Drainage Reports

Abbreveated Water & Sewer Need Reports

Water Study

Wastewater Study

Stormwater Waiver Application

PRELIMINARY DRAINAGE REPORT

PANERA BREAD CAFE

14826 NORTH PIMA ROAD

SCOTTSDALE, AZ 85225

PREPARED FOR

Panera LLC

3630 S. Geyer Rd. Suite 100
Sunset Hills, MO 63127

PREPARED BY

Olsson Associates
7250 N. 16th Street, Suite 210
Phoenix, AZ 85020
602-748-1000

October 2016

Olsson Associates Project No. 016-0804

1.0 INTRODUCTION

This report presents drainage analysis for the proposed Panera Bread Cafe and discusses the routing of offsite and on-site runoffs that impact the development. The analysis includes calculations for pre vs. post runoff and retention, as well as capacity calculations to account for modifications to existing swales running through the site.

1.1 Site/Project Description

The proposed Panera Bread Cafe (hereinafter referred to as the Project) development consists of a leased area within a lot (APN 215-52-039) with project zoning C-2 (Central Business). The leased area will cover approximately 0.42-acres (18,300 SF) on the overall 2.96-gross acre (129,175 SF) site. The Project is located generally within a part of the northeast quarter of Section 12, Township 3 North, Range 4 East of the Gila and Salt River Base and Meridian, Maricopa County, Arizona. More specifically, the project is located at 14826 North Pima Road (see Vicinity Map below). The site is already developed but this project proposes to demolish the existing building and build a new building with a smaller footprint and drive through lane. The project will not be phased.

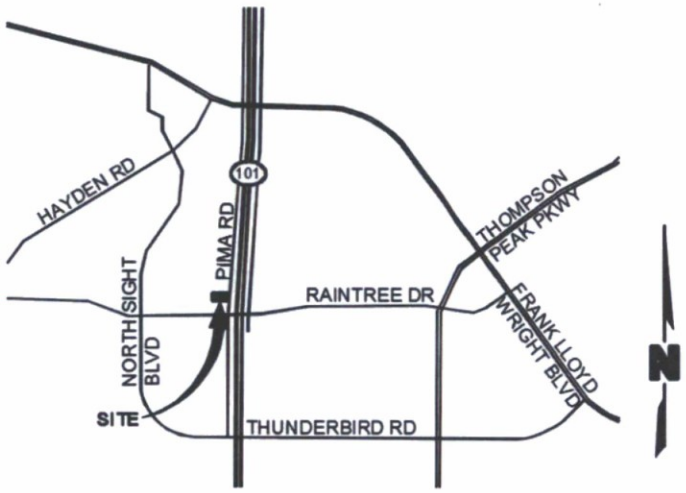

Figure 1: Vicinity Map

1.2 FEMA Flood Insurance Rate Map

The Project is located primarily in Zone "X" according to FEMA Flood Insurance Rate Map (FIRM), Panel 04013C1760L, Revised October 16, 2013. Zone "X" is defined as: Areas of minimal flood hazard from the principal source of flood in the area and determined to be outside of the 0.2 percent annual chance floodplain. The FIRM map for this project is shown in **Appendix A**.

2.0 OFFSITE DRAINAGE

The project has no offsite runoff impacts. Offsite runoff from the surrounding historically flows away from the project and will continue to do so after improvements.

2.1 ONSITE DRAINAGE

The extra runoff generation due to the site modification were found to be a negligible 8 CF (See **Exhibits 1-3** in **Appendix B** and **Tables 1** and **2** below). The existing major grade breaks on-site will remain in place as part of the project. Most drainage modifications occur by slightly modifying minor swales around the site in landscape areas. Capacity calculations done using Bentley Flowmaster V8i for the swales shown in **Exhibits 2** and **3** can be found in **Appendix C**. The runoff expected to be in the swales was calculated using a rainfall intensity of 7.26 in/hr (*NOAA ATLAS 14)* and was then rounded up to 1 cfs for both swales. The calculations show that the proposed swales on the north and east sides will be able to carry flow in the same manner as pre-construction conditions. The south swale will not be modified and flows into it will be slightly reduced due to gutters directing flows west instead of south into the swale. The existing flow in the swales would also be less than 1 CFS and so the calculations would show the same results as in **Appendix C**.

Table 1. Pre-Development Condition

V=(P/12)AC	2.26	in
Pavement Coefficient	0.95	
Landscape Coefficient	0.45	
Pavement area	11,877	SF
Landscape Area	6,490	SF
CF for Pavement	2,125	CF
CF for Landscape	550	CF
CF Total	**2,675**	**CF**

***Area is based on construction limits**

Table 2. Post-Development Condition

V=(P/12)AC	2.26	in
Pavement Coefficient	0.95	
Landscape Coefficient	0.45	
Pavement area	11,957	SF
Landscape Area	6,410	SF
CF for Pavement	2,139	CF
CF for Landscape	543	CF
CF Total	**2,683**	**CF**

***Area is based on construction limits**

2.2 Storm System Maintenance

Ongoing maintenance of the existing drainage systems are required to preserve their design integrity. Poor maintenance can prevent the system from performing to its intended design purpose and can result in reduced performance. A regular maintenance program is required to have drainage systems perform to the level of protection or service as presented in this report and the project's plans and specifications.

3.0 CONCLUSIONS

The following conclusions have been reached as a result of this drainage investigation, in support of the proposed Panera Bread Project:

- This drainage report was prepared in accordance with the recommendations and design parameters from the City of Scottsdale and Maricopa County drainage requirements.
- The proposed project will have negligible adverse impact on the existing drainage patterns for this site and existing infrastructure will be able to support the new site design.
- The Project is located primarily in Zone "X" according to FEMA Flood Insurance Rate Map (FIRM), Panel 04013C1760L, Revised October 16, 2013. Zone "X" is defined as: Areas of minimal flood hazard from the principal source of flood in the area and determined to be outside of the 0.2 percent annual chance floodplain.
- Outfall elevations for the site will remain in their existing conditions and locations.

3.1 References

FEMA Flood Insurance Rate Map (FIRM), Panel 04013C1760L, Revised October 16, 2013.

City of Scottsdale, Chapter 4 Grading and Drainage Manual, January 2010

NOAA ATLAS 14, Volume 1 Version 5

APPENDIX A
FEMA FIRM MAP

MAP SCALE 1" = 1000'

500 0 1000 2000 FEET

METE

NFIP

PANEL 1760L

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

MARICOPA COUNTY, ARIZONA

AND INCORPORATED AREAS

PANEL 1760 OF 4425

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
MARICOPA COUNTY	040037	1760	L
PARADISE VALLEY, TOWN OF	040049	1760	L
PHOENIX, CITY OF	040051	1760	L
SCOTTSDALE, CITY OF	045012	1760	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
04013C1760L

