DRAINAGE REPORT

FOR

MCLINDEN RESIDENCE
5564 E. PALO VERDE LANE
PARADISE VALLEY, ARIZONA 85253

PREPARED FOR:

THE CONSTRUCTION ZONE
1729 E. OSBORN ROAD
PHOENIX, AZ 85016
(602) 230-0383

PREPARED BY:

ATHERTON ENGINEERING, INC.
Civil Engineers & Land Surveyors
1203 EAST MEADOWBROOK AVENUE
PHOENIX, ARIZONA 85014
(602) 279-7331

Registered Professional Engineer (Civil)
CERTIFICATE NO.
11045
ROBERT B.
ATHERTON
Date Signed 3/29/17
ARIZONA, U.S.A.
Expires 03/31/17

March 29, 2017

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INTRODUCTION:

PROJECT NAME

McLinden Residence
5564 E. Palo Verde Lane
Paradise Valley, AZ 85253

PROJECT TYPE/SIZE

This project involves the removal of the existing house and construction of a new main residence along with a casita on the above referenced lot.

LOCATION

This 1.15 net acre of land is located at the cul-de-sac that forms the end of E. Palo Verde Lane in Paradise Valley. The site is bounded on the east, south, west and north by existing residential properties with the exception with the existing cul-de-sac located in the northwest corner of the lot. The site located in the northeast quarter of Section 17, Township 2 North, Range 4 East of the Gila and Salt River Base and Meridian, Maricopa County, Arizona.

OBJECTIVES:

The following Drainage Report with calculations is intended to define the drainage concepts for the construction of a new private residence on 1.154 net acre of land.

This report will provide on site retention capable of containing the 100 year, 2 hour storm in compliance with the Town of Paradise Valley design criteria with supporting documentation.

The results will be incorporated into the final Grading & Drainage Plan. The Grading & Drainage Plan will show the proposed finished floor elevation for the new residence that will be protected from flooding caused by a 100 year storm.

NARRATIVE:

This project involves the removal of the existing house and construction of a new main residence along with a casita on the above referenced lot. This 1.15 net acre of land is located at the cul-de-sac that forms the end of E. Palo Verde Lane in Paradise Valley. The site is bounded on the east, south, west and north by existing residential properties with the exception with the existing cul-de-sac located in the northwest corner of the lot. The site located in the northeast quarter of Section 17, Township 2 North, Range 4 East of the Gila and Salt River Base and Meridian, Maricopa County, Arizona.

