Drainage Reports

WOOD PATEL

PRELIMINARY DRAINAGE REPORT
FOR
7TH DAY ADVENTIST – SCOTTSDALE & SUTTON

November 26, 2019
WP# 194966

This Preliminary Drainage Report has been approved by Stormwater Management with the stipulation that the next application and final plans address the outstanding comments (inserted for reference after this title page).

EXPIRES 03-31-22

14-ZN-2019
12/02/2019

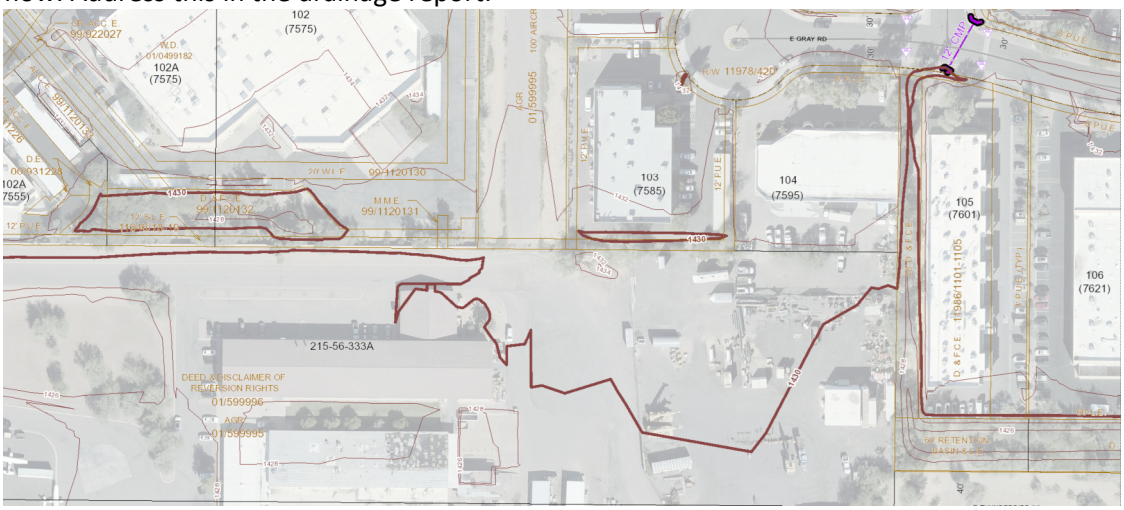
Case Review – Seventh Day Adventist Rezoning

PROJECT NAME: SEVENTH DAY ADVENTIST REZONING
LOCATION: NWC OF SCOTTSDALE ROAD AND SUTTON DRIVE
CASE NUMBER: 14-ZN-2019

The following are outstanding review comments on the case drainage report by Wood Patel sealed November 26, 2019. Our review comments reflect the preliminary drainage report submitted contained in the 14-ZN-2019 case folder. **The drainage report is approved for the purposes of the Zoning case; however the next application and final plans submittal will require the resolution of the comments.** The date of our 1st review was September 9, 2019. Our 2nd review comments, dated December 23, 2019, are provided in **blue**.

Policy and Design Related Issues:

1. 1st Review: The Preliminary Drainage Report states that "no offsite flows appear to impact the Site." Based on available existing topo, it appears that the northeast corner of the site is impacted by offsite flow. Address this in the drainage report.



2nd Review: This comment has only been partially addressed. The report has been revised to acknowledge offsite flow, however this offsite flow is neither quantified or addressed in the conceptual drainage design. This will need to addressed as a stipulation to provide detailed analysis. (AOM 12/23/2019)

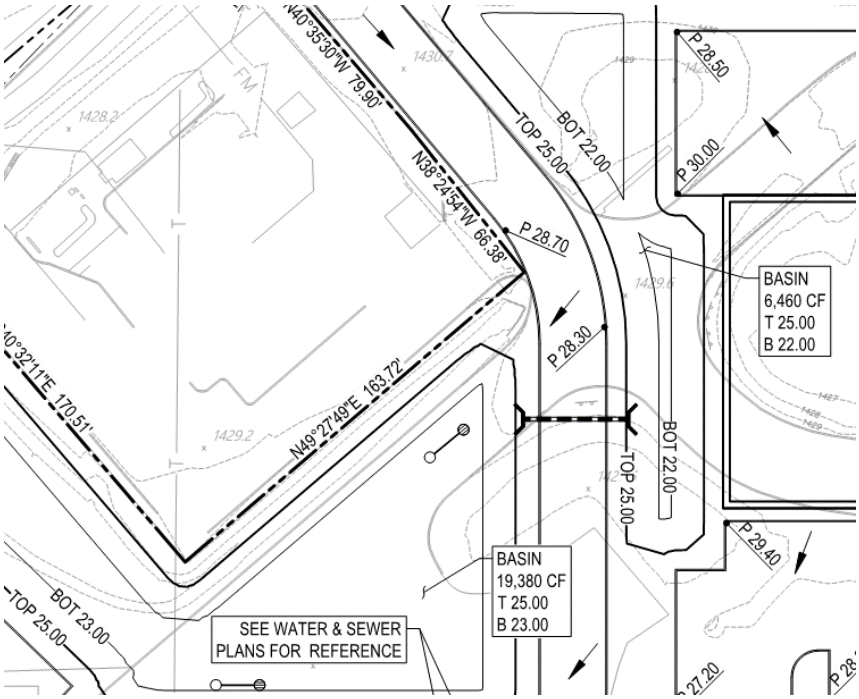
2. 1st Review: Provide a breakdown of stormwater storage calculations per basin along with an exhibit showing the tributary areas for each basin so that runoff volumes can be verified. Provide an exhibit demonstrating how various runoff coefficients were used for the areas draining to each proposed basin.

