MASTER DRAINAGE REPORT
FOR
SCOTTSDALE PERIMETER CENTER
C.W.W. JOB NO. 870514-1

PREPARED FOR:
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JANUARY, 1988
REVISED JUNE, 1988
REVISED JULY, 1988
REVISED JANUARY, 1989

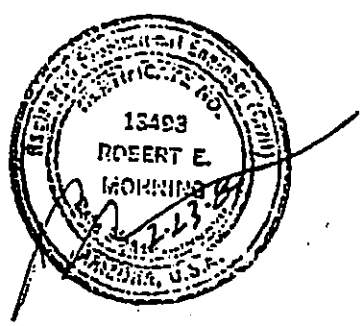
ACCEPTED MASTER PLAN

Water and Wastewater _____

Drainage _____ 4/12/89

Circulation _____

MASTER PLANNING UNIT
COMMUNITY DEVELOPMENT DEPARTMENT
CITY OF SCOTTSDALE



SCOTTSDALE PERIMETER CENTER
MASTER DRAINAGE REPORT

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I. INTRODUCTION

A. Location

Scottsdale Perimeter Center is a planned industrial and commercial development, located within the corporate limits of Scottsdale, Arizona. The area comprising the Scottsdale Perimeter Center is a part of the former State Trust Lands, north of the Bureau of Reclamation's Central Arizona Project Canal.

The site lies west of the proposed Outer Loop Freeway, between Union Hills Drive and Bell Road and east of 83rd Street. Scottsdale Perimeter Center encompasses about 240 acres (gross). See Figure 1 - Vicinity Map. Exhibit 1 shows Union Hills Drive, Pima Road and Bell Road extended to Hayden Road from 83rd Street, although the area west of 83rd Street is not a part of this site.

Westcor purchased Parcels 16, 17, 18, 19 and 20, a portion of the above described State Trust Lands. Parcels 16-20 have been split due to the internal street configuration, and have been renumbered in this report with letters A through K.

The surrounding properties are developing rapidly. In the past two years, the City of Scottsdale Tournament Players Club Golf Course (TPC) and the Princess Hotel have been constructed; and the Eagle Apartments are currently under construction. Based upon current trends, it is anticipated that development in the immediate area will occur at faster rates than most other portions of Maricopa County.

B. Related Drainage Studies

Collar, Williams & White Engineering (CWW) completed the "Preliminary Drainage Report for Forest City Scottsdale Company" in August, 1985, which included about 1400 acres of State Trust Lands. The subject site was included in the preliminary report. Revisions to the report were made in February and May of 1986. Simons, Li and Associates, Inc. (SLA) completed the "Drainage Analysis for State Trust Lands - Outer Loop Highway - Scottsdale Road to Pima Road" in June 1987.

SLA essentially utilized the channelization network proposed in the preliminary report by CWW, with the addition of a detention basin north of the Outer Loop. Freeway between Hayden Road and Pima Road. This basin and the off-site drainage are discussed in further detail in the next section. The SLA report has been approved by the City of Scottsdale.

II. OFF-SITE DRAINAGE

The drainage basins contributing runoff to the subject site have been extensively analyzed and evaluated in the aforementioned drainage reports. Therefore, the off-site drainage will not be discussed in detail for this report. A brief summary of the off-site watersheds from the SLA report, however, is provided below.

The contributing offsite drainage areas affecting the site extend beyond Reata Pass, approximately 8 miles northeast of the subject site. According to SLA, about 1100 acre-feet of runoff volume is generated from the off-site watersheds during the 100 year storm. This volume is proposed to be routed to a large detention basin via upstream training dikes. The proposed location of the detention basin is adjacent to the northern edge of the Outer Loop Freeway, between Hayden Road and Pima Road. The detention basin is proposed to be drained by two outlets; one near Hayden Road and the other near the future Union Hills Road alignment. The peak discharge released form the Hayden Road spillway is 1796 cfs, while the 100 year peak discharge at Union Hills is proposed to be 722 cfs. It is the Union Hills outlet that affects the subject site. Although this drainage concept and corresponding peak discharge rates and locations have been approved by the City of Scottsdale, it should be noted that the Arizona State Land Department and the Arizona Department of Transportation have yet to reach a similar final decision.

In conclusion, Scottsdale Perimeter Center will be subject to an ultimate off-site peak discharge of 722 cfs from the upstream detention basin, plus 300 $\pm$ cfs from an adjacent State Land parcel at Pima Road (northeast of the Outer Loop). The off-site drainage is proposed to be routed in a future concrete-lined channel (subject to the Design Review Board approval) that will parallel the southerly and westerly property boundary of the Outer Loop Freeway from Union Hills to Bell Road, and then south to the TPC. Coordination with the City of Scottsdale and affected property owners will be necessary to design the routing of the 722 cfs from Bell Road to the TPC.

The future channel location and cross-section for routing the above described off-site flows are shown on Exhibit 1.

The construction of the channel, including the roadway culverts, and the detention basin must occur concurrently, or before the construction of, the Outer Loop.

III. ON-SITE DRAINAGE

A. Existing Drainage Conditions

As above, the on-site drainage basins have been previously analyzed. Therefore, only a brief description is presented below.
The site is presently undeveloped and slopes gently to the southwest with an average slope of 1.5 percent. The area is characterized by native desert plant species, with an estimated cover density of 20 percent. Several defined dry washes occur on the site. However, due to the high sediment load during runoff flows, the channels frequently shift depending upon the intensity and duration of the rainfall event. Many of the smaller washes transform from channelized flow to sheet flow, and then back to channelized flow downstream.

According to an earlier Simons, Li and Associates drainage report, entitled "Hydrology Report, Outer Loop Highway, North of the CAP Aqueduct", April 1987, the historical drainage across Bell Road, between Hayden Road and Pima Road, is 6879 cfs. The SLA hydrologic analysis showed that the historic channels are not capable of carrying flows greater than the 2 year event. Larger events are therefore carried in wide strips adjacent to the historic channels with shallow depths and considered sheet flow.

According to the aforementioned CWW drainage report, three (3) concentration points were identified at Bell alignment, between Hayden and Pima Roads. The location of the concentration points and the peak discharges, per the report, are:

Location	100 Year Peak Discharge (cfs)
83rd Street and Bell Road	1643
86th Street and Bell Road	6784
700 ± feet west of Pima Road	193

The magnitudes of the peak discharge values from both reports are similar. However, the location(s) are uncertain. It is obvious, though, that no well defined channel exists between Hayden and Pima Roads to contain the above peak discharges.

B. Developed Drainage Conditions

Scottsdale Perimeter Center encompasses 11 parcels. All parcels are zoned for either industrial or commercial use. A channelization network is proposed to route the on-site runoff safely and effectively through the site. The channels will convey the on-site generated runoff to the TPC.

Since development will probably occur prior to the construction of the detention basin north of the Outer Loop, temporary measures will be required to protect the structures from the off-site flows, as described earlier. Temporary measures could consist of elevating the finished floors, constructing berms, walls and channels, excavating retention basins, or a combination of the above.

Any of the above measures will need to be evaluated and implemented concurrently with the design of any individual site development with evaluation of any change in water surface elevation which would affect downstream properties.

1. Storm Water Storage Facilities

Scottsdale City Code Title 37, Section 37-42 (12)a. requires "as a minimum, all development will make provisions to store runoff from rainfall events up to and including the 100-year 2-hour duration event".

This requirement may be waived if per Section 37-42 (12)a. "The runoff has been included in a storage facility at another location". In the same section of the code, it is stated that if storage is waived, the development shall be required to contribute to the cost of drainage works on the basis of runoff contribution. Section 37-42 allows exceptions to the regulations for "areas covered by master drainage plans, providing that the standards established by the code are met".

The Perimeter Center is an integral part of the State Land Department Core South Master Plan which requires large retention basins to be constructed along the Outer Loop Highway. These basins are specifically intended to mitigate the need for on-site storage within the Core South project area.

Each of the respective parties are required to construct their portion of the drainage project.

The Perimeter Center lays the foundation to satisfy the provisions of the City Code Title 37 for storm water storage facilities.

2. Peak Discharges

Post development peak discharges (100 year, one hour storm) are listed below for each parcel.

Parcel	Area (acres)	Peak Discharge (cfs) 2 Year	10 Year	25 Year	100 Year
A	30.8	70	117	151	186
B	25.2	57	96	124	153
C	13.3	30	51	66	80
D	22.2	50	85	109	134
E	6.9	16	26	34	42
F	9.2	21	35	45	56
G	29.7	67	114	146	179
H	27.2	62	104	134	165
I	24.4	56	93	120	148
J	22.2	51	85	109	134
K	27.6	63	105	136	167

Exhibit 1 shows the routing of the above on-site peak discharges and the proposed channel network.

The U.S. Army Corps of Engineers HEC-1 model was used to calculate the on-site peak discharges. Appendix I contains the peak discharge assumptions, HEC-1 input data and the output summaries.

3. Channels

The channels are proposed to be grass-lined rather than natural earth for the following reasons:

a. Grass-lined channels can sustain a velocity of 7 feet per second (fps) or higher before erosion and scour becomes a serious problem, whereas the velocity limit for earth-lining is about 4 to 5 fps.

b. In order to maintain velocities near 7 fps, the approximate maximum channel bed slope allowed is 0.6 percent; a 0.25 percent slope would be needed to maintain a velocity of 5 fps. Since the natural landform slopes about 1.0 to 1.5 percent, more drop structures would be required to maintain flatter channel slopes.

c. If the channel bed slope was to remain constant, then additional channel width would be necessary to decrease the channel depth, which in turn, would decrease the channel velocity.

