2013P030

FINAL MASTER DRAINAGE REPORT

SAGE RESIDENTIAL – PHASE II SCOTTSDALE

November 2013
DEA PROJECT NO. ISTR00001

DAVID EVANS AND ASSOCIATES INC.

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DRAINAGE REPORT FOR
SAGE RESIDENTIAL – PHASE II
SCOTTSDALE

PREPARED FOR

7445 East Chaparral Road – Scottsdale, LLC
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PREPARED BY

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Frank Koo
Registered Professional Engineer (Civil)
CERTIFICATE NO.
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Date Signed 11-1-13
ARIZONA, U.S.A.
Exp. 12-31-2015

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ARIZONA, U.S.A.

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1.0 INTRODUCTION

This drainage report has been prepared under a contract with 7445 East Chaparral Road - Scottsdale, LLC, owner and developer of the Sage Residential – Phase II (formerly known as Sage Condominiums – Phase II) project in Scottsdale. The purpose of this report is to provide hydrological and hydraulic analysis, required by the City of Scottsdale, to support the site civil engineering elements of Sage Residential - Phase II. The project includes the construction two 25,000 square foot condominium buildings, paved access to the underground garages beneath the buildings, street frontage improvements to Woodmere Fairway, and site landscaping. The buildings are elevated to be constructed above the base flood elevation. Preparation of this report has been done in accordance with the procedures detailed in the *City of Scottsdale Design Standards and* Policies Manual (Reference 1) and Drainage Design Manuals for Maricopa County, Arizona, Volumes I & II (References 2 and 3).

The proposed Sage Residential - Phase II project is located between Woodmere Fairway and the Arizona Canal, adjacent to Highland Avenue, within the City of Scottsdale, Maricopa County, Arizona. The site is located within Section 23, Township 2 North, Range 4 East of the Gila and Salt River Base and Meridian.

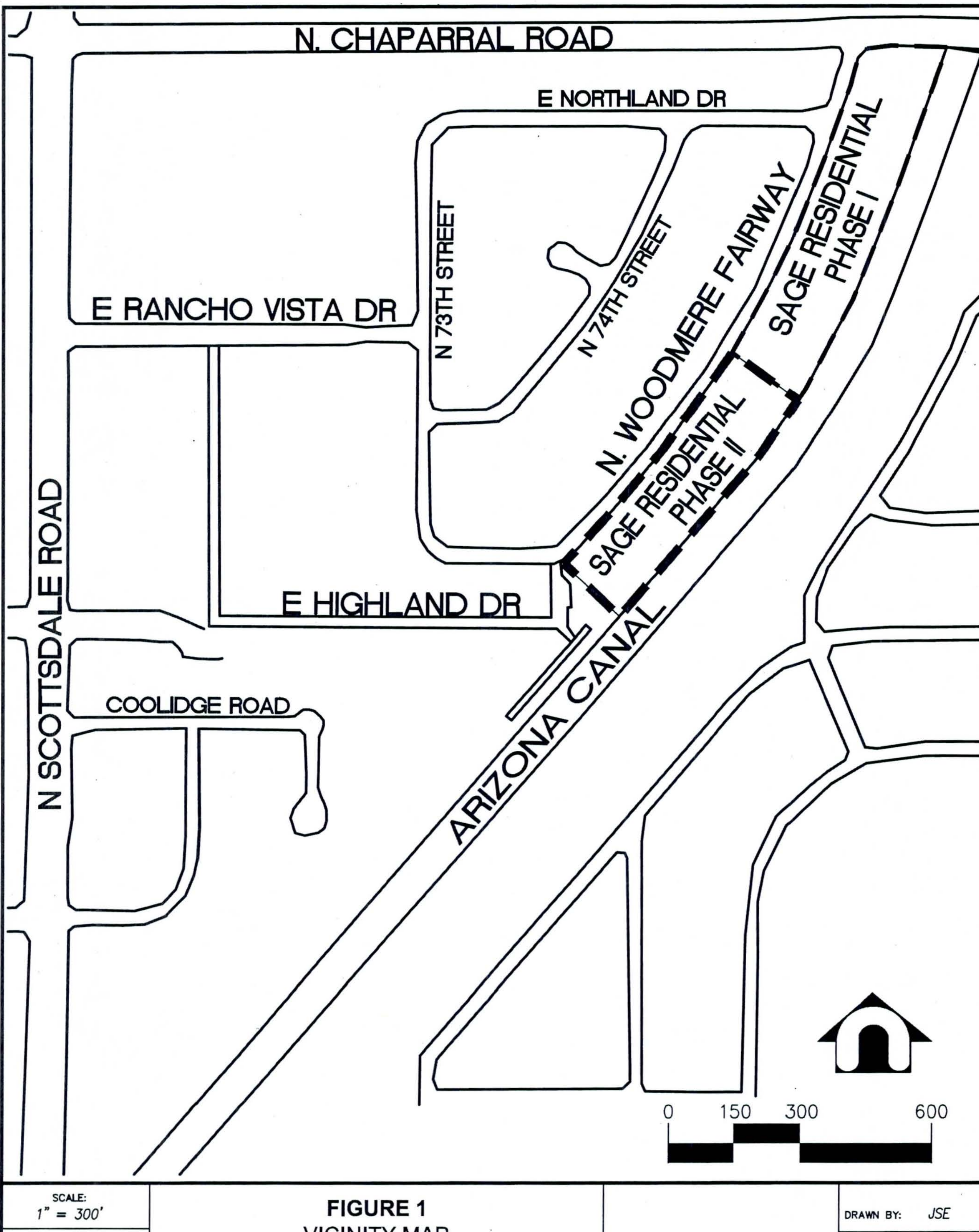
Sage Residential – Phase II is one of the final real estate developments bound within Scottsdale Road, Chaparral Road, and the Arizona Canal. Figure 1 in next page is the Project Vicinity Map. Access to the site will be provided via one entrance off of Woodmere Fairway between the two new buildings of Phase II. The project is located within what is considered the Downtown Core Area of the City of Scottsdale General Plan.

The proposed Sage Residential - Phase II project is approximately 2.17 acres. It consists of two buildings with mixed use. Ground elevations around the building foundations will be raised above the existing 100-year base flood elevation.

2.0 EXISTING DRAINAGE CONDITIONS

According to the existing topography in the area, the general lay of the land is in a southeasterly direction towards to the Arizona Canal. The area is known as Indian Bend Wash Side Channels System - Reach 4. Runoff from this area drains toward the canal and pond against the canal bank. Existing catch basins in the area will collect the runoff and discharge it to an existing10'x5' box culvert along the west bank of the Canal. Emergency outfall is the low points in the canal bank where the runoff can weir over to the east.

Currently, Chaparral Road cuts all the offsite flow from the north. Most of the flow from the north and west is collected in a large grate inlet box next to the Canal north of Chaparral Road. There is a 96" pipe connecting to the inlet box. This 96" pipe conveys most of the flow east under the Canal toward Indian Bend wash. Please refer to Exhibit A in Appendix E for an illustration of the offsite drainage conditions.



SCALE: 1" = 300'	**FIGURE 1** VICINITY MAP SAGE RESIDENTIAL - PHASE II SCOTTSDALE, ARIZONA	4600 East Washington Street, Suite 430 Phoenix Arizona 85034 Phone: 602.678.5151	DRAWN BY: JSE
SHEET 1 OF 1			CHECKED BY:
JOB NO.: ISTR00000001			DATE: March 2013

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Any flow that doesn't get conveyed by the 96" pipe flows through an 8'x'4' box culvert across Chaparral Road to the south. The offsite drainage analysis was performed recently in a Letter of Map Revision (LOMR) for Safari Drive Phase 2 which was approved by City of Scottsdale and is pending FEMA approval (Reference 4). According to this LOMR analysis, there is 68 cfs conveyed by the 8'x'4' box culvert across Chaparral Road to the south during the 100-year event. Combining with the local drainage, the flow increases to 114 cfs at the southwest end of the project. Excerpts from the LOMR study are included in Appendix D.

The 8'x4' box culvert south of Chaparral Road conveys the flow southwesterly through a combination of open channel and a 10'x5' box culvert to a junction box next to the Safari development at the northeast corner of Scottsdale Road and Camelback Road. At that point, an 11'x9.5' box culvert conveys the flow under the Canal toward the east and ultimately discharge into Indian Bend Wash.

Scottsdale Road intercepts and conveys offsite drainage from the north to the south by surface and storm drain. (See Exhibit A). According to the LOMR analysis, the 100-year flow is contained in Scottsdale Road section to the south. Therefore, the only offsite drainage area can potentially impacting the project site is the local area south of Chaparral Road and east of Scottsdale Road.

Woodmere Fairway is a fully improved street with mountable curb and gutter that drains in a southwesterly direction toward Thornwood Drive. It intercepts majority of the local offsite drainage and conveys to a low point where Woodmere Fairway and Thornwood Drive intersect at the southwest end of the project. The runoff then flows toward a spillway structure that is connected to an open channel adjacent to the Canal.

The current published FEMA Flood Insurance Rate Map (FIRM) for this area is 04013C1770L (Effective date is October 16, 2013). Portions of the site were located within Zones A and X.

Zone A is defined as the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the Flood Insurance Study by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no Base Flood Elevations or depths are shown within this zone. Zone X is defined as "areas of 500-year flood; areas of 100-year flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from the 100-year flood." A copy of the FIRM panel is provided as Figure 2 in next page.

According to the recent LOMR study, the project area is not subject to ponding as shown in the current FEMA Insurance Rate Map. Once the LOMR is approved by FEMA, the project site will be located in a Zone X. Please see the excerpts in Appendix D for more details.

However, before the LOMR is approved by FEMA and the floodplain is revised, the project will still be designed as if it is partially located in FEMA's Zone "A" and the finish floors will be designed accordingly and will be described in details in this report.

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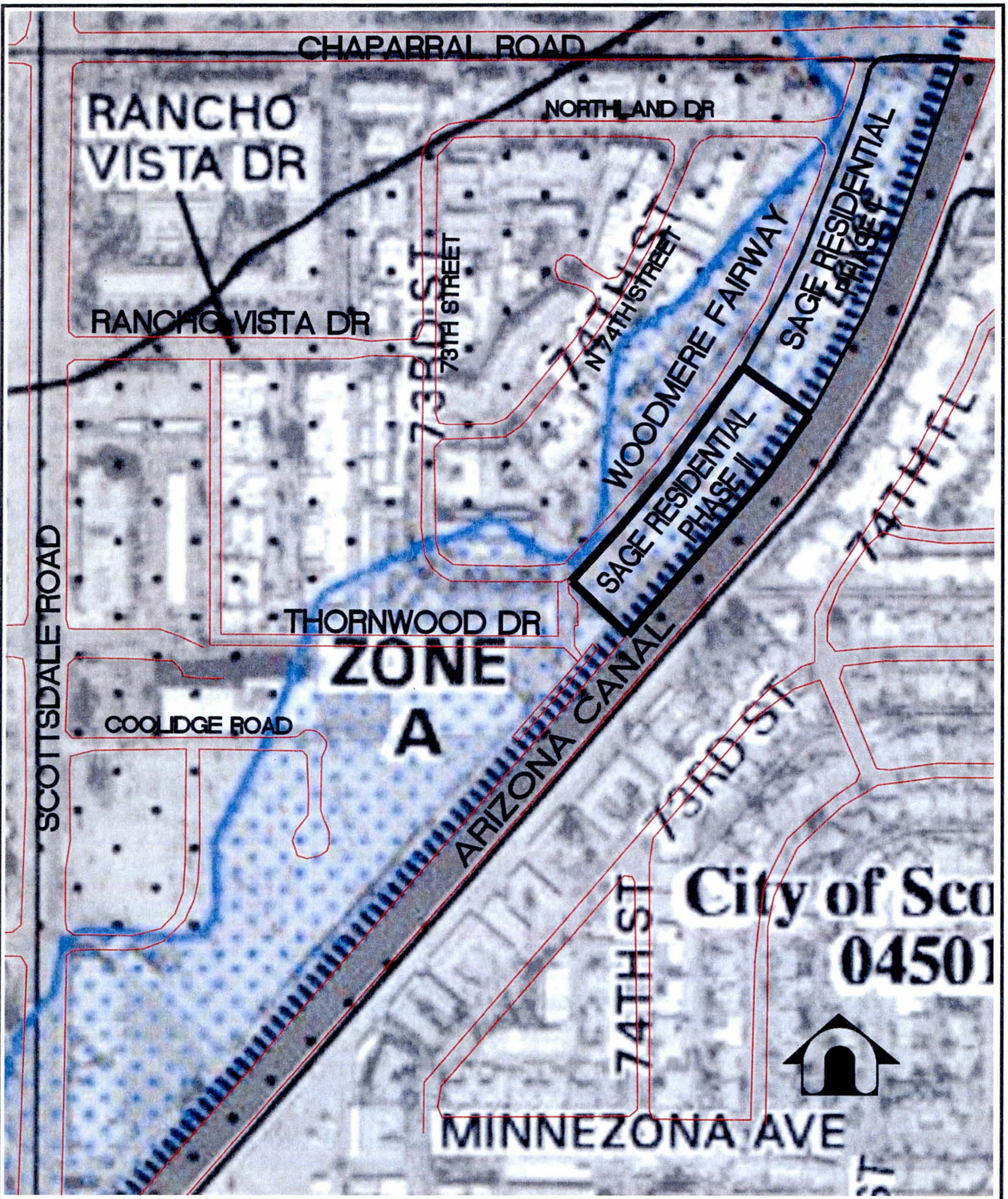

SCALE: NTS	**FIGURE 2** FEMA FLOOD INSURANTE RATE MAP SAGE RESIDENTIAL - PHASE II SCOTTSDALE, ARIZONA PANEL 04013C1695H, SEPTEMBER 30, 2005	DAVID EVANS AND ASSOCIATES INC. 4600 East Washington Street, Suite 430 Phoenix Arizona 85034 Phone: 602.678.5151	DRAWN BY: JSE
SHEET 1 OF 1			CHECKED BY:
JOB NO.: ISTR00000001			DATE: March 2013

3.0 PROPOSED DRAINAGE PLAN

The proposed drainage plan is presented in three parts: onsite drainage, off-site drainage, and storage requirements. The design will follow City of Scottsdale's Design Standards & Policies Manual (Reference 1).

3.1 Offsite Drainage Design

As described previously, Woodmere Fairway intercepts most of the offsite drainage in the roadway. There are three existing catch basins in Woodmere Fairway in front of Sage Residential Phase I and Phase II. These catch basins are connected directly to the existing 10'x5' box culvert adjacent to Arizona Canal.

There is one existing catch basin on Woodmere Fairway in front of the project site (Phase II). As part of this project, this existing catch basin will be replaced by a new catch basin. And an additional catch basin will be installed in front of the north building. These catch basins will be connected with the onsite storm drain systems which connect directly to the 10'x5' box culvert.

The drainage areas for these catch basins are depicted in Exhibit B, Drainage Map (Sub-basins 19 and 20). The north boundary of Sub-basin 20 is delineated at an existing catch basin in Woodmere Fairway. It was designed and installed by Phase I development. It is a 10' curb inlet opening catch basin with grate. It will intercept all the flow from the north. However, if there is any bypass flow, it will simply flow by Catch Basin 11 toward Catch Basin 4. The ultimate outfall for this excess flow is the spillway by Woodmere Fairway at the south end of the project which is only 0.11' higher than the low point at Catch Basin 4.

The hydrology analysis is based on the Rational Method following Maricopa County Flood Control's methodology. NOAA-14 precipitation data are used for the analysis. To simplify the calculations, a minimum of Time of Concentration of 5 minutes was used for these basins. The results are presented in Appendix A.

MAG standard curb opening catch basins will be used for these catch basins on Woodmere Fairway. The sizing of the catch basins is performed using FlowMaster. A clogging factor of 80% is used for the curb opening catch basins in either on-grade or sump conditions according to Table 3.2 of Maricopa County Flood Control District's Hydraulic Manual. The results are included in Appendix B.

Another local offsite drainage impacting the site is Phase I of Sage Condominiums-Phase I immediately northeast of the project site. Sage Condominiums-Phase I was formerly known as the "Reflections on the Canal". Arroyo Engineering prepared the final drainage report for the "Reflections on the Canal". Please see Appendix D for a copy of the report.

Subsequently, Arroyo Engineering prepared two addendums to update the drainage report. A copy of the second addendum is also attached. In summary, Arroyo Engineering's Final Drainage Report and addendums provided overall drainage concepts for both Phase I and Phase II of Sage Condominiums.

M3 Engineering provided the final construction document for Sage Condominiums Phase I. According to the as-built plans prepared by M3 Engineering, the required 100-year 2-hour retention volume is 12,500 ft^3. However, only 3,075 ft^3 was provided. Therefore, there is a 9,425 ft^3 of volume shortfall. The excess runoff will drain toward Phase II at the northeast corner. It was agreed that the volume shortfall would be provided in Phase II.

In order to quantify the flow rate from Phase I, Rational Method was used to estimate the 100-year peak discharge. Maricopa County Flood Control's DDMSW software was used for the Rational calculation. It is estimated that the 100-year rainfall event will result in approximately 8.1 cfs from Phase I. DDMSW output is included in Appendix A. A MAG standard 537 double grate catch basin is installed to incept the flow from Phase I. The hydraulic calculation of this catch basin is provided in Appendix B.

3.2 Onsite Drainage Design

Sage Residential Phase II is divided into 18 drainage sub-basins according to the proposed grading plan. Please refer to Exhibit B, Drainage Map in Appendix E. The runoff from Sub-basins 1 through 6 drains directly into six retention basins next to the Arizona Canal. The runoff from Sub-basins 7 through 18 drains to the front toward Woodmere Fairway. These sub-basins represent onsite areas mostly from the building roofs. Grate inlet catch basins will be installed in these sub-basins to capture the flow between the sidewalk and the buildings. Two storm drain systems are used to convey the flow from these sub-basins.

Rational Method is used to calculate the peak flows for these sub-basins. The 100-year peak flows are used to size the catch basins and storm drains. A conservative runoff coefficient of 0.95 is used for Sub-basins 7 through 18. Catch basins are sized using FlowMaster and a clogging factor of 50% is used for all grate inlets in the sag. There are two storm drain system used to connect all the catch basins, one in front of each building. The storm drains run around the buildings toward the canal and connect to the existing 10'x'5 box culvert at the north and south ends of the project.

Bentley's StormCAD is used to perform the hydraulic calculations for the storm drain systems for both 100-year and 10-year events. The tail water condition is based on the Manning's equation for the 10'x5' box culvert at a slope of 0.003. A rating table is generated using FlowMaster and the values are entered in StormCAD for tailwater calculations. For the 10-year event, half of the flow was used in the box culvert since there is no 10-year analysis in the LOMR study. The StormCAD results along with the tailwater rating table are included in Appendix B.

Composite runoff coefficients are used for Sub-basins 1 through 6 since the runoff from these areas will be used to size the retention basins. See next section for detailed descriptions of retention calculations.

3.3 Retention Requirements

City of Scottsdale requires the retention volume to match pre versus post development for Sage Residential Phase II. Previously, the project consisted of two buildings, parking spaces and tennis courts. A comparison is made between the pre and post development conditions including the runoff coefficients. The results are shown in Appendix C. According to the comparison, the post development almost matches the pre-development conditions with slightly less impervious areas. Therefore, retention requirement can be waived for Phase II of Sage Residential development.

However, the project is still required to provide retention volume for the shortfall of Phase I development, or 9,425 ft^3. Six retention basins are proposed along the Arizona Canal and at the southwest end of the project. The total volume provided by these retention basins is 10,381 ft^3 which is greater than 9,425 ft^3. This also satisfies the first flush requirement to provide retention volume for the first half inch of rainfall as calculated below:

$$V_{\text{first flush}} = 0.5\text{" x Area}$$
$$= (0.5/12) \text{ x } (2.17 \text{ acres x } 43{,}560)$$
$$= 3{,}939 \text{ ft}^3$$

The calculations for the onsite retention basins can be found in Appendix C.

The retention basins are shown on the grading plans and on Exhibit B, in Appendix E. Basin 1 has a high water elevation of 1276.00 and the remaining retention basins have the same high water elevation of 1279.30. Basins 2 through 6 are connected using an 8" storm pipe to provide equalization. There is also an 8" pipe connecting Basin 1 and 2. However, because the high water elevations are different between these basins, there is plate with 2.5" orifice over the 8" pipe to only allow bleed-off water going through. During the 100-year event, the retained water will travel between basins through the equalization pipes among Basins 2 through 6. Any flow that exceeds the capacity of the 8" equalization pipe will overtop the adjacent sidewalk to the next basin. Eventually, the water will overtop Basin 2 into Basin 1 where it will continue overtop in an existing spillway at the south end. The overtopping is modeled using the broad crest weir. The dynamics of flow between basins are analyzed using Culvert Master to model the 8" pipe as a culvert and overtopping as the weir. The 100-year peak flow is used in the analysis and the results are presented in Appendix C.

The bleed off for the retention basins are through two connections directly to the 10'x5' box culvert. The first one is the catch basin located in Basin 4. A 2.5" orifice plate is used to restrict the flow from the catch basin into the culvert. Using an average head of 1.5', the flow through the orifice is estimated to be 0.13 cfs.

The second bleedoff location is located in a headwall in Basin 1. A 2.5" orifice is installed at the inlet of the headwall to restrict the flow. Using an average had of 1.5', the flow through the headwall is also estimated to be 0.13 cfs. Therefore, total bleed off rate is 0.26 cfs. The calculation for the orifice flow is provided by FlowMaster and is provided in Appendix C.

Total time of disposal = V ÷ Bleedoff Rate
= 10,381 ÷ 0.26
= 39,927 seconds
= 11.1 hours

3.4 Water Quality

The Flood Control District of Maricopa County (FCDMC) requires the first flush volume to be treated before discharging to its facility, the 10'x5' box culvert. Therefore, storm water filtration systems will be installed at three locations before storm water is discharged to the 10'x5' box culvert.

There are three locations where the storm water will be discharged into FCDMC's box culvert. Manholes will be installed just before the discharging. The first location is the catch basin in Basin 4. The second and third locations are in the north and south storm drain just before they discharge to the box culvert. A Contech® Stormwater Management CDS System or equivalent will be used at these locations in the manholes.

The filtration system will handle at least the first flush flow rate while letting larger flows pass by. The first flush flow rates are calculated following the standards in the Drainage Policies and Standards for Maricopa County, Arizona. The results are included in Appendix C.

3.5 Storm Water Management Plan

A Storm Water Pollution Prevention Plan (SWPPP) has been prepared according to ADEQ's AZPDES requirements. Silt fence will be installed along the canal bank. All catch basins will have inlet protection to prevent construction water enter the storm drain system. A construction entrance will be constructed to trap construction dirt. A copy of the SWPPP and ADEQ's Notice of Intent (NOI) certificate are included in Appendix F.

3.6 Lowest Finish Floors

The lowest finish floor elevations for both buildings are set at 1280.50' which is over 1' above the high water elevation in the retention basins (1279.30). It is also higher than the highest overtopping elevation of 1279.87 between Basin 2 and Basin 3.

