Drainage Reports
Abbreviated Water & Sewer Need Reports
Water Study
Wastewater Study
Stormwater Waiver Application

Preliminary Drainage Report

For

Northwest Corner of Scottsdale / Lone Mtn

N. Scottsdale Rd

Scottsdale, AZ

Case Numbers: 8-ZN-2018
Plan Check Number:
Job: 366
June 2018

Prepared by:

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Registered Professional Engineer (Civil)
Certificate No. 30489
STEVEN R. BOWSER
Date Signed 8-2-18
Arizona U.S.A.

EXP 9-30-20

8-ZN-2018
8/6/2018

PRELIMINARY DRAINAGE REPORT
FOR
Northwest Corner of Scottsdale / Lone Mtn
Scottsdale, Arizona

1.0 INTRODUCTION

The proposed site is located at the Northwest corner of Scottsdale Rd. and Lone Mtn in the City of Scottsdale, Arizona. The site is situated within the Southeast quarter of Section 15, Township 5 North, Range 4 East of the Gila and Salt River Base and Meridian, Maricopa County, Arizona. The site is an undeveloped site with no site improvements other than existing streets on the east and south side of the property. restaurant building with parking on all sides. This project fronts on Scottsdale Road and Lone Mtn.

2.0 OBJECTIVES – PROJECT DEVELOPMENT AND BACKGROUND

The purpose of this report is to verify the site compliance with the drainage requirements set forth in the *Drainage Design Manual for Maricopa County, Volume II "Hydraulics,* prepared by the Maricopa County Flood Control District; and the City of Scottsdale Design Standards and Procedures Manual dated January 2018.

3.0 EXISTING SITE CONDITIONS

Currently, the site is a undeveloped site. Paved streets and signalized intersection are present on the south and east side of the site.

Streets are fully paved with no curb and gutter. An offsite drainage way crosses Scottsdale Road near the northeast corner of the property and crosses the property and outfalls along the roadway ditch along Lone Mtn at the Southwest corner of the site. Drainageway crosses Scottsdale Road in dip section. No dip section exists along Lone Mtn Road in the vicinity of this property. Drainageway does appear to have a distinct flowpath across the site.

A second small offsite drainageway crosses the northwest corner of the site.

Pre discussion with staff, offsite flow rates uses are per Maricopa County Study, Pinnacle Peak West, Whisper Rock model. Based on that Study, a flow of 120 CFS will be studied crossing Scottsdale Road. Flow 2d results from County Study are showin in Figure 5.

Minor flow in the northwest corner will be unaffected by this site as that corner of the site will not be modified.

Site is undeveloped and contains no current retention.

4.0 FLOOD PLAIN DESIGNATION

The entire site lies within Zone "X shaded" designated flood zone per the Federal Emergency Management Agency's (FEMA) Flood Insurance Rate Map (FIRM), Map Numbers 0895L, dated October 16, 2013.

See Figure 2 for a copy of the FEMA map.

5.0 PROPOSED SITE IMPROVEMENTS

STORMWATER RETENTION / SITE IMPROVEMENTS/OFFSITE FLOW CONVEYANCE

This project will provide Pre vs Post hour retention for the developed areas excluding the drainageway. The contributing areas to the retention basin will be the new building, and onsite paving. A C factor of 0.86 (post) (per DSPM) and 0.45 (pre) for volume calculations. The volume will be retained in a 3' deep basin at the southwest corner of the site. An 8" bleed line will bleed this basin back to the low outfall of the site at the southwest corner of the site. An onsite storm drain will convey roof and pavement areas to the onsite retention basin.

The existing drainageway will enter the site at the northeast corner and cross both driveways with twin barrel box culverts at 8' span x 3' tall. Box culverts will allow easier maintenance for clearing brush and sediment. A graded channel with 4:1 slopes with a 12' bottom will convey flows from the northeast corner of the site to the southwest corner of the site. A HEC-RAS analysis is provided showing depths and sections crossing the site.

Existing offsite improvements will not be modified on Scottsdale Road. Lone Mtn will have curb and gutter added for the frontage distance.

Retention volumes are showing in Figure 3 and HEC RAS results are shown in figure 4.

ULTIMATE OUTFALLS

This project's ultimate outfall will remain at the southwest corner of the site. The finish floor is in excess of 14" above this elevation.

DISPOSAL

Disposal of the storage volume will be by bleed line to the low corner of the site to bleed the basin in 36 hours or less.

404 AND CONSTRUCTION STORMWATER

A 404 delineation will be performed for the site. That work is currently in process. BMPs during construction will be maintained.

6.0 SUMMARY

- This project is the new development of an undeveloped site to an indoor storage building along with parking.
- The site conveys 120 cfs across the site and will be routed into a graded channel along the south and west side of the site.
- The Project Site is located within FEMA designated flood zone "X". New building will be greater than 14" above site outfall.
- Site currently has no retention.
- New construction areas will provide retention for 100 year 2 hour volumes.

7.0 REFERENCES

1. Federal Emergency Management Agency, Flood Insurance Rate Map, Maricopa County, Arizona and Incorporated Areas, Map Number 04013C0895L, Oct 16, 2013.
2. City of Scottsdale, Design Standards and Procedures Manual Chapter 4, 2018.

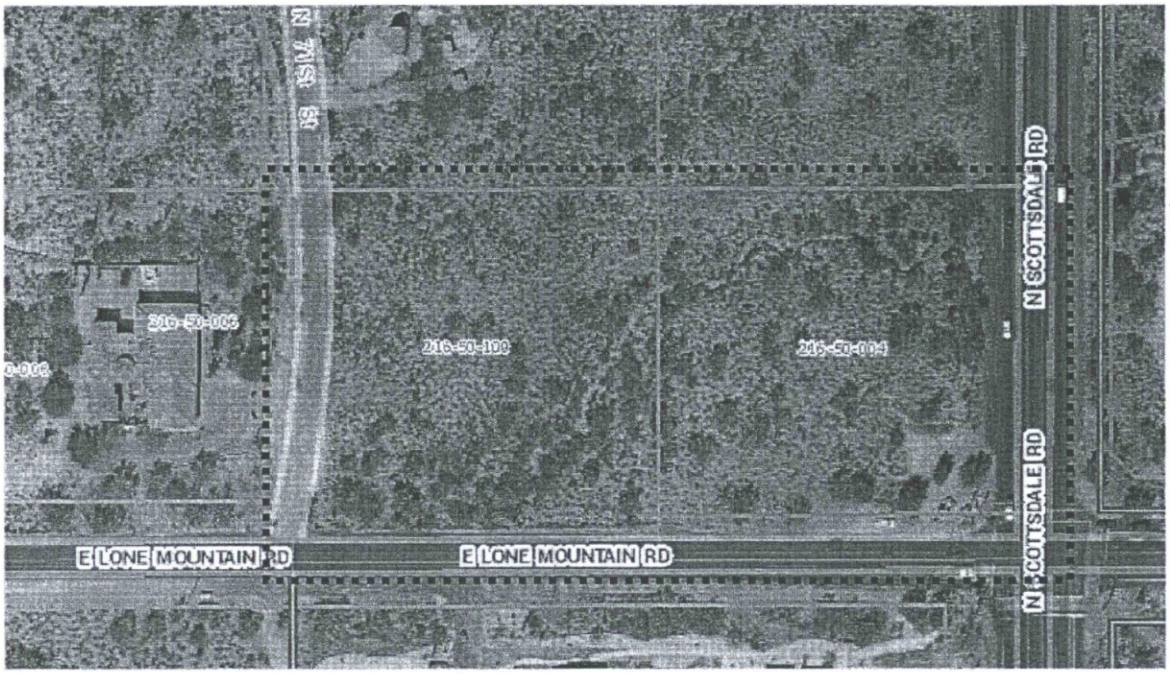


Figure 1-VICINITY MAP / AERIAL MAP

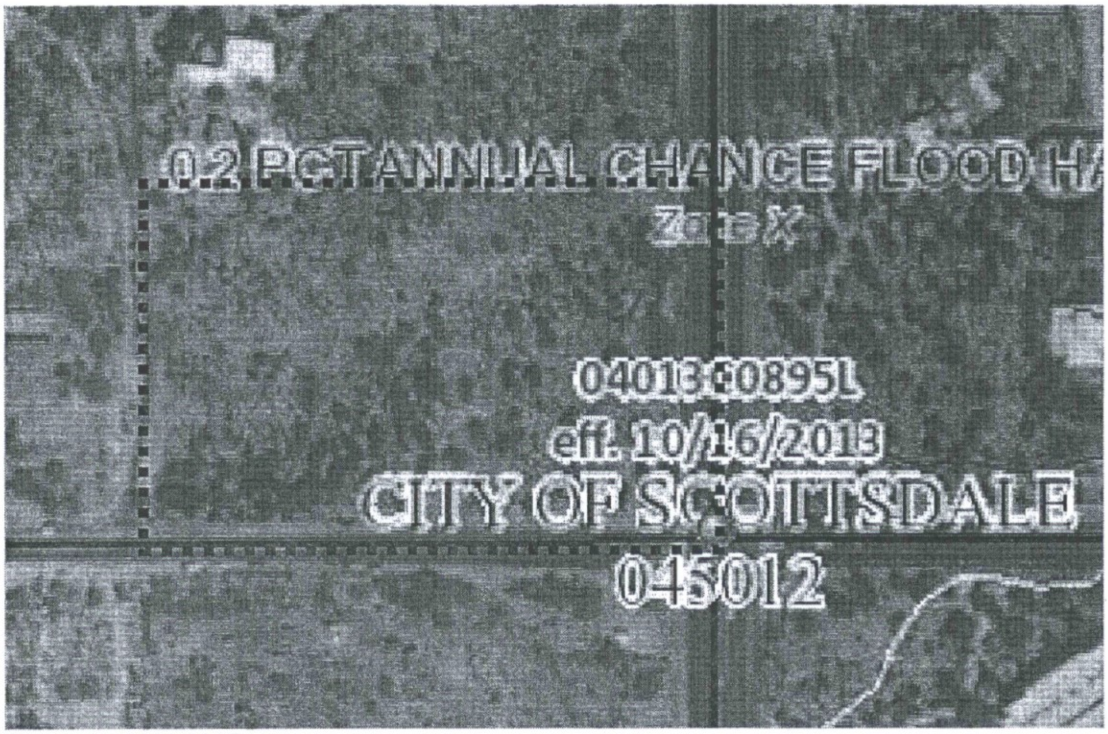


Figure 2-FEMA MAP

Figure 3 - Retention Calculations

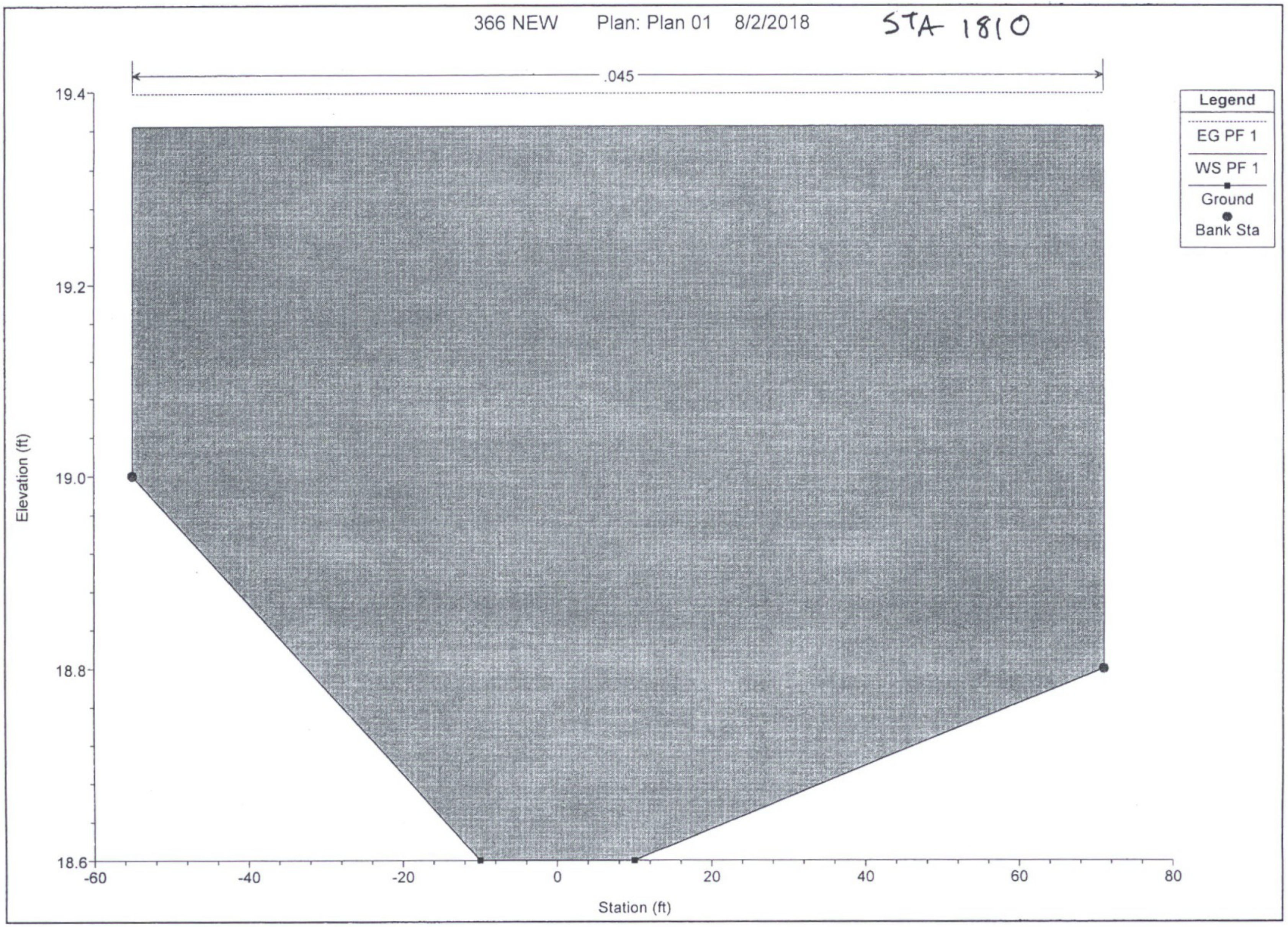
	2.62	INCHES
100 Year 2 hr depth	0.218333	
Overage required	0%	

AREA NAME	SF AREA	LF UG reten	C FACTOR	DEPTH	OVERAGE REQD	VOL REQUIRED	VOL PROVIDED	*excess*	Comments
Pre	77,000		0.45	0.218333	100%	7,565			
Post	77,000		0.86	0.218333	100%	14,458			
Pre Vs Post						6,893	7,400	*507*	

Figure 4 - HEC-RAS analysis

HEC-RAS Plan: Plan 01 River: CHANNEL Reach: 1 Profile: PF 1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
1	1810	PF 1	120.00	18.60	19.36		19.40	0.003642	1.48	81.15	126.00	0.32
1	1775	PF 1	120.00	18.30	18.98		19.12	0.026740	2.95	40.74	101.08	0.82
1	1702	PF 1	120.00	15.00	16.45	16.45	16.99	0.031270	5.93	20.24	18.68	1.00
1	1662		Culvert									
1	1604	PF 1	120.00	12.90	14.62		14.80	0.007712	3.42	35.10	26.97	0.53
1	1520	PF 1	120.00	12.20	13.66		13.93	0.014178	4.15	28.89	26.31	0.70
1	1439	PF 1	120.00	11.20	13.09		13.21	0.004968	2.85	42.05	30.54	0.43
1	1323	PF 1	120.00	10.40	11.56	11.56	12.02	0.030869	5.45	22.03	23.95	1.00
1	1230	PF 1	120.00	9.00	10.54	9.87	10.68	0.005377	3.00	40.04	26.00	0.43
1	1179		Culvert									
1	1143	PF 1	120.00	7.40	8.95		9.09	0.005231	2.97	40.39	26.00	0.42
1	1000	PF 1	120.00	6.50	7.56	7.44	7.77	0.020032	3.63	33.02	47.91	0.77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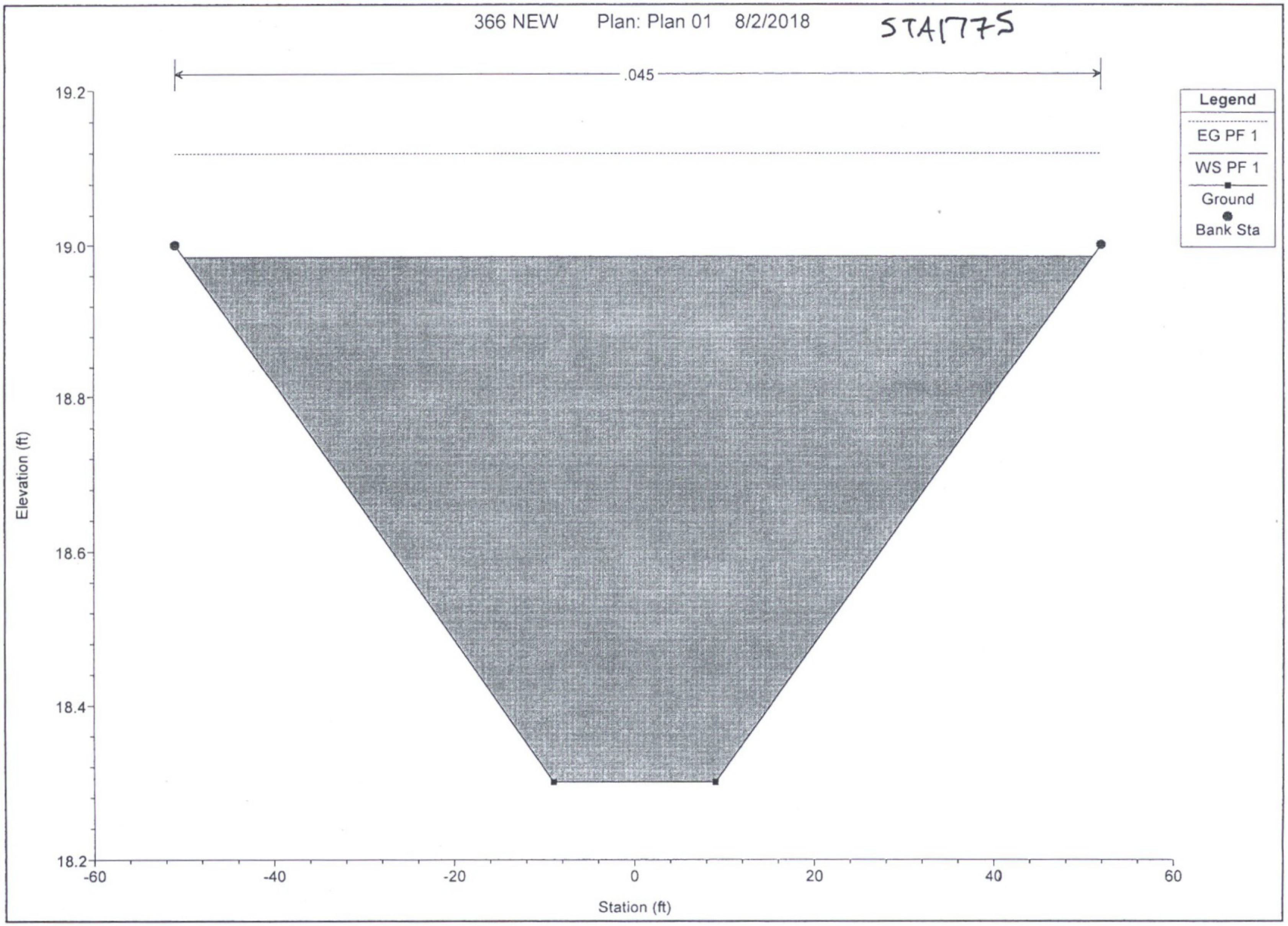
STA 1810
.045
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
19.4
19.2
19.0
18.8
18.6
Station (ft)
-60
-40
-20
0
20
40
60
80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STA1775
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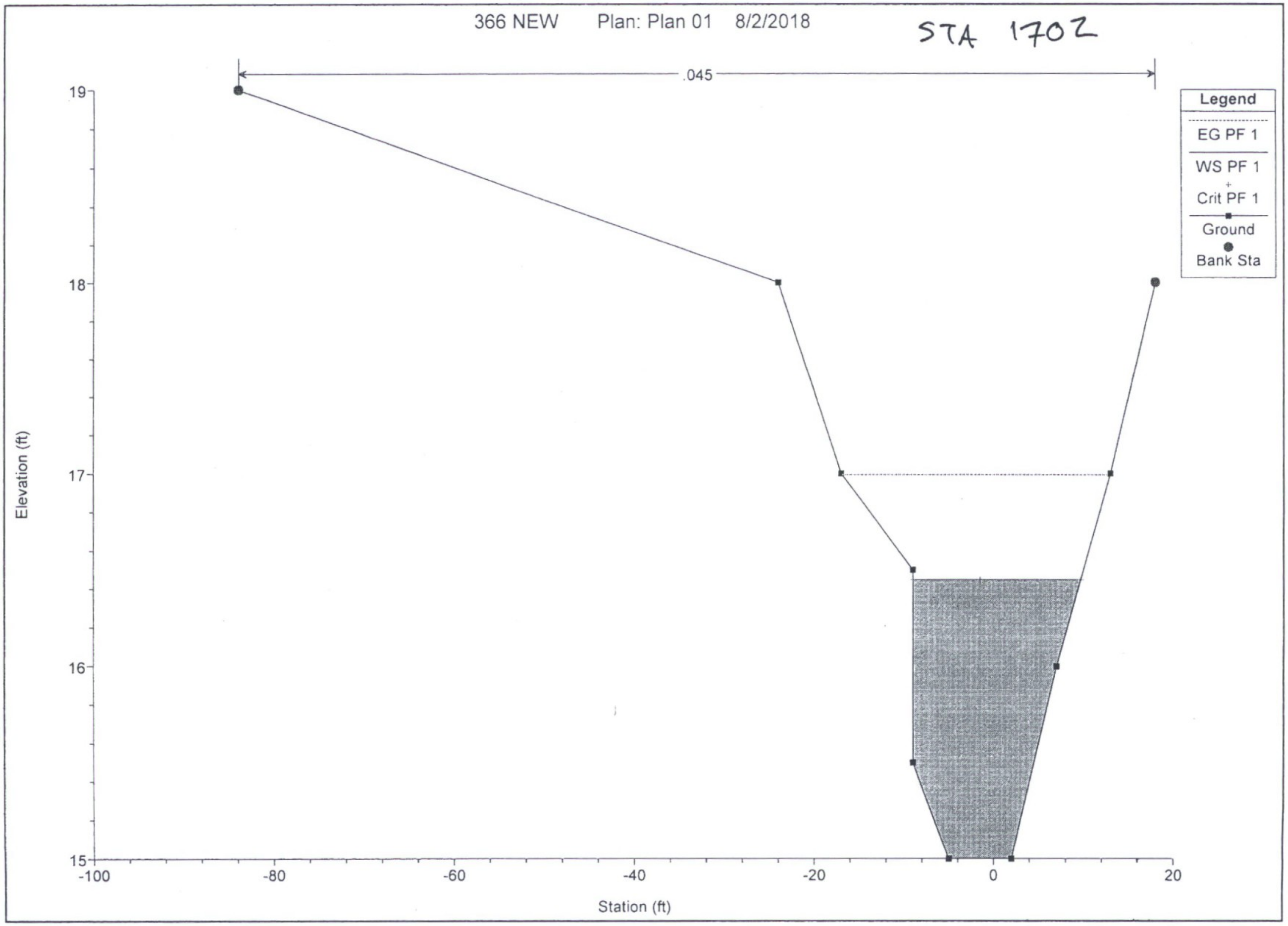
-20
0
20
40
60
Station (ft)



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STA 1702
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WS PF 1
Crit PF 1
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Bank Sta
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16
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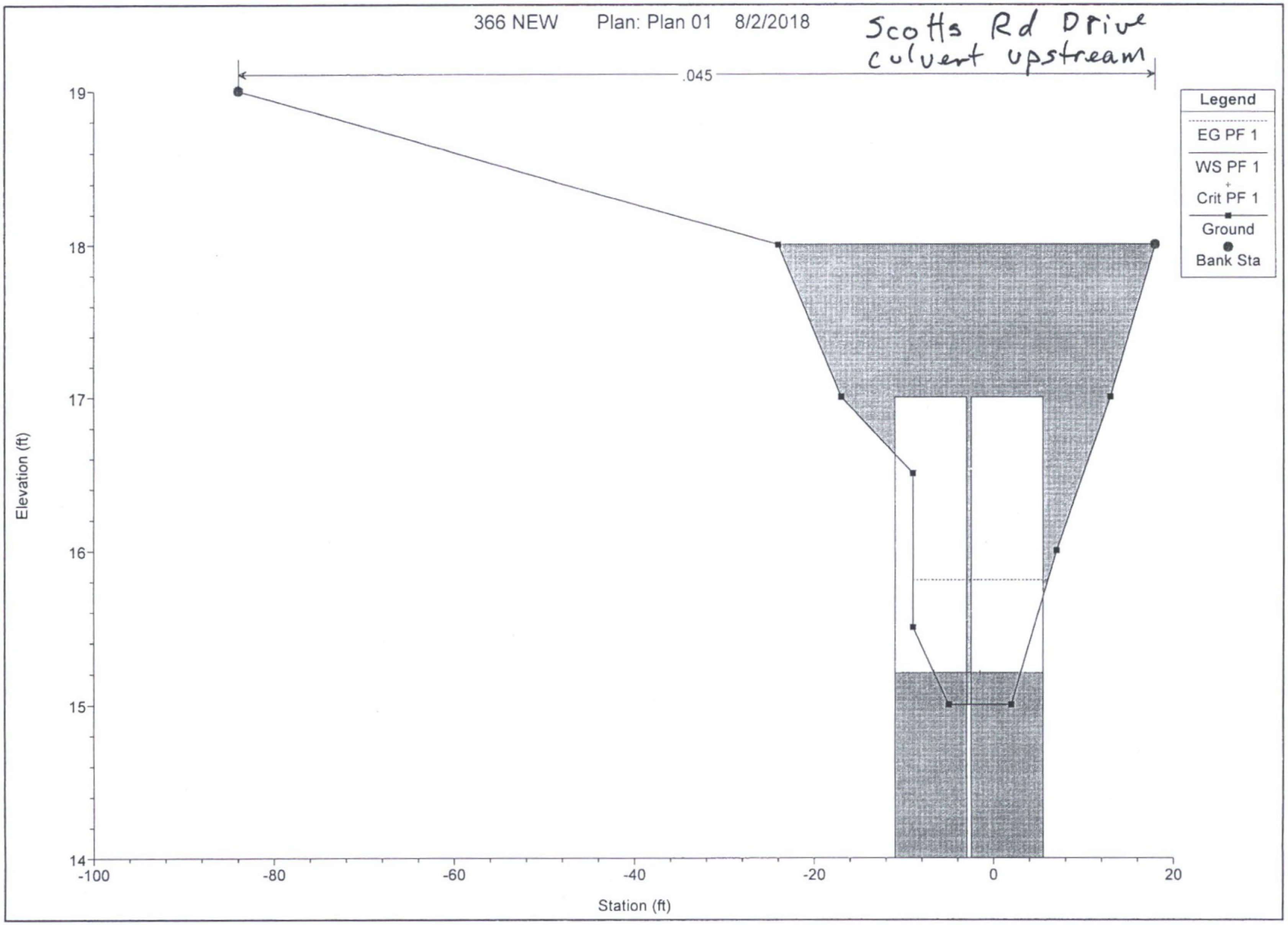
-40
-20
0
20
Station (ft)



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Scotts Rd Drive
culvert upstream
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Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
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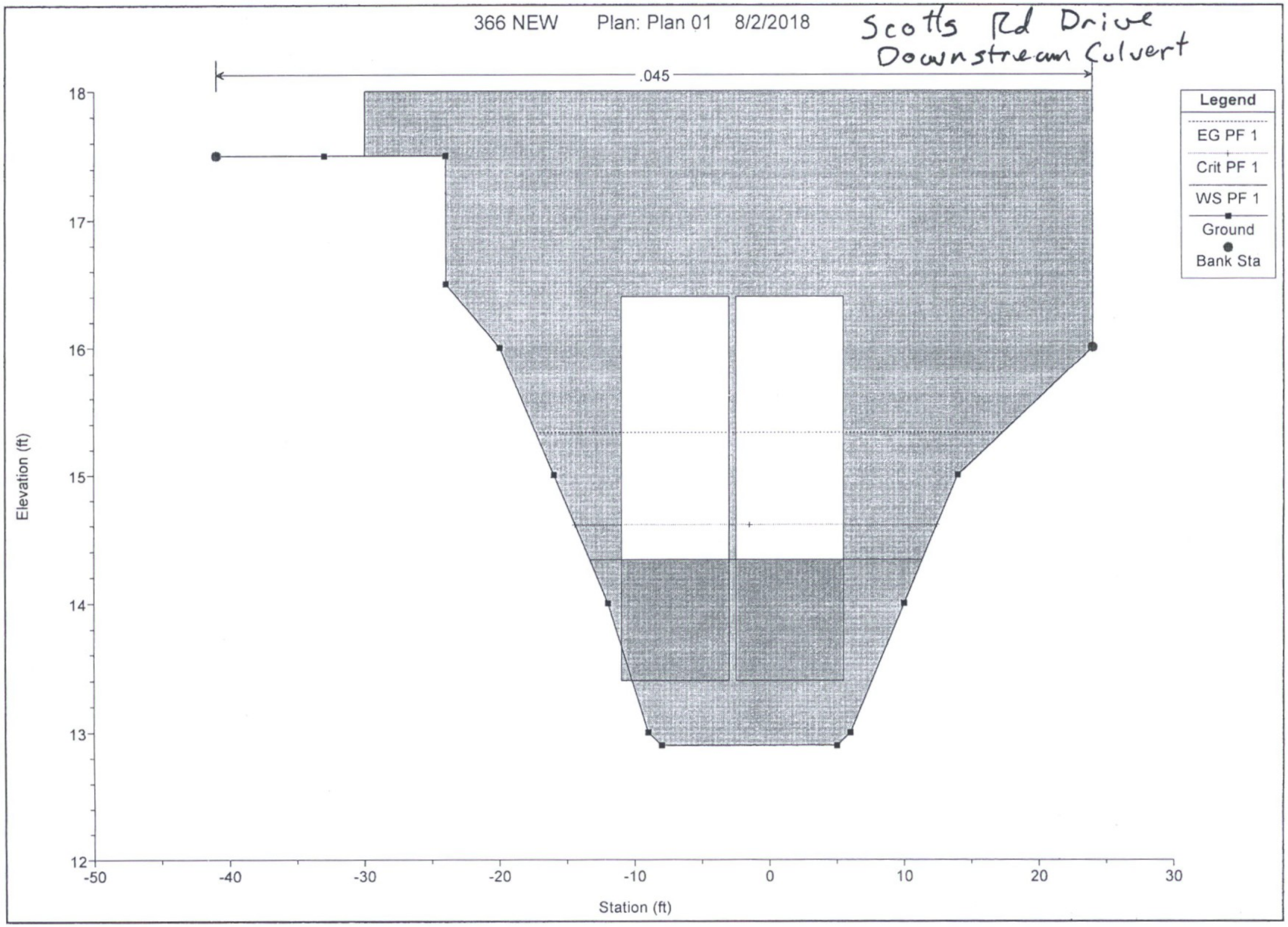
18
17
16
15
14
-100
-80
-60
-40
-20
0
20
Station (ft)


366 NEW Plan: Plan 01 8/2/2018
Scotts Rd Drive
Downstream Culvert
.045
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
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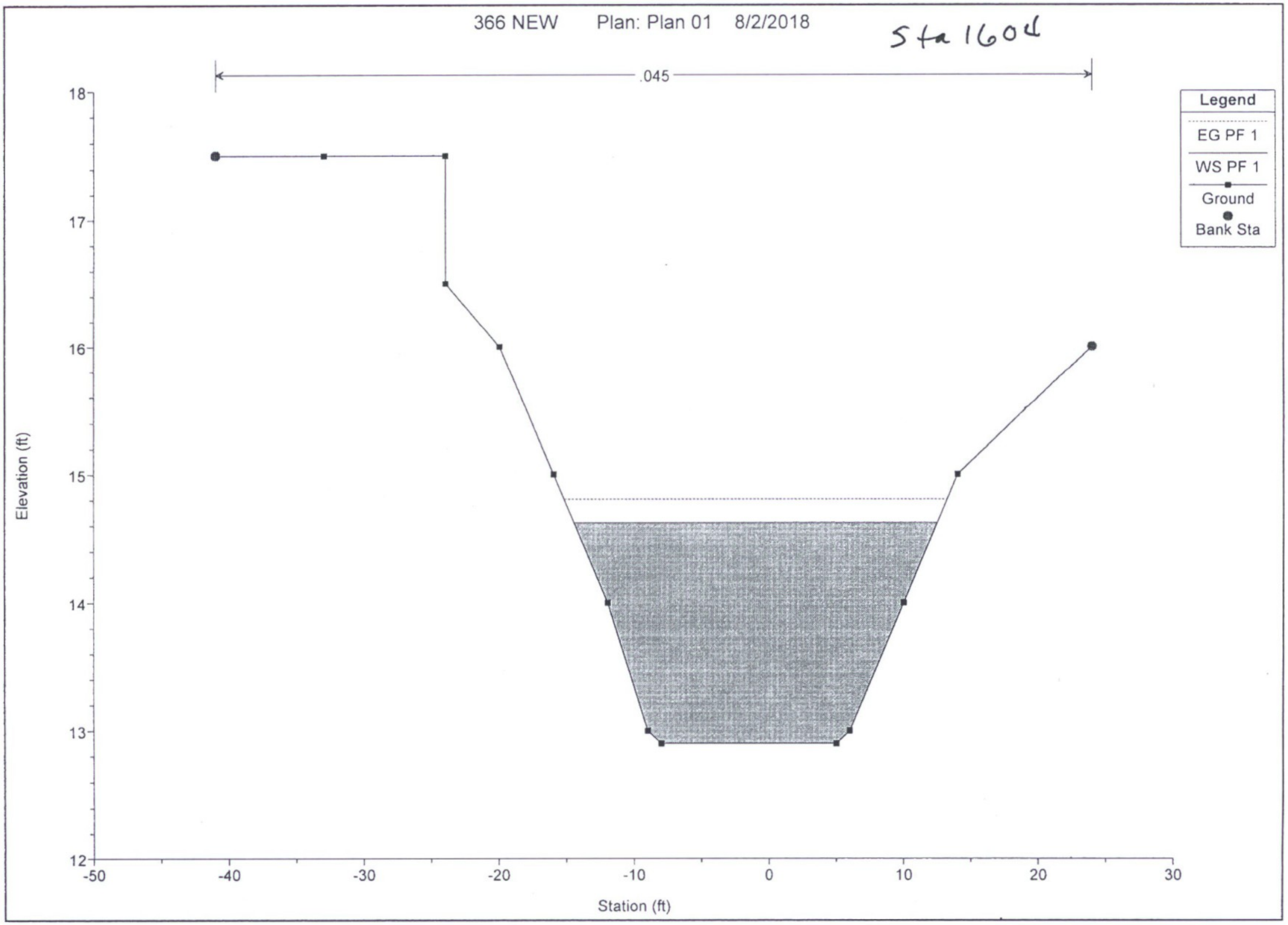
16
15
14
13
12
-50
-40
-30
-20
-10
0
10
20
30



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Sta 160 ℄
.045
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
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17
16
15
14
13
12
Station (ft)
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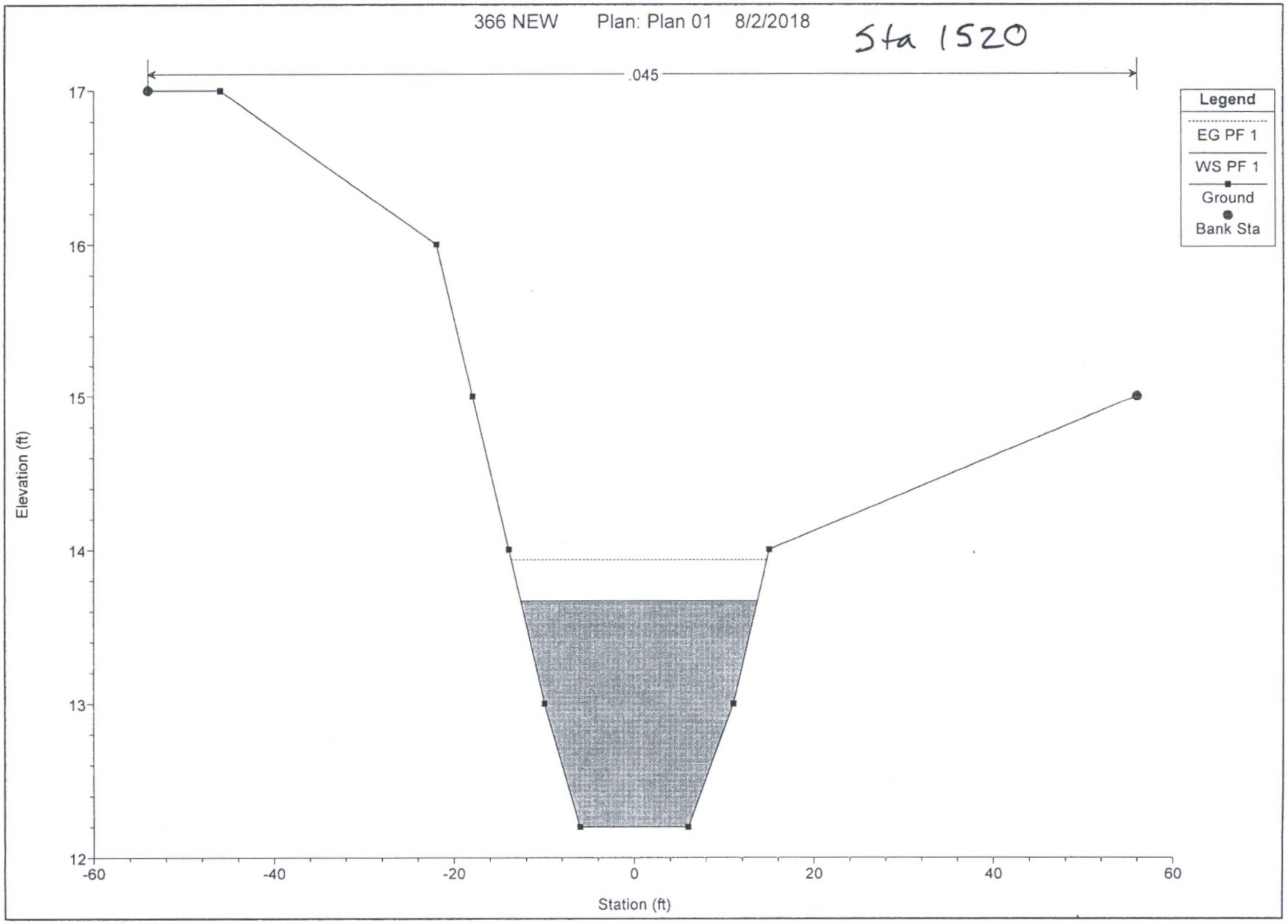
-40
-30
-20
-10
0
10
20
30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Sta 1520
.045
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WS PF 1
Ground
Bank Sta
Elevation (ft)
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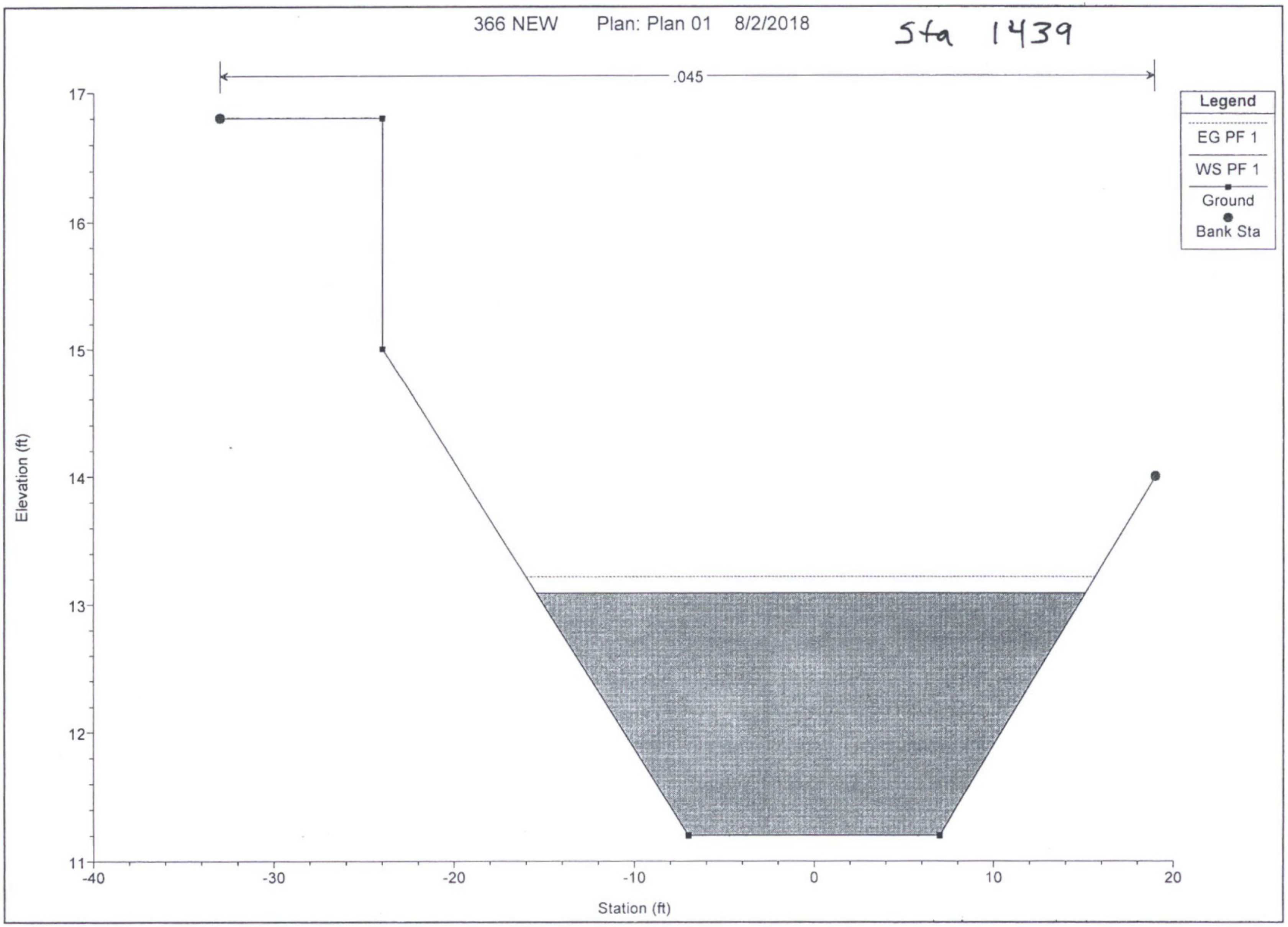
16
15
14
13
12
-60
-40
-20
0
20
40
60
Station (ft)