The following analysis illustrates why grass-lined channels are more favorable for the subject site:

SHAPE	Trapezoidal	Trapezoidal	Trapezoidal
Lining	Grass	Earth	Earth
Sideslopes	4:1	4:1	4:1
Bottom Width	20'	20'	80'
Slope	0.6%	0.25%	0.6%
"n"	0.027	0.030	0.030
Velocity	7.1 fps	4.8 fps	5.0 fps
Design	681 cfs	681 cfs	681 cfs
Top Width	44 feet	52 feet	93 feet
1' Drop structures required at 1.5% natural slope	1 per 112 feet	1 per 80 feet	1 per 112 feet

Therefore, it is apparent that the grass-lined channels are the superior alternative in terms of "acceptable" velocities, minimizing the number of drop structures, and reducing the widths of drainage easements.

To minimize the top width of the required channels and drainage easements, the vertical dimension of the drop structures is 1 foot. The channel depth is usually 4 feet. This depth includes one (1) foot of freeboard. This depth is consistent with the results of the SLA report. Also, 4H:1V sideslopes improve channel stability and maintenance.

Typical channel sections and drainage easement widths are shown on Exhibit 1. The calculations showing the velocities and discharges of the proposed channels are provided in Appendix II.

Two possible corridors for routing stormwater runoff at 83rd Street and Bell Road exist. The primary route i.e., routing runoff south at 83rd Street to the golf course, would require a drainage easement through private land. This route is consistent with historical flow patterns (see Section III A).

Alternative #1, i.e., routing runoff west to Hayden Road and then south to the golf course would also require a drainage easement on private land. Runoff, from this alternative would be combined with runoff from the north (adjacent Hayden Road). Refer to SLA report.

4. Culverts

Culverts are necessary to route the channelized flows under the major streets. Concrete box culverts are proposed for the 100 year peak discharges exceeding about 150 cfs. For locations where peak discharges are less than about 150 cfs, reinforced concrete pipes will probably be a more economical alternative.

Sixteen culvert locations are proposed. The locations are shown on Exhibit 1; the preliminary culvert sizes are listed below. The design sizes are based on an inlet control condition with an available headwater depth of 5 ± 0.5 feet, unless otherwise noted.

CULVERT NUMBER	LOCATION	SIZE	Q100(cfs)	
1	W 1/4 Corner & Bell	Quad 10x4 CBC	1348	
2	Loop & Pima South	Triple 8x3 CBC	632	
3	Loop Road (west) & Pima East	Single 8x3 CBC	184	
4	86th & Pima	Double 6x3 CBC	306	
5	Loop Road (channel "F" & "G" to "H")	8x3 CBC	186	
6	Loop Road (channel "D" to "G") & 86th	30" RCP	51	
7	Loop Road (channel "E" to "F")	30" RCP	57	
8	Loop Road (channels "R" & "S" to "V")	Triple 10x4 CBC	1026	
9	Loop Road (channels "P" & "Q" to "R") and 86th	10x3 CBC	268	
10	Loop Road (channel "O" to "P")	30" RCP	53	
11	Loop Road (channels "M" & "N" to "Q") and 86th	Double 36" RCP	95	
12	86th & Bell	6x3 CBC	167	
13	Hayden & Bell	Six - 10x5 CBC*	3321	(max. est.)
14	Pima & Outer Loop	10x5 CBC**	700	
15	Outer Loop (channel "B" to "C")	10x5 CBC**	1022	
16	Bell & Outer Loop	10x5 CBC**	1022	

* Concrete box culvert based on 6 feet of available headwater depth. This preliminary size of culvert is required for alternative #2 only.
**Based on open channel flow calculations

The final culvert sizes and locations will be determined during the design phase of the roadway infrastructure.

Appendix III contains the culvert calculation worksheets.

IV. PHASING OF DEVELOPMENT

Phase I consists solely of the FFCA site (encompassing a portion of Parcel "J"). The developer intends to construct the roadways to the parcel, which consist of Bell Road to 86th Street, and then 86th Street to the parcel, plus the adjacent Loop Road.

Any excess top soil during the construction phases will be stockpiled in the northeast corner of the site. The soil material will be spread out to eliminate the possibility of floodwater damming, ponding and/or diversion. The damage to any existing vegetation will be minimal, thus preserving the area's visual resources.

Only 20% of the Perimeter Center can be developed until the drainage infrastructure has been completed.

The timeframe for the complete buildout of Scottsdale Perimeter Center is anticipated to be several years. During the interim, preventative siltation measures will be necessary to minimize downstream sedimentation. A small perimeter berm around each parcel boundary is proposed to prevent sediment from entering the channel system.

It will not be possible to alter upstream offsite siltation effects until the proposed upstream detention system is in place.

During and after parcel development, the grading and drainage plan will include a design to "trap and collect" sediment from draining into the channel network.

Careful measures and coordination will be undertaken where drainage enters and crosses the City of Scottsdale golf course to prevent erosion and silting.

It is apparent to CWW that the existing drainage facilities to route runoff through the golf course are inadequate to contain the flows previously given. Therefore, we believe the City of Scottsdale needs to explore further channelization improvements on the TPC property.

V. SUMMARY

The proposed master drainage plan for the Scottsdale Perimeter Center was prepared with close coordination with the City of Scottsdale staff. The master plan follows the recommendations suggested by the Simons, Li and Associates' report entitled "Drainage Analysis for State Trust Lands, Outer Loop Highway, Scottsdale Road to Pima Road", June 1987. This report has been approved by the City of Scottsdale.

The primary goal of this report is two-fold. First, to establish the drainage concept for the eleven parcels of the Scottsdale Perimeter Center; and secondly, to effectively route the off-site runoff and the on-site generated runoff through the development.

The off-site drainage concept as contained herein, i.e., detention basin with training dikes and the 100 year peak discharge bleed-off rate, are adopted in full from the Simons, Li and Associates' report.
The proposed on-site channel network, with the recommended channel cross sections, will satisfy the fully developed conditions of the site.

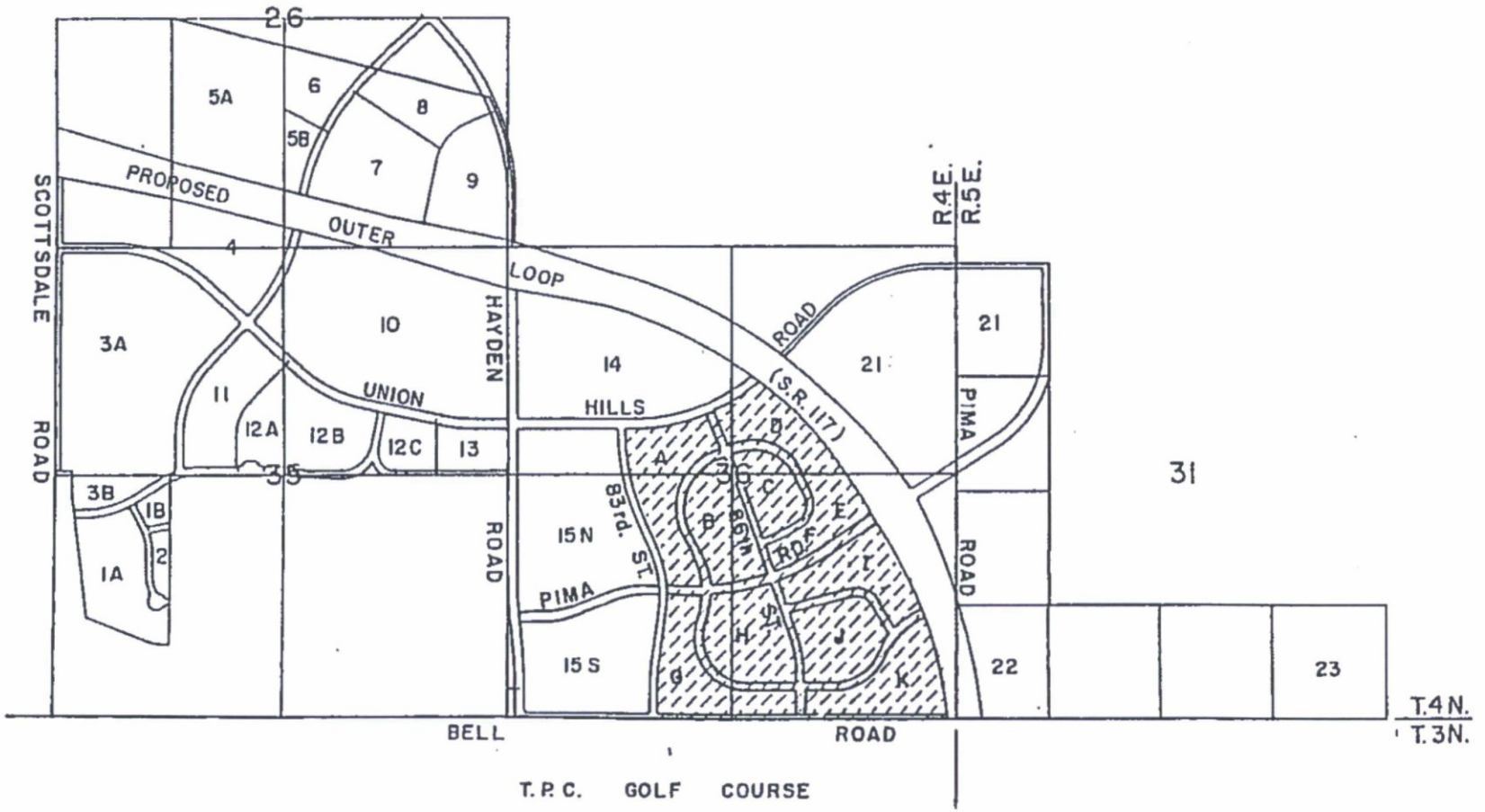
26
5A
6
5B
8
7
9
PROPOSED
OUTER
LOOP
4
SCOTTSDALE
ROAD
3A
10
HAYDEN
ROAD
14
11
UNION
HILLS
12A
12B
12C
13
35
3B
1B
2
1A
15N
83rd. ST.
PIMA
ROAD
15S
R.4E.
R.5E.
ROAD
(S.R. 117)
21
21
PIMA
ROAD
31
22
23
T.4N.
T.3N.
BELL
ROAD
T.P.C. GOLF COURSE

FIGURE....
PAGE.....