   This comment has only been partially addressed. The Preliminary Drainage Map has been revised to show tributary areas to each basin; however, an exhibit showing how the runoff coefficients were calculated has not been provided. This will need to addressed as a stipulation. (AOM 12/23/2019)

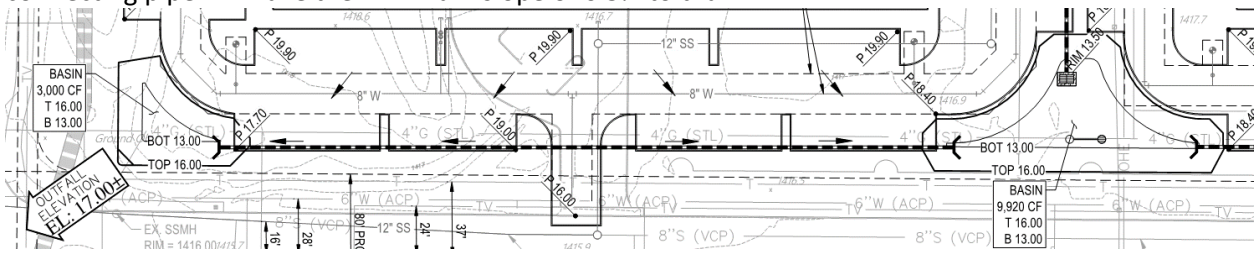
3. Provide the top and bottom elevations of the proposed underground stormwater storage tank (USST). Demonstrate how it can drain via gravity.

This comment has not been addressed. This will need to addressed as a stipulation. (AOM 12/23/2019)

4. Some proposed stormwater basins do not have a means to drain by gravity. For example, as shown below, the basin with a bottom elevation of 23.0 has a proposed drywell; however, the basin with a lower bottom of 22.0 has no means to drain.



In the following example, the basin to the west is intended to be equalized with the basin to the east, which is to drain via drywell. However, in order to drain properly and avoid standing water, the basin to the west should have a bottom that is almost two feet higher so that the approximately 360-ft long connecting pipe will have the minimum slope of 0.5% to drain.



2nd Review: This comment has not been addressed. This will need to addressed as a stipulation. (AOM 12/23/2019)

Technical Corrections to be resolved prior the next application or final plans submittal:

5. 1st Review: Note that the submittal of final plans must follow the City's guidelines for underground stormwater storage tanks (USSTs) as outlined in the DSPM. This includes but is not limited to the following:
    a. Documentation that the system has at least a 75-year life, including the lining and coating of the USST.
    b. Drainage by gravity.

c. A minimum of two access points.
d. Location signs at each end of the USST.
e. Operations and Maintenance (O&M) Manual.
f. Ownership Responsibility Statement, signed and notarized, acknowledging that the owner is responsible for the maintenance, repair and potential replacement of the system, for recordation by the City in the County Recorder's Office.

6. **2nd Review: Note that a more detailed analysis of pre- vs post-project discharges will be required at the Development Review stage. This analysis must include actual stage-storage routing of inflow hydrographs to verify that outflow hydrographs for the post-project condition do not exceed pre-project discharges. The report will also need to address how the project will meet drainage requirements at the various stages of the project. (AOM 12/23/2019)**

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Stormwater Management
City of Scottsdale
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Fax: 480-312-9187

TABLE OF CONTENTS

EXHIBITS

EXPIRES 03-31-22

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Y:\WP\Reports\Commercial\194966 7th Day Adventist - Scottsdale & Sutton Preliminary Drainage Report.docx