Since the project site is located in the Flood Zone A, the finish floor elevations are also set at least 1.2' above the weir elevation in the lowest bank elevation of Arizona Canal. This ultimate outfall is located near the southeast corner of Blue Sky project with the top of bank elevation of 1279.20. This location is approximately 1,175' south of the project along the Canal.

Excerpts from the Final Drainage Report for Blue Sky are included in Appendix D.

Both buildings have underground parking garage. The entrance to the parking garages are set equal to the lowest finish floor elevation of 1280.50.

6.0 CONCLUSIONS

Based on the results of this study, it can be concluded that:

- The Sage Residential - Phase II project will be developed according to the City of Scottsdale Design Standards and Policies Manual.
- The proposed buildings and garage entrances will be free from inundation during a 100-year storm event.
- The site development includes retention basins that are designed to provide adequate retention required for the project and the retained water will be disposed into the existing box culvert along the western side of the Arizona Canal within 36 hours.
- The first flush volume is treated before discharging to Maricopa County Flood Control District's box culvert.

7.0 REFERENCES

1. City of Scottsdale Design Standards and Policies Manual, January 2010.
2. Drainage Design Manuals for Maricopa County, Arizona, Volume I, Hydrology, April 2002.
3. Drainage Design Manuals for Maricopa County, Arizona, Volume II, Hydraulics, April 2002.
4. Drainage Policies and Standards for Maricopa County, Arizona, Maricopa County, 2007.
5. Technical Support Data Notebook for Letter of Map Revision for Arizona Canal between Camelback Road and Chaparral Road, David Evans and Associates, September 2013.
6. StormCAD V8i, Bentley Haestad Methods, Inc. 2012.

7. FlowMaster V8i, Bentley Haestad Methods, Inc. 2009.
8. CulvertMaster V3.3, Bentley Haestad Methods, 2009.
9. Final Drainage Report for Reflections on the Canal, Arroyo Engineering, August 2007.
10. Addendum #2 to the Final Drainage Report for Sage Condominiums-Phase I, Arroyo Engineering, July 2012.
11. Final Drainage Report for Blue Sky Scottsdale Fill Plan, January 2012.

APPENDIX A

Hydrological Supporting Documentation

NOAA Atlas 14, Volume 1, Version 5
Location name: Scottsdale, Arizona, US*
Coordinates: 33.5064, -111.9218
Elevation: 1276ft*
* source: Google Maps

POINT PRECIPITATION FREQUENCY ESTIMATES

Rainfall Depth

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

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

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

Duration	Average recurrence interval(years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**0.184** (0.154–0.225)	**0.241** (0.203–0.294)	**0.328** (0.273–0.398)	**0.394** (0.327–0.476)	**0.484** (0.394–0.582)	**0.553** (0.445–0.662)	**0.624** (0.493–0.744)	**0.696** (0.540–0.830)	**0.792** (0.599–0.946)	**0.866** (0.642–1.04)
10-min	**0.281** (0.235–0.342)	**0.367** (0.308–0.448)	**0.498** (0.416–0.605)	**0.599** (0.497–0.725)	**0.736** (0.600–0.885)	**0.841** (0.677–1.01)	**0.949** (0.750–1.13)	**1.06** (0.822–1.26)	**1.21** (0.912–1.44)	**1.32** (0.977–1.58)
15-min	**0.348** (0.291–0.424)	**0.455** (0.382–0.555)	**0.618** (0.515–0.751)	**0.743** (0.616–0.898)	**0.912** (0.744–1.10)	**1.04** (0.839–1.25)	**1.18** (0.929–1.40)	**1.31** (1.02–1.57)	**1.49** (1.13–1.78)	**1.63** (1.21–1.95)
30-min	**0.468** (0.392–0.572)	**0.612** (0.515–0.747)	**0.832** (0.694–1.01)	**1.00** (0.829–1.21)	**1.23** (1.00–1.48)	**1.40** (1.13–1.68)	**1.58** (1.25–1.89)	**1.77** (1.37–2.11)	**2.01** (1.52–2.40)	**2.20** (1.63–2.63)
60-min	**0.579** (0.485–0.707)	**0.757** (0.637–0.925)	**1.03** (0.859–1.25)	**1.24** (1.03–1.50)	**1.52** (1.24–1.83)	**1.74** (1.40–2.08)	**1.96** (1.55–2.34)	**2.19** (1.70–2.61)	**2.49** (1.88–2.97)	**2.72** (2.02–3.26)
2-hr	**0.672** (0.572–0.804)	**0.871** (0.741–1.04)	**1.16** (0.986–1.39)	**1.39** (1.16–1.65)	**1.70** (1.40–2.00)	**1.93** (1.58–2.28)	**2.17** (1.75–2.56)	**2.42** (1.91–2.85)	**2.75** (2.12–3.24)	**3.01** (2.27–3.56)
3-hr	**0.735** (0.622–0.886)	**0.942** (0.801–1.14)	**1.24** (1.05–1.49)	**1.47** (1.23–1.76)	**1.80** (1.48–2.14)	**2.06** (1.68–2.45)	**2.33** (1.86–2.77)	**2.62** (2.05–3.10)	**3.01** (2.29–3.57)	**3.33** (2.47–3.95)
6-hr	**0.884** (0.764–1.04)	**1.12** (0.970–1.32)	**1.44** (1.24–1.69)	**1.69** (1.44–1.97)	**2.03** (1.71–2.36)	**2.30** (1.91–2.66)	**2.58** (2.11–2.99)	**2.86** (2.30–3.32)	**3.25** (2.55–3.78)	**3.56** (2.72–4.15)
12-hr	**0.987** (0.862–1.15)	**1.25** (1.09–1.45)	**1.58** (1.37–1.83)	**1.84** (1.59–2.13)	**2.19** (1.87–2.53)	**2.46** (2.08–2.83)	**2.74** (2.28–3.16)	**3.02** (2.48–3.48)	**3.40** (2.72–3.94)	**3.70** (2.90–4.31)
24-hr	**1.17** (1.04–1.33)	**1.49** (1.33–1.70)	**1.94** (1.71–2.20)	**2.28** (2.02–2.59)	**2.77** (2.43–3.14)	**3.15** (2.74–3.56)	**3.55** (3.07–4.01)	**3.97** (3.40–4.48)	**4.54** (3.85–5.13)	**4.99** (4.19–5.66)
2-day	**1.27** (1.13–1.44)	**1.62** (1.44–1.84)	**2.13** (1.89–2.41)	**2.54** (2.24–2.87)	**3.10** (2.73–3.51)	**3.55** (3.10–4.02)	**4.03** (3.50–4.56)	**4.53** (3.90–5.12)	**5.22** (4.44–5.92)	**5.78** (4.87–6.57)
3-day	**1.34** (1.19–1.53)	**1.72** (1.53–1.95)	**2.26** (2.00–2.56)	**2.70** (2.38–3.05)	**3.32** (2.91–3.74)	**3.81** (3.32–4.30)	**4.34** (3.75–4.90)	**4.89** (4.20–5.53)	**5.67** (4.81–6.41)	**6.30** (5.29–7.14)
4-day	**1.42** (1.26–1.61)	**1.82** (1.61–2.06)	**2.40** (2.12–2.71)	**2.87** (2.52–3.23)	**3.53** (3.09–3.98)	**4.07** (3.54–4.59)	**4.64** (4.01–5.23)	**5.25** (4.50–5.93)	**6.12** (5.17–6.90)	**6.82** (5.70–7.70)
7-day	**1.58** (1.40–1.80)	**2.02** (1.79–2.29)	**2.67** (2.36–3.02)	**3.19** (2.81–3.61)	**3.94** (3.44–4.45)	**4.54** (3.94–5.12)	**5.17** (4.46–5.84)	**5.85** (5.01–6.61)	**6.81** (5.75–7.70)	**7.58** (6.34–8.59)
10-day	**1.71** (1.52–1.94)	**2.19** (1.95–2.48)	**2.90** (2.56–3.27)	**3.46** (3.05–3.90)	**4.25** (3.73–4.79)	**4.89** (4.26–5.49)	**5.57** (4.82–6.25)	**6.28** (5.39–7.06)	**7.27** (6.17–8.18)	**8.07** (6.78–9.10)
20-day	**2.11** (1.88–2.37)	**2.71** (2.41–3.05)	**3.58** (3.18–4.02)	**4.24** (3.75–4.76)	**5.13** (4.52–5.75)	**5.81** (5.10–6.51)	**6.50** (5.68–7.30)	**7.21** (6.27–8.10)	**8.16** (7.03–9.19)	**8.89** (7.60–10.0)
30-day	**2.46** (2.18–2.77)	**3.17** (2.81–3.57)	**4.18** (3.70–4.69)	**4.95** (4.37–5.54)	**5.98** (5.25–6.70)	**6.77** (5.93–7.57)	**7.58** (6.61–8.48)	**8.41** (7.29–9.40)	**9.52** (8.20–10.7)	**10.4** (8.87–11.6)
45-day	**2.85** (2.54–3.20)	**3.67** (3.27–4.12)	**4.84** (4.31–5.43)	**5.70** (5.06–6.39)	**6.84** (6.06–7.66)	**7.70** (6.79–8.63)	**8.57** (7.52–9.61)	**9.43** (8.25–10.6)	**10.6** (9.18–11.9)	**11.4** (9.87–12.9)
60-day	**3.15** (2.82–3.53)	**4.07** (3.64–4.55)	**5.35** (4.78–5.98)	**6.28** (5.59–7.02)	**7.50** (6.66–8.37)	**8.40** (7.43–9.38)	**9.30** (8.20–10.4)	**10.2** (8.94–11.4)	**11.3** (9.90–12.7)	**12.2** (10.6–13.7)

[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

NOAA Atlas 14, Volume 1, Version 5
Location name: Scottsdale, Arizona, US*
Coordinates: 33.5072, -111.9215
Elevation: 1279 ft*
* source: Google Maps

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

Rainfall Intensity

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	**2.21** (1.85-2.70)	**2.89** (2.44-3.53)	**3.94** (3.28-4.78)	**4.73** (3.92-5.71)	**5.81** (4.73-6.98)	**6.64** (5.34-7.94)	**7.49** (5.92-8.93)	**8.35** (6.48-9.96)	**9.50** (7.19-11.4)	**10.4** (7.70-12.4)
10-min	**1.69** (1.41-2.05)	**2.20** (1.85-2.69)	**2.99** (2.50-3.63)	**3.59** (2.98-4.35)	**4.42** (3.60-5.31)	**5.05** (4.06-6.04)	**5.69** (4.50-6.80)	**6.35** (4.93-7.57)	**7.23** (5.47-8.63)	**7.90** (5.86-9.46)
15-min	**1.39** (1.16-1.70)	**1.82** (1.53-2.22)	**2.47** (2.06-3.00)	**2.97** (2.46-3.59)	**3.65** (2.98-4.39)	**4.17** (3.36-4.99)	**4.70** (3.72-5.62)	**5.25** (4.08-6.26)	**5.98** (4.52-7.14)	**6.53** (4.84-7.82)
30-min	**0.936** (0.784-1.14)	**1.22** (1.03-1.49)	**1.66** (1.39-2.02)	**2.00** (1.66-2.42)	**2.46** (2.00-2.96)	**2.81** (2.26-3.36)	**3.17** (2.50-3.78)	**3.53** (2.75-4.21)	**4.02** (3.04-4.81)	**4.40** (3.26-5.26)
60-min	**0.579** (0.485-0.707)	**0.757** (0.637-0.925)	**1.03** (0.859-1.25)	**1.24** (1.03-1.50)	**1.52** (1.24-1.83)	**1.74** (1.40-2.08)	**1.96** (1.55-2.34)	**2.19** (1.70-2.61)	**2.49** (1.88-2.97)	**2.72** (2.02-3.26)
2-hr	**0.336** (0.286-0.402)	**0.436** (0.370-0.522)	**0.582** (0.493-0.694)	**0.694** (0.582-0.826)	**0.848** (0.702-1.00)	**0.964** (0.789-1.14)	**1.09** (0.874-1.28)	**1.21** (0.956-1.42)	**1.37** (1.06-1.62)	**1.50** (1.13-1.78)
3-hr	**0.245** (0.207-0.295)	**0.314** (0.267-0.380)	**0.412** (0.348-0.497)	**0.490** (0.410-0.587)	**0.598** (0.494-0.714)	**0.685** (0.558-0.815)	**0.776** (0.620-0.922)	**0.871** (0.684-1.03)	**1.00** (0.763-1.19)	**1.11** (0.823-1.32)
6-hr	**0.148** (0.128-0.174)	**0.187** (0.162-0.220)	**0.240** (0.207-0.281)	**0.282** (0.241-0.329)	**0.339** (0.286-0.394)	**0.384** (0.319-0.444)	**0.430** (0.352-0.498)	**0.478** (0.384-0.555)	**0.543** (0.425-0.631)	**0.595** (0.454-0.693)
12-hr	**0.082** (0.072-0.095)	**0.103** (0.090-0.120)	**0.131** (0.114-0.152)	**0.153** (0.132-0.177)	**0.182** (0.155-0.210)	**0.204** (0.172-0.235)	**0.228** (0.189-0.262)	**0.251** (0.206-0.289)	**0.282** (0.226-0.327)	**0.307** (0.241-0.358)
24-hr	**0.049** (0.044-0.056)	**0.062** (0.055-0.071)	**0.081** (0.071-0.092)	**0.095** (0.084-0.108)	**0.115** (0.101-0.131)	**0.131** (0.114-0.148)	**0.148** (0.128-0.167)	**0.165** (0.142-0.187)	**0.189** (0.160-0.214)	**0.208** (0.175-0.236)
2-day	**0.026** (0.023-0.030)	**0.034** (0.030-0.038)	**0.044** (0.039-0.050)	**0.053** (0.047-0.060)	**0.065** (0.057-0.073)	**0.074** (0.065-0.084)	**0.084** (0.073-0.095)	**0.094** (0.081-0.107)	**0.109** (0.093-0.123)	**0.120** (0.101-0.137)
3-day	**0.019** (0.017-0.021)	**0.024** (0.021-0.027)	**0.031** (0.028-0.036)	**0.038** (0.033-0.042)	**0.046** (0.040-0.052)	**0.053** (0.046-0.060)	**0.060** (0.052-0.068)	**0.068** (0.058-0.077)	**0.079** (0.067-0.089)	**0.087** (0.073-0.099)
4-day	**0.015** (0.013-0.017)	**0.019** (0.017-0.021)	**0.025** (0.022-0.028)	**0.030** (0.026-0.034)	**0.037** (0.032-0.041)	**0.042** (0.037-0.048)	**0.048** (0.042-0.055)	**0.055** (0.047-0.062)	**0.064** (0.054-0.072)	**0.071** (0.059-0.080)
7-day	**0.009** (0.008-0.011)	**0.012** (0.011-0.014)	**0.016** (0.014-0.018)	**0.019** (0.017-0.022)	**0.023** (0.020-0.026)	**0.027** (0.023-0.030)	**0.031** (0.027-0.035)	**0.035** (0.030-0.039)	**0.041** (0.034-0.046)	**0.045** (0.038-0.051)
10-day	**0.007** (0.006-0.008)	**0.009** (0.008-0.010)	**0.012** (0.011-0.014)	**0.014** (0.013-0.016)	**0.018** (0.016-0.020)	**0.020** (0.018-0.023)	**0.023** (0.020-0.026)	**0.026** (0.022-0.029)	**0.030** (0.026-0.034)	**0.034** (0.028-0.038)
20-day	**0.004** (0.004-0.005)	**0.006** (0.005-0.006)	**0.007** (0.007-0.008)	**0.009** (0.008-0.010)	**0.011** (0.009-0.012)	**0.012** (0.011-0.014)	**0.014** (0.012-0.015)	**0.015** (0.013-0.017)	**0.017** (0.015-0.019)	**0.019** (0.016-0.021)
30-day	**0.003** (0.003-0.004)	**0.004** (0.004-0.005)	**0.006** (0.005-0.007)	**0.007** (0.006-0.008)	**0.008** (0.007-0.009)	**0.009** (0.008-0.011)	**0.011** (0.009-0.012)	**0.012** (0.010-0.013)	**0.013** (0.011-0.015)	**0.014** (0.012-0.016)
45-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** (0.006-0.007)	**0.007** (0.006-0.008)	**0.008** (0.007-0.009)	**0.009** (0.008-0.010)	**0.010** (0.009-0.011)	**0.011** (0.009-0.012)
60-day	**0.002** (0.002-0.002)	**0.003** (0.003-0.003)	**0.004** (0.003-0.004)	**0.004** (0.004-0.005)	**0.005** (0.005-0.006)	**0.006** (0.005-0.007)	**0.006** (0.006-0.007)	**0.007** (0.006-0.008)	**0.008** (0.007-0.009)	**0.008** (0.007-0.010)

[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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Sage Residential

Rational Method Calculations

Sub-Basin	Area		C	I	$Q_{100\text{-}yr}$	Inlet
	ft^2	acres		(in/hr)	cfs	
1	6914	0.159	0.95	7.49	1.13	Retention Basin 1
2	4990	0.115	0.69	7.49	0.59	Retention Basin 2
3	19464	0.447	0.77	7.49	2.58	Retention Basin 3
4	17029	0.391	0.69	7.49	2.02	Retention Basin 4
5	19811	0.455	0.78	7.49	2.66	Retention Basin 5
6	6028	0.138	0.68	7.49	0.70	Retention Basin 6
7	2720	0.062	0.95	7.49	0.44	CB-7
8	3011	0.069	0.95	7.49	0.49	CB-6
9	3825	0.088	0.95	7.49	0.62	CB-5
10	3911	0.090	0.95	7.49	0.64	CB-3
11	3113	0.071	0.95	7.49	0.51	CB-2
12	4297	0.099	0.95	7.49	0.70	CB-1
13	4076	0.094	0.95	7.49	0.67	CB-8
14	3237	0.074	0.95	7.49	0.53	CB-9
15	4056	0.093	0.95	7.49	0.66	CB-10
16	4086	0.094	0.95	7.49	0.67	CB-12
17	3324	0.076	0.95	7.49	0.54	CB-13
18	3680	0.084	0.95	7.49	0.60	CB-14
19	7371	0.169	0.95	7.49	1.20	CB-11
20	6222	0.143	0.95	7.49	1.02	CB-4
Phase I		2.8	0.62	4.63	8.05	CB-Phase I

Note:

The Rainfall intensity is based on NOAA-14, Tc=5 min for all Phase II sub-basins

For offsite Phase I, see DDMSW Rational Output

Sage Residential

Rational Method Calculations

Sub-Basin	Area		C	I	$Q_{10\text{-}yr}$	Inlet
	ft^2	acres		(in/hr)	cfs	
1	6914	0.159	0.95	4.73	0.71	Retention Basin 1
2	4990	0.115	0.69	4.73	0.37	Retention Basin 2
3	19464	0.447	0.77	7.49	2.58	Retention Basin 3
4	17029	0.391	0.69	4.73	1.28	Retention Basin 4
5	19811	0.455	0.78	4.73	1.68	Retention Basin 5
6	6028	0.138	0.68	4.73	0.45	Retention Basin 6
7	2720	0.062	0.95	4.73	0.28	CB-7
8	3011	0.069	0.95	4.73	0.31	CB-6
9	3825	0.088	0.95	4.73	0.39	CB-5
10	3911	0.090	0.95	4.73	0.40	CB-3
11	3113	0.071	0.95	4.73	0.32	CB-2
12	4297	0.099	0.95	4.73	0.44	CB-1
13	4076	0.094	0.95	4.73	0.42	CB-8
14	3237	0.074	0.95	4.73	0.33	CB-9
15	4056	0.093	0.95	4.73	0.42	CB-10
16	4086	0.094	0.95	4.73	0.42	CB-12
17	3324	0.076	0.95	4.73	0.34	CB-13
18	3680	0.084	0.95	4.73	0.38	CB-14
19	7371	0.169	0.95	4.73	0.76	CB-11
20	6222	0.143	0.95	4.73	0.64	CB-4
Phase I		2.8	0.62	2.65	4.6	CB-Phase I

Note:

The Rainfall intensity is based on NOAA-14, Tc=5 min for all Phase II sub-basins

For offsite Phase I, see DDMSW Rational Output

ID	Area (acres)	Length (ft)	USGE	DSGE	Slope (ft/mi)	Kb		2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
Major Basin ID: 01													
PHASE 1	2.8	940	79.30	78.00	7.3	0.037	Q (cfs)	2.5	3.7	4.6	5.9	7.0	8.1
							C	0.62	0.62	0.62	0.62	0.62	0.62
							CA (ac)	1.74	1.74	1.74	1.74	1.74	1.74
							Tc (min)	25	21	19	18	17	16
							i (in/hr)	1.41	2.10	2.65	3.41	4.01	4.63

Sub Basin Data: Area through Kb; Sub Basin Hydrology Summary: 2 Year through 100 Year.

APPENDIX B

Hydraulic Supporting Documentation

Worksheet for Curb Inlet CB-11 in Woodmere

Project Description

Solve For	Efficiency

Input Data

Discharge	1.02	ft³/s
Slope	0.00067	ft/ft
Gutter Width	1.50	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.015	
Curb Opening Length	4.40	ft
Local Depression	2.00	in
Local Depression Width	1.50	ft

Results

Efficiency	100.00	%
Intercepted Flow	1.02	ft³/s
Bypass Flow	0.00	ft³/s
Spread	11.47	ft
Depth	0.29	ft
Flow Area	1.36	ft²
Gutter Depression	0.06	ft
Total Depression	0.23	ft
Velocity	0.75	ft/s
Equivalent Cross Slope	0.07413	ft/ft
Length Factor	1.10	
Total Interception Length	4.00	ft ← Total openning length req'd

Use MAG STD 531 L=5.5' 80% Clogging

Leff = 4.4' > 4.0'

Worksheet for Curb Inlet CB-4 in Woodmere

Project Description

Solve For	Spread

Input Data

Discharge		1.08	ft³/s
Gutter Width		1.50	ft
Gutter Cross Slope		0.06	ft/ft
Road Cross Slope		0.02	ft/ft
Curb Opening Length		2.80	ft ← Effective length
Opening Height		0.33	ft
Curb Throat Type	Horizontal		
Local Depression		2.00	in
Local Depression Width		1.50	ft
Throat Incline Angle		90.00	degrees

Results

Spread	9.70	ft
Depth	0.25	ft
Gutter Depression	0.06	ft
Total Depression	0.23	ft

MAG STD 530, L=3.5' 80% Clogging

Leff = 2.8'

Worksheet for Grate Inlet In Sag CB-1,2,3,5-18

Project Description

Solve For	Spread

Input Data

Discharge	0.70	ft^3/s
Left Side Slope	12.00	ft/ft (H:V)
Right Side Slope	4.00	ft/ft (H:V)
Bottom Width	2.50	ft
Grate Width	2.50	ft
Grate Length	3.50	ft
Local Depression	0.00	in
Local Depression Width	0.00	ft
Grate Type	P-50 mm (P-1-7/8")	
Clogging	50.00	%

Results

Spread	3.85	ft
Depth	0.08	ft
Wetted Perimeter	3.87	ft
Top Width	3.85	ft
Open Grate Area	3.94	ft^2
Active Grate Weir Length	9.50	ft

MAG STD 537, Single Grate

for CB-1,2,3,5 ~18

$Q_{max}(100) = 0.7$ cfs

Worksheet for Double Grate Inlet in Sag CB-PHASE I

Project Description

Solve For	Spread

Input Data

Discharge		8.10	ft^3/s
Left Side Slope		4.00	ft/ft (H:V)
Right Side Slope		4.00	ft/ft (H:V)
Bottom Width		6.00	ft
Grate Width		2.00	ft
Grate Length		4.00	ft
Local Depression		0.00	in
Local Depression Width		0.00	ft
Grate Type	P-50 mm (P-1-7/8")		
Clogging		50.00	%

Results

Spread	9.34	ft
Depth	0.42	ft
Wetted Perimeter	9.44	ft
Top Width	9.34	ft
Open Grate Area	3.60	ft^2
Active Grate Weir Length	10.00	ft

MAG STD DET 537, Double Grate

Table 3.2
Reduction Factors to Apply to Catch Basins

Condition	Inlet Type	Reduction Factor
Sump	Curb Opening	0.80
Sump	Grated	0.50
Sump	Combination	0.65
Continuous Grade	Curb Opening	0.80
Continuous Grade	Longitudinal Bar Grate Longitudinal Bar Grate with recessed transverse bars	0.75 0.60
Continuous Grade	Combination (1)	Apply factors separately to grate and curb opening
Shallow Sheet Flow (2)	Slotted Drains	0.80

(1) See Section 3.3.4.3, Combination Catch Basins

(2) Slotted drains are most effective for shallow sheet flow conditions. With greater depths and flows, a different type of inlet should be used.