APPENDIX I - PEAK DISCHARGE ASSUMPTIONS HEC-1 INPUT DATA, AND OUTPUT SUMMARIES

1. Per the SCS Aguila-Carefree Soil Survey, April, 1986, the existing soils are classified in the "B" Hydrologic Soil Group.

2. The existing vegetative cover density is 20%. This is consistent with previous drainage reports by CWW and others.

3. Per Figure 2-15, COS Section 2 Design Manual, a "B" soil and 20% cover yields a runoff curve number of 83.

4. During a telephone discussion with Bill Erickson, COS, on 12/22/87, it was agreed upon to calculate post peak discharges based on additional impervious area, rather than adjusting (increasing) the runoff curve number. This approach is consistant with new State and Federal guidelines. The percent of impervious areas with development, both industrial and commercial, is assumed to be 85.

Percent Impervious Modeled

5. Due to the small drainage parcels, all on-site parcels were assumed to have a time of concentration of 10 minutes. Although several of the parcels would have a time of concentration less than 10 minutes, by using either Kirpich's formula or a time of travel relationship in parking areas and/or street, a 10 minute minimum was assumed. This is consistent with ADOT drainage procedures.

   This is an conservative assumption, as the developer will impose sediment control on each development site, thereby increasing the time of concentration.

6. The individual drainage area boundaries are shown on Exhibit 1. The post development sub-basin drainage areas, within the individual parcels, were depicted to conform to the existing topography and landform as much as possible.

7. The 100 year, 1 hour precipitation value of 2.46 inches was obtained from Fig. 2-6, COS Section 2 Design Manual. The 5 minute and 15 minute values, 0.72 inches and 1.41 inches, respectively, were obtained by multiplying the 1 hour value of 0.29 and 0.57. This follows ADOT guidelines, per the "Hydrologic Design for Highway Drainage, Arizona". Likewise, the 2 year, 1 hour value was 0.99 inches, the 10 year, 1 hour value was 1.62 inches, and the 25 year, 1 hour value was 2.05 inches.

8. Channel routing was utilized by the Kinematic Wave channel routing method.

Appendix 5: Warning and Disclaimer of Liability

WARNING & DISCLAIMER OF LIABILITY

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

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

WARNING AND DISCLAIMER OF LIABILITY PURSUANT TO S.R.C §37-22
"The degree of flood protection provided by the requirements in this article is considered reasonable for regulatory purposes and is based on scientific and engineering considerations. Floods larger than the base flood can and will occur on rare occasions. Floodwater heights may be increased by man-made or natural causes. This article (Chapter 37, Article II) shall not create liability on the part of the city, any officer or employee thereof, or the federal government for any flood damages that result from reliance on this article or any administrative decision lawfully made thereunder."

Compliance with Drainage and Floodplain Regulations and Ordinances does not insure complete protection from flooding. The Floodplain Regulations and Ordinances meet established local and federal standards for floodplain management, but neither this review nor the Regulations and Ordinances take into account such flood related problems as natural erosion, streambed meander or man-made obstructions and diversions, all of which may have an adverse affect in the event of a flood. You are advised to consult your own engineer or other expert regarding these considerations.

I have read and understand the above. If I am an agent for an owner I have made the owner aware of and explained this disclaimer.

Plan Check No.	Owner or Agent	Date	
		4/19/18	

PRELIMINARY DRAINAGE REPORT

FOR

Perimeter Center Commons

17300 N. Perimeter Dr.,

Scottsdale, AZ 85255

APNs: 215-07-218, 215-07-001D

Prepared for:

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Plan #
Case # 7-DR-2018
Q-S #
[X] Accepted
[ ] Corrections
M.R. 5/14/18
Reviewed By Date

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REGISTERED PROFESSIONAL ENGINEER (CIVIL)
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38775
MIKE A.
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Date Signed 04/23/2018
ARIZONA, U.S.A.

EXPIRES 3/31/2021

7-DR-2018
04/24/18

April 23, 2018

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INTRODUCTION

The purpose of this report is to indicate the methods used and to provide discussion of the proposed Perimeter Center Commons (the Site) stormwater drainage. The Site is currently undeveloped desert land within an existing masterplan commercial/retail development area. The proposed improvements include connection to an existing driveway and parking located south of the Site. New facilities include parking and a 24,128 SF office commercial building west of Perimeter Drive and north of Hartford Drive in Scottsdale, AZ. This report will indicate how the storm water generated on the subject property is addressed and how it complies with the City of Scottsdale drainage requirements.

The project Site is generally located north of Bell Rd. and east of Hayden Rd. inside the LOOP 101 in Scottsdale, Arizona. The site is bounded by Sonoran Corporate Center to the north, Cachet Homes to the South, and an existing regional drainage channel adjacent to Hartford Dr. The existing drainage channel is designed to capture existing and proposed development runoff for the project Site. The existing zoning associated with the Site is Industrial Park (I-1) and the total property area is approximately 2.38 acres. Refer to Vicinity Map (Figure 1) for a general graphical representation of the Site location.

DESCRIPTION OF EXISITNG DRAINAGE CONDITIONS AND CHARACTERISTICS

The current Site is part of a drainage masterplan and generally slopes from north to south with an elevation variance of approximately 4.0'. There is currently a small mounded area that bisects the property and directs runoff to the southwest and southeast corners of the property. The study area is situated within a fully developed area and no offsite flows are expected to enter the Site. In the existing conditions, the site drains to the parcel to the south where runoff is routed through existing parking areas to curb openings and ultimately to an existing regional drainage channel. This flow pattern will be maintained in the proposed conditions. The western half of the site collects runoff in an existing improved drainage ditch. This ditch connects to the existing regional drainage channel. The regional drainage channel routes westerly and southerly to the regional offsite basin for storage. No local storage is required or provided for the parcel. The existing regional system is covered in the *Master Drainage Report for Scottsdale Perimeter Center*, prepared by Collar, Williams, & White Engineering (CWW Engineering), dated January 1989. The master report anticipated a future development with 85% impervious surface are for this project site. This project has a 15% open space requirement so the planned development will not exceed the 85% impervious. Excerpts from this study are included in **Appendix 4**. The last page of the attached excerpts indicates the input and output summaries from the modeling in the master report, including the assumption of 85% impervious used for the runoff curve number. Additionally, the second sentence of the third paragraph of Article B.1. Storm Water Storage Facilities notes:

"…These basins are specifically intended to mitigate the need for on-site storage within the Core South project area."

The 17 Three Hundred development is within the area discussed in the report by CWW and the basins discussed in the report were constructed; therefore, the development 17 Three Hundred at 17300 Perimeter Drive does not need to provide on-site storage.

FEMA FLOOD ZONE / FIRM MAP

This project resides in a Zone "AO" area as noted on the FEMA / FIRM Map #04013C1320L dated October 16, 2013. This is considered a special flood hazard area with inundation by the 1% annual chance flood, and flood depths of 1 to 3 feet average depth determined. For areas of alluvial fan flooding, velocities also determined. Per the FIRM Map, flow depths of 1' and

velocity of 3 feet per second are anticipated on the project Site. A firmette of this map (Figure 2) is attached in **Appendix 1**.

PROPOSED DRAINAGE PLAN

Based on the proposed grading, the Site has been divided into 4 new drainage areas labeled in this report as drainage areas W-1, W-2, E-1 and E-2. Refer to Figure 3 found in **Appendix 1** for a graphical representation of the proposed drainage area boundaries, discharge locations and outfall provisions.

The proposed Finished Floor is to be set at an elevation of 1564.50 ft. This was established in order to maintain a finished floor elevation 1 foot above the Base Flood Elevation, which means the finished floor must be 2 feet above the high adjacent grade (HAG). Based upon our analysis of as-builts of the area from 1989 obtained from the City of Scottsdale, the HAG is 1560.75 (1929 datum). The datum conversion for this area yielded an elevation difference of 1.73 feet, which put the HAG at 1562.48 (1988 datum). Based upon this the minimum finished floor elevation is 1564.48. We set the design finished floor at 1564.50. A graphical representation of the HAG depicted on the as-built plan is included as **Figure 4**.

From the finished floor, the site is designed to slope away from the building and through the parking lot to the west and south. Further description is provided below.

Drainage area W-1 and W-2 include open space areas and parking lot, as well as the majority of the building footprint. Areas W-1 and W-2 have been designed to convey runoff to an open space area via curb opening and spillway along the western property line. This flow will ultimately discharge south to the existing channel along Hartford Drive. Drainage area E-1 will similarly discharge from the site via curb opening, but to the east. This area predominately consists of parking area adjacent to the building, open space areas, and a portion sidewalks adjacent to the building. Drainage area E-2 is also located at the eastern side of the development and will sheet flow south through the adjacent southern property ultimately discharging to the channel along Hartford Drive.