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Sta 1439
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WS PF 1
Ground
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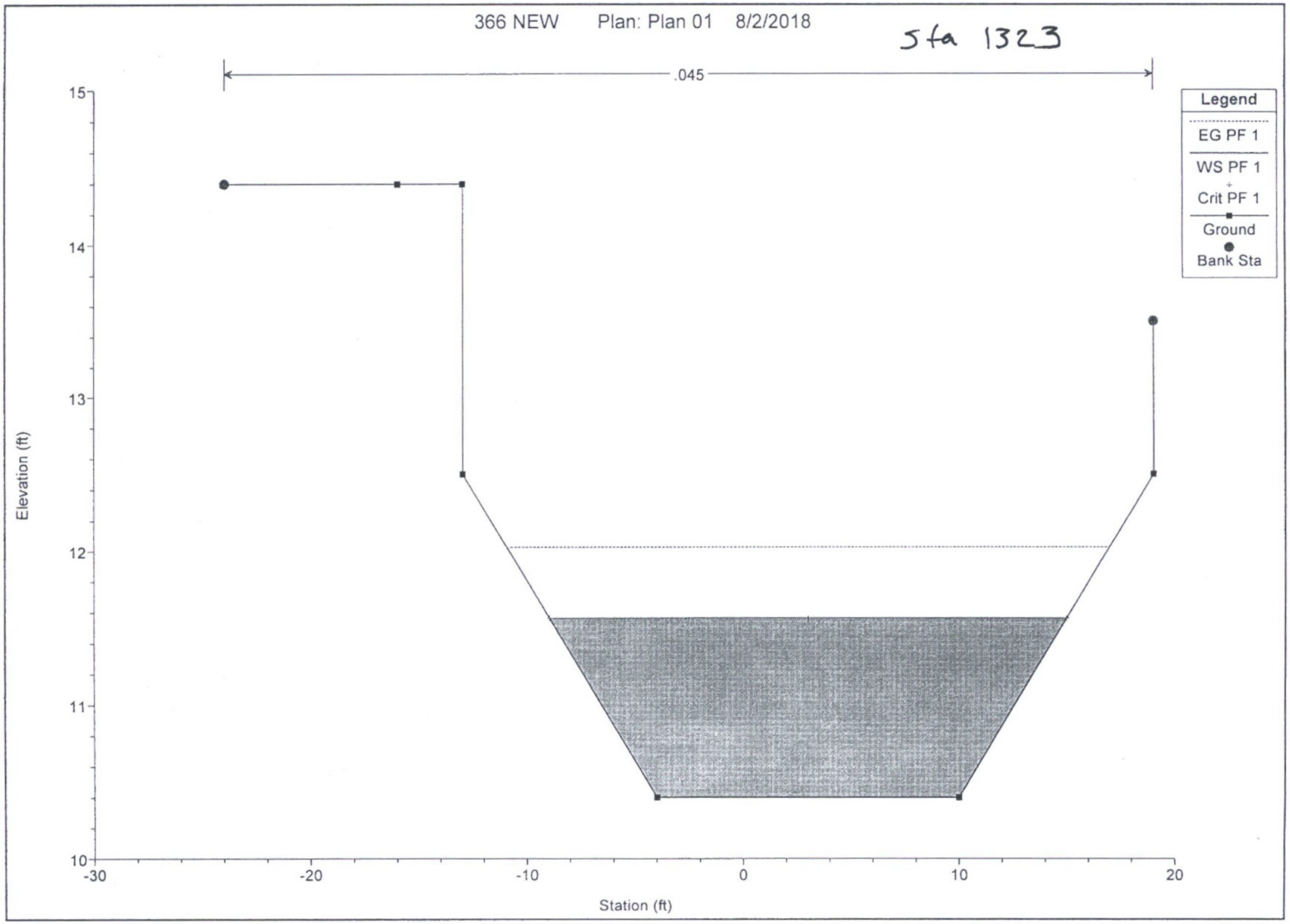
-30
-20
-10
0
10
20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Sta 1323
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WS PF 1
Crit PF 1
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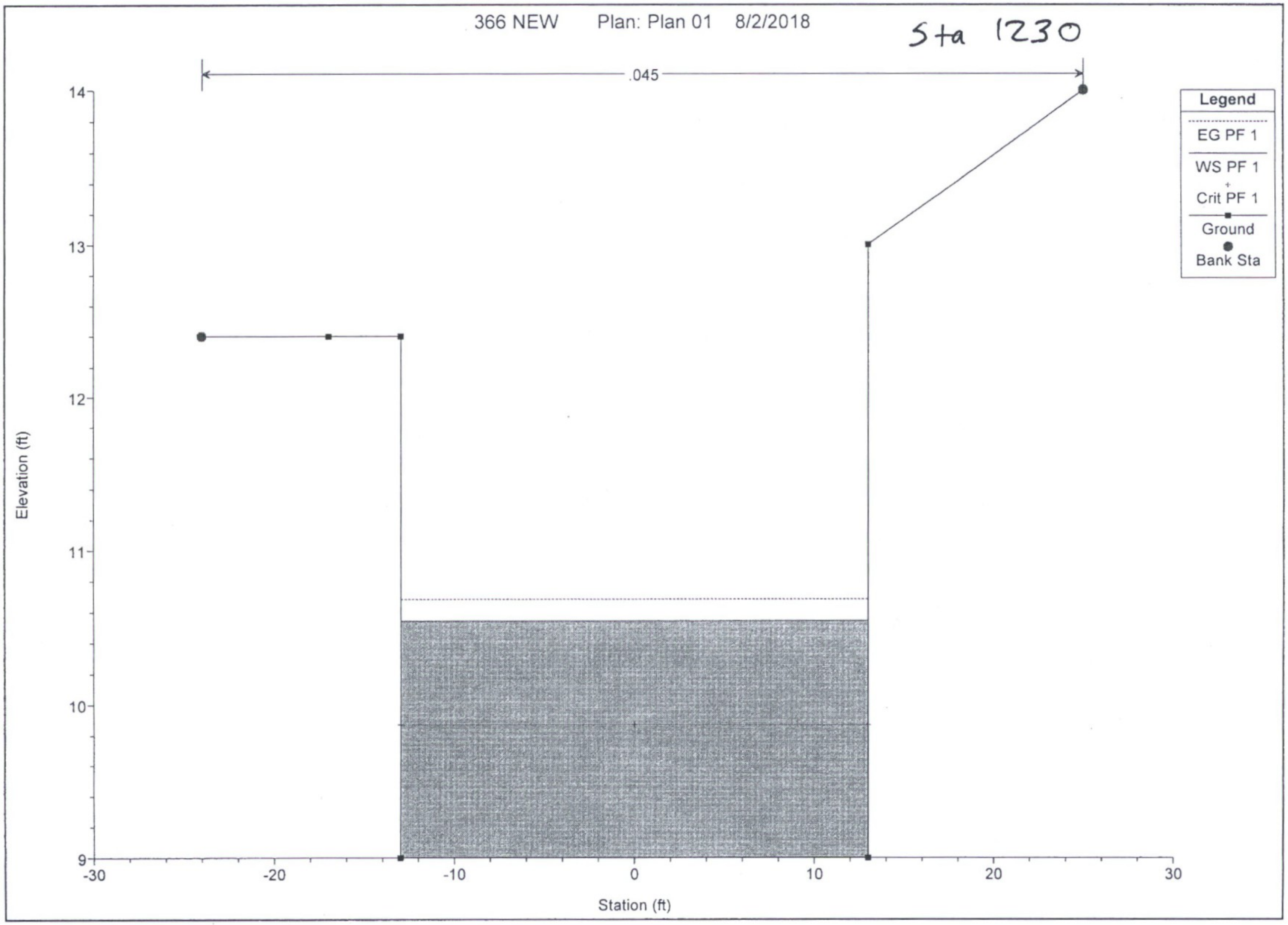
-30
-20
-10
0
10
20



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EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
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9
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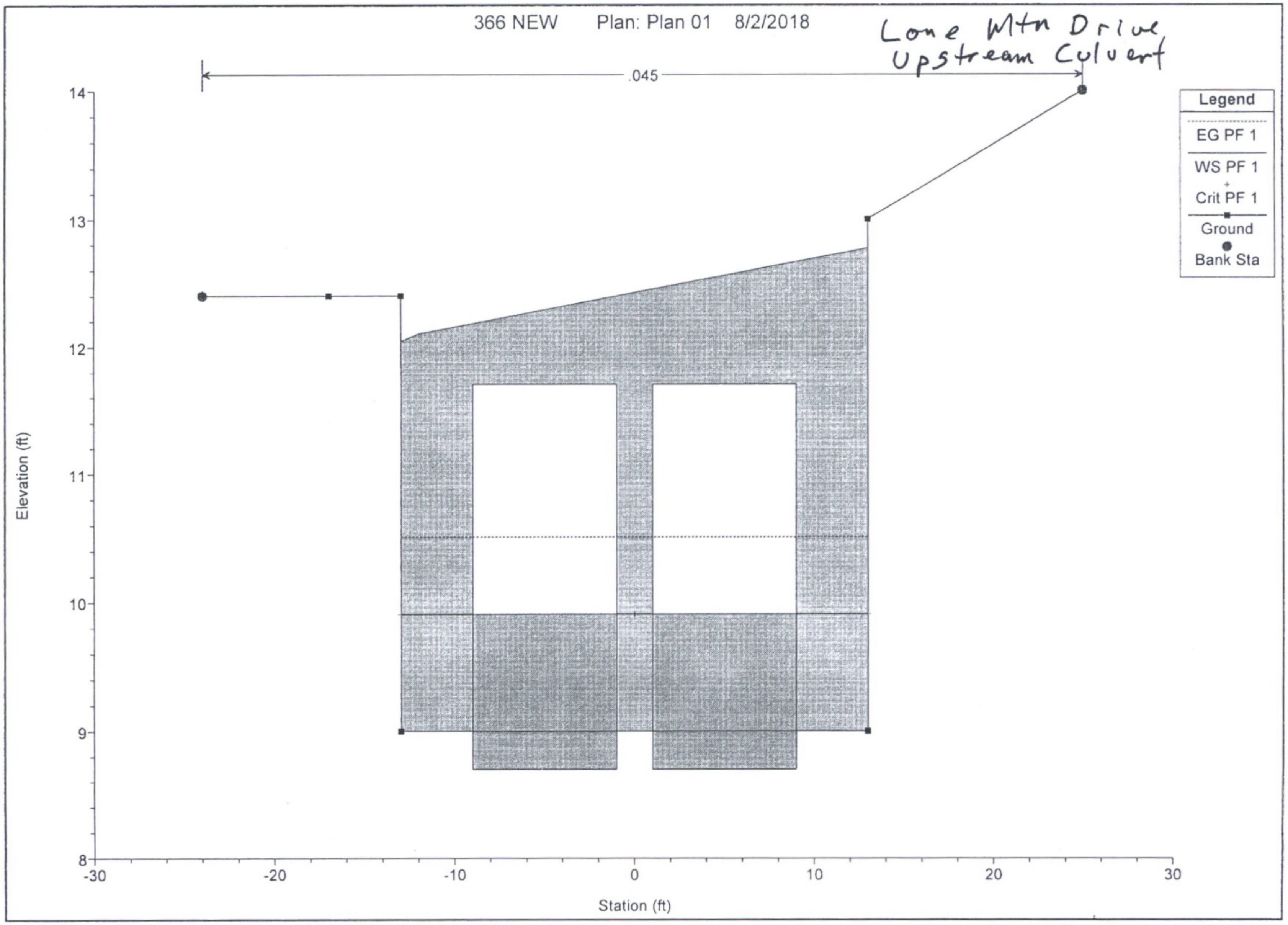
-20
-10
0
10
20
30
Station (ft)


366 NEW Plan: Plan 01 8/2/2018
Lone Mtn Drive
Upstream Culvert
.045
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
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13
12
11
10
9
8
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0
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20
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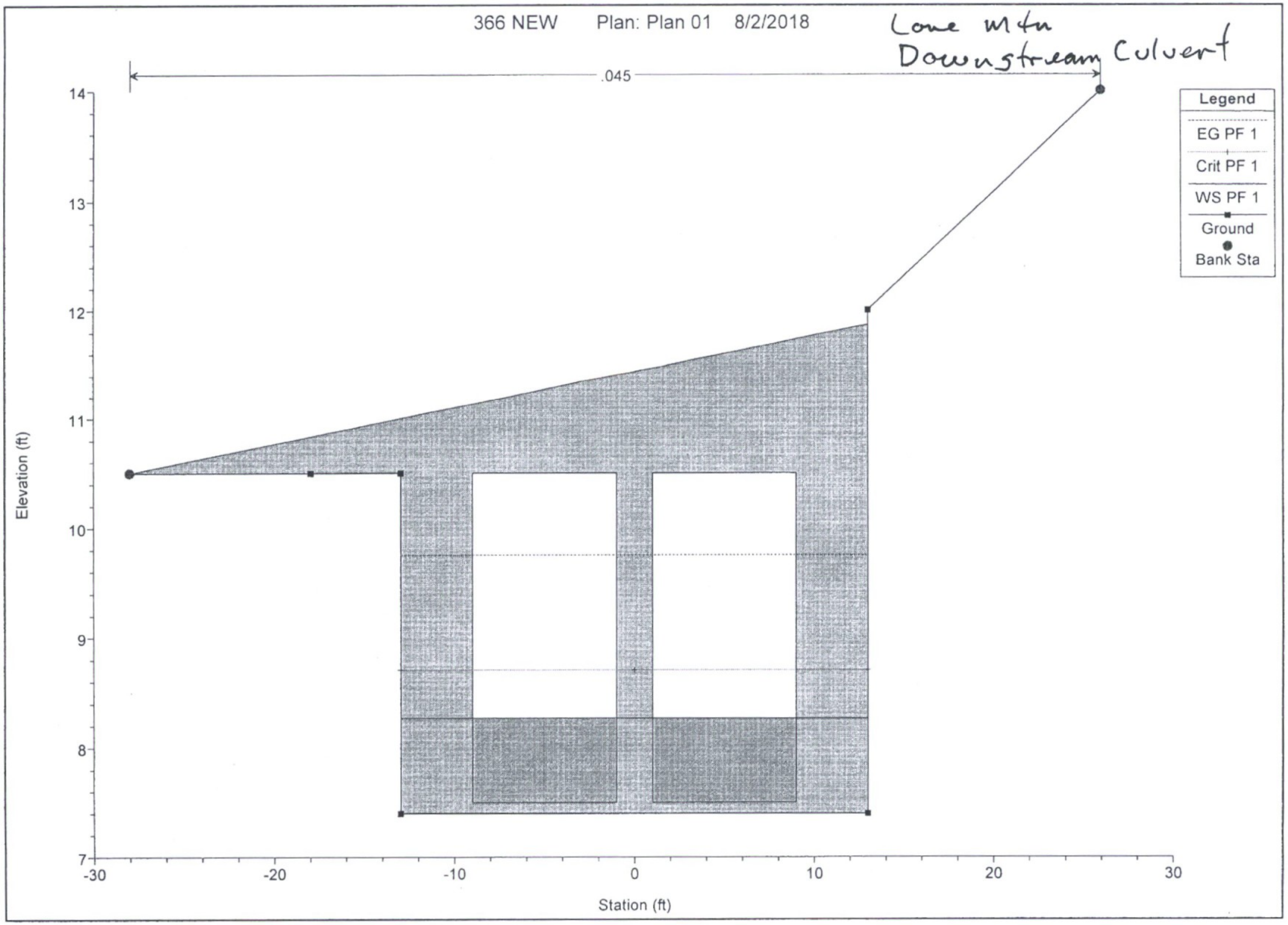
366 NEW Plan: Plan 01 8/2/2018
Lone Mtn
Downstream Culvert
.045
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
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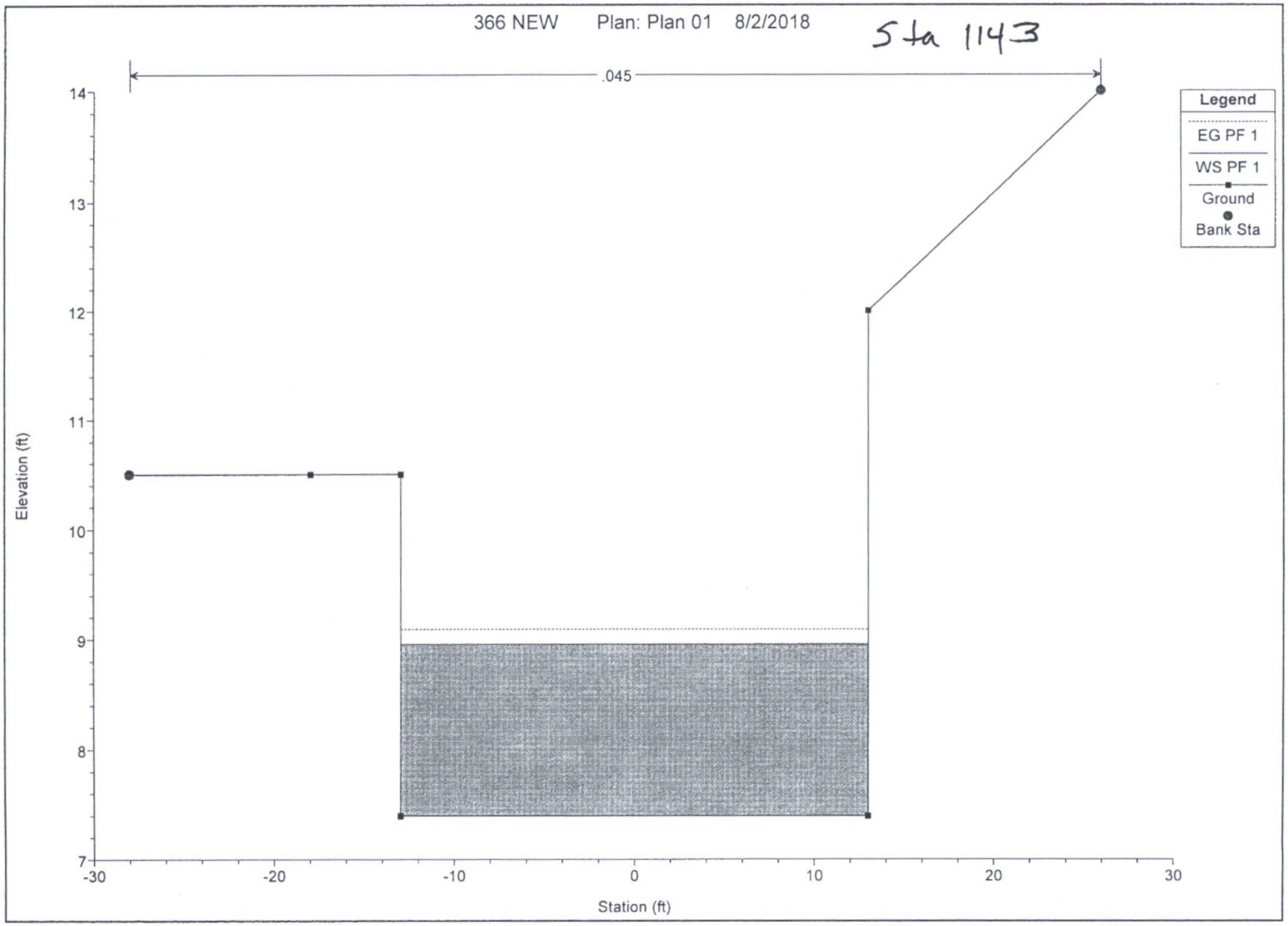
13
12
11
10
9
8
7
-30
-20
-10
0
10
20
30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Sta 1143
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Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
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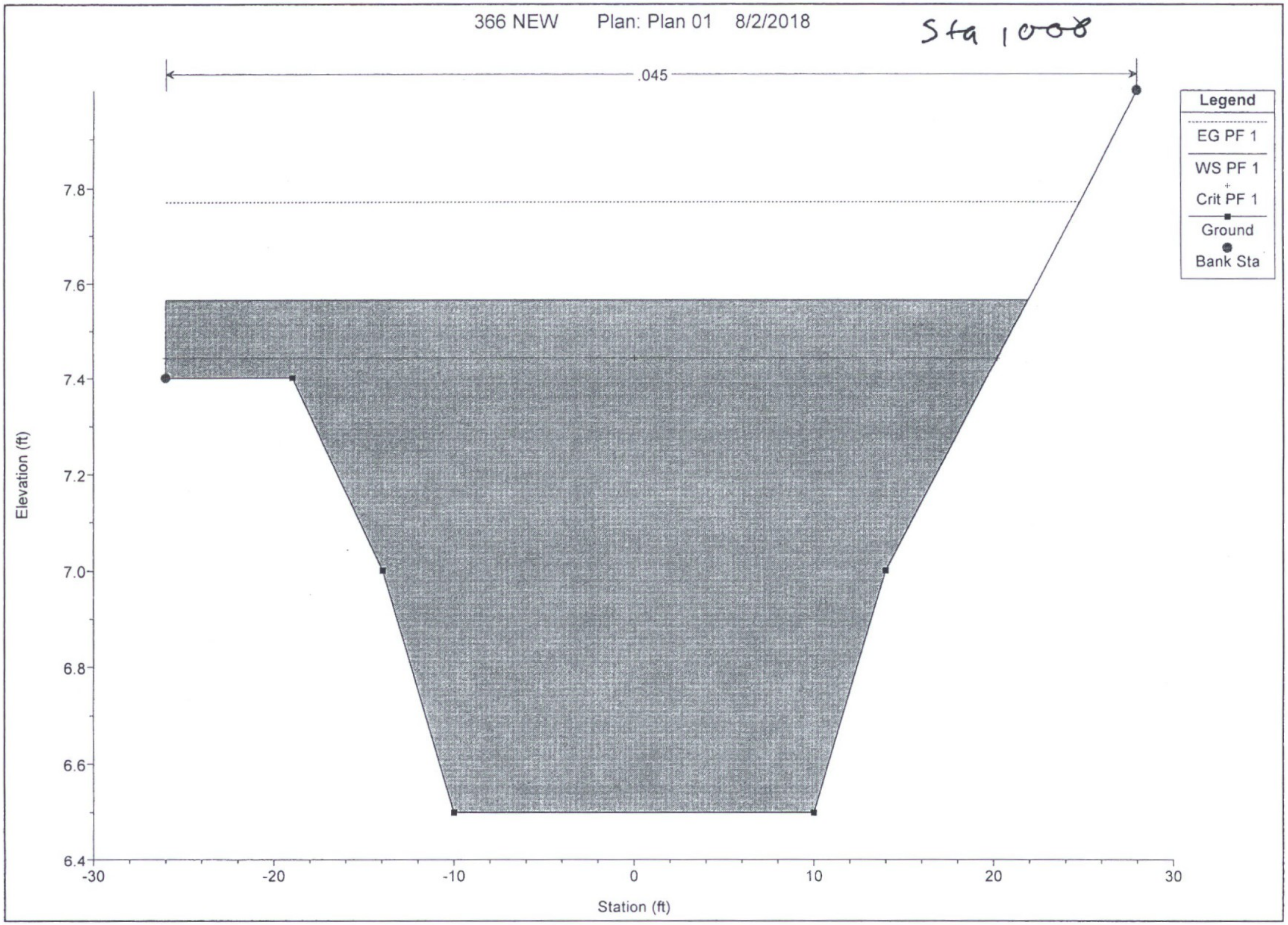
30



366 NEW Plan: Plan 01 8/2/2018
Sta 1008
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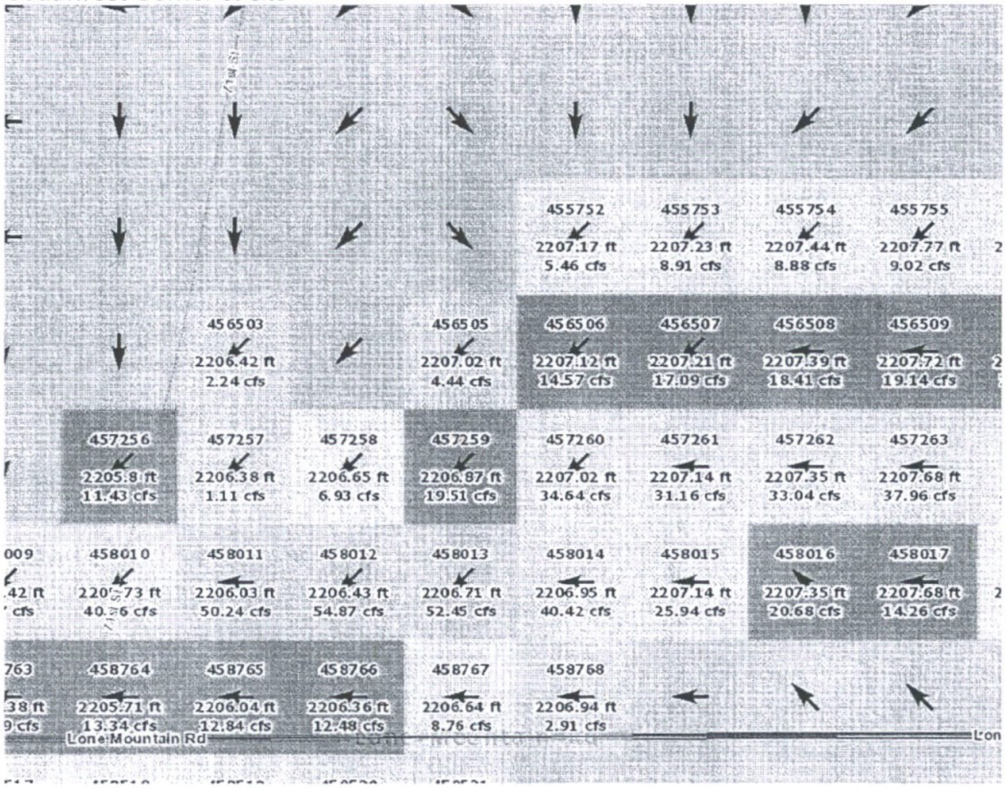
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
7.8
7.6
7.4
7.2
7.0
6.8
6.6
6.4
-30
-20
-10
0
10
20
30
Station (ft)

Figure 5 County Flo 2d data

Southwest Corner of site



Northeast Corner of site

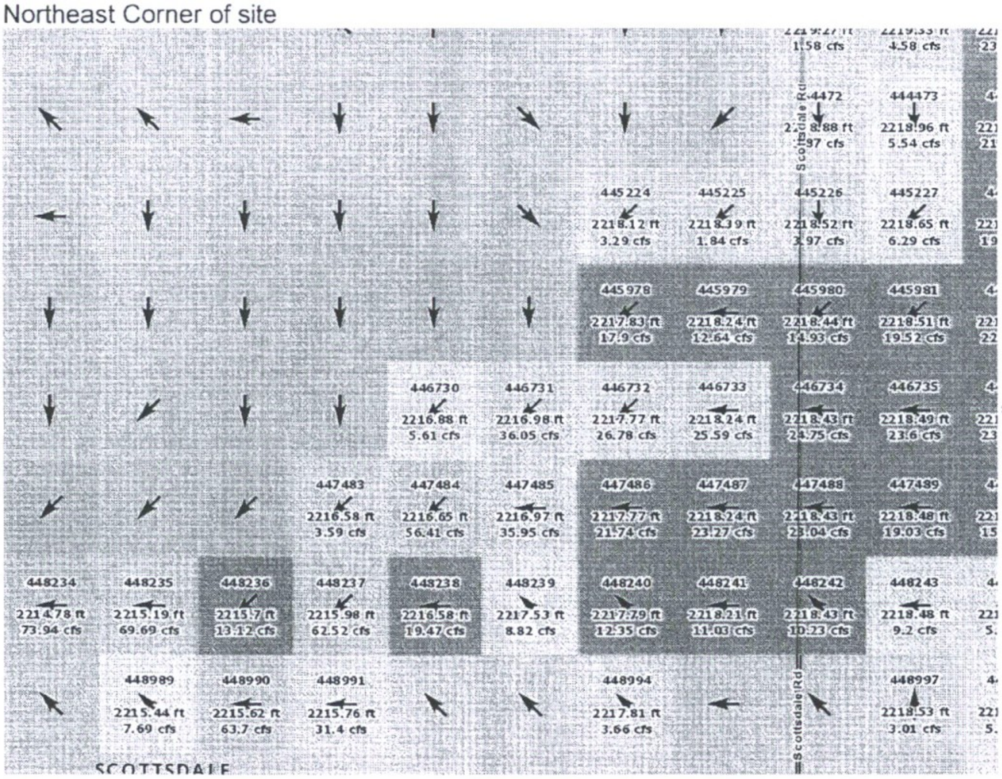


Figure 6 - Prelim GD plan

PRELIMINARY GRADING / DRAINAGE PLAN

INTERNALIZED COMMUNITY SELF STORAGE
SCOTTSDALE / LONE MTN RD
SCOTTSDALE, AZ

A PORTION OF THE SOUTHEAST QUARTER OF SECTION 15, TOWNSHIP 5 NORTH, RANGE 4 EAST, OF THE GILA & SALT RIVER MERIDIAN, MARICOPA COUNTY, ARIZONA

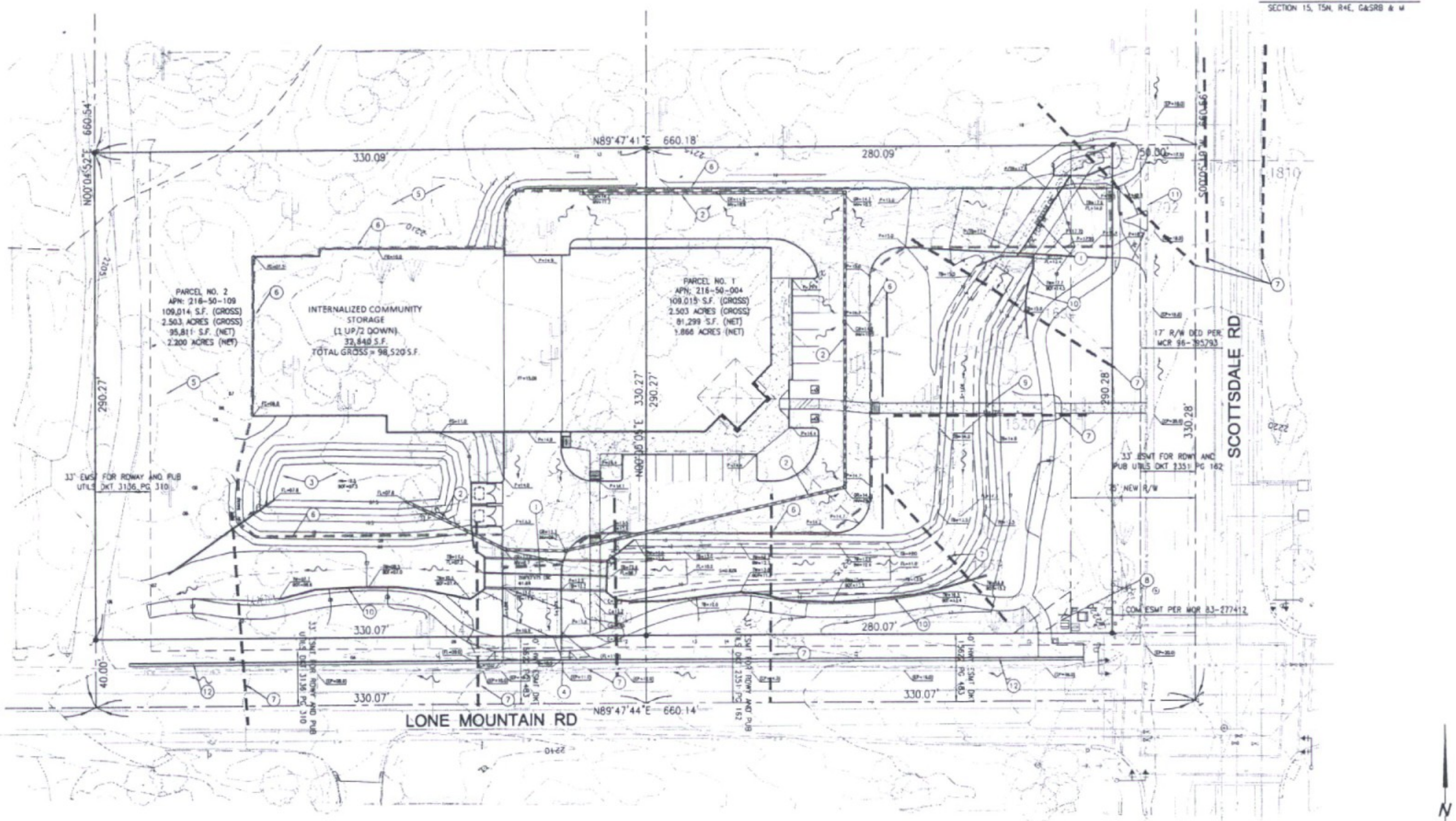
ENGINEER :

HELIX ENGINEERING, LLC
3240 E. UNION HILLS DR
SUITE 112
PHOENIX, ARIZONA 85050
TEL (602) 788-2616
CONTACT: STEVE BOWSER

KEYED NOTES

1. 3'X8' TWO BARREL BOX CULVERT
2. 18" ONSITE STORM DRAIN
3. 3' DEEP BASIN
4. DRIVEWAY PER COS STD DET 2250
5. UNDISTURBED AREA
6. ONSITE CONTRIBUTING AREA
7. HEC-RAS SECTIONS
8. NEW CORNER DEDICATION
9. SIDEWALK CROSSING BY CULVERT OR BRIDGE
10. RETAINING WALL
11. ASPHALT DRIVEWAY WITH 25' RADIUS (RIGHT IN) AND 15' RADIUS (RIGHT OUT). DIVERTER TO BE RAISED ROLL CURB ISLAND
12. NEW VERTICAL CURB ALONG LONE MTN

VICINITY MAP
SECTION 15, T5N, R4E, G&SRB & M



CLIENT:
RKAA Architects, Inc
2233 East Thomas Rd
Phoenix, AZ 85016
(602) 955-3900

Helix Engineering, LLC
Engineering / Surveying / Consulting
3240 E Union Hills
Suite 112
Phoenix AZ 85050
602-788-2616
www.hseng.com

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BLUE STAKE CENTER

RELEASE	
DATE	
6-21-18	PRELIM ENGR
7-30-18	REV SP
8-2-18	REV SP

REVISIONS		
NO.	DATE	
1		
2		
3		

PROJECT NAME

PROJECT ADDRESS
SCOTTSDALE / LONE MTN
SCOTTSDALE, ARIZONA

PROJECT AREA
SCOTTSDALE / LONE MTN

HELIX JOB NUMBER: 325
IN HOUSE: DRAWN BY: MT; CHECKED BY: SB

SHEET TITLE
G / D PLAN

SHEET
PAGE 1 OF 1

PLOT SCALE: 1:1 @ 24"x36"; 1:2.2 @ 11"x17"

COS 2-GP-2018 8-24-2018

PRELIMINARY

Water Basis of Design

For

Storage Facility

Northwest corner of Scottsdale Rd / Lone Mtn

Scottsdale, AZ

Case Numbers:
Plan Check Number:
Job: 366
June 2018

Accepted As Noted
As Preliminary BOD.
City of Scottsdale
Water Resources Administration
9379 E. San Salvador
Scottsdale, AZ 85258
HRahman.
06/06/2018.

Prepared for:

RKAA

Prepared by:

Steve Bowser, PE
Helix Engineering, LLC
3240 E. Union Hills Dr #112
Phoenix, AZ 85050
602-788-2616
sb@hxeng.com

Registered Professional Engineer (Civil)
CERTIFICATE NO.
30489
STEVEN R.
BOWSER
Date Signed 11-20-...
ARIZONA U.S.A.

EXPIRES 9-30-20

Water Basis of Design
FOR
Storage Facility
Northwest corner of Scottsdale Rd / Lone Mtn
Scottsdale, Arizona

A. INTRODUCTION

B. DESIGN DOCUMENTATION

C. EXISTING CONDITIONS

D. PROPOSED CONDITIONS

E. COMPUTATIONS

F. SUMMARY

G. SUPPORTING MAPS / REFERENCES

A. Introduction

The proposed site is located at the Northwest corner of Scottsdale Rd. and Lone Mtn in the City of Scottsdale, Arizona. The site is situated within the Southeast quarter of Section 15, Township 5 North, Range 4 East of the Gila and Salt River Base and Meridian, Maricopa County, Arizona. The site is an undeveloped site with no site improvements other than existing streets on the east and south side of the property. restaurant building with parking on all sides. This project fronts on Scottsdale Road and Lone Mtn.

B. Design Documentation

Project will be analyzed using the design criteria from the DSPM. Water demand of 0.6 gal per sf per day for office uses for the approx 3600 SF office. The only area within the project that generates water demand is the office area. Peak factor per the DSPM of 2x for the Max Day Demand and 3.5x for the Peak Hr Demand will be used. The office is located on the ground level of the new building.

Final fire flow is based on IIB Building per 2015 IFC x 0.25 (6500 gpm x 0.25 = 1625 gpm). Note this flow is using the 75% reduction as this site will have an automatic sprinkler system.

