a portion adjacent to 71st Street zoned R1-7.
- East: Scottsdale Road bounds the site to the east with Drinkwater Boulevard road system across.

2.3 EXISTING SITE DESCRIPTION:

Land ownership, as defined by ALTA/ACSM Land Title Survey by AW Land Surveying, LLC dated 04/13/16 includes 183,705.9 square feet or 4.217+/- acres (net) of commercially developed land. City of Scottsdale zoning map designates this parcel as C-3.

This site is fully developed as a car dealership. The topography generally slopes from the west-northwest to the southeast corner at approximately one-half percent with a change in elevation of approximately three and one-half (3.5) feet. Typical desert landscaping exists at the perimeter of the site. Refer to **FIGURE 2** for an aerial of the overall project existing conditions.

2.4 PROPOSED SITE DEVELOPMENT:

The property is proposed to be re-developed into a 277 unit multi-family residential complex. Development will include a 24' wide paved access road along the southerly property line from Scottsdale Road to 71st Street. A 24' wide fire lane is also proposed along the northerly property line. This is conceptualized to be GrassPave type of reinforcement and an 8' wide pedestrian connection. An open courtyard is proposed in the westerly third of the units, with a parking structure near the center of the site, and an amenities / pool area and clubhouse in the easterly portion. Refer to **FIGURE 5** for proposed site layout.

2.5 FLOOD HAZARD ZONE:

As defined by the Flood Insurance Rate Map (FIRM) for Maricopa County, Arizona, and incorporated areas, Community number 045012, Panel number 2235 of 4425, as shown on Map Number 04013C2235L dated October 16, 2013 this site is designated as **Zone "X"**. As such, it is defined as areas of 0.2-percent-annual-chance (or 500-year) flood; areas of 100-year flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and area protected by levees from the 100 year flood.
Refer to **FIGURE 3** for the FIRM.

3. EXISTING DRAINGE CONDITIONS

3.1 OFF-SITE DRAINAGE PATTERNS:

This site is bound as follows:

- By 71st Street to the west. This road has curb and gutter conveying runoff to the south where it is collected in curb opening catch basin near the Earl Road intersection.
- By developed commercial properties to the north, separated by a masonry screen wall.
- By Scottsdale Road to the east. Runoff is conveyed in curb and gutter towards the south.
- By a mobile home park to the south, separated by a masonry screen wall. The site slopes southerly away from the project site.

No off-site flows impact the subject parcel. Refer to **FIGURE 4** for the ALTA/topo Map indicating existing conditions.

3.2 ON-SITE DRAINAGE:

This site is fully developed as a car dealership. The topography generally slopes from the west-northwest to the southeast corner at approximately one-half percent with a change in elevation of approximately three and one-half (3.5) feet. Typical desert landscaping exists at the perimeter of the site. Runoff from the parcel generally flows overland to two drive entrances that outlet into Scottsdale Road. A scupper under the existing sidewalk in the ROW located approximately 125' north of the southeast property corner also allows runoff into Scottsdale Road

3.3 EXISTING STORM SEWER SYSTEMS:

There are no apparent storm sewers existing on the parcel. Runoff is conveyed to the south / southeast by overland flow and along concrete curbs to Scottsdale Road.

Scottsdale Road runoff is conveyed to curb-opening type catch basins along both sides of the road. There is an existing 72" diameter storm pipe located approximately along the centerline of the road.

4. PROPOSED STORM WATER MANAGEMENT

4.1 DESIGN INTENT:

On-site drainage will be handled within street sections, underground storm systems, onsite channels, or retention basins where necessary. This is a re-development of existing commercial land, therefore, the City of Scottsdale specifies that on-site retention shall be provided to store the difference between the pre vs. post development runoff from the 100-year 2-hour storm event while maintaining existing storage, if any.

If required, on-site retention will be provided as allowed by site configuration within underground retention and/or open space and have total discharge of the storm water within thirty-six hours. The ultimate outfall remains the historical outlet over the sidewalk/drive entrance at the southeast corner of the site with an elevation of approximately 1242.60.

The areas that remain for storm water conveyance are the proposed paved drive along the south property line and the proposed fire lane along the north property line.

- Roof runoff of the exterior units will be via downspouts and allowed to splash on grade with the flow conveyed to the adjacent road or fire lane.
- Roof runoff of the interior units will be directed toward, and combined with the runoff from the adjacent courtyards. This flow will then be conveyed via pipes to an underground retention system in the north fire lane. Redundant systems will be provided within the courtyards to ensure no flooding of the units occurs.
- Roof runoff from the parking structure will be conveyed to an underground retention system in the north fire lane
- The south drive lanes will be graded easterly to discharge the runoff to Scottsdale Road. Due to grade restrictions, a small portion will be directed to 71st Street.
- The north fire lane will incorporate valley gutters to convey runoff to the proposed underground retention system

Refer to Section 5 below for a discussion on proposed finished floor elevations. Refer to **Appendix III** for the Preliminary Grading & Drainage Plan.

4.2 DESIGN STORM REQUIREMENTS:

In accordance with City of Scottsdale requirements, stormwater storage for the 100-year 2-hour storm event based on pre-development versus post development C values.

4.3 CHARACTERISTICS OF BASINS:

The proposed drainage areas are comprised of mixed use buildings and associated parking areas, drives and landscape areas. Based on Figure 4.1-4 of the DS&PM, runoff coefficients for the 100 year storm event used are as follows:

- C=0.30 for grassed areas
- C=0.45 for desert landscaping
- C=0.95 for impervious areas.

HYDROLOGIC ANALYSIS: The hydrologic analysis is determined using the procedures in the City of Scottsdale Design Standards & Policies Manual and the Drainage Design Manual for Maricopa County, Arizona, Volume I. The Rational Method was utilized to compute the on-site peak discharges. The following established the Rational Method equation and the basic input data required:

$Q=C_{wt}IA$

Where: C_{wt} = The runoff coefficient relating runoff to rainfall
I = Average rainfall intensity in inches/hour, lasting for Tc (use 5.65 in/hr @Tc = 10 Min.)
Tc = The time of concentration (minutes)
A = The contributing drainage area in acres

C_{wt} CALCULATIONS:

- Pre-development (ONYX dealership) (Refer to EXHIBIT "A" in Appendix II)
  - Landscape area (Grass): 0.035 Ac. @ C=0.30
  - Landscape area (Desert): 0.232 Ac. @ C=0.45
  - Impervious areas (Roof / Pavement): 3.947 Ac. @ C=0.95

  C_{wt}: 4.214 Ac. @ C_{wt} = 0.92

- Post-development (Refer to EXHIBIT "B" in Appendix II)
  - Landscape area (Grass): 0.000 Ac. @ C=0.30
  - Landscape area (Desert): 0.588 Ac. @ C=0.45
  - Impervious Ares (Roof / Pavement): 3.626 Ac. @ C=0.95

  C_{wt}: 4.214 Ac. @ C_{wt} = 0.88

OVERALL RUNOFF RATE COMPARISON:

Q_{100} PRE = 0.92 * 5.65 in/hr * 4.214 ac = **22.62 CFS**

Q_{100} POST = 0.88 * 5.65 in/hr * 4.214 ac = **20.95 CFS**

DEVELOPED RUNOFF FLOWS to OFF-SITE:

- To 71st Street: (DA 1 + 2)
  A (ac.) = 0.01 + 0.03 = 0.04 Acres
  C_{wt} = ((0.01*0.57) + (0.03*0.90))/0.04 = 0.82
  Q_{100} = 0.82 * 5.65 in/hr * 0.04 ac = **0.19 CFS POST (0.0 CFS PRE)**

- To Scottsdale Road:
  North Side piped (DA 3, 4, 6, 8, 12, 13 and 15):
  A (ac.) = 0.38 + 0.50 + 0.65 + 0.77 + 0.11 + 0.12 + 0.33 = 2.86 Acres
  C_{wt} = ((0.38*0.83) + (0.50*0.89) + (0.65*0.95) + (0.77*0.88) + (0.11*0.57) + (0.12*0.58) + (0.33*0.95))/2.86 = 0.85
  Q_{100} = 0.85 * 5.65 in/hr * 2.86 ac = **13.74 CFS**

  East Side Overland: (DA 10 + 11 + 14):
  A (ac.) = 0.32 + 0.21 + 0.13 = 0.66 Acres
  C_{wt} = ((0.32*0.95) + (0.21*0.67) + (0.13*0.94))/0.66 = 0.86
  Q_{100} = 0.86 * 5.65 in/hr * 0.66 ac = **3.21 CFS**

  South Side Overland: (DA 5 + 7 + 9)
  A (ac.) = 0.13 + 0.31 + 0.21 = 0.65 Acres
  C_{wt} = ((0.13*0.93) + (0.31*0.95) + (0.21*0.93))/0.65 = 0.94
  Q_{100} = 0.94 * 5.65 in/hr * 0.65 ac = **3.45 CFS**

  Total flow to Scottsdale Road = 13.74 + 3.21 + 3.45 = 20.4 CFS POST (22.62 PRE)

4.4 OFF-SITE FLOW :

No off-site flows contribute to this site.

4.5 STORMWATER RETENTION:

Stormwater storage will be provided based on the difference between Pre vs Post development conditions or as required by site grading and drainage constraints. On-site inspection and review of current topographic survey did not provide evidence that there is existing on-site retention.

REQUIRED STORAGE (Pre vs Post):

Stormwater storage required is calculated In accordance with the COS – DS&PM. Required Retention (Acre-Feet) = $(P/12)*A*(C_{post} - C_{pre})$

Where: P = 100 Yr. 2 Hr. Precipitation in Inches (Ref: Isopluvial from DS&PM, Appendix 4-1D, pg. 11)
A = Area (Acres)
C = Cpost – Cpre

$V_{Required}$ = (2.17/12)*4.22 Ac * (0.88 – 0.92) = -0.031 ac-ft or **-1,350 c.f.**

From Section 4.3 above, the C_{wt} is decreased from 0.92 pre-development to 0. 88 post-development (4.3%) therefore no additional retention is required as a result of the redevelopment.

Based upon topographic survey information and on-site inspections, there is no existing stormwater retention provided on this parcel. The runoff is conveyed via sheet flow to Scottsdale Road. Per Section 4.5 above, the impervious area is reduced as a result of the new development. Therefore, no retention is required.