MAP REVISED
OCTOBER 16, 2013

Federal Emergency Management Agency

APPENDIX B
DRAINAGE MAPS/EXHIBITS

DWG: F:\2016\0501-1000\016-0804\40-Design\Reports\Drainage\DRAINAGE EXHIBIT-POST.dwg USER: svossler
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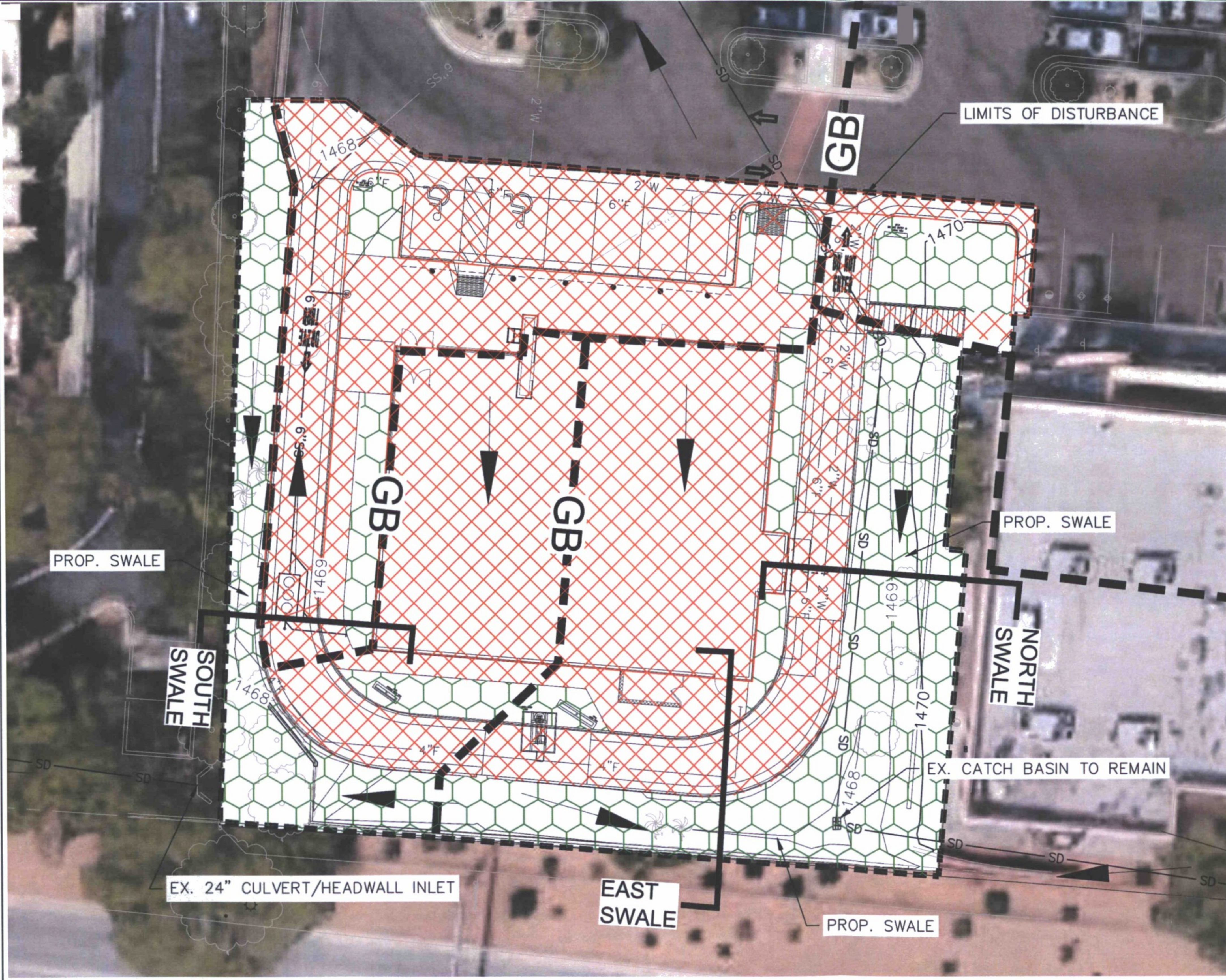


N

0' 10' 20' 40'
SCALE IN FEET

IMPERVIOUS OR PAVEMENT/BUILDING AREA

PERVIOUS OR LANDSCAPE AREA

SD = EXISTING STORM DRAIN

GB = GRADE BREAK

Totals

	PRE	POST	
Coefficient	0.77	0.78	
Pavement/Building Area	11,877	11,957	SF
Landscape Area	6,490	6,410	SF
Retention Required Pavement	2,125	2,139	CF
Retention Required Landscape	550	543	CF
Total CF Required	2,675	**2,683**	**CF**
Difference between pre/post		**8**	**CF**

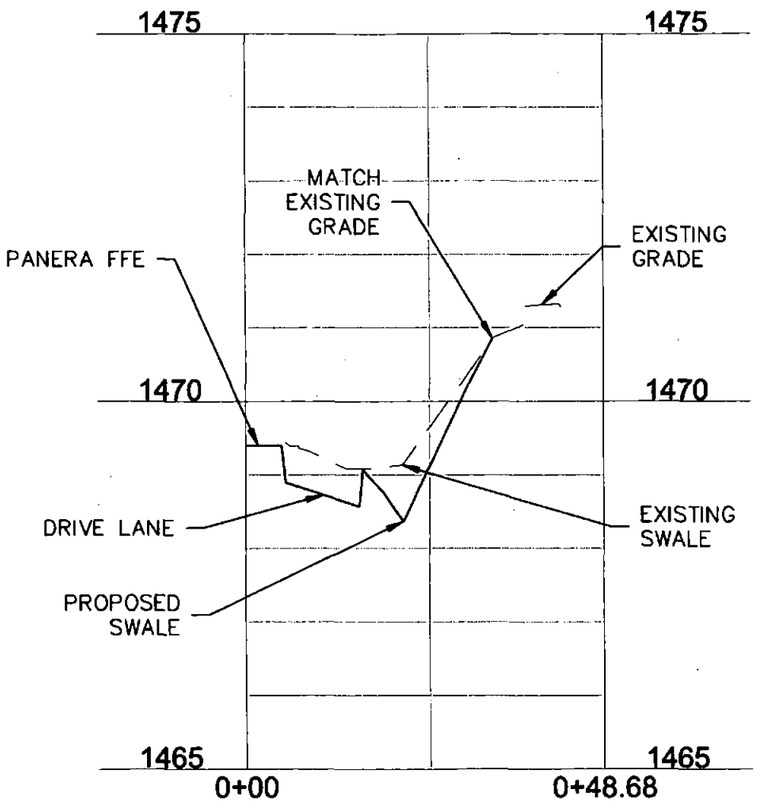
PROJECT NO:	**016-0804**
DRAWN BY:	**SJV**
DATE:	**10/03/2016**

POST-DEVELOPMENT AERIAL MAP

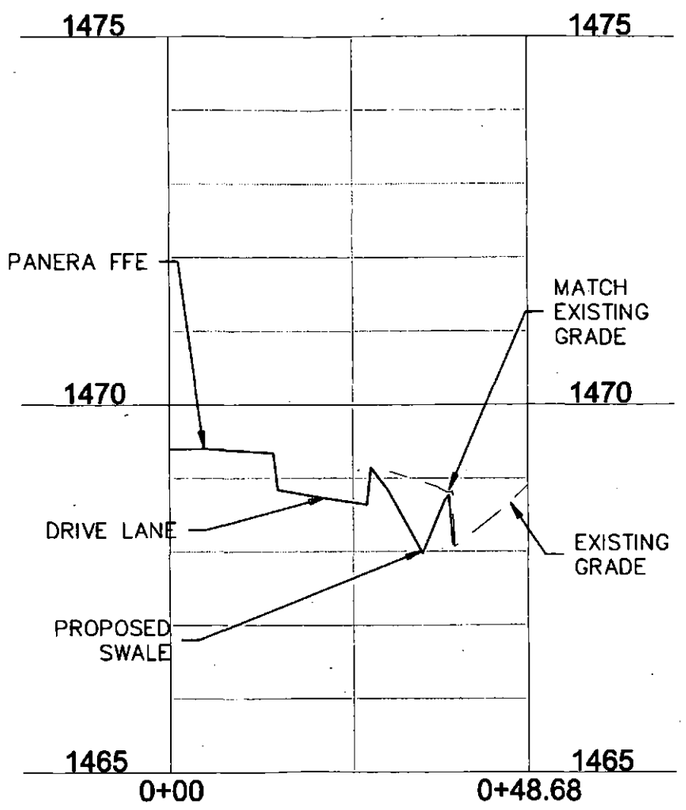
OLSSON ASSOCIATES
7250 North 16th Street
Suite 210
Phoenix, AZ 85020-5282
TEL 602.748.1000
FAX 602.748.1001