3.3.4 Catch Basin Design Procedures

Figures 3.9 to 3.19 (pages 3-27 to 3-37) are capacity curves for standard catch basins. When designing a *nonstandard* catch basin, use the equations and procedures outlined herein. The approval of the governing municipality should be obtained before designing a nonstandard catch basin. The procedures and equations in this section are adapted from the Federal Highway Administration Hydraulic Engineering Circular No. 12 (HEC-12), *Drainage of Highway Pavements* (USDOT, FHWA, 1984). Refer to Section 3.1 for definitions of coefficients used in the following equations.

3.3.4.1 Curb Opening Catch Basins:

On-Grade: The length of curb opening catch basin required for total interception of gutter flow on a pavement section with a straight cross slope is expressed as:

$$L_T = 0.6Q^{0.42}S^{0.3}\left(\frac{1}{nS_x}\right)^{0.6} \qquad (3.4)$$

Figure 3.20 (page 3-38) is a nomograph for the solution of Equation 3.4.

StormCAD Output
100-year Event

StormCAD Conduit Output

100-year Event

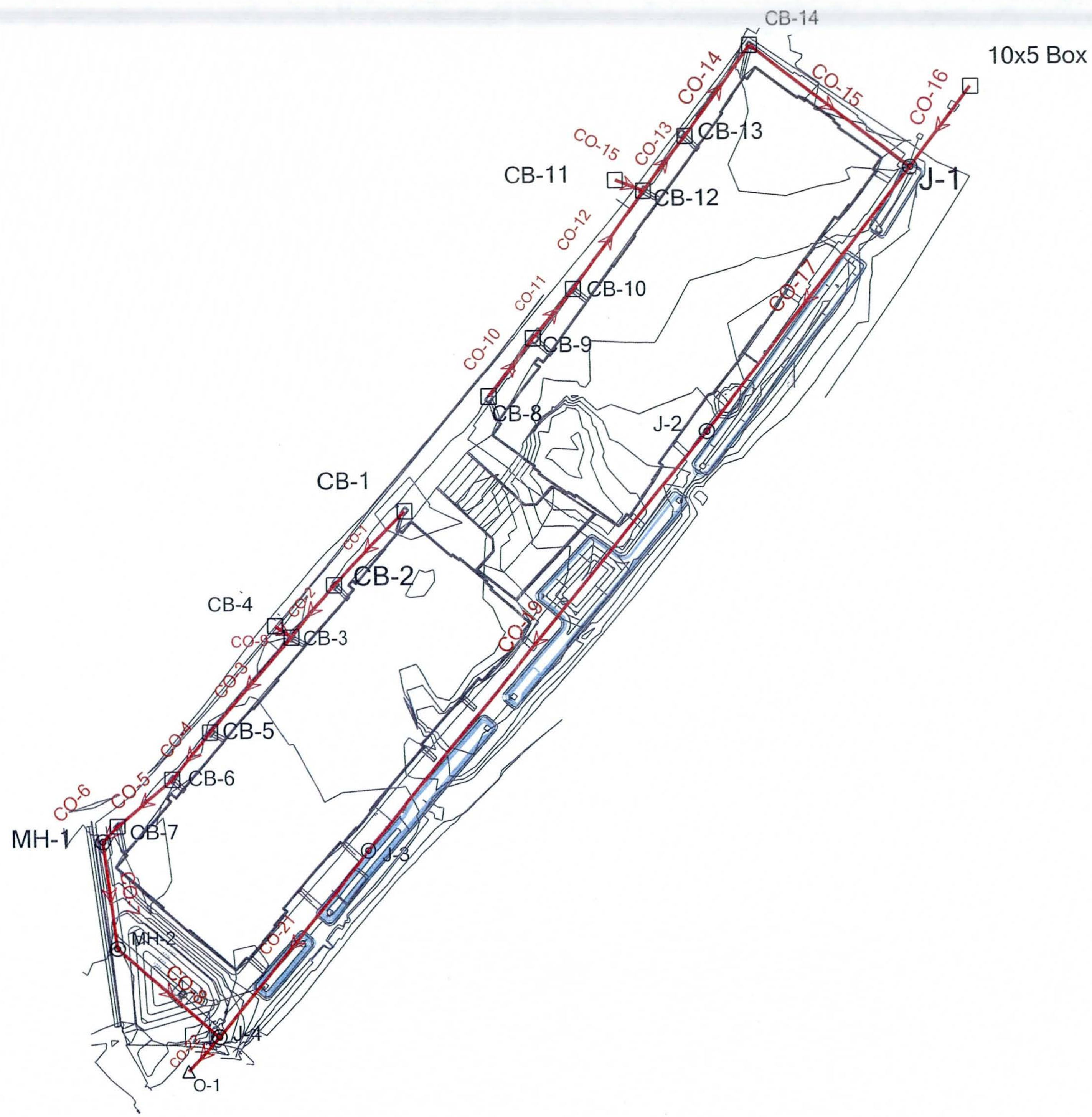
Sage Residential Phase II

Pipe ID	From	To	Inverts Start	Inverts End	Length (ft)	Slope (ft/ft)	Section Type	Section Size	Manning's n	Capacity (cfs)	$Flow_{100\text{-}yr}$ (cfs)	Velocity (fps)
CO-1	CB-1	CB-2	1,277.20	1,276.98	62.6	0.003	Circle	8"	0.013	0.66	0.70	2.15
CO-2	CB-2	CB-3	1,276.98	1,276.40	40.7	0.016	Circle	8"	0.013	1.53	1.21	4.87
CO-3	CB-3	CB-5	1,276.40	1,276.05	75.5	0.005	Circle	18"	0.013	7.37	3.05	3.97
CO-4	CB-5	CB-6	1,276.05	1,275.87	36.6	0.005	Circle	18"	0.013	7.76	3.67	4.33
CO-5	CB-6	CB-7	1,275.87	1,275.00	43.3	0.025	Circle	18"	0.013	16.56	4.16	7.80
CO-6	CB-7	MH-1	1,275.00	1,274.78	13.1	0.020	Circle	18"	0.013	14.85	4.60	7.41
CO-7	MH-1	MH-2	1,274.78	1,272.50	65.1	0.035	Circle	18"	0.013	19.66	4.60	9.08
CO-8	MH-2	J-4	1,272.50	1,269.39	81.3	0.038	Circle	18"	0.013	20.55	4.60	9.37
CO-9	CB-4	CB-3	1,276.70	1,276.40	12.0	0.025	Circle	18"	0.013	16.62	1.20	5.46
CO-10	CB-8	CB-9	1,277.20	1,276.98	44.5	0.005	Circle	8"	0.013	0.89	0.67	2.79
CO-11	CB-9	CB-10	1,276.98	1,276.40	38.3	0.017	Circle	8"	0.013	1.58	1.20	4.97
CO-12	CB-10	CB-12	1,276.40	1,276.05	73.4	0.005	Circle	18"	0.013	7.48	1.86	3.51
CO-13	CB-12	CB-13	1,276.05	1,275.87	41.6	0.005	Circle	18"	0.013	7.33	3.55	4.12
CO-14	CB-13	CB-14	1,275.87	1,275.00	67.4	0.013	Circle	18"	0.013	11.88	4.09	6.10
CO-15	CB-11	CB-12	1,276.70	1,276.05	18.4	0.035	Circle	8"	0.013	2.27	1.02	6.33
CO-15	CB-14	J-1	1,275.00	1,270.20	122.2	0.041	Circle	18"	0.013	21.18	4.69	9.63
CO-16	10x5 Box	J-1	1,270.24	1,270.20	61.2	0.001	Box	10'x5'	0.013	205.46	114.00	4.24
CO-17	J-1	J-2	1,270.20	1,270.10	202.1	0.000	Box	10'x5'	0.013	178.70	118.69	3.89
CO-19	J-2	J-3	1,270.10	1,269.66	325.5	0.001	Box	10'x5'	0.013	295.36	118.69	5.52
CO-21	J-3	J-4	1,269.66	1,269.39	144.6	0.002	Box	10'x5'	0.013	347.17	118.69	6.16
CO-22	J-4	O-1	1,269.39	1,269.30	28.1	0.003	Box	10'x5'	0.013	454.91	123.29	7.47

StormCAD Node Output
100-year Event
Sage Residential Phase II

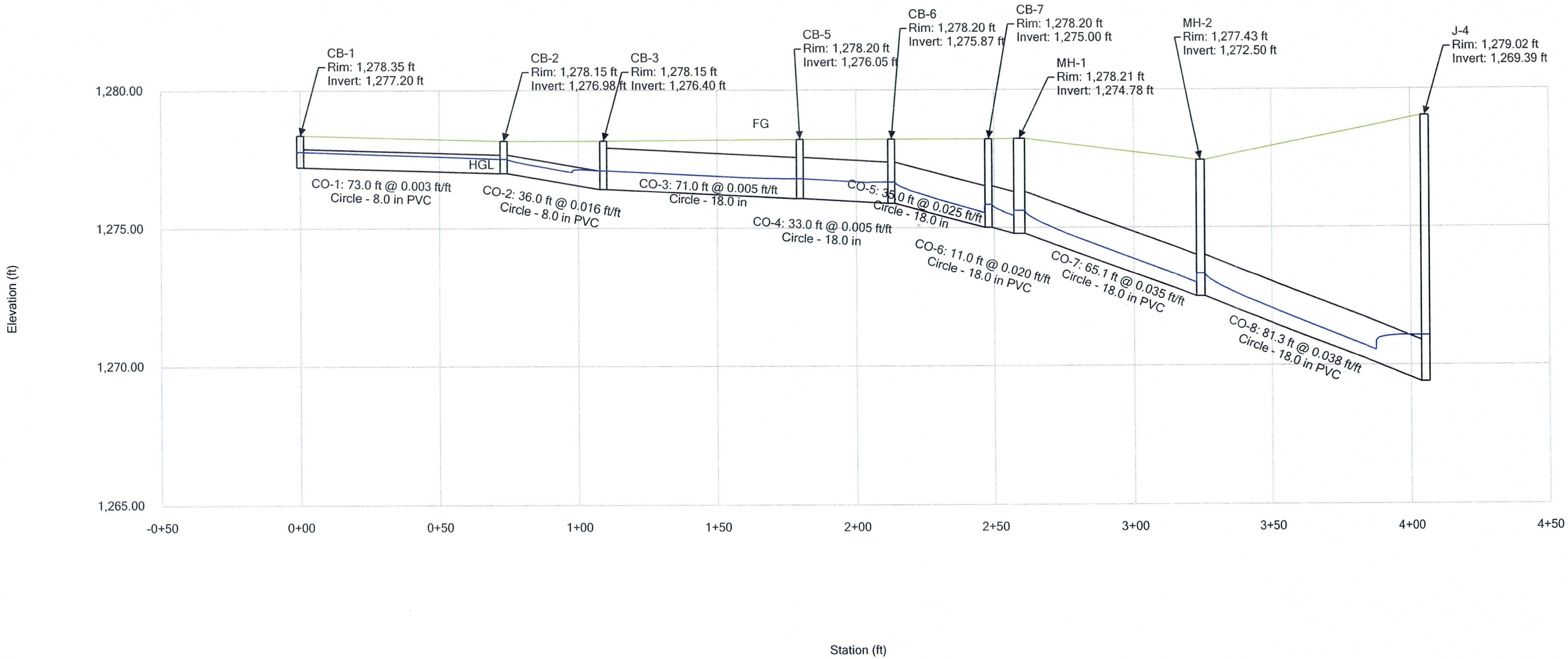
Basin ID	Rim Elevation	Invert Elevation	Hydraulic Grade Line	Inflow (cfs)
10x5 Box	1,278.00	1,270.24	1,272.61	114
CB-1	1,278.35	1,277.20	1,277.76	0.7
CB-2	1,278.15	1,276.98	1,277.50	0.51
CB-3	1,278.15	1,276.40	1,277.07	0.64
CB-4	1,277.86	1,276.70	1,277.11	1.02
CB-5	1,278.20	1,276.05	1,276.78	0.62
CB-6	1,278.20	1,275.87	1,276.65	0.49
CB-7	1,278.20	1,275.00	1,275.82	0.44
CB-8	1,278.20	1,277.20	1,277.64	0.67
CB-9	1,278.20	1,276.98	1,277.50	0.53
CB-10	1,278.30	1,276.40	1,276.91	0.66
CB-11	1,277.92	1,276.70	1,277.18	1.2
CB-12	1,278.25	1,276.05	1,276.79	0.67
CB-13	1,278.25	1,275.87	1,276.64	0.54
CB-14	1,278.00	1,275.00	1,275.83	0.6
J-1	1,278.69	1,270.20	1,272.54	
J-2	1,279.48	1,270.10	1,272.19	
J-3	1,279.15	1,269.66	1,271.55	
J-4	1,279.02	1,269.39	1,271.07	
MH-1	1,278.21	1,274.78	1,275.60	
MH-2	1,277.43	1,272.50	1,273.32	

Scenario: Base



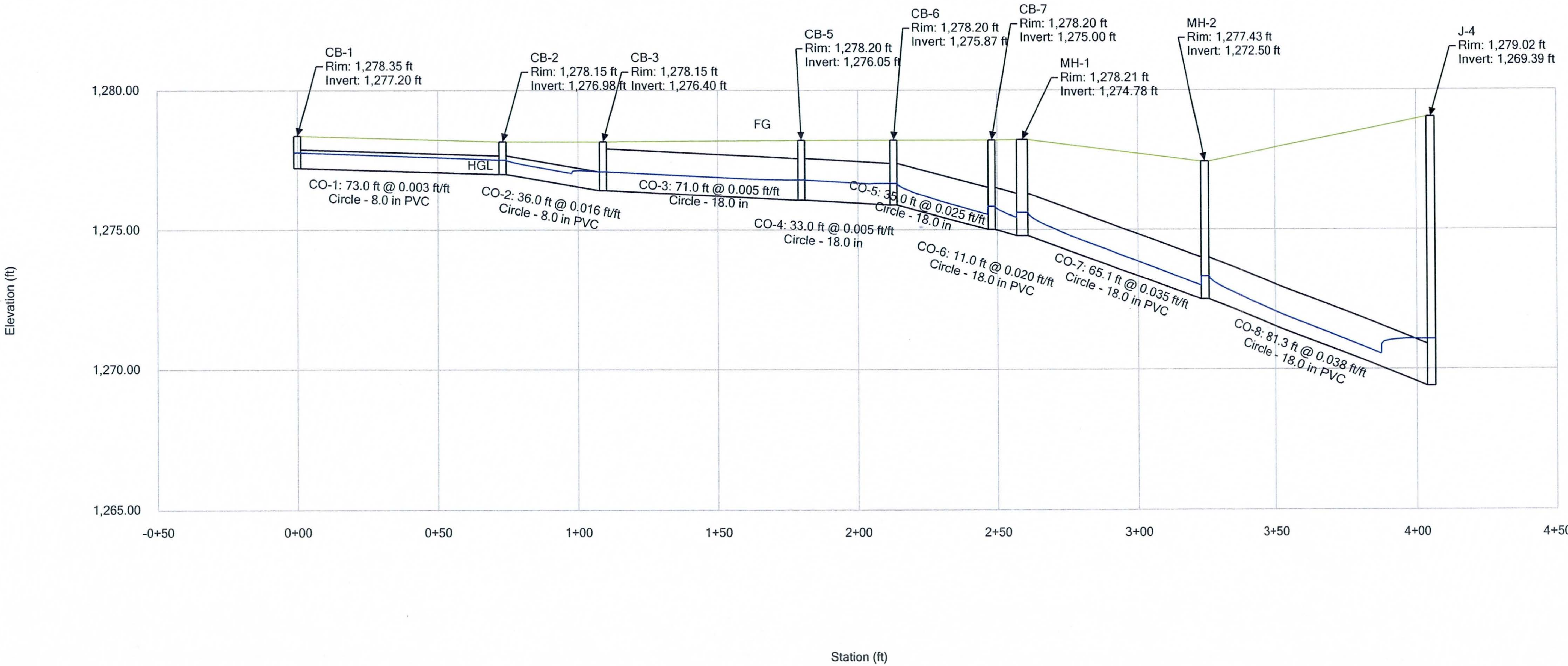
Profile Report

Engineering Profile - South Building (100-yr) (ISTR0001-STORMDRAIN (100).stsw)



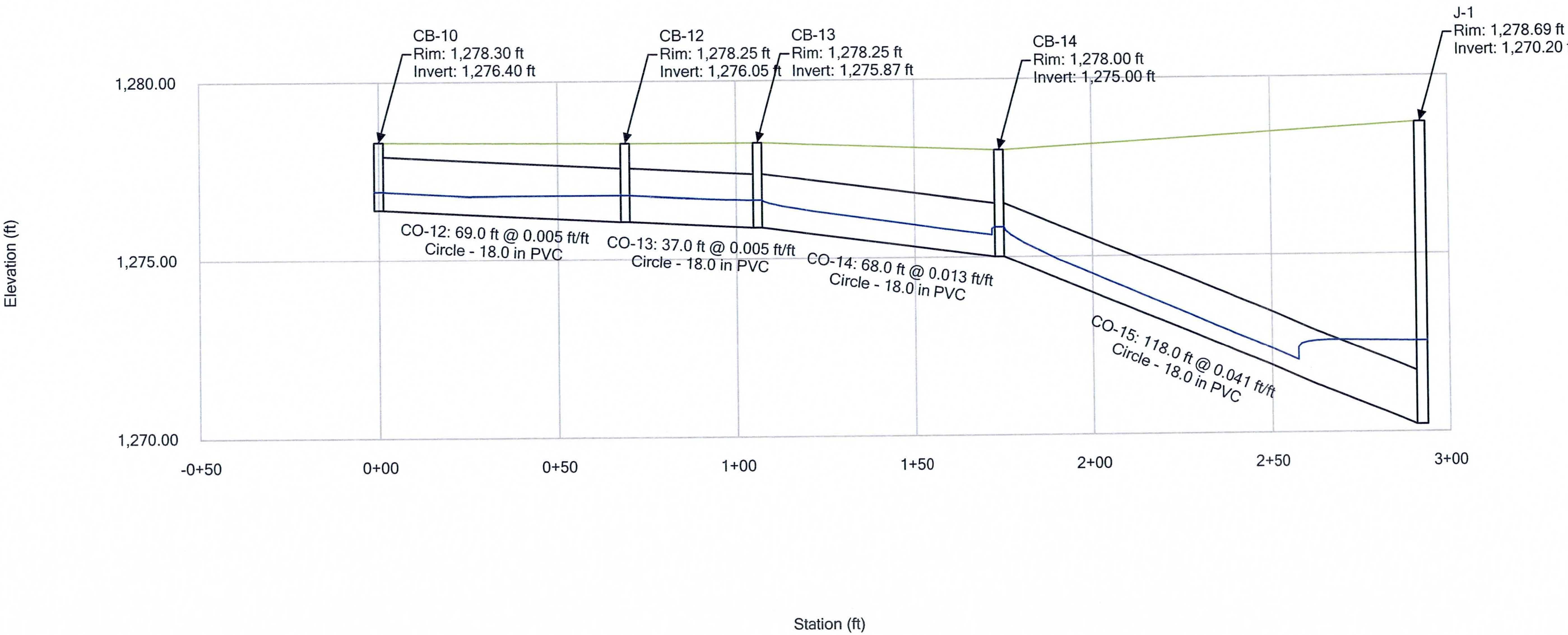
Profile Report

Engineering Profile - South Building (100-yr) (ISTR0001-STORMDRAIN (100).stsw)



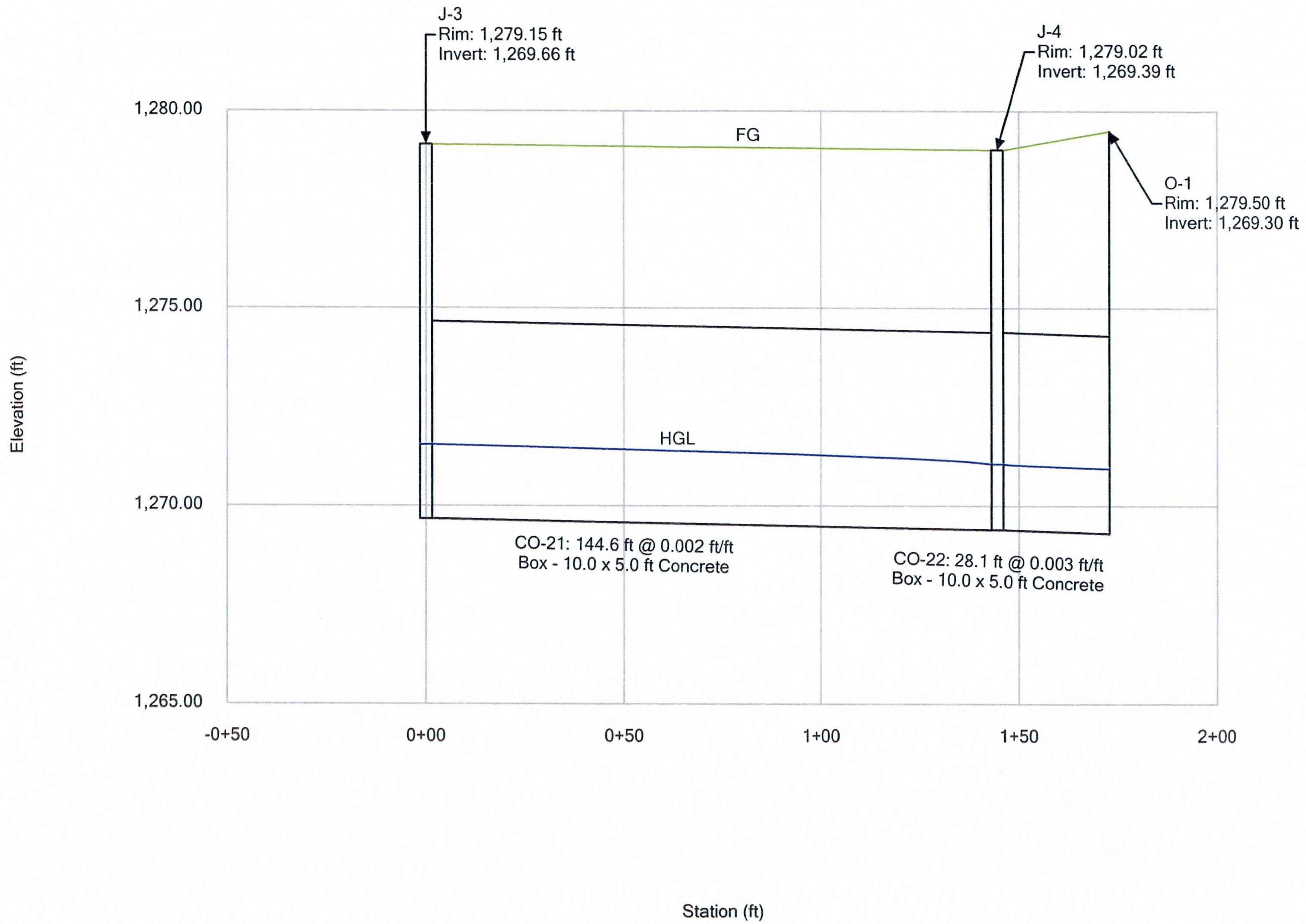
Profile Report

Engineering Profile - North Building (100-yr) (ISTR0001-STORMDRAIN (100).stsw)