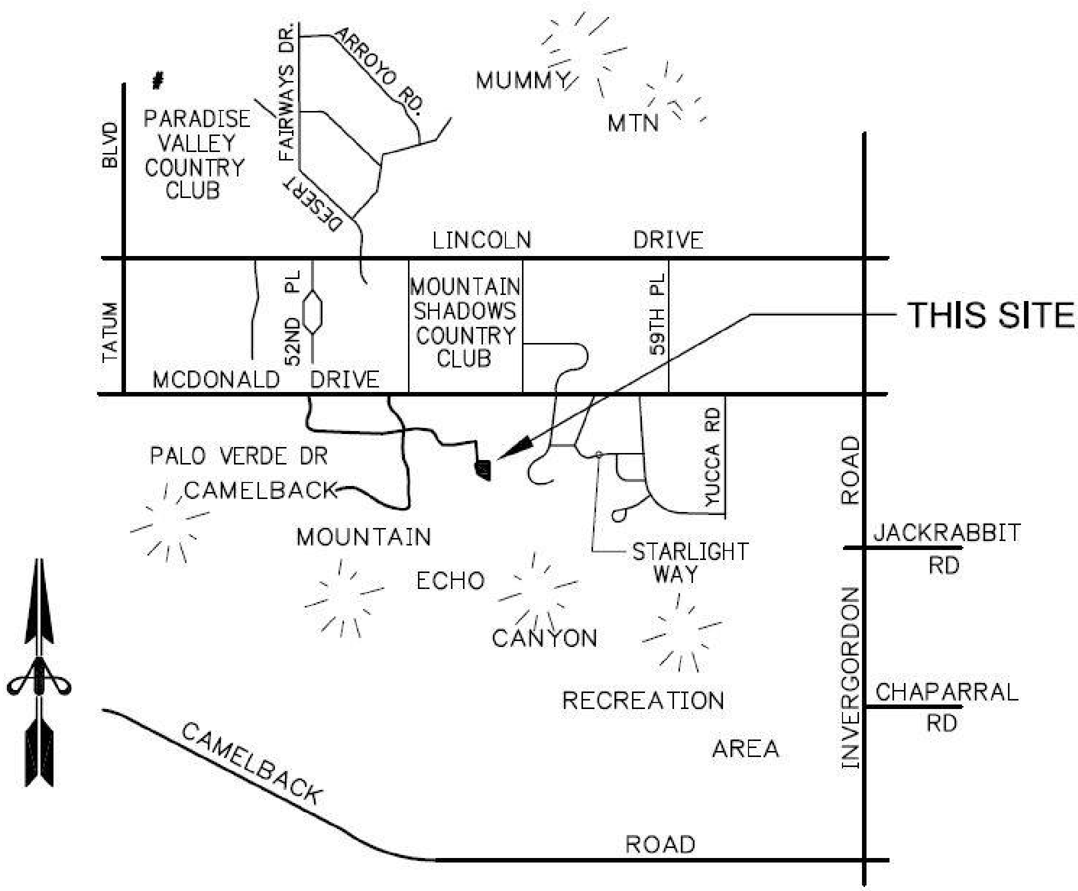
The lot is located on the north slopes of Camelback Mountain and has a site slope across the lot of 10%. There are 2 existing washes that are located on the east side and the west side of this lot. The easterly wash, “A” drains an area of 32.47 acres with a 100 year flow of 159.30 c.f.s. The westerly wash, “B” drains an area of 0.96 acres with a 100 year flow of 6.19 c.f.s. The flow in both washes is contained within the existing banks and does not impact the new house.

On site retention calculations are shown on page 6. Using a 100 year precipitation rate of 2.82 inches and a “C” value of 0.10 (post – pre) the required retention is 1,181 cubic feet with 1,448 cubic feet provided. A small one foot deep retention basin is shown in the northwest corner of the lot and is sized to contain the runoff. The basin will drain in 36 hours by a combination of ground percolation and evaporation.

The site is located in flood zone “X” as shown on the attached FIRM, map number 04013C1765L, dated October 16, 2013 and is not impacted by any offsite flows.

The NOAA, Atlas 14 point precipitation frequency estimate chart is shown in the back of this report. The 100 year, 2 hour storm precipitation is 2.25 inches. Per the requirement of Paradise Valley the 100 year, 2 hour storm precipitation value used in this report is 2.82 inches.

VICINITY MAP:



VICINITY MAP
N.T.S.

DRAINAGE AREA OF LOT

1. Area = 50.256 s.f.

2. Weighted “C” value = Pre – Post construction = (0.45 – 0.35) = 0.10

3. P = 2.82 inches

4. Vol $_{Req.}$ = (50,256) (0.10) (2.82 / 12) = 1,181 c.f.

5. Volume provided in retention basin #1, @ 1.00’ feet of depth: = 1,448 c.f.

6. Dry Up Calculations:

   Since the basin is less than 1 foot in depth, it will drain by a combination of ground percolation and evaporation.

OFF SITE RUNOFF CALCULATIONS, EASTERLY WASH, "A"

1. Off Site Drainage Area = 1,414,451 s.f. = 32.47 acres

2. "C" = 0.85

3. Time of concentration was determined using the formula:

$$T_c = 11.4\ L^{0.5}\ K_b^{0.52}\ S^{-0.31}\ i^{-0.38} \text{ where:}$$

L = 2,100 ft = 0.397 miles
K_b = mlogA + b, where m = -0.03000, A = 32.47 and b = 0.20
K_b = 0.1547
Elevation change = 2540.00 – 1460.00 = 1,080.00 feet
S = 1,080.00 / 0.398 = 2,715

$$T_c = 11.4\ (0.397)^{0.5}\ (0.1547)^{0.52}\ (2{,}715)^{-0.31}\ i^{-0.38}$$
$$T_c = 0.2346\ i^{-0.38}$$