EXHIBIT
2

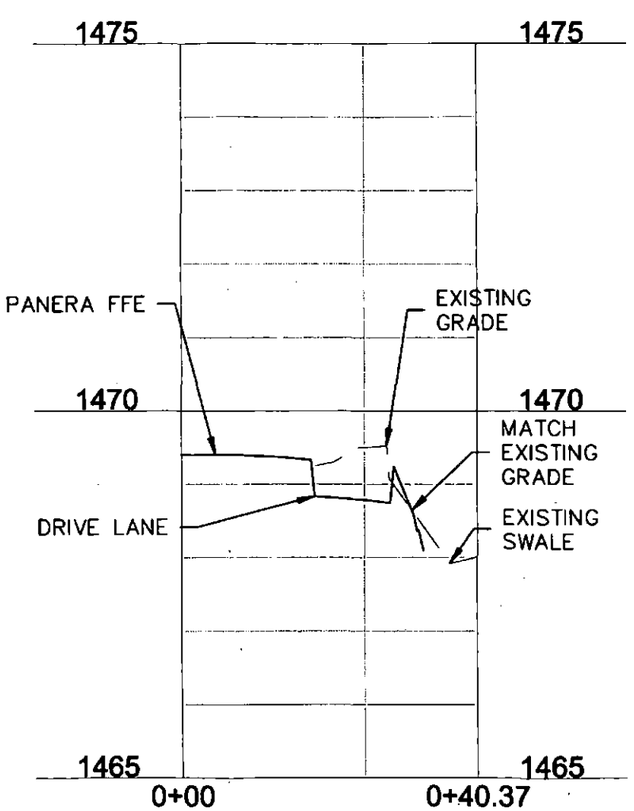
NORTH SWALE



EAST SWALE



SOUTH SWALE

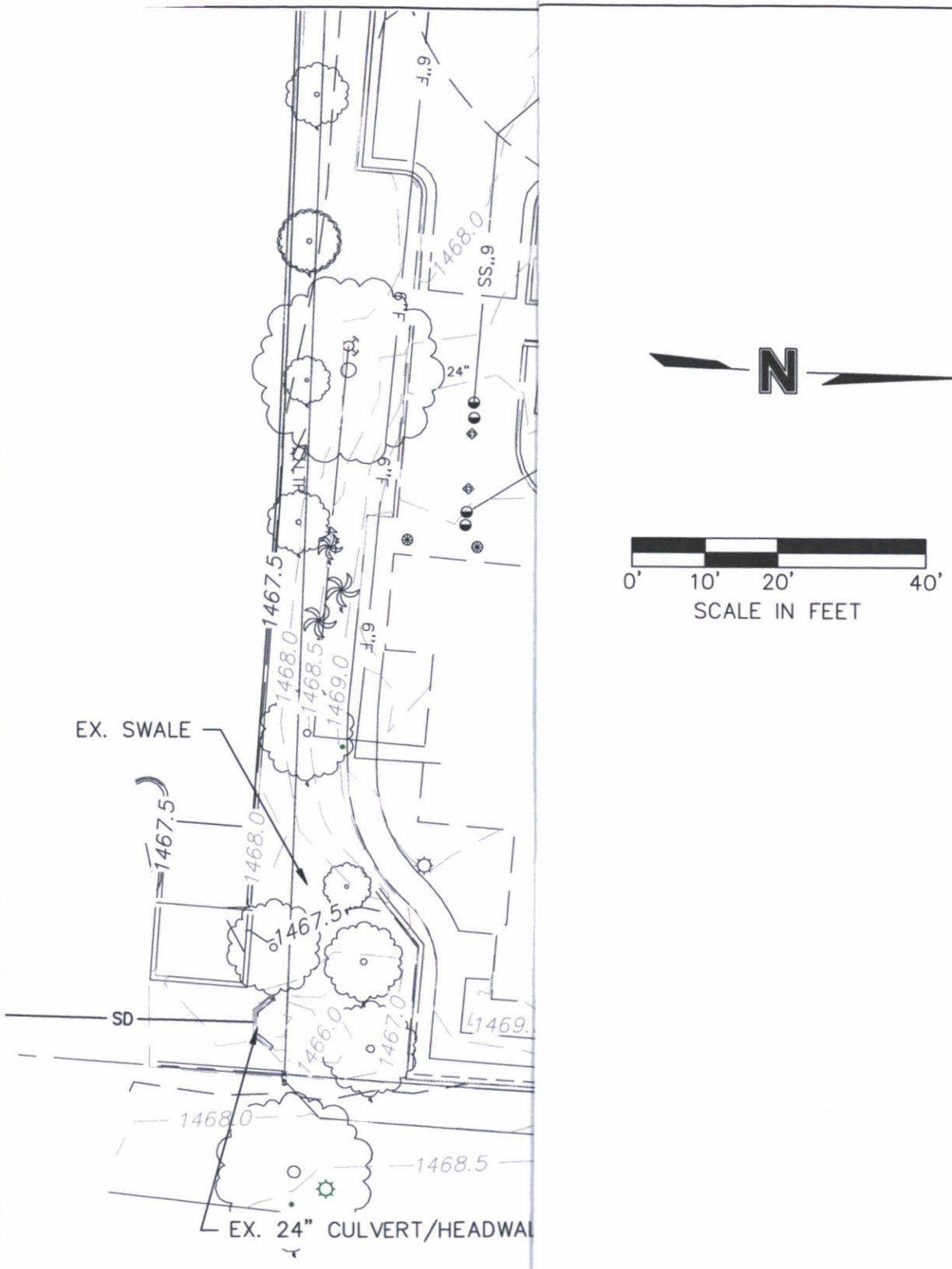


PROJECT NO:	016-0804
DRAWN BY:	SJV
DATE:	10/03/2016

SWALE CROSS-SECTIONS

OLSSON. 7250 North 16th Street Suite 210 Phoenix, AZ 85020-5282

EXHIBIT



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PROJECT NO: 016-0804		OLSSON ASSOCIATES	EXHIBIT
DRAWN BY: SJV		7250 North 16th Street Suite 210 Phoenix, AZ 85020-5282 TEL 602.748.1000 FAX 602.748.1001	4
DATE: 10/04/2016			