BUILDING ROOF AND COURTYARD STORM SYSTEMS:

To be conservative, underground piping will be calculated using a Tc of 5 minutes (I = 7.43 in/hr). The Q_{100} runoff developed by the building roofs and courtyards that require underground piping is calculation as follows:

West End of Building (DA3)

Q_{100} = 0.38 ac * 0.83 * 7.43 in/hr = 2.34 cfs

West Courtyard (DA4)

Q_{100} = 0.50 ac * 0.89 * 7.43 in/hr = 3.31 cfs

Parking Structure (DA6)

Q_{100} = 0.65 ac * 0.95 * 7.43 in/hr = 4.59 cfs

East Courtyard (DA8)

Q_{100} = 0.77 ac * 0.88 * 7.43 in/hr = 5.03 cfs

Based on the above calculations, 18" dia. pipes will be used for the conveyance of runoff from the interior portions of the building (courtyards and parking structure) and 15" pipes will convey the runoff from the west end of the building. The courtyards will have redundant drainage systems outletting to the underground pipe system.

The piped system is proposed to tie into an existing manhole on the existing 72" pipe in Scottsdale Road. From available information, the 100-year HGL of the existing system at the MH is 40.60. Based on HGL calculations though the system, the HGL will be approximately 0.19' below the FFE of the garage. A restricted outlet (flap gate or TideFlex valve) will be considered to protect the structure. A pumped sump system is also proposed as a backup.

Refer to Pipe Calculations in Appendix II.

4.6 STREET CAPACITY CALCULATIONS:

Exterior unit roof drainage will be directed to the adjacent drives. DA 1 and 2 will be directed to 71st Street (See Section 4.3 above). Runoff from DA 10, 11, and 14 will be discharged directly to Scottsdale Road (See Section 4.3 above). Runoff to be conveyed in each drive is as follows:

NORTH DRIVE:

To CB 4A (west ditch): (DA 12A + 15A).

- A (ac.) = 0.07 + 0.09 = 0.16 Acres
- C_{wt} = ((0.07*0.57) + (0.09*0.95))/0.16 = 0.78
- Q_{100} = 0.78 * 5.65 in/hr * 0.16 ac = **0.71 CFS**

To CB 4A (east ditch): (DA 12B + 15B).

- A (ac.) = 0.04 + 0.05 = 0.09 Acres
- C_{wt} = ((0.04*0.57) + (0.05*0.95))/0.09 = 0.78
- Q_{100} = 0.78 * 5.65 in/hr * 0.09 ac = **0.40 CFS**

To CB 3A (west ditch): (DA 13A + 16A).

- A (ac.) = 0.07 + 0.09 = 0.16 Acres
- C_{wt} = ((0.07*0.58) + (0.09*0.95))/0.16 = 0.79
- Q_{100} = 0.79 * 5.65 in/hr * 0.16 ac = **0.71 CFS**

To CB 3A (east ditch): (DA 13B + 16B).

- A (ac.) = 0.05 + 0.10 = 0.15 Acres
- C_{wt} = ((0.05*0.58) + (0.10*0.95))/0.15 = 0.83
- Q_{100} = 0.83 * 5.65 in/hr * 0.15 ac = **0.70 CFS**

- Flows will be directed east / west along the screen wall to each of two inlet structures entering the underground storm system.
- Section = 10' @ 2% (across walkway); 14' @ 4.5% max across grass pave to wall. Longitudinal slope = 0.33% minimum. Normal Depth = 0.29'. Refer to FlowMaster calculations in Appendix II for grass pave channel capacity.

SOUTH DRIVE: (DA 5 + 7 + 9)

- A (ac.) = 0.13 + 0.31 + 0.21 = 0.65 Acres
- C_{wt} = ((0.13*0.93) + (0.31*0.95) + (0.21*0.93))/0.65 = 0.94
- Q_{100} = 0.94 * 5.65 in/hr * 0.65 ac = **3.45 CFS**
- This flow is conveyed to Scottsdale Road via a curb and gutter.
  Section = 24' @ 2% - 5% (across drive); 6" curb. Longitudinal slope = 0.5% minimum. Normal Depth = 0.37' with 5% cross slope. Refer to FlowMaster calculations in Appendix II for curb and gutter capacity.

4.7 STORM DRAIN INLET CALCULATIONS:

The north drive will generally drain toward the north edge and flows will be conveyed along the wall and into 2' x 2' Nyloplast inlets. A clogging factor of 50% has been applied to the grates receiving a flow of 1.41 cfs. (worst case, CB3A). Depth over inlet is approximately 0.22'. Refer to Inlet Capacity Chart is Appendix II

5. FLOOD SAFETY FOR DWELLINGS

5.1 FINISHED FLOOR ELEVATIONS

The ultimate outfall for this project is located at the southeast corner of the parcel at an elevation of approximately 1242.60. The lowest conceptual finished floor elevation is 1245. All building finished floor elevations will be set a minimum of 14 inches above ultimate outfalls and a minimum of 12 inches above the 100-year high-water elevation of any adjacent streets and drainage paths. This will ensure that each building will be well above the 100-year water level.

- CB-3A rim = 43.67 + 0.22' head with 50% clogging factor = 43.89 = 13.2" below FFE 45.00; OK
  - An emergency outlet is provided at elevation 43.80 (14.4" below FFE via a valley gutter to Scottsdale Road.
- CB-4A rim = 44.67 + 0.22' head with 50% clogging factor = 44.89 = 13.2" below FFE 46.00; OK
  - An emergency outlet is provided at elevation 44.90 to convey runoff to CB-3A area/Scottsdale Road.

6. CONCLUSIONS

6.1 OVERALL PROJECT:

1. Off-site storm water does not impact this project
3. The finish floor elevations will be designed a minimum of 12 inches above the 100-year water surface in adjacent streets and drainage paths and a minimum of 14 inches above the low top of curb of the lot.
4. Storm water storage will be provided to, as a minimum, maintain existing conditions and discharge within 36 hours in accordance with City of Scottsdale requirements.

6.2 PROJECT PHASING:

This development is anticipated to be constructed in a single phase.

7. WARNING AND DISCLAIMER OF LIABILITY

RE: following page.

8. REFERENCES

1. *Design Standards & Policies Manual, City of Scottsdale – January 2010*
2. *Drainage Design Manual for Maricopa County, Arizona, Volume I, Hydrology, Flood Control District of Maricopa County, Fourth Edition, November 18, 2009 amended through February 10, 2011*
3. *Drainage Design Manual for Maricopa County, Arizona, Volume II, Hydraulics, Flood Control District of Maricopa County, January 28, 1996*

Appendix 4-1C

WARNING & DISCLAIMER OF LIABILITY

The Drainage and Floodplain Regulations and Ordinances of the City of Scottsdale are intended to "minimize the occurrence of losses, hazards and conditions adversely affecting the public health, safety and general welfare which might result from flooding caused by the surface runoff of rainfall" (Scottsdale Revised Code §37-16).

As defined in S.R.C. §37-17, a flood plain or "*Special flood hazard* area means an area having flood and/or flood related erosion hazards as shown on a FHBM or FIRM as zone A, AO, A1-30, AE, A99, AH, or E, and those areas identified as such by the floodplain administrator, delineated in accordance with subsection 37-18(b) and adopted by the floodplain board." It is possible that a property could be inundated by greater frequency flood events or by a flood greater in magnitude than a 100-year flood. Additionally, much of the Scottsdale area is a dynamic flood area; that is, the floodplains may shift from one location to another, over time, due to natural processes.

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 man-made 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 affect 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.