1.0 INTRODUCTION

The proposed multi-use development is a 49.2-acre site located in the northeast corner of North Scottsdale Road and East Sutton Drive. The 7th Day Adventist – Scottsdale & Sutton (Site) is the redevelopment of a portion of the existing Seventh-Day Adventist Church campus and adjacent commercial/industrial properties. The Site is bounded by North Scottsdale Road to the west, a City of Scottsdale park and ride facility and East Thunderbird Road to the north, North Miller Road (76th Street) to the east and East Sutton Drive and the Seventh-Day Adventist Church campus to the south. More specifically, the Site is located in a portion of the south half of Section 11, Township 3 North, Range 4 East and a portion of the north half of Section 14, Township 3 North, Range 4 East of the Gila and Salt River Base and Meridian. The Site is located within Assessor Parcel Number 215-56-333A and a portion of 175-04-002A. (Refer to *Exhibit 1 – Vicinity Map)*

The proposed uses include 158,000 square-feet of office, 46,800 square-feet of residential, 76,250 square-feet of hangars and 184,450 square-feet of industrial. The proposed redevelopment will include landscaped open space areas, hardscape areas and paved areas including parking lots, loading areas, a taxiway and apron for aircraft maneuvering and parking.

This report is to document the drainage design criteria used for preparation of the preliminary grading and drainage design and to support the request for rezoning of the Site. This Preliminary Drainage Report has been prepared in accordance with the Wood, Patel & Associates, Inc. (WOODPATEL) understanding of the City of Scottsdale technical drainage requirements applicable to the Site.

2.0 EXISTING DRAINAGE CONDITIONS AND CHARACTERISTICS

2.1 Existing Conditions

The Site proposed for redevelopment includes an office building, twenty (20) single-family residences, three (3) hangars and several commercial/industrial buildings. Paved areas include parking lots, internal roadways and equipment/storage yards. Some equipment and materials storage yards are unpaved. Open spaces include areas of xeriscape landscaping and areas of irrigated turf landscaping.

The 20 single-family residences proposed for redevelopment are a part of the Seventh-Day Adventist Church campus. The remainder of the existing 27.6-acre campus, including the church, the Thunderbird Adventist Academy and the Thunderbird Christian Elementary, are not included in the proposed development.

A drainage channel is located between the Site and the City of Scottsdale park and ride facility. The channel collects runoff from the City of Scottsdale Airport north of Thunderbird Road, from Thunderbird Road and from the park and ride facility. The channel discharges to an existing 90-inch diameter storm drain adjacent to Scottsdale Road. The 90-inch storm drain is located in a drainage easement on the west side of the Site and conveys runoff to the south.

The existing ground elevation ranges from approximately 1,431-feet in the northeast corner of the Site to approximately 1,417-feet in the southwest corner (City of Scottsdale Datum NAVD 88).

Historical aerial photography identifies portions of the Site to be first developed in the early 1950s including two (2) hangars. The balance of the Site was substantially developed by the mid-1980s including the office building in the southwest corner of the Site. It does not appear that stormwater retention basins or drywells are located within the Site.

The Site generally drains in a southwesterly direction to the church campus and to Sutton Road. Offsite runoff enters the northeastern portion of the Site.

2.2 FEMA Floodplain

Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) panel number 04013C1760L, dated October 16, 2013, identifies the Site to be within Zone "X" (refer to *Exhibit 3 – FEMA FIRM Map*). Zone "X" is defined by FEMA as follows:

"*0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flow with average depth less than one foot or with drainage areas of less than one square mile."*

3.0 PROPOSED DRAINAGE PLAN

3.1 Proposed Conditions

No outfall is available for the facilities proposed for the storage of stormwater runoff. For that reason, the stormwater storage facilities are designed to retain runoff. Proposed onsite stormwater retention facilities consist of both surface basins and below-ground storage tanks. Stormwater stored in surface basins will be dissipated within 36 hours by a combination of basin floor percolation and drywells while stormwater stored within the below-ground tanks will be dissipated within 36 hours by drywells.

The proposed retention facilities will store onsite runoff resulting from the 100-year, 2-hour event. The first flush volume resulting from the first 0.5 inches of precipitation will also be retained.

Surface retention basins are designed with 4H:1V side slopes and depths no greater than three (3) feet. Some basins will be interconnected by equalization pipes which may result in depths less than three (3) feet in the upstream basins. Each 10-foot diameter, corrugated metal pipe (CMP) below-ground storage tank will have positive slope to drain to a drywell. The CMP tanks shall be provided with a smooth interior floor in conformance with City of Scottsdale Standard Detail 2554.

The proposed vehicular driveway from the Site to the City of Scottsdale park and ride facility crosses the existing channel. Preliminarily, two 3-foot by 10-foot concrete box culverts are proposed for construction at this location. The required culvert size will be verified with further analysis.