Profile Report

Engineering Profile - 10x5 box culvert (100-yr) (ISTR0001-STORMDRAIN (100).stsw)



Tailwater Rating Table for 10'x5' Box Culvert

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00300	ft/ft
Normal Depth	5.00	ft
Height	5.00	ft
Bottom Width	10.00	ft

Depth (ft)	Discharge (ft^3/s)	Velocity (ft/s)	Flow Area (ft^2)	Wetted Perimeter (ft)	Top Width (ft)
0.00	0.00	0.00	0.00	10.00	10.00
0.50	18.51	3.70	5.00	11.00	10.00
1.00	55.44	5.54	10.00	12.00	10.00
1.50	103.31	6.89	15.00	13.00	10.00
2.00	158.82	7.94	20.00	14.00	10.00
2.50	220.01	8.80	25.00	15.00	10.00
3.00	285.58	9.52	30.00	16.00	10.00
3.50	354.62	10.13	35.00	17.00	10.00
4.00	426.45	10.66	40.00	18.00	10.00
4.50	500.57	11.12	45.00	19.00	10.00
5.00	440.03	8.80	50.00	30.00	10.00

↑

Outlet Invert Elevation = 1269.30

T.W. = 1269.30 + Depth

StormCAD Output
10-year Event

StormCAD Conduit Output

10-year Event

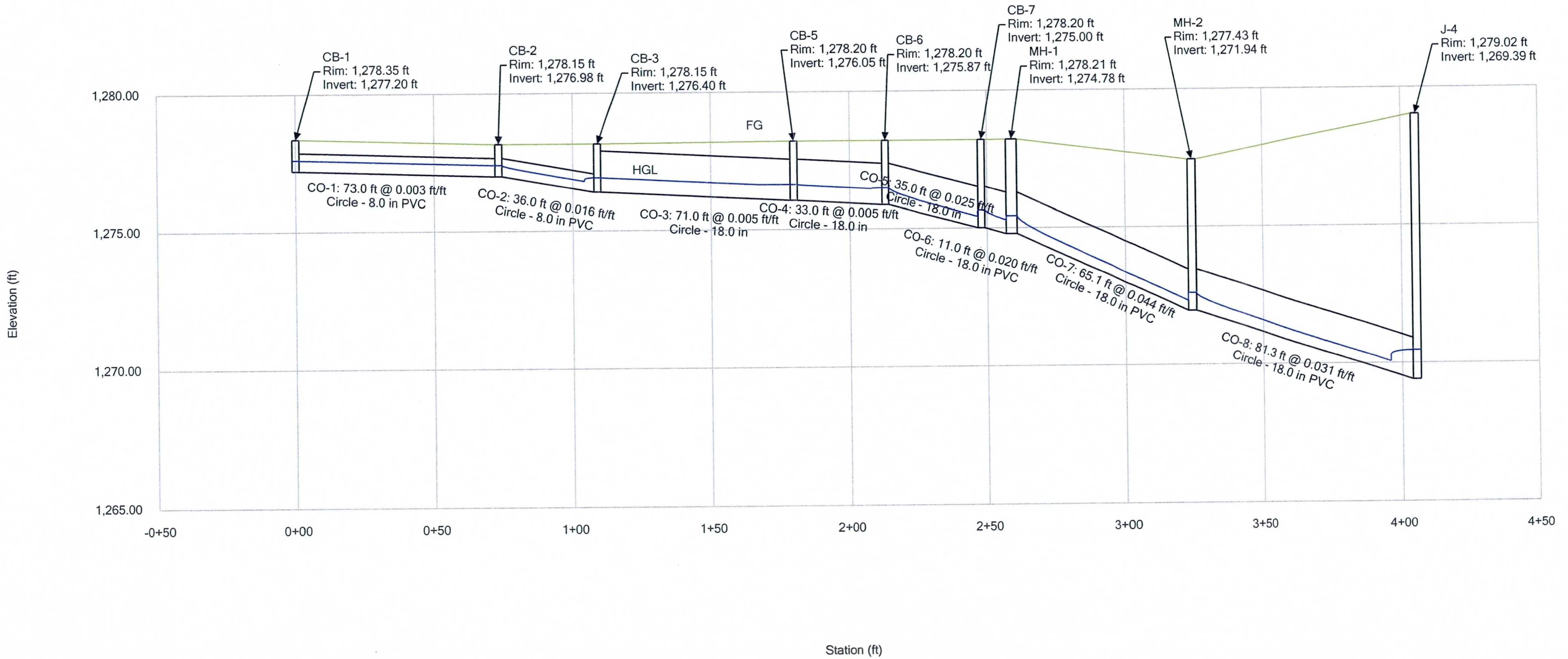
Sage Residential Phase II

			Inverts		Length	Slope	Section	Section	Manning's	Capacity	$Flow_{100-yr}$	Velocity
Pipe ID	From	To	Start	End	(ft)	(ft/ft)	Type	Size	n	(cfs)	(cfs)	(fps)
CO-1	CB-1	CB-2	1,277.20	1,276.98	62.6	0.003	Circle	8"	0.013	0.66	0.44	2.03
CO-2	CB-2	CB-3	1,276.98	1,276.40	40.7	0.016	Circle	8"	0.013	1.53	0.76	4.39
CO-3	CB-3	CB-5	1,276.40	1,276.05	75.5	0.005	Circle	18"	0.013	7.37	1.92	3.51
CO-4	CB-5	CB-6	1,276.05	1,275.87	36.6	0.005	Circle	18"	0.013	7.76	2.31	3.83
CO-5	CB-6	CB-7	1,275.87	1,275.00	43.3	0.025	Circle	18"	0.013	16.56	2.62	6.84
CO-6	CB-7	MH-1	1,275.00	1,274.78	13.1	0.020	Circle	18"	0.013	14.85	2.90	6.52
CO-7	MH-1	MH-2	1,274.78	1,271.94	65.1	0.044	Circle	18"	0.013	21.94	2.90	8.61
CO-8	MH-2	J-4	1,271.94	1,269.39	81.3	0.031	Circle	18"	0.013	18.61	2.90	7.66
CO-9	CB-4	CB-3	1,276.70	1,276.40	12.0	0.025	Circle	18"	0.013	16.62	0.76	4.77
CO-10	CB-8	CB-9	1,277.20	1,276.98	44.5	0.005	Circle	8"	0.013	0.89	0.42	2.50
CO-11	CB-9	CB-10	1,276.98	1,276.40	38.3	0.017	Circle	8"	0.013	1.58	0.75	4.47
CO-12	CB-10	CB-12	1,276.40	1,276.05	73.4	0.005	Circle	18"	0.013	7.48	1.17	3.08
CO-13	CB-12	CB-13	1,276.05	1,275.87	41.6	0.005	Circle	18"	0.013	7.33	2.27	3.65
CO-14	CB-13	CB-14	1,275.87	1,275.00	67.4	0.013	Circle	18"	0.013	11.88	2.27	5.18
CO-15	CB-11	CB-12	1,276.70	1,276.05	18.4	0.035	Circle	8"	0.013	2.27	0.68	5.68
CO-15	CB-14	J-1	1,275.00	1,270.20	126.6	0.041	Circle	18"	0.013	21.18	2.27	7.82
CO-16	10x5 Box	J-1	1,270.24	1,270.20	61.4	0.001	Box	10'x5'	0.013	205.05	57.00	3.40
CO-17	J-1	J-2	1,270.20	1,270.10	201.5	0.000	Box	10'x5'	0.013	178.98	59.27	3.14
CO-19	J-2	J-3	1,270.10	1,269.66	326.3	0.001	Box	10'x5'	0.013	295.01	59.27	4.38
CO-21	J-3	J-4	1,269.66	1,269.39	144.6	0.002	Box	10'x5'	0.013	347.17	59.27	4.87
CO-22	J-4	O-1	1,269.39	1,269.30	28.1	0.003	Box	10'x5'	0.013	454.91	62.17	5.90

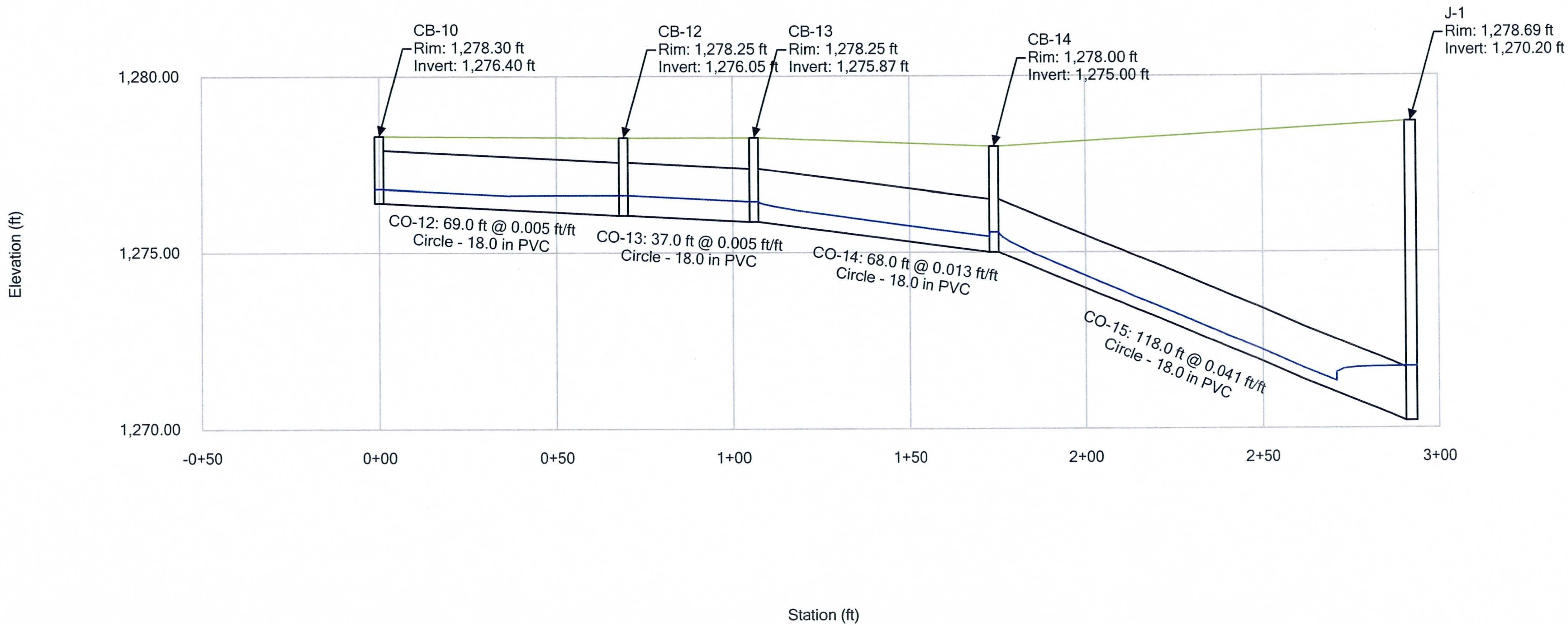
StormCAD Node Output
10-year Event
Sage Residential Phase II

Basin ID	Rim Elevation	Invert Elevation	Hydraulic Grade Line	Inflow (cfs)
10x5 Box	1,278.00	1,270.24	1,271.79	57
CB-1	1,278.35	1,277.20	1,277.60	0.44
CB-2	1,278.15	1,276.98	1,277.39	0.32
CB-3	1,278.15	1,276.40	1,276.92	0.4
CB-4	1,277.86	1,276.70	1,277.02	0.64
CB-5	1,278.20	1,276.05	1,276.62	0.39
CB-6	1,278.20	1,275.87	1,276.48	0.31
CB-7	1,278.20	1,275.00	1,275.65	0.28
CB-8	1,278.20	1,277.20	1,277.52	0.42
CB-9	1,278.20	1,276.98	1,277.39	0.33
CB-10	1,278.30	1,276.40	1,276.80	0.42
CB-11	1,277.92	1,276.70	1,277.09	0.76
CB-12	1,278.25	1,276.05	1,276.62	0.42
CB-13	1,278.25	1,275.87	1,276.44	0.34
CB-14	1,278.00	1,275.00	1,275.57	0.38
J-1	1,278.69	1,270.20	1,271.74	
J-2	1,279.48	1,270.10	1,271.44	
J-3	1,279.15	1,269.66	1,270.87	
J-4	1,279.02	1,269.39	1,270.45	
MH-1	1,278.21	1,274.78	1,275.43	
MH-2	1,277.43	1,271.94	1,272.59	

Profile Report
Engineering Profile - South Building (10-year) (ISTR0001-STORMDRAIN (10).stsw)

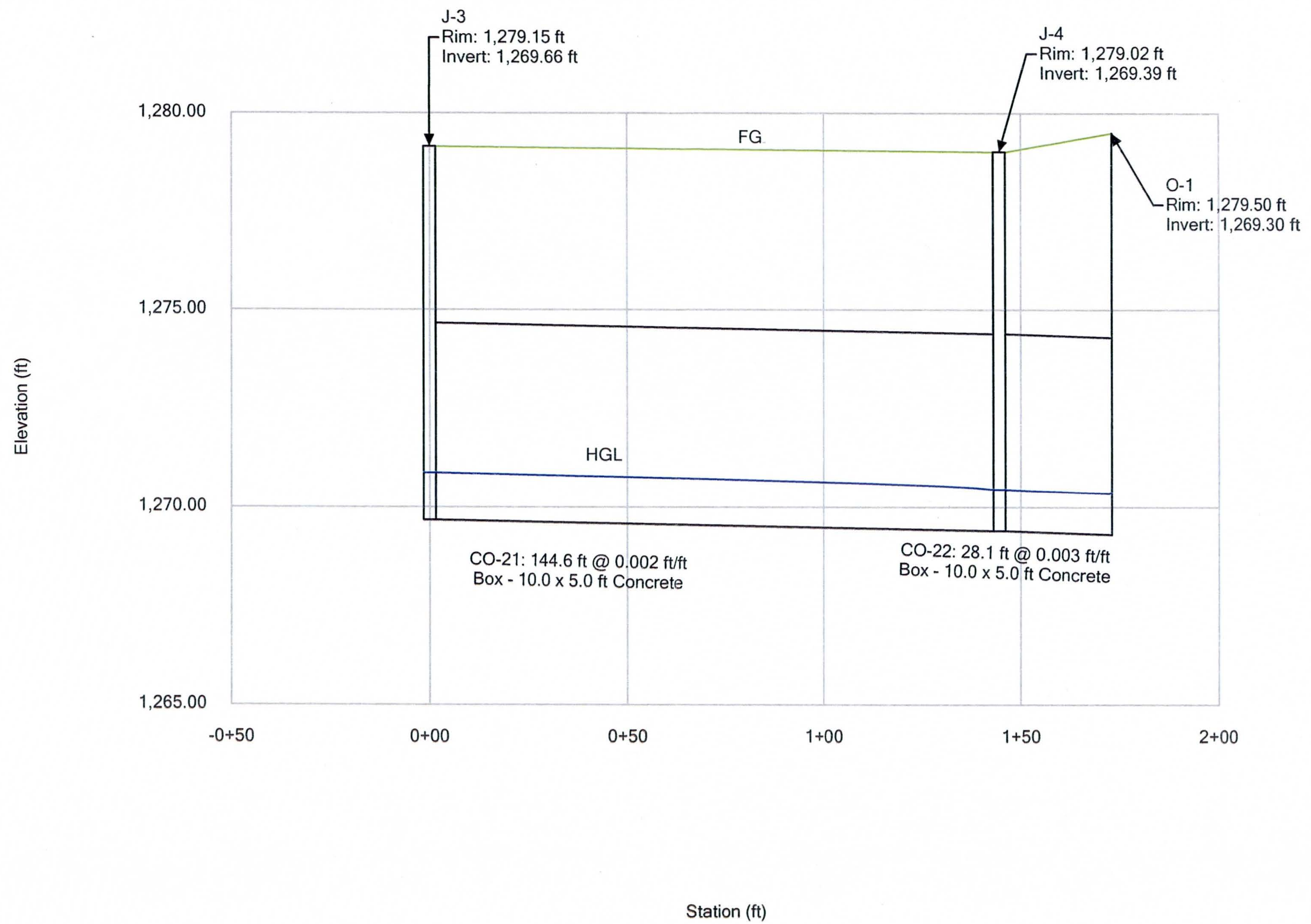


Profile Report
Engineering Profile - North Building (10-year) (ISTR0001-STORMDRAIN (10).stsw)



Profile Report

Engineering Profile - 10x5 box culvert (10-year) (ISTR0001-STORMDRAIN (10).stsw)



Tailwater Rating Table for 10'x5' Box Culvert

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00300	ft/ft
Normal Depth	5.00	ft
Height	5.00	ft
Bottom Width	10.00	ft

Depth (ft)	Discharge (ft^3/s)	Velocity (ft/s)	Flow Area (ft^2)	Wetted Perimeter (ft)	Top Width (ft)
0.00	0.00	0.00	0.00	10.00	10.00
0.50	18.51	3.70	5.00	11.00	10.00
1.00	55.44	5.54	10.00	12.00	10.00
1.50	103.31	6.89	15.00	13.00	10.00
2.00	158.82	7.94	20.00	14.00	10.00
2.50	220.01	8.80	25.00	15.00	10.00
3.00	285.58	9.52	30.00	16.00	10.00
3.50	354.62	10.13	35.00	17.00	10.00
4.00	426.45	10.66	40.00	18.00	10.00
4.50	500.57	11.12	45.00	19.00	10.00
5.00	440.03	8.80	50.00	30.00	10.00