APPENDIX C
DRAINAGE CALCULATIONS

Worksheet for North Swale

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.030	
Channel Slope	0.01500	ft/ft
Left Side Slope	5.00	ft/ft (H:V)
Right Side Slope	10.00	ft/ft (H:V)
Discharge	1.00	ft^3/s

Results

Normal Depth	0.28	ft
Flow Area	0.61	ft^2
Wetted Perimeter	4.31	ft
Hydraulic Radius	0.14	ft
Top Width	4.27	ft
Critical Depth	0.26	ft
Critical Slope	0.02636	ft/ft
Velocity	1.64	ft/s
Velocity Head	0.04	ft
Specific Energy	0.33	ft
Froude Number	0.77	
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	0.28	ft
Critical Depth	0.26	ft
Channel Slope	0.01500	ft/ft
Critical Slope	0.02636	ft/ft

Worksheet for East Swale

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.030	
Channel Slope	0.00500	ft/ft
Left Side Slope	5.00	ft/ft (H:V)
Right Side Slope	5.00	ft/ft (H:V)
Discharge	1.00	ft^3/s

Results

Normal Depth	0.41	ft
Flow Area	0.83	ft^2
Wetted Perimeter	4.17	ft
Hydraulic Radius	0.20	ft
Top Width	4.08	ft
Critical Depth	0.30	ft
Critical Slope	0.02530	ft/ft
Velocity	1.20	ft/s
Velocity Head	0.02	ft
Specific Energy	0.43	ft
Froude Number	0.47	
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	0.41	ft
Critical Depth	0.30	ft
Channel Slope	0.00500	ft/ft
Critical Slope	0.02530	ft/ft

N

0' 10' 20' 40'

SCALE IN FEET

IMPERVIOUS OR PAVEMENT/BUILDING AREA

PERVIOUS OR LANDSCAPE AREA

SD = EXISTING STORM DRAIN

GB = GRADE BREAK

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Difference between pre/post		8	CF

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PROJECT NO:	016-0804
DRAWN BY:	SJV
DATE:	10/04/2016

PRE-DEVELOPMENT AERIAL MAP

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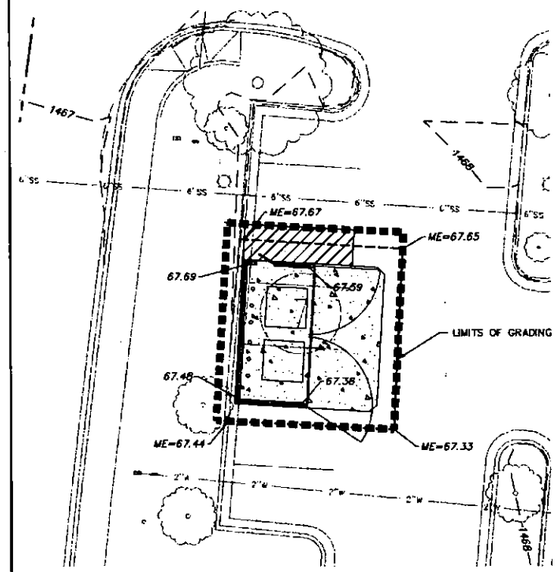
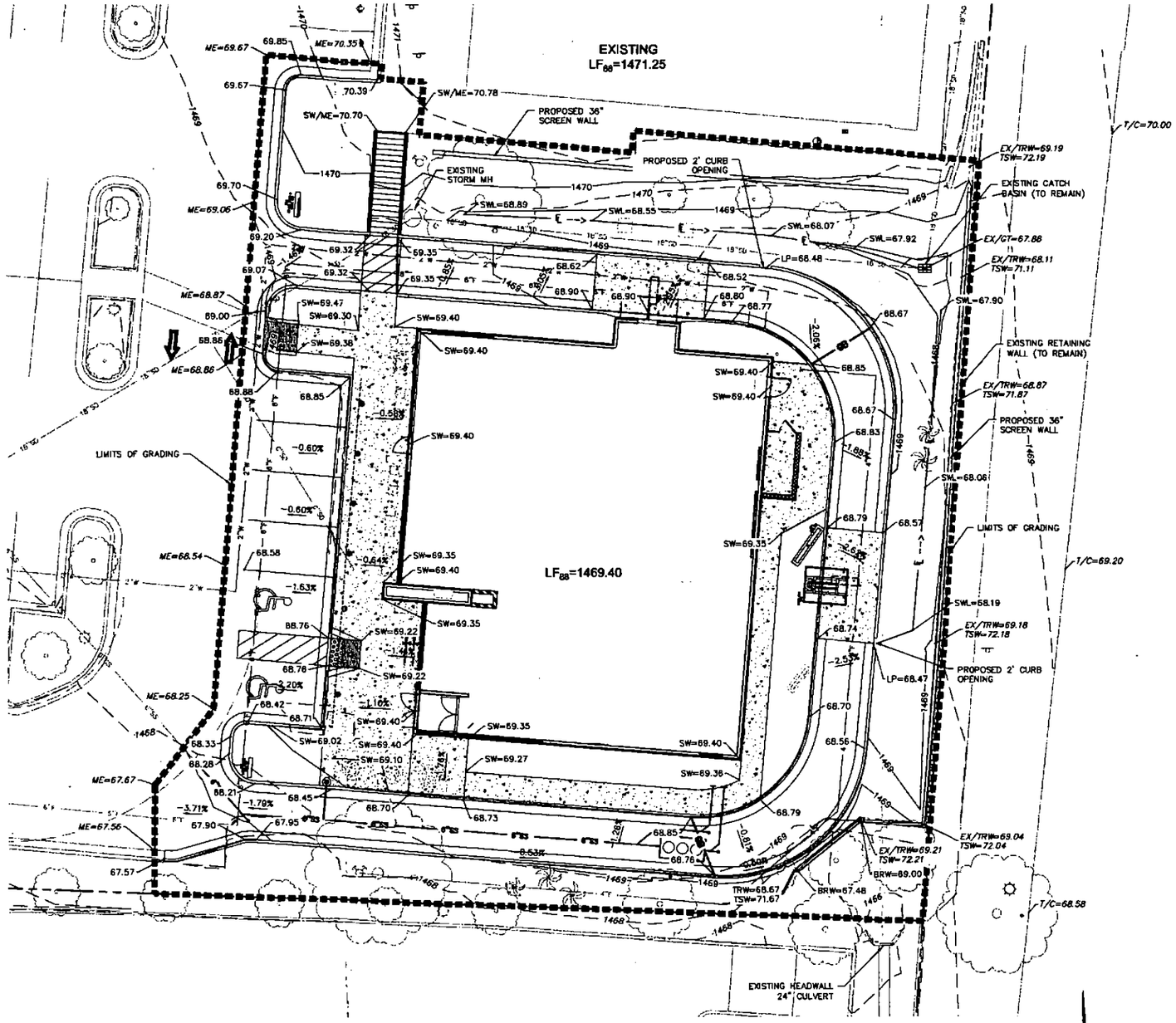
EXHIBIT

1

FOR PANERA CAFE

PART OF THE SOUTHEAST QUARTER OF SECTION 1, AND THE NORTH EAST QUARTER OF SECTION 12, TOWNSHIP 3 NORTH, RANGE 4 EAST, GILA AND SALT RIVER MERIDIAN, MARICOPA COUNTY, ARIZONA