NOAA, ATLAS 14	PT. RAINFALL, IN.	PT.RAINFALL, IN/HR
100 year, 5 minute	0.632	7.584
100 year, 10 minute	0.962	5.772
100 year, 15 minute	1.19	4.76
100 year, 30 minute	1.61	3.22
100 year, 1 hr.	1.99	1.99

ITERATIONS

Try rainfall intensity of 5.772 in/hr. for T_c = 10 minutes
$T_c = 0.2346\ (5.772)^{-0.38}$ = 0.159 hr. = 9.55 minutes, delta = 0.45 minutes

Try rainfall intensity of 4.76 in/hr. for T_c = 15 minutes
$T_c = 0.2346\ (4.76)^{-0.38}$ = 0.130 hr. = 7.78 minutes, delta = 7.22 minutes

Use rainfall intensity of 5.772 in/hr. for T_c = 10 minutes

$Q_{(100)\ existing}$ = (C) (I) (A) = (0.85) (5.772) (32.47 ac.) = 159.30 c.f.s.

OFF SITE RUNOFF CALCULATIONS, WESTERLY WASH, "B"

1. Off Site Drainage Area = 42,000 s.f. = 0.96 acres

2. "C" = 0.85

3. Time of concentration was determined using the formula:

$$T_c = 11.4\ L^{0.5}\ K_b^{0.52}\ S^{-0.31}\ i^{-0.38} \text{ where:}$$

L = 275 ft = 0.052 miles
K_b = mlogA + b, where m = -0.03000, A = 0.96 and b = 0.20
K_b = 0.2005
Elevation change = 1508.00 – 1460.00 = 48.00 feet
S = 48.00 / 0.052 = 922

$$T_c = 11.4\ (0.052)^{0.5}\ (0.2005)^{0.52}\ (922)^{-0.31}\ i^{-0.38}$$
$$T_c = 0.1358\ i^{-0.38}$$

NOAA, ATLAS 14	PT. RAINFALL, IN.	PT.RAINFALL, IN/HR
100 year, 5 minute	0.632	7.584
100 year, 10 minute	0.962	5.772
100 year, 15 minute	1.19	4.76
100 year, 30 minute	1.61	3.22
100 year, 1 hr.	1.99	1.99

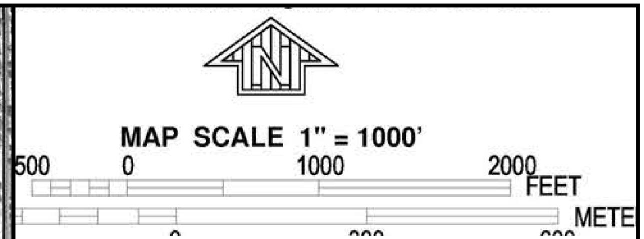
ITERATIONS

Try rainfall intensity of 7.584 in/hr. for T_c = 5 minutes
$T_c = 0.1358\ (7.584)^{-0.38}$ = 0.063 hr. = 3.77 minutes, delta = 1.23 minutes

Try rainfall intensity of 5.772 in/hr. for T_c = 10 minutes
$T_c = 0.1358\ (5.772)^{-0.38}$ = 0.070 hr. = 4.19 minutes, delta = 5.81 minutes

Use rainfall intensity of 7.584 in/hr. for T_c = 5 minutes

$Q_{(100)\ \text{existing}}$ = (C) (I) (A) = (0.85) (7.584) (0.96 ac.) = 6.19 c.f.s.