Offsite runoff that enters the northeastern portion of the Site will either be routed through or around the Site. Alternatively, the offsite runoff may be retained with onsite runoff in the proposed retention facilities. The disposition of offsite runoff will be dependent upon the final site plan configuration.

Retention and Dissipation

Onsite runoff resulting from the 100-year, 2-hour event will be retained. The required volume, V_R, is determined as:

$V_R = \Delta C\ (R/12)\ A$

Where: ΔC = Runoff Coefficient (Pre-Development vs. Post-Development)

R = Precipitation depth = 2.23 inches)

A = Disturbed area = 2,145,861 square feet)

The runoff coefficient used for the post-developed condition is 0.86 (commercial and industrial areas). The runoff coefficient for the pre-developed condition is the weighted average of pervious and impervious areas. The total area is 2,145,861 square-feet of which 811,280 square-feet is comprised of impervious surfaces and 1,334,581 is comprised of three (3) types of pervious surfaces.

The pervious surfaces include approximately 333,645 square-feet of gravel with a runoff coefficient of 0.82, approximately 500,468 square-feet of turf with a runoff coefficient of 0.30 and approximately 500,468 square-feet of desert landscaping with a runoff coefficient of 0.45. The weighted average of the pervious areas is then:

$C_{PERVIOUS}$ = [(333,645)(0.82) + (500,467)(0.30) + (500,467)(0.45)] / 1,334,581

= 0.49

and

$C_{PRE\text{-}DEVELOPED}$ = [(1,334,581)(0.49) + (811,280)(0.95) / 2,145,861

= 0.66

and

$\Delta C = C_{POST\text{-}DEVELOPED} - C_{PRE\text{-}DEVELOPED}$

= 0.95 – 0.66

= 0.29

The required retention volume is:

$V_R = \Delta C\ (R/12)\ A$

= (0.29)(2.23/12)(2,145,861)

= 115,644 cubic feet

Retention of the first one-half inch of precipitation is required. The first-flush volume, V_F, is determined as:

$V_F = C\ (R/12)\ A$

Where: C = 1.0

R = Precipitation depth = 0.5 inches

A = Disturbed area = 2,145,861 square-feet

V_F = (1.0) (0.5/12) (2,145,861)

= 89,410 cubic feet

Therefore, retention of runoff from the 100-year, 2-hour event will satisfy the first-flush requirement.

Stormwater will be stored in fifteen (15) surface basins and two (2) below-ground tanks. The stormwater stored in surface basins will be dissipated within 36 hours by a combination of basin floor percolation and drywells while stormwater stored within each below-ground tank will be dissipated within 36 hours by a drywell. The stormwater dissipated by percolation is not considered in this analysis but will be addressed as the grading and drainage design is later advanced.

Drywells are assumed to dissipate stormwater at the rate of 0.1 cubic-feet per second per drywell which equates to 36 cubic-feet per hour per drywell. Therefore, each drywell can dissipate 12,920 cubic-feet within 36 hours. The minimum number of drywells required to dissipate the required retention volume of 115,644 cubic-feet is determined as:

Number of drywells = 115,644 cubic feet/(12,920 cubic feet/drywell)
= 9 drywells (rounding up)

The proposed retention basins and below-ground tanks are distributed throughout the 49.2-acre Site. This is to maintain proportionality between the volume of each storage facility and the anticipated runoff from each corresponding contributory area. On this basis, fifteen (15) surface basins and two (2) below-ground tanks provide a total retention volume of 156,620 cubic-feet. Twelve (12) drywells are proposed. The locations and number of basins, tanks and drywells may change as the grading and drainage design is advanced. Refer to Exhibit 4 – *Preliminary Drainage Map* for the preliminary drainage system and drainage sub-basin boundaries. Refer to Exhibit 5 – *Retention Volumes* for the retention volumes required and volumes provided for each sub-basin.

3.2 Lowest Floor Elevations

The preliminary grading design provides overflow routes to two (2) outfalls at the perimeter of the Site, should the capacity of the onsite storage and/or conveyance facilities be exceeded. One (1) outfall with elevation of approximately 1,417.0-feet is located at the southwest corner of the Site. The lowest finished floor elevation in proximity to this outfall is anticipated to be 1,420.5 feet which is 3.5-feet higher than the outfall elevation.

The other outfall with elevation of approximately 1,423.4-feet is located adjacent to Miller Road on the east side of the Site. The lowest finished floor elevation in proximity to this outfall is anticipated to be 1,427.0 which is 3.6-feet higher than the outfall elevation.