FLOOD INSURANCE RATE MAP INFORMATION

COMMUNITY NUMBER	PANEL NUMBER (DATE)	SUFFIX	DATE OF FIRM (INDEX DATE)	FIRM ZONE	BASED FLOOD ELEVATION (IN AO ZONE, USE DEPTH)
445012	1760 10/16/2013	L	10/16/2013	X	N/A

ZONE X AREAS OF 0.2% ANNUAL CHANCE FLOOD; AREAS OF 1% ANNUAL CHANCE FLOOD WITH

N

0 5 10 20

NOTES:
1. SOME ELEVATIONS ARE SHORTENED FOR CLARITY

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JASON M. TARR
31317
KENNETH M. TARR
REGISTERED
ARIZONA U.S.A.
Expires 06/30/2018

OLSSON ASSOCIATES ASSUMES NO RESPONSIBILITY FOR EXISTING UTILITY LOCATIONS (HORIZONTAL OR VERTICAL). THE EXISTING UTILITIES SHOWN ON THIS DRAWING HAVE BEEN PLOTTED FROM THE BEST AVAILABLE INFORMATION. IT IS HOWEVER THE RESPONSIBILITY OF THE CONTRACTOR TO FIELD VERIFY THE LOCATION OF ALL UTILITIES PRIOR TO THE COMMENCEMENT OF ANY CONSTRUCTION ACTIVITIES.

REV. NO.	DATE	REVISIONS DESCRIPTION
		REVISIONS

GRADING PLAN

PANERA BREAD CAFE
14826 N. PIMA ROAD
SCOTTSDALE, ARIZONA 85255

2016

drawn by: EIS
designed by: EW
checked by: KT
QA/QC by: EW
project no.: 016-0804
date: 10/27/16

F:\2016\0501-1000\016-0804\40-Design\AutoCAD\Final Plans\Sheets\C_GRD_60804.dwg USER: dlowe C_PTBLK_060804 C_FDF_060804
Oct 27, 2016 2:12pm XREFS: C_XBASE_060804 A_PBLDG_060804 R1 C_PBASE_060804

ARIZONA811
Call at least two full working days before you begin excavation

NOAA Atlas 14, Volume 1, Version 5
Location name: Scottsdale, Arizona, USA*
Latitude: 33.6193°, Longitude: -111.892°
Elevation: 1470.49 ft**
* source: ESRI Maps
** source: USGS

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	0.193 (0.160–0.236)	0.252 (0.211–0.309)	0.340 (0.281–0.415)	0.407 (0.336–0.495)	0.498 (0.404–0.604)	0.568 (0.456–0.683)	0.640 (0.504–0.769)	0.711 (0.551–0.852)	0.808 (0.611–0.970)	0.882 (0.653–1.06)
10-min	0.293 (0.243–0.360)	0.383 (0.320–0.470)	0.517 (0.428–0.631)	0.620 (0.511–0.754)	0.758 (0.615–0.920)	0.864 (0.693–1.04)	0.974 (0.768–1.17)	1.08 (0.839–1.30)	1.23 (0.929–1.48)	1.34 (0.994–1.61)
15-min	0.364 (0.302–0.445)	0.475 (0.397–0.582)	0.641 (0.531–0.782)	0.768 (0.634–0.935)	0.940 (0.763–1.14)	1.07 (0.860–1.29)	1.21 (0.952–1.45)	1.34 (1.04–1.61)	1.53 (1.15–1.83)	1.66 (1.23–2.00)
30-min	0.490 (0.406–0.600)	0.640 (0.535–0.784)	0.863 (0.715–1.05)	1.04 (0.854–1.26)	1.27 (1.03–1.54)	1.44 (1.16–1.74)	1.63 (1.28–1.95)	1.81 (1.40–2.17)	2.05 (1.55–2.46)	2.24 (1.66–2.69)
60-min	0.606 (0.503–0.742)	0.792 (0.662–0.970)	1.07 (0.885–1.30)	1.28 (1.06–1.56)	1.57 (1.27–1.90)	1.79 (1.43–2.15)	2.01 (1.59–2.42)	2.24 (1.73–2.68)	2.54 (1.92–3.05)	2.77 (2.05–3.33)
2-hr	0.709 (0.596–0.847)	0.917 (0.775–1.10)	1.22 (1.02–1.45)	1.45 (1.21–1.73)	1.77 (1.46–2.10)	2.01 (1.63–2.37)	2.26 (1.80–2.65)	2.51 (1.97–2.95)	2.84 (2.18–3.34)	3.10 (2.33–3.66)
3-hr	0.786 (0.662–0.964)	1.01 (0.851–1.24)	1.32 (1.11–1.61)	1.56 (1.30–1.90)	1.90 (1.56–2.30)	2.17 (1.76–2.61)	2.46 (1.95–2.95)	2.75 (2.15–3.30)	3.16 (2.39–3.78)	3.48 (2.58–4.18)
6-hr	0.949 (0.814–1.13)	1.20 (1.03–1.43)	1.53 (1.30–1.81)	1.79 (1.51–2.11)	2.15 (1.79–2.52)	2.43 (1.99–2.84)	2.72 (2.20–3.17)	3.02 (2.40–3.53)	3.42 (2.65–3.99)	3.74 (2.82–4.37)
12-hr	1.06 (0.914–1.25)	1.34 (1.15–1.58)	1.69 (1.45–1.98)	1.96 (1.67–2.30)	2.33 (1.96–2.73)	2.62 (2.18–3.05)	2.91 (2.39–3.39)	3.21 (2.60–3.73)	3.60 (2.84–4.21)	3.91 (3.03–4.60)
24-hr	1.24 (1.09–1.43)	1.57 (1.39–1.82)	2.03 (1.78–2.34)	2.39 (2.09–2.76)	2.90 (2.51–3.33)	3.30 (2.83–3.78)	3.71 (3.16–4.26)	4.14 (3.49–4.75)	4.74 (3.93–5.45)	5.22 (4.26–6.02)
2-day	1.34 (1.17–1.54)	1.71 (1.49–1.97)	2.23 (1.94–2.57)	2.65 (2.30–3.04)	3.23 (2.78–3.71)	3.69 (3.15–4.24)	4.18 (3.53–4.80)	4.68 (3.93–5.40)	5.38 (4.44–6.22)	5.95 (4.84–6.89)
3-day	1.44 (1.26–1.65)	1.84 (1.61–2.11)	2.42 (2.12–2.77)	2.89 (2.52–3.30)	3.54 (3.07–4.05)	4.07 (3.50–4.65)	4.64 (3.96–5.30)	5.23 (4.42–6.00)	6.06 (5.05–6.97)	6.74 (5.54–7.78)
4-day	1.54 (1.36–1.76)	1.97 (1.74–2.25)	2.61 (2.29–2.96)	3.12 (2.74–3.55)	3.86 (3.36–4.38)	4.45 (3.86–5.06)	5.10 (4.38–5.80)	5.78 (4.91–6.60)	6.74 (5.65–7.71)	7.53 (6.24–8.66)
7-day	1.73 (1.52–1.99)	2.22 (1.95–2.54)	2.94 (2.57–3.37)	3.53 (3.08–4.03)	4.36 (3.78–4.98)	5.04 (4.34–5.76)	5.77 (4.92–6.59)	6.54 (5.53–7.51)	7.64 (6.37–8.79)	8.54 (7.03–9.87)
10-day	1.88 (1.65–2.15)	2.41 (2.12–2.75)	3.19 (2.80–3.64)	3.82 (3.34–4.34)	4.71 (4.09–5.35)	5.43 (4.69–6.16)	6.19 (5.30–7.05)	7.00 (5.94–7.99)	8.15 (6.82–9.32)	9.08 (7.50–10.4)
20-day	2.33 (2.05–2.65)	3.00 (2.64–3.41)	3.96 (3.49–4.50)	4.70 (4.12–5.33)	5.69 (4.98–6.46)	6.46 (5.62–7.34)	7.26 (6.28–8.26)	8.07 (6.93–9.20)	9.16 (7.79–10.5)	10.0 (8.44–11.5)
30-day	2.73 (2.41–3.10)	3.52 (3.11–3.99)	4.64 (4.09–5.26)	5.50 (4.84–6.22)	6.66 (5.83–7.54)	7.56 (6.58–8.55)	8.49 (7.34–9.59)	9.43 (8.11–10.7)	10.7 (9.12–12.2)	11.7 (9.87–13.3)
45-day	3.18 (2.82–3.61)	4.11 (3.64–4.65)	5.42 (4.79–6.12)	6.40 (5.64–7.23)	7.70 (6.76–8.70)	8.68 (7.60–9.83)	9.69 (8.42–11.0)	10.7 (9.25–12.2)	12.1 (10.3–13.8)	13.1 (11.1–15.0)
60-day	3.53 (3.14–3.99)	4.57 (4.06–5.15)	6.02 (5.34–6.78)	7.08 (6.26–7.98)	8.47 (7.46–9.54)	9.51 (8.34–10.7)	10.6 (9.21–11.9)	11.6 (10.1–13.1)	13.0 (11.2–14.7)	14.0 (12.0–16.0)