Two existing drainage areas south of the building, EX-W and EX-E have already been considered as part of the development to the south. Since the southern property 17200 N. Perimeter Dr. has been developed, the property line has been adjusted, however, when approved the two existing drainage areas EX-W and EX-E were accounted for as part of the southern development. Additionally, Drainage E-2 has been considered with EX-E as part of the proposed development to the south and the curb openings to the south are adequately sized to combined existing and proposed discharge.

DATA ANALYSIS METHODS

The 100-year 2-hour storm event peak flow computations included in this report are based on the Rational Method and the procedure described in the City of Scottsdale Design Standards and Policies Manual and the design standards and methodologies developed by the Flood Control District of Maricopa County.

The following table provides a summary of the criteria that has been assumed for the hydrologic analysis.

Discharge point	Area Total (ft.2)1	Area Total (ac)	Runoff Coefficient "C"	Min time of Concentration (min.)	Precipitation Intensity 10yr (in./hr.)	Precipitation Intensity 100yr (in./hr.)	10-Year Peak Discharge (cfs)	100-Year Peak Discharge (cfs)
W-1	21,107.00	0.48	0.9	5	4.96	7.78	2.16	3.39
W-2	29,086.00	0.67	0.9	5	4.96	7.78	2.98	4.68
EX-W	81,466.00	1.87	0.9	5	4.96	7.78	8.35	13.10
E-1	8,035.00	0.18	0.9	5	4.96	7.78	0.82	1.29
E-2**	19,865.00	0.46	0.9	5	4.96	7.78	2.04	3.19
EX-E**	61,795.00	1.42	0.9	5	4.96	7.78	6.33	9.93
**Drainage Areas E-2 and EX-E are combined for a total runoff of 13.12 CFS								

For scour protection, inlets and outlets at all proposed drainage structures will be provided with riprap areas. The median riprap stone size (D50) is proposed to be 6-inch with a riprap layer thickness equal to 14 inches.

SWPPP

The project site is more than 2.0 acres almost all of which will be disturbed, therefore an ADEQ NOI certification, a set of SWPPP plans, and a SWPPP booklet will be submitted with the Improvement Plan submittal.

WARNING AND DISCLAIMER OF LIABILITY

Refer to **Appendix 5** for a copy of the Warning & Disclaimer of Liability form.

CONCLUSION

This project has been designed to conform to the City of Scottsdale DSPM and will match the pre-existing drainage patterns. Proposed drainage improvements will include discharge points sized for the 100-year, 2-hour storm event. The majority of the proposed improvements will either sheet flow east or west, however the southern portion of the site will sheet flow south though the existing development discharge points (City of Scottsdale Plan check number 844-16). The existing discharge outfall to the channel along Hartford Drive is sized to accommodate the increased flow from the proposed development. It is also expected no adverse impacts to the offsite downstream properties are anticipated as a result of the proposed improvements.

REFERENCES

City of Scottsdale, Design Standards & Policies Manual, January 2010.

Flood Control District of Maricopa County. Drainage Design Manual for Maricopa County, Arizona, Volume 1. August 15, 2013.

Flood Control District of Maricopa County. Drainage Design Manual for Maricopa County, Arizona, Volume 2. August 15, 2013.

CWW Engineering. Master Drainage Report for Scottsdale Perimeter Center, January 1989

Appendix 1: Figures

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Arizona State Plane Central zone (FIPSZONE 0202). The **horizontal datum** was NAD 83 HARN, GRS1980 spheroid. Differences in datum, spheroid, projection or State Plane zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These **differences** do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988 (NAVD 88). These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. Map users wishing to obtain flood elevations referenced to the National Geodetic Vertical Datum of 1929 (NGVD 29) may use the following Maricopa County website application: http://www.fcd.maricopa.gov/Maps/gismaps/apps/gdacs/appication/index.cfm

This web tool allows users to obtain point-specific datum conversion values by zooming in and hovering over a VERTCON checkbox on the layers menu on the left side of the screen. The VERTCON grid referenced in this web application was also used to convert existing flood elevations from NGVD 29 to NAVD 88.

To obtain current **elevation**, description, and/or location information for National Geodetic Survey bench marks shown on this map, please contact the Information Services Branch of the National Geodetic Survey at (301) 713-3242, or visit its website at http://www.ngs.noaa.gov. To obtain information about Geodetic Densification and Cadastral Survey bench marks produced by the Maricopa County Department of Transportation, please visit the Flood Control District of Maricopa County website at: http://www.fcd.maricopa.gov/Maps/gismaps/apps/gdacs/application/index.cfm.

Base map information shown on this FIRM was derived from multiple sources. Aerial imagery was provided in digital format by the Maricopa County Department of Public Works, Flood Control District. The imagery is dated October 2009 to November 2009. Additional National Agricultural Imagery Program (NAIP) imagery was provided by the Arizona State Land Department (ALRIS) and is dated 2007. The coordinate system used for the production of the digital FIRM is State Plane Arizona Central NAD83 HARN, International Feet.

The **profile base line** depicted on this map represents the hydraulic modeling baselines that match flood profiles in the FIS report. As a result of improved topographic data, the profile base line, in some cases, may deviate significantly from the channel centerline or appear outside the SFHA.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community, as well as a listing of the panels on which each community is located.

For information on available products associated with this FIRM, visit the **FEMA Map Service Center (MSC)** website at http://msc.fema.gov. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, or digital versions of this map. Many of these products can be ordered or obtained directly from the MSC website.

If you have **questions about this map**, how to order products, or the National Flood Insurance Program in general, please call the **FEMA Map Information eXchange (FMIX) at 1-877-FEMA MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/.

SPECIAL FLOOD HAZARD AREAS (SFHAs) subject to inundation by the 1% annual chance flood. The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A No Base Flood Elevations determined.

ZONE AE Base Flood Elevations determined.

ZONE AH Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.

ZONE AO Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.

ZONE AR Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.

ZONE A99 Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.

ZONE V Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.

ZONE VE Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X Areas determined to be outside the 0.2% annual chance floodplain.

ZONE D Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

- 1% annual chance floodplain boundary
- 0.2% annual chance floodplain boundary
- Floodway boundary
- Zone D boundary
- CBRS and OPA boundary
- Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
- 513 — Base Flood Elevation line and value; elevation in feet*
- (EL 987) — Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the North American Vertical Datum of 1988 (NAVD 88)

- A — A — Cross section line
- 23 — 23 — Transect line
- 97°07'30", 32°22'30" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)
- 4278000mN — 1000-meter Universal Transverse Mercator grid ticks, zone 12
- 6000000 M — 5000-foot grid ticks: Arizona State Plane coordinate system, central zone (FIPSZONE 0202), Transverse Mercator
- DX5510 — Bench mark (see explanation in Notes to Users section of this FIRM panel)
- M1.5 — River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
April 15, 1988

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL
December 3, 1993 - September 30, 1995 - July 16, 2001 - September 30, 2005
October 16, 2013 - to add base flood elevation, to add special flood hazard areas, to incorporate previously issued letters of map revision, to add roads and road names, to update corporate limits, to change floodway, to advance suffix, to change base flood elevations, and to add floodway

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 1000'
500 0 1000 2000 FEET
300 0 300 600 METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 1320L

FIRM
FLOOD INSURANCE RATE MAP
MARICOPA COUNTY, ARIZONA
AND INCORPORATED AREAS

PANEL 1320 OF 4425
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
MARICOPA COUNTY	040037	1320	L
PHOENIX, CITY OF	040051	1320	L
SCOTTSDALE, CITY OF	045012	1320	L

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

MAP NUMBER
04013C1320L

MAP REVISED
OCTOBER 16, 2013

NOTE: The side-slope of all Channels and Berms shown on this plan is 4:1 (max.) unless other wise noted.

Double 36" Pipe Culvert w/ Drop Inlet

CONSTRUCT CONCRETE VALLEY GUTTER PER MARK STA. 0+00 - 2+40

Meandering Sidewalk (Typical)

Inv.=54.75

SCALE: 1" = 40'

0 20 40 80

PARCEL J

PARCEL H

1560.75

Approximate Location of Proposed BLDG

SEE SHEET 7

SEE SHEET 5

SEE S.P.C. PHASE ONE GRADING AND DRAINAGE PLANS SHEET 8 OF 8

HAG = 1560.75 1929 datum

△ 1988 datum to 1929 datum = 1.73 ft

HAG = 1562.48 1988 datum

18532

REVISIONS			
NO.	DATE	BY	DESCRIPTION

DESIGNED D.B.C.
DRAWN D.D.R.
CHECKED R.E.M.
DATE FEB., 1989
SCALE 1"=40'

GRADING AND DRAINAGE PLANS FOP

SCOTTSDALE PERIMETER CENTER PHASE TWO

SHEET 8 OF 22

SURVEY PROJECT NO. 88117
DESIGN PROJECT NO. 88118

15-DR-88

FIGURE 4: HIGH ADJACENT GRADE

Appendix 2: NOAA 14 Precipitation Values

NOAA Atlas 14, Volume 1, Version 5
Location name: Scottsdale, Arizona, USA*
Latitude: 33.6426°, Longitude: -111.8976°
Elevation: 1561.25 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