3.3 Operation and Maintenance

The property owner shall be solely responsible for the operation and maintenance of the storm water drainage system. In accordance with the City of Scottsdale's *Design Specifications and Policies Manual*, the owner will dedicate a public drainage easement for the storm water retention facilities. Operation and maintenance reference material will be provided in the Final Drainage Report.

4.0 SPECIAL CONDITIONS

Currently, there are no washes with 100-year flows greater than 50 cfs that traverse the Site. Also, there are no designated Section 404 washes within the Site; therefore, no Section 404 permit is required.

5.0 DATA ANALYSIS

5.1 Hydrologic Analysis

The drainage improvements will be developed consistent with Chapter 4 of the City of Scottsdale's *Design Standards and Policies Manual*, 2018 (DSPM). The Rational Method will be used to quantify peak discharge values for onsite concentration points for the full buildout scenario during the 100-year, 2-hour storm event. Weighted "C" coefficients will be referenced from Chapter 4 of the City of Scottsdale DSPM.

5.2 Hydraulic Analysis

For this preliminary report, the rim elevations of the catchbasins information are in the Conceptual Improvement Plan. Hydraulic analysis of the proposed storm drains will be forthcoming once the City approves the conceptual stormwater retention scenario. The onsite storm drain system will be designed to accommodate the 10-year storm event. Bentley StormCAD Version 5.6 will be utilized to analyze the proposed storm sewer system. StormCAD printouts and storm drain profiles will be available.

6.0 CONCLUSIONS

Based on our analysis of the site, the following conclusions can be made:

1. The proposed drainage infrastructure will be designed in accordance with the City of Scottsdale Design Standards and Policies Manual, 2018.

2. The Site lies within a FEMA-designated “Other Flood Areas” Zone “X” shaded. Per the FEMA map (Panel 1760L), the FIRM information is as follows: “0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flow with average depth less than one (1) foot or with drainage areas of less than one (1) square mile.”

3. Offsite flow enters the northeastern portion of the Site.

4. The Rational Method will be used to estimate peak discharges for all onsite drainage areas.

5. Stormwater retention will be provided for the 100-year, 2-hour storm event and the first-flush event (2.23 inches and 0.5 inches of rainfall, respectively).

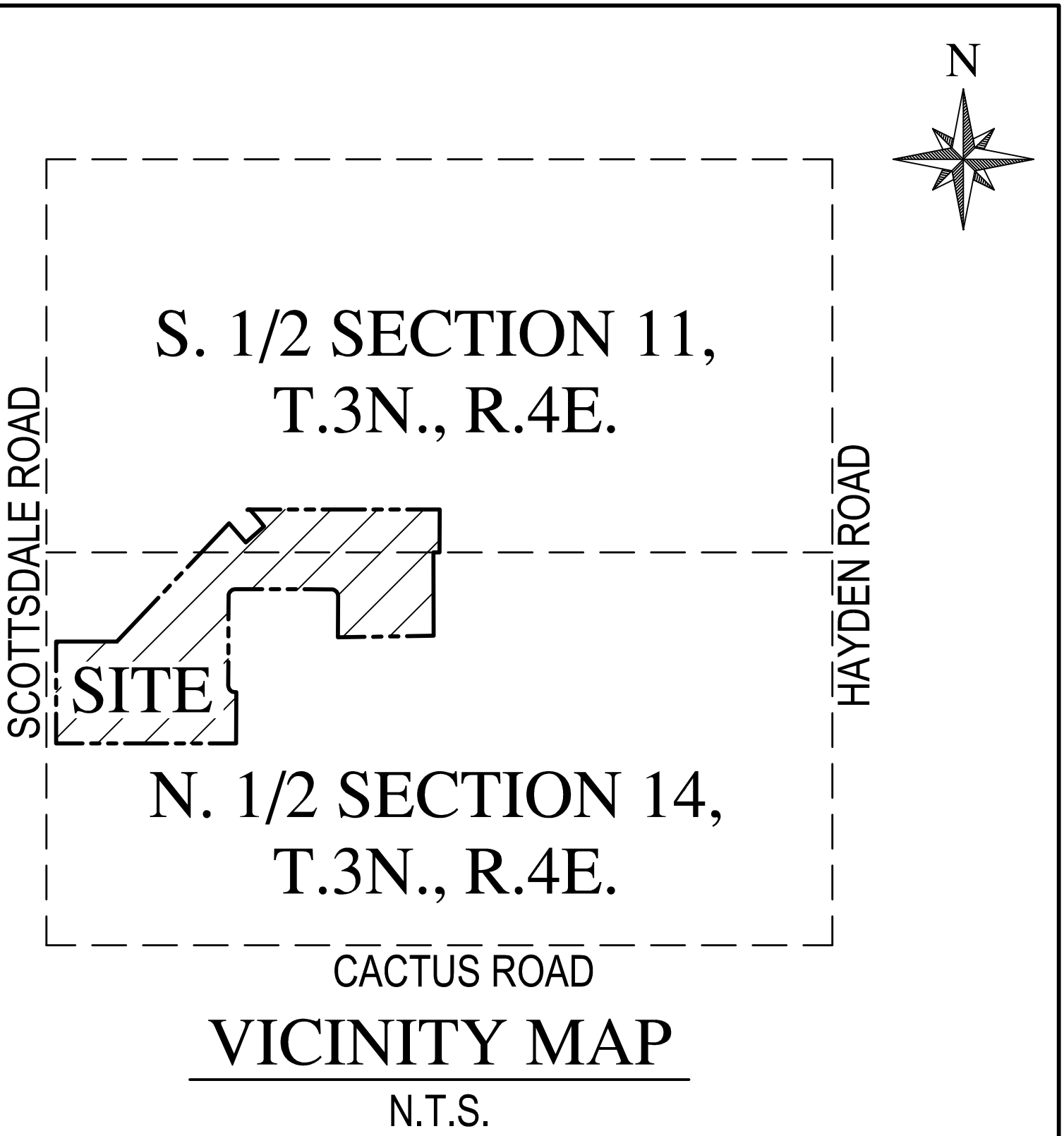
6. Stormwater retention will be provided in fifteen (15) retention basins and two (2) below-ground tanks. The volume required for the Site is 116,712 cubic feet and the volume provided is 156,620.