[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.

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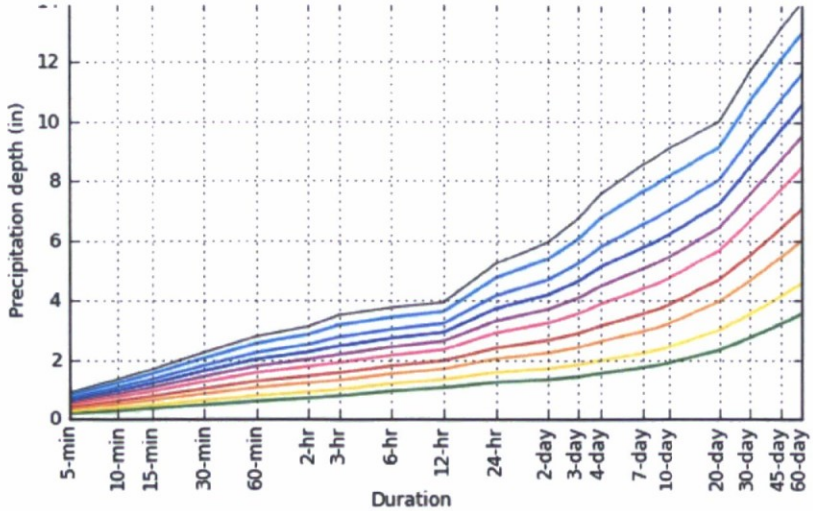
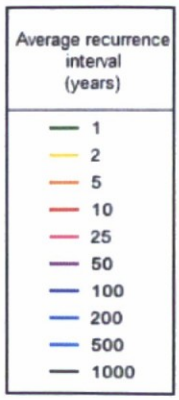
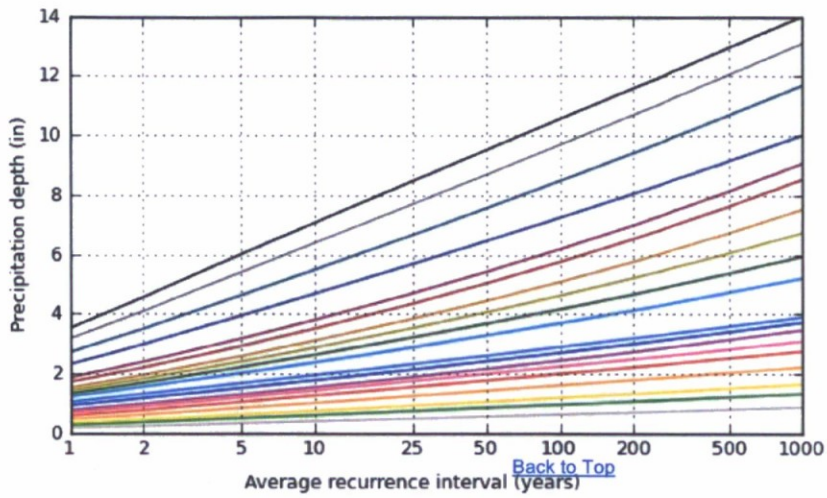
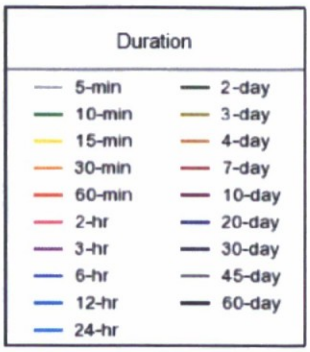
PF graphical









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Maps & aerials

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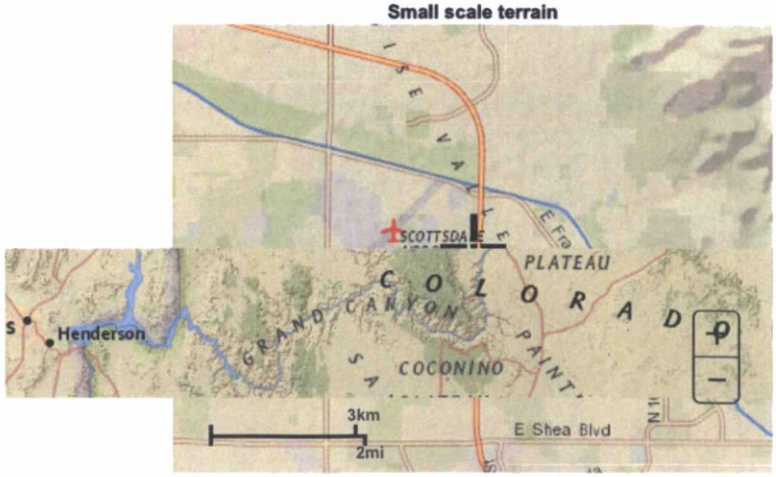
Small scale terrain