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

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

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

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	2.35 (1.94-2.88)	3.07 (2.57-3.76)	4.14 (3.42-5.05)	4.96 (4.08-6.04)	6.06 (4.92-7.36)	6.90 (5.53-8.32)	7.78 (6.12-9.35)	8.64 (6.70-10.4)	9.82 (7.40-11.8)	10.7 (7.92-12.9)
10-min	1.79 (1.48-2.19)	2.33 (1.95-2.86)	3.14 (2.60-3.85)	3.77 (3.11-4.59)	4.61 (3.74-5.59)	5.26 (4.21-6.32)	5.92 (4.66-7.11)	6.58 (5.09-7.88)	7.47 (5.63-8.97)	8.15 (6.02-9.80)
15-min	1.48 (1.22-1.81)	1.93 (1.61-2.36)	2.60 (2.15-3.18)	3.12 (2.57-3.80)	3.81 (3.09-4.62)	4.34 (3.48-5.23)	4.89 (3.85-5.88)	5.44 (4.21-6.52)	6.17 (4.66-7.42)	6.73 (4.98-8.10)
30-min	0.994 (0.826-1.22)	1.30 (1.09-1.59)	1.75 (1.45-2.14)	2.10 (1.73-2.56)	2.57 (2.08-3.11)	2.92 (2.34-3.52)	3.29 (2.59-3.96)	3.66 (2.83-4.39)	4.16 (3.14-4.99)	4.53 (3.35-5.45)
60-min	0.615 (0.511-0.754)	0.804 (0.671-0.985)	1.08 (0.897-1.32)	1.30 (1.07-1.58)	1.59 (1.29-1.93)	1.81 (1.45-2.18)	2.04 (1.60-2.45)	2.27 (1.75-2.72)	2.57 (1.94-3.09)	2.81 (2.08-3.38)
2-hr	0.360 (0.302-0.430)	0.464 (0.392-0.558)	0.618 (0.520-0.738)	0.736 (0.611-0.877)	0.898 (0.738-1.06)	1.02 (0.826-1.20)	1.14 (0.912-1.35)	1.27 (0.996-1.49)	1.44 (1.10-1.70)	1.57 (1.18-1.86)
3-hr	0.264 (0.223-0.324)	0.339 (0.287-0.417)	0.443 (0.372-0.541)	0.525 (0.436-0.638)	0.640 (0.524-0.772)	0.732 (0.592-0.878)	0.826 (0.656-0.991)	0.926 (0.723-1.11)	1.06 (0.804-1.27)	1.17 (0.867-1.40)
6-hr	0.160 (0.137-0.190)	0.202 (0.173-0.240)	0.257 (0.220-0.304)	0.302 (0.255-0.355)	0.362 (0.302-0.425)	0.409 (0.337-0.478)	0.458 (0.371-0.533)	0.509 (0.404-0.594)	0.576 (0.446-0.672)	0.629 (0.476-0.735)
12-hr	0.090 (0.077-0.105)	0.113 (0.097-0.133)	0.142 (0.122-0.167)	0.166 (0.141-0.194)	0.197 (0.166-0.230)	0.221 (0.184-0.257)	0.246 (0.202-0.285)	0.271 (0.220-0.314)	0.304 (0.240-0.355)	0.330 (0.256-0.387)
24-hr	0.053 (0.046-0.061)	0.067 (0.059-0.078)	0.086 (0.075-0.100)	0.102 (0.089-0.118)	0.123 (0.107-0.142)	0.141 (0.120-0.162)	0.159 (0.134-0.183)	0.177 (0.148-0.204)	0.203 (0.167-0.234)	0.224 (0.182-0.259)
2-day	0.028 (0.025-0.033)	0.036 (0.032-0.042)	0.048 (0.041-0.055)	0.057 (0.049-0.065)	0.069 (0.059-0.079)	0.079 (0.067-0.091)	0.089 (0.075-0.103)	0.100 (0.084-0.116)	0.116 (0.095-0.134)	0.128 (0.103-0.149)
3-day	0.020 (0.018-0.023)	0.026 (0.023-0.030)	0.034 (0.030-0.039)	0.041 (0.036-0.047)	0.051 (0.044-0.058)	0.058 (0.050-0.066)	0.066 (0.056-0.076)	0.075 (0.063-0.086)	0.087 (0.072-0.100)	0.097 (0.079-0.112)
4-day	0.016 (0.014-0.019)	0.021 (0.019-0.024)	0.028 (0.025-0.032)	0.033 (0.029-0.038)	0.041 (0.036-0.047)	0.048 (0.041-0.054)	0.055 (0.047-0.062)	0.062 (0.053-0.071)	0.073 (0.061-0.083)	0.081 (0.067-0.093)
7-day	0.011 (0.009-0.012)	0.014 (0.012-0.016)	0.018 (0.016-0.021)	0.022 (0.019-0.025)	0.027 (0.023-0.031)	0.031 (0.027-0.035)	0.036 (0.030-0.041)	0.040 (0.034-0.046)	0.047 (0.039-0.054)	0.053 (0.043-0.061)
10-day	0.008 (0.007-0.009)	0.010 (0.009-0.012)	0.014 (0.012-0.016)	0.016 (0.014-0.019)	0.020 (0.018-0.023)	0.023 (0.020-0.027)	0.027 (0.023-0.030)	0.030 (0.026-0.035)	0.035 (0.029-0.040)	0.039 (0.032-0.045)
20-day	0.005 (0.004-0.006)	0.006 (0.006-0.007)	0.009 (0.008-0.010)	0.010 (0.009-0.011)	0.012 (0.011-0.014)	0.014 (0.012-0.016)	0.016 (0.014-0.018)	0.017 (0.015-0.020)	0.020 (0.017-0.023)	0.022 (0.018-0.025)
30-day	0.004 (0.003-0.004)	0.005 (0.004-0.006)	0.007 (0.006-0.008)	0.008 (0.007-0.009)	0.010 (0.008-0.011)	0.011 (0.009-0.012)	0.012 (0.011-0.014)	0.014 (0.012-0.015)	0.015 (0.013-0.018)	0.017 (0.014-0.019)
45-day	0.003 (0.003-0.003)	0.004 (0.003-0.004)	0.005 (0.005-0.006)	0.006 (0.005-0.007)	0.007 (0.007-0.008)	0.008 (0.007-0.009)	0.009 (0.008-0.011)	0.010 (0.009-0.012)	0.012 (0.010-0.013)	0.013 (0.011-0.015)
60-day	0.003 (0.002-0.003)	0.003 (0.003-0.004)	0.004 (0.004-0.005)	0.005 (0.005-0.006)	0.006 (0.005-0.007)	0.007 (0.006-0.008)	0.008 (0.007-0.009)	0.008 (0.007-0.010)	0.009 (0.008-0.011)	0.010 (0.009-0.012)

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

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

Please refer to NOAA Atlas 14 document for more information.

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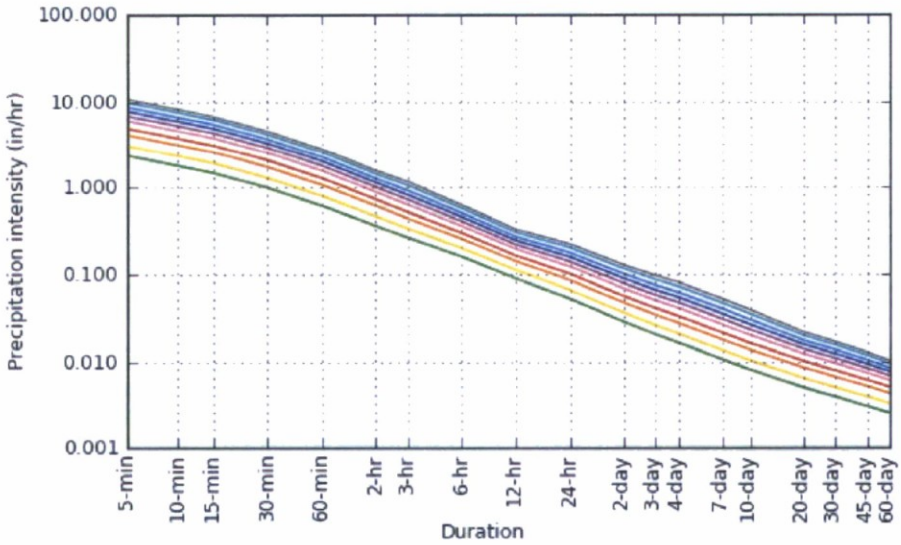
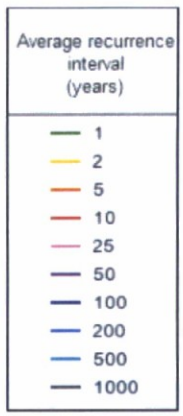
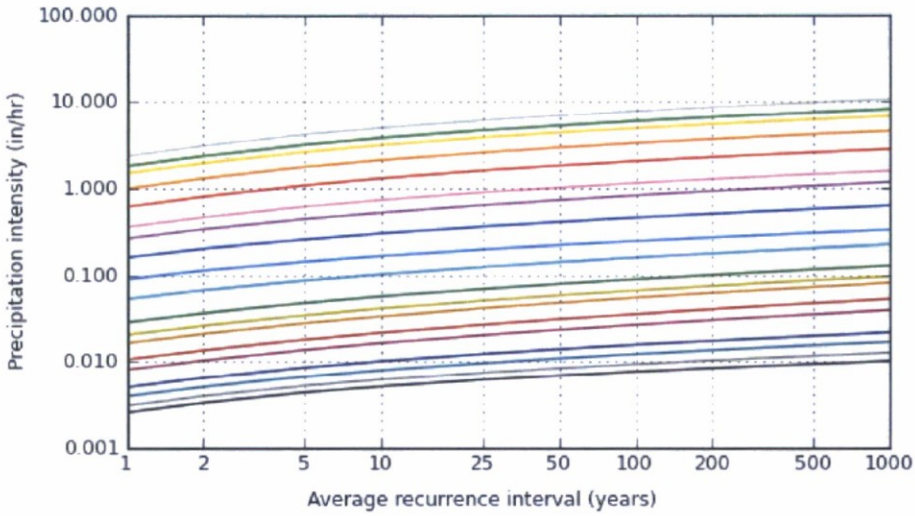
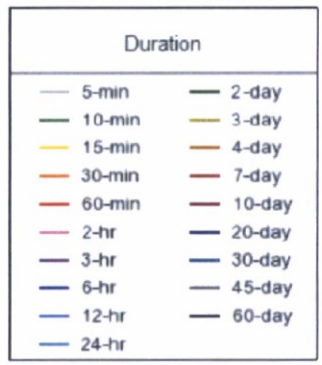
PF graphical