EPANET version 2.00 was used for this analysis.

C. Existing Conditions

There are existing 8", 12" and 16" mains located in Lone Mtn and Scottsdale Roads. No fire hydrants are located on the frontage of this site. Water system in this area is developed and interconnected to lines within this pressure zone. This area is Pressure Zone 9. See Exhibit 3. Fire hydrants are located on the east side of Scottsdale Road.

D. Proposed Conditions

which Line? Specify Water Meter & Fire Line Size.

Site will connect to existing public mains and install a public hydrant at the Scottsdale Road Driveway.

Building is type IIB, 97,761 sf (6500 gpm) with a 75% reduction (1625 gpm fire flow).

This project is in city water zone 9 and does not abut city water zone 10. Zone 8 is short distance west.

New water meters, new public fire hydrant, and new fireline will be installed on this project.

No public main extensions are proposed.

E. Computations

Office: Average Day Demand: 0.6 gallons per SF (using 3600 SF office space) = 2160 gal per day
Max Day Demand: 2x Average Day Demand = 2 x 2160= 4320 gal per day
Peak Hour Demand: 3.5x Average Day Demand (use a conservative 10 operational day) = (3.5 x 2160) / 10 hours = 756 gal per hour (13 gpm) (flow at ground floor - location of office space) ✓

The model was run with flow the fire flow (1625 gpm). Model enclosed has the following criteria:

Main hydrant: 1625 gpm
Total System flow: 1625 gpm ✓
Per IFC B105.3 - flow required is the greater of fire flow code and the sprinkler demand + hose stream. At final design, this will be verified however given the use and relatively low hazard, fire flow code is most likely to be the controlling flow.

Mains along Scottsdale Road are slightly higher in elevation than the main floor of the site. Final fire protection designs will need to verify pressures can be provided at top floors. If required, fire protection system may require booster pump to achieve 30 psi at top floors. → Verify for Final BOD.

Lines in Scottsdale were modeled north and south points of interconnecting lines.

System assumption is that flows can be sustained for duration of required fire flow.

Results: 1625 ?
Pressure at Hydrant is calculated to be 58 PSI flowing at 1525 gpm.

Add All Model Scenarios in Final BOD per DSPM section 6-1.202.

F. SUMMARY

- This project is the construction of one storage building with one office area.
- Project will install one new fire hydrant, new domestic meter and fireline to serve internal sprinkler system.
- Fire flow (using the 75% reduction) will be 1625 gpm
- Model tested using 1625 gpm at hydrant shows 58 PSI.

G. SUPPORTING MAPS / REFERENCES

1. City of Scottsdale, Design Standards and Procedures Manual, January 2018.
2. QS Map 55-44

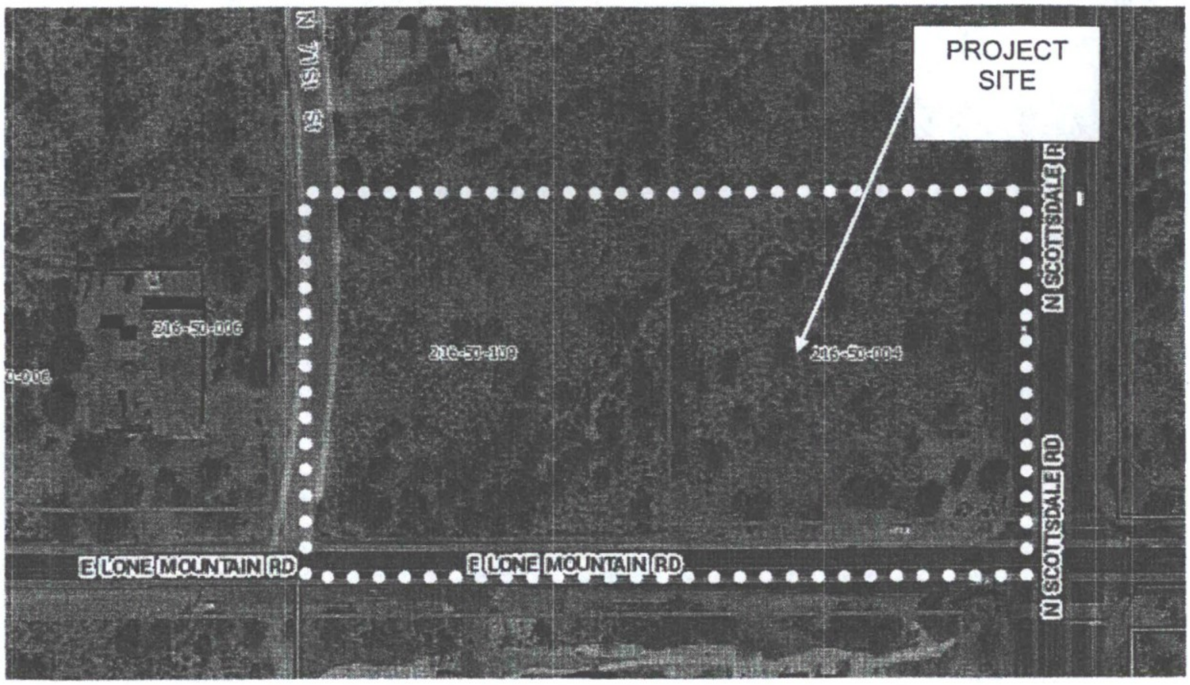


Figure 1-VICINITY MAP

Figure 2-WATER-SEWER QS MAP 55-44

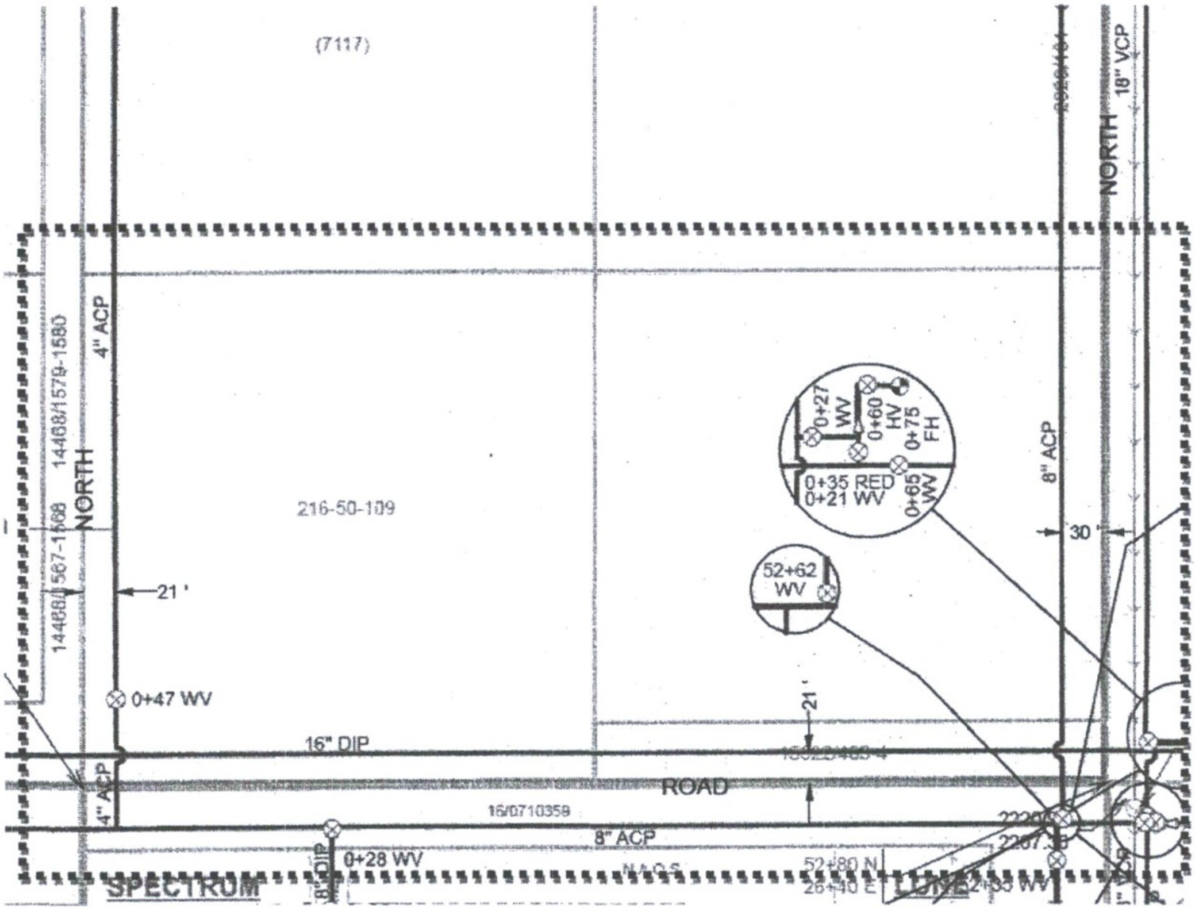


Figure 3-PRESSURE ZONE MAP

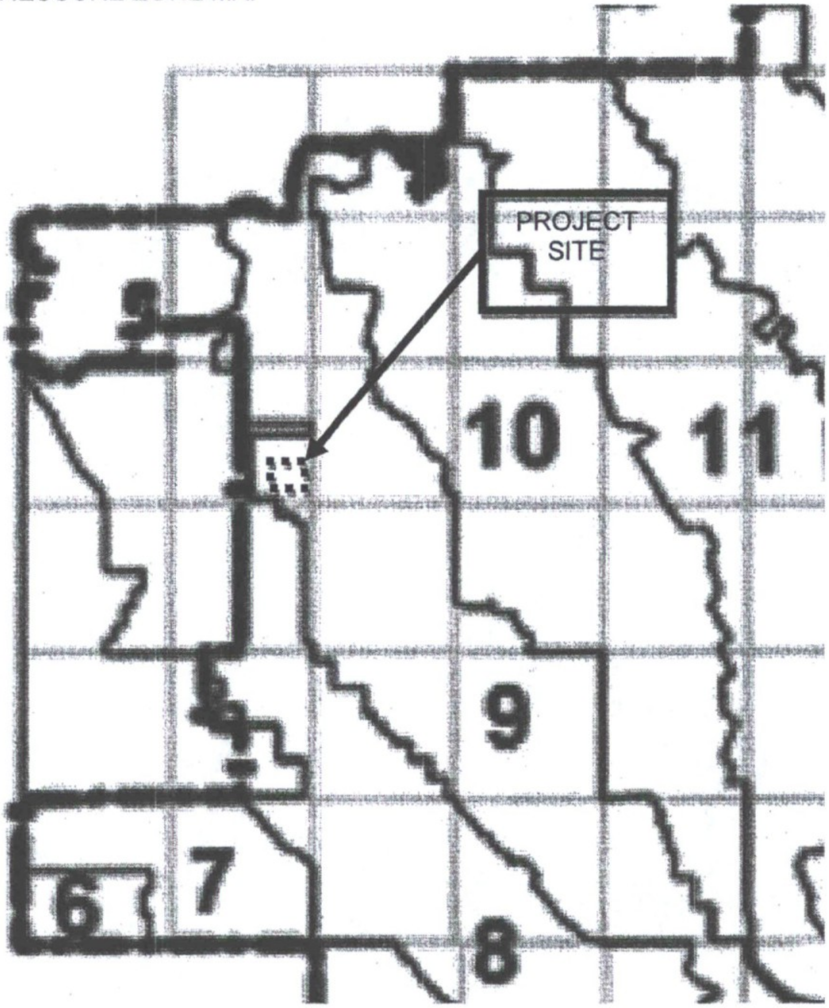
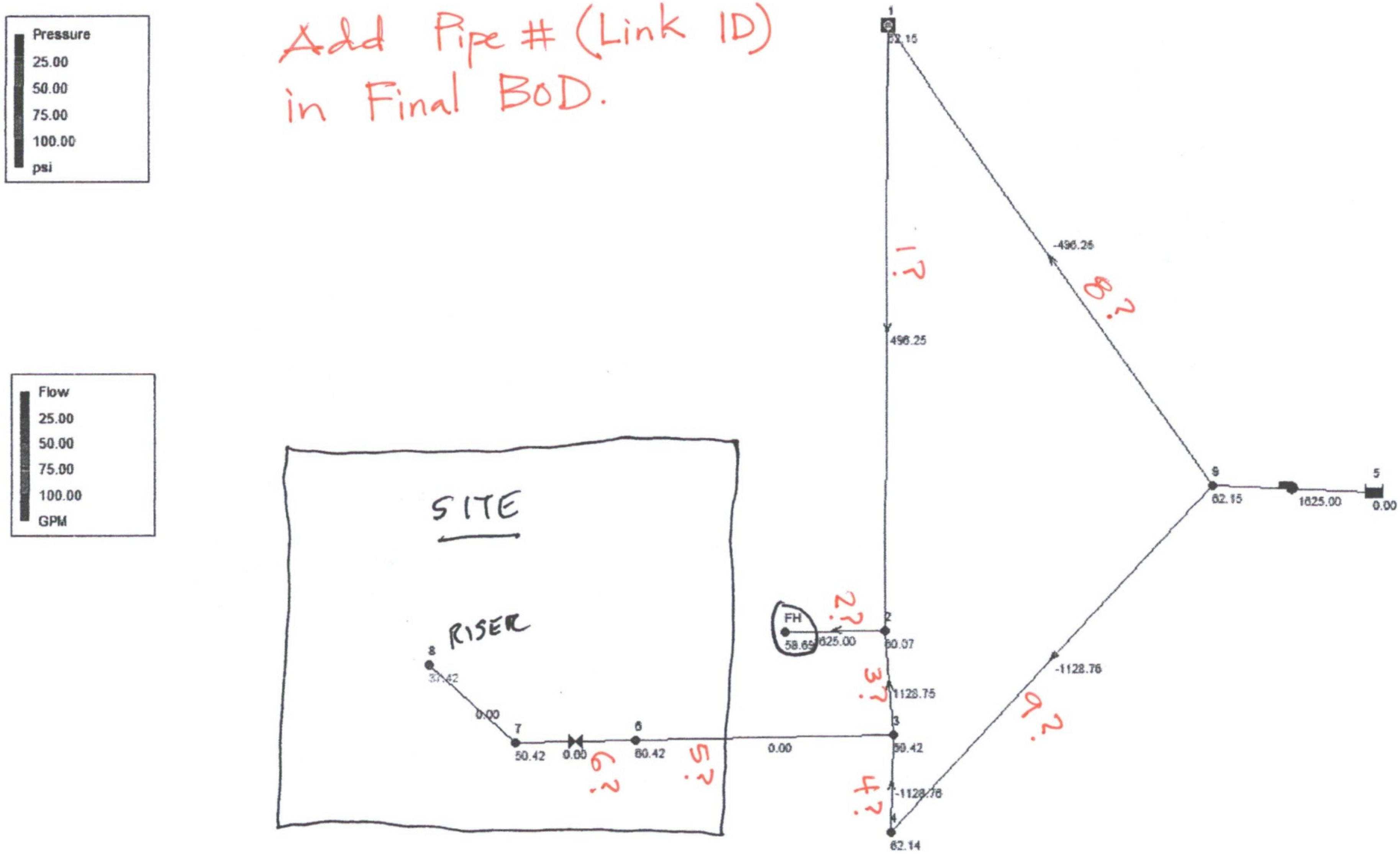


Figure 4 - WATER NETWORK CALCULATIONS


Add Pipe # (Link ID) in Final BOD.
Pressure
25.00
50.00
75.00
100.00
psi
Flow
25.00
50.00
75.00
100.00
GPM
1
62.15
1?
496.25
-496.25
8?
9
62.15
1625.00
5
0.00
SITE
RISER
FH
58.69
2?
1625.00
2
60.07
3?
1128.75
-1128.76
9?
3
59.42
4?
-1128.76
4
62.14
8
37.42
0.00
7
50.42
0.00
6?
6
60.42
5?
0.00

Network Table - Nodes

Node ID	Elevation ft	Base Demand GPM	Pressure psi
Junc 1	0	0	62.15
Junc 2	0	0	60.07
Junc 3	0	0	60.42
Junc 4	0	0	62.14
Junc FH	0	1625	58.69
Junc 6	0	0	60.42
Junc 7	0	0	50.42
Junc 8	30	0	37.42
Junc 9	0	0	62.15
Resvr 5	0	#N/A	0.00

FIRE HYDRANT

-RISER

Network Table - Links

Add Pipe Losses to the Table.

Link ID	Length ft	Diameter in	Flow GPM	Velocity fps
Pipe 1	1100	8	496.25	3.17
Pipe 2	20	6	1625.00	18.44
Pipe 3	40	8	1128.75	7.20
Pipe 4	200	8	-1128.76	7.20
Pipe 5	150	8	0.00	0.00
Pipe 7	30	6	0.00	0.00
Pipe 8	712' 1	12	-496.25	1.41
Pipe 9	494' 1	12	-1128.76	3.20
Pump 10	#N/A	#N/A	1625.00	0.00
Valve 6	#N/A	6	0.00	0.00

Incorrect Model Setup. If Two Flow Hydrants (F1 & F2) are Used For Total Flow, The pump shall be @ Residual Fire Hydrant Location and All Actual Pipe Lengths shall be Calculated from This Hydrant. Update Model in Final BOD to Reflect Fire Hydrant Test.

Figure 5 - FLOW TEST

E•J | Flow Test Summary

Project Name:	EJFT 18129
Project Address:	31400 N Scottsdale Rd, Scottsdale, AZ 85266
Date of Flow Test:	2018-06-19
Time of Flow Test:	7:30 AM ✓
Data Reliable Until:	2018-12-19
Conducted By:	Austin Gourley & Eder Cueva (EJ Flow Tests) 602.999.7637
Witnessed By:	Jim Demarbiex (City of Scottsdale) 602.541.0586
City Forces Contacted:	City of Scottsdale (602.228.2187)
Permit Number:	C55645

Note Scottsdale requires a max static pressure of 72 psi for safety factor

Raw Flow Test Data

Static Pressure:	74.0 PSI
Residual Pressure:	60.0 PSI
Flowing GPM:	3,455
GPM @ 20 PSI:	7,162

Is This Flow from F1 or from F1+F2?

Data with a 10 % Safety Factor

Static Pressure:	66.6 PSI
Residual Pressure:	52.6 PSI
Flowing GPM:	3,455
GPM @ 20 PSI:	6,614

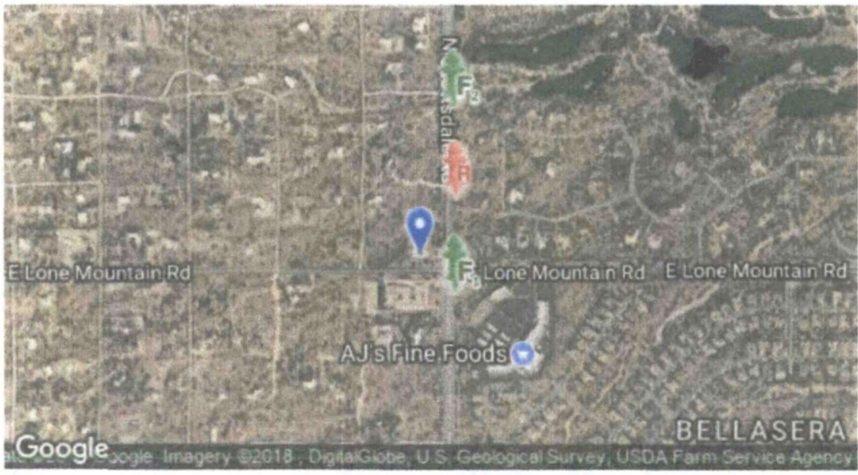
Hydrant F_1

Pitot Pressure (1):	25	PSI
Coefficient of Discharge (1):	0.9	
Hydrant Orifice Diameter (1):	2.5	inches
Pitot Pressure (2):	29	PSI
Coefficient of Discharge (2):	0.9	
Hydrant Orifice Diameter (2):	2.5	inches

Hydrant F_2

Pitot Pressure (1):	26	PSI
Coefficient of Discharge (1):	0.9	
Hydrant Orifice Diameter (1):	2.5	inches
Pitot Pressure (2):	26	PSI
Coefficient of Discharge (2):	0.9	
Hydrant Orifice Diameter (2):	2.5	inches

Distance Bet^n F1 & R Per City GIS Map is 494'.



Project Site

Static-Residual Hydrant

Flow Hydrant — F2 ?

Distance Between F_1 and R
712 ft (measured linearly)

Static-Residual Elevation
~~2223~~ ft (above sea level) — 2219.5'

Flow Hydrant (F_1) Elevation
~~2222~~ ft (above sea level) — 2220.6'

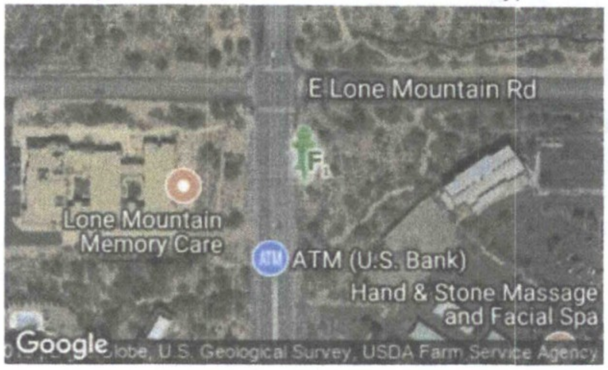
Elevation & distance values are approximate

F2 @ 2228.8'

Per City GIS Map

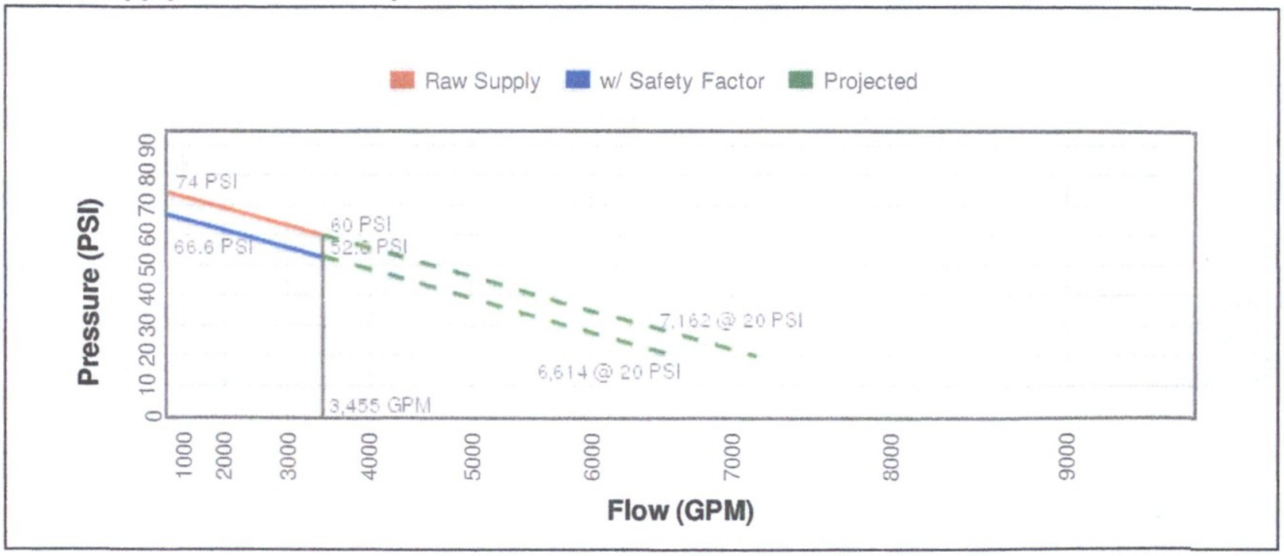
Static-Residual Hydrant

Flow Hydrant (only hydrant F1 shown for clarity)



Approximate Project Site

Water Supply Curve $N^{1.85}$ Graph



HYDFLOW Version 2.0
Hydrant Flow Test Calculations Template

Situation: Scottsdale / Lone Mtn Date: 06/20/18

HYDRANT FLOW CALCULATIONS

Supply Pressure:	66.60	
Supply Elevation:	0.00	
Test Point Static Pressure:	66.60	(No Hydrant Flow)
Test Point Elevation	0.00	
Test Point Residual Pressure:	52.60	(Hydrant Flowing)

a.	Supply HGL:	153.85
b.	Test Point Static HGL:	153.85
c.	Test Point Residual HGL:	121.51

Static Head Loss (a-b):	0
Residual Head Loss(a-c):	32.34

	Hydrant: #1	#2	#3
Flow Pressure in PSI:	25.00	29.00	26.00
Nozzle Diameter in Inches:	2.50	2.50	2.50
Calculated Flow in GPM:	839.3	903.9	855.9

Total Hydrant Flows in GPM:	3454.9

System Equivalent Base Flow in GPM:	0.0

System Base Flow Peaking Factor:	1
Source Pressure:	66.6
Source HGL	153.846

Test Point Available Flow:

Residual Pressure	HGL	Total Flow	Equiv Base Flow	Available GPM
20	46	6618	0	6618
26	60	6157	0	6157
32	73	5665	0	5665
37	87	5133	0	5133
43	100	4550	0	4550
49	113	3895	0	3895
55	127	3128	0	3128
61	140	2151	0	2151
66.6	154	0	0	0

PRELIMINARY

Sewer Basis of Design

For

Storage Facility

Northwest corner of Scottsdale Rd / Lone Mtn

Scottsdale, AZ

Case Numbers:
Plan Check Number:
Job: 366
June 2018

Accepted As Noted
As Preliminary BOD.

City of Scottsdale
Water Resources Administration
9379 E. San Salvador
Scottsdale, AZ 85258

06/06/2018.

Prepared for:

RKAA

Prepared by:

Steve Bowser, PE
Helix Engineering, LLC
3240 E. Union Hills Dr #112
Phoenix, AZ 85050
602-788-2616
sb@hxeng.com

Registered Professional Engineer (Civil)
CERTIFICATE NO.
30489
STEVEN R.
BOWSER
Date Signed 6-21-18
ARIZONA U.S.A.

EXPIRES 9-30-17

Sewer Basis of Design
FOR
Storage Facility
Northwest corner of Scottsdale Rd / Lone Mtn
Scottsdale, Arizona

C. Introduction

The proposed site is located at the Northwest corner of Scottsdale Rd. and Lone Mtn in the City of Scottsdale, Arizona. The site is situated within the Southeast quarter of Section 15, Township 5 North, Range 4 East of the Gila and Salt River Base and Meridian, Maricopa County, Arizona. The site is an undeveloped site with no site improvements other than existing streets on the east and south side of the property. restaurant building with parking on all sides. This project fronts on Scottsdale Road and Lone Mtn. ✓

D. Design Documentation

Project will be analyzed using the design criteria from the DSPM. Sewer demand of 0.4 gal per sf per day for office uses for the approx 3600 SF office. The only area within the project that generates sewer is the office area. Peak factor of 3.0 will be used. Project does not involve high peak uses (such as restaurants, hotels or condos). ✓

C. Existing Conditions

Currently, the site is undeveloped with an 18" public sewer in Scottsdale Road along the east side of the site.

D. Proposed Conditions

The building will be placed centrally in the site with the office on the east side of the site. A single 6" private sewer service will exit the building and run directly to the public main in Scottsdale Road. No part of the site is in a flood plain.

→ Will Require a Manhole to Tap to 18" Sewer per DSPM, Section 7-1.409.

E. Computations

Office Areas: 3600 SF

Average Day Sewer Demand: 0.4 gallons per SF= 1440 gal per day ✓
Peak Factor: 3x
Peak Day Demand: 3x Average Day Sewer Demand = 3 x 1440= 4320 gal per day ✓
(Peak Demand based on conservative 10 hour operational day) = **7 gpm** ✓

Proposed 6" private main at 1.04% slope capacity=**256 GPM** (0.57 CFS)

→ Is this slope Achievable?

F. Summary

- This project is the construction of single commercial storage building with a 3600 SF office.
- Office area is the only wastewater generator on the site.
- The project will connect to the existing 18" sewer main in Scottsdale Road.

G. Supporting Maps / References

1. City of Scottsdale, Design Standards and Procedures Manual, January 2018.
2. QS map 55-44

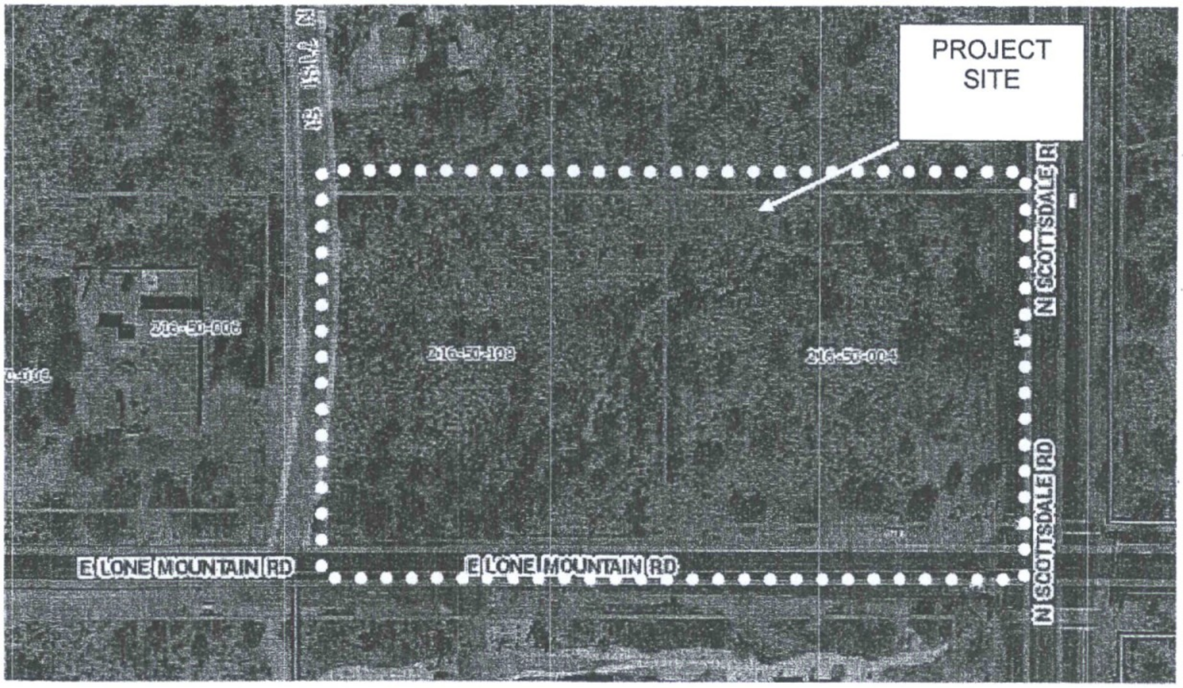


Figure 1-VICINITY MAP

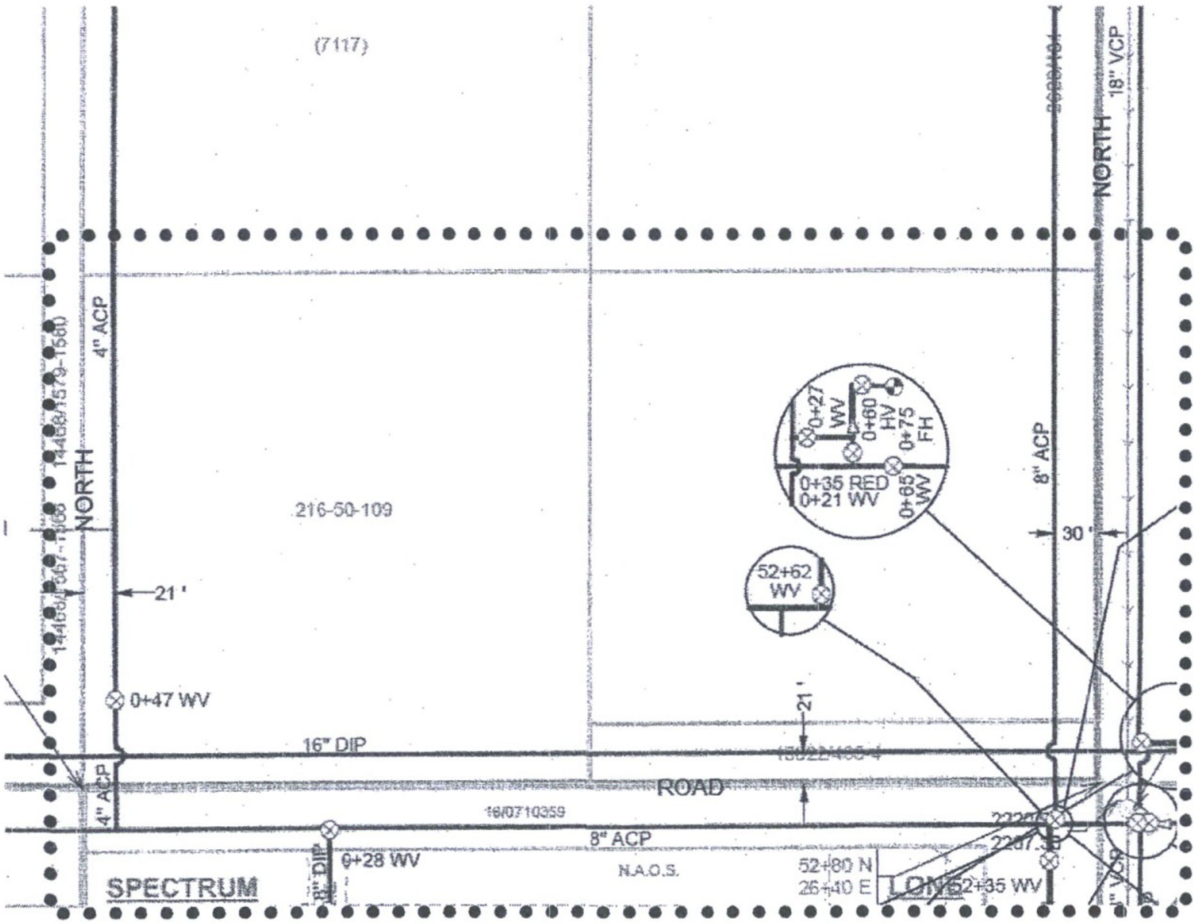


Figure 2-WATER-SEWER QS MAP (55-44)

Figure 3-SEWER CALCULATIONS

Sewer / Water Demand

SEWER

Bldg	SF	City Avg Day Demand gal per sf per day	Avg Day Demand gal per day	Peak Factor	Peak Flow gal per day	Peak Flow (based on 10 hr day) gpm	Peak Flow (based on 10 hr day) CFS
Office	3,600	0.4	1440	3.0	4320	7	0.016
Total Storage Bldg	*3,600*				*4320*	*7*	*0.016*

Note: only the office generates wastewater and the area of the office area is planned to use city criteria of 0.4 gal per sf per day.
No other areas in the project generate wastewater

0.016
Peak Flow

6" pipe at 1.04% slope capacity =	0.57	CFS
	4.3	GPS
	255.8	GPM

TRAFFIC IMPACT ANALYSIS

NWC Scottsdale Road and Lone Mountain Road
Scottsdale, Arizona

Prepared for:

RKAA Architects, Inc.

Kimley»Horn

8-ZN-2018
6/11/18

TRAFFIC IMPACT ANALYSIS

NWC Scottsdale Road and Lone Mountain Road

Scottsdale, Arizona

Prepared for:

RKAA Architects, Inc.
2233 East Thomas Road
Phoenix, Arizona 85016

Registered Professional Engineer (Civil)
CERTIFICATE NO. 19271
Charles R. Wright
DATE SIGNED 6/8/18
ARIZONA U.S.A.
Exp. 12-31-19

Charles R Wright

Prepared By:

Kimley-Horn and Associates, Inc.
7740 North 16th Street, Suite 300
Phoenix, Arizona 85020

291002005
June 2018

Kimley»Horn

Contents

Figures

Tables

1.0 EXECUTIVE SUMMARY

1.1 INTRODUCTION

This report documents a traffic impact analysis performed for a proposed self-storage facility on the northwest corner of the intersection of Scottsdale Road and Lone Mountain Road in Scottsdale, Arizona. The site will include a mini-warehouse facility and is anticipated to be built out by 2020.

1.2 REPORT PURPOSE AND OBJECTIVES

Kimley-Horn and Associates, Inc., has been retained by RKAA Architects, Inc. to perform the traffic impact analysis for the proposed development.

The purpose of this study is to address traffic and transportation impacts of the proposed development on surrounding streets and intersections. This traffic impact study was prepared based on criteria set forth by the City of Scottsdale, Category 2 Traffic Impact and Mitigation Analysis (TIMA). The specific objectives of this study are:

- To provide a trip generation comparison of the proposed development plan versus allowed development under current zoning;
- To evaluate lane requirements on all existing roadway links and at all existing intersections within the study area;
- To determine future level of service (LOS) for all existing intersections within the study area and recommend any capacity-related improvements;
- To determine necessary lane configurations at all new driveways within the proposed development in order to provide acceptable future levels of service;
- To evaluate the need for auxiliary lanes at all study area intersections; and
- To evaluate the need for future traffic signals.

1.3 PRINCIPAL FINDINGS AND RECOMMENDATIONS

The proposed development is expected to generate 140 daily trips, with 11 trips occurring in the AM peak hour and 15 trips occurring in the PM peak hour. To ensure that the estimate of the traffic impacts is the maximum that can be expected, it is assumed that the site will be 100 percent occupied upon buildout in 2020.

- The trip generation comparison of the proposed development plan versus allowed development under current zoning shows a slight increase in trip generation. The trip generation change is not expected to significantly impact traffic conditions.
- The signalized intersection and site driveways and are expected to operate at an acceptable LOS in 2020.

- In order to provide smooth ingress and egress to the proposed development, all site driveways should be constructed with appropriate throat lengths.
- It is recommended that sight triangles be provided at all site access points to give drivers exiting the site a clear view of oncoming traffic. The landscaping within sight triangles must not obstruct drivers' views of the adjacent travel lanes.

2.0 PROPOSED DEVELOPMENT

2.1 SITE LOCATION

The proposed development, a self-storage mini-warehouse, is located on the northwest corner of the intersection of Scottsdale Road and Lone Mountain Road in Scottsdale, Arizona. The project location is shown in **Figure 1**.

2.2 LAND USE AND SITE PLAN

The overall development consists of a self-storage mini-warehouse. The proposed development will occupy two parcels with existing R1-70 zoning. The proposed zoning for the site is C-1. The total site area is on approximately 5.0 acres. **Table 1** illustrates the land use of the proposed development.

Table 1. Land Use

General Description	ITE Land Use	Size
Mini-Warehouse	151	775 Storage Units

The layout of the site is illustrated in **Figure 2**.

2.3 SITE ACCESSIBILITY

The site is accessed locally via Scottsdale Road and Lone Mountain Road. Regional access is expected to be provided by the other arterial streets in the vicinity such as 56th Street, Pima Road, and Dixileta Drive.

2.4 SITE CIRCULATION

The site plan is shown in previously referenced **Figure 2**. The site consists of two driveways; Driveway D1 is proposed as a full-access driveway onto Lone Mountain Road approximately 440 feet west of Scottsdale Road. Driveway D2 is proposed as a full-access driveway onto Scottsdale Road approximately 310 feet north of Lone Mountain Road.