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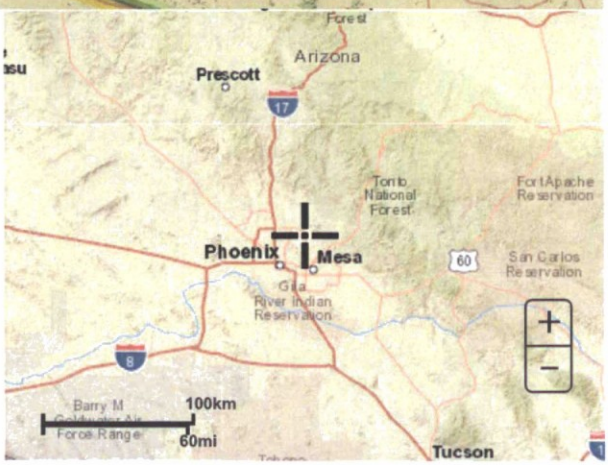
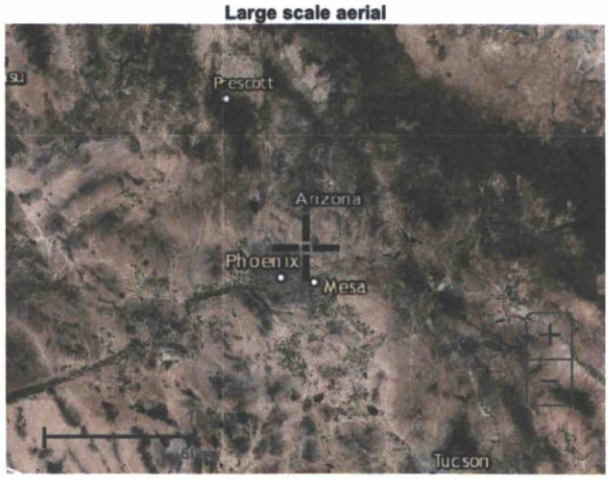


Large scale aerial



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1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

NOAA Atlas 14, Volume 1, Version 5
Location name: Scottsdale, Arizona, USA*
Latitude: 33.6193°, Longitude: -111.892°
Elevation: 1470.49 ft**
* source: ESRI Maps
** source: USGS

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	2.32 (1.92–2.83)	3.02 (2.53–3.71)	4.08 (3.37–4.98)	4.88 (4.03–5.94)	5.98 (4.85–7.25)	6.82 (5.47–8.20)	7.68 (6.05–9.23)	8.53 (6.61–10.2)	9.70 (7.33–11.6)	10.6 (7.84–12.7)
10-min	1.76 (1.46–2.16)	2.30 (1.92–2.82)	3.10 (2.57–3.79)	3.72 (3.07–4.52)	4.55 (3.69–5.52)	5.18 (4.16–6.23)	5.84 (4.61–7.02)	6.49 (5.03–7.78)	7.38 (5.57–8.86)	8.05 (5.96–9.67)
15-min	1.46 (1.21–1.78)	1.90 (1.59–2.33)	2.56 (2.12–3.13)	3.07 (2.54–3.74)	3.76 (3.05–4.56)	4.28 (3.44–5.16)	4.83 (3.81–5.80)	5.36 (4.16–6.43)	6.10 (4.61–7.32)	6.65 (4.93–8.00)
30-min	0.980 (0.812–1.20)	1.28 (1.07–1.57)	1.73 (1.43–2.11)	2.07 (1.71–2.52)	2.53 (2.05–3.07)	2.89 (2.32–3.47)	3.25 (2.56–3.90)	3.61 (2.80–4.33)	4.11 (3.10–4.93)	4.48 (3.32–5.38)
60-min	0.606 (0.503–0.742)	0.792 (0.662–0.970)	1.07 (0.885–1.30)	1.28 (1.06–1.56)	1.57 (1.27–1.90)	1.79 (1.43–2.15)	2.01 (1.59–2.42)	2.24 (1.73–2.68)	2.54 (1.92–3.05)	2.77 (2.05–3.33)
2-hr	0.354 (0.298–0.424)	0.458 (0.388–0.549)	0.610 (0.512–0.726)	0.726 (0.603–0.864)	0.885 (0.729–1.05)	1.00 (0.816–1.19)	1.13 (0.900–1.33)	1.25 (0.984–1.47)	1.42 (1.09–1.67)	1.55 (1.17–1.83)
3-hr	0.262 (0.220–0.321)	0.336 (0.283–0.413)	0.438 (0.368–0.536)	0.519 (0.431–0.632)	0.633 (0.518–0.765)	0.724 (0.585–0.870)	0.818 (0.649–0.982)	0.917 (0.715–1.10)	1.05 (0.796–1.26)	1.16 (0.858–1.39)
6-hr	0.158 (0.136–0.189)	0.200 (0.171–0.238)	0.255 (0.217–0.302)	0.299 (0.252–0.352)	0.359 (0.299–0.421)	0.405 (0.333–0.474)	0.454 (0.367–0.529)	0.504 (0.400–0.589)	0.571 (0.442–0.666)	0.624 (0.472–0.730)
12-hr	0.088 (0.076–0.104)	0.111 (0.095–0.131)	0.140 (0.120–0.165)	0.163 (0.139–0.191)	0.194 (0.163–0.226)	0.217 (0.181–0.253)	0.242 (0.198–0.281)	0.266 (0.216–0.310)	0.299 (0.236–0.350)	0.325 (0.251–0.382)
24-hr	0.052 (0.045–0.060)	0.066 (0.058–0.076)	0.084 (0.074–0.098)	0.100 (0.087–0.115)	0.121 (0.105–0.139)	0.137 (0.118–0.157)	0.155 (0.132–0.178)	0.173 (0.145–0.198)	0.198 (0.164–0.227)	0.217 (0.178–0.251)
2-day	0.028 (0.024–0.032)	0.036 (0.031–0.041)	0.046 (0.040–0.054)	0.055 (0.048–0.063)	0.067 (0.058–0.077)	0.077 (0.066–0.088)	0.087 (0.074–0.100)	0.097 (0.082–0.112)	0.112 (0.093–0.130)	0.124 (0.101–0.144)
3-day	0.020 (0.018–0.023)	0.026 (0.022–0.029)	0.034 (0.029–0.038)	0.040 (0.035–0.046)	0.049 (0.043–0.056)	0.057 (0.049–0.065)	0.064 (0.055–0.074)	0.073 (0.061–0.083)	0.084 (0.070–0.097)	0.094 (0.077–0.108)
4-day	0.016 (0.014–0.018)	0.021 (0.018–0.023)	0.027 (0.024–0.031)	0.033 (0.029–0.037)	0.040 (0.035–0.046)	0.046 (0.040–0.053)	0.053 (0.046–0.060)	0.060 (0.051–0.069)	0.070 (0.059–0.080)	0.078 (0.065–0.090)
7-day	0.010 (0.009–0.012)	0.013 (0.012–0.015)	0.017 (0.015–0.020)	0.021 (0.018–0.024)	0.026 (0.023–0.030)	0.030 (0.026–0.034)	0.034 (0.029–0.039)	0.039 (0.033–0.045)	0.045 (0.038–0.052)	0.051 (0.042–0.059)
10-day	0.008 (0.007–0.009)	0.010 (0.009–0.011)	0.013 (0.012–0.015)	0.016 (0.014–0.018)	0.020 (0.017–0.022)	0.023 (0.020–0.026)	0.026 (0.022–0.029)	0.029 (0.025–0.033)	0.034 (0.028–0.039)	0.038 (0.031–0.043)
20-day	0.005 (0.004–0.006)	0.006 (0.006–0.007)	0.008 (0.007–0.009)	0.010 (0.009–0.011)	0.012 (0.010–0.013)	0.013 (0.012–0.015)	0.015 (0.013–0.017)	0.017 (0.014–0.019)	0.019 (0.016–0.022)	0.021 (0.018–0.024)
30-day	0.004 (0.003–0.004)	0.005 (0.004–0.006)	0.006 (0.006–0.007)	0.008 (0.007–0.009)	0.009 (0.008–0.010)	0.010 (0.009–0.012)	0.012 (0.010–0.013)	0.013 (0.011–0.015)	0.015 (0.013–0.017)	0.016 (0.014–0.019)
45-day	0.003 (0.003–0.003)	0.004 (0.003–0.004)	0.005 (0.004–0.006)	0.006 (0.005–0.007)	0.007 (0.006–0.008)	0.008 (0.007–0.009)	0.009 (0.008–0.010)	0.010 (0.009–0.011)	0.011 (0.010–0.013)	0.012 (0.010–0.014)
60-day	0.002 (0.002–0.003)	0.003 (0.003–0.004)	0.004 (0.004–0.005)	0.005 (0.004–0.006)	0.006 (0.005–0.007)	0.007 (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)

[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.