_____	_____	_____
Plan Check No.	Owner or Agent	Date

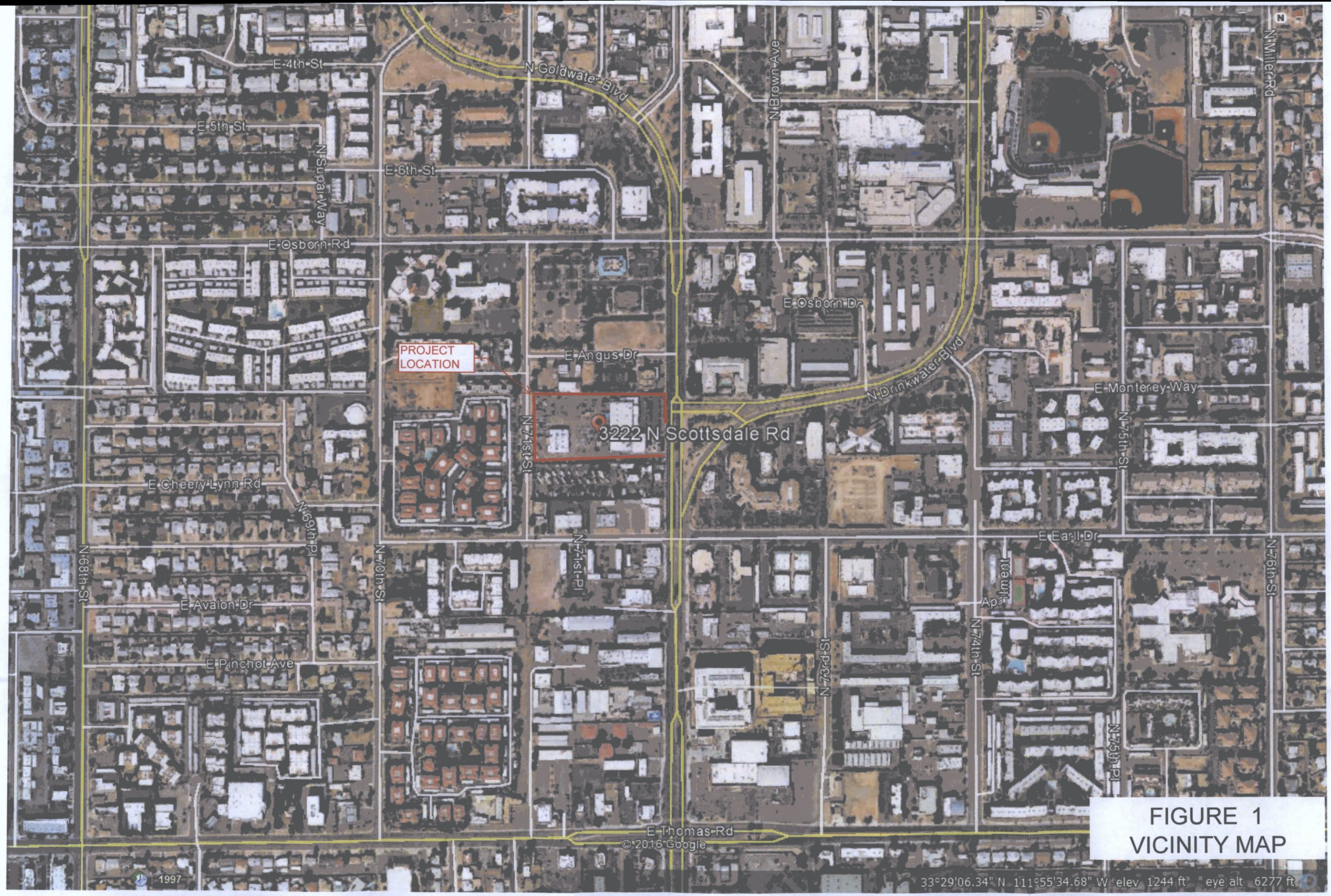
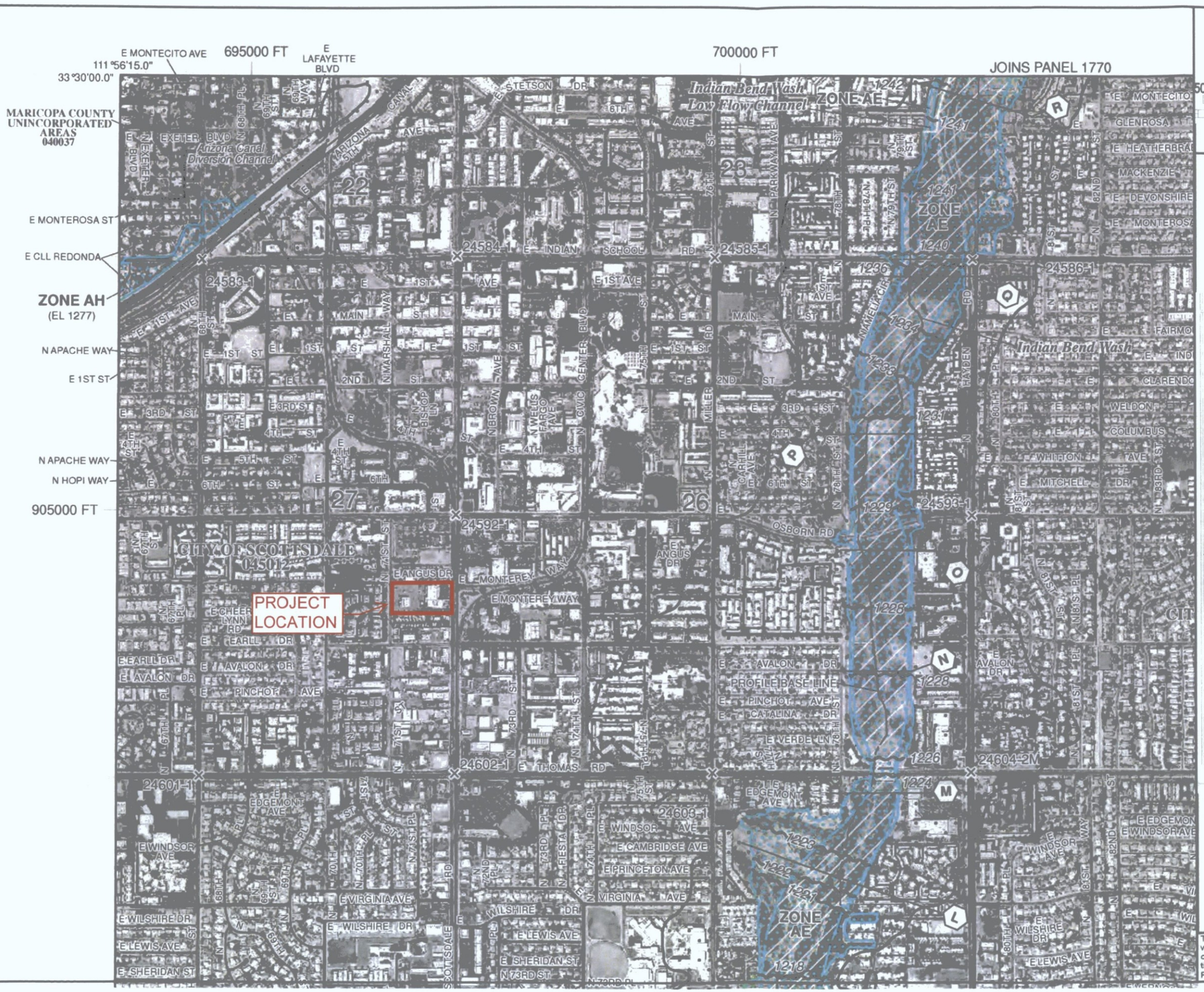


FIGURE 1
VICINITY MAP

FIGURE 2
AERIAL



MAP SCALE 1" = 1000'

500 0 1000 2000 FEET METE

NFIP PANEL 2235L

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

MARICOPA COUNTY, ARIZONA

AND INCORPORATED AREAS

PANEL 2235 OF 4425

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
MARICOPA COUNTY	040037	2235	L
MESA, CITY OF	040048	2235	L
SCOTTSDALE, CITY OF	045012	2235	L
TEMPE, CITY OF	040054	2235	L

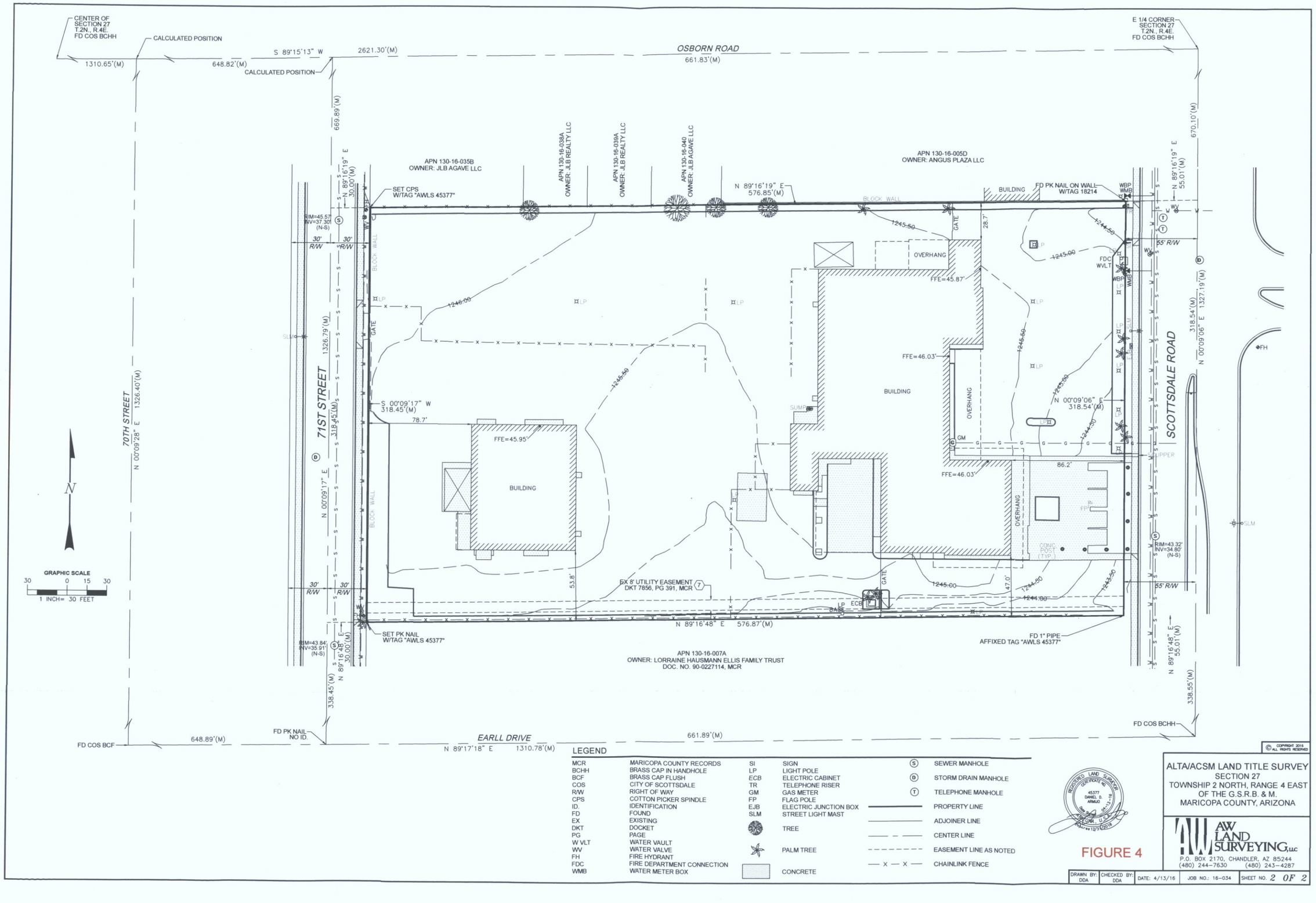
Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
04013C2235L

MAP REVISED
OCTOBER 16, 2013

Federal Emergency Management Agency

FIGURE 3



LEGEND

MCR	MARICOPA COUNTY RECORDS	SI	SIGN	(S)	SEWER MANHOLE
BCHH	BRASS CAP IN HANDHOLE	LP	LIGHT POLE	(D)	STORM DRAIN MANHOLE
BCF	BRASS CAP FLUSH	ECB	ELECTRIC CABINET	(T)	TELEPHONE MANHOLE
COS	CITY OF SCOTTSDALE	TR	TELEPHONE RISER		PROPERTY LINE
R/W	RIGHT OF WAY	GM	GAS METER		ADJOINER LINE
CPS	COTTON PICKER SPINDLE	FP	FLAG POLE		CENTER LINE
ID.	IDENTIFICATION	EJB	ELECTRIC JUNCTION BOX		EASEMENT LINE AS NOTED
FD	FOUND	SLM	STREET LIGHT MAST	— x — x —	CHAINLINK FENCE
EX	EXISTING		TREE		
DKT	DOCKET		PALM TREE		
PG	PAGE		CONCRETE		
W VLT	WATER VAULT				
WV	WATER VALVE				
FH	FIRE HYDRANT				
FDC	FIRE DEPARTMENT CONNECTION				
WMB	WATER METER BOX				