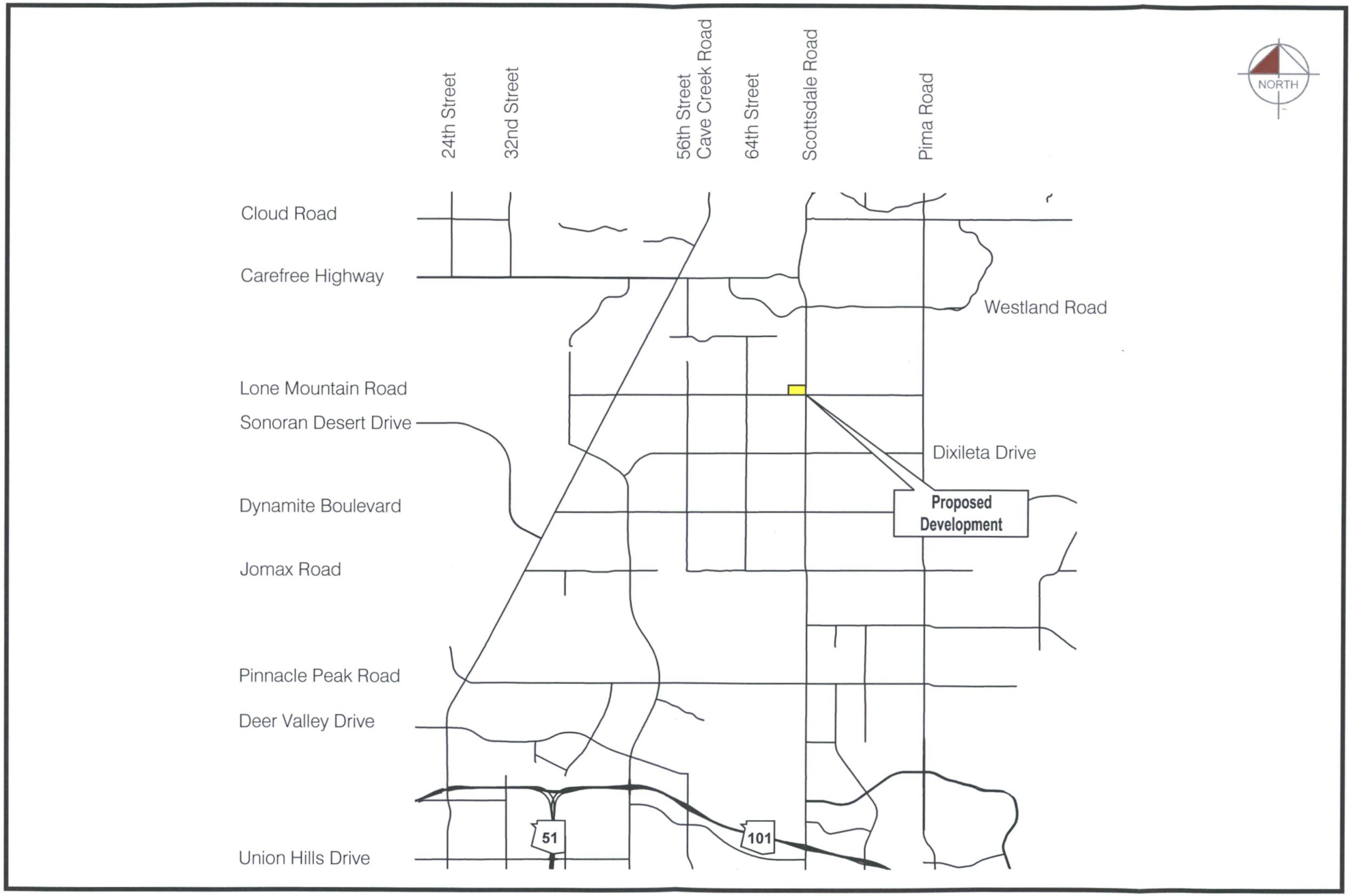


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Figure 1
Vicinity Map

June 2018

NWC Scottsdale Road and Lone Mountain Road | Traffic Impact Analysis

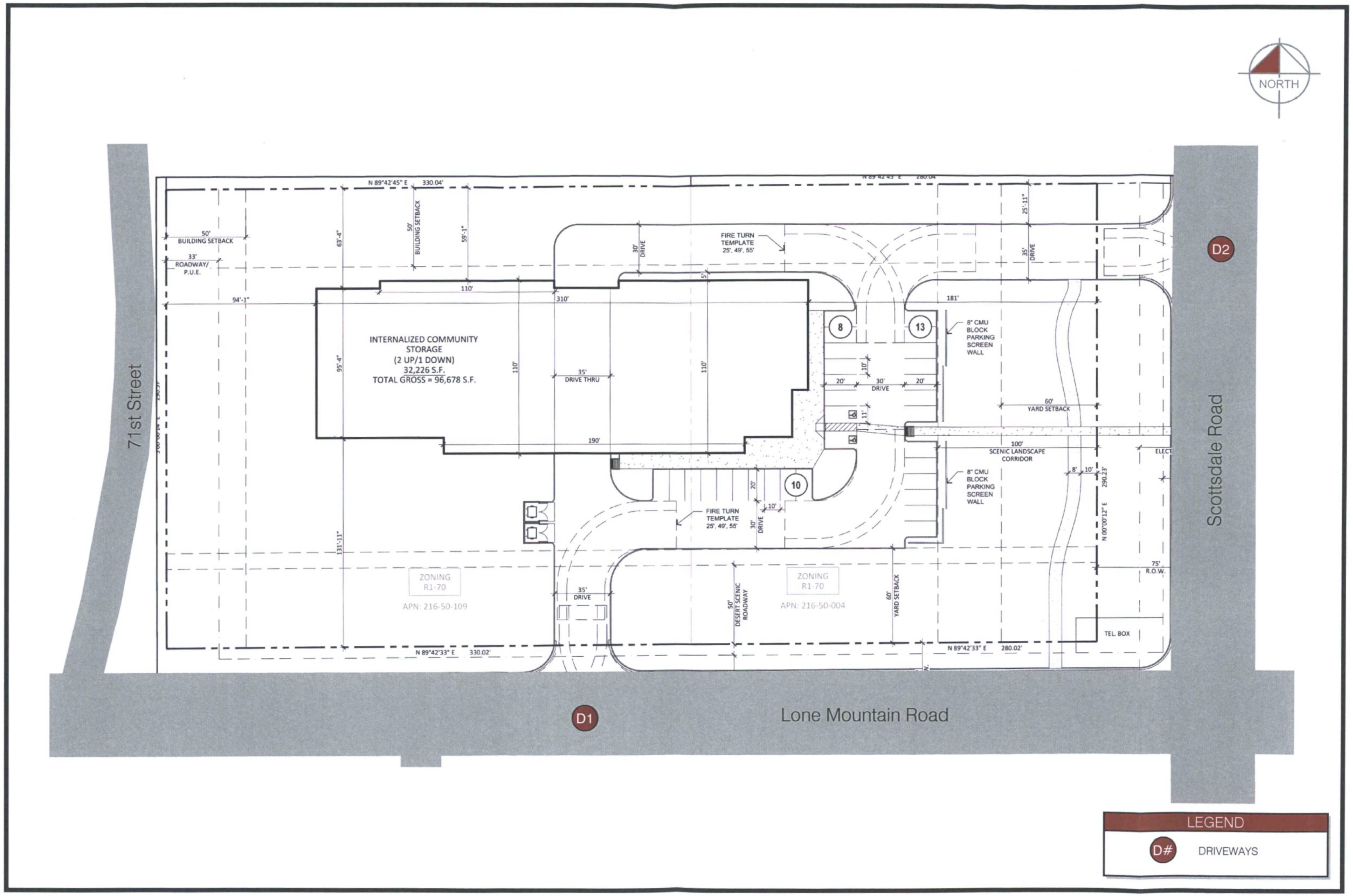

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Figure 2
Site Plan

3.0 STUDY AREA

3.1 STUDY AREA

The study area includes the intersection of Scottsdale Road with Lone Mountain Road as well as the site driveways along Scottsdale Road and Lone Mountain Road.

3.2 ADJACENT LAND USE

The area in the vicinity of the site contains a mix of land uses that is comprised primarily of residential, retail, and recreational land use types. A memory care facility is located immediately south of the site on the southwest corner of Scottsdale Road and Lone Mountain Road. A mix of retail development occupies the southeast corner of the intersection. Residential land uses and a golf course occupy the northeast corner of the intersection of Scottsdale Road and Lone Mountain Road. The majority of the surrounding land uses are primarily comprised of single-family residential.

4.0 EXISTING CONDITIONS

4.1 PHYSICAL CHARACTERISTICS

The existing roadway network within the study area includes Scottsdale Road and Lone Mountain Road. The existing intersection lane use and traffic control is shown in **Figure 3**.

Scottsdale Road currently extends north-south with two lanes in each direction in the vicinity of the site. Scottsdale Road extends approximately 2 miles north of Lone Mountain Road to Carefree Highway where it turns into Tom Darlington Drive. Tom Darlington Drive extends approximately 2 miles north of Carefree Highway to Cave Creek Road. The City of Scottsdale classifies Scottsdale Road as a minor arterial in the vicinity of the site, and the posted speed limit is 50 miles per hour in both directions.

Lone Mountain Road currently extends east-west with one lane in each direction and a two-way left turn lane in the vicinity of the site. The City of Scottsdale classifies Lone Mountain Road as a minor collector, and the posted speed limit is 45 miles per hour in both directions.

The existing intersection analyzed in this report is Scottsdale Road/Lone Mountain Road (signalized) with protected-permitted left turn phasing for the northbound and southbound approaches and permitted left turn phasing for the eastbound and westbound approaches.

4.2 TRAFFIC VOLUMES

Turning movement counts were collected at the intersection of Scottsdale Road/Lone Mountain Road on Wednesday, May 30, 2018. The counts were performed between 7:00 AM and 9:00 AM and between 4:00 PM and 6:00 PM. The results of these counts are shown in **Figure 3**. A copy of the counts is attached in the **Appendix**.

In addition to peak hour turning movement counts, 24-hour bidirectional volume counts were performed along Scottsdale Road north of Lone Mountain Road and along Lone Mountain Road west of Scottsdale Road on Wednesday, May 30, 2018. A copy of the counts is attached in the **Appendix**.

The City of Scottsdale provides monthly adjustment factors of 1.01 for May and 1.03 for June. Because the data was collected on May 30th, a seasonal adjustment factor of 1.02 was applied to the existing turning movement and ADT counts to account for seasonal variability. The seasonally adjusted volumes were used with this analysis. The City of Scottsdale monthly adjustment factors and the adjusted existing volume figure are included in the **Appendix**.

4.3 LEVEL OF SERVICE

The LOS at the intersection of Scottsdale Road and Lone Mountain Road was evaluated using the traffic counts collected on Wednesday, May 30, 2018. The LOS for the intersection was evaluated using the *Highway Capacity Manual 6th Edition* methodology for signalized intersections. The signalized intersection was evaluated using the existing signal timing data provided by the City of Scottsdale. LOS analysis worksheets and signal timing assumptions are included in the **Appendix**. The existing intersection geometry and control, shown in **Figure 3**, was used to obtain the LOS. The results of this analysis are shown in **Table 2**.

Table 2. Existing Level of Service: Signalized Intersection

Intersection	NB			SB			EB			WB			Intersection
	L	T	R	L	T	R	L	T	R	L	T	R	LOS
Scottsdale Road and Lone Mountain Road													
AM Peak	A	A	A	A	B		C	C	C	C	C	C	B
PM Peak	A	B	A	A	B		D	C	C	C	C	C	B

The signalized intersection of Scottsdale Road and Lone Mountain Road operates at an acceptable LOS.

4.4 CRASH DATA

Crash data at the intersection of Scottsdale Road and Lone Mountain Road was obtained from the City of Scottsdale for February 2013 through February 2018. The crash data is included in the **Appendix**.

Based on the crash data obtained from the City of Scottsdale, there were 54 crashes reported at the intersection of Scottsdale Road and Lone Mountain Road over the five year period. There were seven possible injuries and eight non-incapacitating injuries. One crash was a single vehicle, thirteen were front to side angle crashes, twelve were left turn crashes, eighteen were rear end crashes, two were head on crashes, seven were sideswipe crashes, and one crash was categorized as other.

No collisions were reported on the segment of Scottsdale Road between Lone Mountain Road and Ashler Hills in 2014. The 2014 average segment collision rate was 1.35 collisions per million vehicle miles in the City of Scottsdale. The crash data indicates that the number of collisions along the Scottsdale Road roadway segment is below the historical, citywide average crash rate.

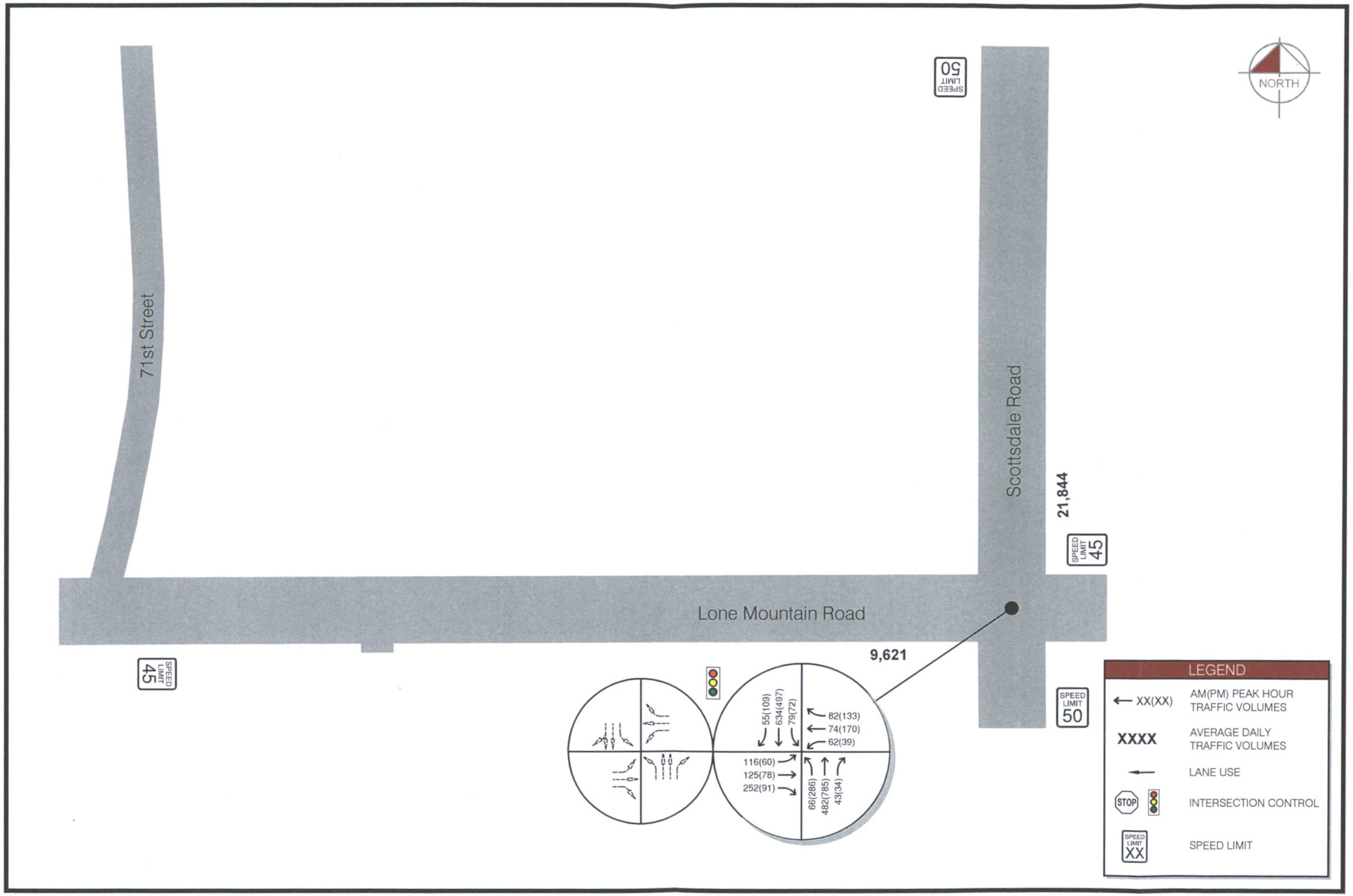

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Figure 3
Existing Condtions

5.0 PROJECTED TRAFFIC

5.1 SITE TRAFFIC FORECASTS

5.1.1 TRIP GENERATION

The Institute of Transportation Engineers' (ITE) *Trip Generation, 10th Edition,* was used to obtain daily and peak-hour trip generation rates and inbound-outbound percentages, which were then used to estimate the number of daily and peak hour trips that can be attributed to the proposed development. The trip generation characteristics of the site are summarized in **Table 3**.

Table 3. Project Trip Generation

Land Use	ITE Code	Quantity	Units	Daily Total	AM Peak			PM Peak		
					In	Out	Total	In	Out	Total
Mini-Warehouse	151	775	Storage Units	140	6	5	11	8	7	15
Total Trips				**140**	**6**	**5**	**11**	**8**	**7**	**15**

The proposed development is expected to generate 140 daily trips, with 11 trips occurring in the AM peak hour and 15 trips occurring in the PM peak hour.

Under the existing R1-70 zoning, single-family residential could be developed on the two vacant parcels. A trip generation comparison of a potential land use under the existing zoning and the proposed development under C-1 zoning is summarized in **Table 4**.

Table 4. Trip Generation Comparison

Land Use	ITE Code	Quantity	Units	Daily Total	AM Peak			PM Peak		
					In	Out	Total	In	Out	Total
Mini-Warehouse	151	775	Storage Units	140	6	5	11	8	7	15
Single-Family Detached Housing	210	2	Dwelling Units	20	0	1	1	1	1	2
Trip Generation Change				**120**	**6**	**4**	**10**	**7**	**6**	**13**

The calculations indicate that the proposed land use may increase daily trips by as much as 120 trips. During the AM peak hour, the proposed development may increase trip generation by 10 trips; during the PM peak hour, the trip generation may increase by 13 trips when compared to an existing potential use for the site. The increase in trip generation is not expected to significantly impact traffic conditions in the vicinity of the site.

5.1.2 TRIP DISTRIBUTION

Daily trips were distributed based on the Maricopa Association of Governments' (MAG) estimate of total households within a 7-mile radius of the site and distributed over the cardinal directions. This radius is based on the average trip length for other family/personal errands as discussed in the *2009 National Household Travel Survey*.

Percent to and from:	2015	2040
North	17 %	12 %
East	14 %	13 %
South	40 %	44 %
West	29 %	31 %

The results of this distribution are used as a basis for determining the ultimate trip distribution for the self-storage site. In addition to the MAG projected trip distribution, the ultimate surrounding roadway system also is taken into consideration when trip distribution is determined; therefore, the distribution shown above was further refined by considering the future roadway network near the site. **Figure 4** illustrates the trip distribution for the study area.

5.1.3 TRAFFIC ASSIGNMENT

Trips generated by the proposed development were assigned to the roadway network on the basis of the trip distribution and the likely travel patterns to and from the site. **Figure 5** shows the results of the traffic assignment.

5.2 FUTURE TRAFFIC FORECASTING

The background traffic volumes for the buildout year 2020 were calculated based on 2018 traffic counts, the monthly adjustment factor, and the calculated annual traffic growth rate. The 2018 ADT counts were collected on Wednesday, May 30, 2018. A seasonal adjustment factor of 1.02 was applied to the traffic counts to account for the seasonal variability of traffic volumes.

The 2030 Lone Mountain Road ADT is from the City of Scottsdale Transportation Master Plan, and the 2035 Scottsdale Road volume projection was provided by the City of Scottsdale. The traffic volume data is included in the **Appendix**. **Table 5** shows the closest available average daily traffic (ADT) volumes in the vicinity of the site and the corresponding growth rate.

Table 5. Traffic Growth

Roadway	2018 ADT (vehicles per day, both directions)	2030/2035 ADT (vehicles per day, both directions)	Average Annual Growth
Lone Mountain Road	9,813	13,900	2.9%
Scottsdale Road	22,281	31,500	2.1%

On the basis of the above growth rates, an annual growth rate of 3.0 percent and 2.1 percent per year was applied to the existing turning movements to obtain background traffic volumes for the year 2020 for Lone Mountain Road and Scottsdale Road, respectively. The resulting 2020 background traffic volumes are shown in **Figure 6**.

5.3 TOTAL TRAFFIC

The results of the traffic assignment were added to the year 2020 background traffic volumes shown in **Figure 6** to produce total traffic volumes for the study area. These total traffic volumes are shown in **Figure 7**.

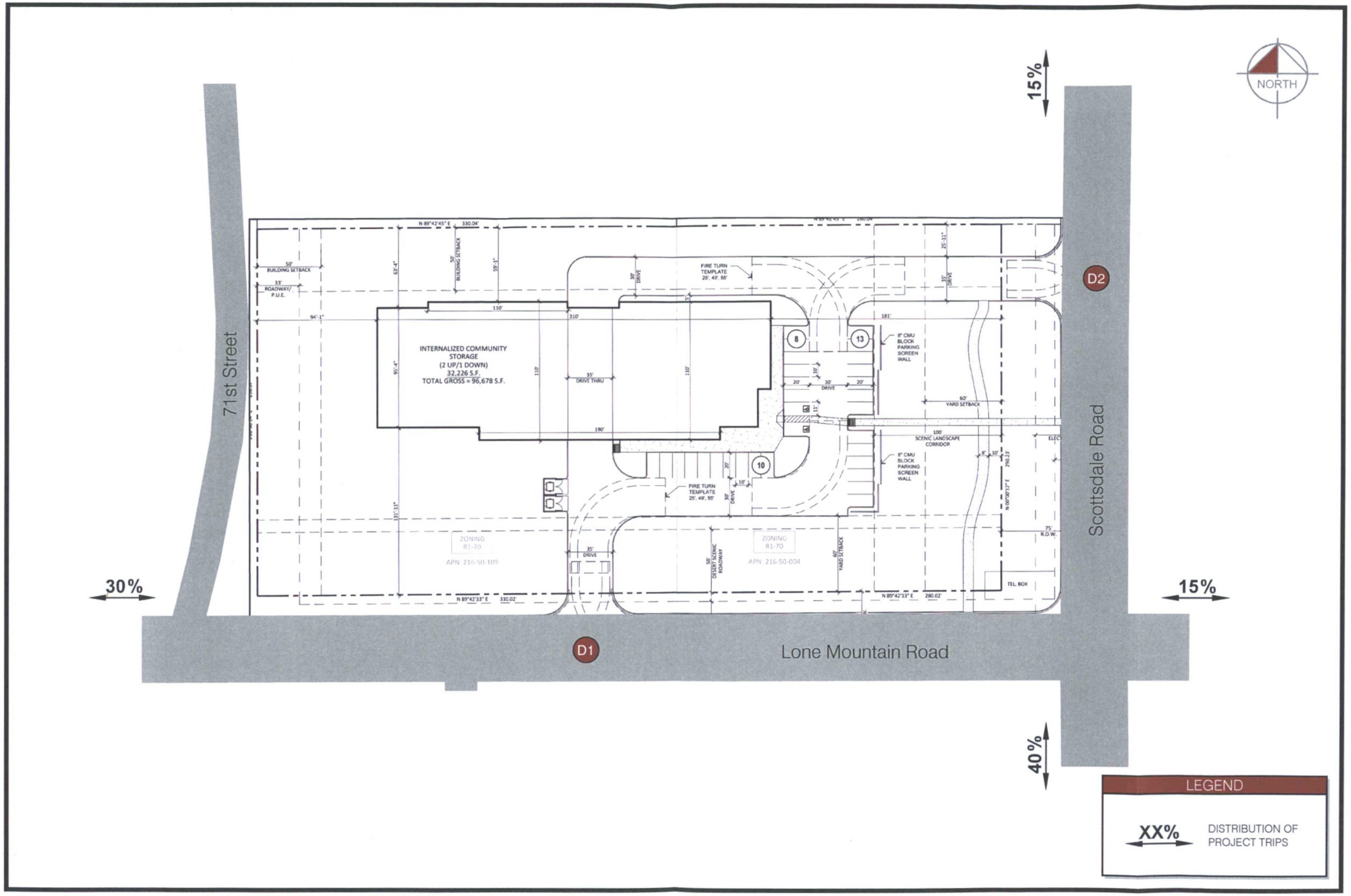

Figure 4
Trip Distribution

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June 2018

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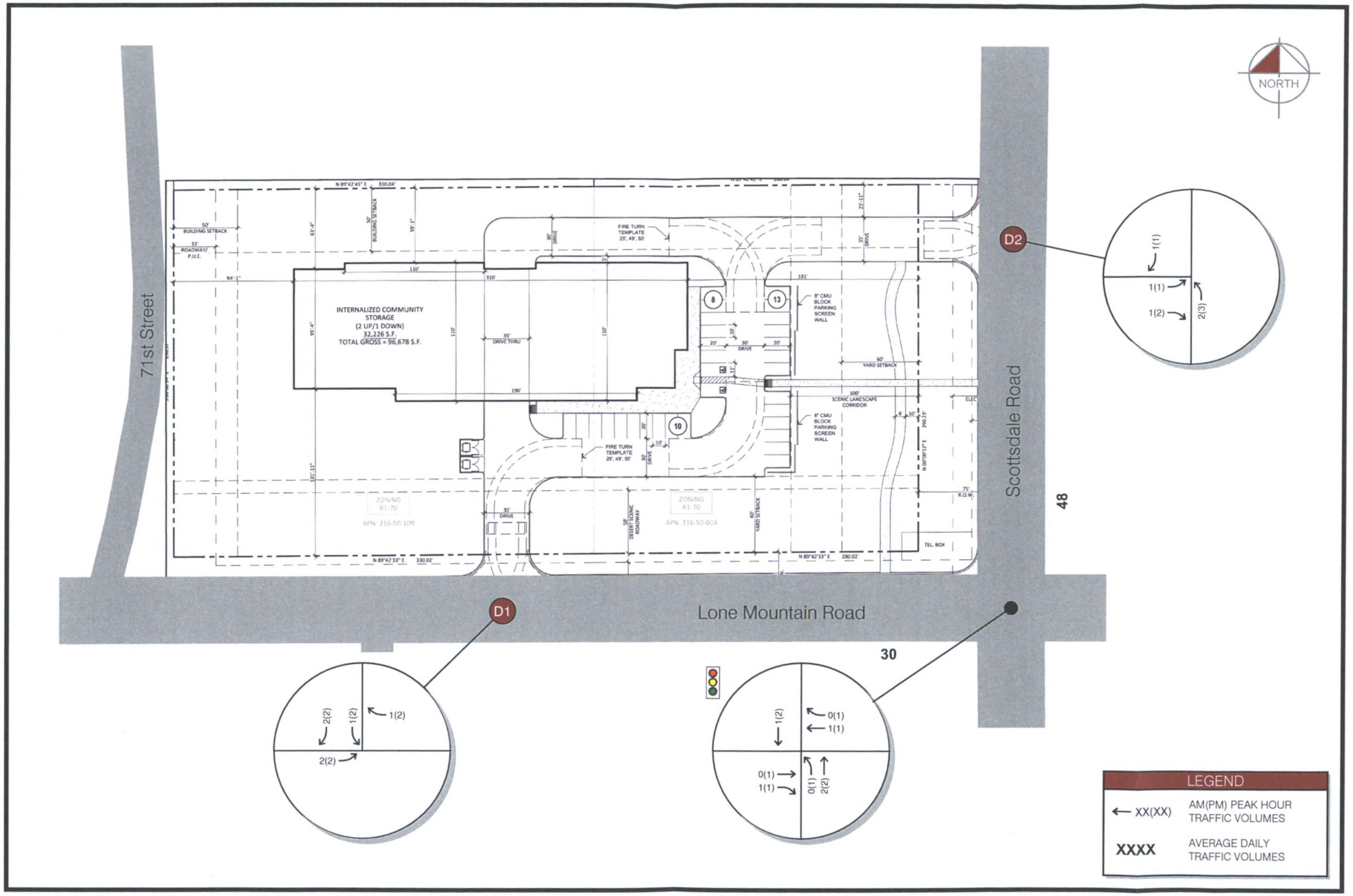

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Figure 5

Site Traffic Assignment

June 2018

NWC Scottsdale Road and Lone Mountain Road | Traffic Impact Analysis

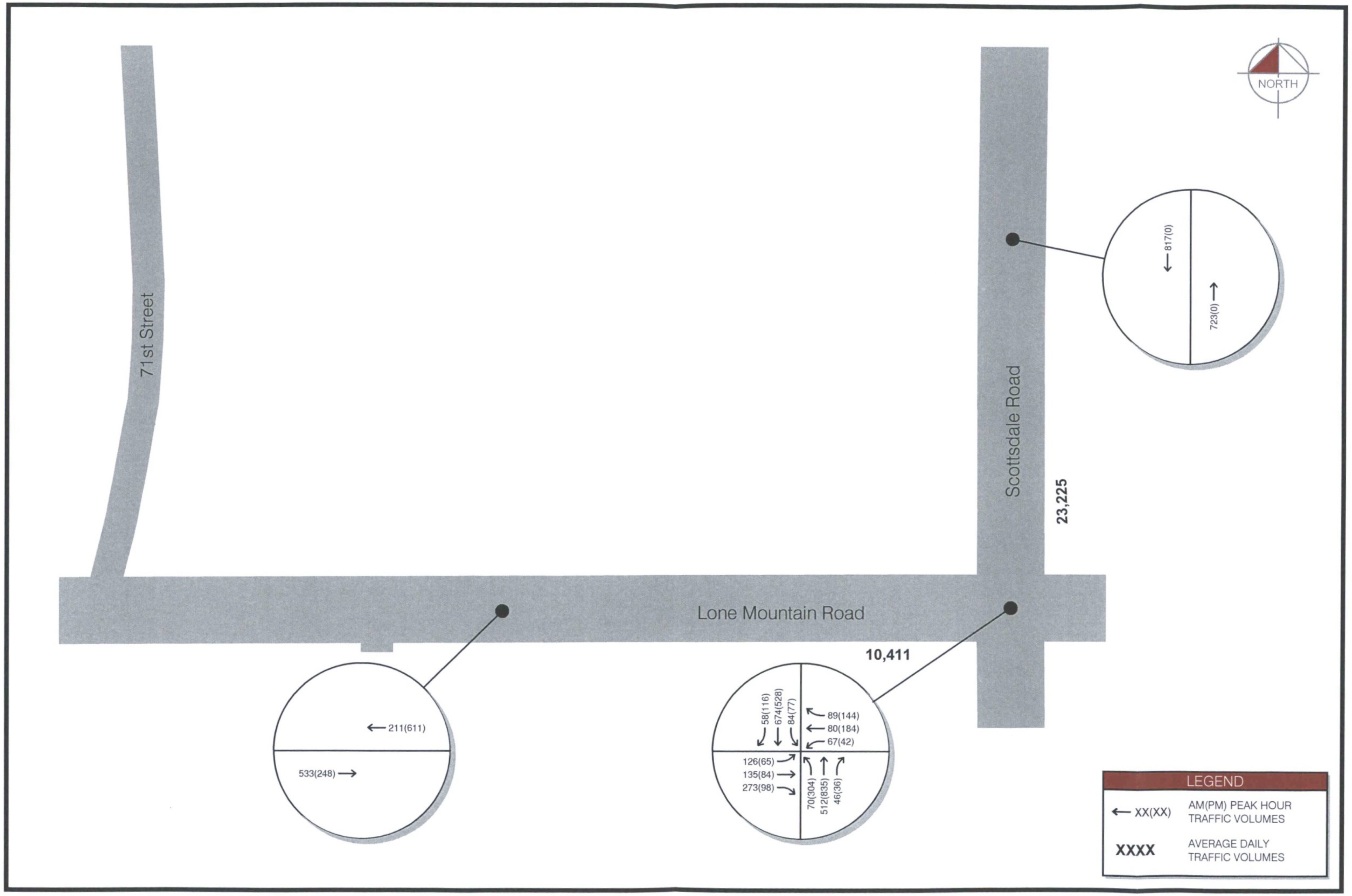
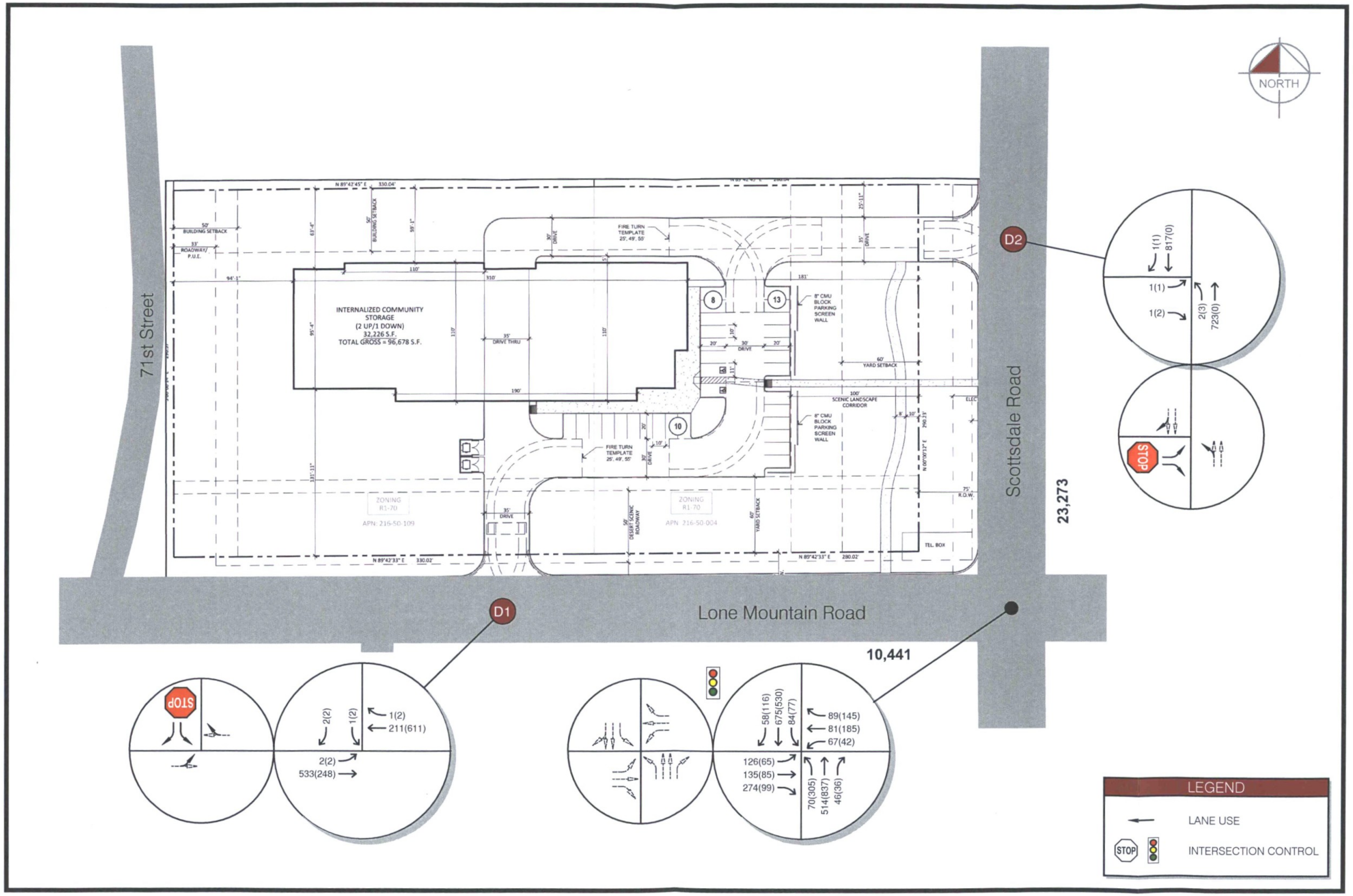


Figure 6
2020 Background Traffic



Kimley»Horn

Figure 7

2020 Total Traffic and Recommended Geometry

June 2018

NWC Scottsdale Road and Lone Mountain Road | Traffic Impact Analysis

6.0 TRAFFIC AND IMPROVEMENT ANALYSIS

6.1 LEVEL OF SERVICE ANALYSIS

The LOS for the study area intersections for 2020 was evaluated using the *Highway Capacity Manual 6th Edition* methodology for unsignalized and signalized intersections using *Synchro 10* analysis software. The signalized intersection was evaluated using the existing signal timing data provided by the City of Scottsdale. LOS analysis worksheets and signal timing assumptions are included in the **Appendix**.

6.1.1 2020 BACKGROUND TRAFFIC LEVEL OF SERVICE ANALYSIS

The signalized intersection in the study area was evaluated on the basis of the 2020 background traffic shown in **Figure 6**, and the existing geometry shown in **Figure 3**. The results of this analysis are shown in **Table 6**.

Table 6. 2020 Background Level of Service: Signalized Intersection

Intersection	NB			SB			EB			WB			Intersection
	L	T	R	L	T	R	L	T	R	L	T	R	LOS
Scottsdale Road and Lone Mountain Road													
AM Peak	A	B	A	A	B		C	C	C	C	C	C	B
PM Peak	B	B	A	B	B		D	C	C	C	C	C	B

The signalized intersection of Scottsdale Road and Lone Mountain Road is expected to operate at an acceptable LOS in 2020.

6.1.1 2020 TOTAL TRAFFIC LEVEL OF SERVICE ANALYSIS

The unsignalized intersections in the study area were evaluated on the basis of the 2020 total traffic and recommended geometry shown in **Figure 7**. The results of the analysis for the site driveways are shown in **Table 7**.

Table 7. 2020 Total Traffic Level of Service: Unsignalized Intersections

Intersection	NB			SB			EB			WB		
	L	T	R	L	T	R	L	T	R	L	T	R
Driveway D1 and Lone Mountain Road												
AM Peak		-		B	-	A	A	-	-	-	-	
PM Peak		-		B	-	B	A	-	-	-	-	
Scottsdale Road and Driveway D2												
AM Peak	A	A	-	-	-		D	-	B		-	
PM Peak	A	A	-	-	-		A	-	A		-	

The site driveways are expected to operate at a satisfactory LOS in 2020.

The signalized intersection in the study area was evaluated on the basis of the 2020 total traffic and recommended geometry shown in **Figure 7**. The results of this analysis are shown in **Table 8**.

Table 8. 2020 Total Traffic Level of Service: Signalized Intersection

Intersection	NB			SB			EB			WB			Intersection LOS
	L	T	R	L	T	R	L	T	R	L	T	R	
Scottsdale Road and Lone Mountain Road													
AM Peak	A	B	A	A	B		C	C	C	C	C	C	B
PM Peak	B	B	A	B	B		D	C	C	C	C	C	B

The signalized intersection of Scottsdale Road and Lone Mountain Road is expected to operate at an acceptable LOS in 2020.

6.2 LEFT-TURN STORAGE ANALYSIS

The signalized intersection in the study area was analyzed to determine the left-turn storage needed to accommodate the expected traffic volumes in the year 2020.

The left-turn storage lengths were determined for the left-turn movements at the study area intersections. The existing and calculated storage lengths are summarized in **Table 9**. The calculations associated with these conclusions are included in the **Appendix**. The recommended storage lengths are based on total traffic volumes shown in **Figure 7**.

Table 9. Left Turn Storage

Intersection and Approach	*Existing*	Calculated
Scottsdale Road and Lone Mountain Road		
- Northbound Approach	110 feet	275 feet
- Southbound Approach	160 feet	100 feet*
- Eastbound Approach	185 feet	125 feet*
- Westbound Approach	100 feet	100 feet*

*Calculated value less than existing.

The proposed development is not expected to significantly impact the northbound left turn lane at the Scottsdale Road and Lone Mountain Road intersection. The left turn lane has 110 feet of striped storage. There is additional pavement width available for queueing beyond the limits of the striped left turn lane. There is approximately 315 feet between the stop bar and the raised median to the south, which is anticipated to accommodate the calculated queue.

6.3 RIGHT-TURN LANES

Right-turn lanes are often recommended on roadways where right-turning vehicles create delays or safety problems for other traffic movements. The need for a right-turn lane depends on the speed of traffic on the road, the volume of traffic turning right, and the through traffic volume in the same lane as the right-turning traffic.

6.3.1 DRIVEWAY

The City of Scottsdale recommends a right-turn deceleration lane at site driveways when the following criteria is met:

- At least 5,000 vehicles per day are expected to use the street;
- The 85th percentile traffic speed on the street is at least 35 miles per hour;
- At least 30 vehicles will make right turns into the driveway during a one hour period.

Review of the 2020 total traffic volumes reveals that a right turn deceleration lane is not warranted at the site driveways.

6.4 SITE CIRCULATION

In order to provide smooth ingress and egress to the proposed development, all site driveways should be constructed with appropriate throat lengths. Provision of sufficient throat lengths at all site driveways will prevent entering vehicles from obstructing traffic flow on the adjacent public street system and provide adequate on-site storage for exiting vehicles. Based on queuing analysis for unsignalized intersections, the recommended on-site storage lengths are summarized in **Table 10**.