7. The lowest proposed finished floor elevations are no less than 3.5-feet higher than the ultimate outfall elevations.

7.0 REFERENCES

1. *Design Standards and Policies Manual, Chapter 4: Grading and Drainage*, City of Scottsdale, January 2018.

EXHIBIT 1 - VICINITY MAP



VICINITY MAP

N.T.S.

NOT
FOR
CONSTRUCTION
OR RECORDING

WOOD PATEL

SEVENTH-DAY

VICINITY MAP EXHIBIT

DATE	07/26/2019	SCALE	N.T.S.	SHEET	## OF ##
JOB NO.	194966	DESIGN	TB	CHECK	LB
		DRAWN	JO	RFI #	

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14-ZN-2019
12/02/2019

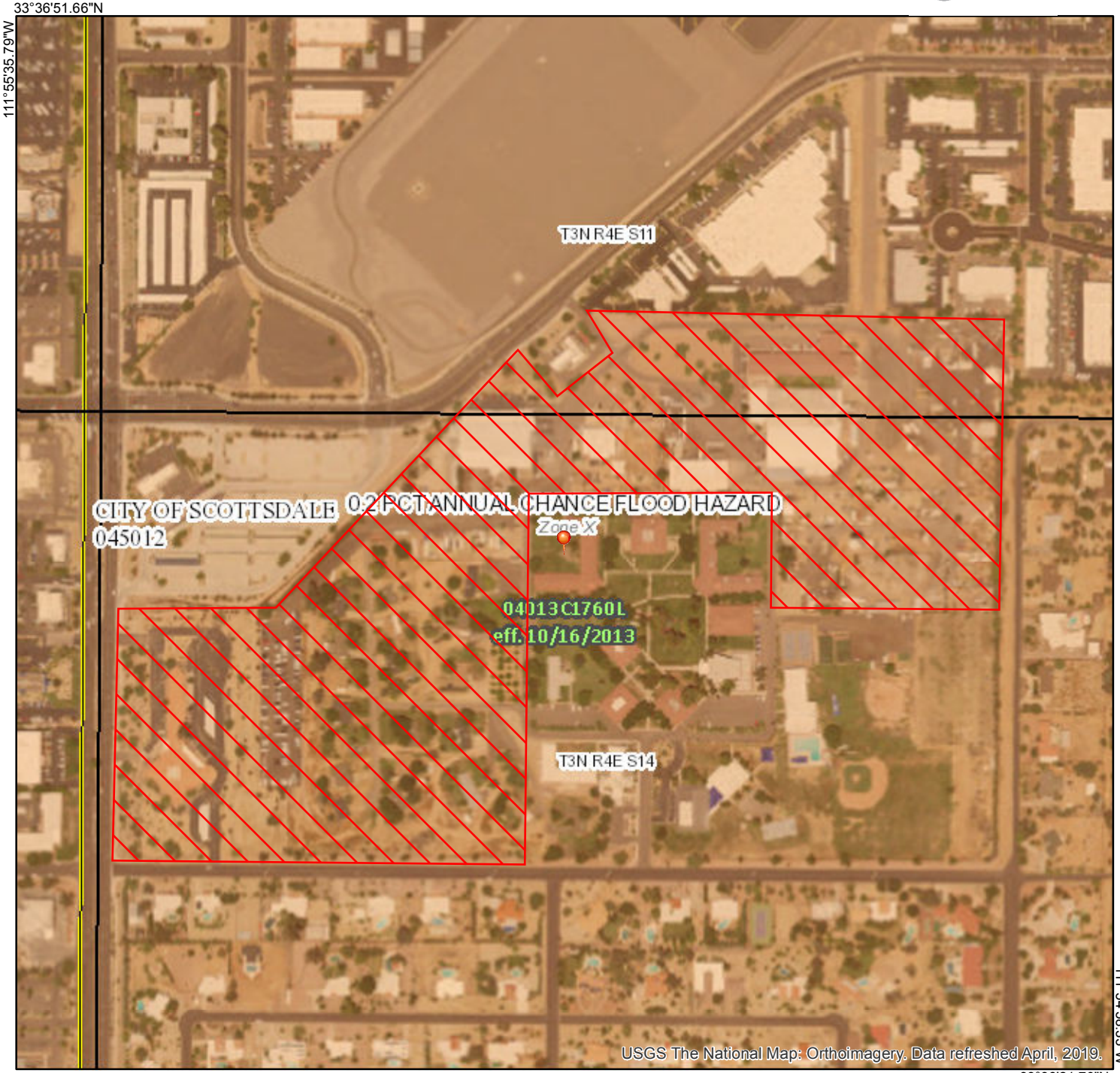
EXHIBIT 2 – FEMA FIRM MAP

National Flood Hazard Layer FIRMette

FEMA

33°36'51.66"N

111°55'35.79"W



111°54'58.33"W

33°36'21.70"N

Feet

0 250 500 1,000 1,500 2,000

1:6,000

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 / 17.5 Cross Sections with 1% Annual Chance Water Surface Elevation
- Coastal Transect
- 513 Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 8/2/2019 at 3:15:17 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective unmapped and unmodernized areas can regulatory purposes.