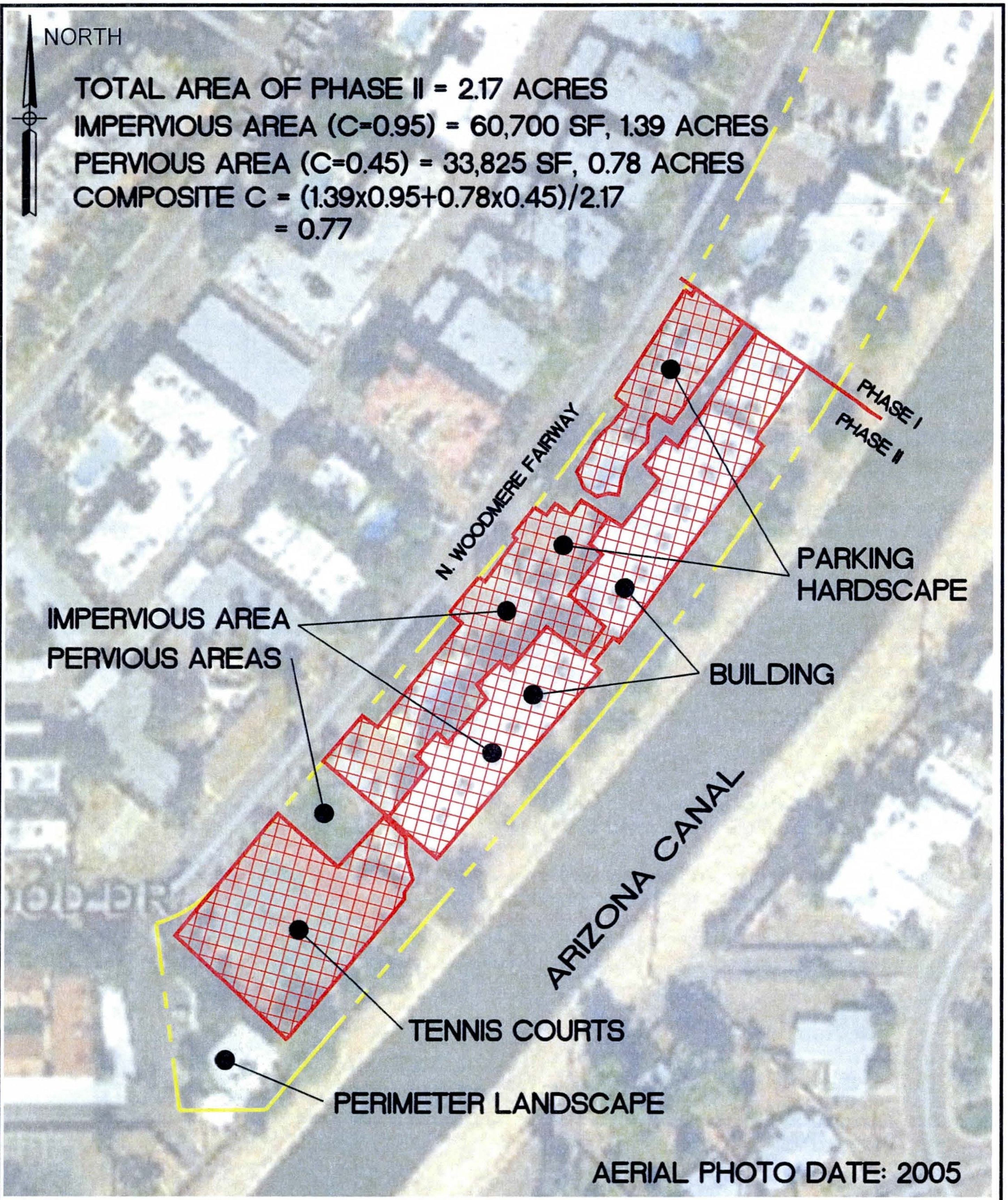
Outlet Invert = 1269.30

T.W. = 1269.30 + Depth

APPENDIX C

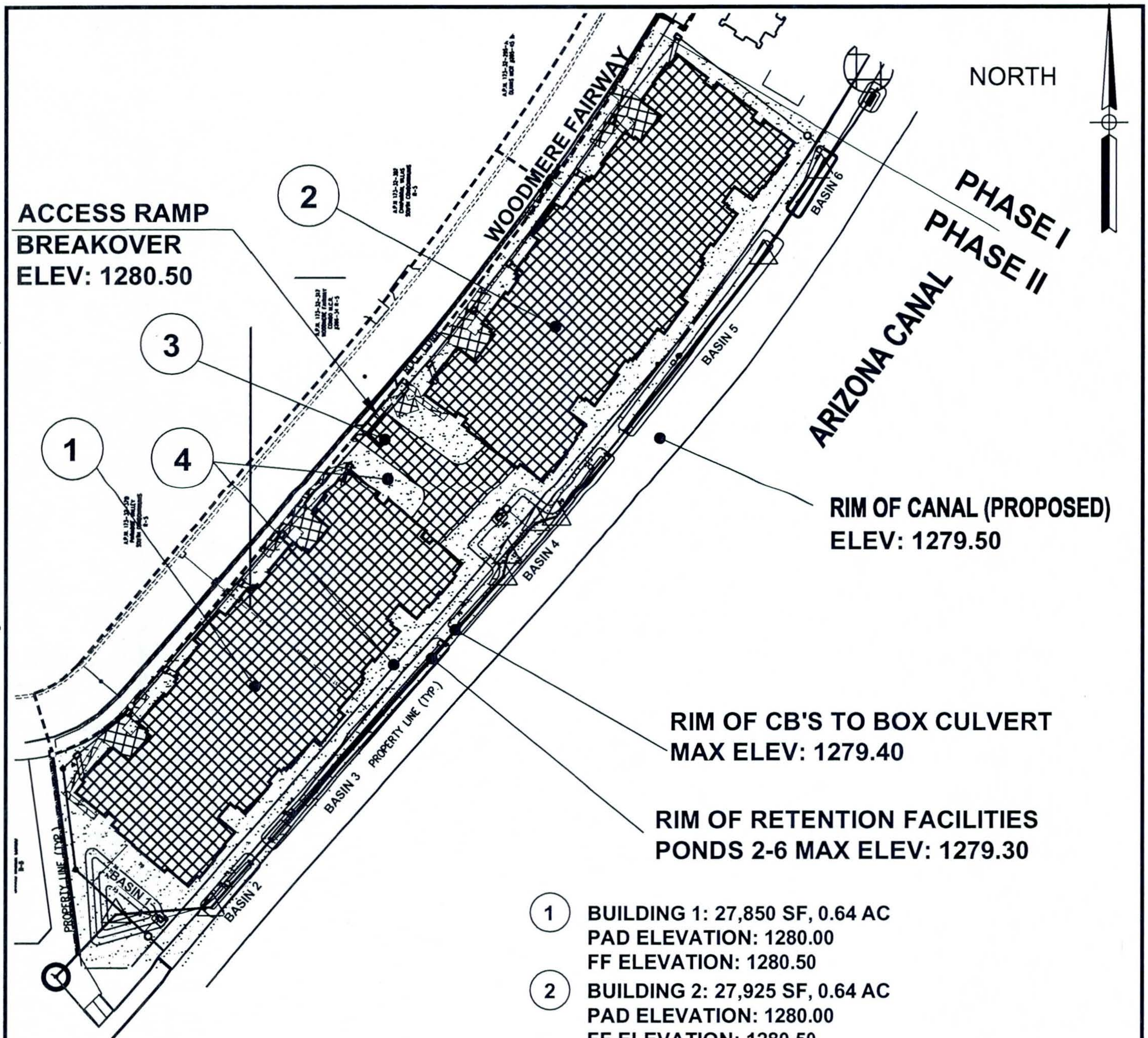
Retention Calculations

Pre- versus post-Development Comparison



SCALE: NTS	PREDEVELOPED ONSITE BASIN AREAS SAGE RESIDENTAIL - PHASE II SCOTTSDALE, ARIZONA	DAVID EVANS AND ASSOCIATES INC. 4600 East Washington Street, Suite 430 Phoenix Arizona 85034 Phone: 602.678.5151	DRAWN BY: JSE
SHEET 1 OF 1			CHECKED BY:
JOB NO.: ISTR0000001			DATE: March 2013

P:\\ISTR0000001\0400CAD\EC\Exhibits\Drainage Report\EC-DR-ISTR0001 - APP A - Ex D-E-G-Fig 1.dwg fmk Oct 12, 2013 12:50:24pm



1) BUILDING 1: 27,850 SF, 0.64 AC
PAD ELEVATION: 1280.00
FF ELEVATION: 1280.50

2) BUILDING 2: 27,925 SF, 0.64 AC
PAD ELEVATION: 1280.00
FF ELEVATION: 1280.50

3) ACCESS DRIVE: 3,470 SF, 0.08 AC

4) LANDSCAPE AREA: 35,319 SF, 0.81 AC

TOTAL AREA WITHIN PHASE II
PHASE II AREA: 94,619 SF, 2.17 ACRES
PERVIOUS AREA (C=0.45): 35,319 SF, 0.81 ACRES
IMPERVIOUS AREA (C=0.95): 59,300 SF, 1.36 ACRES
COMPOSITE C = (0.81x0.45+1.36x0.95)/2.17
= 0.76

VOLUME BASIN 1: 3,071 CF
VOLUME BASINS 2-6: 7,310 CF
TOTAL VOLUME PROVIDED: 10,381 CF

SCALE: 1" = 100'	**EXHIBIT F** POSTDEVELOPED BASIN AREAS SAGE RESIDENTIAL - PHASE II SCOTTSDALE, ARIZONA	4600 East Washington Street, Suite 430 Phoenix Arizona 85034 Phone: 602.678.5151	DRAWN BY: JSE
SHEET 1 OF 1			CHECKED BY:
JOB NO.: 1STR00000001			DATE: March 2013

Retention Basin Calculations

Contributing Drainage Areas: 1
Retention Basin(s): 1

(This is a redevelopment project. The proposed development has a lower runoff coefficient 'C' than the previous development. Therefore, no retention volume is required. However, volume is provided for shortage from Sage Condominium Phase I. The 100-year 2-hour runoff volume from the corresponding contributing area is used to estimate the basin size)

	Area		'C' Coefficient	Precipitation	Retention Required	
Type	**(ft^2)**	**(Ac)**	**C**	**(Inches)**	**(ft^3)**	**(Ac-ft)**
Residential	0	0.00	0.94	2.17	0	0.00
Pavement/Retention	6,914	0.16	0.95	2.17	1,188	0.03
Landscaped	0	0.00	0.45	2.17	0	0.00
Total	6,914	0.16	0.95		**1,188**	**0.03**

RETENTION BASIN CALCULATIONS

Elevation	Delta Depth (ft)	Surface Area (ft^2)		Volume Provided (ft^3)	Σ (ft^3)	(Ac-ft)	Σ (Ac-ft)
1276.0	1.0	1,969		1,608	3,071	0.04	0.07
1275.0	1.0	1,273		976	1,463	0.02	0.03
1274.0	1.0	707		487	487	0.01	0.01
1273.0	0.0	296			*3,071*		*0.07*
			Provided		3,071		0.07
			Required		1,188		0.03
Basin HWE	*Basin Depth*		*Balance*		**1,884**		**0.04**
1276.00	3.00						

Contributing Drainage Areas: 2
Retention Basin(s): 2

	Area		'C' Coefficient	Precipitation	Retention Required	
Type	**(ft^2)**	**(Ac)**	**C**	**(Inches)**	**(ft^3)**	**(Ac-ft)**
Residential	1,849	0.04	0.94	2.17	314	0.01
Pavement	560	0.01	0.95	2.17	96	0.00
Landscaped	2,581	0.06	0.45	2.17	210	0.00
Total	4,990	0.11	0.69		**621**	**0.01**

RETENTION BASIN CALCULATIONS

Elevation	Delta Depth (ft)	Surface Area (ft^2)		Volume Provided (ft^3)	Σ (ft^3)	(Ac-ft)	Σ (Ac-ft)
1279.3	0.0	618		0	418	0.00	0.01
1279.3	0.3	618		165	418	0.00	0.01
1279.0	0.8	483		253	253	0.01	0.01
1278.2		176			*418*		*0.01*
			Provided		418		0.01
			Required		621		0.01
Basin HWE	*Basin Depth*		*Balance*		**-202**		**0.00**
1279.30	1.10			Overflow to Basin 1			

Contributing Drainage Areas: 3
Retention Basin(s): 3

(This is a redevelopment project. The proposed development has a lower runoff coefficient 'C' than the previous development. Therefore, no retention volume is required. However, volume is provided for shortage from Sage Condominium Phase I. The 100-year 2-hour runoff volume from the corresponding contributing area is used to estimate the basin size)

	Area		'C' Coefficient	Precipitation	Retention Required	
Type	**(ft^2)**	**(Ac)**	**C**	**(Inches)**	**(ft^3)**	**(Ac-ft)**
Residential	10,220	0.23	0.94	2.17	1,737	0.04
Pavement	2,560	0.06	0.95	2.17	440	0.01
Landscaped	6,684	0.15	0.45	2.17	544	0.01
Total	19,464	0.45	0.77		**2,721**	**0.06**

RETENTION BASIN CALCULATIONS

Elevation	Delta Depth	Surface Area		Volume Provided			
	(ft)	**(ft^2)**		**(ft^3)**	**Σ (ft^3)**	**(Ac-ft)**	**Σ (Ac-ft)**
1279.3	0.0	1,987		0	1,182	0.00	0.03
1279.3	0.3	1,987		535	1,182	0.01	0.03
1279.0	0.8	1,586		647	647	0.01	0.01
1278.2		233			*1,182*		*0.03*
			Provided		1,182		0.03
			Required		2,721		0.06
Basin HWE	*Basin Depth*		*Balance*		**-1,539**		**-0.03**
1279.30	1.10				Overflow to Basin 2		

Contributing Drainage Areas: 4
Retention Basin(s): 4

VOLUME REQUIRED CALCULATIONS

	Area		'C' Coefficient	Precipitation	Retention Required	
Type	**(ft^2)**	**(Ac)**	**C**	**(Inches)**	**(ft^3)**	**(Ac-ft)**
Residential	6,612	0.15	0.94	2.17	1,124	0.03
Pavement	1,440	0.03	0.95	2.17	247	0.01
Landscaped	8,977	0.21	0.45	2.17	731	0.02
Total	17,029	0.39	0.68		**2,102**	**0.06**

RETENTION BASIN CALCULATIONS

Elevation	Delta Depth	Surface Area		Volume Provided			
	(ft)	**(ft^2)**		**(ft^3)**	**Σ (ft^3)**	**(Ac-ft)**	**Σ (Ac-ft)**
1279.3	0.3	3,237		892	3,548	0.02	0.08
1279.0	1.0	2,715		1,838	2,656	0.04	0.06
1278.0	1.0	1,084		818	818	0.02	0.02
1277.0		578			*3,548*		*0.08*
			Provided		3,548		0.08
			Required		2,102		0.06
Basin HWE	*Basin Depth*		*Balance*		**1,446**		**0.02**
1279.30	2.30						

Contributing Drainage Areas: 5
Retention Basin(s): 5

(This is a redevelopment project. The proposed development has a lower runoff coefficient 'C' than the previous development. Therefore, no retention volume is required. However, volume is provided for shortage from Sage Condominium Phase I. The 100-year 2-hour runoff volume from the corresponding contributing area is used to estimate the basin size)

Type	Area (ft^2)	Area (Ac)	'C' Coefficient C	Precipitation (Inches)	Retention Required (ft^3)	Retention Required (Ac-ft)
Residential	9,762	0.22	0.94	2.17	1,659	0.04
Pavement	3,440	0.08	0.95	2.17	591	0.01
Landscaped	6,609	0.15	0.45	2.17	538	0.01
Total	19,811	0.45	0.78		**2,788**	**0.06**

RETENTION BASIN CALCULATIONS

Elevation	Delta Depth (ft)	Surface Area (ft^2)		Volume Provided (ft^3)	Σ (ft^3)	(Ac-ft)	Σ (Ac-ft)
1279.3	0.0	2,305		0	1,808	0.00	0.04
1279.3	0.3	2,305		628	1,808	0.01	0.04
1279.0	1.0	1,887		1,180	1,180	0.03	0.03
1278.0		594			*1,808*		*0.04*
			Provided		1,808		0.04
			Required		2,788		0.06
Basin HWE	*Basin Depth*		*Balance*		**-980**		**-0.02**
1279.30	1.30				Overflow to Basin 4		

Contributing Drainage Areas: 6
Retention Basin(s): 6

VOLUME REQUIRED CALCULATIONS

Type	Area (ft^2)	Area (Ac)	'C' Coefficient C	Precipitation (Inches)	Retention Required (ft^3)	Retention Required (Ac-ft)
Residential	1,789	0.04	0.94	2.17	304	0.01
Pavement	1,000	0.02	0.95	2.17	172	0.00
Landscaped	3,225	0.07	0.45	2.17	262	0.01
Total	6,024	0.14	0.68		**738**	**0.02**

RETENTION BASIN CALCULATIONS

Elevation	Delta Depth (ft)	Surface Area (ft^2)		Volume Provided (ft^3)	Σ (ft^3)	(Ac-ft)	Σ (Ac-ft)
1279.3	0.0	596		0	354	0.00	0.01
1279.3	0.3	596		153	354	0.00	0.01
1279.0	1.0	426		201	201	0.00	0.00
1278.0		43			*354*		*0.01*
			Provided		354		0.01
			Required		738		0.02
Basin HWE	*Basin Depth*		*Balance*		**-384**		**-0.01**
1279.30	1.30				Overflow to Basin 5		

Total Volume Provided	**10,381**	0.238
	cf	0.240
Total Volume Required Ph1	9425 cf	

2.5-inch bleed off pipe rate 0.13 cfs
Two bleedoff locations (Basin 1 and Basin 4)
Total Bleedoff rate = 0.26 cfs
Drain Time = 10381/0.26/3600 **=11.1 hr**

Sage Residential Phase II

First Flush Flow Rate Calculations

First Flush Flow Rate:

North Storm Drain System:			
Sub-basin Served:	13,14,15,16,17,18,20		
Total Area:	0.658	acres	
$Q_{FF:}$	**0.33**	cfs	(Q_{FF}=CIA=1 x 0.5 x A)

Catch Basin in Basin 4:			
Sub-basin Served:	4,5,6		
Total Area:	1.00	acres	
$Q_{FF:}$	**0.50**	cfs	(Q_{FF}=CIA=1 x 0.5 x A)
However, the bleedoff flow is restricted by the 2" orifice in the catch basin.			
Actual $Q_{FF:}$	0.08	cfs	

South Storm Drain System:			
Sub-basin served:	1,2,3,7,8,9,10,11,12,19		
Sub-basins 1,2 and 3 will go through the 2" orifice in a headwall			
Actual $Q_{FF:}$	0.08	cfs	
Total Area:	0.63	acres	(7-12 and 19)
$Q_{FF:}$	0.32	cfs	(Q_{FF}=CIA=1 x 0.5 x A)
Total $Q_{FF:}$	**0.40**	cfs	

Flow between basins
(Culvert Master Output)

Culvert Designer/Analyzer Report
Between Basin 2 and 1

Analysis Component			
Storm Event	Design	Discharge	2.95 cfs

Peak Discharge Method: User-Specified			
Design Discharge	2.95 cfs	Check Discharge	2.95 cfs

Tailwater Conditions: Constant Tailwater	
Tailwater Elevation	1,279.00 ft

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	1-2.5 inch Circular	0.08 cfs	1,279.66 ft	2.39 ft/s
Weir	Broad Crested	2.87 cfs	1,279.66 ft	N/A
Total	----------------	2.95 cfs	1,279.66 ft	N/A

$$Q_{100} = Q_{sub\text{-}basin\ 3} + Q_{sub\text{-}basin\ 2}$$
$$= 2.58 + 0.37$$
$$= 2.95 \text{ cfs}$$

Culvert Designer/Analyzer Report
Between Basin 2 and 1

Component:Culvert-1

Culvert Summary					
Computed Headwater Elevation	1,279.66	ft	Discharge	0.08	cfs
Inlet Control HW Elev.	1,279.00	ft	Tailwater Elevation	1,279.00	ft
Outlet Control HW Elev.	1,279.66	ft	Control Type	Outlet Control	
Headwater Depth/Height	7.01				

Grades					
Upstream Invert	1,278.20	ft	Downstream Invert	1,274.50	ft
Length	29.00	ft	Constructed Slope	0.127586	ft/ft

Hydraulic Profile					
Profile	PressureProfile		Depth, Downstream	4.50	ft
Slope Type	N/A		Normal Depth	0.09	ft
Flow Regime	N/A		Critical Depth	0.18	ft
Velocity Downstream	2.39	ft/s	Critical Slope	0.017755	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.012	
Section Material	Corrugated HDPE (Smooth Interior)		Span	0.21	ft
Section Size	2.5 inch		Rise	0.21	ft
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev.	1,279.66	ft	Upstream Velocity Head	0.09	ft
Ke	0.20		Entrance Loss	0.02	ft

Inlet Control Properties					
Inlet Control HW Elev.	1,279.00	ft	Flow Control	Submerged	
Inlet Type	Beveled ring, 33.7° bevels		Area Full	0.0	ft²
K	0.00180		HDS 5 Chart	3	
M	2.50000		HDS 5 Scale	B	
C	0.02430		Equation Form	1	
Y	0.83000				

Culvert Designer/Analyzer Report
Between Basin 2 and 1

Component:Weir

Hydraulic Component(s): Broad Crested

Discharge	2.87	cfs	Allowable HW Elevation	1,279.66	ft
Weir Coefficient	3.00	US	Length	15.00	ft
Crest Elevation	1,279.50	ft	Headwater Elevation	1,279.66	ft

Culvert Analysis Report
Between Basin 3 and 2

Analysis Component			
Storm Event	Design	Discharge	2.58 cfs

Peak Discharge Method: User-Specified			
Design Discharge	2.58 cfs	Check Discharge	2.58 cfs

Tailwater Conditions: Constant Tailwater	
Tailwater Elevation	1,279.00 ft

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	1-8 inch Circular	1.70 cfs	1,279.87 ft	4.86 ft/s
Weir	Broad Crested	0.89 cfs	1,279.87 ft	N/A
Total	----------------	2.59 cfs	1,279.87 ft	N/A

$Q_{100} = Q_{\text{Sub-Basin 3}} = 2.58$ cfs

Culvert Analysis Report
Between Basin 3 and 2

Component:Culvert-1

Culvert Summary					
Computed Headwater Elevation	1,279.87	ft	Discharge	1.70	cfs
Inlet Control HW Elev.	1,279.29	ft	Tailwater Elevation	1,279.00	ft
Outlet Control HW Elev.	1,279.87	ft	Control Type	Outlet Control	
Headwater Depth/Height	2.69				

Grades					
Upstream Invert	1,278.08	ft	Downstream Invert	1,278.05	ft
Length	22.00	ft	Constructed Slope	0.001364	ft/ft

Hydraulic Profile					
Profile	PressureProfile		Depth, Downstream	0.95	ft
Slope Type	N/A		Normal Depth	N/A	ft
Flow Regime	N/A		Critical Depth	0.60	ft
Velocity Downstream	4.86	ft/s	Critical Slope	0.017362	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.013	
Section Material	Concrete		Span	0.67	ft
Section Size	8 inch		Rise	0.67	ft
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev.	1,279.87	ft	Upstream Velocity Head	0.37	ft
Ke	0.20		Entrance Loss	0.07	ft

Inlet Control Properties					
Inlet Control HW Elev.	1,279.29	ft	Flow Control	Submerged	
Inlet Type	Groove end projecting		Area Full	0.3	ft²
K	0.00450		HDS 5 Chart	1	
M	2.00000		HDS 5 Scale	3	
C	0.03170		Equation Form	1	
Y	0.69000				

Culvert Analysis Report
Between Basin 3 and 2

Component:Weir

Hydraulic Component(s): Broad Crested

Discharge	0.89 cfs	Allowable HW Elevation	1,279.87 ft
Weir Coefficient	3.00 US	Length	15.00 ft
Crest Elevation	1,279.80 ft	Headwater Elevation	1,279.87 ft

Culvert Analysis Report
Between Basin 5 and 4

Analysis Component			
Storm Event	Design	Discharge	2.13 cfs

Peak Discharge Method: User-Specified			
Design Discharge	2.13 cfs	Check Discharge	2.13 cfs

Tailwater Conditions: Constant Tailwater	
Tailwater Elevation	1,279.00 ft

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	1-8 inch Circular	1.18 cfs	1,279.53 ft	3.38 ft/s
Weir	Broad Crested	0.96 cfs	1,279.53 ft	N/A
Total	----------------	2.14 cfs	1,279.53 ft	N/A

$Q_{100} = Q_{sub\text{-}basin\ 6} + Q_{sub\text{-}basin\ 5}$

$= 0.45 + 1.68$

$= 2.13$ cfs

Culvert Analysis Report
Between Basin 5 and 4

Component:Culvert-1

Culvert Summary			
Computed Headwater Elevation	1,279.53 ft	Discharge	1.18 cfs
Inlet Control HW Elev.	1,279.00 ft	Tailwater Elevation	1,279.00 ft
Outlet Control HW Elev.	1,279.53 ft	Control Type	Outlet Control
Headwater Depth/Height	2.29		

Grades			
Upstream Invert	1,278.00 ft	Downstream Invert	1,278.00 ft
Length	33.00 ft	Constructed Slope	0.000000 ft/ft

Hydraulic Profile			
Profile	PressureProfile	Depth, Downstream	1.00 ft
Slope Type	N/A	Normal Depth	N/A ft
Flow Regime	N/A	Critical Depth	0.51 ft
Velocity Downstream	3.38 ft/s	Critical Slope	0.010731 ft/ft

Section			
Section Shape	Circular	Mannings Coefficient	0.013
Section Material	Concrete	Span	0.67 ft
Section Size	8 inch	Rise	0.67 ft
Number Sections	1		

Outlet Control Properties			
Outlet Control HW Elev.	1,279.53 ft	Upstream Velocity Head	0.18 ft
Ke	0.20	Entrance Loss	0.04 ft

Inlet Control Properties			
Inlet Control HW Elev.	1,279.00 ft	Flow Control	Submerged
Inlet Type	Groove end projecting	Area Full	0.3 ft²
K	0.00450	HDS 5 Chart	1
M	2.00000	HDS 5 Scale	3
C	0.03170	Equation Form	1
Y	0.69000		

Culvert Analysis Report
Between Basin 5 and 4

Component:Weir

Hydraulic Component(s): Broad Crested					
Discharge	0.96	cfs	Allowable HW Elevation	1,279.53	ft
Weir Coefficient	3.00	US	Length	15.00	ft
Crest Elevation	1,279.45	ft	Headwater Elevation	1,279.53	ft

Culvert Analysis Report
Between Basin 6 and 5

Analysis Component			
Storm Event	Design	Discharge	0.45 cfs

Peak Discharge Method: User-Specified			
Design Discharge	0.45 cfs	Check Discharge	0.45 cfs

Tailwater Conditions: Constant Tailwater	
Tailwater Elevation	1,279.00 ft

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	1-8 inch Circular	0.45 cfs	1,279.06 ft	1.28 ft/s
Weir	Broad Crested	0.00 cfs	1,279.06 ft	N/A
Total	----------------	0.45 cfs	1,279.06 ft	N/A