Table 10. On-Site Storage

Intersection and Approach	*Proposed*	Recommended
Driveway D1 and Lone Mountain Road		
- Southbound Approach	85 feet	50 feet*
Scottsdale Road and Driveway D2		
- Eastbound Approach	185 feet	50 feet*

*Calculated value less than proposed.

The internal site circulation is expected to accommodate two-way traffic.

6.5 SIGHT TRIANGLES

It is recommended that sight triangles be provided at all site access points to give drivers exiting the site a clear view of oncoming traffic. The landscaping within sight triangles must not obstruct drivers' views of the adjacent travel lanes.

7.0 CONCLUSIONS AND RECOMMENDATIONS

The proposed development is expected to generate 140 daily trips, with 11 trips occurring in the AM peak hour and 15 trips occurring in the PM peak hour. To ensure that the estimate of the traffic impacts is the maximum that can be expected, it is assumed that the site will be 100 percent occupied upon buildout in 2020.

The trip generation comparison of the proposed development plan versus allowed development under current zoning shows a slight increase in trip generation. The trip generation change is not expected to significantly impact traffic conditions.

The signalized intersection and site driveways and are expected to operate at an acceptable LOS in 2020.

In order to provide smooth ingress and egress to the proposed development, all site driveways should be constructed with appropriate throat lengths.

It is recommended that sight triangles be provided at all site access points to give drivers exiting the site a clear view of oncoming traffic. The landscaping within sight triangles must not obstruct drivers' views of the adjacent travel lanes.

APPENDIX

- Traffic Counts
- Existing Traffic Volume Figure with Adjustment Factor Applied
- Signal Timing Information
- Existing AM Traffic Capacity Analysis
- Existing PM Traffic Capacity Analysis
- Crash Data
- ADT Traffic Volume Information
- 2020 Background AM Traffic Capacity Analysis
- 2020 Background PM Traffic Capacity Analysis
- 2020 Total AM Traffic Capacity Analysis
- 2020 Total PM Traffic Capacity Analysis
- Left Turn Storage Calculations

Traffic Counts

Intersection Turning Movement
Prepared by:

FIELD DATA SERVICES OF ARIZONA, INC.
520.316.6745

veracitytrafficgroup

N-S STREET:	Scottsdale Rd.	DATE:	05/30/18	LOCATION:	Scottsdale
E-W STREET:	Lone Mountain Rd.	DAY:	WEDNESDAY	PROJECT#	18-1260-001

	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	1	2	1	1	2	0	1	1	1	1	1	1	
6:00 AM													
6:15 AM													
6:30 AM													
6:45 AM													
7:00 AM	13	79	10	10	148	10	16	26	72	5	16	7	412
7:15 AM	17	80	14	17	152	8	10	42	82	14	12	15	463
7:30 AM	12	108	8	14	167	13	25	48	86	6	16	20	523
7:45 AM	11	103	7	19	146	11	27	39	67	12	13	11	466
8:00 AM	21	116	9	18	191	8	22	25	70	17	19	11	527
8:15 AM	13	118	11	18	158	12	32	38	67	19	19	29	534
8:30 AM	16	118	10	27	152	17	29	29	70	12	25	20	525
8:45 AM	16	130	13	16	133	18	33	33	45	14	11	22	484
9:00 AM													
9:15 AM													
9:30 AM													
9:45 AM													
10:00 AM													
10:15 AM													
10:30 AM													
10:45 AM													
11:00 AM													
11:15 AM													
11:30 AM													
11:45 AM													

TOTAL	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
Volumes	119	852	82	139	1247	97	194	280	559	99	131	135	3934
Approach %	11.30	80.91	7.79	9.37	84.09	6.54	18.78	27.11	54.11	27.12	35.89	36.99	
App/Depart	1053	/	1181	1483	/	1905	1033	/	501	365	/	347	

AM Peak Hr Begins at: 800 AM

PEAK	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
Volumes	66	482	43	79	634	55	116	125	252	62	74	82	2070
Approach %	11.17	81.56	7.28	10.29	82.55	7.16	23.53	25.35	51.12	28.44	33.94	37.61	
PEAK HR. FACTOR:		0.929			0.885			0.900			0.813		0.969

CONTROL: Signal
COMMENT 1:
GPS: 32.770261, -111.925894

Intersection Turning Movement

FIELD DATA SERVICES OF ARIZONA, INC.
520.316.6745
veracitytrafficgroup

N-S STREET: Scottsdale Rd. 0
E-W STREET: Lone Mountain Rd.
DATE: 05/30/18
DAY: WEDNESDAY
LOCATION: Scottsdale
PROJECT# 18-1260-001

	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	1	2	1	1	2	0	1	1	1	1	1	1	
1:00 PM													
1:15 PM													
1:30 PM													
1:45 PM													
2:00 PM													
2:15 PM													
2:30 PM													
2:45 PM													
3:00 PM													
3:15 PM													
3:30 PM													
3:45 PM													
4:00 PM	49	188	10	20	141	28	12	17	24	18	27	28	562
4:15 PM	72	216	9	19	110	22	15	18	19	11	30	31	572
4:30 PM	54	185	5	17	141	15	20	20	26	15	25	26	549
4:45 PM	66	195	4	22	120	20	17	24	19	12	27	28	554
5:00 PM	62	180	9	18	146	26	8	16	24	6	34	37	566
5:15 PM	71	187	10	17	123	33	15	24	24	14	52	44	614
5:30 PM	87	223	11	15	108	30	20	14	24	7	57	24	620
5:45 PM	71	165	7	18	96	25	21	12	17	7	23	29	491
6:00 PM													
6:15 PM													
6:30 PM													
6:45 PM													

TOTAL	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
Volumes	532	1539	65	146	985	199	128	145	177	90	275	247	4528
Approach %	24.91	72.05	3.04	10.98	74.06	14.96	28.44	32.22	39.33	14.71	44.93	40.36	
App/Depart	2136	/	1914	1330	/	1252	450	/	356	612	/	1006	

PM Peak Hr Begins at: 445 PM

PEAK													
Volumes	286	785	34	72	497	109	60	78	91	39	170	133	2354
Approach %	25.88	71.04	3.08	10.62	73.30	16.08	26.20	34.06	39.74	11.40	49.71	38.89	

PEAK HR. FACTOR:	0.861	0.892	0.909	0.777	0.949

CONTROL: Signal
COMMENT 1: 0
GPS: 32.770261, -111.925894

Prepared by: Field Data Services of Arizona/Veracity Traffic Group (520) 316-6745

Volumes for: Wednesday, May 30, 2018 City: Scottsdale Project #: 18-1260-002

Location: Scottsdale Rd. approx. 300' north of Lone Mountain Rd.

AM Period	NB		SB		EB	WB		PM Period	NB		SB		EB	WB	
00:00	4		8					12:00	200		201				
00:15	5		3					12:15	195		205				
00:30	4		6					12:30	205		216				
00:45	14	27	7	24			51	12:45	177	777	202	824			1601
01:00	4		3					13:00	188		190				
01:15	7		3					13:15	228		184				
01:30	9		2					13:30	208		214				
01:45	4	24	4	12			36	13:45	218	842	220	808			1650
02:00	1		3					14:00	200		226				
02:15	4		1					14:15	203		182				
02:30	4		7					14:30	203		195				
02:45	5	14	6	17			31	14:45	243	849	199	802			1651
03:00	3		4					15:00	233		240				
03:15	5		10					15:15	222		209				
03:30	1		4					15:30	240		172				
03:45	4	13	8	26			39	15:45	212	907	198	819			1726
04:00	10		11					16:00	228		189				
04:15	16		18					16:15	262		151				
04:30	20		28					16:30	231		173				
04:45	21	67	32	89			156	16:45	240	961	162	675			1636
05:00	18		38					17:00	225		190				
05:15	42		39					17:15	246		173				
05:30	54		61					17:30	267		153				
05:45	52	166	73	211			377	17:45	215	953	139	655			1608
06:00	57		107					18:00	200		144				
06:15	57		132					18:15	165		123				
06:30	98		136					18:30	167		101				
06:45	93	305	156	531			836	18:45	130	662	111	479			1141
07:00	102		168					19:00	144		110				
07:15	105		177					19:15	99		97				
07:30	153		194					19:30	117		76				
07:45	141	501	176	715			1216	19:45	85	445	86	369			814
08:00	149		217					20:00	92		76				
08:15	179		188					20:15	99		61				
08:30	167		196					20:30	74		64				
08:45	185	680	167	768			1448	20:45	56	321	56	257			578
09:00	150		170					21:00	58		37				
09:15	175		191					21:15	43		42				
09:30	175		230					21:30	42		33				
09:45	192	692	193	784			1476	21:45	39	182	33	145			327
10:00	193		201					22:00	22		27				
10:15	188		201					22:15	35		24				
10:30	194		197					22:30	25		27				
10:45	177	752	209	808			1560	22:45	17	99	16	94			193
11:00	186		215					23:00	21		8				
11:15	190		217					23:15	9		11				
11:30	188		212					23:30	15		11				
11:45	193	757	195	839			1596	23:45	13	58	9	39			97
Total Vol.		3998		4824			**8822**			7056		5966			**13022**

GPS Coordinates: 33.771534, -111.925884

Daily Totals

NB	SB	EB	WB	Combined
11054	10790			**21844**

	AM			PM		
Split %	45.3%	54.7%	**40.4%**	54.2%	45.8%	**59.6%**
Peak Hour	11:45	10:45	**11:45**	16:45	13:15	**14:45**
Volume	793	853	**1610**	978	844	**1758**
P.H.F.	0.97	0.98	**0.96**	0.92	0.93	**0.93**

Prepared by: Field Data Services of Arizona/Veracity Traffic Group (520) 316-6745

Volumes for: Wednesday, May 30, 2018 City: Scottsdale Project #: 18-1260-003

Location: Lone Mountain Rd. approx. 300' west of Scottsdale Rd.

AM Period	NB	SB	EB		WB			PM Period	NB	SB	EB		WB		
00:00			2		3			12:00			62		84		
00:15			7		4			12:15			66		90		
00:30			1		4			12:30			70		70		
00:45			1	11	3	14	25	12:45			63	261	85	329	590
01:00			2		3			13:00			79		65		
01:15			3		6			13:15			66		103		
01:30			2		0			13:30			88		114		
01:45			1	8	4	13	21	13:45			60	293	91	373	666
02:00			0		0			14:00			80		94		
02:15			2		1			14:15			59		100		
02:30			2		4			14:30			86		94		
02:45			1	5	1	6	11	14:45			57	282	101	389	671
03:00			0		1			15:00			73		155		
03:15			1		2			15:15			65		97		
03:30			5		1			15:30			68		96		
03:45			18	24	1	5	29	15:45			52	258	115	463	721
04:00			14		0			16:00			53		104		
04:15			30		4			16:15			52		124		
04:30			38		5			16:30			66		94		
04:45			34	116	6	15	131	16:45			60	231	113	435	666
05:00			34		4			17:00			48		122		
05:15			37		7			17:15			63		156		
05:30			75		9			17:30			58		174		
05:45			52	198	11	31	229	17:45			50	219	119	571	790
06:00			69		17			18:00			52		123		
06:15			104		19			18:15			38		87		
06:30			108		16			18:30			48		80		
06:45			119	400	21	73	473	18:45			43	181	67	357	538
07:00			114		39			19:00			53		51		
07:15			134		37			19:15			37		45		
07:30			159		41			19:30			43		53		
07:45			133	540	35	152	692	19:45			15	148	55	204	352
08:00			117		48			20:00			31		61		
08:15			137		44			20:15			31		50		
08:30			128		58			20:30			23		47		
08:45			111	493	45	195	688	20:45			17	102	38	196	298
09:00			95		47			21:00			20		26		
09:15			79		55			21:15			13		39		
09:30			98		47			21:30			14		30		
09:45			82	354	60	209	563	21:45			11	58	28	123	181
10:00			83		62			22:00			4		28		
10:15			82		47			22:15			8		21		
10:30			76		69			22:30			7		17		
10:45			69	310	76	254	564	22:45			9	28	10	76	104
11:00			67		74			23:00			5		9		
11:15			67		79			23:15			4		7		
11:30			71		81			23:30			5		4		
11:45			63	268	74	308	576	23:45			2	16	6	26	42
Total Vol.				2727		1275	**4002**					2077		3542	**5619**

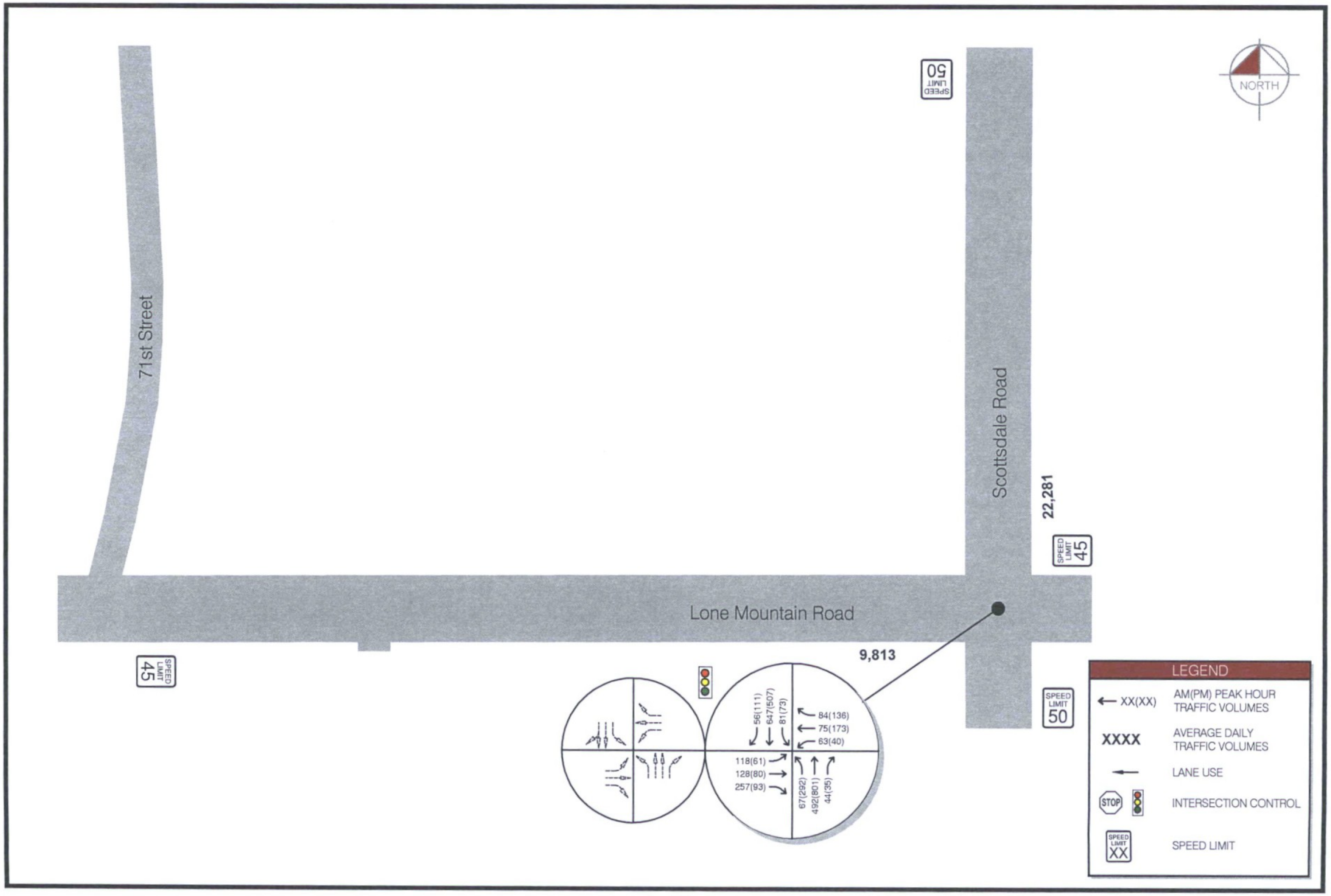
GPS Coordinates: 33.770263, -111.926802

Daily Totals

NB	SB	EB	WB	Combined
		4804	4817	**9621**

	AM			PM		
Split %	68.1%	31.9%	**41.6%**	37.0%	63.0%	**58.4%**
Peak Hour	07:30	11:30	**07:30**	12:45	17:15	**17:15**
Volume	546	329	**714**	296	572	**795**
P.H.F.	0.86	0.91	**0.89**	0.84	0.82	**0.86**

Existing Traffic Volume Figure with Adjustment Factor Applied



Kimley»Horn

Appendix

Existing Condtions with Seasonal Adjustment

June 2018

Signal Timing Information

SCOTTSDALE & LONE MOUNTAIN

BASIC TIMING PLANS

CITY OF SCOTTSDALE

RECOMMENDED CLEARANCES

	N/S	E/W	LEFT TURN STANDARD
F.D.W.	15	20	
YELLOW	4.7	4.3	3.0
ALL-RED	1.3	1.7	1.0

DATE DESIGNED	
9/23/2014	
SYSTEM #	SECTION #
184	101

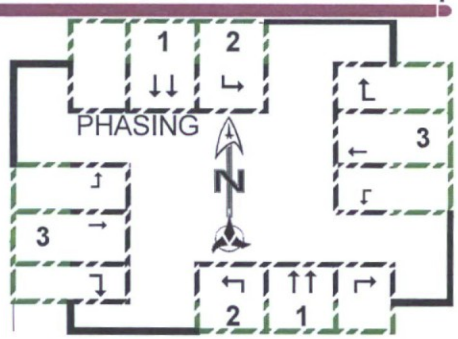
COMMUNICATIONS	I.P. ADDRESS
MM-1-5-1	172.17. 11.84

TIMING #1 | TIMING #2 | TIMING #3 | TIMING #4

CLEARANCE | SEQUENCE | PATTERNS | HISTORY

MM-2-1 TIMING PLAN #1

	PHASE	1	2	3						9	10	11	12	13	14	15	16
	MOVEMENT	NST	NSL	EWT													
	NOTES																
GREENS	MIN GRN	10	4	10													
	BK MGRN																
	CS MGRN																
	DLY GRN																
PEDESTRIAN	WALK	15		10													
	WALK2																
	WLK MAX																
	PED CLR/FDW	15		20													
	PD CLR2																
	PC MAX																
	PED CO																
MAXIMUMS	VEH EXT		1	2													
	VH EXT2																
	MAX 1	40	20	30													
	MAX 2	50	30	40													
	MAX 3																
	DYM MAX																
	DYM STP																
	YELLOW	4.7	3	4.3													
REDS	RED CLR	1.3	1	1.7													
	RED MAX																
	RED RVT	2		2													
VOL DENSITY	ACT B4																
	SEC/ACT																
	MAX INT																
	TIME B4																
	CARS WT																
	STPTDUC																
	TTREDUC																
	MIN GAP																
MM-2-8 RECALLS	LOCK DET																
	VEH RECALL																
	PED RECALL	X															
	MAX RECALL																
	SOFT RECALL																
	NO REST																
	ADD INIT CAL																



1	2	3	4	5	6	7	8
-6	-4	-6	0	0	0	0	0
-6	-4	-6	0	0	0	0	0

SPLIT PLAN MAXIMUMS

NOTES

ONLY VALID WHEN STAMPED

Existing AM
Traffic Capacity Analysis

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	116	125	252	62	74	82	66	482	43	79	634	55
Future Volume (veh/h)	116	125	252	62	74	82	66	482	43	79	634	55
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	129	139	280	77	91	101	71	518	46	89	712	62
Peak Hour Factor	0.90	0.90	0.90	0.81	0.81	0.81	0.93	0.93	0.93	0.89	0.89	0.89
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	286	384	326	227	384	326	462	1958	873	569	1834	160
Arrive On Green	0.21	0.21	0.21	0.21	0.21	0.21	0.04	0.55	0.55	0.04	0.55	0.55
Sat Flow, veh/h	1191	1870	1585	968	1870	1585	1781	3554	1585	1781	3308	288
Grp Volume(v), veh/h	129	139	280	77	91	101	71	518	46	89	382	392
Grp Sat Flow(s),veh/h/ln	1191	1870	1585	968	1870	1585	1781	1777	1585	1781	1777	1819
Q Serve(g_s), s	8.1	5.1	13.6	5.9	3.2	4.3	1.4	6.1	1.1	1.7	9.8	9.8
Cycle Q Clear(g_c), s	11.3	5.1	13.6	11.0	3.2	4.3	1.4	6.1	1.1	1.7	9.8	9.8
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		0.16
Lane Grp Cap(c), veh/h	286	384	326	227	384	326	462	1958	873	569	985	1008
V/C Ratio(X)	0.45	0.36	0.86	0.34	0.24	0.31	0.15	0.26	0.05	0.16	0.39	0.39
Avail Cap(c_a), veh/h	549	796	675	441	796	675	971	1958	873	1072	985	1008
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	31.2	27.2	30.6	32.0	26.5	26.9	7.6	9.4	8.3	7.2	10.1	10.1
Incr Delay (d2), s/veh	0.4	0.2	2.6	0.3	0.1	0.2	0.1	0.3	0.1	0.0	1.2	1.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	2.2	2.1	5.0	1.3	1.4	1.5	0.4	2.0	0.3	0.5	3.3	3.4
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	31.6	27.4	33.2	32.3	26.6	27.1	7.6	9.7	8.4	7.2	11.2	11.2
LnGrp LOS	C	C	C	C	C	C	A	A	A	A	B	B
Approach Vol, veh/h		548			269			635			863	
Approach Delay, s/veh		31.4			28.4			9.4			10.8	
Approach LOS		C			C			A			B	
Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	7.4	50.0		22.4	7.2	50.3		22.4				
Change Period (Y+Rc), s	4.0	* 6		* 6	4.0	* 6		* 6				
Max Green Setting (Gmax), s	26.0	* 44		* 34	26.0	* 44		* 34				
Max Q Clear Time (g_c+I1), s	3.7	8.1		15.6	3.4	11.8		13.0				
Green Ext Time (p_c), s	0.0	0.0		0.8	0.0	0.2		0.4				
Intersection Summary												
HCM 6th Ctrl Delay			17.4									
HCM 6th LOS			B									

Notes

* HCM 6th computational engine requires equal clearance times for the phases crossing the barrier.

Existing PM
Traffic Capacity Analysis

Crash Data

CITY OF SCOTTSDALE

'17 -'18 COLLISION SUMMARY

REPORT #	DATE YYMMDD	TIME HHMM	NORTH / SOUTH ST.	TYPE	EAST WEST ST.	TYPE	DIR FROM	DIST FROM	INJ. SEV. #1	INJ. SEV. #2	PHYS. COND. #1	PHYS. COND. #2	VIOLATION #1	VIOLATION #2	ACTION #1	ACTION #2	TRAV. DIR. #1	TRAV. DIR. #2	MANNER OF COLLISION	COMMENTS
1802612	180202	1830	SCOTTSDALE	RD	LONE MOUNTAIN	RD	AT		2	99	0	99	1	2	3	1	SB	SB	4	HIT AND RUN
1724163	171031	1551	SCOTTSDALE	RD	LONE MOUNTAIN	RD	AT		3	2	0	0	20	1	4	1	NB	NB	3	
1717135	170803	1612	SCOTTSDALE	RD	LONE MOUNTAIN	RD	AT		3	1	0	0	2	1	1	3	NB	NB	4	
1716126	170720	1734	SCOTTSDALE	RD	LONE MOUNTAIN	RD	AT		2		6	0	2	1	1	14	NB	NB	2	
1712221	170530	1728	SCOTTSDALE	RD	LONE MOUNTAIN	RD	AT		3	4	99	0	6	1	4	1	EB	NB	2	
1709432	170426	1055	SCOTTSDALE	RD	LONE MOUNTAIN	RD	AT		99	1	99	0	20	1	4	1	SB	NB	3	HIT AND RUN
1704755	170227	1345	SCOTTSDALE	RD	LONE MOUNTAIN	RD	N	60	1	1	0	0	99	1	1	3	SB	SB	4	
1708990	170420	1050	SCOTTSDALE	RD	LONE MOUNTAIN	RD	E	110	1	3	0	0	7	1	6	1	EB	EB	6	
1711697	170524	1337	SCOTTSDALE	RD	LONE MOUNTAIN	RD	S	150	1	1	0	0	20	1	5	1	SB	SB	2	
1712711	170606	1552	SCOTTSDALE	RD	LONE MOUNTAIN	RD	E	500	2	2	3	0	8	1	1	1	WB	EB	5	
1700888	170112	1423	SCOTTSDALE	RD	LONE MOUNTAIN	RD	E	585	1	1	0	0	20	1	4	1	NB	WB	3	

REPORT #	DATE YYMMDD	TIME HHMM	NORTH / SOUTH ST.	TYPE	EAST WEST ST.	TYPE	DIR FROM	DIST FROM	INJ. SEV. #1	#2	PHYS. COND. #1	#2	VIOLATION #1	#2	ACTION #1	#2	TRAV. DIR. #1	#2	MANNER OF COLLISION	COMMENTS

KEY

INJURY SEVERITY:
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VIOLATION:
1=NO IMPROPER ACTION, 2=SPEED TOO FAST FOR CONDITIONS, 3=EXCEEDED LAWFUL SPEED 4=FOLLOWED TOO CLOSELY. 5=RAN STOP SIGN, 6=DISREGAREDED TRAFFIC SIGNAL7=MADE IMPROPER TURN, 8=DROVE/RODE IN OPPOSING TRAFFIC LANE, 9=KNOWINGLY OPERATED WITH FAULTY / MISSING EQUIPMENT, 10=REQUIRED MOTORCYCLE SAFETY EQUIPMENT NOT USED, 11=PASSED IN NO PASSING ZONE, 12=UNSAFE LANE CHANGE, 13=FAILED TO KEEP IN PROPER LANE, 14=DISREGARDED PAVEMENT MARKINGS, 15=OTHER UNSAFE PASSING, 16=INATTENTION/DISTRACTION, 17=DID NOT USE CROSSWALK, 18=WALKED ON WRONG SIDE OF ROAD, 19=ELECTRONIC COMMUNICATIONS DEVICE, 20=FAILED TO YIELD RIGHT OF WAY (added August 2014), 97=OTHER, 99 UNKNOWN

ACTION:
1=GOING STRAIGHT AHEAD, 2=SLOWING IN TRAFFICWAY, 3=STOPPED IN TRAFFICWAY, 4=MAKING LEFT TURN, 5=MAKING RIGHT TURN, 6=MAKING U-TURN, 7=OVERTAKING/PASSING, 8=CHANGING LANES, 9=NEGOTIATING A CURVE, 10=BACKING, 11=AVOIDING VEH/OBJ/PED/CYCLIST/ANIMAL, 12=ENTERING PARKING POSITION, 13=LEAVING PARKING POSITION, 14=PROPERLY PARKED, 15=IMPROPERLY PARKED, 16=DRIVERLESS MOVING VEHICLE, 17=CROSING ROAD, 18=WALKING WITH TRAFFIC, 19=WALKING AGAINST TRAFFIC, 20=STANDING, 21=LYING, 22=GETTING ON OR OFF VEHICLE, 23=WORKING ON/PUSHING VEHICLE, 24=WORKING ON ROAD, 97=OTHER, 99=UKNOWN

MANNER OF COLLISION:
1=SINGLE VEHICLE, 2=ANGLE (front to side, other than left turn), 3=LEFT TURN, 4=REAR END (front to rear), 5=HEAD-ON (front to front, other than left turn), 6=SIDESWIPE (same direction), 7=SIDESWIPE (opposite direction), 8=REAR-TO-SIDE, 9=REAR TO REAR, 97=OTHER, 99=UNKNOWN

TOTAL **11**

REPORT #	DATE YYMMDD	TIME HHMM	NORTH / SOUTH ST.	TYPE	EAST WEST ST.	TYPE	DIR FROM	DIST FROM	INJ. SEV. #1	INJ. SEV. #2	PHYS. COND. #1	PHYS. COND. #2	VIOLATION #1	VIOLATION #2	ACTION #1	ACTION #2	TRAV. DIR. #1	TRAV. DIR. #2	MANNER OF COLLISION	COMMENTS
16-03359	160210	1558	SCOTTSDALE	RD	LONE MOUNTAIN	RD	AT		1	2	0	0	6	1	1	1	SB	EB	2	MULTI VEH 3
15-09458	150423	2217	SCOTTSDALE	RD	LONE MOUNTAIN	RD	AT		3	4	0	0	6	1	1	4	NB	WB	3	
15-10876	150511	1805	SCOTTSDALE	RD	LONE MOUNTAIN	RD	AT		2	2	4	0	2	1	1	1	SB	SB	4	DUI, HIT AND RUN
15-11145	150515	0800	SCOTTSDALE	RD	LONE MOUNTAIN	RD	AT		1	1	0	0	2	1	1	3	NB	NB	4	
15-11715	150522	2137	SCOTTSDALE	RD	LONE MOUNTAIN	RD	AT		2	99	0	0	20	1	4	1	NB	SB	5	
15-15459	150713	1215	SCOTTSDALE	RD	LONE MOUNTAIN	RD	AT		1	1	0	0	99	99	1	1	EB	SB	2	
15-22519	151016	1412	SCOTTSDALE	RD	LONE MOUNTAIN	RD	AT		99	1	0	0	20	97	4	1	WB	SB	3	MULTI VEH 3
16-02805	160204	1746	SCOTTSDALE	RD	LONE MOUNTAIN	RD	AT		1	1	0	4	20	1	4	1	NB	SB	3	DUI
16-28081	161216	1133	SCOTTSDALE	RD	LONE MOUNTAIN	RD	AT		1	1	0	0	4	1	1	3	SB	SB	4	MULTI VEH 3
16-09127	160418	1953	SCOTTSDALE	RD	LONE MOUNTAIN	RD	AT		1	1	0	0	20	1	4	1	WB	SB	3	
16-10570	160506	2020	SCOTTSDALE	RD	LONE MOUNTAIN	RD	AT		1	2	0	0	20	1	1	1	SB	EB	2	
16-15821	160712	1820	SCOTTSDALE	RD	LONE MOUNTAIN	RD	AT		2	3	0	0	20	1	4	1	WB	SB	3	
16-20549	160913	1054	SCOTTSDALE	RD	LONE MOUNTAIN	RD	AT		1	1	0	0	97	1	10	3	EB	EB	97	
16-20888	160917	1328	SCOTTSDALE	RD	LONE MOUNTAIN	RD	AT		1	1	0	0		1	1	1	NB	NB	4	
16-22316	161005	1547	SCOTTSDALE	RD	LONE MOUNTAIN	RD	AT		1	1	0	0	7	1	4	1	NB	SB	3	
15-27033	151210	0658	SCOTTSDALE	RD	LONE MOUNTAIN	RD	AT		2	1	0	0	7	1	4	1	WB	EB	3	
16-15882	160713	1721	SCOTTSDALE	RD	LONE MOUNTAIN	RD	S	70	1	1	0	0	12	1	8	1	SB	SB	6	
16-15716	160711	0706	SCOTTSDALE	RD	LONE MOUNTAIN	RD	W	100	1	1	0	0	12	1	8	2	EB	EB	6	
15-03195	150206	1928	SCOTTSDALE	RD	LONE MOUNTAIN	RD	S	101	1	3	0	0	20	1	4	1	WB	NB	2	
15-23734	151031	1306	SCOTTSDALE	RD	LONE MOUNTAIN	RD	S	150	1	1	0	0		1	1	1	NB	NB	2	
15-25485	151121	1144	SCOTTSDALE	RD	LONE MOUNTAIN	RD	N	956	1	2	0	0	2	1	2	3	NB	NB	4	

REPORT #	DATE YYMMDD	TIME HHMM	NORTH / SOUTH ST.	TYPE	EAST WEST ST.	TYPE	DIR FROM	DIST FROM	INJ. SEV. #1	INJ. SEV. #2	PHYS. COND. #1	PHYS. COND. #2	VIOLATION #1	VIOLATION #2	ACTION #1	ACTION #2	TRAV. DIR. #1	TRAV. DIR. #2	MANNER OF COLLISION	COMMENTS

KEY

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MANNER OF COLLISION: 1=SINGLE VEHICLE, 2=ANGLE (front to side, other than left turn), 3=LEFT TURN, 4=REAR END (front to rear), 5=HEAD-ON (front to front, other than left turn), 6=SIDESWIPE (same direction), 7=SIDESWIPE (opposite direction), 8=REAR-TO-SIDE, 9=REAR TO REAR, 97=OTHER, 99=UNKNOWN

TOTAL **21**

CITY OF SCOTTSDALE

'13 -'14 COLLISION SUMMARY

REPORT #	DATE YYMMDD	TIME HHMM	NORTH / SOUTH ST.	TYPE	EAST WEST ST.	TYPE	DIR FROM	DIST FROM	INJ. SEV. #1	INJ. SEV. #2	PHYS. COND. #1	PHYS. COND. #2	VIOLATION #1	VIOLATION #2	ACTION #1	ACTION #2	TRAV. DIR. #1	TRAV. DIR. #2	MANNER OF COLLISION	COMMENTS
13-29829	131227	1543	SCOTTSDALE	RD	LONE MOUNTAIN	RD	AT		3	1	0	0	4	1	1	2	NB	NB	4	MULTI VEH 3
13-03228	130209	0816	SCOTTSDALE	RD	LONE MOUNTAIN	RD	S	800	1		99		2		1		SB		1	HIT AND RUN
13-03330	130210	1458	SCOTTSDALE	RD	LONE MOUNTAIN	RD	S	443	1	1	0	0	12	1	1	2	SB	SB	6	MULTI VEH 3
13-04101	130219	1719	SCOTTSDALE	RD	LONE MOUNTAIN	RD	AT		1	1	0	0	12	1	8	1	SB	SB	6	
13-05745	130311	1434	SCOTTSDALE	RD	LONE MOUNTAIN	RD	W	621	1	1	0	0	2	1	1	3	EB	EB	4	
13-12873	130603	0754	SCOTTSDALE	RD	LONE MOUNTAIN	RD	AT		3	1	0	0	12	1	5	1	NB	NB	4	
13-13302	130608	2055	SCOTTSDALE	RD	LONE MOUNTAIN	RD	S	1732	1	1	0	0	2	1	7	3	NB	NB	6	
13-21833	130923	1527	SCOTTSDALE	RD	LONE MOUNTAIN	RD	AT		1	3	0	0	2	1	1	3	NB	NB	4	
13-23936	131018	1442	SCOTTSDALE	RD	LONE MOUNTAIN	RD	AT		1	1	0	0	99	99	1	4	NB	SB	3	
13-02818	130204	1532	SCOTTSDALE	RD	LONE MOUNTAIN	RD	E	600	1	1	0	0	7	1	6	1	NB	EB	2	
13-25825	131109	1635	SCOTTSDALE	RD	LONE MOUNTAIN	RD	AT		1	3	0	0	7	1	4	17	WB	EB	2	CAR/BICYCLE
14-27082	141216	1420	SCOTTSDALE	RD	LONE MOUNTAIN	RD	AT		1	1	0	0		1	1	3	EB	EB	4	
14-01330	140117	1232	SCOTTSDALE	RD	LONE MOUNTAIN	RD	S	1243	1	1	0	0	16	1	1	3	SB	SB	4	
14-01457	140118	1417	SCOTTSDALE	RD	LONE MOUNTAIN	RD	AT		99	1	99	0	2	1	1	3	NB	NB	4	HIT AND RUN
14-03374	140210	1621	SCOTTSDALE	RD	LONE MOUNTAIN	RD	AT		1	1	0	0	7	1	4	1	NB	SB	2	MULTI VEH 3
14-06036	140315	1900	SCOTTSDALE	RD	LONE MOUNTAIN	RD	AT		1	1	4	0	16	1	1	2	SB	SB	4	DUI
14-06254	140318	0917	SCOTTSDALE	RD	LONE MOUNTAIN	RD	AT		1	1	0	0	97	1	4	1	SB	NB	3	
14-09496	140427	1053	SCOTTSDALE	RD	LONE MOUNTAIN	RD	AT		3	3	0	0	16	1	4	2	NB	SB	2	MULTI VEH 3
14-12504	140606	1413	SCOTTSDALE	RD	LONE MOUNTAIN	RD	AT		3	1	0	0	16	1	10	3	EB	EB	4	
14-15435	140717	1157	SCOTTSDALE	RD	LONE MOUNTAIN	RD	AT		1	1	0	0	5	1	1	1	EB	SB	2	
14-25436	141125	1144	SCOTTSDALE	RD	LONE MOUNTAIN	RD	S	229	1	1	0	0	97	1	2	3	NB	NB	4	
13-25142	131101	1647	SCOTTSDALE	RD	LONE MOUNTAIN	RD	AT		1	1	0	0	13	1	1	1	NB	NB	6	

REPORT #	DATE YYMMDD	TIME HHMM	NORTH / SOUTH ST.	TYPE	EAST WEST ST.	TYPE	DIR FROM	DIST FROM	INJ. SEV. #1	#2	PHYS. COND. #1	#2	VIOLATION #1	#2	ACTION #1	#2	TRAV. DIR. #1	#2	MANNER OF COLLISION	COMMENTS

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TOTAL **22**

2014 Segment Collision Rates and Volumes, Sorted by Location

2014 Average Segment Collision Rate = 1.35 collisions per million vehicle miles

PRIMARY STREET	FROM	TO	VOLUME	LENGTH	NO. OF COL	COL RATE
SCOTTSDALE	DYNAMITE	DIXILETA	23900	1.00	0	0.00
SCOTTSDALE	DIXILETA	LONE MOUNTAIN	23600	1.00	2	0.23
SCOTTSDALE	LONE MOUNTAIN	ASHLER HILLS	24000	0.50	0	0.00
SCOTTSDALE	ASHLER HILLS	TERRAVITA/WESTLAND	20500	1.00	1	0.13
SCOTTSDALE	TERRAVITA/WESTLAND	CAREFREE HWY	19000	0.50	4	1.15
DRINKWATER	SCOTTSDALE	OSBORN	8700	0.40	4	3.15
DRINKWATER	OSBORN	INDIAN SCHOOL	12400	0.50	4	1.77
DRINKWATER	INDIAN SCHOOL	SCOTTSDALE	9200	0.50	7	4.17
MILLER	MCKELLIPS	ROOSEVELT	5800	0.50	0	0.00
MILLER	ROOSEVELT	MCDOWELL	7200	0.50	0	0.00
MILLER	MCDOWELL	OAK	8300	0.50	4	2.64
MILLER	OAK	THOMAS	9700	0.50	2	1.13
MILLER	THOMAS	OSBORN	12400	0.50	9	3.98
MILLER	OSBORN	INDIAN SCHOOL	12600	0.50	4	1.74
MILLER	INDIAN SCHOOL	CAMELBACK	12700	0.50	11	4.75
MILLER	CAMELBACK	CHAPARRAL	7200	0.50	3	2.28
HAYDEN	MCKELLIPS	ROOSEVELT	26400	0.50	2	0.42
HAYDEN	ROOSEVELT	MCDOWELL	26600	0.50	6	1.24
HAYDEN	MCDOWELL	OAK	27800	0.50	3	0.59
HAYDEN	OAK	THOMAS	30100	0.50	13	2.37
HAYDEN	THOMAS	OSBORN	32900	0.50	11	1.83
HAYDEN	OSBORN	INDIAN SCHOOL	30600	0.50	4	0.72
HAYDEN	INDIAN SCHOOL	CAMELBACK	29900	0.50	3	0.55
HAYDEN	CAMELBACK	CHAPARRAL	32000	0.50	2	0.34
HAYDEN	CHAPARRAL	MCDONALD	28800	1.00	15	1.43
HAYDEN	MCDONALD	INDIAN BEND	27900	1.00	4	0.39
HAYDEN	INDIAN BEND	MCCORMICK	30300	0.50	3	0.54
HAYDEN	MCCORMICK	VIA DE VENTURA	28500	0.80	5	0.60
HAYDEN	VIA DE VENTURA	VIA LINDA	23500	1.00	9	1.05
HAYDEN	VIA LINDA	MOUNTAIN VIEW	26500	0.60	8	1.38
HAYDEN	MOUNTAIN VIEW	SHEA	24100	0.50	3	0.68
HAYDEN	SHEA	CACTUS	19000	1.00	4	0.58
HAYDEN	CACTUS	SWEETWATER	20500	0.50	1	0.27
HAYDEN	SWEETWATER	REDFIELD	21500	0.70	2	0.36
HAYDEN	REDFIELD	RAINTREE	24800	0.40	4	1.10
HAYDEN	RAINTREE	NORTHSIGHT	22700	0.90	7	0.94
HAYDEN	NORTHSIGHT	FRANK LLOYD WRIGHT	21000	0.25	10	5.22
GREENWAY/HAYDEN	FRANK LLOYD WRIGHT	BELL	22000	0.60	0	0.00
HAYDEN	BELL	PRINCESS	17600	0.60	0	0.00
HAYDEN	PRINCESS	101 FWY	13700	0.75	0	0.00
HAYDEN	101 FWY	THOMPSON PEAK	28600	1.25	8	0.61
HAYDEN	THOMPSON PEAK	GRAYHAWK	18200	0.50	0	0.00
HAYDEN	GRAYHAWK	DEER VALLEY	16300	0.50	1	0.34
MILLER	DEER VALLEY	WILLIAMS	14300	0.50	2	0.77
MILLER	WILLIAMS	PINNACLE PEAK	12200	0.50	0	0.00
GRANITE REEF	ROOSEVELT	MCDOWELL	4200	0.50	2	2.61
GRANITE REEF	MCDOWELL	OAK	3900	0.50	2	2.81
GRANITE REEF	OAK	THOMAS	2800	0.50	2	3.91
GRANITE REEF	THOMAS	OSBORN	1900	0.50	1	2.88

2020 Background AM
Traffic Capacity Analysis

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑	↱	↰	↑	↱	↰	↑↑	↱	↰	↑↱	
Traffic Volume (veh/h)	126	135	273	67	80	89	70	512	46	84	674	58
Future Volume (veh/h)	126	135	273	67	80	89	70	512	46	84	674	58
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	140	150	303	83	99	110	75	551	49	94	757	65
Peak Hour Factor	0.90	0.90	0.90	0.81	0.81	0.81	0.93	0.93	0.93	0.89	0.89	0.89
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	295	411	348	231	411	348	432	1921	857	539	1801	155
Arrive On Green	0.22	0.22	0.22	0.22	0.22	0.22	0.04	0.54	0.54	0.04	0.54	0.54
Sat Flow, veh/h	1173	1870	1585	938	1870	1585	1781	3554	1585	1781	3312	284
Grp Volume(v), veh/h	140	150	303	83	99	110	75	551	49	94	406	416
Grp Sat Flow(s),veh/h/ln	1173	1870	1585	938	1870	1585	1781	1777	1585	1781	1777	1819
Q Serve(g_s), s	9.1	5.5	15.0	6.7	3.6	4.7	1.5	6.9	1.2	1.9	11.0	11.0
Cycle Q Clear(g_c), s	12.6	5.5	15.0	12.2	3.6	4.7	1.5	6.9	1.2	1.9	11.0	11.0
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		0.16
Lane Grp Cap(c), veh/h	295	411	348	231	411	348	432	1921	857	539	966	989
V/C Ratio(X)	0.47	0.37	0.87	0.36	0.24	0.32	0.17	0.29	0.06	0.17	0.42	0.42
Avail Cap(c_a), veh/h	527	781	662	416	781	662	929	1921	857	1031	966	989
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	31.4	26.9	30.6	32.1	26.2	26.6	8.3	10.2	8.9	7.8	11.0	11.0
Incr Delay (d2), s/veh	0.4	0.2	2.7	0.4	0.1	0.2	0.1	0.4	0.1	0.1	1.3	1.3
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	2.4	2.3	5.5	1.4	1.5	1.7	0.5	2.3	0.4	0.6	3.8	3.9
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	31.8	27.2	33.3	32.5	26.3	26.8	8.3	10.5	9.0	7.8	12.3	12.3
LnGrp LOS	C	C	C	C	C	C	A	B	A	A	B	B
Approach Vol, veh/h		593			292			675			916	
Approach Delay, s/veh		31.4			28.3			10.2			11.9	
Approach LOS		C			C			B			B	
Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	7.5	50.0		23.9	7.3	50.3		23.9				
Change Period (Y+Rc), s	4.0	* 6		* 6	4.0	* 6		* 6				
Max Green Setting (Gmax), s	26.0	* 44		* 34	26.0	* 44		* 34				
Max Q Clear Time (g_c+I1), s	3.9	8.9		17.0	3.5	13.0		14.2				
Green Ext Time (p_c), s	0.0	0.0		0.9	0.0	0.2		0.5				
Intersection Summary												
HCM 6th Ctrl Delay			18.0									
HCM 6th LOS			B									

Notes

* HCM 6th computational engine requires equal clearance times for the phases crossing the barrier.