PDS-based intensity-duration-frequency (IDF) curves
Latitude: 33.6426°, Longitude: -111.8976°









NOAA Atlas 14, Volume 1, Version 5

Created (GMT): Thu Jan 4 21:39:56 2018

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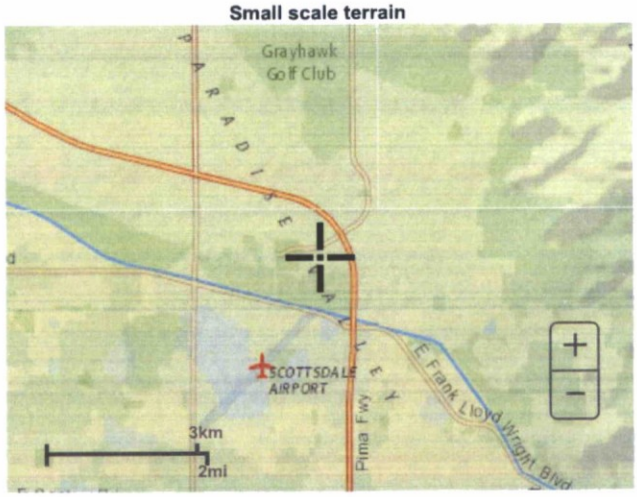
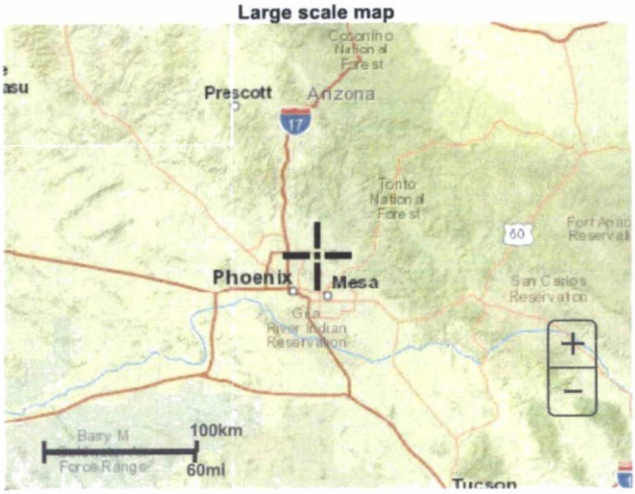
Maps & aerials

Small scale terrain

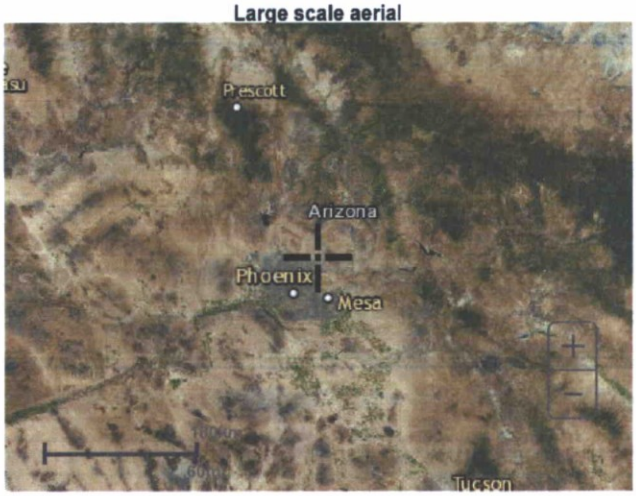


Large scale terrain

Large scale map



Large scale aerial



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US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Disclaimer

Appendix 3: Drainage Calculations

Discharge point	Area Total (ft.2)1	Area Total (ac)	Runoff Coefficient "C"	Min time of Concentration (min.)	Precipitation Intensity 10yr (in./hr.)	Precipitation Intensity 100yr (in./hr.)	10-Year Peak Discharge (cfs)	100-Year Peak Discharge (cfs)
W-1	21,107.00	0.48	0.9	5	4.96	7.78	2.16	3.39
W-2	29,086.00	0.67	0.9	5	4.96	7.78	2.98	4.68
EX-W	81,466.00	1.87	0.9	5	4.96	7.78	8.35	13.10
E-1	8,035.00	0.18	0.9	5	4.96	7.78	0.82	1.29
E-2**	19,865.00	0.46	0.9	5	4.96	7.78	2.04	3.19
EX-E**	61,795.00	1.42	0.9	5	4.96	7.78	6.33	9.93
**Drainage Areas E-1 and EX-E are combined for a total runoff of 13.12 CFS								

Appendix 4: Excerpts from Master Drainage Study

MASTER DRAINAGE REPORT
FOR
SCOTTSDALE PERIMETER CENTER
C.W.W. JOB NO. 870514-1

PREPARED FOR:
WESTCOR COMPANY
11411 NORTH TATUM BOULEVARD
PHOENIX, ARIZONA 85028

SUBMITTED BY:
COLLAR, WILLIAMS & WHITE ENGINEERING
2702 NORTH 44TH STREET, SUITE 100-A
PHOENIX, ARIZONA 85008

JANUARY, 1988
REVISED JUNE, 1988
REVISED JULY, 1988
REVISED JANUARY, 1989

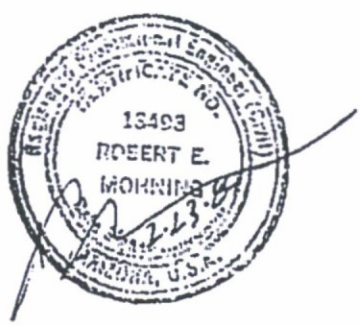
ACCEPTED MASTER PLAN

Water and Wastewater _____

Drainage _____ 4/12/89

Circulation _____

MASTER PLANNING UNIT
COMMUNITY DEVELOPMENT DEPARTMENT
CITY OF SCOTTSDALE



SCOTTSDALE PERIMETER CENTER
MASTER DRAINAGE REPORT

Table of Contents

I. INTRODUCTION

A. Location

Scottsdale Perimeter Center is a planned industrial and commercial development, located within the corporate limits of Scottsdale, Arizona. The area comprising the Scottsdale Perimeter Center is a part of the former State Trust Lands, north of the Bureau of Reclamation's Central Arizona Project Canal.

The site lies west of the proposed Outer Loop Freeway, between Union Hills Drive and Bell Road and east of 83rd Street. Scottsdale Perimeter Center encompasses about 240 acres (gross). See Figure 1 - Vicinity Map. Exhibit 1 shows Union Hills Drive, Pima Road and Bell Road extended to Hayden Road from 83rd Street, although the area west of 83rd Street is not a part of this site.

Westcor purchased Parcels 16, 17, 18, 19 and 20, a portion of the above described State Trust Lands. Parcels 16-20 have been split due to the internal street configuration, and have been renumbered in this report with letters A through K.

The surrounding properties are developing rapidly. In the past two years, the City of Scottsdale Tournament Players Club Golf Course (TPC) and the Princess Hotel have been constructed; and the Eagle Apartments are currently under construction. Based upon current trends, it is anticipated that development in the immediate area will occur at faster rates than most other portions of Maricopa County.

B. Related Drainage Studies

Collar, Williams & White Engineering (CWW) completed the "Preliminary Drainage Report for Forest City Scottsdale Company" in August, 1985, which included about 1400 acres of State Trust Lands. The subject site was included in the preliminary report. Revisions to the report were made in February and May of 1986. Simons, Li and Associates, Inc. (SLA) completed the "Drainage Analysis for State Trust Lands - Outer Loop Highway - Scottsdale Road to Pima Road" in June 1987.

SLA essentially utilized the channelization network proposed in the preliminary report by CWW, with the addition of a detention basin north of the Outer Loop. Freeway between Hayden Road and Pima Road. This basin and the off-site drainage are discussed in further detail in the next section. The SLA report has been approved by the City of Scottsdale.

II. OFF-SITE DRAINAGE

The drainage basins contributing runoff to the subject site have been extensively analyzed and evaluated in the aforementioned drainage reports. Therefore, the off-site drainage will not be discussed in detail for this report. A brief summary of the off-site watersheds from the SLA report, however, is provided below.