$Q_{100} = Q_{sub-basin\ 6} = 0.45$ cfs

Culvert Analysis Report
Between Basin 6 and 5

Component:Culvert-1

Culvert Summary			
Computed Headwater Elevation	1,279.06 ft	Discharge	0.45 cfs
Inlet Control HW Elev.	1,279.00 ft	Tailwater Elevation	1,279.00 ft
Outlet Control HW Elev.	1,279.06 ft	Control Type	Outlet Control
Headwater Depth/Height	1.59		

Grades			
Upstream Invert	1,278.00 ft	Downstream Invert	1,278.00 ft
Length	22.00 ft	Constructed Slope	0.000000 ft/ft

Hydraulic Profile			
Profile	PressureProfile	Depth, Downstream	1.00 ft
Slope Type	N/A	Normal Depth	N/A ft
Flow Regime	N/A	Critical Depth	0.31 ft
Velocity Downstream	1.28 ft/s	Critical Slope	0.006857 ft/ft

Section			
Section Shape	Circular	Mannings Coefficient	0.013
Section Material	Concrete	Span	0.67 ft
Section Size	8 inch	Rise	0.67 ft
Number Sections	1		

Outlet Control Properties			
Outlet Control HW Elev.	1,279.06 ft	Upstream Velocity Head	0.03 ft
Ke	0.20	Entrance Loss	0.01 ft

Inlet Control Properties			
Inlet Control HW Elev.	1,279.00 ft	Flow Control	Unsubmerged
Inlet Type	Groove end projecting	Area Full	0.3 ft²
K	0.00450	HDS 5 Chart	1
M	2.00000	HDS 5 Scale	3
C	0.03170	Equation Form	1
Y	0.69000		

Culvert Analysis Report
Between Basin 6 and 5

Component:Weir

Hydraulic Component(s): Broad Crested					
Discharge	0.00	cfs	Allowable HW Elevation	1,279.06	ft
Weir Coefficient	3.00	US	Length	15.00	ft
Crest Elevation	1,279.79	ft	Headwater Elevation	N/A	ft

Worksheet for Bleed off Circular Orifice(2.5")

Project Description

Solve For	Discharge

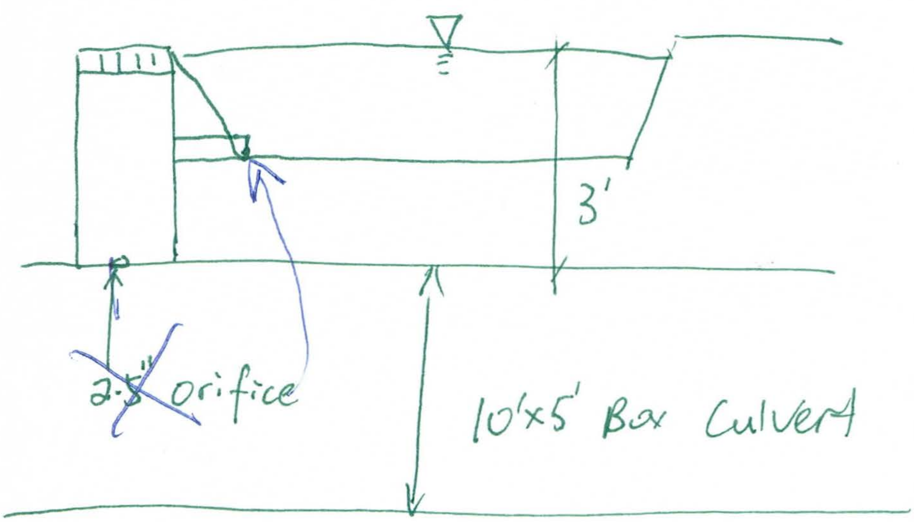
Input Data

Headwater Elevation	1.50	ft
Centroid Elevation	0.10	ft
Tailwater Elevation	1.00	ft
Discharge Coefficient	0.67	
Diameter	2.50	in

Results

Discharge	0.13	ft^3/s ←
Headwater Height Above Centroid	1.40	ft
Tailwater Height Above Centroid	0.90	ft
Flow Area	0.03	ft^2
Velocity	3.80	ft/s

USE average head of 1.5'



Two Bleed-off location: Basin 1 and Basin 4

Total Bleed-off rate = 2x0.13 = 0.26 cfs.

APPENDIX D

References

Excerpts from Safari Drive Phase 2 LOMR

Technical Support Data Notebook

for

Letter of Map Revision (LOMR)

Arizona Canal
Between Camelback Road and Chaparral Road
Safari adjacent to Reach 4 of Side Channel System

(Local Government Submittal)

Prepared for:

ST Residential, LLC
175 W. Jackson Boulevard
Suite 540
Chicago, IL 60604

DRAFT

Prepared by:

David Evans and Associates
4600 East Washington Street, Suite 430
Phoenix, AZ 85034
Telephone: (602)678-5151

September 24, 2013

DEA Project No. STRS0000-00001

```
ISAV1       1  FIRST ORDINATE PUNCHED OR SAVED
ISAV2     510  LAST ORDINATE PUNCHED OR SAVED
TIMINT   .017  TIME INTERVAL IN HOURS
```

1

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

	OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
+	HYDROGRAPH AT	S-10	113.	4.03	6.	4.	4.	.05		
+	ROUTED TO	R-11	113.	4.10	6.	4.	4.	.05		
+	HYDROGRAPH AT	S-11	112.	4.02	5.	4.	4.	.05		
+	2 COMBINED AT	N-11	202.	4.07	11.	8.	8.	.10		
+	ROUTED TO	R-12	201.	4.17	11.	8.	8.	.10		
+	HYDROGRAPH AT	S-12	195.	4.07	10.	7.	7.	.09		
+	2 COMBINED AT	N-12	349.	4.13	22.	15.	15.	.19		
+	ROUTED TO	R-13	348.	4.17	22.	15.	15.	.19		
+	HYDROGRAPH AT	S-13	117.	4.02	6.	4.	4.	.05		
+	2 COMBINED AT	N-13	396.	4.17	28.	20.	20.	.24		
+	ROUTED TO	R-14	394.	4.20	28.	20.	20.	.24		
+	HYDROGRAPH AT	S-14	122.	4.03	8.	6.	6.	.05		
+	2 COMBINED AT	N-14	456.	4.18	35.	25.	25.	.28		

+	ROUTED TO	R-15	450.	4.27	35.	25.	25.	.28
+	HYDROGRAPH AT	S-15	167.	4.07	12.	8.	8.	.07
+	2 COMBINED AT	N-15	521.	4.25	47.	33.	33.	.35
+	ROUTED TO	R-24	520.	4.30	47.	33.	33.	.35
+	HYDROGRAPH AT	S-20	88.	4.10	6.	4.	4.	.05
+	ROUTED TO	R-21	88.	4.18	6.	4.	4.	.05
+	HYDROGRAPH AT	S-21	75.	4.12	5.	4.	4.	.04
+	2 COMBINED AT	N-21	157.	4.17	11.	8.	8.	.09
+	ROUTED TO	R-22	155.	4.27	11.	8.	8.	.09
+	HYDROGRAPH AT	S-22	122.	4.25	12.	8.	8.	.08
+	2 COMBINED AT	N-22	276.	4.27	23.	16.	16.	.17
+	ROUTED TO	R-23	287.	4.30	23.	16.	16.	.17
+	HYDROGRAPH AT	S-23	111.	4.20	10.	7.	7.	.06
+	HYDROGRAPH AT	S-24	108.	4.03	7.	5.	5.	.05
+	4 COMBINED AT	N-24	853.	4.30	84.	60.	60.	.64
+	ROUTED TO	R-31	849.	4.35	84.	59.	59.	.64
+	HYDROGRAPH AT	S-30	132.	4.08	10.	7.	7.	.06

+	DIVERSION TO	SPLIT	117.	4.08	9.	7.	7.	.06
+	HYDROGRAPH AT	D-30	15.	4.08	1.	1.	1.	.06
+	ROUTED TO	R-31	16.	4.23	1.	1.	1.	.06
+	HYDROGRAPH AT	S-31	157.	4.15	14.	10.	10.	.08
+	3 COMBINED AT	N-31	882.	4.35	96.	68.	68.	.79
+	DIVERSION TO	Divert	814.	4.35	89.	63.	63.	.79
+	HYDROGRAPH AT	D-31	68.	4.35	7.	5.	5.	.79
+	ROUTED TO	R-40	61.	4.50	7.	5.	5.	.79
+	HYDROGRAPH AT	S-40	89.	4.20	8.	6.	6.	.05
+	HYDROGRAPH AT	S-41	45.	4.10	4.	3.	3.	.02
+	3 COMBINED AT	N-40	114.	4.38	19.	14.	14.	.86
+	HYDROGRAPH AT	B1	642.	4.13	69.	49.	49.	.41
+	ROUTED TO	RB1B2	638.	4.22	69.	49.	49.	.41
+	HYDROGRAPH AT	B2	411.	4.15	47.	33.	33.	.32
+	2 COMBINED AT	CB1B2	929.	4.20	111.	79.	79.	.73
+	ROUTED TO	RB2B3	925.	4.25	111.	79.	79.	.73
+	HYDROGRAPH AT	B3	355.	4.22	63.	45.	45.	.36

	2 COMBINED AT							
+		CB2B3	1123.	4.25	166.	119.	119.	1.09
	HYDROGRAPH AT							
+		C	141.	4.35	36.	26.	26.	.19
	HYDROGRAPH AT							
+		SPLIT	117.	4.08	9.	7.	7.	.06
	ROUTED TO							
+		RS30E	115.	4.32	10.	7.	7.	.06
	HYDROGRAPH AT							
+		E	152.	4.13	23.	16.	16.	.10
	HYDROGRAPH AT							
+		F	43.	4.08	5.	4.	4.	.02
	5 COMBINED AT							
+		CB3EF	1332.	4.27	231.	166.	166.	1.39
	HYDROGRAPH AT							
+		D1	126.	4.12	12.	9.	9.	.09
	ROUTED TO							
+		RD1D2	124.	4.52	13.	9.	9.	.09
	HYDROGRAPH AT							
+		D2	235.	4.23	39.	28.	28.	.26
	2 COMBINED AT							
+		CD1D2	311.	4.48	51.	37.	37.	.36

1

SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
(FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)

						INTERPOLATED TO COMPUTATION INTERVAL			
ISTAQ	ELEMENT	DT	PEAK	TIME TO PEAK	VOLUME	DT	PEAK	TIME TO PEAK	VOLUME
		(MIN)	(CFS)	(MIN)	(IN)	(MIN)	(CFS)	(MIN)	(IN)
FOR STORM = 1 STORM AREA (SQ MI) = .00									
S-10	MANE	1.00	114.16	241.22	1.16	1.00	114.01	242.00	1.16

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .3113E+01 OUTFLOW= .3093E+01 BASIN STORAGE= .5322E-02 PERCENT ERROR= .5

FOR STORM = 2 STORM AREA (SQ MI) = .50

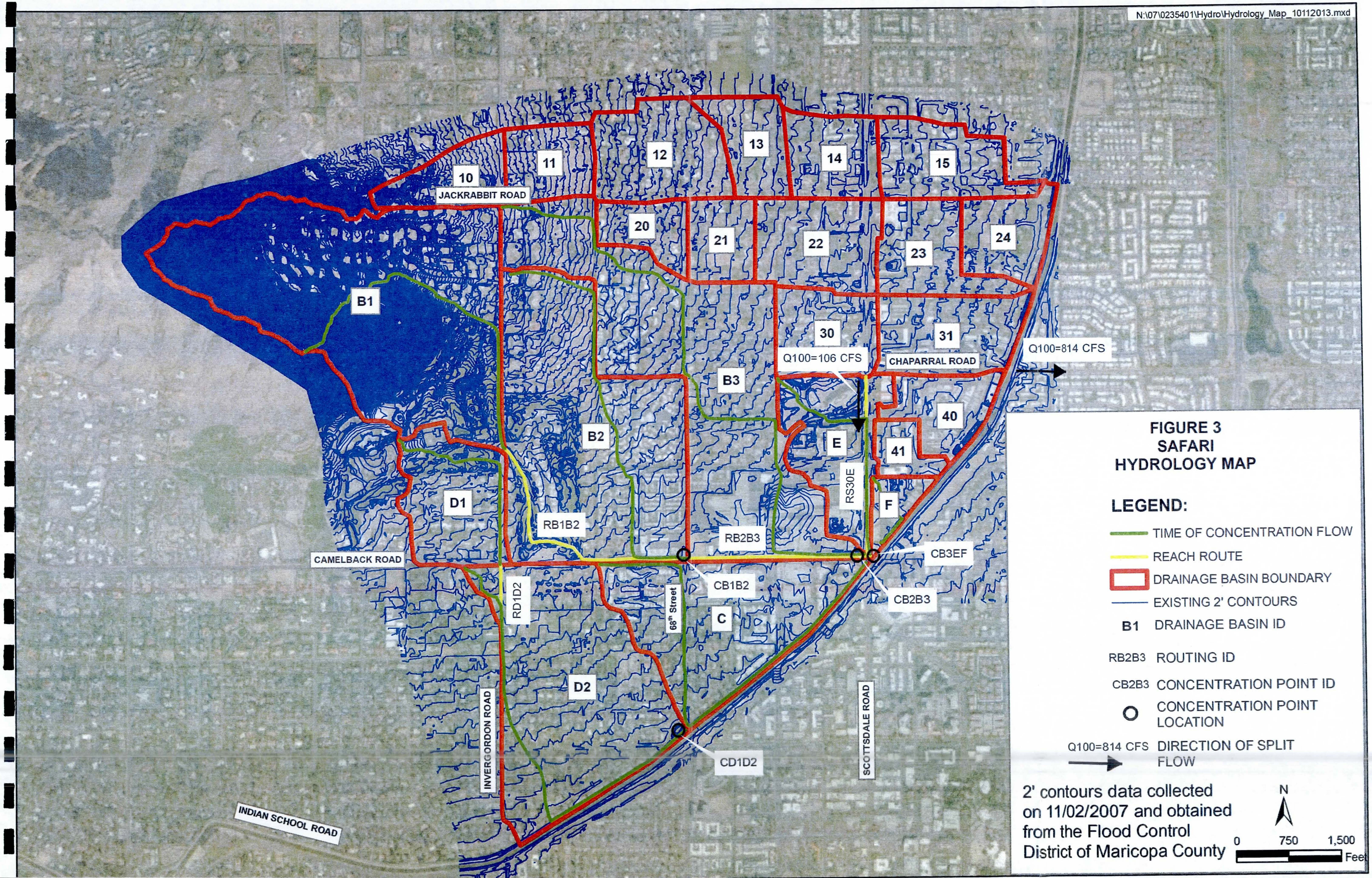

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FIGURE 3
SAFARI
HYDROLOGY MAP
LEGEND:
TIME OF CONCENTRATION FLOW
REACH ROUTE
DRAINAGE BASIN BOUNDARY
EXISTING 2' CONTOURS
B1 DRAINAGE BASIN ID
RB2B3 ROUTING ID
CB2B3 CONCENTRATION POINT ID
CONCENTRATION POINT LOCATION
Q100=814 CFS DIRECTION OF SPLIT FLOW
2' contours data collected on 11/02/2007 and obtained from the Flood Control District of Maricopa County
N
0
750
1,500
Feet
JACKRABBIT ROAD
CHAPARRAL ROAD
CAMELBACK ROAD
INDIAN SCHOOL ROAD
INVERGORDON ROAD
SCOTTSDALE ROAD
68th Street
Q100=106 CFS
Q100=814 CFS
10
11
12
13
14
15
20
21
22
23
24
30
31
40
41
B1
B2
B3
C
D1
D2
E
F
RB1B2
RB2B3
RD1D2
RS30E
CB1B2
CB2B3
CB3EF
CD1D2

REVISION | DATE | BY

DRAWN BY: JCF
DESIGN BY:
CHECKED BY: FMK
DATE: 2/2013

DAVID EVANS AND ASSOCIATES INC.
4600 East Washington Street, Suite 430
Phoenix Arizona 85034
Phone 602.678.5151

XPSWMM RESULTS (MIN. 1 FT DEPTH)
SAFARI DRIVE PHASE 2 LOMR
SCOTTSDALE, ARIZONA

SECTION: 23
TWNSHP: 2N
RANGE: 4E

SHEET 1 OF 1

JOB NO.: STRS0001

P:\S\STRS00000001\0400CAD\EX_SHEETS\EXHIBITS\EC-FG-007_STRS0001_XPSWMM_1_depth.dwg fmk Oct 11, 2013 10:56:25am

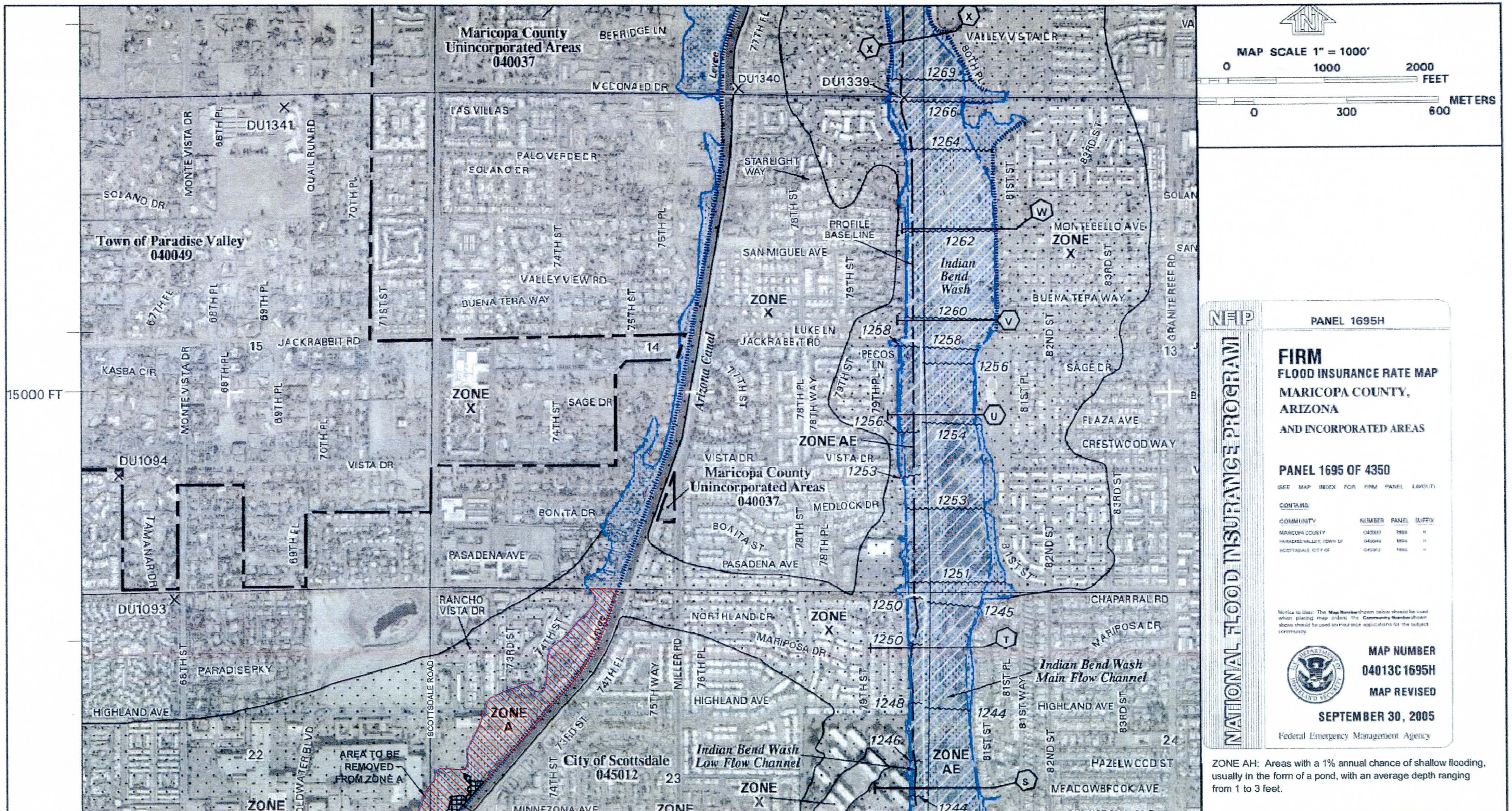

FIGURE 7

ANNOTATED FLOOD INSURANCE RATE MAP

Excerpts from Final Drainage Report for Blue Sky Scottsdale

FINAL DRAINAGE REPORT

2nd 1/5/12

BLUE SKY SCOTTSDALE
FILL PLAN

Plan #
Case # 62-DR-2011
Q-S #
[X] Accepted
[ ] Corrections
Joe Pru 1-19-12
Reviewed By Date

January 2012
DEA PROJECT NO. GRYD00001

DAVID EVANS AND ASSOCIATES INC.

4994-11

FINAL DRAINAGE REPORT
FOR
BLUE SKY SCOTTSDALE FILL PLAN

PREPARED FOR

GRAY DEVELOPMENT
1400 E. CAMELBACK ROAD, SUITE 275
PHOENIX, AZ 85018

PREPARED BY

PAUL PAL, P.E.
RAMZI GEORGES, PE, CFM
DAVID EVANS AND ASSOCIATES, INC.
4600 E WASHINGTON STREET, SUITE 430
PHOENIX, AZ 85034
(602) 678-5151

Registered Professional Engineer (Civil)
CERTIFICATE NO.
37287
RAMZI
GEORGES
Date Signed 1/14/12
ARIZONA, U.S.A.
EXP: 3-31-2014

January 2012
DEA PROJECT NO. GRYD00001

FlowMaster (Reference 7), a Bentley computer program, has been utilized to analyze the hydraulic capacity for the adjacent street sections to determine the 100-year high water surface elevations based on known offsite runoff along Scottsdale Road. The Flow Master cross sections were cut along Scottsdale Road just south of every intersection with Coolidge Street and Fashion Square Road (Scottsdale slopes in a southerly direction). The cross section south of every intersection was used for split flow analysis (equating the water surface elevation in both directions) because there is momentum with runoff along Scottsdale Road in a southerly direction. In addition, weir to the east will occur after the after runoff reaches the intersection itself and this would another reason for the south location of the cross sections used in the split flow analysis. If the sections were cut to the north of the intersection, it would not represent the field conditions. However the cross sections are include Appendix D but are not used in the analysis.

Camelback Road split flow analysis was based on the top of curb road capacity as shown in Exhibit C. FlowMaster analysis is based on Manning's equation. Refer to Appendix D for detailed input and output data sheets.

DEA modeled the weir along the Arizona Canal based on 1,202 cfs mentioned in section 3.2 using StormCAD software (Reference 9). The high water elevation along the Arizona Canal bank canal was determined to be 1279.50. Survey points were used in modeling the weir over the canal. A separate model was prepared to determine the flow along Scottsdale Road, south of Camelback Road which was determined to be 75 cfs.

StormCAD software (Reference 6) was used in determining the capacity of the culverts installed during the Safari Drive development along Coolidge Street and along the canal. Refer to Appendix D for detailed hydraulic input/output data sheets. The 100-year Hydraulic Grade Line (HGL) was kept below the 100 year weir elevation along the canal and below the 100 year ponding depth along Coolidge Street.