2020 Background PM
Traffic Capacity Analysis

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	65	84	98	42	184	144	304	835	36	77	528	116
Future Volume (veh/h)	65	84	98	42	184	144	304	835	36	77	528	116
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	71	92	108	54	236	185	353	971	42	87	593	130
Peak Hour Factor	0.91	0.91	0.91	0.78	0.78	0.78	0.86	0.86	0.86	0.89	0.89	0.89
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	176	397	336	283	397	336	550	2016	899	379	1431	313
Arrive On Green	0.21	0.21	0.21	0.21	0.21	0.21	0.11	0.57	0.57	0.04	0.49	0.49
Sat Flow, veh/h	966	1870	1585	1182	1870	1585	1781	3554	1585	1781	2899	634
Grp Volume(v), veh/h	71	92	108	54	236	185	353	971	42	87	363	360
Grp Sat Flow(s),veh/h/ln	966	1870	1585	1182	1870	1585	1781	1777	1585	1781	1777	1756
Q Serve(g_s), s	6.4	3.6	5.1	3.5	10.1	9.3	8.1	14.5	1.1	2.1	11.6	11.6
Cycle Q Clear(g_c), s	16.5	3.6	5.1	7.2	10.1	9.3	8.1	14.5	1.1	2.1	11.6	11.6
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		0.36
Lane Grp Cap(c), veh/h	176	397	336	283	397	336	550	2016	899	379	877	867
V/C Ratio(X)	0.40	0.23	0.32	0.19	0.60	0.55	0.64	0.48	0.05	0.23	0.41	0.42
Avail Cap(c_a), veh/h	339	713	605	484	713	605	865	2016	899	825	877	867
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	39.1	29.1	29.7	32.1	31.7	31.3	9.6	11.5	8.6	10.6	14.4	14.4
Incr Delay (d2), s/veh	0.6	0.1	0.2	0.1	0.5	0.5	0.5	0.8	0.1	0.1	1.4	1.5
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.5	1.6	1.9	1.0	4.4	3.4	2.4	4.8	0.3	0.7	4.3	4.3
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	39.7	29.2	29.9	32.2	32.2	31.9	10.1	12.3	8.7	10.7	15.8	15.8
LnGrp LOS	D	C	C	C	C	C	B	B	A	B	B	B
Approach Vol, veh/h		271			475			1366			810	
Approach Delay, s/veh		32.2			32.1			11.6			15.3	
Approach LOS		C			C			B			B	
Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	7.7	56.6		24.9	14.2	50.0		24.9				
Change Period (Y+Rc), s	4.0	* 6		* 6	4.0	* 6		* 6				
Max Green Setting (Gmax), s	26.0	* 44		* 34	26.0	* 44		* 34				
Max Q Clear Time (g_c+I1), s	4.1	16.5		18.5	10.1	13.6		12.1				
Green Ext Time (p_c), s	0.0	0.0		0.4	0.1	0.2		0.6				
Intersection Summary												
HCM 6th Ctrl Delay			17.9									
HCM 6th LOS			B									
Notes												

* HCM 6th computational engine requires equal clearance times for the phases crossing the barrier.

2020 Total AM
Traffic Capacity Analysis

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑	↱	↰	↑	↱	↰	↑↑	↱	↰	↑↱	
Traffic Volume (veh/h)	126	135	274	67	81	89	70	514	46	84	675	58
Future Volume (veh/h)	126	135	274	67	81	89	70	514	46	84	675	58
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	140	150	304	83	100	110	75	553	49	94	758	65
Peak Hour Factor	0.90	0.90	0.90	0.81	0.81	0.81	0.93	0.93	0.93	0.89	0.89	0.89
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	295	412	349	231	412	349	431	1920	856	538	1799	154
Arrive On Green	0.22	0.22	0.22	0.22	0.22	0.22	0.04	0.54	0.54	0.04	0.54	0.54
Sat Flow, veh/h	1172	1870	1585	937	1870	1585	1781	3554	1585	1781	3312	284
Grp Volume(v), veh/h	140	150	304	83	100	110	75	553	49	94	407	416
Grp Sat Flow(s),veh/h/ln	1172	1870	1585	937	1870	1585	1781	1777	1585	1781	1777	1819
Q Serve(g_s), s	9.1	5.5	15.1	6.7	3.6	4.7	1.5	6.9	1.2	1.9	11.0	11.0
Cycle Q Clear(g_c), s	12.7	5.5	15.1	12.3	3.6	4.7	1.5	6.9	1.2	1.9	11.0	11.0
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		0.16
Lane Grp Cap(c), veh/h	295	412	349	231	412	349	431	1920	856	538	965	988
V/C Ratio(X)	0.47	0.36	0.87	0.36	0.24	0.32	0.17	0.29	0.06	0.17	0.42	0.42
Avail Cap(c_a), veh/h	526	781	662	416	781	662	928	1920	856	1029	965	988
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	31.4	26.9	30.6	32.1	26.2	26.6	8.3	10.2	8.9	7.8	11.0	11.0
Incr Delay (d2), s/veh	0.4	0.2	2.7	0.4	0.1	0.2	0.1	0.4	0.1	0.1	1.3	1.3
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	2.4	2.3	5.6	1.4	1.5	1.7	0.5	2.3	0.4	0.6	3.8	3.9
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	31.8	27.1	33.3	32.5	26.3	26.8	8.4	10.6	9.0	7.9	12.4	12.3
LnGrp LOS	C	C	C	C	C	C	A	B	A	A	B	B
Approach Vol, veh/h		594			293			677			917	
Approach Delay, s/veh		31.4			28.2			10.2			11.9	
Approach LOS		C			C			B			B	
Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	7.5	50.0		23.9	7.3	50.3		23.9				
Change Period (Y+Rc), s	4.0	* 6		* 6	4.0	* 6		* 6				
Max Green Setting (Gmax), s	26.0	* 44		* 34	26.0	* 44		* 34				
Max Q Clear Time (g_c+I1), s	3.9	8.9		17.1	3.5	13.0		14.3				
Green Ext Time (p_c), s	0.0	0.0		0.9	0.0	0.2		0.5				
Intersection Summary												
HCM 6th Ctrl Delay			18.0									
HCM 6th LOS			B									
Notes												

* HCM 6th computational engine requires equal clearance times for the phases crossing the barrier.

Intersection	
Int Delay, s/veh	0

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑	↱		↰	↗
Traffic Vol, veh/h	2	533	211	1	1	2
Future Vol, veh/h	2	533	211	1	1	2
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	0
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	2	579	229	1	1	2

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	230	0	-	0	813	230
Stage 1	-	-	-	-	230	-
Stage 2	-	-	-	-	583	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	1338	-	-	-	348	809
Stage 1	-	-	-	-	808	-
Stage 2	-	-	-	-	558	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1338	-	-	-	347	809
Mov Cap-2 Maneuver	-	-	-	-	448	-
Stage 1	-	-	-	-	806	-
Stage 2	-	-	-	-	558	-

Approach	EB	WB	SB
HCM Control Delay, s	0	0	10.7
HCM LOS			B

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1	SBLn2
Capacity (veh/h)	1338	-	-	-	448	809
HCM Lane V/C Ratio	0.002	-	-	-	0.002	0.003
HCM Control Delay (s)	7.7	-	-	-	13.1	9.5
HCM Lane LOS	A	-	-	-	B	A
HCM 95th %tile Q(veh)	0	-	-	-	0	0

Intersection	
Int Delay, s/veh	0

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	1	1	2	723	817	1
Future Vol, veh/h	1	1	2	723	817	1
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	1	1	2	786	888	1

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1286	445	889	0	-	0
Stage 1	889	-	-	-	-	-
Stage 2	397	-	-	-	-	-
Critical Hdwy	6.84	6.94	4.14	-	-	-
Critical Hdwy Stg 1	5.84	-	-	-	-	-
Critical Hdwy Stg 2	5.84	-	-	-	-	-
Follow-up Hdwy	3.52	3.32	2.22	-	-	-
Pot Cap-1 Maneuver	156	561	758	-	-	-
Stage 1	362	-	-	-	-	-
Stage 2	648	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	155	561	758	-	-	-
Mov Cap-2 Maneuver	155	-	-	-	-	-
Stage 1	360	-	-	-	-	-
Stage 2	648	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	19.9	0	0
HCM LOS	C		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	758	-	155	561	-	-
HCM Lane V/C Ratio	0.003	-	0.007	0.002	-	-
HCM Control Delay (s)	9.8	0	28.4	11.4	-	-
HCM Lane LOS	A	A	D	B	-	-
HCM 95th %tile Q(veh)	0	-	0	0	-	-

2020 Total PM
Traffic Capacity Analysis

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑	↱	↰	↑	↱	↰	↑↑	↱	↰	↑↱	
Traffic Volume (veh/h)	65	85	99	42	185	145	305	837	36	77	530	116
Future Volume (veh/h)	65	85	99	42	185	145	305	837	36	77	530	116
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	71	93	109	54	237	186	355	973	42	87	596	130
Peak Hour Factor	0.91	0.91	0.91	0.78	0.78	0.78	0.86	0.86	0.86	0.89	0.89	0.89
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	175	398	337	283	398	337	549	2015	899	378	1430	311
Arrive On Green	0.21	0.21	0.21	0.21	0.21	0.21	0.12	0.57	0.57	0.04	0.49	0.49
Sat Flow, veh/h	964	1870	1585	1180	1870	1585	1781	3554	1585	1781	2902	631
Grp Volume(v), veh/h	71	93	109	54	237	186	355	973	42	87	364	362
Grp Sat Flow(s),veh/h/ln	964	1870	1585	1180	1870	1585	1781	1777	1585	1781	1777	1757
Q Serve(g_s), s	6.4	3.7	5.2	3.5	10.2	9.3	8.2	14.6	1.1	2.1	11.7	11.7
Cycle Q Clear(g_c), s	16.6	3.7	5.2	7.2	10.2	9.3	8.2	14.6	1.1	2.1	11.7	11.7
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		0.36
Lane Grp Cap(c), veh/h	175	398	337	283	398	337	549	2015	899	378	875	865
V/C Ratio(X)	0.40	0.23	0.32	0.19	0.60	0.55	0.65	0.48	0.05	0.23	0.42	0.42
Avail Cap(c_a), veh/h	337	712	603	481	712	603	862	2015	899	823	875	865
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	39.2	29.1	29.7	32.1	31.7	31.4	9.7	11.5	8.6	10.6	14.5	14.5
Incr Delay (d2), s/veh	0.6	0.1	0.2	0.1	0.5	0.5	0.5	0.8	0.1	0.1	1.5	1.5
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.5	1.6	1.9	1.0	4.4	3.4	2.4	4.9	0.3	0.7	4.4	4.4
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	39.7	29.2	29.9	32.2	32.2	31.9	10.2	12.4	8.7	10.7	15.9	16.0
LnGrp LOS	D	C	C	C	C	C	B	B	A	B	B	B
Approach Vol, veh/h		273			477			1370			813	
Approach Delay, s/veh		32.3			32.1			11.7			15.4	
Approach LOS		C			C			B			B	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	7.7	56.6		25.0	14.3	50.0		25.0
Change Period (Y+Rc), s	4.0	* 6		* 6	4.0	* 6		* 6
Max Green Setting (Gmax), s	26.0	* 44		* 34	26.0	* 44		* 34
Max Q Clear Time (g_c+I1), s	4.1	16.6		18.6	10.2	13.7		12.2
Green Ext Time (p_c), s	0.0	0.0		0.4	0.1	0.2		0.6

Intersection Summary	
HCM 6th Ctrl Delay	17.9
HCM 6th LOS	B

Notes

* HCM 6th computational engine requires equal clearance times for the phases crossing the barrier.

Intersection	
Int Delay, s/veh	0.1

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑	↱		↰	↱
Traffic Vol, veh/h	2	248	611	2	2	2
Future Vol, veh/h	2	248	611	2	2	2
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	0
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	2	270	664	2	2	2

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	666	0	-	0	939	665
Stage 1	-	-	-	-	665	-
Stage 2	-	-	-	-	274	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	923	-	-	-	293	460
Stage 1	-	-	-	-	511	-
Stage 2	-	-	-	-	772	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	923	-	-	-	292	460
Mov Cap-2 Maneuver	-	-	-	-	403	-
Stage 1	-	-	-	-	509	-
Stage 2	-	-	-	-	772	-

Approach	EB	WB	SB
HCM Control Delay, s	0.1	0	13.5
HCM LOS			B

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1	SBLn2
Capacity (veh/h)	923	-	-	-	403	460
HCM Lane V/C Ratio	0.002	-	-	-	0.005	0.005
HCM Control Delay (s)	8.9	-	-	-	14	12.9
HCM Lane LOS	A	-	-	-	B	B
HCM 95th %tile Q(veh)	0	-	-	-	0	0

Intersection						
Int Delay, s/veh	6.7					

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	1	2	3	0	0	1
Future Vol, veh/h	1	2	3	0	0	1
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	1	2	3	0	0	1

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	7	1	1	0	-	0
Stage 1	1	-	-	-	-	-
Stage 2	6	-	-	-	-	-
Critical Hdwy	6.84	6.94	4.14	-	-	-
Critical Hdwy Stg 1	5.84	-	-	-	-	-
Critical Hdwy Stg 2	5.84	-	-	-	-	-
Follow-up Hdwy	3.52	3.32	2.22	-	-	-
Pot Cap-1 Maneuver	1013	1083	1620	-	-	-
Stage 1	1022	-	-	-	-	-
Stage 2	1016	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	1011	1083	1620	-	-	-
Mov Cap-2 Maneuver	1011	-	-	-	-	-
Stage 1	1020	-	-	-	-	-
Stage 2	1016	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	8.4	7.2	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	1620	-	1011	1083	-	-
HCM Lane V/C Ratio	0.002	-	0.001	0.002	-	-
HCM Control Delay (s)	7.2	0	8.6	8.3	-	-
HCM Lane LOS	A	A	A	A	-	-
HCM 95th %tile Q(veh)	0	-	0	0	-	-

Left-Turn Storage Calculations

Left-turn Storage Analysis

Intersection	Direction (N,S,E,W)	Peak volume (vph)	Signalized??? (Place an "X") Yes	No	If signalized Cycle Length (seconds)	# of Left-turn Lanes (#)	Required Storage per Lane (ft.) (75' min. default)
							0
Scottsdale Rd and Lone Mountain Road	NB	305	X		80	1	275
	SB	84	X		80	1	100
	EB	126	X		80	1	125
	WB	67	X		80	1	100
							0
							0
							0
							0
							0
							0
							0
							0
							0
							0
							0
							0
							0
							0
							0
							0
							0
							0

SAMPLE CALCULATIONS

SIGNALIZED INTERSECTIONS

Storage: = [((veh/interval) + z x (SQRT(veh/interval)))/L] x 25 ft/vehicle

N = (veh/interval)
N = [(V) x (C/3600)]

Where :

z = 1.282 for 90 % confidence level (Most commenly used)
z = 1.645 for 95 % confidence level

Where:

V = vehicles per hour
C = cycle length in seconds
25 ft/veh = Average Length of Vehicles
L = number of left turn lanes

UNSIGNALIZED INTERSECTIONS

Storage = [(V/60 minutes) x 2 minutes] x 25 ft/vehicle

Where:

V = vehicles per hour
25 ft/veh = Average Length of Vehicles

PARTNER

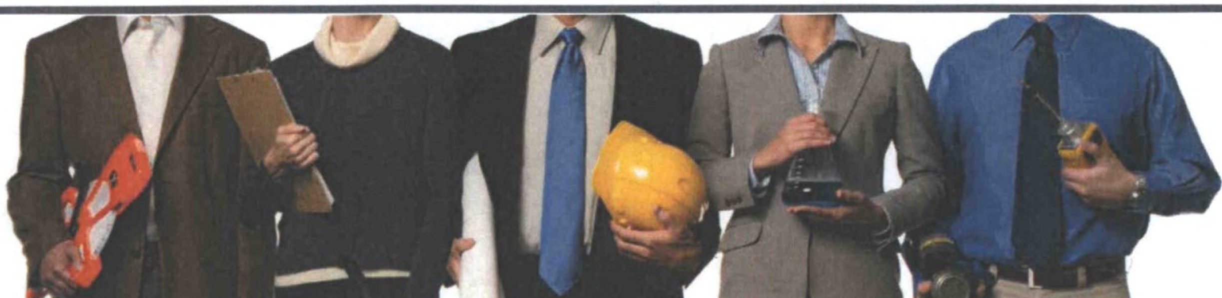
GEOTECHNICAL REPORT

New Internalized Community Storage
N.W.C. of East Lone Mountain Road & North Scottsdale Road
Phoenix, Arizona 85266

July 30, 2018
Partner Project Number: 18-218317.1

Prepared for:

RKAA Architects
2233 East Thomas Road
Phoenix, Arizona 85016



8-ZN-2018/2-GP-2018
09/18/18

Engineers who understand your business

PARTNER

July 30, 2018

M. Michelle Bach
RKAA Architects
2233 E. Thomas Road
Phoenix, Arizona 85016

Subject: **Geotechnical Report**
Internalized Community Storage
North west corner of East Lone Mountain Road & North Scottsdale Road
Scottsdale, Arizona 85266
Partner Project No. 18-218317.1

Dear M. Bach:

Partner Assessment Corporation (Partner) presents the following general opinion regarding the geotechnical conditions at the subject site, based on the information contained within this geotechnical report and our general experience with construction practices and geotechnical conditions on other sites. This statement does not constitute an engineering recommendation.

- ***The geotechnical conditions on the site related to the planned construction are expected to be similar to less favorable than other similar sites*; given the presence of very dense caliche (cemented soils) at basement depths.***

The descriptions and findings of our geotechnical report are presented for your use in this electronic format, for your use as shown in the hyperlinked outline below. To return to this page after clicking a hyperlink, hold "alt" and press the "left arrow key" on your keyboard.

We appreciate the opportunity to be of service during this phase of the work.

Sincerely,

Registered Professional Engineer (Civil) CERTIFICATE NO. 43546 MATTHEW W. MARCUS Date Signed 7/30/18 ARIZONA U.S.A. EXPIRES 12/31/20

Matthew Marcus, PE
Technical Director – Geotechnical Engineering

Eric Brown
Project Geologist

** "similar sites" refers to sites with similar planned and current use, where we have recently performed similar work, and is a general statement not based on statistical analysis.*

1. GEOTECHNICAL EXECUTIVE SUMMARY

Geologic Zones and Site Hazards:

According to the report*: The project site is located in City of Scottsdale in the Basin and Range geophysical province of Arizona. Scottsdale is adjacent to McDowell Mountains and New River Mountains. Site soils were composed of alluvial fan deposits composed of silty sands and cemented soils (caliche). The site has historically been undeveloped with adjacent residential and commercial development. Earth fissures, subsidence and hydro-collapse-susceptible soils are considered geologic hazards in the Basin and Range. The site is not located in a zone of known earth fissure or major subsidence activity, though hydro-collapse soils may affect the project.

Excavation Conditions

According to the report*: Native soils consisted of dense silty sands and sands that were moderately/heavily cemented in the form of caliche; which should be excavatable using conventional construction equipment though may call for heavy duty excavation equipment with depth. Additionally, large granitic boulders are known to be buried within alluvial fan deposits and make be difficult to remove. The granular materials were relatively dry, and could be prone to caving during some excavations, and will call for sloping and/or shoring. We anticipate a shoring system will be required due to basement excavations. Groundwater was not encountered during drilling and is not anticipated to affect the site, however, groundwater levels can fluctuate over time. Bedrock was not encountered on the site, however, if areas of hard cementation are encountered they could slow the speed of excavations on the site.

Foundation/Slab Support

According to the report*: We understand a 2-story basement is planned; we recommend that building foundations be supported on a layer of non-expansive engineered fill that extends 2 feet below the foundation bearing grade or to competent native soil, whichever is deeper. We encountered very dense cemented soils at the proposed final depth of the structure. Following approval, the base should be scarified and compacted in place prior to replacing the soil below the building. In slab on grade areas, following the removal of vegetation, the subgrade should be proofrolled and repaired. The approved subgrade should be scarified, moisture conditioned, and compacted.

Soil Reuse

According to the report*: Site soils are generally suitable for re-use as engineered fill across provided they are free of deleterious materials, and meet fill requirements in Appendix C. We recommend the use of non-expansive structural fill that is free of deleterious materials, and is properly moisture conditioned and compacted to 95% or more of the standard Proctor maximum dry density (ASTM D 698).

Pavement Design: According to the report*:

Roadway Type	*Subgrade Preparation*	*Pavement Section*
Parking Area Light Duty	Proof-rolled and compacted	3-in asphalt & 6-in aggregate base
Parking Area Heavy Duty	Proof-rolled and compacted	4-in asphalt & 6-in aggregate base

This summary in no way replaces or overrides the detailed sections of the report*

2. REPORT OVERVIEW & LIMITATIONS

2.1 Report Overview

To develop this report, Partner accessed existing information and obtained site specific data from our exploration program. Partner also used standard industry practices and our experience on previous projects to perform engineering analysis and provide recommendations for construction along with construction considerations to guide the methods of site development. The opinions on the cover letter of this report do not constitute engineering recommendations, and are only general, based on our recent anecdotal experiences and not statistical analysis. Section 1.0, Executive Geotechnical Summary, compiles data from each of the report sections, while each of sections in the report presents a detailed description of our work. The detailed descriptions in Section 5.0 and Appendix C constitute our engineering recommendations for the project, and they supersede the Executive Geotechnical Summary.

The report overview, including a description of the planned construction and a list of references, as well as an explanation of the report limitations is provided in Section 2.0. The findings of Partner's geologic review are included in Section 3.0 Geologic Conditions and Hazards. The descriptions of our methods of exploration and testing, as well as our findings are included in Section 4.0 Geotechnical Exploration and Laboratory Results. In addition, logs of our exploration excavations are included in Appendix A of the report, and laboratory testing is included in Appendix B of the report. Site Location and Site Plan maps are included as Figures in the report.

2.2 Assumed Construction

Partner's understanding of the planned construction was based on information provided by the project team. The proposed site plan is included as Figure 2 to this report. Partner's assumptions regarding the new construction are presented in the below table.

Property Data	
Property Use:	New Internalized Community Storage
Building footprint/height	~32,587 sf, 2-stories above grade and 2-stories below grade
Land Acreage (Ac):	Approx. 3.6 Ac.
Number of Buildings:	1
Expected Cuts and Fills	25 feet for 2-story basement
Type of Construction:	Concrete slab on grade, masonry or metal framing
Foundations Type	Spread footings, Slab on grade
Anticipated Loads	4,000 psf
Traffic Loading	Parking lot/ dumpster pad
Site Information Sources:	RKAA Architects, Inc., *"Internalized Community Storage"*, SP-1 6/6/18

2.3 References

The following references were used to generate this report:

Natural Hazards in Arizona, AZGS Online, accessed 7/17/18

Richard, S.M., Reynolds, S.J., Spencer, J.E., and Pearthree, P.A., 2000, Geologic map of Arizona: Arizona Geological Survey, Map 35, scale 1:1,000,000

Federal Emergency Management Agency, FEMA Flood Map Service Center (online), accessed 7/17/18

Google Earth Pro (Online), accessed 7/17/18

Historic Aerials by NETR Online, accessed 7/17/18

United States Geological Survey, Lower 48 States 2014 Seismic Hazard Map, accessed online 7/17/18

United States Geologic Survey, Earthquake Hazards Program (Online), 7/17/18

2.4 Limitations

The conclusions, recommendations, and opinions in this report are based upon soil samples and data obtained in widely spaced borings, and are subject to field confirmation that the samples we obtained were representative of site conditions. If conditions on the site are different than what was encountered in our borings, the report recommendations should be reviewed by our office, and new recommendations should be provided based on the new information and possible additional exploration if needed. It should be noted that geotechnical subsurface evaluations are not capable of predicting all subsurface conditions, and that our evaluation was performed to industry standards at the time of the study, no other warranty or guarantee is made.

Likewise, our document review and geologic research study made a good-faith effort to review readily available documents that we could access and were aware of at the time, as listed in this letter. We are not able to guarantee that we have discovered, observed, and reviewed all relevant site documents and conditions. If new documents or studies are available following the completion of the report, the recommendations herein should be reviewed by our office, and new recommendations should be provided based on the new information and possible additional exploration if needed.

This report is intended for the use of the client in its entirety for the proposed project as described in the text. Information from this report is not to be used for other projects or for other sites. All of the report must be reviewed and applied to the project or else the report recommendations may no longer apply. If pertinent changes are made in the project plans or conditions are encountered during construction that appear to be different than indicated by this report, please contact this office for review. Significant variations may necessitate a re-evaluation of the recommendations presented in this report. The findings in this report are valid for one year from the date of the report.

If parties other than Partner are engaged to provide construction geotechnical services, they must be notified that they will be required to assume complete responsibility for the geotechnical phase of the project by concurring with the findings and recommendations in this report or providing alternate recommendations.

3. GEOLOGIC CONDITIONS & HAZARDS

This section presents the results of a geologic review performed by Partner, for a proposed new construction on site. The general location of the project is shown on Figure 1.

3.1 Site Location and Project Information

The planned construction will be situated on a currently undeveloped parcel in Scottsdale, Arizona. The immediately surrounding properties consist of residential homes and arterial streets. Figure 2 presents the project site and the locations of our site exploration. Based on our review of available documents, the site has had the following previous uses:

Historical Use Information		
Period/Date	**Source**	**Description/Use**
1962 – Present	Historical Aerial Photographs and Onsite Observations	Undeveloped Land

3.2 Geologic Setting

The project site is located in city of Scottsdale in the Basin and Range geophysical province of Arizona. Phoenix is adjacent to the Salt River and is composed of quaternary river deposits and Aeolian sand. The site was previously developed with signs of previous construction. Remnants of the previous grading activities, including old fills and previous construction materials are expected to impact the project. This portion of the country is susceptible to low seismic activity.

Geologic Data		
Parameter	**Value**	**Source**
Geomorphic Zone	Basin and Range	AZGS
Ground Elevation	1164 feet above MSL	USGS
Flood Elevation	Zone X (0.2% Annual Chance of flooding)	FEMA
Seismic Hazard Zone	Low	USGS
Geologic Hazards	Collapsible Soils, Subsidence, Expansive Clay	AZGS
Surface Cover	Fill	Google Earth
Site Modifications	Previous Retail Space	Google Earth
Surficial Geology	Alluvium	USGS
Depth to Bedrock	150+ feet	Partner ESA
Groundwater Depth	200+ feet	Partner ESA

3.3 Geologic Hazards

The project site is located in City of Scottsdale in the Basin and Range geophysical province of Arizona. Scottsdale is adjacent to McDowell Mountains and New River Mountains. Site soils were composed of alluvial fan deposits composed of silty sands and cemented soils (caliche). The site has historically been undeveloped with adjacent residential and commercial development. Earth fissures, subsidence and hydro-collapse-susceptible soils are considered geologic hazards in the Basin and Range. The site is not located in a zone of known earth fissure or major subsidence activity, though hydro-collapse soils may affect the project along with caliche and large buried boulders.

This portion of Arizona is considered to have low to moderate seismic activity. Seismic design parameters are provided below.

Seismic Item	***Value***	***Seismic Item***	***Value***
Site Classification	D	Seismic Design Category	B
Fa	1.6	Fv	2.4
Ss	0.227g	S_1	0.069g
S_{MS}	0.363g	S_{M1}	0.166g
S_{DS}	0.242g	S_{D1}	0.111g

4. GEOTECHNICAL EXPLORATION & LABORATORY RESULTS

Our evaluation of soils on the site included field exploration and laboratory testing. The field exploration and laboratory testing programs are briefly described below. Data reports from the field exploration and laboratory testing are provided in Appendix A and Appendix B, respectively.

4.1 Soil Borings

The soil boring program was conducted on June 28, 2018. Six (6) borings were advanced by the use of a truck-mounted drill using hollow stem auger drilling techniques. The borings were made to a depth of 17-20 feet in the buildings footprint (B1 – B6). The approximate locations of the exploratory borings and infiltration tests are shown on Figure 2.

Logs of subsurface conditions encountered in the borings were prepared in the field by a representative of Partner Engineering. Soil samples consisting of relatively undisturbed brass ring samples and Standard Penetration Tests (SPT) samples were collected at approximately 2.5 and 5-foot depth intervals and were returned to the laboratory for testing. The SPTs were performed in accordance with ASTM D 1586. Typed boring logs were prepared from the field logs and are presented in Appendix A. A summary table description is provided below:

Surficial Geology		
Strata	**Depth to Bottom of Layer (bgs*)**	**Description**
Surface Cover	1 feet	Vegetation and topsoil
Native Stratum 1	15 feet	Dense Silty Sand
Native Stratum 2	20 feet	Very Dense Sand with cementation (Caliche)
Groundwater	NA	In boring
Bedrock	NA	Not observed

bgs – below ground surface

4.2 Groundwater/Soil Moisture:

Groundwater was not encountered on the site during drilling. However, groundwater levels fluctuate over time and may be different at the time of construction and during the project life.

4.3 Laboratory Evaluation

Selected samples collected during drilling activities were tested in the laboratory to assist in evaluating engineering properties of subsurface materials at the site. The results of laboratory analyses are presented in Appendix B. Site soils contained silty sands.

5. GEOTECHNICAL RECOMMENDATIONS & PARAMETERS

The following discussion of findings for the site is based on the assumed construction, geologic review, results of the field exploration, and laboratory testing programs. The recommendations of this report are contingent upon adherence to Appendix C of this report, General Geotechnical Design and Construction Considerations. For additional details on the below recommendations, please see Appendix C.

5.1 Geotechnical Recommendations

- The proposed construction is generally feasible from a geotechnical perspective provided the recommendations and assumptions of this report are followed.

Geologic/General Site Considerations

- The project site is located in City of Scottsdale in the Basin and Range geophysical province of Arizona. Scottsdale is adjacent to McDowell Mountains and New River Mountains. Site soils were composed of alluvial fan deposits composed of silty sands and cemented soils (caliche). The site has historically been undeveloped with adjacent residential and commercial development. Earth fissures, subsidence and hydro-collapse-susceptible soils are considered geologic hazards in the Basin and Range. The site is not located in a zone of known earth fissure or major subsidence activity, though hydro-collapse soils may affect the project along with caliche and large buried boulders.

Excavation Considerations

- Native soils consisted of dense silty sands and sands that were moderately/heavily cemented in the form of caliche; which should be excavatable using conventional construction equipment though may call for heavy duty excavation equipment with depth. Additionally, large granitic boulders are known to be buried within alluvial fan deposits and make be difficult to remove. The granular materials were relatively dry, and could be prone to caving during some excavations, and will call for sloping and/or shoring. Groundwater was not encountered during drilling and is not anticipated to affect the site, however, groundwater levels can fluctuate over time. Bedrock was not encountered on the site, however, if areas of hard cementation are encountered they could slow the speed of excavations on the site.
- Given the depth of the planned excavation a specially designed excavation will be needed to establish foundation subgrade levels. Such a system would likely consist of a drilled soldier pile wall with lagging and soil anchors. The design of this system should be performed by the contractor performing the work, and should consider the impacts of installing anchors, and deflection of the soil behind the walls. All of these factors could result in damage to surrounding properties. The design can use soil data from section 5.2 of this report. The groundwater levels used in the design can be adjusted based on the monitoring data obtained as well as engineering judgement. Appendix C of this report contains a section regarding additional Excavation and Dewatering considerations for the site.

Spread Foundations

- We understand a 2-story basement is planned; we recommend that building foundations be supported on a layer of non-expansive engineered fill that extends 2 feet below the foundation bearing grade or to competent native soil, whichever is deeper. We encountered very dense cemented soils at the proposed final depth of the structure. Following approval, the base should be scarified and compacted in place prior to replacing the soil below the building. In slab on grade areas, following the removal of vegetation, the subgrade should be proofrolled and repaired. The approved subgrade should be scarified, moisture conditioned, and compacted.

On-Grade Construction Considerations

- All vegetation and remnants of previous construction (if encountered) should be removed from structural areas of the site. In new fill, planned slabs, and pavement areas, cleaned subgrade should be proofrolled and evaluated by the engineer with a loaded water truck (4,000 gallon) or equivalent rubber tired equipment. Soft or unstable areas should be repaired per the direction of the engineer. Following approval, the subgrade should be scarified, moisture conditioned, and compacted. The improvements should extend a distance of 2 feet beyond the planned area of new construction at finished grade (for fill sites, 2 feet inside the top of slope).

Soil Reuse Considerations

- Site soils are generally suitable for re-use as engineered fill across provided they are free of deleterious materials, and meet fill requirements in Appendix C. We recommend the use of non-expansive structural fill that is free of deleterious materials, and is properly moisture conditioned and compacted to 95% or more of the standard Proctor maximum dry density (ASTM D 698).

Concrete Considerations

- Concrete should be corrosion resistant, using Type II/V Portland Cement, and fly ash mixtures of 25 percent cement replacement. We recommend a water/cement ratio of 0.40 or less. Site soil may be corrosive to un-protected metallic elements such as pipes, poles, etc. Concrete exposed to freezing weather in cold climates should be air-entrained.

Site Storm Water Considerations

- Site soils were generally clayey sands, and potentially favorable for infiltration basins pending additional testing. Surface drainage and landscaping design should be carefully planned to protect the new structures from erosion/undermining, and to maintain the site earthwork and structure subgrades in a relatively consistent moisture condition. Water should not flow towards or pond near to new structures, and high-water demand plants should not be planned near to structures.

5.2 Geotechnical Parameters

Based on the findings of our field and laboratory testing, we recommend that design and construction proceed per industry accepted practices and procedures, as described in Appendix C, General Geotechnical Design and Construction Considerations (Considerations).

Subgrade Preparation Parameters – (hyperlink to Construction Considerations)

Subgrade Preparation				
Structure	**Bearing Capacity**	**Embedment Depth**	**Bearing Surface [a]**	**Settlement [d]**
Grade Slabs	k=150 pci [b]	NA	Scarified and re-compacted native soils per Sec 5.1	<1 inch
Spread Foundations	4,000 [c] psf	25 Feet	Engineered fill to 2 ft depth, over compacted in-place native soil	<1 inch

[a] Repairs in bearing *surface areas should be structural fill per the recommendation of the* Earthwork *section of Appendix C that is moisture conditioned to within 3 percent below to optimum moisture content and compacted to 95 percent or more of the soil maximum dry density per ASTM D698. Expansive material should not be located within the upper* 3 feet of the soil subgrade.