REGISTERED LAND SURVEYOR — CERTIFICATE NO. 45377 — DANIEL D. ARMIJO — ARIZONA, U.S.A. — Expires 12/31/2016

FIGURE 4

ALTA/ACSM LAND TITLE SURVEY

SECTION 27
TOWNSHIP 2 NORTH, RANGE 4 EAST
OF THE G.S.R.B. & M.
MARICOPA COUNTY, ARIZONA

AW LAND SURVEYING, LLC
P.O. BOX 2170, CHANDLER, AZ 85244
(480) 244-7630 (480) 243-4287

DRAWN BY:	CHECKED BY:	DATE:	JOB NO.:	SHEET NO.
DDA	DDA	4/13/16	16-034	2 OF 2

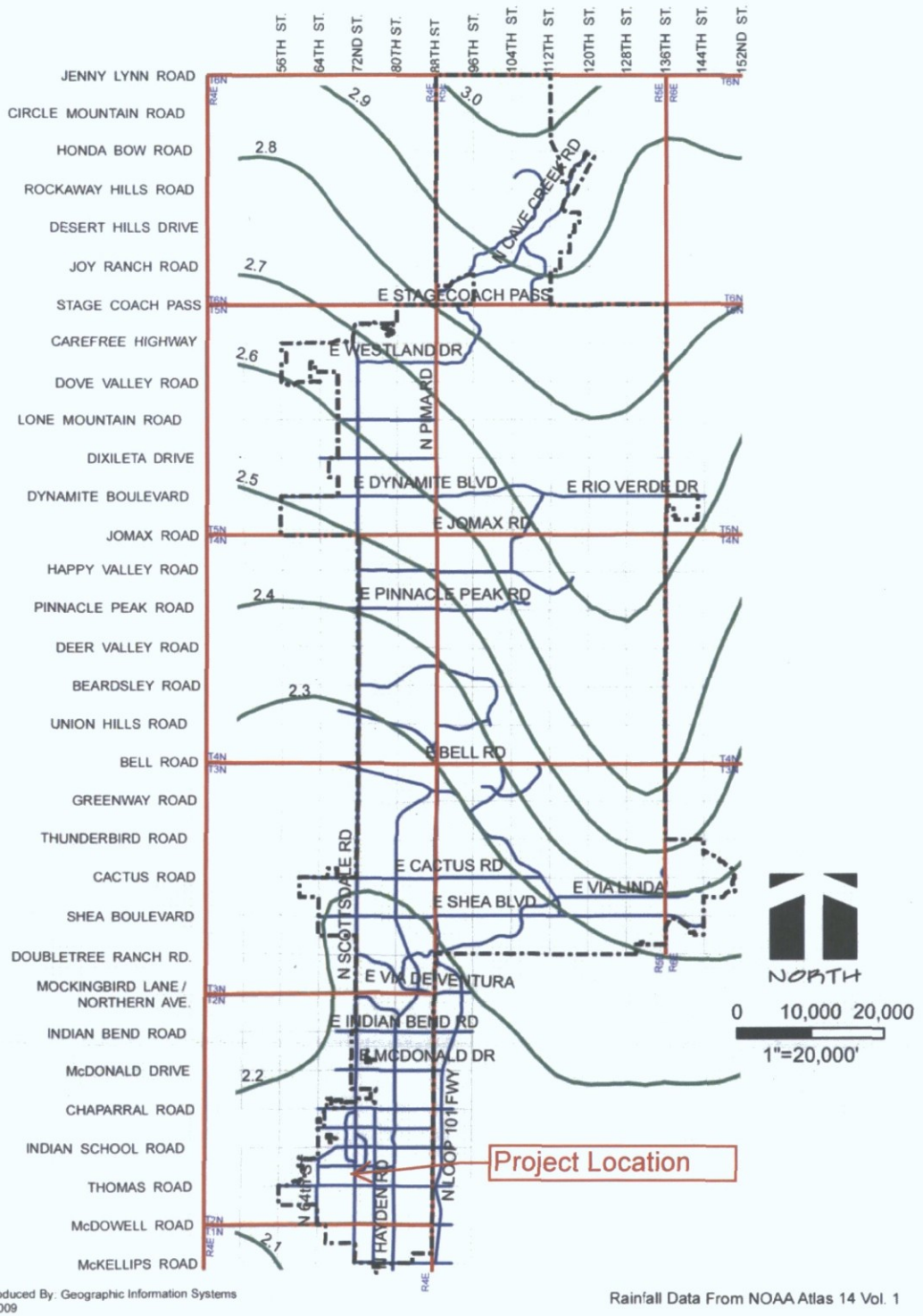
APPENDIX I

Rainfall Data

8280 E. Gelding Dr., Suite 101
Scottsdale, AZ 85260
info@azSEG.com 480.588.7226 www.azSEG.com

ISOPLUVIALS

100 Year 2 Hour Precipitation in Inches



Map Produced By: Geographic Information Systems
04/03/2009

Rainfall Data From NOAA Atlas 14 Vol. 1

NOAA Atlas 14, Volume 1, Version 5
Location name: Scottsdale, Arizona, US*
Latitude: 33.4850°, Longitude: -111.9291°
Elevation: 1247 ft*
* source: Google Maps

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

PF tabular | PF graphical | Maps & aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches/hour)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	2.20 (1.84-2.66)	2.87 (2.42-3.48)	3.89 (3.26-4.73)	4.68 (3.90-5.65)	5.76 (4.72-6.91)	6.59 (5.33-7.87)	7.43 (5.89-8.86)	8.29 (6.47-9.86)	9.44 (7.18-11.3)	10.3 (7.69-12.3)
10-min	1.67 (1.40-2.03)	2.18 (1.84-2.65)	2.96 (2.48-3.59)	3.56 (2.97-4.30)	4.38 (3.59-5.26)	5.01 (4.05-5.99)	5.65 (4.48-6.73)	6.31 (4.92-7.51)	7.18 (5.45-8.57)	7.85 (5.85-9.38)
15-min	1.38 (1.16-1.68)	1.80 (1.52-2.19)	2.45 (2.05-2.97)	2.95 (2.45-3.56)	3.62 (2.96-4.34)	4.14 (3.35-4.95)	4.67 (3.70-5.56)	5.21 (4.07-6.20)	5.94 (4.51-7.08)	6.49 (4.84-7.76)
30-min	0.928 (0.778-1.13)	1.21 (1.02-1.48)	1.65 (1.38-2.00)	1.98 (1.65-2.39)	2.44 (2.00-2.93)	2.79 (2.25-3.33)	3.14 (2.49-3.75)	3.51 (2.74-4.18)	4.00 (3.04-4.77)	4.37 (3.26-5.22)
60-min	0.574 (0.481-0.698)	0.751 (0.633-0.913)	1.02 (0.855-1.24)	1.23 (1.02-1.48)	1.51 (1.24-1.81)	1.73 (1.39-2.06)	1.95 (1.54-2.32)	2.17 (1.69-2.59)	2.47 (1.88-2.95)	2.71 (2.01-3.23)
2-hr	0.332 (0.284-0.396)	0.430 (0.368-0.514)	0.576 (0.490-0.685)	0.688 (0.578-0.816)	0.840 (0.698-0.990)	0.958 (0.785-1.13)	1.08 (0.870-1.27)	1.20 (0.952-1.41)	1.37 (1.06-1.60)	1.49 (1.13-1.76)
3-hr	0.240 (0.204-0.289)	0.308 (0.263-0.372)	0.406 (0.344-0.487)	0.483 (0.405-0.576)	0.590 (0.489-0.701)	0.676 (0.552-0.800)	0.766 (0.615-0.906)	0.859 (0.678-1.02)	0.989 (0.757-1.17)	1.09 (0.816-1.30)
6-hr	0.145 (0.126-0.171)	0.184 (0.160-0.216)	0.236 (0.205-0.277)	0.278 (0.238-0.324)	0.334 (0.283-0.387)	0.379 (0.316-0.437)	0.425 (0.349-0.491)	0.472 (0.380-0.547)	0.537 (0.422-0.623)	0.588 (0.451-0.684)
12-hr	0.081 (0.071-0.094)	0.102 (0.089-0.119)	0.129 (0.113-0.150)	0.151 (0.131-0.174)	0.180 (0.154-0.207)	0.202 (0.171-0.232)	0.225 (0.188-0.258)	0.248 (0.204-0.285)	0.279 (0.224-0.323)	0.304 (0.239-0.353)
24-hr	0.048 (0.043-0.055)	0.062 (0.055-0.069)	0.080 (0.071-0.090)	0.094 (0.084-0.106)	0.114 (0.101-0.128)	0.130 (0.114-0.145)	0.147 (0.128-0.164)	0.164 (0.141-0.183)	0.187 (0.160-0.209)	0.206 (0.174-0.231)
2-day	0.026 (0.023-0.029)	0.033 (0.030-0.036)	0.044 (0.039-0.049)	0.052 (0.047-0.059)	0.064 (0.057-0.072)	0.073 (0.064-0.082)	0.083 (0.073-0.093)	0.093 (0.081-0.105)	0.108 (0.092-0.121)	0.119 (0.101-0.134)
3-day	0.018 (0.016-0.021)	0.024 (0.021-0.027)	0.031 (0.028-0.035)	0.037 (0.033-0.042)	0.046 (0.040-0.051)	0.052 (0.046-0.059)	0.060 (0.052-0.067)	0.067 (0.058-0.075)	0.078 (0.066-0.087)	0.086 (0.073-0.097)
4-day	0.015 (0.013-0.016)	0.019 (0.017-0.021)	0.025 (0.022-0.028)	0.029 (0.026-0.033)	0.036 (0.032-0.041)	0.042 (0.037-0.047)	0.048 (0.041-0.053)	0.054 (0.047-0.060)	0.063 (0.053-0.070)	0.070 (0.059-0.078)
7-day	0.009 (0.008-0.010)	0.012 (0.011-0.013)	0.016 (0.014-0.018)	0.019 (0.017-0.021)	0.023 (0.020-0.026)	0.026 (0.023-0.030)	0.030 (0.026-0.034)	0.034 (0.029-0.038)	0.040 (0.034-0.045)	0.044 (0.037-0.050)
10-day	0.007 (0.006-0.008)	0.009 (0.008-0.010)	0.012 (0.011-0.013)	0.014 (0.013-0.016)	0.017 (0.015-0.019)	0.020 (0.018-0.022)	0.023 (0.020-0.025)	0.026 (0.022-0.029)	0.030 (0.025-0.033)	0.033 (0.028-0.037)
20-day	0.004 (0.004-0.005)	0.006 (0.005-0.006)	0.007 (0.007-0.008)	0.009 (0.008-0.010)	0.010 (0.009-0.012)	0.012 (0.011-0.013)	0.013 (0.012-0.015)	0.015 (0.013-0.016)	0.017 (0.014-0.019)	0.018 (0.016-0.020)
30-day	0.003 (0.003-0.004)	0.004 (0.004-0.005)	0.006 (0.005-0.006)	0.007 (0.006-0.007)	0.008 (0.007-0.009)	0.009 (0.008-0.010)	0.010 (0.009-0.011)	0.011 (0.010-0.013)	0.013 (0.011-0.014)	0.014 (0.012-0.016)
45-day	0.003 (0.002-0.003)	0.003 (0.003-0.004)	0.004 (0.004-0.005)	0.005 (0.005-0.006)	0.006 (0.006-0.007)	0.007 (0.006-0.008)	0.008 (0.007-0.009)	0.009 (0.008-0.010)	0.010 (0.008-0.011)	0.010 (0.009-0.012)
60-day	0.002 (0.002-0.002)	0.003 (0.003-0.003)	0.004 (0.003-0.004)	0.004 (0.004-0.005)	0.005 (0.005-0.006)	0.006 (0.005-0.006)	0.006 (0.006-0.007)	0.007 (0.006-0.008)	0.008 (0.007-0.009)	0.008 (0.007-0.009)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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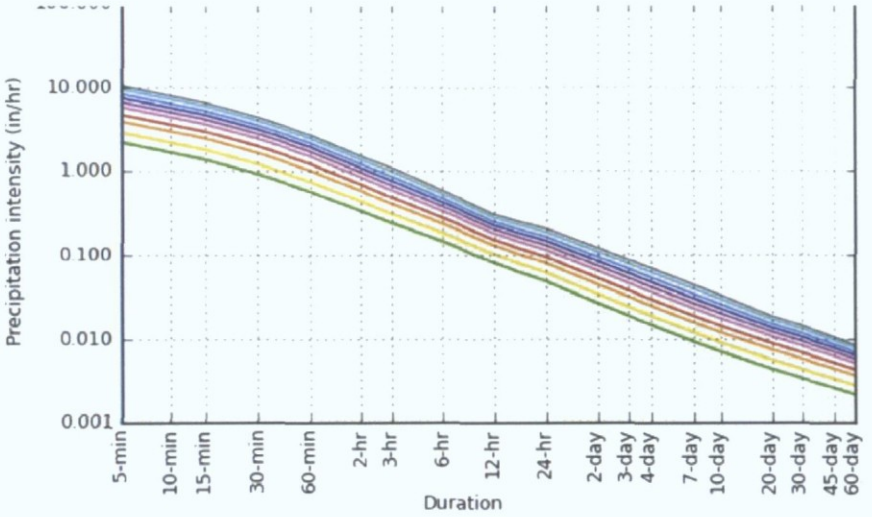
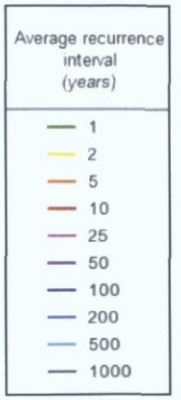
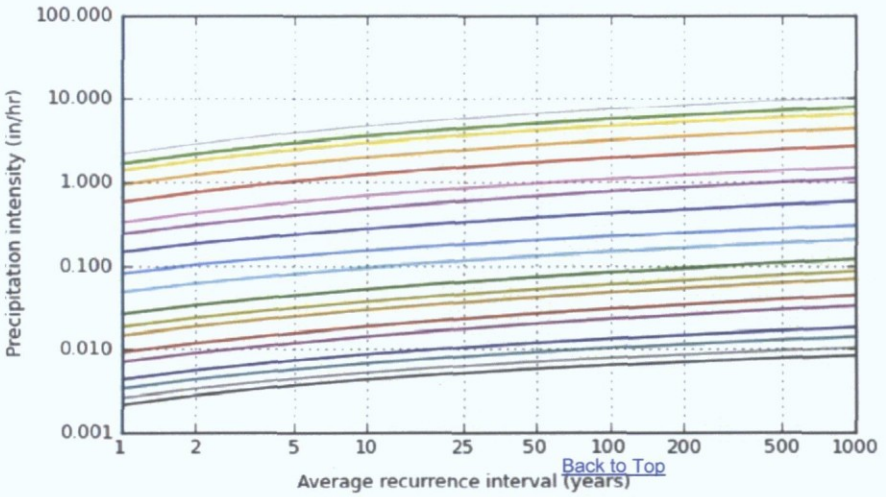
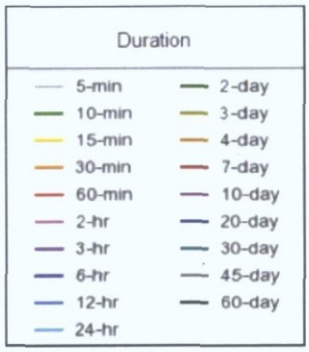
PF graphical