6.0 CONCLUSIONS

Based on the results of this study, it can be concluded that:

- The site will be filled according to the City of Scottsdale Design Standards and Policies Manual.
- The site has a retention waiver and it will directly discharge into the existing box culvert along the western side of the Arizona Canal.
- Coordination with the Flood Control District has been initiated.
- The ultimate outfall (Elevation 1279.20) is located at the southeast corner of the project site maintaining the historic outfall condition.
- Raising a portion of the site above the floodplain elevation will not adversely impact adjacent properties south of the site.
- Properties in the floodplain north of the site are at higher elevations then the project and are not impacted by the proposed development
- Refer to Appendix H for the Warning and Disclaimer Liability form.
- Refer to Appendix I for the Section 404 Certification form.

Culvert Analysis Report
Arizona Canal OverBank

AZ Canal Weir Analysis, Refer to Exhibit C located under Appendix A

Component:Weir

Hydraulic Component(s): Roadway			
Discharge	1,202.00 cfs	Allowable HW Elevation	79.50 ft
Roadway Width	12.00 ft	Overtopping Coefficient	2.99 US
Low Point	77.52 ft	Headwater Elevation	79.50 ft
Discharge Coefficient (Cr)	2.99	Submergence Factor (Kt)	1.00
Tailwater Elevation	0.00 ft		

Sta (ft)	Elev. (ft)
-200.00	79.00
0.00	79.56
30.00	79.59
56.00	79.38
109.00	79.64
190.00	79.68
245.00	79.72
303.00	79.74
386.00	79.95
517.00	79.58
661.00	79.47
693.00	79.45
735.00	79.69
802.00	79.46
831.00	79.43
856.00	79.39
955.00	79.21
1,030.00	79.34
1,097.00	79.42
1,146.00	79.29
1,196.00	79.25
1,304.00	79.69
1,330.00	80.36
1,364.00	79.69
1,388.00	78.56
1,467.00	79.08
1,494.00	78.53
1,532.00	79.17
1,532.50	79.59
1,536.00	79.66
1,536.50	79.22
1,561.00	79.03
1,561.50	79.53
1,615.50	78.95
1,616.00	78.43
1,658.00	78.32
1,710.00	77.52
1,710.50	77.96
1,735.00	77.72
1,751.00	77.61
1,752.00	80.18
1,752.50	79.67
1,773.50	79.74
1,794.50	79.58
1,795.00	80.00

The Weir elevations are based on the survey points taken in the field

Excerpts from Reflections on the Canal

FINAL DRAINAGE REPORT FOR

REFLECTIONS ON THE CANAL

WOODMERE FAIRWAY AND CHAPARRAL ROAD

SCOTTSDALE, ARIZONA

C.O.S. Project 47-DR-2005

ARROYO ENGINEERING, LLC
Water Resources & Civil Engineering Consultants

FINAL DRAINAGE REPORT FOR

REFLECTIONS ON THE CANAL

WOODMERE FAIRWAY AND CHAPARRAL ROAD

SCOTTSDALE, ARIZONA

C.O.S. Project 47-DR-2005

Portion of the NW 1/4 Section 23, T-2-N, R-4-E
7445 East Chaparral Road
APN: 173-32-026 (about 4.6 acres)

Prepared in Conjunction with:

M3 Engineering and Technology Corporation
2227 West Pecos Road, Suite 10
Chandler, Arizona 85224
Tele. (480) 753-3607

Prepared by:

Arroyo Engineering, LLC
5675 North Oracle Road, Suite 3203
Tucson, Arizona 85704
Tele. (520) 882-0206

First Submittal December 4, 2006
Fifth Submittal August 27, 2007

Registered Professional Engineer (Civil)
CERTIFICATE NO.
15293
JUSTIN M. TURNER
8·27·07
Date Signed
ARIZONA, U.S.A.

ARROYO ENGINEERING, LLC

Executive Summary

This Final Drainage Report pertains to the Reflections on the Canal development of a 4.6-acre parcel located on the southeast corner of Chaparral Road and Woodmere Fairway, immediately northwest of the Arizona Canal, in Scottsdale, Arizona.

The purpose of the report, in accordance with Section 37-42.a of the Scottsdale City Code (Floodplain Regulations), is to present information regarding the effects this proposed development may have upon local rainfall and runoff, and to demonstrate that the planned development has been designed so it is protected from flooding, as well as to minimize possible drainage-related impacts to others.

Furthermore, this Final Drainage Report demonstrates that this project complies with four DRB Stipulations (47-DR-2005), including: (1) the development will maintain historic flow patterns; (2) site improvements will not adversely affect other properties; (3) demonstrate a public benefit to the area as a function of the storm water improvements; and (4) receive approval by Scottsdale's Flood Plain Administrator to measure the building height one foot above the nearest adjacent Arizona Canal bank.

As part of this study, flood peaks were predicted for the 0.8-square-mile offsite watershed using HEC-1 and procedures outlined in the City of Scottsdale's *Design Standards and Policies Manual*. Additionally, floodplain boundary maps were developed based on the results from a HEC-RAS computer program. Also, hydraulic calculations were prepared as part of the design of the new regional stormdrain system consisting of: (1) 1500 linear feet of new 10'x 5' Reinforced Concrete Box Culvert between Chaparral Road and the south boundary of the subject property; (2) 280 linear feet of new 8'x 6' Reinforced Concrete Rectangular Open Channel between the south boundary of the subject property and the inlet to a new stormdrain being constructed by the adjoining Safari project; and (3) lateral stormdrains from Woodmere Fairway to the new 10'x 5' Reinforced Concrete Box Culvert.

The planned stormdrain system has a 100-year design capacity and it replaces a 30-year-old open-channel system along side the Arizona Canal that only has a 25-year design capacity.

These new storm water improvements have been designed to intercept and convey the 100-year peak discharge, and its overall efficiency is only controlled by offsite conditions. The Reflections on the Canal project has been specifically designed to protect itself from flood hazards, while at the same time adding new stormdrains and related flood-control facilities that will significantly reduce or even remove entirely the frequency and severity of local flooding of the existing residences located along or near Woodmere Fairway. Map showing existing and future floodplain boundaries can be found in Appendix B of this report.

TABLE OF CONTENTS

Registered Professional Engineer (Civil)
CERTIFICATE NO.
15293
JUSTIN M.
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8·27·07
Date Signed
ARIZONA, U.S.A.

ARROYO ENGINEERING, LLC

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

Registered Professional Engineer (Civil)
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15293
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TURNER
8-27-07
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ARIZONA, U.S.A.

J M TURNER

ARROYO ENGINEERING, LLC

I. INTRODUCTION

1.1 Project Location

This Final Drainage Report pertains to the planned development of a 4.6-acre parcel located on the southeast corner of Chaparral Road and Woodmere Fairway, immediately northwest of the Arizona Canal, in Scottsdale, Arizona. More specifically, this property is located within the northwest one-quarter of Section 23, of Township 2 North, Range 4 East, Gila and Salt River Baseline and Meridian. Chaparral Road bounds this property to the north, Woodmere Fairway to the west, and the Arizona Canal to the east and south.

This property is currently the Hotel Waterfront Ivy and related parking areas. The Reflections on the Canal project generally includes the demolition and removal of this exiting motel, filling and grading the entire property so it is above the existing 100-year flood plain (equal to or above the top of the adjacent canal bank), construction of substantial stormdrain systems, and the subsequent construction of a multi-family residential development, driveways, parking areas, and other related drainage and site improvements.

According to the effective Flood Insurance Rate Map of this area, the subject property is located entirely within an unnumbered Flood Hazard Zone A. The Reflections on the Canal project has been specifically designed to protect itself from these existing flood hazards, while at the same time adding new stormdrains and related flood-control facilities that will significantly reduce or even remove entirely the frequency and severity of local flooding of the existing residences located along or near Woodmere Fairway.

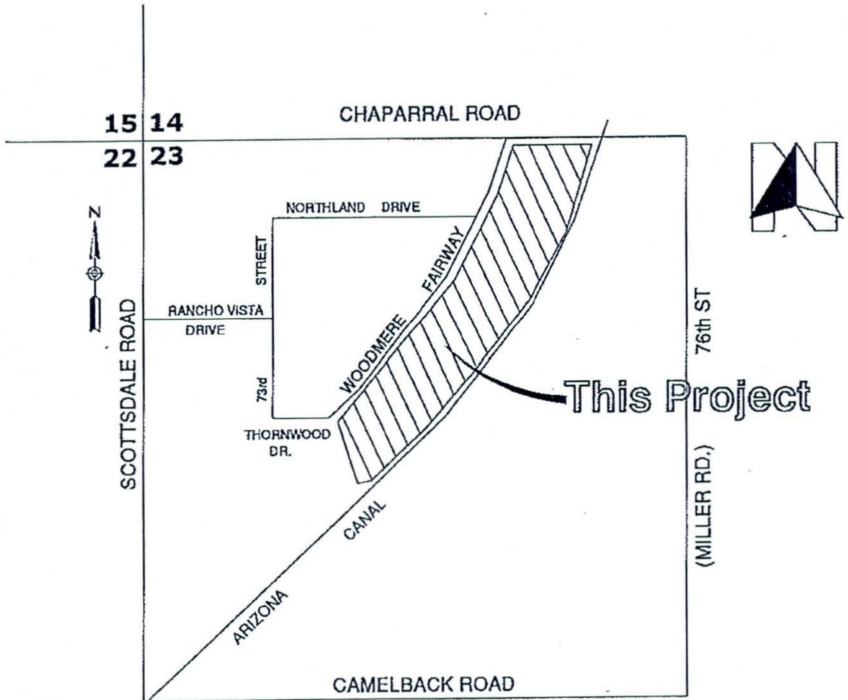
For reference, Figure 1 of this report contains a site location map, and Figure 2 of this report contains an aerial photograph of the subject property taken in 2002. In addition, Figure 3 contains a portion of the effective Flood Insurance Rate Map of this area, showing that the subject property is entirely within an Unnumbered A Zone. And for comparison, Figure 4 contains a map showing the portions of the subject property that have been removed from the effective Zone A Flood Hazard Area by a recently issued Conditional Letter of Map Revision Based on Fill (CLOMR-F Case No. 07-09-0635C, dated March 13, 2007). A copy of which can be found in Appendix D.

1.2 Purpose and Objectives

This Final Drainage Report was prepared for submittal to the City of Scottsdale's Development Services Department in conjunction with a Rough Grading Plan and Paving/Grading Plans, which are being prepared by *M3 Engineering and Technology*. A copy of these construction drawings will be submitted together with this report (see Appendixes C and D).

This Final Drainage Report identifies the drainage characteristics of the area affecting this development. It also identifies drainage-related design requirements in accordance with the City of Scottsdale's *Design Standards and Policy Manual* (Chapter 4, 2006), *Floodplain and Stormwater Regulations* (Chapter 37 of the Scottsdale City Code), and the *Drainage Design Manual for Maricopa County* (Volumes 1, 2, and 3).

The purpose of the report, in accordance with Section 37-42.a of the Scottsdale City Code (Floodplain Regulations), is to present information regarding the effects this proposed development may have upon local rainfall and runoff, and to demonstrate that the planned development has been designed so it is protected from flooding, as well as to minimize possible drainage-related impacts to others.



VICINITY MAP/KEY MAP

Scale: 1"=6 miles

QS: 18–45

Reflections on the Canal

7445 East Chaparral Road

A Portion of NW 1/4 of Section 23,

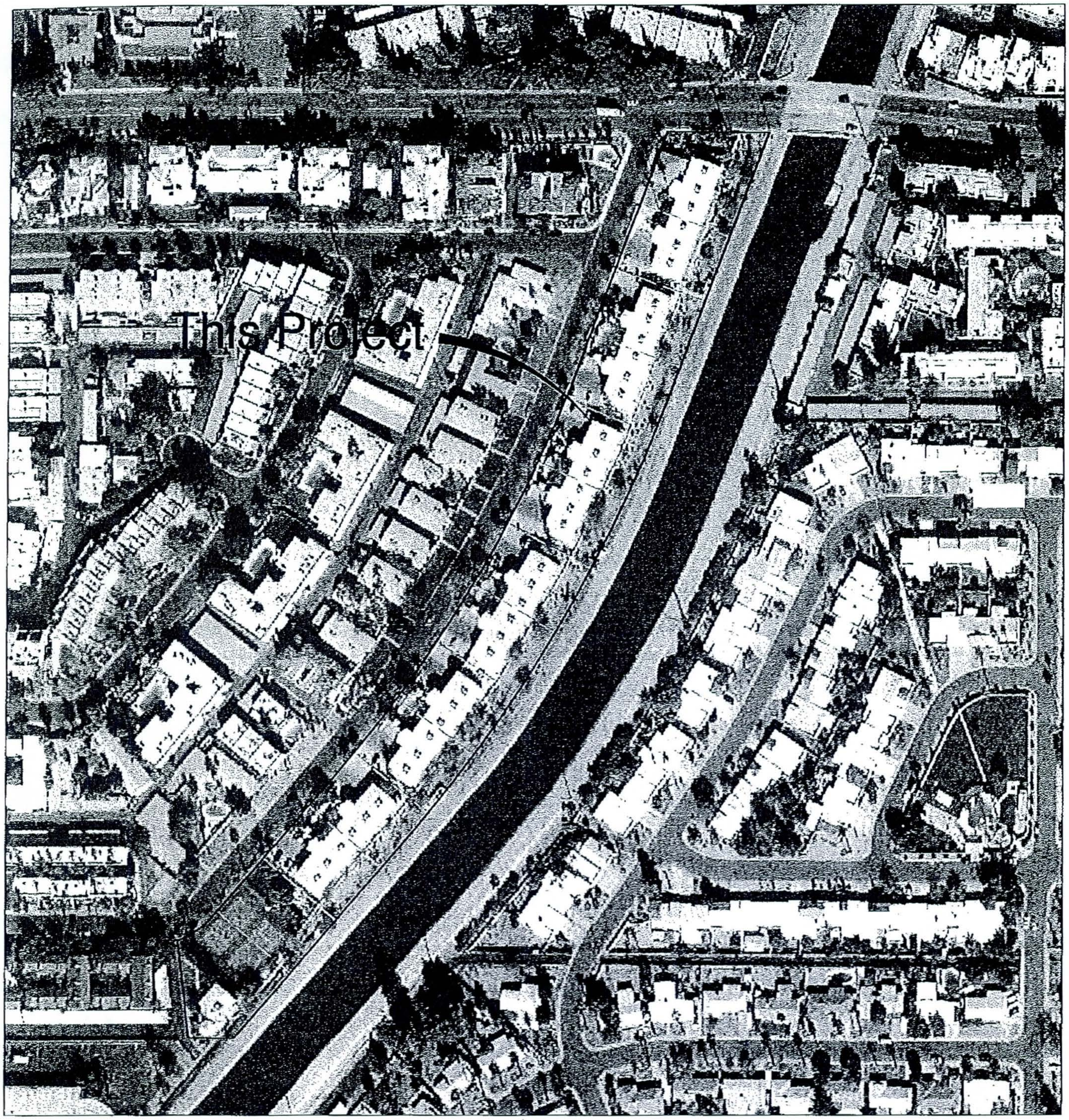
T-2- N, R-4-E, G.& S.R.B.& M. (QS 18-45)

Scottsdale, Arizona

Figure 1

Location Map

ARROYO ENGINEERING, LLC
Water Resources & Civil Engineering Consultants
5675 N. Oracle Road, Suite 3203, Tucson, Ariz. 85704
Ph. (520) 882-0206, Fax (520) 882-8574



100' 0 100' 200'

Scale: 1"=200'
2002 Aerial Photo

ARROYO ENGINEERING, LLC
Water Resources & Civil Engineering Consultants
5675 N. Oracle Road, Suite 3203, Tucson, Ariz. 85704
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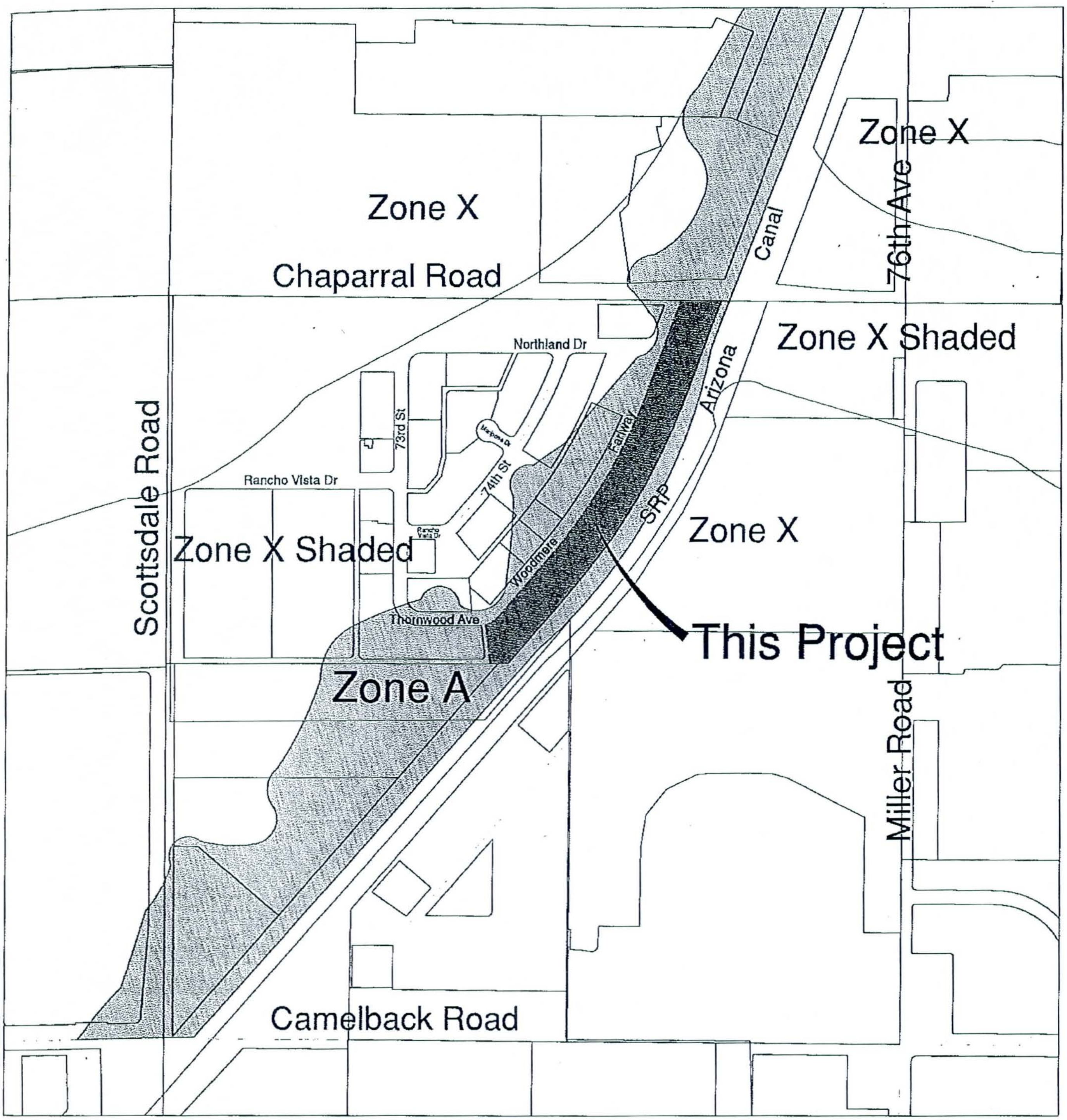
Reflections on the Canal
7445 East Chaparral Road
A Portion of NW 1/4 of Section 23,
T-2- N, R-4-E, G.& S.R.B.& M. (QS 18-45)
Scottsdale, Arizona

Figure 2
Aerial Photograph



250' 0 250' 500'

Scale: 1"=500'
FIRM # 04013C 1695 H, Eff. Sept. 30, 2005

Reflections on the Canal
7445 East Chaparral Road
A Portion of NW 1/4 of Section 23,
T-2- N, R-4-E, G.& S.R.B.& M. (QS 18-45)
Scottsdale, Arizona

ARROYO ENGINEERING, LLC
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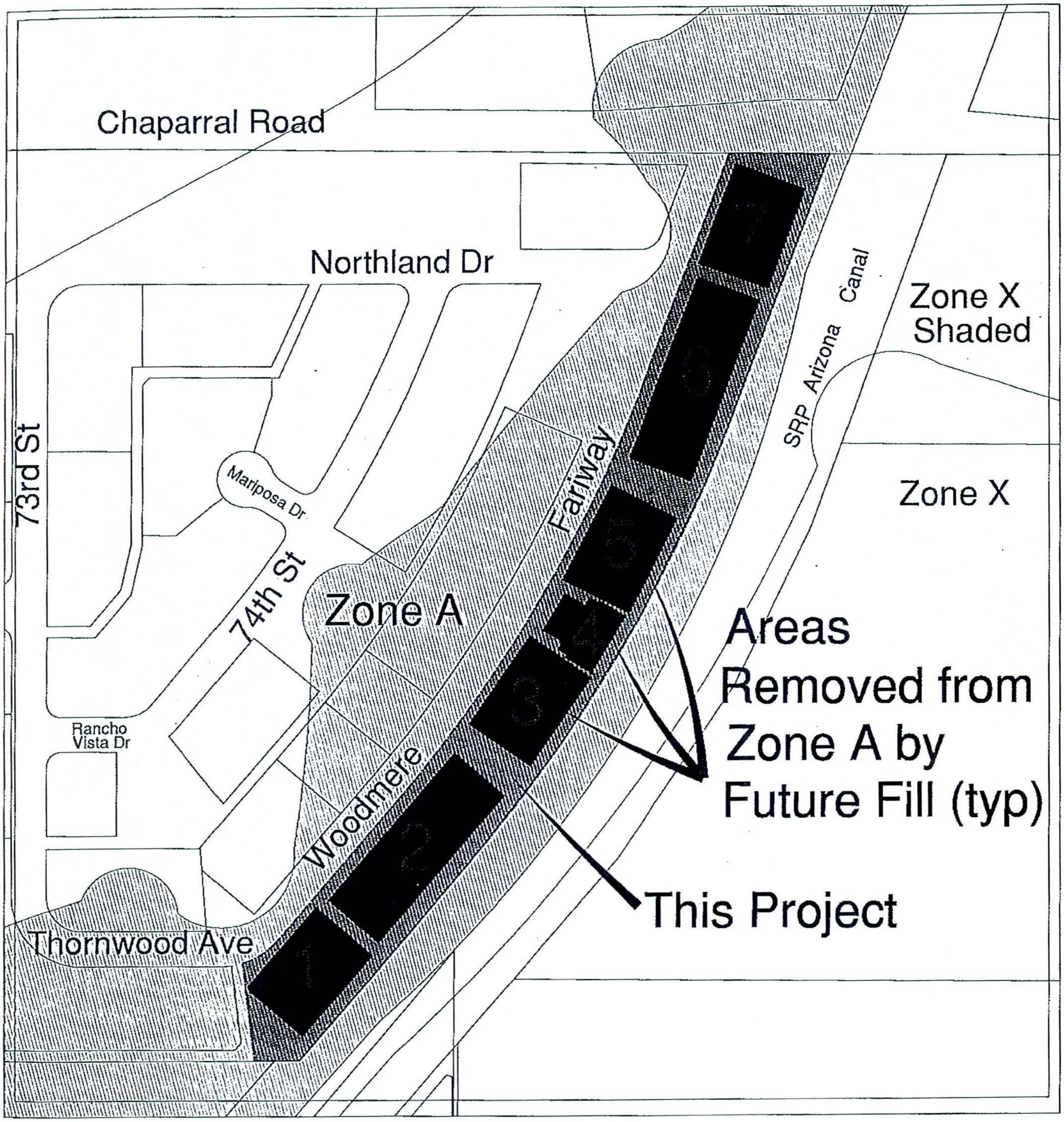
Figure 3
Flood Insurance Rate Map



100' 0 100' 200'
Scale: 1"=200'
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Reflections on the Canal
7445 East Chaparral Road
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Figure 4
CLOMR-F Boundaries

Accordingly, this report documents the drainage considerations made in conjunction with the hydraulic design of this project. As an introduction to this project, the major drainage issues and the general approach used to handle them are as follows:

1. Remove portions of the subject property from the FEMA flood plain through the CLOMR-F process. According to the effective FIRM of the area (#04013C1695H), the subject property is located entirely within an Unnumbered Flood Hazard Zone A. Furthermore, according to Section 37-42.f.2 of the Scottsdale City Code (Development Requirements), within such flood-hazard areas, all new residential structures or the substantial improvements to an existing residential structure shall have its lowest floor constructed at least one (1) foot above the base-flood elevation. In addition, in the absence of a designated base-flood elevation, it is customary to elevate structures and their lowest finished-floors so they are one foot or more above the top of the highest adjacent Arizona Canal bank (FEMA written communication, 1987).