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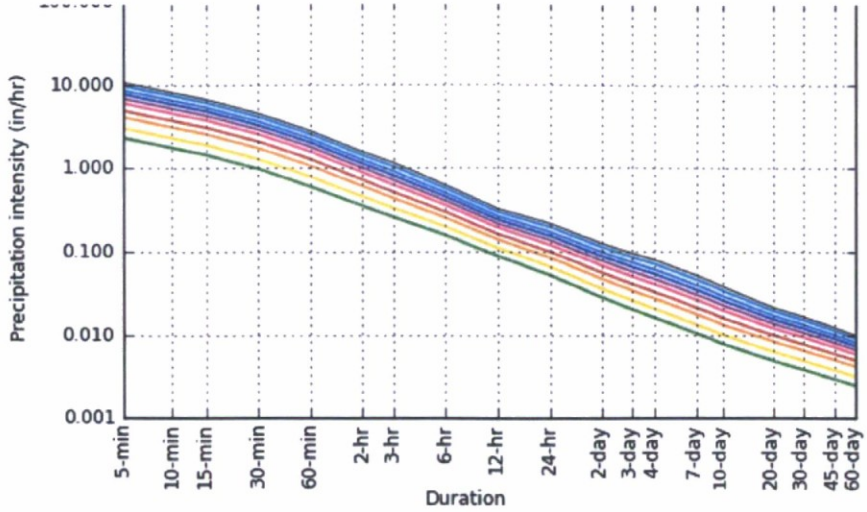
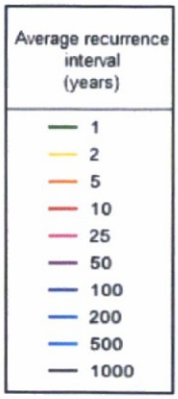
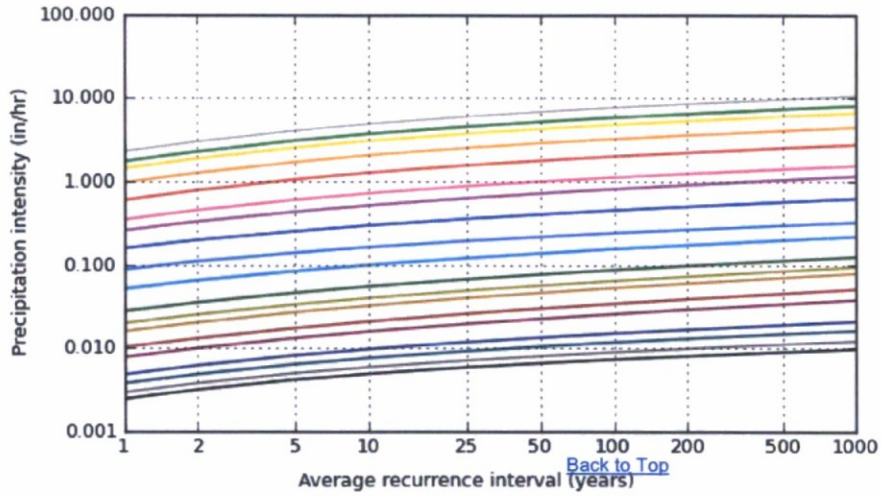
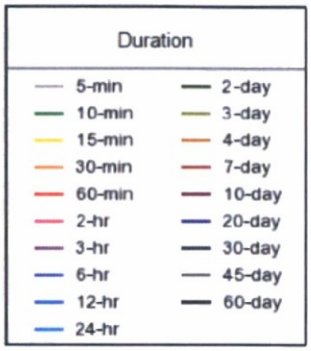
PF graphical









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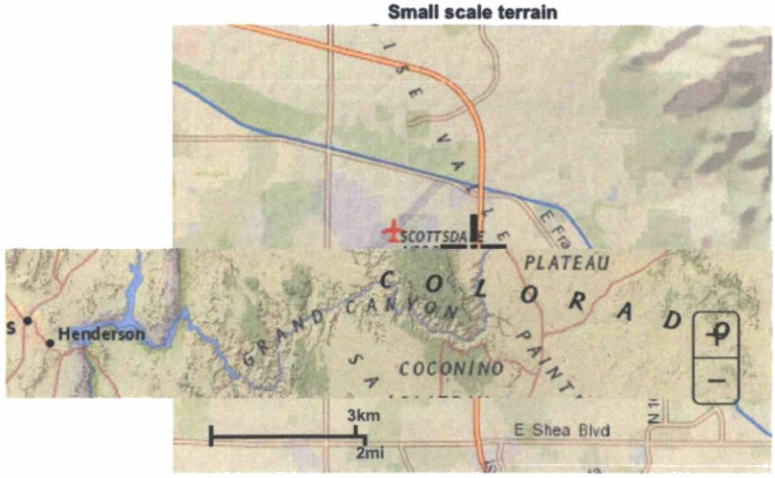

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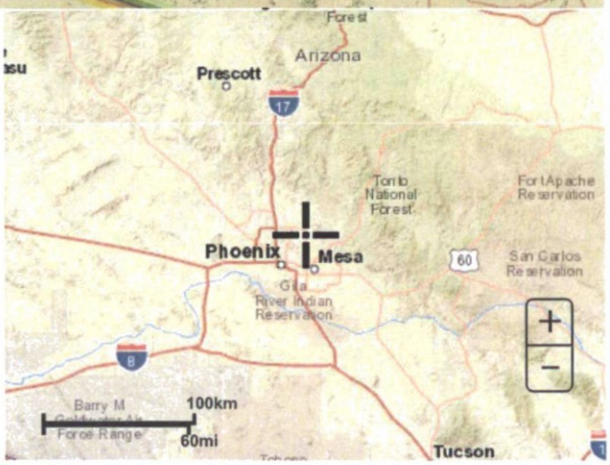

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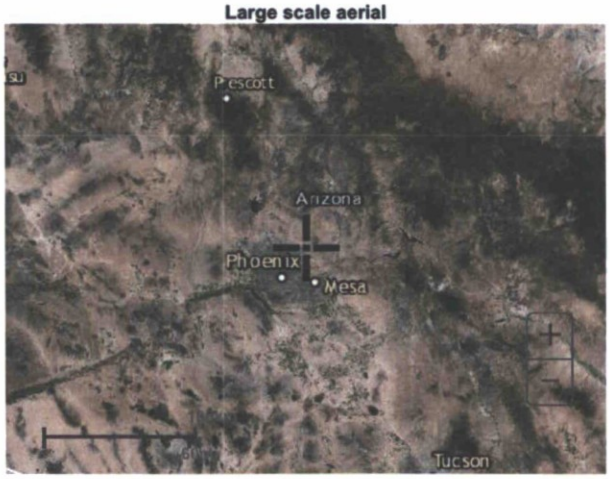

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