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Maps & aerials

NOAA Atlas 14, Volume 1, Version 5

Created (GMT): Sun Apr 10 17:50:28 2016

Small scale terrain

NOAA Atlas 14, Volume 1, Version 5
Location name: Scottsdale, Arizona, US*
Latitude: 33.4850°, Longitude: -111.9291°
Elevation: 1247 ft*
* source: Google Maps

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

PF tabular | PF graphical | Maps & aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.183 (0.153–0.222)	0.239 (0.202–0.290)	0.324 (0.272–0.394)	0.390 (0.325–0.471)	0.480 (0.393–0.576)	0.549 (0.444–0.656)	0.619 (0.491–0.738)	0.691 (0.539–0.822)	0.787 (0.598–0.938)	0.860 (0.641–1.03)
10-min	0.278 (0.233–0.338)	0.363 (0.307–0.442)	0.494 (0.414–0.599)	0.594 (0.495–0.717)	0.730 (0.598–0.876)	0.835 (0.675–0.998)	0.941 (0.747–1.12)	1.05 (0.820–1.25)	1.20 (0.909–1.43)	1.31 (0.975–1.56)
15-min	0.344 (0.289–0.419)	0.450 (0.380–0.548)	0.612 (0.513–0.742)	0.737 (0.613–0.889)	0.905 (0.741–1.09)	1.04 (0.837–1.24)	1.17 (0.926–1.39)	1.30 (1.02–1.55)	1.48 (1.13–1.77)	1.62 (1.21–1.94)
30-min	0.464 (0.389–0.564)	0.607 (0.512–0.738)	0.825 (0.691–1.00)	0.992 (0.826–1.20)	1.22 (0.998–1.46)	1.39 (1.13–1.67)	1.57 (1.25–1.87)	1.75 (1.37–2.09)	2.00 (1.52–2.38)	2.19 (1.63–2.61)
60-min	0.574 (0.481–0.698)	0.751 (0.633–0.913)	1.02 (0.855–1.24)	1.23 (1.02–1.48)	1.51 (1.24–1.81)	1.73 (1.39–2.06)	1.95 (1.54–2.32)	2.17 (1.69–2.59)	2.47 (1.88–2.95)	2.71 (2.01–3.23)
2-hr	0.664 (0.567–0.792)	0.861 (0.735–1.03)	1.15 (0.981–1.37)	1.38 (1.16–1.63)	1.68 (1.40–1.98)	1.92 (1.57–2.25)	2.16 (1.74–2.53)	2.40 (1.90–2.82)	2.73 (2.11–3.21)	2.99 (2.26–3.53)
3-hr	0.722 (0.613–0.867)	0.926 (0.790–1.12)	1.22 (1.03–1.46)	1.45 (1.22–1.73)	1.77 (1.47–2.10)	2.03 (1.66–2.40)	2.30 (1.85–2.72)	2.58 (2.04–3.05)	2.97 (2.27–3.51)	3.29 (2.45–3.90)
6-hr	0.869 (0.754–1.02)	1.10 (0.959–1.30)	1.41 (1.23–1.66)	1.66 (1.43–1.94)	2.00 (1.70–2.32)	2.27 (1.89–2.62)	2.55 (2.09–2.94)	2.83 (2.28–3.27)	3.22 (2.53–3.73)	3.52 (2.70–4.10)
12-hr	0.972 (0.851–1.13)	1.23 (1.08–1.43)	1.56 (1.36–1.80)	1.82 (1.58–2.10)	2.17 (1.86–2.49)	2.43 (2.06–2.79)	2.71 (2.26–3.11)	2.99 (2.46–3.44)	3.36 (2.70–3.89)	3.66 (2.88–4.26)
24-hr	1.16 (1.04–1.31)	1.48 (1.32–1.67)	1.92 (1.71–2.15)	2.26 (2.01–2.54)	2.74 (2.42–3.07)	3.12 (2.74–3.49)	3.52 (3.06–3.93)	3.93 (3.39–4.39)	4.49 (3.84–5.03)	4.94 (4.18–5.54)
2-day	1.26 (1.12–1.42)	1.61 (1.44–1.81)	2.11 (1.88–2.37)	2.51 (2.23–2.82)	3.07 (2.72–3.44)	3.52 (3.09–3.94)	3.99 (3.48–4.48)	4.48 (3.88–5.03)	5.17 (4.43–5.81)	5.72 (4.85–6.45)
3-day	1.33 (1.19–1.50)	1.70 (1.52–1.91)	2.24 (1.99–2.51)	2.67 (2.37–2.99)	3.28 (2.90–3.67)	3.77 (3.30–4.21)	4.28 (3.73–4.80)	4.83 (4.17–5.41)	5.60 (4.78–6.28)	6.21 (5.25–6.99)
4-day	1.40 (1.25–1.58)	1.79 (1.60–2.02)	2.36 (2.10–2.65)	2.83 (2.51–3.17)	3.48 (3.07–3.90)	4.01 (3.52–4.49)	4.58 (3.98–5.12)	5.18 (4.47–5.80)	6.02 (5.13–6.74)	6.71 (5.66–7.53)
7-day	1.55 (1.38–1.75)	1.98 (1.77–2.24)	2.62 (2.33–2.94)	3.13 (2.78–3.52)	3.86 (3.41–4.33)	4.44 (3.90–4.98)	5.07 (4.41–5.68)	5.73 (4.95–6.43)	6.66 (5.68–7.48)	7.42 (6.25–8.34)
10-day	1.69 (1.51–1.90)	2.16 (1.93–2.43)	2.85 (2.54–3.20)	3.41 (3.02–3.81)	4.18 (3.69–4.67)	4.81 (4.22–5.37)	5.47 (4.76–6.11)	6.16 (5.33–6.89)	7.14 (6.10–7.99)	7.92 (6.70–8.88)
20-day	2.07 (1.86–2.32)	2.67 (2.39–2.98)	3.52 (3.15–3.93)	4.17 (3.71–4.64)	5.04 (4.47–5.61)	5.71 (5.05–6.35)	6.39 (5.62–7.12)	7.08 (6.20–7.89)	8.01 (6.95–8.95)	8.72 (7.51–9.76)
30-day	2.42 (2.16–2.71)	3.12 (2.79–3.48)	4.11 (3.66–4.57)	4.86 (4.33–5.40)	5.87 (5.20–6.52)	6.64 (5.86–7.38)	7.44 (6.54–8.26)	8.25 (7.21–9.16)	9.34 (8.10–10.4)	10.2 (8.75–11.3)
45-day	2.81 (2.52–3.13)	3.62 (3.25–4.03)	4.76 (4.27–5.31)	5.61 (5.02–6.25)	6.73 (6.00–7.49)	7.57 (6.73–8.43)	8.42 (7.45–9.38)	9.27 (8.16–10.3)	10.4 (9.08–11.6)	11.2 (9.76–12.6)
60-day	3.11 (2.80–3.46)	4.01 (3.61–4.46)	5.28 (4.74–5.86)	6.20 (5.55–6.88)	7.39 (6.61–8.21)	8.28 (7.37–9.19)	9.17 (8.13–10.2)	10.0 (8.87–11.2)	11.2 (9.81–12.5)	12.0 (10.5–13.4)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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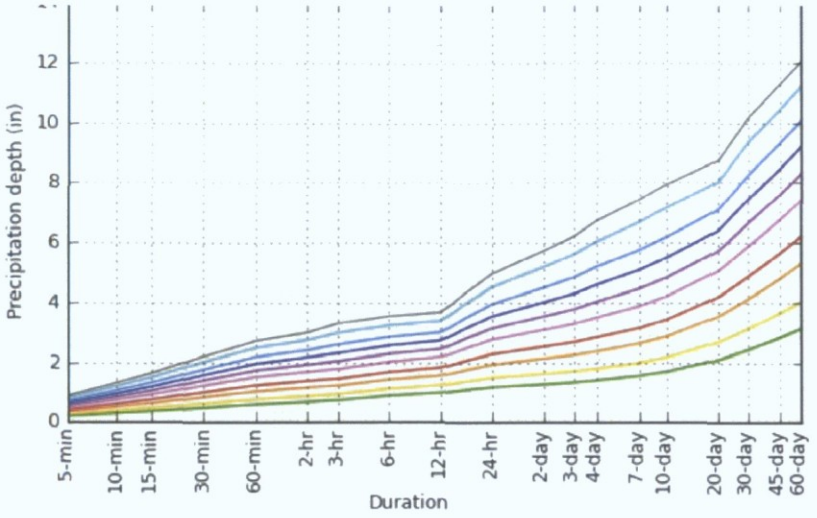
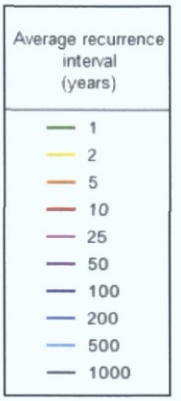
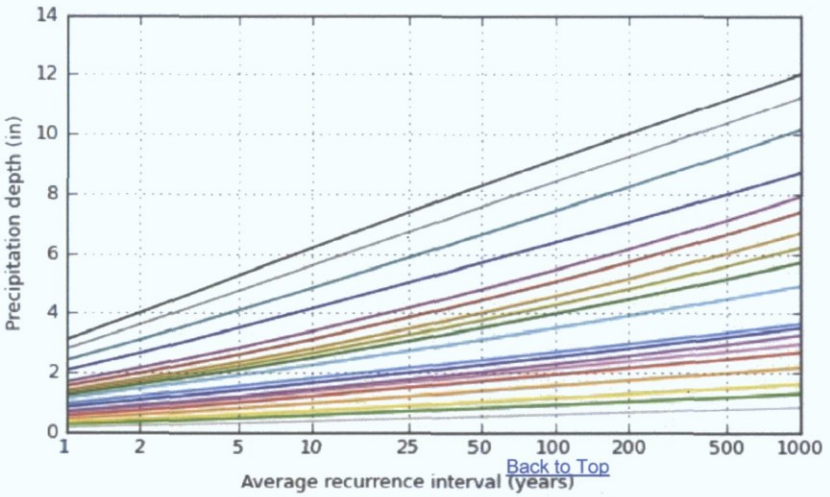
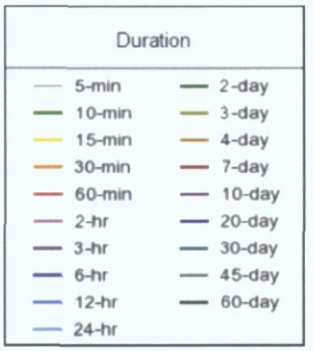
PF graphical