The contributing offsite drainage areas affecting the site extend beyond Reata Pass, approximately 8 miles northeast of the subject site. According to SLA, about 1100 acre-feet of runoff volume is generated from the off-site watersheds during the 100 year storm. This volume is proposed to be routed to a large detention basin via upstream training dikes. The proposed location of the detention basin is adjacent to the northern edge of the Outer Loop Freeway, between Hayden Road and Pima Road. The detention basin is proposed to be drained by two outlets; one near Hayden Road and the other near the future Union Hills Road alignment. The peak discharge released form the Hayden Road spillway is 1796 cfs, while the 100 year peak discharge at Union Hills is proposed to be 722 cfs. It is the Union Hills outlet that affects the subject site. Although this drainage concept and corresponding peak discharge rates and locations have been approved by the City of Scottsdale, it should be noted that the Arizona State Land Department and the Arizona Department of Transportation have yet to reach a similar final decision.

In conclusion, Scottsdale Perimeter Center will be subject to an ultimate off-site peak discharge of 722 cfs from the upstream detention basin, plus 300 $\pm$ cfs from an adjacent State Land parcel at Pima Road (northeast of the Outer Loop). The off-site drainage is proposed to be routed in a future concrete-lined channel (subject to the Design Review Board approval) that will parallel the southerly and westerly property boundary of the Outer Loop Freeway from Union Hills to Bell Road, and then south to the TPC. Coordination with the City of Scottsdale and affected property owners will be necessary to design the routing of the 722 cfs from Bell Road to the TPC.

The future channel location and cross-section for routing the above described off-site flows are shown on Exhibit 1.

The construction of the channel, including the roadway culverts, and the detention basin must occur concurrently, or before the construction of, the Outer Loop.

III. ON-SITE DRAINAGE

A. Existing Drainage Conditions

As above, the on-site drainage basins have been previously analyzed. Therefore, only a brief description is presented below.
The site is presently undeveloped and slopes gently to the southwest with an average slope of 1.5 percent. The area is characterized by native desert plant species, with an estimated cover density of 20 percent. Several defined dry washes occur on the site. However, due to the high sediment load during runoff flows, the channels frequently shift depending upon the intensity and duration of the rainfall event. Many of the smaller washes transform from channelized flow to sheet flow, and then back to channelized flow downstream.

According to an earlier Simons, Li and Associates drainage report, entitled "Hydrology Report, Outer Loop Highway, North of the CAP Aqueduct", April 1987, the historical drainage across Bell Road, between Hayden Road and Pima Road, is 6879 cfs. The SLA hydrologic analysis showed that the historic channels are not capable of carrying flows greater than the 2 year event. Larger events are therefore carried in wide strips adjacent to the historic channels with shallow depths and considered sheet flow.

According to the aforementioned CWW drainage report, three (3) concentration points were identified at Bell alignment, between Hayden and Pima Roads. The location of the concentration points and the peak discharges, per the report, are:

Location	100 Year Peak Discharge (cfs)
83rd Street and Bell Road	1643
86th Street and Bell Road	6784
700 ± feet west of Pima Road	193

The magnitudes of the peak discharge values from both reports are similar. However, the location(s) are uncertain. It is obvious, though, that no well defined channel exists between Hayden and Pima Roads to contain the above peak discharges.

B. Developed Drainage Conditions

Scottsdale Perimeter Center encompasses 11 parcels. All parcels are zoned for either industrial or commercial use. A channelization network is proposed to route the on-site runoff safely and effectively through the site. The channels will convey the on-site generated runoff to the TPC.

Since development will probably occur prior to the construction of the detention basin north of the Outer Loop, temporary measures will be required to protect the structures from the off-site flows, as described earlier. Temporary measures could consist of elevating the finished floors, constructing berms, walls and channels, excavating retention basins, or a combination of the above.

Any of the above measures will need to be evaluated and implemented concurrently with the design of any individual site development with evaluation of any change in water surface elevation which would affect downstream properties.

1. Storm Water Storage Facilities

Scottsdale City Code Title 37, Section 37-42 (12)a. requires "as a minimum, all development will make provisions to store runoff from rainfall events up to and including the 100-year 2-hour duration event".

This requirement may be waived if per Section 37-42 (12)a. "The runoff has been included in a storage facility at another location". In the same section of the code, it is stated that if storage is waived, the development shall be required to contribute to the cost of drainage works on the basis of runoff contribution. Section 37-42 allows exceptions to the regulations for "areas covered by master drainage plans, providing that the standards established by the code are met".

The Perimeter Center is an integral part of the State Land Department Core South Master Plan which requires large retention basins to be constructed along the Outer Loop Highway. These basins are specifically intended to mitigate the need for on-site storage within the Core South project area.

Each of the respective parties are required to construct their portion of the drainage project.

The Perimeter Center lays the foundation to satisfy the provisions of the City Code Title 37 for storm water storage facilities.

2. Peak Discharges

Post development peak discharges (100 year, one hour storm) are listed below for each parcel.

Parcel	Area (acres)	Peak Discharge (cfs) 2 Year	10 Year	25 Year	100 Year
A	30.8	70	117	151	186
B	25.2	57	96	124	153
C	13.3	30	51	66	80
D	22.2	50	85	109	134
E	6.9	16	26	34	42
F	9.2	21	35	45	56
G	29.7	67	114	146	179
H	27.2	62	104	134	165
I	24.4	56	93	120	148
J	22.2	51	85	109	134
K	27.6	63	105	136	167

Exhibit 1 shows the routing of the above on-site peak discharges and the proposed channel network.

The U.S. Army Corps of Engineers HEC-1 model was used to calculate the on-site peak discharges. Appendix I contains the peak discharge assumptions, HEC-1 input data and the output summaries.

3. Channels

The channels are proposed to be grass-lined rather than natural earth for the following reasons:

a. Grass-lined channels can sustain a velocity of 7 feet per second (fps) or higher before erosion and scour becomes a serious problem, whereas the velocity limit for earth-lining is about 4 to 5 fps.

b. In order to maintain velocities near 7 fps, the approximate maximum channel bed slope allowed is 0.6 percent; a 0.25 percent slope would be needed to maintain a velocity of 5 fps. Since the natural landform slopes about 1.0 to 1.5 percent, more drop structures would be required to maintain flatter channel slopes.

c. If the channel bed slope was to remain constant, then additional channel width would be necessary to decrease the channel depth, which in turn, would decrease the channel velocity.

The following analysis illustrates why grass-lined channels are more favorable for the subject site:

SHAPE	Trapezoidal	Trapezoidal	Trapezoidal
Lining	Grass	Earth	Earth
Sideslopes	4:1	4:1	4:1
Bottom Width	20'	20'	80'
Slope	0.6%	0.25%	0.6%
"n"	0.027	0.030	0.030
Velocity	7.1 fps	4.8 fps	5.0 fps
Design	681 cfs	681 cfs	681 cfs
Top Width	44 feet	52 feet	93 feet
1' Drop structures required at 1.5% natural slope	1 per 112 feet	1 per 80 feet	1 per 112 feet

Therefore, it is apparent that the grass-lined channels are the superior alternative in terms of "acceptable" velocities, minimizing the number of drop structures, and reducing the widths of drainage easements.

To minimize the top width of the required channels and drainage easements, the vertical dimension of the drop structures is 1 foot. The channel depth is usually 4 feet. This depth includes one (1) foot of freeboard. This depth is consistent with the results of the SLA report. Also, 4H:1V sideslopes improve channel stability and maintenance.

Typical channel sections and drainage easement widths are shown on Exhibit 1. The calculations showing the velocities and discharges of the proposed channels are provided in Appendix II.

Two possible corridors for routing stormwater runoff at 83rd Street and Bell Road exist. The primary route i.e., routing runoff south at 83rd Street to the golf course, would require a drainage easement through private land. This route is consistent with historical flow patterns (see Section III A).

Alternative #1, i.e., routing runoff west to Hayden Road and then south to the golf course would also require a drainage easement on private land. Runoff, from this alternative would be combined with runoff from the north (adjacent Hayden Road). Refer to SLA report.

4. Culverts

Culverts are necessary to route the channelized flows under the major streets. Concrete box culverts are proposed for the 100 year peak discharges exceeding about 150 cfs. For locations where peak discharges are less than about 150 cfs, reinforced concrete pipes will probably be a more economical alternative.

Sixteen culvert locations are proposed. The locations are shown on Exhibit 1; the preliminary culvert sizes are listed below. The design sizes are based on an inlet control condition with an available headwater depth of 5 $\pm$ 0.5 feet, unless otherwise noted.

CULVERT NUMBER	LOCATION	SIZE	Q100(cfs)	
1	W 1/4 Corner & Bell	Quad 10x4 CBC	1348	
2	Loop & Pima South	Triple 8x3 CBC	632	
3	Loop Road (west) & Pima East	Single 8x3 CBC	184	
4	86th & Pima	Double 6x3 CBC	306	
5	Loop Road (channel "F" & "G" to "H")	8x3 CBC	186	
6	Loop Road (channel "D" to "G") & 86th	30" RCP	51	
7	Loop Road (channel "E" to "F")	30" RCP	57	
8	Loop Road (channels "R" & "S" to "V")	Triple 10x4 CBC	1026	
9	Loop Road (channels "P" & "Q" to "R") and 86th	10x3 CBC	268	
10	Loop Road (channel "O" to "P")	30" RCP	53	
11	Loop Road (channels "M" & "N" to "Q") and 86th	Double 36" RCP	95	
12	86th & Bell	6x3 CBC	167	
13	Hayden & Bell	Six - 10x5 CBC*	3321	(max. est.)
14	Pima & Outer Loop	10x5 CBC**	700	
15	Outer Loop (channel "B" to "C")	10x5 CBC**	1022	
16	Bell & Outer Loop	10x5 CBC**	1022	

* Concrete box culvert based on 6 feet of available headwater depth. This preliminary size of culvert is required for alternative #2 only.
**Based on open channel flow calculations

The final culvert sizes and locations will be determined during the design phase of the roadway infrastructure.