NFIP

PANEL 1765L

NATIONAL FLOOD INSURANCE PROGRAM

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

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

NOAA Atlas 14, Volume 1, Version 5
Location name: Paradise Valley, Arizona, USA*
Latitude: 33.5219°, Longitude: -111.9621°
Elevation: 1445.76 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	0.188 (0.157–0.229)	0.245 (0.206–0.299)	0.333 (0.278–0.405)	0.401 (0.332–0.485)	0.491 (0.401–0.592)	0.561 (0.452–0.672)	0.632 (0.500–0.755)	0.704 (0.548–0.840)	0.801 (0.607–0.957)	0.875 (0.649–1.05)
10-min	0.285 (0.239–0.348)	0.374 (0.314–0.456)	0.507 (0.423–0.616)	0.610 (0.505–0.737)	0.747 (0.610–0.901)	0.854 (0.688–1.02)	0.962 (0.760–1.15)	1.07 (0.834–1.28)	1.22 (0.924–1.46)	1.33 (0.988–1.60)
15-min	0.354 (0.296–0.432)	0.463 (0.390–0.565)	0.629 (0.524–0.764)	0.756 (0.626–0.914)	0.927 (0.756–1.12)	1.06 (0.852–1.27)	1.19 (0.943–1.42)	1.33 (1.03–1.59)	1.51 (1.15–1.81)	1.65 (1.23–1.98)
30-min	0.477 (0.399–0.582)	0.624 (0.525–0.761)	0.847 (0.706–1.03)	1.02 (0.844–1.23)	1.25 (1.02–1.50)	1.43 (1.15–1.71)	1.61 (1.27–1.92)	1.79 (1.39–2.14)	2.04 (1.54–2.43)	2.22 (1.65–2.66)
60-min	0.590 (0.494–0.720)	0.772 (0.649–0.942)	1.05 (0.874–1.27)	1.26 (1.04–1.52)	1.54 (1.26–1.86)	1.77 (1.42–2.11)	1.99 (1.57–2.37)	2.22 (1.72–2.64)	2.52 (1.91–3.01)	2.75 (2.04–3.30)
2-hr	0.683 (0.581–0.816)	0.884 (0.752–1.06)	1.18 (1.00–1.41)	1.41 (1.18–1.68)	1.72 (1.43–2.04)	1.96 (1.60–2.31)	2.20 (1.78–2.60)	2.45 (1.94–2.89)	2.78 (2.15–3.28)	3.04 (2.30–3.61)
3-hr	0.747 (0.632–0.902)	0.957 (0.814–1.16)	1.26 (1.06–1.52)	1.49 (1.25–1.79)	1.83 (1.51–2.18)	2.09 (1.70–2.48)	2.37 (1.89–2.81)	2.65 (2.08–3.14)	3.05 (2.32–3.62)	3.37 (2.50–4.00)
6-hr	0.900 (0.777–1.06)	1.14 (0.987–1.35)	1.46 (1.26–1.72)	1.71 (1.46–2.01)	2.06 (1.74–2.40)	2.34 (1.94–2.71)	2.62 (2.14–3.04)	2.91 (2.33–3.38)	3.30 (2.58–3.84)	3.61 (2.76–4.22)
12-hr	1.01 (0.882–1.18)	1.28 (1.11–1.49)	1.62 (1.40–1.88)	1.89 (1.62–2.19)	2.25 (1.91–2.60)	2.52 (2.12–2.91)	2.81 (2.33–3.24)	3.10 (2.54–3.57)	3.48 (2.78–4.04)	3.79 (2.97–4.42)
24-hr	1.21 (1.07–1.40)	1.54 (1.36–1.77)	2.00 (1.75–2.30)	2.36 (2.06–2.71)	2.86 (2.49–3.29)	3.26 (2.81–3.73)	3.67 (3.14–4.21)	4.10 (3.48–4.70)	4.69 (3.94–5.38)	5.16 (4.29–5.93)
2-day	1.31 (1.16–1.50)	1.68 (1.48–1.92)	2.21 (1.94–2.52)	2.63 (2.30–3.00)	3.22 (2.81–3.68)	3.69 (3.20–4.21)	4.19 (3.60–4.79)	4.71 (4.02–5.38)	5.44 (4.59–6.23)	6.03 (5.03–6.92)
3-day	1.40 (1.23–1.60)	1.79 (1.57–2.04)	2.36 (2.07–2.69)	2.82 (2.46–3.21)	3.46 (3.01–3.95)	3.98 (3.44–4.54)	4.54 (3.89–5.17)	5.12 (4.36–5.84)	5.94 (5.00–6.79)	6.61 (5.50–7.56)
4-day	1.48 (1.30–1.69)	1.89 (1.66–2.17)	2.51 (2.19–2.86)	3.00 (2.62–3.42)	3.71 (3.21–4.22)	4.27 (3.68–4.87)	4.88 (4.18–5.56)	5.53 (4.69–6.31)	6.44 (5.40–7.34)	7.19 (5.96–8.21)
7-day	1.66 (1.46–1.91)	2.13 (1.86–2.44)	2.82 (2.46–3.23)	3.38 (2.94–3.87)	4.18 (3.62–4.78)	4.82 (4.15–5.51)	5.51 (4.70–6.29)	6.24 (5.29–7.14)	7.28 (6.08–8.32)	8.12 (6.71–9.30)
10-day	1.80 (1.57–2.06)	2.30 (2.02–2.64)	3.05 (2.66–3.48)	3.65 (3.18–4.16)	4.49 (3.89–5.11)	5.17 (4.45–5.87)	5.89 (5.04–6.69)	6.65 (5.65–7.57)	7.72 (6.48–8.78)	8.58 (7.13–9.77)
20-day	2.22 (1.96–2.52)	2.86 (2.52–3.24)	3.78 (3.33–4.29)	4.49 (3.93–5.08)	5.43 (4.74–6.14)	6.16 (5.36–6.96)	6.90 (5.97–7.81)	7.66 (6.59–8.68)	8.68 (7.41–9.87)	9.48 (8.02–10.8)
30-day	2.60 (2.28–2.95)	3.35 (2.94–3.80)	4.42 (3.88–5.02)	5.24 (4.59–5.94)	6.34 (5.52–7.18)	7.19 (6.24–8.13)	8.07 (6.96–9.11)	8.95 (7.69–10.1)	10.2 (8.66–11.5)	11.1 (9.38–12.6)
45-day	3.00 (2.65–3.40)	3.87 (3.41–4.38)	5.11 (4.51–5.78)	6.03 (5.30–6.82)	7.25 (6.35–8.20)	8.17 (7.13–9.24)	9.11 (7.91–10.3)	10.1 (8.69–11.4)	11.3 (9.70–12.9)	12.3 (10.5–14.0)
60-day	3.31 (2.93–3.74)	4.28 (3.79–4.83)	5.64 (4.99–6.36)	6.64 (5.85–7.48)	7.93 (6.98–8.93)	8.90 (7.79–10.0)	9.87 (8.61–11.1)	10.8 (9.40–12.2)	12.1 (10.4–13.7)	13.0 (11.2–14.8)