14-ZN-2019
12/02/2019

EXHIBIT 3 – EXISTING DRAINAGE MAP

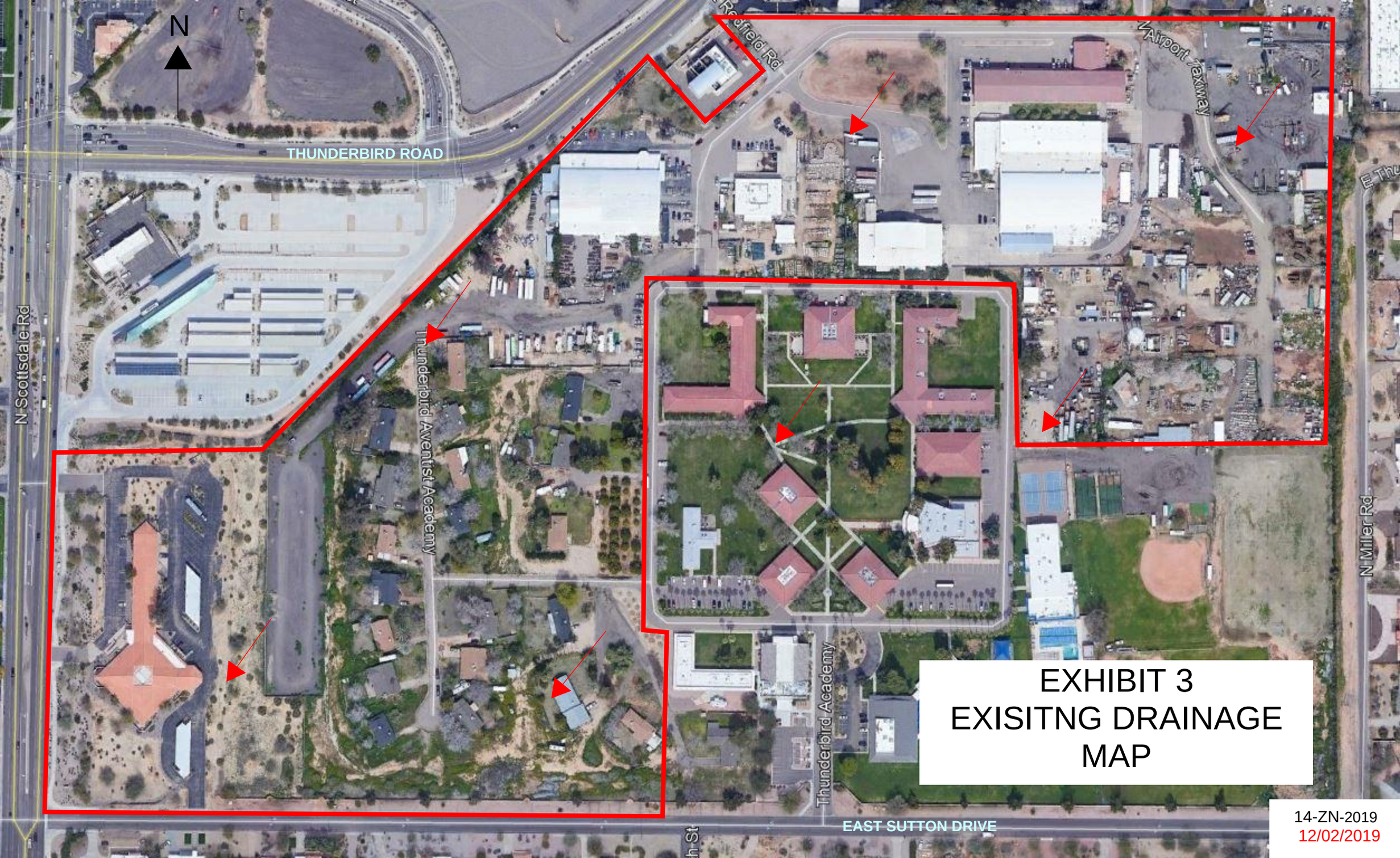

N
THUNDERBIRD ROAD
N Scottsdale Rd
Thunderbird Aventist Academy
Thunderbird Academy
EAST SUTTON DRIVE
N Miller Rd
Airport Taxiway
EXHIBIT 3
EXISITNG DRAINAGE
MAP
14-ZN-2019
12/02/2019

EXHIBIT 4 – PRELIMINARY DRAINAGE MAP

LEGEND

- EXISTING STORM DRAIN
- PROPOSED STORM DRAIN
- PROPOSED DRYWELL
- PROPERTY LINE
- PROPOSED RETENTION TANK

N

0 200 400

Horz. 1 in. = 200 ft.

E. THUNDERBIRD ROAD

N. SCOTTSDALE ROAD

N. MILLER ROAD

E. SUTTON DRIVE

SUB BASIN 1
V_R = 10,285 CF
V_P = 12,840 CF

SUB BASIN 2
V_R = 14,552 CF
V_P = 17,990 CF

SUB BASIN 3
V_R = 16,167 CF
V_P = 16,450 CF

SUB BASIN 4
V_R = 8,271 CF
V_P = 25,840 CF

SUB BASIN 5
V_R = 5,893 CF
V_P = 6,000 CF

SUB BASIN 6
V_R = 5,276 CF
V_P = 12,860 CF

SUB BASIN 7
V_R = 9,194 CF
V_P = 12,920 CF

SUB BASIN 8
V_R = 47,074 CF
V_P = 51,720 CF

PROP. CMP TANK

PROP. CATCH BASIN (TYP)

PROP. RETENTION BASIN (TYP)

PROP. HEAD WALL (TYP)

PROP. DRYWELL (TYP)

PROP. STORM DRAIN (TYP)

NOT FOR CONSTRUCTION OR RECORDING

WOOD PATEL

SEVENTH-DAY

EXHIBIT 4