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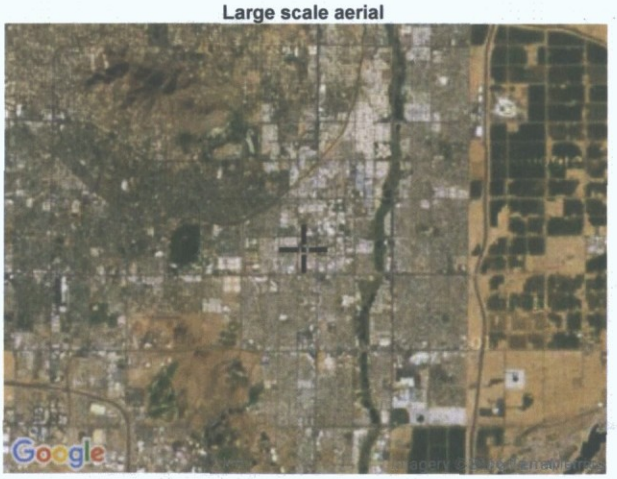
Small scale terrain

Large scale terrain

Large scale map

Large scale aerial



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US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910

APPENDIX II

Calculations

8280 E. Gelding Dr., Suite 101
Scottsdale, AZ 85260
info@azSEG.com 480.588.7226 www.azSEG.com

2. Time of Concentration

Time of concentration "**Tc**" is the total time of travel from the most hydraulically remote part of the watershed to the concentration point of interest. The calculation of "Tc" must follow FCDMC Hydrology Manual procedures.

***Note:** **Do not add a standard set amount of time to the estimated "Tc" for lot runoff delay (such as 5 or 10 minutes).** Natural land slopes are too variable in Scottsdale to add a set amount of time for lot runoff.

3. Runoff Coefficients

Use Figure 4.1-4 or equivalent to obtain the runoff coefficients or "**C**" values. Composite "**C**" values for the appropriate zoning category or weighted average values calculated for the specific site are both acceptable approaches.

RUNOFF COEFFICIENTS - "C" VALUE

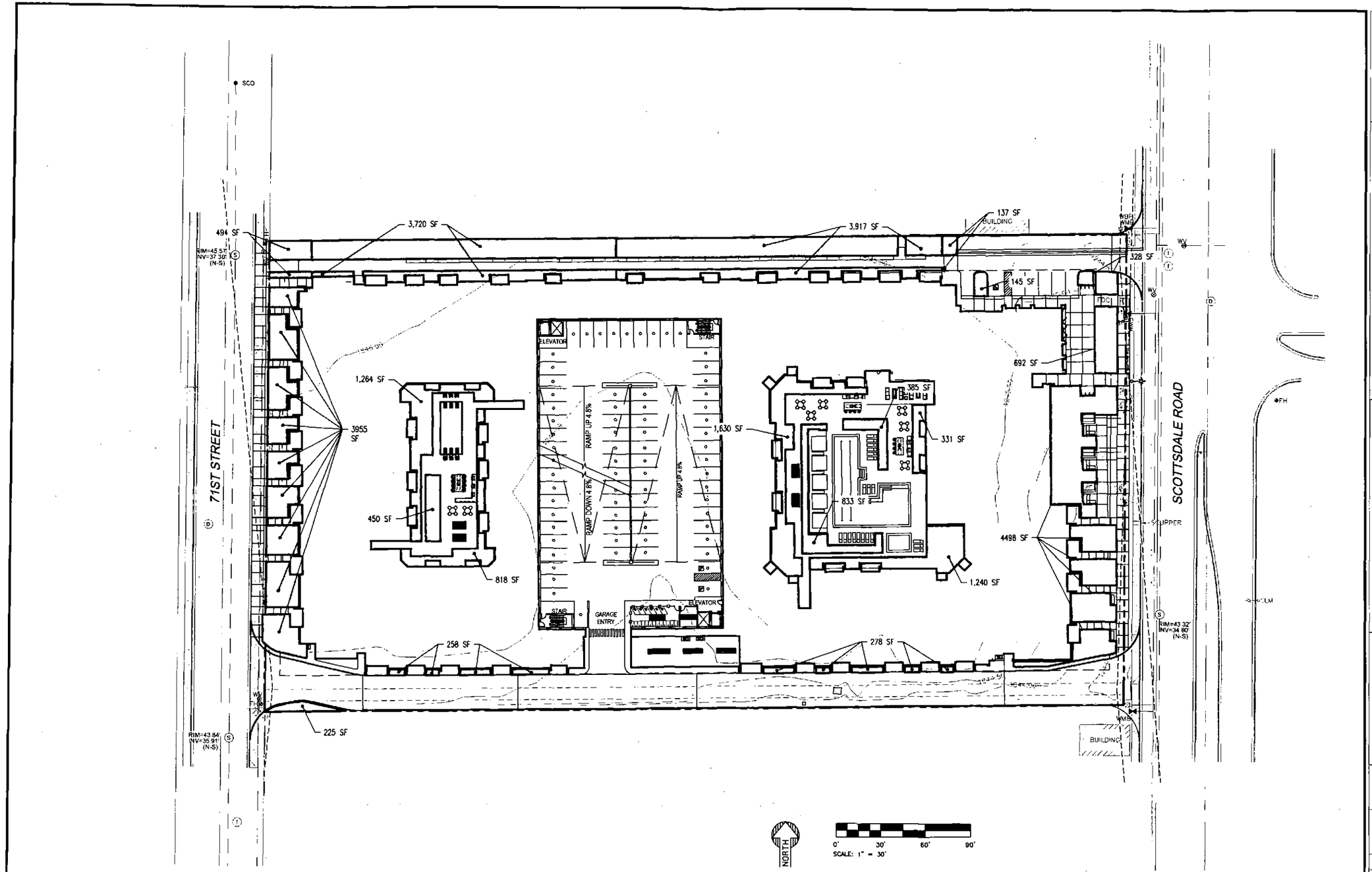
Land Use	Storm Frequency		
Composite Area-wide Values	2-25 Year	50 Year	100 Year
Commercial & Industrial Areas	0.80	0.83	0.86
Residential Areas-Single Family (average lot size)			
R1-1-1901	0.33	0.50	0.53
R1-130	0.35	0.51	0.59
R1-70	0.37	0.52	0.60
R1-43	0.38	0.55	0.61
R1-35 (35,000 square feet/lot)	0.40	0.56	0.62
R1-18 (18,000 square feet/lot)	0.43	0.58	0.64
R1-10 (10,000 square feet/lot)	0.47	0.62	0.67
R1-7 (7,000 square feet/lot)	0.51	0.64	0.94
Townhouses (R-2, R-4)	0.63	0.74	0.94
Apartments & Condominiums (R-3, R-5)	0.76	0.83	0.94
Specific Surface Type Values			
Paved streets, parking lots (concrete or asphalt), roofs, drive-ways, etc.	0.90	0.93	0.95
Lawns, golf courses, & parks (grassed areas)	0.20	0.25	0.30
Undisturbed natural desert or desert landscaping (no impervious weed barrier)	0.37	0.42	045
Desert landscaping (with impervious weed barrier)	0.63	0.73	0.83
Mountain terrain – slopes greater than 10%	0.60	0.70	0.80
Agricultural areas (flood-irrigated fields)	0.16	0.18	0.20

FIGURE 4.1-4 RUNOFF COEFFICIENTS FOR USE WITH RATIONAL METHOD

Grass = 0.35 ac. @ C=0.30
Desert Landscape = 0.232 ac. @C=0.45
Impervious = 3.947 ac. @ C= 0.95
Cwt = 4.214 ac @ C=0.92