[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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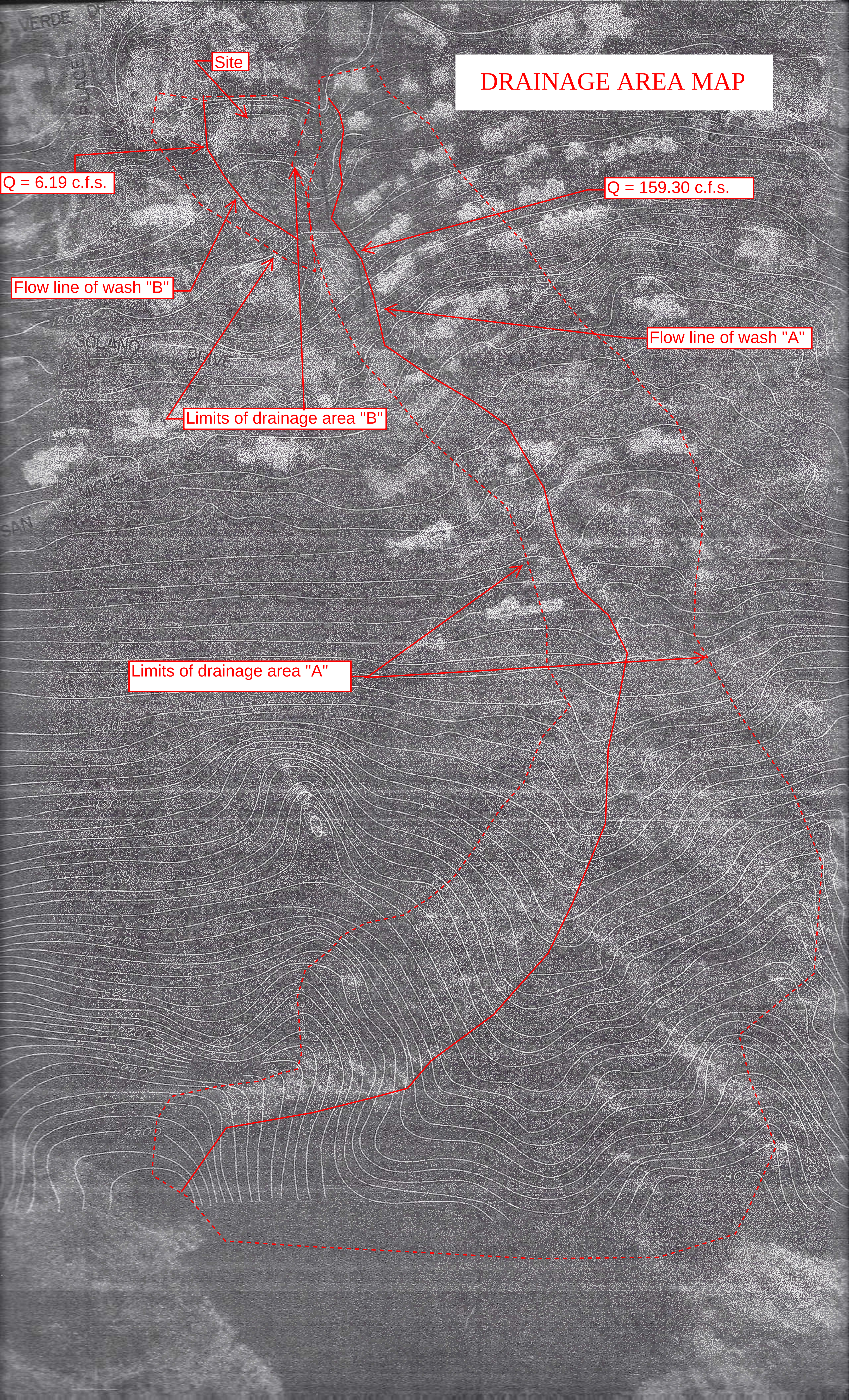
DRAINAGE AREA MAP
Site
Q = 6.19 c.f.s.
Q = 159.30 c.f.s.
Flow line of wash "B"
Flow line of wash "A"
Limits of drainage area "B"
Limits of drainage area "A"
SOLANO
DRIVE