PRELIMINARY DRAINAGE MAP

DATE	11/26/2019	SCALE	1" = 200'	SHEET	1 OF 1
JOB NO.	194966	DESIGN	AJB	DRAWN	JO

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14-ZN-2019
12/02/2019

EXHIBIT 5 – RETENTION VOLUMES

WOOD/PATEL
MISSION: CLIENT SERVICE®

PRE-DEVELOPMENT vs POST-DEVELOPMENT VOLUME

Project: 7TH DAY ADVENTIST
Location: Scottsdale, Arizona
Project No.: 194966
Project Eng.: Anthony J Beuche, P.E.
References: City of Scottsdale Design Standards and Policies Manual
Description: Retention Volume
Rainfall Depth, "P" = 2.23 inches

Drainage Subbasin ID	Retention Basin ID	Drainage Area "A" (SF)	100 YR Runoff Coefficient "C"	Required Retention (CF)	Provided Volume (Surface Storage) (CF)	Provided Volume (Underground Storage) (CF)	Provided Volume (Total) (CF)
1	A	190,844	0.29	10,285	12,840		12,840
2	B	270,017	0.29	14,552	17,990		17,990
3	C	299,995	0.29	16,167	12,920	3,530	16,450
4	D	153,476	0.29	8,271	25,840		25,840
5	E	109,357	0.29	5,893	500	5,500	6,000
6	F	97,896	0.29	5,276	12,860		12,860
7	G	170,607	0.29	9,194	12,920		12,920
8	H	873,487	0.29	47,074	51,720		51,720
TOTAL		2,165,679		116,712	147,590	9,030	156,620