[b] *Subgrade modulus value "k", assuming the grade slab is supported by aggregate layer roughly equal to slab thickness (minimum 4 inches)*

[c] *Can be increased by 1/3 for temporary loading such as seismic and wind*

[d] Differential settlement is expected to be half of total settlement

Paving Structural Sections – (hyperlink to Construction Considerations)

Pavement Sections		
Roadway Type	**Subgrade Preparation [a]**	**Pavement Section [b]**
Parking Area Light Duty	Proof-rolled and compacted	3-in asphalt & 6-in aggregate base
Parking Area Heavy Duty	Proof-rolled and compacted	4-in asphalt & 6-in aggregate base

[a] *Repairs in proofrolled areas should be structural fill per the recommendation of the* Earthwork *(hyperlink to Construction Considerations) that is moisture conditioned to within 3 percent below to optimum moisture content and compacted to 95 percent or more of the soil maximum dry density per ASTM D698.*

Laterally Loaded Structures Parameters– (hyperlink to Construction Considerations)

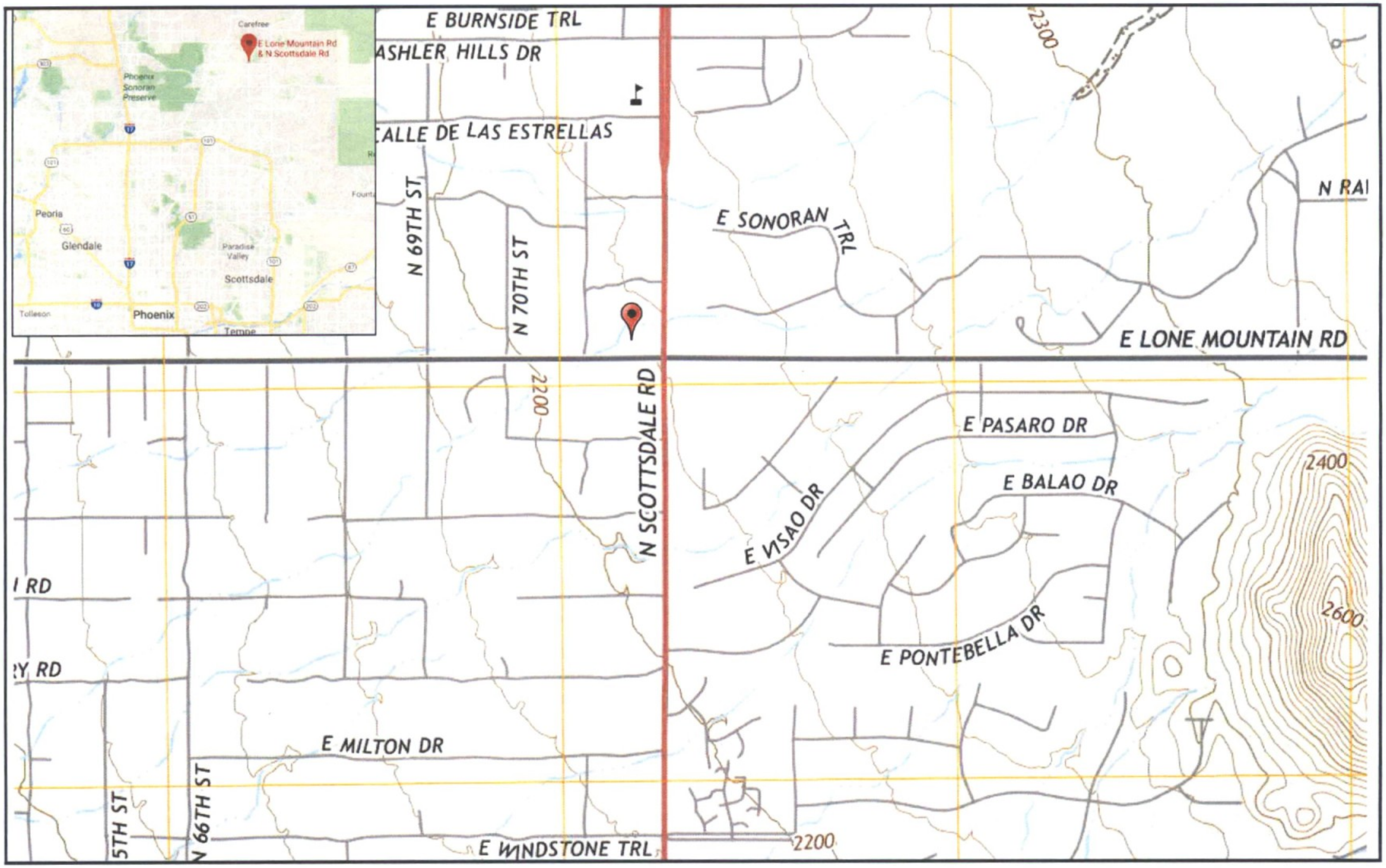
Lateral Earth Pressures –				
Soil Type	**Coefficient of Friction (μ)**	**Static Fluid Pressure (pcf)**	**Active Fluid Pressure (pcf)**	**Passive Fluid Pressure (pcf)**
Native Silty Sand (Upper 15 feet)	0.5	50	35	400
Native Cemented Sandy Soil (15 – 30 ft)	0.5	55	40	360

[a] *Assumed GW table at 100 ft bgs, for underground structures where water is only on one side, the hydrostatic pressure of 62.4 psf should be added*

FIGURES

- Site Location Map
- Site Exploration Map

PARTNER



N

Key:

Approximate Site Location

Key:

Approximate Boring Location

APPENDIX A

Boring Logs

PARTNER

BORING LOG KEY - EXPLANATION OF TERMS

SURFACE COVER: General discription with thickness to the inch, ex. Topsoil, Concrete, Asphalt, etc,

FILL: General description with thickness to the 0.5 feet. Ex. Roots, Debris, Processed Materials (Pea Gravel, etc.)

NATIVE GEOLOGIC MATERIAL: Deposit type, 1.Color, 2.moisture, 3.density, 4.SOIL TYPE, other notes - Thickness to 0.5 feet

1. Color - Generalized

Light Brown (usually indicates dry soil, rock, caliche)
Brown (usually indicates moist soil)
Dark Brown (moist to wet soil, organics, clays)
Reddish (or other bright colors) Brown (moist, indicates some soil development/or residual soil)
Greyish Brown (Marine, sub groundwater - not the same as light brown above)
Mottled (brown and gray, indicates groundwater fluctuations)

2. Moisture

dry - only use for wind-blown silts in the desert
damp - soil with little moisture content
moist - near optimum, has some cohesion and stickyness
wet - beyond the plastic limit for clayey soils, and feels wet to the touch for non clays
saturated - Soil below the groundwater table, sampler is wet on outside

3. Density (based on blow counts or hand evaluation)

SPT	Ring	Granular	Cohesive		
0-5	0-7	very loose	very soft	Unsuitable	Thumb penetrates through
5-10	7-14	loose	soft	<1,500psf	Thumb penetrates part way
10-20	14-28	medium dense	firm	<3,000psf	Thumb dents only
20-75	28-100	dense	stiff	>3,000psf	Thumbnail dents
75+	100+	very dense	hard	Hard Dig	Thumbnail does not dent

4. Classification

Determine percent Gravel (bigger than 3/8")
Determine percent fines (silt and clay feel soft, with no grit)
Determine percent sand (between silt and clay, feels gritty)
Determine if clayey (make soil moist, if it easily roll into a snake it is clayey)

Sands and gravels (more gravel starts with G, more sand starts with S)

GP	SP	Mostly sand and gravel, with less than 5 % fines	sandy GRAVEL	SAND
GP-GM	SP-SM	Mostly sand and gravel 7-12% fines, non-clayey	sandy GRAVEL with silt	SAND with Silt
GP-GC	SP-SC	Mostly sand and gravel 7-12% fines, clayey	sandy GRAVEL with clay	SAND with clay
GC	SC	Mostly sand and gravel >12% fines clayey	clayey GRAVEL	clayey SAND
GM	SM	Mostly sand and gravel >12% fines non-clayey	silty GRAVEL	silty SAND

Cohesive Soil (generaly forms long chunks (more than 2 inches) in sampler

ML	Soft, non clayey	SILT with sand
MH	Very rare, holds a lot of water, and is pliable with very low strength	high plasticity SILT
CL	If sandy can be hard when dry, will be stiff/plastic when wet	CLAY with sand/silt
CH	Hard and resiliant when dry, very strong/sticky when wet (may have sand in it)	FAT CLAY

H = Liquid limit over 50%, L - LL under 50%
C = Clay
M = Silt

Samplers

S = Standard split spoon (SPT)
R = Modified ring
Bulk = Excavation spoils
ST = Shelby tube
C = Rock core

Boring Number:	B1	Boring Log Page 1 of 1	
Location:	North west corner of proposed building	Date Started:	6/28/2018
Site Address:	North west corner of Lone Mtn. Rd. & Scottsdale Rd.	Date Completed:	6/28/2018
	Scottsdale, Arizona 85266	Depth to Groundwater:	Dry
Project Number:	18-218317.1	Field Technician:	Andres A.
Drill Rig Type:	CME-75	**Partner Engineering and Science**	
Sampling Equipment:	Split Spoon Sampler and Rings	**4518 North 12th Street**	
Borehole Diameter:	8"	**Phoenix, Arizona 85016**	

Depth	Sample	N-Value	USCS	Description
0				**SURFACE COVER**: Vegitated soil
1				
2	S	80 / 10	SM	**NATIVE**: Brown, dry, dense, silty SAND with gravel
3				
4				
5	S	74 / 10		
6				
7				
8				
9				
10	S	59		
11				
12				
13				
14				
15	S	59		
16				
17				
18				
19				
20	S	26	CL	
21				Boring terminated at 21.5'
22				Backfilled with spoils upon completion
23				Groundwater not encountered
24				
25				
26				
27				
28				
29				

Boring Number:	B2	Boring Log Page 1 of 1	
Location:	South west corner of proposed building	Date Started:	6/28/2018
Site Address:	North west corner of Lone Mtn. Rd. & Scottsdale Rd.	Date Completed:	6/28/2018
	Scottsdale, Arizona 85266	Depth to Groundwater:	Dry
Project Number:	18-218317.1	Field Technician:	Andres A.
Drill Rig Type:	CME-75	**Partner Engineering and Science**	
Sampling Equipment:	Split Spoon Sampler and Rings	**4518 North 12th Street**	
Borehole Diameter:	8"	**Phoenix, Arizona 85016**	

Depth	Sample	N-Value	USCS	Description
0				**SURFACE COVER**: Vegitated soil
1				
2	S	36	SM	**NATIVE**: Brown, dry, dense, silty SAND with abundant gravel
3				
4				
5	S	19		
6				
7				
8				
9				
10	S	27		
11				
12				
13				
14				
15	S	50 / 5		
16				
17				
18				
19				
20	S	48	SP	Light brown, dry, dense, SAND with silt
21				Boring terminated at 21.5'
22				Backfilled with spoils upon completion
23				Groundwater not encountered
24				
25				
26				
27				
28				
29				

Boring Number:	B3	Boring Log Page 1 of 1	
Location:	North center portion of proposed building	Date Started:	6/28/2018
Site Address:	North west corner of Lone Mtn. Rd. & Scottsdale Rd.	Date Completed:	6/28/2018
	Scottsdale, Arizona 85266	Depth to Groundwater:	Dry
Project Number:	18-218317.1	Field Technician:	Andres A.
Drill Rig Type:	CME-75	**Partner Engineering and Science**	
Sampling Equipment:	Split Spoon Sampler and Rings	**4518 North 12th Street**	
Borehole Diameter:	8"	**Phoenix, Arizona 85016**	

Depth	Sample	N-Value	USCS	Description
0				**SURFACE COVER**: Vegitated soil
1				
2	S	38	SM	**NATIVE**: Brown, dry, dense, silty SAND
3				
4				
5	S	46		
6				
7				
8				
9				
10	S	41		
11				
12				
13				
14				
15	S	50 / 6		
16				
17				
18				
19				
20	S	85 / 7		
21				Boring terminated at 21.5'
22				Backfilled with spoils upon completion
23				Groundwater not encountered
24				
25				
26				
27				
28				
29				

Boring Number:	B4		Boring Log Page 1 of 1
Location:	South east corner of proposed building	Date Started:	6/28/2018
Site Address:	North west corner of Lone Mtn. Rd. & Scottsdale Rd.	Date Completed:	6/28/2018
	Scottsdale, Arizona 85266	Depth to Groundwater:	Dry
Project Number:	18-218317.1	Field Technician:	Andres A.
Drill Rig Type:	CME-75	**Partner Engineering and Science**	
Sampling Equipment:	Split Spoon Sampler and Rings	**4518 North 12th Street**	
Borehole Diameter:	8"	**Phoenix, Arizona 85016**	

Depth	Sample	N-Value	USCS	Description
0				**SURFACE COVER**: Vegitated soil
1				
2	S	4	SP	**NATIVE**: Light brown, dry, very loose, SAND
3				
4				
5	S	33		Dense
6				
7	S	25		
8				
9				
10	S	75 / 8	SM	Light brown, dry, very dense, silty SAND with gravel
11				
12				
13				
14				
15	S	69 / 10	SP	Light brown, dry, dense, SAND
16				
17				
18				Auger refusal at 17'
19				Backfilled with spoils upon completion
20				Groundwater not encountered
21				
22				
23				
24				
25				
26				
27				
28				
29				

Boring Number:	B5		Boring Log Page 1 of 1
Location:	Center of proposed building	Date Started:	6/28/2018
Site Address:	North west corner of Lone Mtn. Rd. & Scottsdale Rd.	Date Completed:	6/28/2018
	Scottsdale, Arizona 85266	Depth to Groundwater:	Dry
Project Number:	18-218317.1	Field Technician:	Andres A.
Drill Rig Type:	CME-75	**Partner Engineering and Science**	
Sampling Equipment:	Split Spoon Sampler and Rings	**4518 North 12th Street**	
Borehole Diameter:	8"	**Phoenix, Arizona 85016**	

Depth	Sample	N-Value	USCS	Description
0				**SURFACE COVER**: Vegitated soil
1				
2	S	12	SM	**NATIVE**: Brown, dry, medium dense, silty SAND
3				
4				
5	S	4		Very loose
6				
7	S	65 / 8		Dense
8				
9				
10	S	63		
11				
12				
13				
14				
15	S	50 / 5		
16				
17				
18				
19				
20	S	71 / 11		
21				Boring terminated at 21.5'
22				Backfilled with spoils upon completion
23				Groundwater not encountered
24				
25				
26				
27				
28				
29				

Boring Number:	B6		Boring Log Page 1 of 1
Location:	North east corner of proposed building	Date Started:	6/28/2018
Site Address:	North west corner of Lone Mtn. Rd. & Scottsdale Rd.	Date Completed:	6/28/2018
	Scottsdale, Arizona 85266	Depth to Groundwater:	Dry
Project Number:	18-218317.1	Field Technician:	Andres A.
Drill Rig Type:	CME-75	**Partner Engineering and Science**	
Sampling Equipment:	Split Spoon Sampler and Rings	**4518 North 12th Street**	
Borehole Diameter:	8"	**Phoenix, Arizona 85016**	

Depth	Sample	N-Value	USCS	Description
0				**SURFACE COVER**: Vegitated soil
1				
2	S	30	SM	**NATIVE**: Brown, dry, dense, silty SAND
3				
4				
5	S	29	SP	Brown, dry, dense, SAND with gravel
6				
7	S	71 / 10	SM	Brown, dry, dense, silty SAND
8				
9				
10	S	50 / 6		
11				
12				
13				
14				
15	S	16		Medium dense
16				
17				
18				
19				
20	S	70 / 10		Dense
21				Boring terminated at 21.5'
22				Backfilled with spoils upon completion
23				Groundwater not encountered
24				
25				
26				
27				
28				
29				

APPENDIX B

Lab Data

PARTNER

LABORATORY TEST DATA

Index Test Results

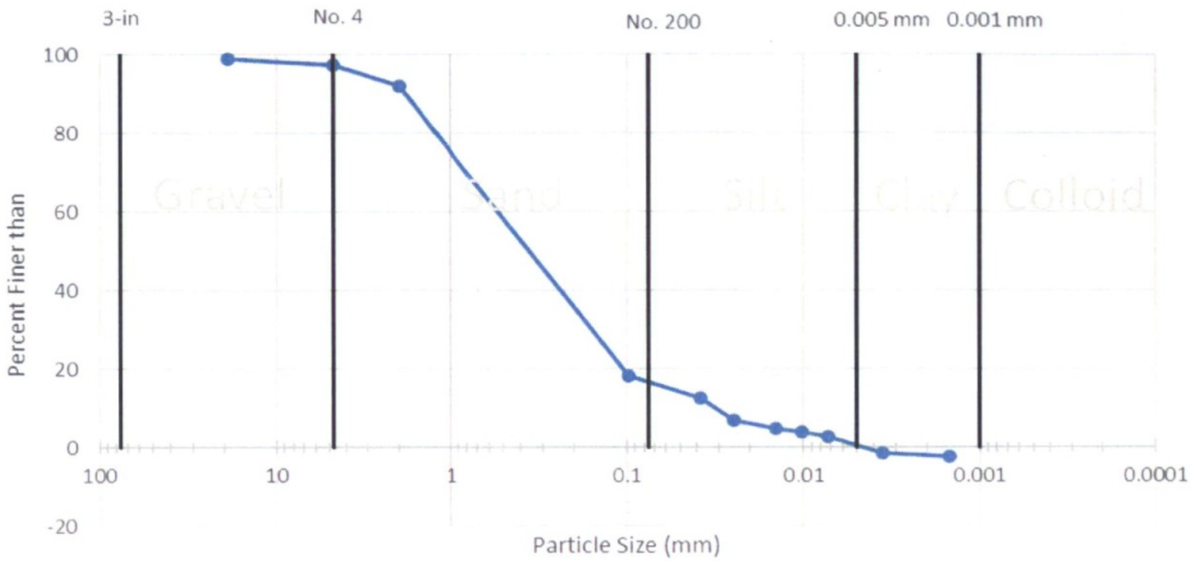
Soil Sample	*Plasticity Index*	*Liquid Limit*	*Fines Content (%)*	*Minus No. 10 Sieve Content (%)*
B1 @ 5 feet	NP	NP	18	92
B2 @ 15 feet	NP	NP	6	85
B4 @ 7 feet	NP	NP	8	83
B5 @ 2 feet	7	27	20	86
B6 @ 2 feet	NP	NP	18	83
B7 @ 25 feet	NP	NP	23	84
B7 @ 30 feet	NP	NP	12	85

In-Place Moisture and Density

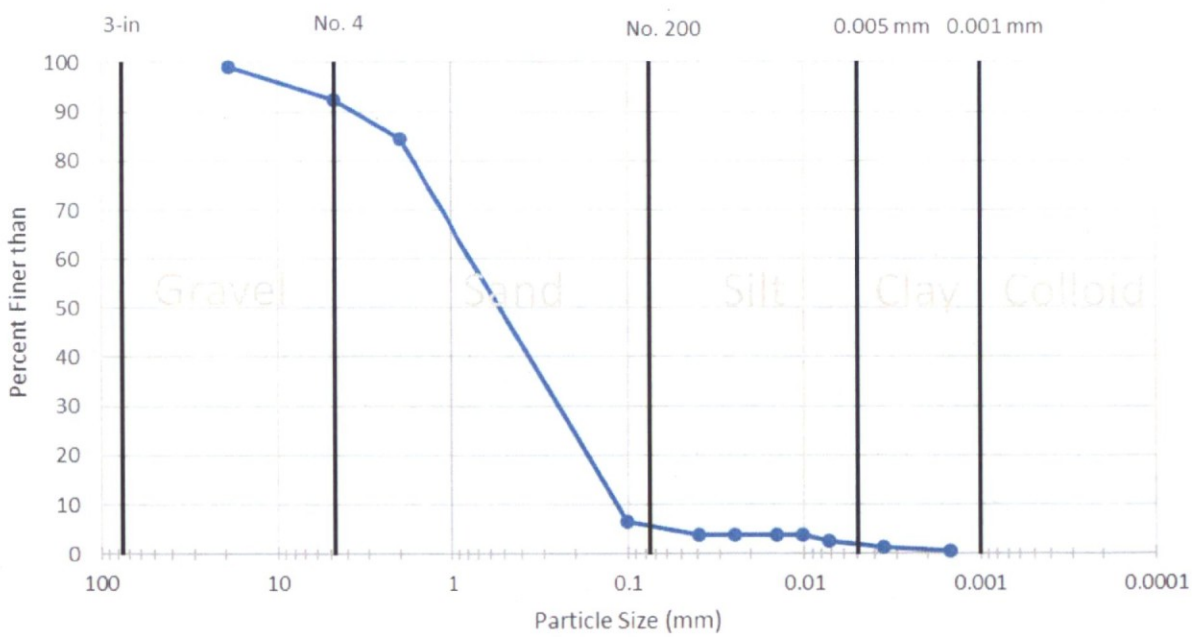
Soil Sample	*Moisture Content (%)*
B1 @ 5 feet	4.9
B2 @ 15 feet	2.8
B4 @ 7 feet	3.1
B5 @ 5 feet	2.4
B6 @ 2 feet	3.4
B7 @ 25 feet	3.2
B7 @ 30 feet	2.1

HYDROMETER TEST DATA

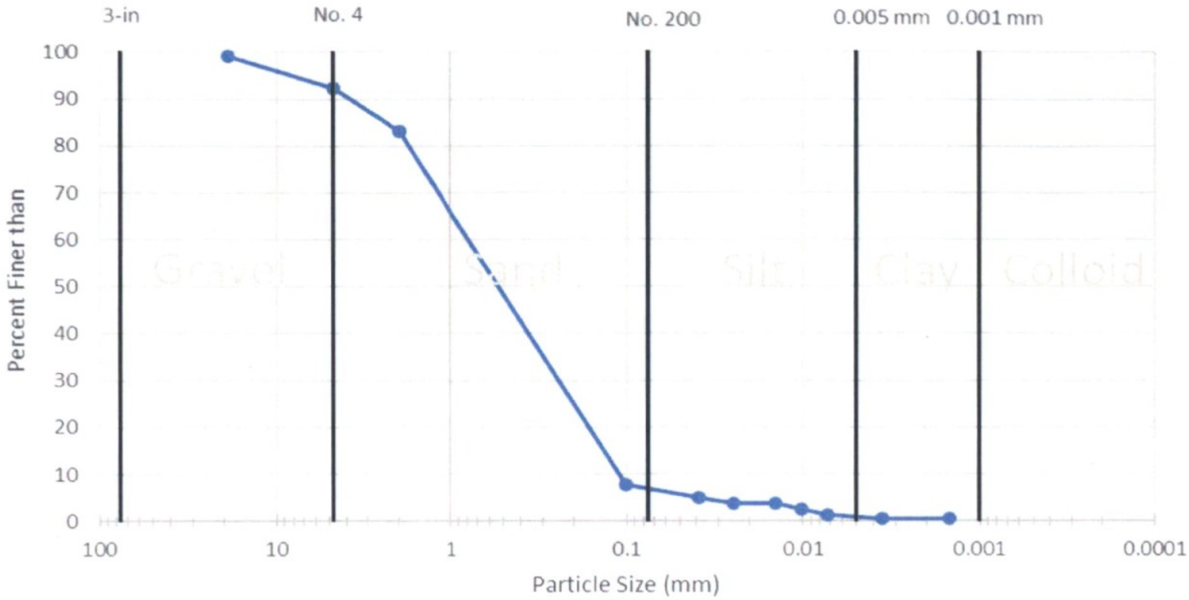
Grain Size Distribution
Boring B1 @ 5 ft



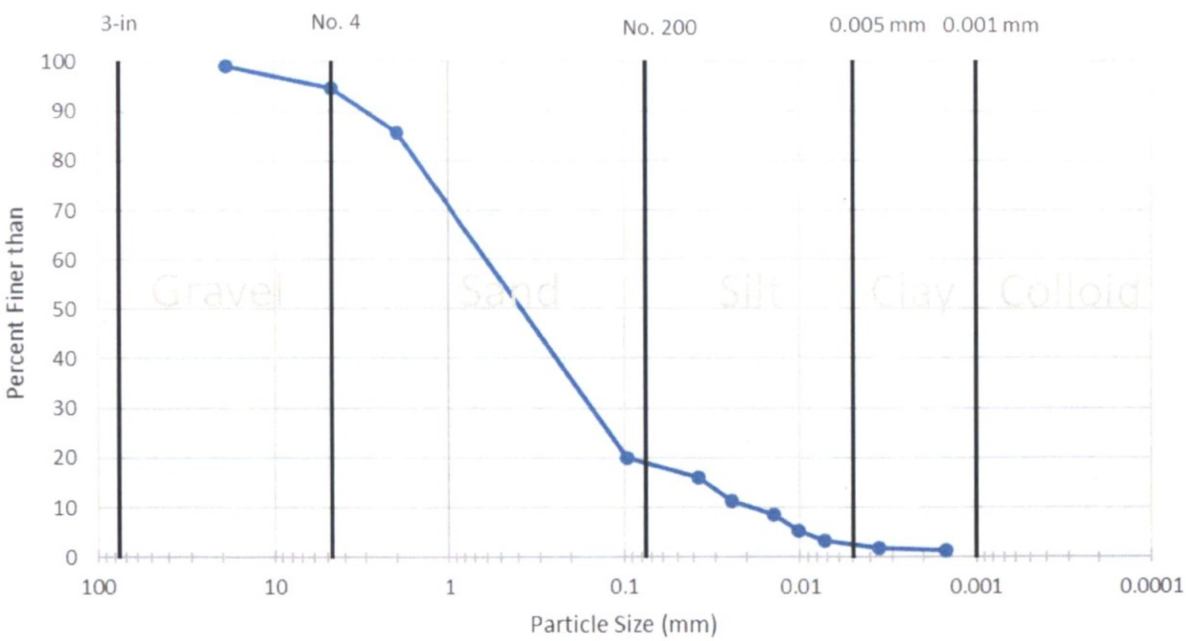
Grain Size Distribution
Boring B2 @ 15 ft



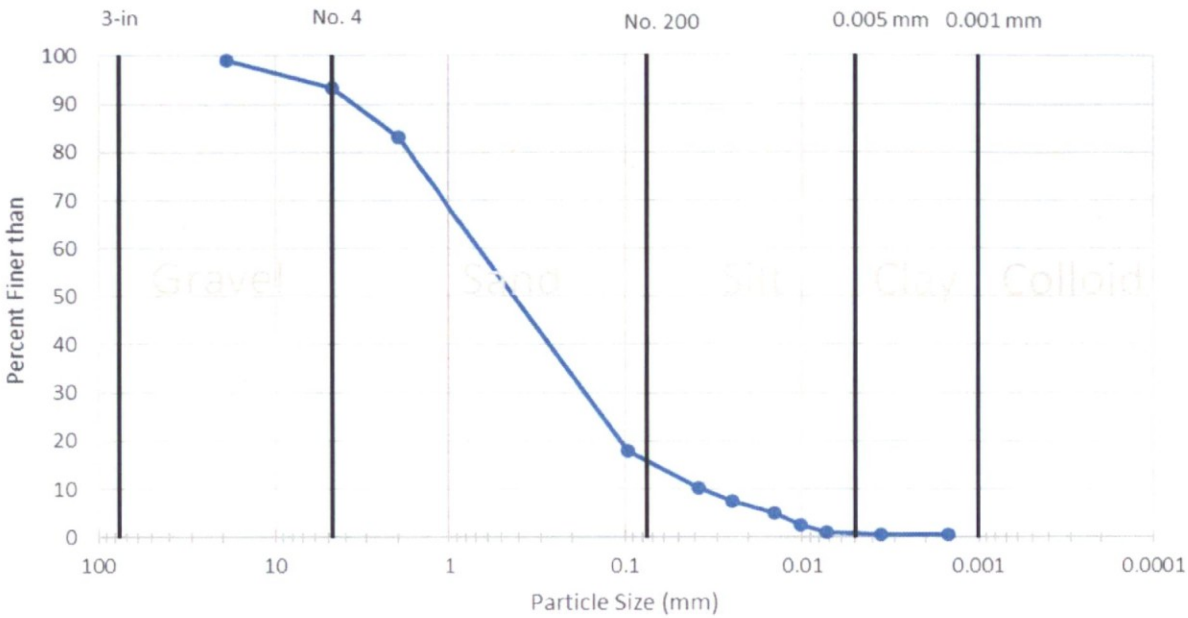
Grain Size Distribution
Boring B4 @ 7 ft



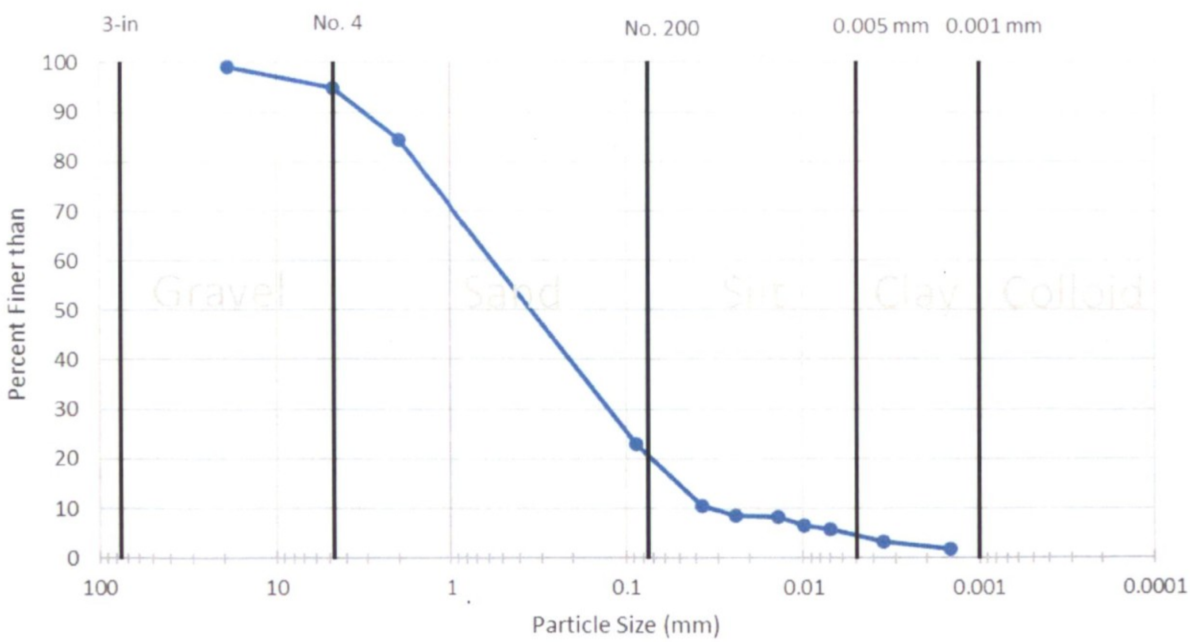
Grain Size Distribution
Boring B5 @ 5 ft



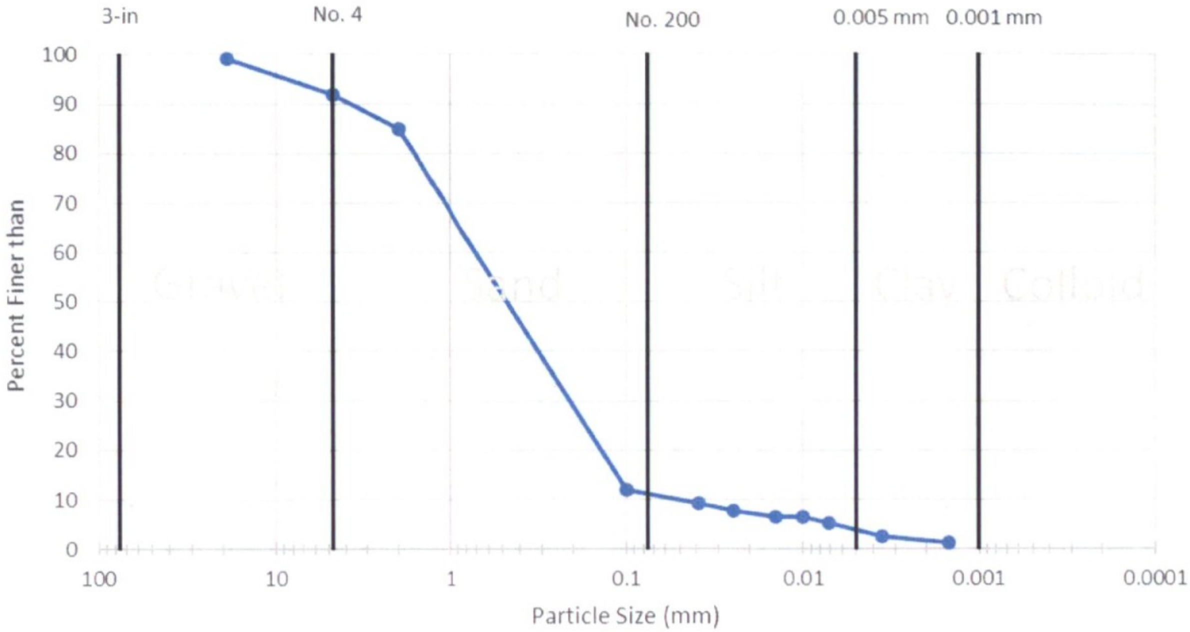
Grain Size Distribution
Boring B6 @ 2 ft



Grain Size Distribution
Boring B7 @ 25 ft



Grain Size Distribution
Boring B7 @ 30 ft



APPENDIX C

General Geotechnical Design and Construction Considerations

Subgrade Preparation

Earthwork – Structural Fill/Excavations

Underground Pipeline Installation – Structural Backfill

Cast-in-Place Concrete

Foundations

Laterally Loaded Structures

Excavations and Dewatering

Waterproofing and Drainage

Chemical Treatment of Soils

Paving

Site Grading and Drainage

PARTNER

SUBGRADE PREPARATION

1. In general, construction should proceed per the project specifications and contract documents, as well as governing jurisdictional guidelines for the project site, including but not limited to the applicable State Department of Transportation, City and/or County, Army Corps of Engineers, Federal Aviation, Occupational Safety and Health Administration (OSHA), and any other governing standard details and specifications. In areas where multiple standards are applicable the more stringent should be considered. Work should be performed by qualified, licensed contractors with experience in the specific type of work in the area of the site.
2. Subgrade preparation in this section is considered to apply to the initial modifications to existing site conditions to prepare for new planned construction.
3. Prior to the start of subgrade preparation, a detailed conflict study including as-builts, utility locating, and potholing should be conducted. Existing features that are to be demolished should also be identified and the geotechnical study should be referenced to determine the need for subgrade preparation, such as over-excavation, scarification and compaction, moisture conditioning, and/or other activities below planned new structural fills, slabs on grade, pavements, foundations, and other structures.
4. The site conflicts, planned demolitions, and subgrade preparation requirements should be discussed in a pre-construction meeting with the pertinent parties, including the geotechnical engineer, inspector, contractors, testing laboratory, surveyor, and others.
5. In the event of preparations that will require work near to existing structures to remain in-place, protection of the existing structures should be considered. This also includes a geotechnical review of excavations near to existing structures and utilities and other concerns discussed in General Geotechnical Design and Construction Considerations, EARTHWORK and UNDERGROUND PIPELINE INSTALLATION.
6. Features to be demolished should be completely removed and disposed of per jurisdictional requirements and/or other conditions set forth as a part of the project. Resulting excavations or voids should be backfilled per the recommendations in the General Geotechnical Design and Construction Considerations, EARTHWORK section.
7. Vegetation, roots, soils containing organic materials, debris and/or other deleterious materials on the site should be removed from structural areas and should be disposed of as above. Replacement of such materials should be in accordance with the recommendations in the General Geotechnical Design and Construction Considerations, EARTHWORK section
8. Subgrade preparation required by the geotechnical report may also call for as over-excavation, scarification and compaction, moisture conditioning, and/or other activities below planned structural fills, slabs on grade, pavements, foundations, and other structures. These requirements should be provided within the geotechnical report. The execution of this work should be observed by the geotechnical engineering representative or inspector for the site. Testing of the subgrade preparation should be performed per the recommendations in the General Geotechnical Design and Construction Considerations, EARTHWORK section.

9. Subgrade Preparation cannot be completed on frozen ground or on ground that is not at a proper moisture condition. Wet subgrades may be dried under favorable weather if they are disked and/or actively worked during hot, dry, weather, when exposed to wind and sunlight. Frozen ground or wet material can be removed and replaced with suitable material. Dry material can be pre-soaked, or can have water added and worked in with appropriate equipment. The soil conditions should be monitored by the geotechnical engineer prior to compaction. Following this type of work, approved subgrades should be protected by direction of surface water, covering, or other methods, otherwise, re-work may be needed.

EARTHWORK – STRUCTURAL FILL

1. In general, construction should proceed per the governing jurisdictional guidelines for the project site, including but not limited to the applicable State Department of Transportation, City and/or County, Army Corps of Engineers, Federal Aviation, Occupational Safety and Health Administration (OSHA), and any other governing standard details and specifications. In areas where multiple standards are applicable the more stringent should be considered. Work should be performed by qualified, licensed contractors with experience in the specific type of work in the area of the site.
2. Earthwork in this section is considered to apply to the re-shaping and grading of soil, rock, and aggregate materials for the purpose of supporting man-made structures. Where earthwork is needed to raise the elevation of the site for the purpose of supporting structures or forming slopes, this is referred to as the placement of structural fill. Where lowering of site elevations is needed prior to the installation of new structures, this is referred to as earthwork excavations.
3. Prior to the start of earthwork operations, the geotechnical study should be referenced to determine the need for subgrade preparation, such as over-excavation or scarification and compaction of unsuitable soils below planned structural fills, slabs on grade, pavements, foundations, and other structures. These required preparations should be discussed in a pre-construction meeting with the pertinent parties, including the geotechnical engineer, inspector, contractors, testing laboratory, surveyor, and others. The preparations should be observed by the inspector or geotechnical engineer representative, and following such subgrade preparation, the geotechnical engineer should observe the prepared subgrade to approve it for the placement of earthwork fills or new structures.
4. Structural fill materials should be relatively free of organic materials, man-made debris, environmentally hazardous materials, and brittle, non-durable aggregate, frozen soil, soil clods or rocks and/or any other materials that can break down and degrade over time.
5. In deeper structural fill zones, expansive soils (greater than 1.5 percent swell at 100 pounds per square foot surcharge) and rock fills (fills containing particles larger than 4 inches and/or containing more than 35 percent gravel larger than ¾-inch diameter or more than 50 percent gravel) may be used with the approval and guidance of the geotechnical report or geotechnical engineer. This may require the placement of geotextiles or other added costs and/or conditions. These conditions may also apply to corrosive soils (less than 2,000 ohm-cm resistivity, more than 50 ppm chloride content, more than 0.1 percent sulfates)
6. For structural fill zones that are closer in depth below planed structures, low expansive materials, and materials with smaller particle size are generally recommended, as directed by the geotechnical report (see criteria above in 5). This may also apply to corrosive soils.
7. For structural fill materials, in general the compaction equipment should be appropriate for the thickness of the loose lift being placed, and the thickness of the loose lift being placed should be at least two times the maximum particle size incorporated in the fill.
8. Fill lift thickness (including bedding) should generally be proportioned to achieve 95 percent or more of a standard proctor (ASTM D689) maximum dry density (MDD) or 90 percent or more of a modified proctor (ASTM D1557) MDD, depending on the state practices. For subgrades below

roadways, the general requirement for soil compaction is usually increased to 100 percent or more of the standard proctor MDD and 95 percent or more of the modified proctor MDD.

9. Soil compaction should be performed at a moisture content generally near optimum moisture content determined by either standard or modified proctor, and ideally within 3 percent below to 1 percent over the optimum for a standard proctor, and from 2 percent below to 2 percent above optimum for a modified proctor.
10. In some instances fill areas are difficult to access. In such cases a low-strength soil-cement slurry can be used in the place of compacted fill soil. In general such fills should be rated to have a 28-day strength of 75 to 125 psi, which in some areas is referred to as a "1-sack" slurry. It should be noted that these materials are wet during placement, and require a period of 2 days (24 hours) to cure before additional fill can be placed above them. Testing of this material can be done using concrete cylinder compression strength testing equipment, but care is needed in removing the test specimens from the molds. Field testing using the ball method, and spread or flow testing is also acceptable.
11. For fills to be placed on slopes, benching of fill lifts is recommended, which may require cutting into existing slopes to create a bench perpendicular to the slope where soil can be placed in a relatively horizontal orientation. For the construction of slopes, the slopes should be over-built and cut back to grade, as the material in the outer portion of the slope may not be well compacted.
12. For subgrade below roadways, runways, railways or other areas to receive dynamic loading, a proofroll of the finished, compacted subgrade should be performed by the geotechnical engineer or inspector prior to the placement of structural aggregate, asphalt or concrete. Proofrolling consists of observing the performance of the subgrade under heavy-loaded equipment, such as full, 4,000 Gallon water truck, loaded tandem-axel dump truck or similar. Areas that exhibit instability during proofroll should be marked for additional work prior to approval of the subgrade for the next stage of construction.
13. Quality control testing should be provided on earthwork. Proctor testing should be performed on each soil type, and one-point field proctors should be used to verify the soil types during compaction testing. If compaction testing is performed with a nuclear density gauge, it should be periodically correlated with a sand cone test for each soil type. Density testing should be performed per project specifications and or jurisdictional requirements, but not less than once per 12 inches elevation of any fill area, with additional tests per 12-inch fill area for each additional 7,500 square-foot section or portion thereof.
14. For earthwork excavations, OSHA guidelines should be referenced for sloping and shoring. Excavations over a depth of 20 feet require a shoring design. In the event excavations are planned near to existing structures, the geotechnical engineer should be consulted to evaluate whether such excavation will call for shoring or underpinning the adjacent structure. Pre-construction and post-construction condition surveys and vibration monitoring might also be helpful to evaluate any potential damage to surrounding structures.
15. Excavations into rock, partially weathered rock, cemented soils, boulders and cobbles, and other hard soil or "hard-pan" materials, may result in slower excavation rates, larger equipment with

specialized digging tools, and even blasting. It is also not unusual in these situations for screening and or crushing of rock to be called for. Blasting, hard excavating, and material processing equipment have special safety concerns and are more costly than the use of soil excavation equipment. Additionally, this type of excavation, especially blasting, is known to cause vibrations that should be monitored at nearby structures. As above, a pre-blast and post-blast conditions assessment might also be warranted.