Appendix III contains the culvert calculation worksheets.

IV. PHASING OF DEVELOPMENT

Phase I consists solely of the FFCA site (encompassing a portion of Parcel "J"). The developer intends to construct the roadways to the parcel, which consist of Bell Road to 86th Street, and then 86th Street to the parcel, plus the adjacent Loop Road.

Any excess top soil during the construction phases will be stockpiled in the northeast corner of the site. The soil material will be spread out to eliminate the possibility of floodwater damming, ponding and/or diversion. The damage to any existing vegetation will be minimal, thus preserving the area's visual resources.

Only 20% of the Perimeter Center can be developed until the drainage infrastructure has been completed.

The timeframe for the complete buildout of Scottsdale Perimeter Center is anticipated to be several years. During the interim, preventative siltation measures will be necessary to minimize downstream sedimentation. A small perimeter berm around each parcel boundary is proposed to prevent sediment from entering the channel system.

It will not be possible to alter upstream offsite siltation effects until the proposed upstream detention system is in place.

During and after parcel development, the grading and drainage plan will include a design to "trap and collect" sediment from draining into the channel network.

Careful measures and coordination will be undertaken where drainage enters and crosses the City of Scottsdale golf course to prevent erosion and silting.

It is apparent to CWW that the existing drainage facilities to route runoff through the golf course are inadequate to contain the flows previously given. Therefore, we believe the City of Scottsdale needs to explore further channelization improvements on the TPC property.

V. SUMMARY

The proposed master drainage plan for the Scottsdale Perimeter Center was prepared with close coordination with the City of Scottsdale staff. The master plan follows the recommendations suggested by the Simons, Li and Associates' report entitled "Drainage Analysis for State Trust Lands, Outer Loop Highway, Scottsdale Road to Pima Road", June 1987. This report has been approved by the City of Scottsdale.

The primary goal of this report is two-fold. First, to establish the drainage concept for the eleven parcels of the Scottsdale Perimeter Center; and secondly, to effectively route the off-site runoff and the on-site generated runoff through the development.

The off-site drainage concept as contained herein, i.e., detention basin with training dikes and the 100 year peak discharge bleed-off rate, are adopted in full from the Simons, Li and Associates' report.
The proposed on-site channel network, with the recommended channel cross sections, will satisfy the fully developed conditions of the site.

BOLLAR, WILLIAMS & WHITE
ENGINEERING

FIGURE....
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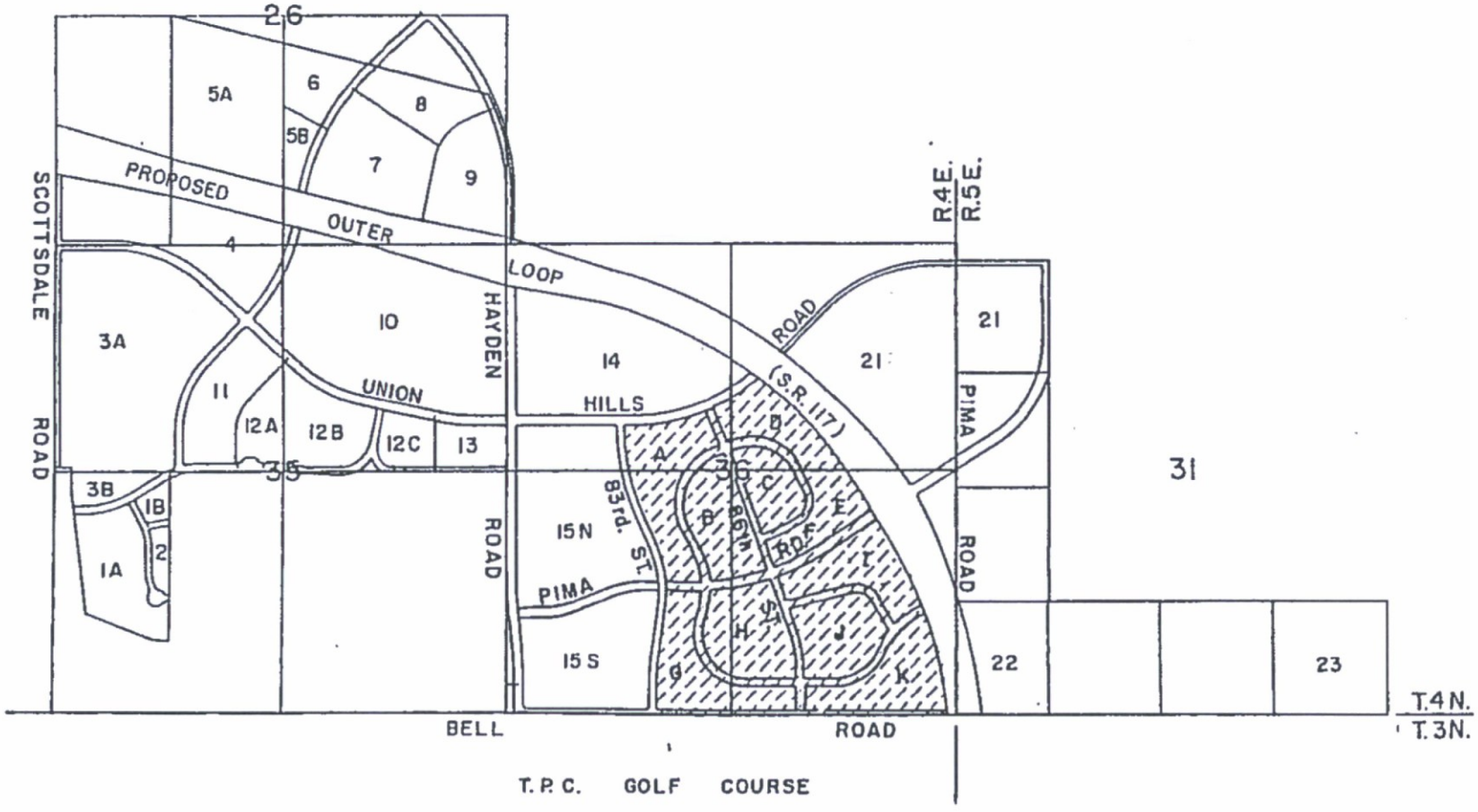

APPENDIX I - PEAK DISCHARGE ASSUMPTIONS HEC-1 INPUT DATA, AND OUTPUT SUMMARIES

1. Per the SCS Aguila-Carefree Soil Survey, April, 1986, the existing soils are classified in the "B" Hydrologic Soil Group.

2. The existing vegetative cover density is 20%. This is consistent with previous drainage reports by CWW and others.

3. Per Figure 2-15, COS Section 2 Design Manual, a "B" soil and 20% cover yields a runoff curve number of 83.

4. During a telephone discussion with Bill Erickson, COS, on 12/22/87, it was agreed upon to calculate post peak discharges based on additional impervious area, rather than adjusting (increasing) the runoff curve number. This approach is consistant with new State and Federal guidelines. The percent of impervious areas with development, both industrial and commercial, is assumed to be 85.

Percent Impervious Modeled

5. Due to the small drainage parcels, all on-site parcels were assumed to have a time of concentration of 10 minutes. Although several of the parcels would have a time of concentration less than 10 minutes, by using either Kirpich's formula or a time of travel relationship in parking areas and/or street, a 10 minute minimum was assumed. This is consistent with ADOT drainage procedures.

   This is an conservative assumption, as the developer will impose sediment control on each development site, thereby increasing the time of concentration.

6. The individual drainage area boundaries are shown on Exhibit 1. The post development sub-basin drainage areas, within the individual parcels, were depicted to conform to the existing topography and landform as much as possible.

7. The 100 year, 1 hour precipitation value of 2.46 inches was obtained from Fig. 2-6, COS Section 2 Design Manual. The 5 minute and 15 minute values, 0.72 inches and 1.41 inches, respectively, were obtained by multiplying the 1 hour value of 0.29 and 0.57. This follows ADOT guidelines, per the "Hydrologic Design for Highway Drainage, Arizona". Likewise, the 2 year, 1 hour value was 0.99 inches, the 10 year, 1 hour value was 1.62 inches, and the 25 year, 1 hour value was 2.05 inches.

8. Channel routing was utilized by the Kinematic Wave channel routing method.

Appendix 5: Warning and Disclaimer of Liability

WARNING & DISCLAIMER OF LIABILITY

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

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

WARNING AND DISCLAIMER OF LIABILITY PURSUANT TO S.R.C §37-22
"The degree of flood protection provided by the requirements in this article is considered reasonable for regulatory purposes and is based on scientific and engineering considerations. Floods larger than the base flood can and will occur on rare occasions. Floodwater heights may be increased by man-made or natural causes. This article (Chapter 37, Article II) shall not create liability on the part of the city, any officer or employee thereof, or the federal government for any flood damages that result from reliance on this article or any administrative decision lawfully made thereunder."

Compliance with Drainage and Floodplain Regulations and Ordinances does not insure complete protection from flooding. The Floodplain Regulations and Ordinances meet established local and federal standards for floodplain management, but neither this review nor the Regulations and Ordinances take into account such flood related problems as natural erosion, streambed meander or man-made obstructions and diversions, all of which may have an adverse affect in the event of a flood. You are advised to consult your own engineer or other expert regarding these considerations.

I have read and understand the above. If I am an agent for an owner I have made the owner aware of and explained this disclaimer.

Plan Check No.	Owner or Agent	Date
		4/19/18