WASH "A"

TRAPEZOIDAL CHANNEL ANALYSIS
CRITICAL DEPTH COMPUTATION

March 29, 2017

PROGRAM INPUT DATA

DESCRIPTION	VALUE
Flow Rate (cfs)	159.3
Channel Bottom Slope (ft/ft)	0.0833
Manning's Roughness Coefficient (n-value)	0.01
Channel Left Side Slope (horizontal/vertical)	2.0
Channel Right Side Slope (horizontal/vertical)	2.0
Channel Bottom Width (ft)	10.0

COMPUTATION RESULTS

DESCRIPTION	VALUE
Critical Depth (ft)	1.76
Critical Slope (ft/ft)	0.0014
Flow Velocity (fps)	6.7
Froude Number	1.0
Velocity Head (ft)	0.7
Energy Head (ft)	2.46
Cross-Sectional Area of Flow (sq ft)	23.77
Top Width of Flow (ft)	17.03

WASH "B"

TRAPEZOIDAL CHANNEL ANALYSIS
CRITICAL DEPTH COMPUTATION

March 29, 2017

PROGRAM INPUT DATA

DESCRIPTION	VALUE
Flow Rate (cfs)	6.19
Channel Bottom Slope (ft/ft)	0.0588
Manning's Roughness Coefficient (n-value)	0.01
Channel Left Side Slope (horizontal/vertical)	2.0
Channel Right Side Slope (horizontal/vertical)	2.0
Channel Bottom Width (ft)	12.0

COMPUTATION RESULTS

DESCRIPTION	VALUE
Critical Depth (ft)	0.2
Critical Slope (ft/ft)	0.0025
Flow Velocity (fps)	2.5
Froude Number	1.0
Velocity Head (ft)	0.1
Energy Head (ft)	0.3
Cross-Sectional Area of Flow (sq ft)	2.48
Top Width of Flow (ft)	12.8