UNDERGROUND PIPELINE – STRUCTURAL BACKFILL

1. In general, construction should proceed per the governing jurisdictional guidelines for the project site, including but not limited to the applicable State Department of Transportation, the State Department of Environmental Quality, the US Environmental Protection Agency, City and/or County Public Works, Occupational Safety and Health Administration (OSHA), Private Utility Companies, and any other governing standard details and specifications. In areas where multiple standards are applicable the more stringent should be considered, and in some cases work may take place to multiple different standards. Work should be performed by qualified, licensed contractors with experience in the specific type of work in the area of the site.
2. Underground pipeline in this section is considered to apply to the installation of underground conduits for water, storm water, irrigation water, sewage, electricity, telecommunications, gas, etc. Structural backfill refers to the activity of restoring the grade or establishing a new grade in the area where excavations were needed for the underground pipeline installation.
3. Prior to the start of underground pipeline installation, a detailed conflict study including as-builts, utility locating, and potholing should be conducted. The geotechnical study should be referenced to determine subsurface conditions such as caving soils, unsuitable soils, shallow groundwater, shallow rock and others. In addition, the utility company responsible for the line also will have requirements for pipe bedding and support as well as other special requirements. Also, if the underground pipeline traverses other properties, rights-of-way, and/or easements etc. (for roads, waterways, dams, railways, other utility corridors, etc.) those owners may have additional requirements for construction.
4. The required preparations above should be discussed in a pre-construction meeting with the pertinent parties, including the geotechnical engineer, inspector, contractors, testing laboratory, surveyor, and other stake holders.
5. For pipeline excavations, OSHA guidelines should be referenced for sloping and shoring. Excavations over a depth of 20 feet require a shoring design. In the event excavations are planned near to existing structures or pipelines, the geotechnical engineer should be consulted to evaluate whether such excavation will call for shoring or supporting the adjacent structure or pipeline. A pre-construction and post-construction condition survey and vibration monitoring might also be helpful to evaluate any potential damage to surrounding structures.
6. Excavations into rock, partially weathered rock, cemented soils, boulders and cobbles, and other hard soil or "hard-pan" materials, may result in slower excavation rates, larger equipment with specialized digging tools, and even blasting. It is also not unusual in these situations for screening and or crushing of rock to be called for. Blasting, hard excavating and material processing equipment have special safety concerns and are more costly than the use soil excavation equipment. Additionally, this type of excavation, especially blasting, is known to cause vibrations that should be monitored at nearby structures. As above, a pre-blast and post-blast conditions assessment might also be warranted.
7. Bedding material requirements vary between utility companies and might depend of the type of pipe material and availability of different types of aggregates in different locations. In

general, bedding refers to the material that supports the bottom of the pipe, and extends to 1 foot above the top of the pipe. In general the use of aggregate base for larger diameter pipes (6-inch diameter or more) is recommended lacking a jurisdictionally specified bedding material. Gas lines and smaller diameter lines are often backfilled with fine aggregate meeting the ASTM requirements for concrete sand. In all cases bedding with less than 2,000 ohm-cm resistivity, more than 50 ppm chloride content or more than 0.1 percent sulfates should not be used.

8. Structural backfill materials above the bedding should be relatively free of organic materials, man-made debris, environmentally hazardous materials, frozen material, and brittle, non-durable aggregate, soil clods or rocks and/or any other materials that can break down and degrade over time.
9. In general the backfill soil requirements will depend on the future use of the land above the buried line, but in most cases, excessive settlement of the pipe trench is not considered advisable or acceptable. As such, the structural backfill compaction equipment should be appropriate for the thickness of the loose lift being placed. The thickness of the loose lift being placed should be at least two times the maximum particle size incorporated in the fill. Care should be taken not to damage the pipe during compaction or compaction testing.
10. Fill lift thickness (including bedding) should generally be proportioned to achieve 95 percent or more of a standard proctor (ASTM D689) maximum dry density (MDD) or 90 percent or more of a modified proctor (ASTM D1557) MDD, depending on the state practices (in general the modified proctor is required in California and for projects in the jurisdiction of the Army Corps of Engineers). For backfills within the upper poritons of roadway subgrades, the general requirement for soil compaction is usually increased to 100 percent or more of the standard proctor MDD and 95 percent or more of the modified proctor MDD.
11. Soil compaction should be performed at a moisture content generally near optimum moisture content determined by either standard or modified proctor, and ideally within 3 percent below to 1 percent over the optimum for a standard proctor, and from 2 percent below to 2 percent above optimum for a modified proctor.
12. In some instances fill areas are difficult to access. In such cases a low-strength soil-cement slurry can be used in the place of compacted fill soil. In general such fills should be rated to have a 28-day strength of 75 to 125 psi, which in some areas is referred to as a "1-sack" slurry. It should be noted that these materials are wet, and require a period of 2 days (24 hours) to cure before additional fill can be placed above it. Testing of this material can be done using concrete cylinder compression strength testing equipment, but care is needed in removing the test specimens from the molds. Field testing using the ball method, and spread or flow testing is also acceptable.
13. Quality control testing should be provided on structural backfill to assist the contractor in meeting project specifications. Proctor testing should be performed on each soil type, and one-point field proctors should be used to verify the soil types during compaction testing. If compaction testing is performed with a nuclear density gauge, it should be periodically correlated with a sand cone test for each soil type.

14. Density testing should be performed on structural backfill per project specifications and or jurisdictional requirements, but not less than once per 12 inches elevation in each area, and additional tests for each additional 500 linear-foot section or portion thereof.

CAST-IN-PLACE CONCRETE SLABS-ON-GRADE/STRUCTURES/PAVEMENTS

1. In general, construction should proceed per the governing jurisdictional guidelines for the project site, including but not limited to the applicable American Concrete Institute (ACI), International Code Council (ICC), State Department of Transportation, City and/or County, Army Corps of Engineers, Federal Aviation, Occupational Safety and Health Administration (OSHA), and any other governing standard details and specifications. In areas where multiple standards are applicable the more stringent should be considered. Work should be performed by qualified, licensed contractors with experience in the specific type of work in the area of the site.
2. Cast-in-place concrete (concrete) in this section is considered to apply to the installation of cast-in-place concrete slabs on grade, including reinforced and non-reinforced slabs, structures, and pavements.
3. In areas where concrete is bearing on prepared subgrade or structural fill soils, testing and approval of this work should be completed prior to the beginning of concrete construction.
4. In locations where a concrete is approved to bear on in-place (native) soil or in locations where approved documented fills have been exposed to weather conditions after approval, a concrete subgrade evaluation should be performed prior to the placement of reinforcing steel and or concrete. This can consist of probing with a "t"-handled rod, borings, penetrometer testing, dynamic cone penetration testing and/or other methods requested by the geotechnical engineer and/or inspector. Where unsuitable, wet, or frozen bearing material is encountered, the geotechnical engineer should be consulted for additional recommendations.
5. Slabs on grade should be placed on a 4-inch thick or more capillary barrier consisting of non-corrosive (more than 2,000 ohm-cm resistivity, less than 50 ppm chloride content and less than 0.1 percent sulfates) aggregate base or open-graded aggregate material. This material should be compacted or consolidated per the recommendations of the structural engineer or otherwise would be covered by the General Considerations for EARTHWORK.
6. Depending on the site conditions and climate, vapor barriers may be required below in-door grade-slabs to receive flooring. This reduces the opportunity for moisture vapor to accumulate in the slab, which could degrade flooring adhesive and result in mold or other problems. Vapor barriers should be specified by the structural engineer and/or architect. The installation of the barrier should be inspected to evaluate the correct product and thickness is used, and that it has not been damaged or degraded.
7. At times when rainfall is predicted during construction, a mud-mat or a thin concrete layer can be placed on prepared and approved subgrades prior to the placement of reinforcing steel or tendons. This serves the purpose of protecting the subgrades from damage once the reinforcement placement has begun.
8. Prior to the placement of concrete, exposed subgrade or base material and forms should be wetted, and form release compounds should be applied. Reinforcement support stands or ties should be

checked. Concrete bases or subgrades should not be so wet that they are softened or have standing water.

9. For a cast-in-place concrete, the form dimensions, reinforcement placement and cover, concrete mix design, and other code requirements should be carefully checked by an inspector before and during placement. The reinforcement should be specified by the structural engineering drawings and calculations.
10. For post-tension concrete, an additional check of the tendons is needed, and a tensioning inspection form should be prepared prior to placement of concrete.
11. For Portland cement pavements, forms an additional check of reinforcing dowels should performed per the design drawings.
12. During placement, concrete should be tested, and should meet the ACI and jurisdictional requirements and mix design targets for slump, air entrainment, unit weight, compressive strength, flexural strength (pavements), and any other specified properties. In general concrete should be placed within 90 minutes of batching at a temperature of less than 90 degrees Fahrenheit. Adding of water to the truck on the jobsite is generally not encouraged.
13. Concrete mix designs should be created by the accredited and jurisdictionally approved supplier to meet the requirements of the structural engineer. In general a water/cement ratio of 0.45 or less is advisable, and aggregates, cement, flyash, and other constituents should be tested to meet ASTM C-33 standards, including Alkali Silica Reaction (ASR). To further mitigate the possibility of concrete degradation from corrosion and ASR, Type II or V Portland Cement should be used, and fly ash replacement of 25 percent is also recommended. Air entrained concrete should be used in areas where concrete will be exposed to frozen ground or ambient temperatures below freezing.
14. Control joints are recommended to improve the aesthetics of the finished concrete by allowing for cracking within partially cut or grooved joints. The control joints are generally made to depths of about 1/4 of the slab thickness and are generally completed within the first day of construction. The spacing should be laid out by the structural engineer, and is often in a square pattern. Joint spacing is generally 5 to 15 feet on-center but this can vary and should be decided by the structural engineer. For pavements, construction joints are generally considered to function as control joints. Post-tensioned slabs generally do not have control joints.
15. Some slabs are expected to meet flatness and levelness requirements. In those cases, testing for flatness and levelness should be completed as soon as possible, usually the same day as concrete placement, and before cutting of control joints if possible. Roadway smoothness can also be measured, and is usually specified by the jurisdictional owner if is required.
16. Prior to tensioning of post-tension structures, placement of soil backfills or continuation of building on newly-placed concrete, a strength requirement is generally required, which should be specified by the structural engineer. The strength progress can be evaluated by the use of concrete compressive strength cylinders or maturity monitoring in some jurisdictions. Advancing with backfill, additional concrete work or post-tensioning without reaching strength benchmarks could result in damage and failure of the concrete, which could result in danger and harm to nearby people and property.

17. In general, concrete should not be exposed to freezing temperatures in the first 7 days after placement, which may require insulation or heating. Additionally, in hot or dry, windy weather, misting, covering with wet burlap or the use of curing compounds may be called for to reduce shrinkage cracking and curling during the first 7 days.

FOUNDATIONS

1. In general, construction should proceed per the governing jurisdictional guidelines for the project site, including but not limited to the applicable American Concrete Institute (ACI), International Code Council (ICC), State Department of Transportation, City and/or County, Army Corps of Engineers, Federal Aviation, Occupational Safety and Health Administration (OSHA), and any other governing standard details and specifications. In areas where multiple standards are applicable the more stringent should be considered. Work should be performed by qualified, licensed contractors with experience in the specific type of work in the area of the site.
2. Foundations in this section are considered to apply to the construction of structural supports which directly transfer loads from man-made structures into the earth. In general, these include shallow foundations and deep foundations. Shallow foundations are generally constructed for the purpose of distributing the structural loads horizontally over a larger area of earth. Some types of shallow foundations (or footings) are spread footings, continuous footings, mat foundations, and reinforced slabs-on-grade. Deep foundations are generally designed for the purpose of distributing the structural loads vertically deeper into the soil by the use of end bearing and side friction. Some types of deep foundations are driven piles, auger-cast piles, drilled shafts, caissons, helical piers, and micro-piles.
3. For shallow foundations, the minimum bearing depth considered should be greater than the maximum design frost depth for the location of construction. This can be found on frost depth maps (ICC), but the standard of practice in the city and/or county should also be consulted. In general the bearing depth should never be less than 18 inches below planned finished grades.
4. Shallow continuous foundations should be sized with a minimum width of 18 inches and isolated spread footings should be a minimum of 24 inches in each direction. Foundation sizing, spacing, and reinforcing steel design should be performed by a qualified structural engineer.
5. The geotechnical engineer will provide an estimated bearing capacity and settlement values for the project based on soil conditions and estimated loads provided by the structural engineer. It is assumed that appropriate safety factors will be applied by the structural engineer.
6. In areas where shallow foundations are bearing on prepared subgrade or structural fill soils, testing and approval of this work should be completed prior to the beginning of foundation construction.
7. In locations where the shallow foundations are approved to bear on in-place (native) soil or in locations where approved documented fills have been exposed to weather conditions after approval, a foundation subgrade evaluation should be performed prior to the placement of reinforcing steel. This can consist of probing with a "t"-handled rod, borings, penetrometer testing, dynamic cone penetration testing and/or other methods requested by the geotechnical engineer and/or inspector. Where unsuitable foundation bearing material is encountered, the geotechnical engineer should be consulted for additional recommendations.
8. For shallow foundations to bear on rock, partially weathered rock, hard cemented soils, and/or boulders, the entire foundation system should bear directly on such material. In this case, the rock surface should be prepared so that it is clean, competent, and formed into a roughly horizontal, stepped base. If that is not possible, then the entire structure should be underlain by a zone of

structural fill. This may require the over-excavation in areas of rock removal and/or hard dig. In general this zone can vary in thickness but it should be a minimum of 1 foot thick. The geotechnical engineer should be consulted in this instance.

9. At times when rainfall is predicted during construction, a mud-mat or a thin concrete layer can be placed on prepared and approved subgrades prior to the placement of reinforcing steel. This serves the purpose of protecting the subgrades from damage once the reinforcing steel placement has begun.
10. For cast-in-place concrete foundations, the excavations dimensions, reinforcing steel placement and cover, structural fill compaction, concrete mix design, and other code requirements should be carefully checked by an inspector before and during placement.

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11. For deep foundations, the geotechnical engineer will generally provide design charts that provide foundations axial capacity and uplift resistance at various depths given certain-sized foundations. These charts may be based on blow count data from drilling and or laboratory testing. In general safety factors are included in these design charts by the geotechnical engineer.
12. In addition, the geotechnical engineer may provide other soil parameters for use in the lateral resistance analysis. These parameters are usually raw data, and safety factors should be provided by the shaft designer. Sometimes, direct shear and or tri-axial testing is performed for this analysis.
13. In general the spacing of deep foundations is expected to be 6 shaft diameters or more. If that spacing is reduced, a group reduction factor should be applied by the structural engineer to the foundation capacities per FHWA guidelines. The spacing should not be less than 2.5 shaft diameters.
14. For deep foundations, a representative of the geotechnical engineer should be on-site to observe the excavations (if any) to evaluate that the soil conditions are consistent with the findings of the geotechnical report. Soil/rock stratigraphy will vary at times, and this may result in a change in the planned construction. This may require the use of fall protection equipment to perform observations close to an open excavation.
15. For driven foundations, a representative of the geotechnical engineer should be on-site to observe the driving process and to evaluate that the resistance of driving is consistent with the design assumptions. Soil/rock stratigraphy will vary at times and may this may result in a change in the planned construction.
16. For deep foundations, the size, depth, and ground conditions should be verified during construction by the geotechnical engineer and/or inspector responsible. Open excavations should be clean, with any areas of caving and groundwater seepage noted. In areas below the groundwater table, or areas where slurry is used to keep the trench open, non-destructive testing techniques should be used as outlined below.
17. Steel members including structural steel piles, reinforcing steel, bolts, threaded steel rods, etc. should be evaluated for design and code compliance prior to pick-up and placement in the foundation. This includes verification of size, weight, layout, cleanliness, lap-splices, etc. In addition, if non-destructive testing such as crosshole sonic logging or gamma-gamma logging is required, access tubes should be attached to the steel reinforcement prior to placement, and should be

relatively straight, capped at the bottom, and generally kept in-round. These tubes must be filled with water prior to the placement of concrete.

18. In cases where steel welding is required, this should be observed by a certified welding inspector.
19. In many cases, a crane will be used to lower steel members into the deep foundations. Crane picks should be carefully planned, including the ground conditions at placement of outriggers, wind conditions, and other factors. These are not generally provided in the geotechnical report, but can usually be provided upon request.
20. Cast-in-place concrete, grout or other cementations materials should be pumped or distributed to the bottom of the excavation using a tremmie pipe or hollow stem auger pipe. Depending on the construction type, different mix slumps will be used. This should be carefully checked in the field during placement, and consolidation of the material should be considered. Use of a vibrator may be called for.
21. For work in a wet excavation (slurry), the concrete placed at the bottom of the excavation will displace the slurry as it comes up. The upper layer of concrete that has interacted with the slurry should be removed and not be a part of the final product.
22. Bolts or other connections to be set in the top after the placement is complete should be done immediately after final concrete placement, and prior to the on-set of curing.
23. For shafts requiring crosshole sonic logging or gamma-gamma testing, this should be performed within the first week after placement, but not before a 2 day curing period. The testing company and equipment manufacturer should provide more details on the requirements of the testing.
24. Load testing of deep foundations is recommended, and it is often a project requirement. In some cases, if test piles are constructed and tested, it can result in a significant reduction of the amount of needed foundations. The load testing frame and equipment should be sized appropriately for the test to be performed, and should be observed by the geotechnical engineer or inspector as it is performed. The results are provided to the structural engineer for approval.

LATERALLY LOADED STRUCTURES - RETAINING WALLS/SLOPES/DEEP FOUNDATIONS/MISCELLANEOUS

1. In general, construction should proceed per the governing jurisdictional guidelines for the project site, including but not limited to the applicable American Concrete Institute (ACI), International Code Council (ICC), State Department of Transportation, City and/or County, Army Corps of Engineers, Federal Aviation, Occupational Safety and Health Administration (OSHA), and any other governing standard details and specifications. In areas where multiple standards are applicable the more stringent should be considered. Work should be performed by qualified, licensed contractors with experience in the specific type of work in the area of the site.
2. Laterally loaded structures for this section are generally meant to describe structures that are subjected to loading roughly horizontal to the ground surface. Such structures include retaining walls, slopes, deep foundations, tall buildings, box culverts, and other buried or partially buried structures.
3. The recommendations put forth in General Geotechnical Design and Construction Considerations for FOUNDATIONS, CAST-IN-PLACE CONCRETE, EARTHWORK, and SUBGRADE PREPARATION should be reviewed, as they are not all repeated in this section, but many of them will apply to the work. Those recommendations are incorporated by reference herein.
4. Laterally loaded structures are generally affected by overburden pressure, water pressure, surcharges, and other static loads, as well as traffic, seismic, wind, and other dynamic loads. The structural engineer must account for these loads. In addition, eccentric loading of the foundation should be evaluated and accounted for by the structural engineer. The structural engineer is also responsible for applying the appropriate factors of safety to the raw data provided by the geotechnical engineer.
5. The geotechnical report should provide data regarding soil lateral earth pressures, seismic design parameters, and groundwater levels. In the report the pressures are usually reported as raw data in the form of equivalent fluid pressures for three cases. 1. Static is for soil pressure against a structure that is fixed at top and bottom, like a basement wall or box culvert. 2. Active is for soil pressure against a wall that is free to move at the top, like a retaining wall. 3. Passive is for soil that is resisting the movement of the structure, usually at the toe of the wall where the foundation and embedded section are located. The structural engineer is responsible for deciding on safety factors for design parameters and groundwater elevations based on the raw data in the geotechnical report.
6. Generally speaking, direct shear or tri-axial shear testing should be performed for this evaluation in cases of soil slopes or unrestrained soil retaining walls over 6 feet in height or in lower walls in some cases based on the engineer's judgment. For deep foundations and completely buried structures, this testing will be required per the discretion of the structural engineer.
7. For non-confined retaining walls (walls that are not attached at the top) and slopes, a geotechnical engineer should perform overall stability analysis for sliding, overturning, and global stability. For walls that are structurally restrained at the top, the geotechnical engineer does not generally perform this analysis. Internal wall stability should be designed by the structural engineer.

8. Cut slopes into rock should be evaluated by an engineering geologist, and rock coring to identify the orientation of fracture plans, faults, bedding planes, and other features should be performed. An analysis of this data will be provided by the engineering geologist to identify modes of failure including sliding, wedge, and overturning, and to provide design and construction recommendations.
9. For laterally loaded deep foundations that support towers, bridges or other structures with high lateral loads, geotechnical reports generally provide parameters for design analysis which is performed by the structural engineer. The structural engineer is responsible for applying appropriate safety factors to the raw data from the geotechnical engineer.
10. Construction recommendations for deep foundations can be found in the General Geotechnical Design and Construction Considerations-FOUNDATIONS section.
11. Construction of retaining walls often requires temporary slope excavations and shoring, including soil nails, soldier piles and lagging or laid-back slopes. This should be done per OSHA requirements and may require specialty design and contracting.
12. In general, surface water should not be directed over a slope or retaining wall, but should be captured in a drainage feature trending parallel to the slope, with an erosion protected outlet to the base of the wall or slope.
13. Waterproofing for retaining walls is generally required on the backfilled side, and they should be backfilled with an 18-inch zone of open graded aggregate wrapped in filter fabric or a synthetic draining product, which outlets to weep holes or a drain at the base of the wall. The purpose of this zone, which is immediately behind the wall is to relieve water pressures from building behind the wall.
14. Backfill compaction around retaining walls and slopes requires special care. Lighter equipment should be considered, and consideration to curing of cementitious materials used during construction will be called for. Additionally, if mechanically stabilized earth walls are being constructed, or if tie-backs are being utilized, additional care will be necessary to avoid damaging or displacing the materials. Use of heavy or large equipment, and/or beginning of backfill prior to concrete strength verification can create dangers to construction and human safety. Please refer to the General Geotechnical Design and Construction Considerations-CAST-IN-PLACE CONCRETE section. These concerns will also apply to the curing of cell grouting within reinforced masonry walls.
15. Usually safety features such as handrails are designed to be installed at the top of retaining walls and slopes. Prior to their installation, workers in those areas will need to be equipped with appropriate fall protection equipment.

EXCAVATION AND DEWATERING

1. In general, construction should proceed per the governing jurisdictional guidelines for the project site, including but not limited to the applicable American Concrete Institute (ACI), International Code Council (ICC), State Department of Transportation, City and/or County, Army Corps of Engineers, Federal Aviation, Occupational Safety and Health Administration (OSHA), and any other governing standard details and specifications. In areas where multiple standards are applicable the more stringent should be considered. Work should be performed by qualified, licensed contractors with experience in the specific type of work in the area of the site.
2. Excavation and Dewatering for this section are generally meant to describe structures that are intended to create stable, excavations for the construction of infrastructure near to existing development and below the groundwater table.
3. The recommendations put forth in General Geotechnical Design and Construction Considerations for LATERALLY LOADED STRUCTURES, FOUNDATIONS, CAST-IN-PLACE CONCRETE, EARTHWORK, and SUBGRADE PREPARATION should be reviewed, as they are not all repeated in this section, but many of them will apply to the work. Those recommendations are incorporated by reference herein.
4. The site excavations will generally be affected by overburden pressure, water pressure, surcharges, and other static loads, as well as traffic, seismic, wind, and other dynamic loads. The structural engineer must account for these loads as described in Section 5.2 of this report. In addition, eccentric loading of the foundation should be evaluated and accounted for by the structural engineer. The structural engineer is also responsible for applying the appropriate factors of safety to the raw data provided by the geotechnical engineer.
5. The geotechnical report should provide data regarding soil lateral earth pressures, seismic design parameters, and groundwater levels. In the report the pressures are usually reported as raw data in the form of equivalent fluid pressures for three cases. 1. Static is for soil pressure against a structure that is fixed at top and bottom, like a basement wall or box culvert. 2. Active is for soil pressure against a wall that is free to move at the top, like a retaining wall. 3. Passive is for soil that is resisting the movement of the structure, usually at the toe of the wall where the foundation and embedded section are located. The structural engineer is responsible for deciding on safety factors for design parameters and groundwater elevations based on the raw data in the geotechnical report.
6. The parameters provided above are based on laboratory testing and engineering judgement. Since numerous soil layers with different properties will be encountered in a large excavation, assumptions and judgement are used to generate the equivalent fluid pressures to be used in design. Factors of safety are not included in those numbers and should be evaluated prior to design.
7. Groundwater, if encountered will dramatically change the stability of the excavation. In addition, pumping of groundwater from the bottom of the excavation can be difficult and costly, and it can result in potential damage to nearby structures if groundwater drawdown occurs. As such, we recommend that groundwater monitoring be performed across the site during design and prior to construction to assist in the excavation design and planning.
8. Groundwater pumping tests should be performed if groundwater pumping will be needed during construction. The pumping tests can be used to estimate drawdown at nearby properties, and also

will be needed to determine the hydraulic conductivity of the soil for the design of the dewatering system.

9. For excavation stabilization in granular and dense soil, the use of soldier piles and lagging is recommended. The soldier pile spacing and size should be determined by the structural engineer based on the lateral loads provided in the report. In general, the spacing should be more than two pile diameters, and less than 8 feet. Soldier piles should be advanced 5 feet or more below the base of the excavation. Passive pressures from Section 5.2 can be used in the design of soldier piles for the portions of the piles below the excavation.
10. If the piles are drilled, they should be grouted in-place. If below the groundwater table, the grouting should be accomplished by tremmie pipe, and the concrete should be a mix intended for placement below the groundwater table. For work in a wet excavation, the concrete placed at the bottom of the excavation will displace the water as it comes up. The upper layer of concrete that has interacted with the water should be removed and not be a part of the final product. Lagging should be specially designed timber or other lagging. The temporary excavation will need to account for seepage pressures at the toe of the wall as well as hydrostatic forces behind the wall.
11. Depending on the loading, tie back anchors and/or soil nails may be needed. These should be installed beyond the failure envelope of the wall. This would be a plane that is rotated upward 55 degrees from horizontal. The strength of the anchors behind this plane should be considered, and bond strength inside the plane should be ignored. If friction anchors are used, they should extend 10 feet or more beyond the failure envelope. Evaluation of the anchor length and encroachment onto other properties, and possible conflicts with underground utilities should be carefully considered. Anchors are typically installed 25 to 40 degrees below horizontal. The capacity of the anchors should be checked on 10% of locations by loading to 200% of the design strength. All should be loaded to 120% of design strength, and should be locked off at 80%
12. The shoring and tie backs should be designed to allow less than ½ inch of deflection at the top of the excavation wall, where the wall is within an imaginary 1:1 line extending downward from the base of surrounding structures. This can be expanded to 1 inch of deflection if there is no nearby structure inside that plane. An analysis of nearby structures to locate their depth and horizontal position should be conducted prior to shored excavation design.
13. Assuming that the excavations will encroach below the groundwater table, allowances for drainage behind and through the lagging should be made. The drainage can be accomplished by using an open-graded gravel material that is wrapped in geotextile fabric. The lagging should allow for the collected water to pass through the wall at select locations into drainage trenches below the excavation base. These trenches should be considered as sump areas where groundwater can be pumped out of the excavation.
14. The pumped groundwater needs to be handled properly per jurisdictional guidelines.
15. In general, surface water should not be directed over a slope or retaining wall, but should be captured in a drainage feature trending parallel to the slope, with an erosion protected outlet to the base of the wall or slope.

16. Safety features such as handrails or barriers are to be designed to be installed at the top of retaining walls and slopes. Prior to their installation, workers in those areas will need to be equipped with appropriate fall protection equipment.

Waterproofing and Back Drainage

1. In general, construction should proceed per the governing jurisdictional guidelines for the project site, including but not limited to the applicable American Concrete Institute (ACI), International Code Council (ICC), State Department of Transportation, City and/or County, Army Corps of Engineers, Federal Aviation, Occupational Safety and Health Administration (OSHA), and any other governing standard details and specifications. In areas where multiple standards are applicable the more stringent should be considered. Work should be performed by qualified, licensed contractors with experience in the specific type of work in the area of the site.
2. Waterproofing and Back drainage structures for this section are generally meant to describe permanent subgrade structures that are planned to be below the historic high groundwater elevation of 20 feet below existing grades.
3. The recommendations put forth in General Geotechnical Design and Construction Considerations for FOUNDATIONS, CAST-IN-PLACE CONCRETE, EARTHWORK, and SUBGRADE PREPARATION should be reviewed, as they are not all repeated in this section, but many of them will apply to the work. Those recommendations are incorporated by reference herein.
4. In general, surface water should not be directed over a slope or retaining wall, but should be captured in a drainage feature trending parallel to the slope, with an erosion protected outlet to the base of the wall or slope.
5. Waterproofing for retaining walls is generally required on the backfilled side, and they should be backfilled with an 18-inch zone of open graded aggregate wrapped in filter fabric or a synthetic draining product, which outlets to weep holes or a drain at the base of the wall. The purpose of this zone, which is immediately behind the wall is to relieve water pressures from building behind the wall.
6. For the basement walls on this site, sump pumps will be needed to reduce the build-up of water in the basement. The design should be for a historic high groundwater level of 20 feet bgs. The pumping system should be designed to keep the slab and walls relatively dry so that mold, efflorescence, and other detrimental effects to the concrete structure will not result.
7. Backfill compaction around retaining walls and slopes requires special care. Lighter equipment should be considered, and consideration to curing of cementitious materials used during construction will be called for. Additionally, if mechanically stabilized earth walls are being constructed, or if tie-backs are being utilized, additional care will be necessary to avoid damaging or displacing the materials. Use of heavy or large equipment, and/or beginning of backfill prior to concrete strength verification can create dangers to construction and human safety. Please refer to the General Geotechnical Design and Construction Considerations-CAST-IN-PLACE CONCRETE section. These concerns will also apply to the curing of cell grouting within reinforced masonry walls.

CHEMICAL TREATMENT OF SOIL

1. In general, construction should proceed per the governing jurisdictional guidelines for the project site, including but not limited to the applicable American Concrete Institute (ACI), International Code Council (ICC), State Department of Transportation, State Department of Environmental Quality, the US Environmental Protection Agency, City and/or County, Army Corps of Engineers, Federal Aviation, Occupational Safety and Health Administration (OSHA), and any other governing standard details and specifications. In areas where multiple standards are applicable the more stringent should be considered. Work should be performed by qualified, licensed contractors with experience in the specific type of work in the area of the site.
2. Chemical treatment of soil for this section is generally meant to describe the process of improving soil properties for a specific purpose, using cement or chemical lime.
3. A mix design should be performed by the geotechnical engineer to help it meet the specific strength, plasticity index, durability, and/or other desired properties. The mix design should be performed using the proposed chemical lime or cement proposed for use by the contractor, along with samples of the site soil that are taken from the material to be used in the process.
4. For the mix design the geotechnical engineer should perform proctor testing to determine optimum moisture content of the soil, and then mix samples of the soil at 3 percent above optimum moisture content with varying concentrations of lime or cement. The samples will be prepared and cured per ASTM standards, and then after 7-days for curing, they will be tested for compression strength. Durability testing goes on for 28 days.
5. Following this testing, the geotechnical engineer will provide a recommended mix ratio of cement or chemical lime in the geotechnical report for use by the contractor. The geotechnical engineer will generally specify a design ratio of 2 percent more than the minimum to account for some error during construction.
6. Prior to treatment, the in-place soil moisture should be measured so that the correct amount of water can be used during construction. Work should not be performed on frozen ground.
7. During construction, special considerations for construction of treated soils should be followed. The application process should be conducted to prevent the loss of the treatment material to wind which might transport the materials off site, and workers should be provided with personal protective equipment for dust generated in the process.
8. The treatment should be applied evenly over the surface, and this can be monitored by use of a pan placed on the subgrade. This can also be tested by preparing test specimens from the in-place mixture for laboratory testing.
9. Often, after or during the chemical application, additional water may be needed to activate the chemical reaction. In general, it should be maintained at about 3 percent or more above optimum moisture. Following this, mixing of the applied material is generally performed using specialized equipment.
10. The total amount of chemical provided can be verified by collecting batch tickets from the delivery trucks, and the depth of the treatment can be verified by digging of test pits, and the use of reagents that react with lime and or cement.

11. For the use of lime treatment, compaction should be performed after a specified amount of time has passed following mixing and re-grading. For concrete, compaction should be performed immediately after mixing and re-grading. In both cases, some swelling of the surface should be expected. Final grading should be performed the following day of the initial work for lime treatment, and within 2 to 4 hours for soil cement.
12. Quality control testing of compacted treated subgrades should be performed per the recommendations of the geotechnical report, and generally in accordance with General Geotechnical Design and Construction Considerations - EARTHWORK

PAVING

1. In general, construction should proceed per the governing jurisdictional guidelines for the project site, including but not limited to the applicable American Concrete Institute (ACI), International Code Council (ICC), State Department of Transportation, City and/or County, Army Corps of Engineers, Federal Aviation, Occupational Safety and Health Administration (OSHA), and any other governing standard details and specifications. In areas where multiple standards are applicable the more stringent should be considered. Work should be performed by qualified, licensed contractors with experience in the specific type of work in the area of the site.
2. Paving for this section is generally meant to describe the placement of surface treatments on travel-ways to be used by rubber-tired vehicles, such as roadways, runways, parking lots, etc.
3. The geotechnical engineer is generally responsible for providing structural analysis to recommend the thickness of pavement sections, which can include asphalt, concrete pavements, aggregate base, cement or lime treated aggregate base, and cement or lime treated subgrades.
4. The civil engineer is generally responsible for determining which surface finishes and mixes are appropriate, and often the owner, general contractor and/or other party will decide on lift thickness, the use of tack coats and surface treatments, etc.
5. The geotechnical engineer will generally be provided with the planned traffic loading, as well as reliability, design life, and serviceability factors by the jurisdiction, traffic engineer, designer, and/or owner. The geotechnical study will provide data regarding soil resiliency and strength. A pavement modeling software is generally used to perform the analysis for design, however, jurisdictional minimum sections also must be considered, as well as construction considerations and other factors.
6. The geotechnical report report will generally provide pavement section thicknesses if requested.
7. For construction of overlays, where new pavement is being placed on old pavement, an evaluation of the existing pavement is needed, which should include coring the pavement, evaluation of the overall condition and thickness of the pavement, and evaluation of the pavement base and subgrade materials.
8. In general, the existing pavement is milled and treated with a tack coat prior to the placement of new pavement for the purpose of creating a stronger bond between the old and new material. This is also a way of removing aged asphalt and helping to maintain finished grades closer to existing conditions grading and drainage considerations.
9. If milling is performed, a minimum of 2 inches of existing asphalt should be left in-place to reduce the likelihood of equipment breaking through the asphalt layer and destroying its integrity. After milling and before the placement of tack coat, the surface should be evaluated for cracking or degradation. Cracked or degraded asphalt should be removed, spanned with geosynthetic reinforcement, or be otherwise repaired per the direction of the civil and or geotechnical engineer prior to continuing construction. Proofrolling may be requested.
10. For pavements to be placed on subgrade or base materials, the subgrade and base materials should be prepared per the General Geotechnical Design and Construction Considerations – EARTHWORK section.

11. Following the proofrolling as described in the General Geotechnical Design and Construction Considerations – EARTHWORK section, the application of subgrade treatment, base material, and paving materials can proceed per the recommendations in the geotechnical report and/or project plans. The placement of pavement materials or structural fills cannot take place on frozen ground.
12. The placement of aggregate base material should conform to the jurisdictional guidelines. In general the materials should be provided by an accredited supplier, and the material should meet the standards of ASTM C-33. Material that has been stockpiled and exposed to weather including wind and rain should be retested for compliance since fines could be lost. Frozen material cannot be used.
13. The placement of asphalt material should conform to the jurisdictional guidelines. In general the materials should be provided by an accredited supplier, and the material should meet the standards of ASTM C-33. The material can be placed in a screed by end-dumping, or it can be placed directly on the paving surface. The temperature of the mix at placement should generally be on the order of 300 degrees Fahrenheit at time of placement and screeding.
14. Compaction of the screeded asphalt should begin as soon as practical after placement, and initial rolling should be performed before the asphalt has cooled significantly. Compaction equipment should have vibratory capabilities, and should be of appropriate size and weight given the thickness of the lift being placed and the sloping of the ground surface.
15. In cold and/or windy weather, the cooling of the screeded asphalt is a quality issue, so preparations should be made to perform screeding immediately after placement, and compaction immediately after screeding.
16. Quality control testing of the asphalt should be performed during placement to verify compaction and mix design properties are being met and that delivery temperatures are correct. Results of testing data from asphalt laboratory testing should be provided within 24 hours of the paving.

SITE GRADING AND DRAINAGE

1. In general, construction should proceed per the governing jurisdictional guidelines for the project site, including but not limited to the applicable American Concrete Institute (ACI), International Code Council (ICC), State Department of Transportation, State Department of Environmental Quality, the US Environmental Protection Agency, City and/or County, Army Corps of Engineers, Federal Aviation, Occupational Safety and Health Administration (OSHA), and any other governing standard details and specifications. In areas where multiple standards are applicable the more stringent should be considered. Work should be performed by qualified, licensed contractors with experience in the specific type of work in the area of the site.
2. Site grading and drainage for this section is generally meant to describe the effect of new construction on surface hydrology, which impacts the flow of rainfall or other water running across, onto or off-of, a newly constructed or modified development.
3. This section does not apply to the construction of site grading and drainage features. Recommendations for the construction of such features are covered in General Geotechnical Design and Construction Considerations for Earthwork – Structural Fills section and Underground Pipeline Installation – Backfill section.
4. In general, surface water flows should be directed towards storm drains, natural channels, retention or detention basins, swales, and/or other features specifically designed to capture, store, and or transmit them to specific off-site outfalls.
5. The surface water flow design is generally performed by a site civil engineer, and it can be impacted by hydrology, roof lines, and other site structures that do not allow for water to infiltrate into the soil, and that modify the topography of the site.
6. Soil permeability, density, and strength properties are relevant to the design of storm drain systems, including dry wells, retention basins, swales, and others. These properties are usually only provided in a geotechnical report if specifically requested, and recommendations will be provided in the geotechnical report in those cases.
7. Structures or site features that are not a part of the surface water drainage system should not be exposed to surface water flows, standing water or water infiltration. In general, roof drains and scuppers, exterior slabs, pavements, landscaping, etc. should be constructed to drain water away from structures and foundations. The purpose of this is to reduce the opportunity for water damage, erosion, and/or altering of structural soil properties by wetting. In general, a 5 percent or more slope away from foundations, structural fills, slopes, structures, etc. should be maintained.
8. Special considerations should be used for slopes and retaining walls, as described in the General Geotechnical Design and Construction Considerations - LATERALLY LOADED STRUCTURES section.
9. Additionally, landscaping features including irrigation emitters and plants that require large amounts of water should not be placed near to new structures, as they have the potential to alter soil moisture states. Changing of the moisture state of soil that provides structural support can lead to damage to the supported structures.