PRE-DEVELOPMENT DRAINAGE AREA MAP

EXHIBIT "A"



DESERT LSCP = 0.588 AC @ Cwt=0.45
IMPERVIOUS = 3.626 AC @ Cwt=0.95
Cwt= 4.214 AC @ Cwt=0.88

SEG
SUSTAINABILITY ENGINEERING GROUP
8280 E GELDING DR #101, SCOTTSDALE, ARIZONA 85260
WWW.AZSEG.COM TEL 480.588.7226

PROJECT
WOOD PARTNERS
RESIDENTIAL DEVELOPMENT

LOCATION
3220 N SCOTTSDALE RD,
SCOTTSDALE, AZ. 85251

DRAWN	POUNDS
DESIGNED	POUNDS
CHECKED	COUNSELL
PROJ. MGR.	FAKIH

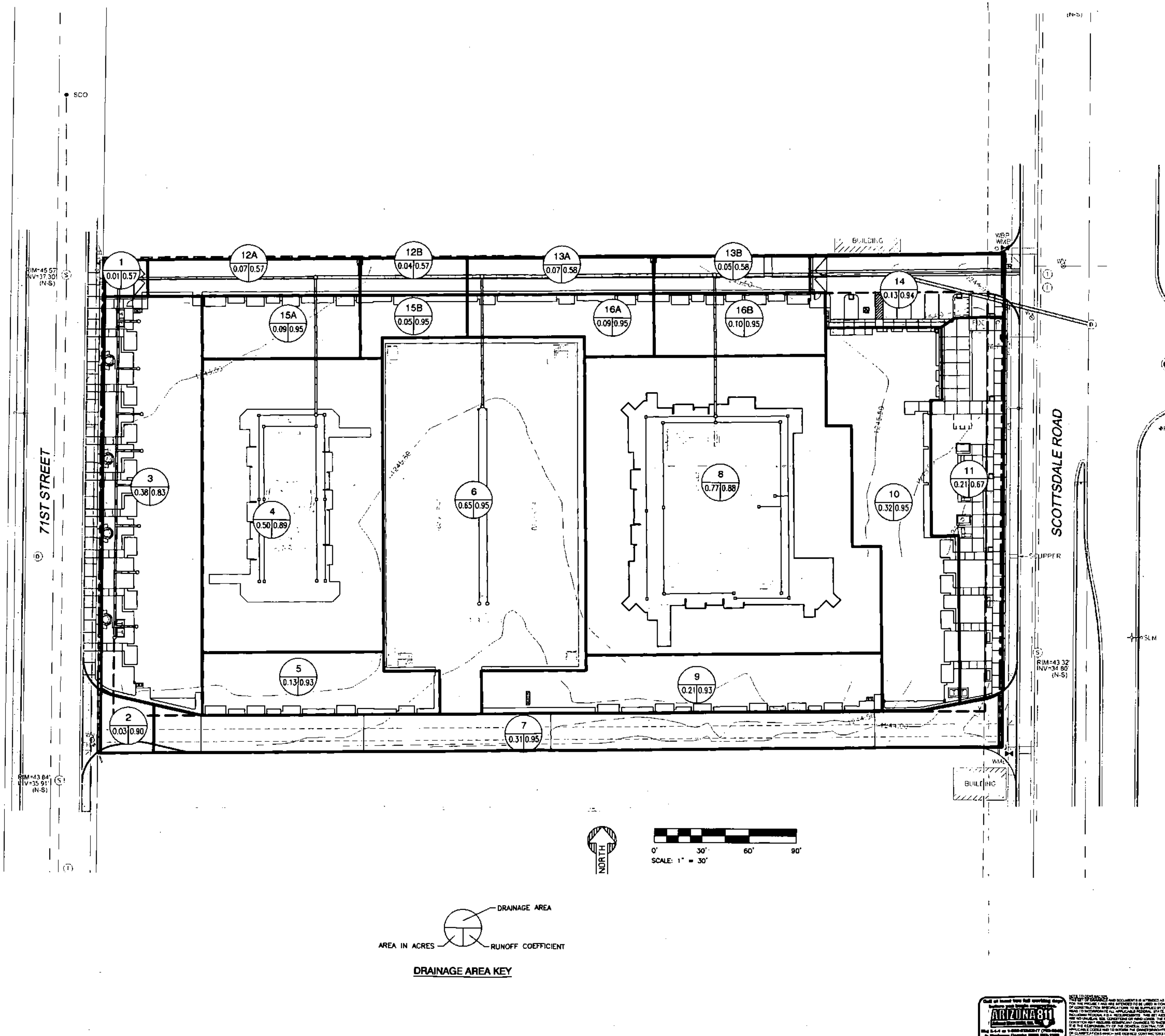
DATE: 08/30/2016
ISSUED FOR: DRB

REVISION NO.	DATE:
1	
2	
3	
4	

JOB NO 160410

SHEET TITLE
POST DEVELOPMENT Cwt

SHEET NO.
EXHIBIT "B"



SEAL

EXPIRES 12-31-17

PREPARED UNDER THE DIRECT SUPERVISION OF ALI FAKIH, P.E. ARIZONA REGISTRATION NO. 45621 FOR AND ON BEHALF OF SUSTAINABILITY ENGINEERING GROUP, LLC

SEG SUSTAINABILITY ENGINEERING GROUP

8280 E GELDING DR #101, SCOTTSDALE, ARIZONA 85260
WWW AZSEG COM TEL 480 588 7226

PROJECT
WOOD PARTNERS
RESIDENTIAL DEVELOPMENT

LOCATION
3220 N SCOTTSDALE RD.
SCOTTSDALE, AZ 85251

DRAWN — POUNDS
DESIGNED — POUNDS
CHECKED — COUNSELL
PROJ MGR. — FAKIH

DATE: 10/18/2016

ISSUED FOR: DRB

REVISION NO:		DATE
1		
2		
3		
4		

JOB NO 160410

SHEET TITLE: DRAINAGE AREA MAP

SHEET NO: DAM

Worksheet for Irregular Section - South Drive channel @ 0.5%

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00500	ft/ft
Discharge	3.45	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	0.50
0+00	0.00
0+24	0.48

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 0.50)	(0+24, 0.48)	0.013

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth		0.26	ft
Elevation Range	0.00 to 0.50 ft		
Flow Area		1.69	ft²
Wetted Perimeter		13.26	ft
Hydraulic Radius		0.13	ft
Top Width		13.00	ft
Normal Depth		0.26	ft
Critical Depth		0.26	ft
Critical Slope		0.00499	ft/ft
Velocity		2.04	ft/s

Worksheet for Irregular Section - South Drive channel @ 0.5%

Results

Velocity Head		0.06	ft
Specific Energy		0.32	ft
Froude Number		1.00	
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
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.26	ft
Critical Depth	0.26	ft
Channel Slope	0.00500	ft/ft
Critical Slope	0.00499	ft/ft

Cross Section for Irregular Section - South Drive channel cross section

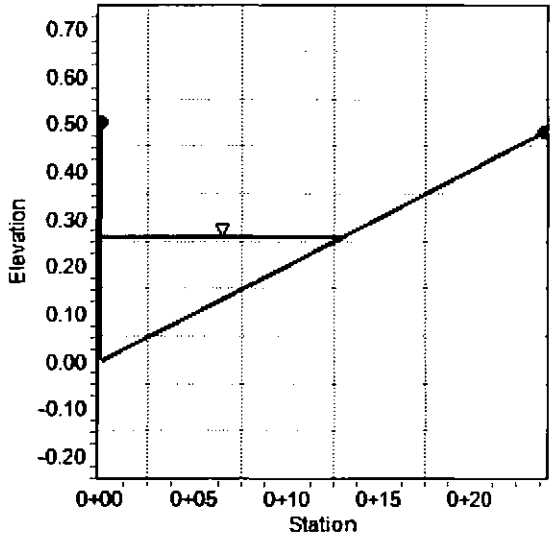
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00500	ft/ft
Normal Depth	0.26	ft
Discharge	3.45	ft³/s

Cross Section Image



Worksheet for Irregular Section - 2 South Channel 5% cross slope

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00500	ft/ft
Discharge	3.45	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	0.50
0+00	0.00
0+24	1.20

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 0.50)	(0+24, 1.20)	0.013

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.37	ft
Elevation Range	0.00 to 1.20 ft	
Flow Area	1.36	ft²
Wetted Perimeter	7.76	ft
Hydraulic Radius	0.18	ft
Top Width	7.38	ft
Normal Depth	0.37	ft
Critical Depth	0.37	ft
Critical Slope	0.00460	ft/ft
Velocity	2.53	ft/s

Worksheet for Irregular Section - 2 South Channel 5% cross slope

Results

Velocity Head		0.10	ft
Specific Energy		0.47	ft
Froude Number		1.04	
Flow Type	Supercritical		

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
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.37	ft
Critical Depth	0.37	ft
Channel Slope	0.00500	ft/ft
Critical Slope	0.00460	ft/ft

Cross Section for Irregular Section - 2 South Channel 5% cross slope

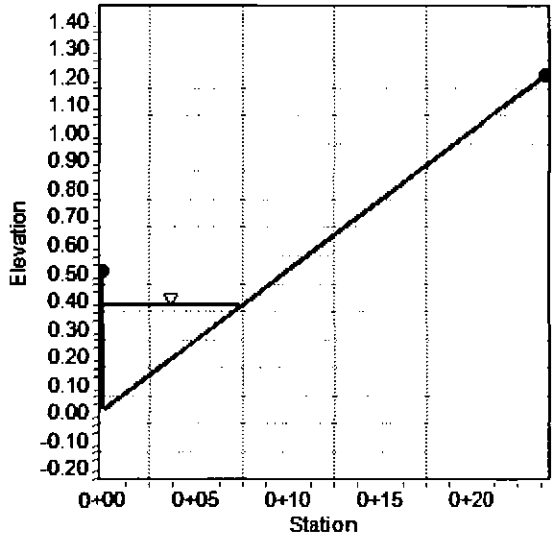
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00500	ft/ft
Normal Depth	0.37	ft
Discharge	3.45	ft³/s

Cross Section Image



Worksheet for Irregular Section - North Channel

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00330	ft/ft
Discharge	0.71	ft^3/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	0.83
0+10	0.63
0+24	0.00
0+24	0.50

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 0.83)	(0+24, 0.50)	0.030

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.29	ft
Elevation Range	0.00 to 0.83 ft	
Flow Area	0.93	ft^2
Wetted Perimeter	6.73	ft
Hydraulic Radius	0.14	ft
Top Width	6.44	ft
Normal Depth	0.29	ft
Critical Depth	0.19	ft
Critical Slope	0.03048	ft/ft

Worksheet for Irregular Section - North Channel

Results

Velocity		0.76	ft/s
Velocity Head		0.01	ft
Specific Energy		0.30	ft
Froude Number		0.35	
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
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.29	ft
Critical Depth	0.19	ft
Channel Slope	0.00330	ft/ft
Critical Slope	0.03048	ft/ft

Cross Section for Irregular Section - North Drive Section

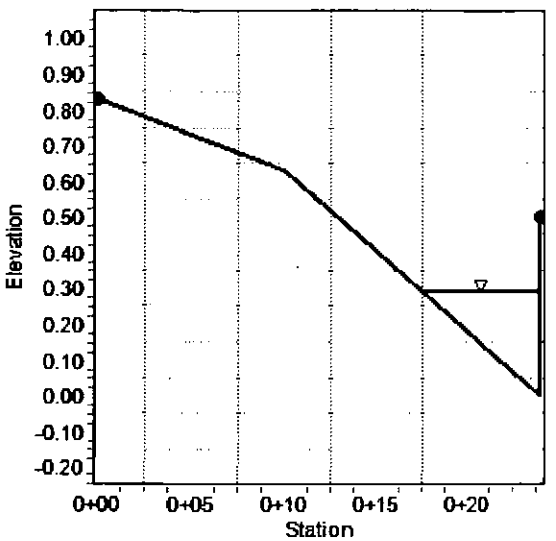
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

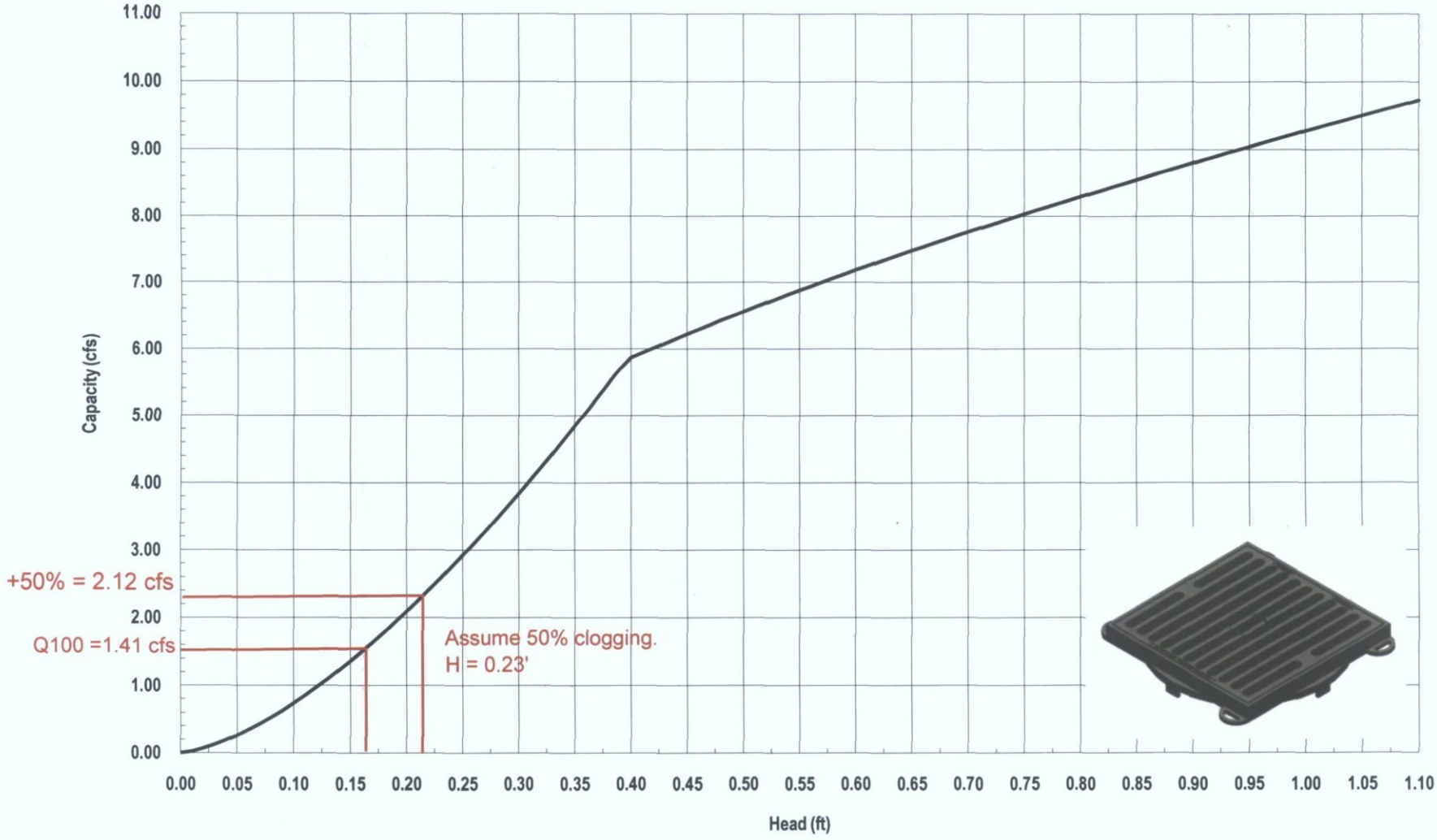
Input Data

Channel Slope	0.00330	ft/ft
Normal Depth	0.29	ft
Discharge	0.71	ft³/s

Cross Section Image



Nyloplast 2' x 2' Road & Highway Grate Inlet Capacity Chart



Nyloplast

3130 Verona Avenue • Buford, GA 30518

(866) 888-8479 / (770) 932-2443 • Fax: (770) 932-2490

STORM DESIGN

Project: Wood Parnters-Osborne — 100 Year
Job No: 160410 — 0.013
Date: 10/19/16
Location Scottsdale, AZ

			A	C	(AxC)	L	t	I - 100	Q - 100	D	V	S	v		A	P	R	Q
Drainage Area	Runoff Entering Structure	To Downstream Structure	Area contributing to structure (ACRES)	Imperviousness	Equivalent Area	Length of travel in pipe (ft)	Time of Concentration (min)	Rainfall Intensity 100 Year Storm (in/hr)	Quantity of Rainfall 100 Year Storm (cfs)	Standard pipe size needed	Volume in pipe (storage - cf)	Slope (%) of Individual Gradient	Velocity (ft/s) Flowing Full	Time (min) of Flow to Next M.H.	Area (ft^2)	Perimeter (ft)	hyd rad (ft)	Discharge Capactiy (cfs)
3	**CB-6**	**CB-5**	0.38	0.83	0.32	**235.0**	5.00	7.43	2.34	**15 in.**	288.4	**0.40%**	3.34	1.17	1.23	3.93	0.31	**4.10**
1	**CB-5**	**MH-4**	0.01	0.57	0.01	**126.0**	5.00	7.43	2.39	**15 in.**	154.6	**0.40%**	3.34	0.63	1.23	3.93	0.31	**4.10**
4	**MH-4B**	**MH-4**	0.50	0.89	0.45	**89.0**	5.00	7.43	3.31	**18 in.**	157.3	**0.25%**	2.98	0.50	1.77	4.71	0.38	**5.27**
	MH-4	**CB-4A**	0.00	0.00	0.00	**28.0**	5.00	7.43	5.69	**24 in.**	88.0	**0.38%**	4.45	0.10	3.14	6.28	0.50	**13.98**
12+15A	**CB-4A**	**MH-3**	0.25	0.78	0.20	**78**	5.00	7.43	7.14	**24 in.**	245.0	**0.38%**	4.45	0.29	3.14	6.28	0.50	**13.98**
6	**MH-3B**	**MH-3**	0.65	0.95	0.62	**84.0**	5.00	7.43	4.59	**18 in.**	148.4	**0.20%**	2.67	0.53	1.77	4.71	0.38	**4.71**
	MH-3	**CB-3A**	0.00	0.00	0.00	**110.0**	5.00	7.43	11.73	**48 in.**	1382.3	**0.15%**	4.44	0.41	12.57	12.57	1.00	**55.78**
13+15B	**CB-3A**	**MH-2**	0.31	0.81	0.25	**40.0**	5.00	7.43	13.59	**48 in.**	502.7	**0.15%**	4.44	0.15	12.57	12.57	1.00	**55.78**
8	**MH-2A**	**MH-2**	0.77	0.88	0.68	**91.0**	5.00	7.43	5.03	**18 in.**	160.8	**0.25%**	2.98	0.51	1.77	4.71	0.38	**5.27**
	MH-2	**CB-1**	0.00	0.00	0.00	**115.0**	5.00	7.43	18.63	**48 in.**	1445.1	**0.23%**	5.50	0.35	12.57	12.57	1.00	**69.07**
14	**CB-1**	**EX-MH**	0.13	0.94	0.12	**129.0**	5.00	7.43	19.54	**48 in.**	1621.1	**0.23%**	5.50	0.39	12.57	12.57	1.00	**69.07**
	garage	**MH-3B**				**125.0**	5.00	7.43	1.15	**10 in.**	68.2	**0.30%**	2.21		0.55	2.62	0.21	**1.20**

STORM DESIGN

		IE	IE		HGL	HGL	Rim		
Runoff Entering Structure	To Downstream Structure	INVERT UPSTREAM (ft)	INVERT DOWNSTREAM (ft)	Hydraulic Slope (%)	Hydraulic Grade Line Elevation UPSTREAM	Hydraulic Grade Line Elevation DOWNSTREAM	Rim Elevation (UPSTREAM)	Cover over Pipe - upstream	HGL at upstream Structure
CB-6	CB-5	40.87	39.93	0.13%	41.23	40.92	45.00	2.88	3.77
CB-5	MH-4	39.71	39.23	0.14%	40.92	40.75	45.67	4.71	4.75
MH-4B	MH-4	39.25	39.23	0.10%	40.84	40.75	45.00	4.25	4.16
MH-4	CB-4A	38.63	38.52	0.06%	40.75	40.73	45.30	4.67	4.55
CB-4A	MH-3	38.52	38.23	0.10%	40.73	40.65	44.67	4.15	3.94
MH-3B	MH-3	38.40	38.23	0.19%	40.81	40.65	41.00	1.10	0.19
MH-3	CB-3A	37.93	37.97	0.01%	40.65	40.65	44.90	2.97	4.25
CB-3A	MH-2	37.97	37.69	0.01%	40.65	40.64	43.67	1.70	3.02
MH-2A	MH-2	38.23	38.00	0.23%	40.85	40.64	44.00	4.27	3.15
MH-2	CB-1	37.69	37.42	0.02%	40.64	40.62	44.30	2.61	3.66
CB-1	EX-MH	37.42	37.13	0.02%	40.62	40.60	44.07	2.65	3.45

APPENDIX III

Preliminary Grading Plan