   Thus, as part of the Reflections on the Canal project, portions of the 4.6-acre property will initially be filled with compacted soil (refer to Figure 4) so that the top of this resulting mound will be entirely above the top of the adjoining canal bank. Furthermore, all future finished floors for new residential structures on this property shall be set at least one (1) foot or more above the highest adjacent canal bank. Minimum Finished-Floor Elevations (referenced to NAVD-1988) are shown on the Site Plan.

   A CLOMR-F was given to this project on March 13, 2007. Refer to Appendix D.

2. Construct new Catchbasins, Laterals, and a Regional Storm Drain System to Improve Local Drainage Conditions. Reasonable efforts will be made to improve local drainage conditions. The largest improvements to be built in conjunction with this project include the removal blockages caused by the three existing pedestrian walkways going over Reach 4 of the Side Channel. Additionally, a new 10'x5'x 1500' RCBC will be built beneath the existing Side Channel, and it will be used to convey runoff from Chaparral Road and Woodmere Fairway to the new 8'x6' RCBC currently being built immediately downstream by the Safari/ Riverwalk project. Furthermore, the 280-foot-long space between the subject property and the nearby Safari/ Riverwalk property will have an equivalent rectangular open channel, and the coordination of this critical hydraulic connection will be the responsibility of this project.

Also, with regard to other drainage improvements to be made, six sets of new grated catchbasins and laterals will be built so they intercept and convey stormwater concentrating along Woodmere Fairway. This includes a grated catchbasin and lateral stormdrain near the intersection of Woodmere Fairway and Chaparral. Once this project is built, local drainage problems will not be eliminated, although drainage conditions will be substantially improved. Refer to Appendix B.

Likewise, the construction of the new 10'x5'x 1500' RCBC along the Side Channel of the Arizona Canal will provide the City of Scottsdale with the potential for improving flooding conditions on the north side of Chaparral Road once a larger outfall at Scottsdale Road is provided, and once a larger box culvert beneath Chaparral Road is built. This project provides that valuable stormwater-management potential at little or not additional cost to the City.

3. Provide Onsite Stormwater Detention. According to Section 37-42.1 of the Scottsdale City Code (Stormwater Storage Facilities), development of all land within the city must include provisions for the management of stormwater, including the design and construction of provisions to store runoff from rainfall events up to and including the one-hundred-year two-hour duration event. In this case, the required 23,000 cubic feet of storage will be provided onsite within depressed landscape areas, and will drain within 12 hours per Sec. 4.402.B.12 of the 2006 City of Scottsdale Design Standards and Policy Manual. Refer to Appendix E for stormwater detention calculations.

4. Floodproof Underground Parking Structures. Two of the new multi-family residential structures (Condominium Buildings #1 and #2) to be built as part of this project will have underground parking garages. As currently designed, their driveway crests will be set 0.5 feet or more above the Base Flood Elevation, which is equal to the top of the nearby canal bank. (Refer to the construction plans in Appendix C).

5. Construct a new Regional Stormdrain System along the South Bank of the Arizona Canal. This project includes the construction of about 1,780 LF of new box culvert and concrete open channel from Chaparral Road to the junction with the new 8'x6' RCBC currently under construction on the Safari/ Riverwalk property. Included in this is about 280 LF of new 8'x6' open channel which will be located on a neighboring property not owned by the subject property, and also within an SRP/FCDMC easement. In order for this new open channel to operate properly, the connection across this intervening property must be constructed. It will be the responsibility of the owners of the subject property to coordinate the construction of this neighboring segment of box culvert. Refer to the construction plans in Appendix C.

II. DESCRIPTION OF EXISTING DRAINAGE CONDITIONS AND CHARACTERISTICS

2.1 Hydrologic Analysis of Onsite Drainage

Under existing conditions, the subject property has a measured landscaped area of 61,350 square feet, or about 30 percent of the total area of the property. Conversely, under proposed conditions, the subject property has an even larger landscaped area of 72,800 square feet, or about 36 percent of the total area of the property (an increase of about 6% of the total project acreage). The majority of these landscaped areas found under existing and proposed conditions are located within and along the Side Channel located between the existing/future buildings and the Arizona Canal.

Based on hydrolgic calculations representing existing and proposed conditions, the 2-, 10-, and 100-year flood peaks for existing conditions are predicted to be 9.2 cfs, 15.4 cfs, and 28.8 cfs, respectively, whereas under proposed conditions the predicted flood peaks will be 8.8 cfs, 14.8, and 27.7 cfs, respectively (as calculated using the Maricopa Rational Method). Therefore, from a drainage perspective, given that the future land use will have more landscaped, pervious cover, the peak amounts of runoff produced by this property will be about 5% less than those found under existing conditions. Furthermore, rooftop drains will discharge directly into the adjoining stormdrain system, thereby further significantly reducing surface flooding of the area.

2.2 Existing Drainage Network

With regard to local stormwater runoff, the subject property is located within the lower Indian Bend Wash watershed, in southwest Scottsdale. The offsite watershed affecting this property is about 0.8 square miles (510 acres), and is currently developed with mostly medium density residential structures. Furthermore, the usual southeasterly flow of stormwater runoff within this portion of the watershed has been interrupted by a levee system built prior to 1894 by the Salt River Project in conjunction with Arizona Canal. As a consequence, the natural drainage patterns have been altered so that the majority of stormwater runoff is now being directed into streets and a few public drainageways, ultimately ponding against the Arizona Canal embankment, and with some drainage relief afforded by the Side Channel flood-control facilities and other smaller stormdrain systems. The hydrologic characteristics of this regional offsite watershed were evaluated using the HEC-1 program, described later in Section 5.2 of this report.

The Reflections on the Canal project is located in an area of Scottsdale having several major drainage improvements, the largest of which are Reach 3 and Reach 4 of the Army Corps of Engineers Side Channels System (LAD USACE, 1981). The largest of these existing drainage facilities, Reach 3 of the Side Channel, generally consists of a regional stormdrain system and grated catchbasins that collect floodwaters concentrating uphill from, and to the north of the subject property (LAC UASCE 1981). Both the McDonald Road and Chaparral Road watersheds contribute runoff to this location. Excerpts from the USACE Design Memorandum for Reach 3 and Reach 4 can be found in Appendix A.

From this investigation, it is known or believed that, under existing conditions:

1. The 10-year flood peak (estimated to be 325 cfs), equal to about 25% of the 100-year peak discharge, will be collected and conveyed by the existing Reach 3 system (which has a maximum reported capacity of 670 cfs) and taken beneath the abutting Arizona Canal in a 96"-diameter RCP and to the Indian Bend Wash for disposal. Any stormwater runoff greater than 670 cfs and arriving at the north side of Chaparral Road and not taken away to the IBW, will either be impounded behind the roadway as floodwater storage, flow through an existing 6'x4' RCBC located beneath Chaparral Road and northwest of the

subject property, or weir over the sag in the vertical curve of Chaparral Road and flow into and along Woodmere Fairway, adjacent to the subject property, as follows.

2. Discharges less than or equal to 670 cfs will not overtop the top of the Arizona Canal.
3. Discharges less than or equal to 670 cfs will be intercepted by the Reach 3 inlet grate and conveyed by the 96-inch-diam RCP and taken to the IBW. Thus, all flows less than 670 cfs will simply go into the existing IBW diversion storm drain without traveling farther downstream.
4. Flows equal to 900 cfs (approximately equal to the 25-year flood) will overtop the Arizona Canal along the reach located upstream of the 96-inch-diam RCP and cause 230 cfs to weir over the Arizona Canal bank (900 cfs at X-Sec 20 - 670 at X-Sec 16.2), leaving 670 cfs to go towards the inlet of the 96-inch-diam RCP, of which 670 cfs will be diverted, leaving about 1 cfs to go through the box culvert under Chaparral Road (about 0 cfs) or over the sag in Chaparral and into Woodmere Fairway (about 0 cfs). In other words, substantially no flood waters overtop or flow through Chaparral Road during floods equal to, or smaller than, a 25-year flood.
5. Flows equal to 1100 cfs (approximately equal to the 50-year flood) will overtop the Arizona Canal along the reach located upstream of the 96-inch-diam RCP and cause 153 cfs to weir over the Arizona Canal bank (1100 cfs at X-Sec 20 - 947 at X-Sec 16.2), leaving 947 cfs to go towards the inlet of the 96-inch-diam RCP, of which 670 cfs will be diverted, leaving 277 cfs to go through the box culvert under Chaparral Road (0 cfs) or over the sag in Chaparral and into Woodmere Fairway (277 cfs).
6. Flows equal to 1299 cfs (equal to the 100-year flood) will overtop the Arizona Canal along the reach located upstream of the 96-inch-diam RCP and cause 302 cfs to weir over the Arizona Canal bank (1299 cfs at X-Sec 20 - 997 at X-Sec 16.2), leaving 997 cfs to go towards the inlet of the 96-inch-diam RCP, of which 670 cfs will be diverted, leaving 327 cfs to go through the box culvert under Chaparral Road and then over the pedestrian

bridges (17 cfs) or over the sag in Chaparral and into Woodmere Fairway (311 cfs).

Another part of this largest existing drainage facility, Reach 4 of the Side Channel system, generally consists of a series of unlined trapezoidal open channel, concrete-lined rectangular channel, and a buried 72" RCP (LAC UASCE 1981). The upstream-most portion of Reach 4 abuts the subject property. The downstream-most reach of Reach 4 is located near the 6-way intersection of Scottsdale Road, Camelback Road, and the Arizona Canal. Stormwater runoff arriving at that location will either be taken beneath the Arizona Canal in an 11'x9.5' RCBC and taken to the IBW for disposal, will either be impounded behind the canal embankment as floodwater storage, or weir over the banks of the Arizona Canal and be taken away by this SRP facility, should it be drawn down in time.

According to Design Memorandum No. 5 (Plates 15 and 19, LAC UASCE 1981), the upstream segment of Reach 4, including the concrete rectangular channel located on the subject property, was designed to convey a 25-year peak discharge of only 120 cfs, and with no runoff contributed by areas located upstream or north of Chaparral Road (and this is consistent with items #3 and #4 listed immediately above).

The 3200-foot-long segment of Reach 4 located between Scottsdale Road and Chaparral Road is, or will soon be, modified and improved. The Safari/ Riverwalk Square project is currently replacing portions of the existing Side Channel with a new 1,250-foot-long 8'x6' RCBC that will connect to the existing system at a grated junction structure located near the intersection of Scottsdale and Camelback Roads (David Evans and Associated, June 2006; Tri-Core Engineering, 2005). The Safari's 8'x 6' RCBC was designed to convey the 100-year flood peak, and all new inlet structures were designed to replace the existing inlets built by the Corps (Ramzi Georges, David Evans & Assoc., written communication, December 7, 2006). In addition, this Reflections on the Canal project will include the construction of an equivalent box culvert or open channel between their upstream terminus and the existing box culvert beneath Chaparral Road.

2.3 Context Relative to Adjoining Developments

One of the significant drainage improvements that will be constructed as part of this project will be the construction of 1,500 LF of new box culvert and 280 LF of concrete open channel, all of which will be constructed from Chaparral Road to the junction with the new 8'x6'x1250' RCBC currently under construction on the Safari/ Riverwalk property. The design of the stormdrain system for this project requires the coordination with the design aspects of the drainage system currently under construction downstream on the Safari project. This coordination, in part, included the hydraulic analysis of the Safari stormdrain, described later in this report.

2.4 FEMA Flood Hazard Zones

According to the effective Flood Insurance Rate Map of this area, the subject property is located entirely within an unnumbered Flood Hazard Zone A (refer to Figure 3). Furthermore, a CLOMR-F has been written (Case # 07-09-0635C), which effectively removes, upon construction, designated portions of the subject property from the 100-year flood plain (refer to Figure 4). All areas of new residential construction will be removed from the regulatory flood plain by this CLOMR-F. Volume 6 of 17 of the Flood Insurance Study of Maricopa County and Incorporated Areas (FEMA, Sept. 30, 2005) provides flood profiles of the Indian Bend Wash Low Flow Channel (Plates 220P and 221P). These show that the 100-year water surface is substantially equal to the top of the adjoining Arizona Canal bank.

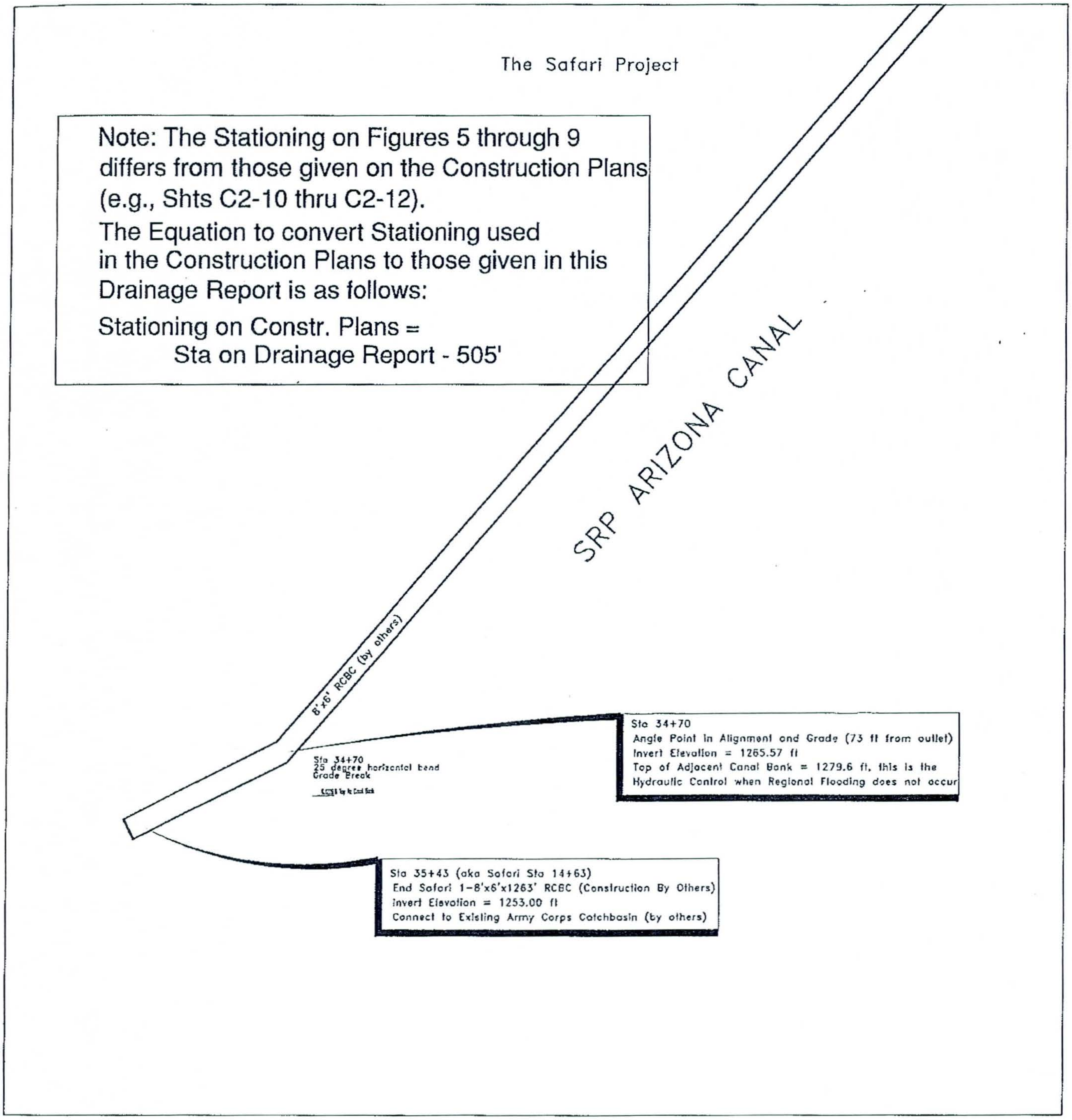
III. PROPOSED DRAINAGE PLAN

3.1 Hydraulic Analysis of Proposed Drainage Systems

Figures 5 through 9 of this report present a graphical summary of the proposed drainage improvements to be built as part of this project. In general, these improvements consist of: (1) 1500 LF of new 10'x5' RCBC between Chaparral and the southern end of the subject property; (2) six sets of catchbasins and laterals to be built between Woodmere Fairway and the new 10'x5' RCBC; (3) 280 LF of new 8'x 6' rectangular open channel between the outlet of the new 10'x5' RCBC and the new 8'x6 RCBC currently being built on the nearby Safari/ Riverwalk project.

Figures 5 through 9 provide the general dimensions, invert elevations, and design cover for these new stormdrain segments and their related inlets and junction structures. The hydraulic design of the planned 10'x 5' RCBC was based on a 100-year peak discharge of 327 cfs at Chaparral Road which will go through the existing 8'x 4' RCBC under Chaparral Road (224 cfs) and over the sag in Chaparral Road (103 cfs) and be collected in a new grate and catchbasin in Woodmere Fairway (Lateral #6). In addition, in order to account for other inflow sources, the design was based on a 100-year peak discharge of 400 cfs at the south property line of the subject property (Lateral #1). The new culvert will operate under Inlet Control.

Appendix C of this report contains the Hydraulic Grade Line Calculations for the mainline and its two principal laterals. From these calculations, it is apparent that the 100-year hydraulic grade line is lower than the gutter grades, and will therefore not surcharge. Likewise, the hydraulic grade line is also lower than the top of the adjacent canal bank, and will therefore not overtop the canal.



30' 0 30' 60'

Scale: 1"=60'

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Reflections on the Canal

7445 East Chaparral Road
A Portion of NW 1/4 of Section 23,
T-2- N, R-4-E, G.& S.R.B.& M. (QS 18-45)
Scottsdale, Arizona

Figure 5.
Location of Proposed Drainage Improvements

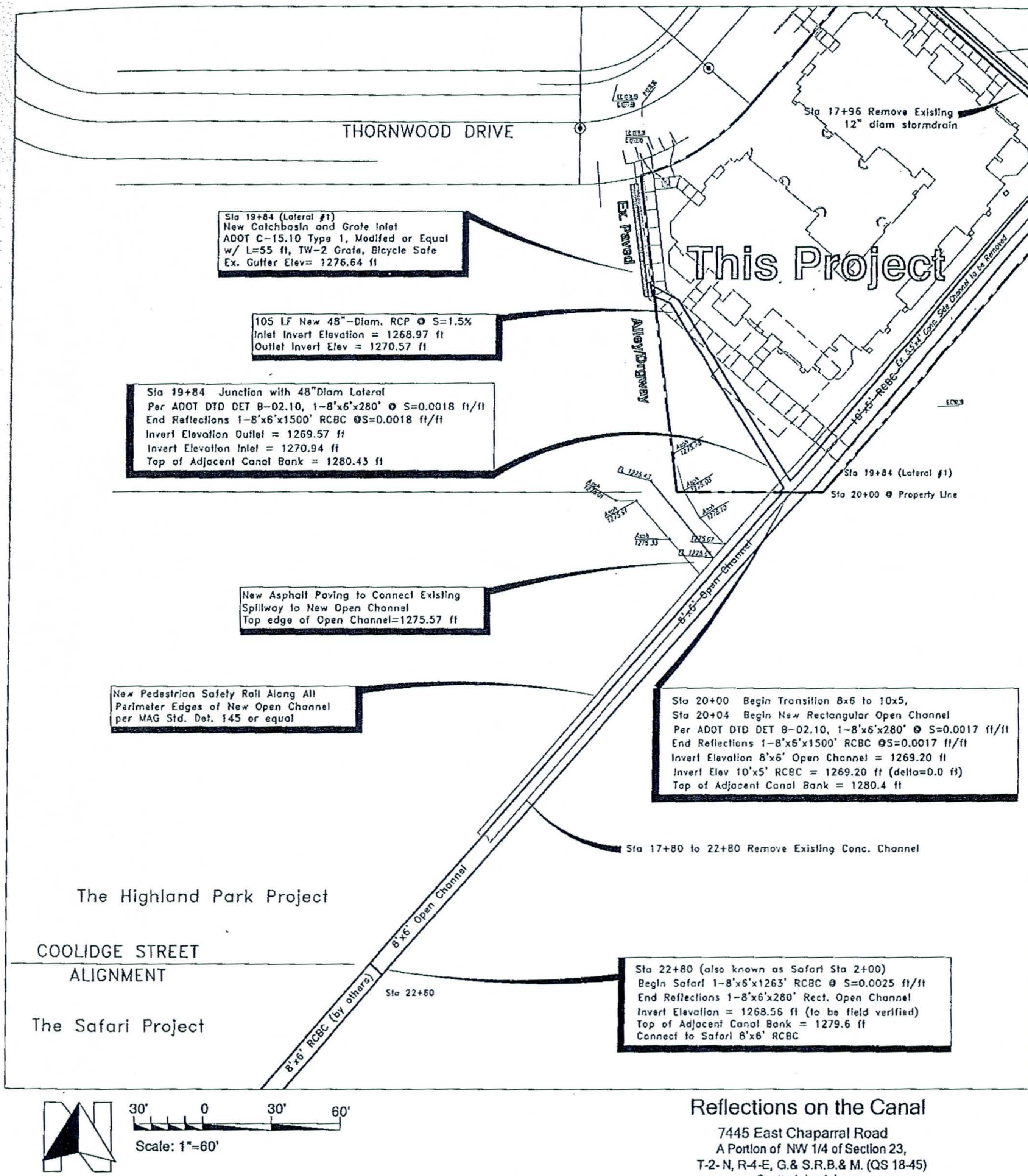

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Figure 6.
Location of Proposed Drainage Improvements

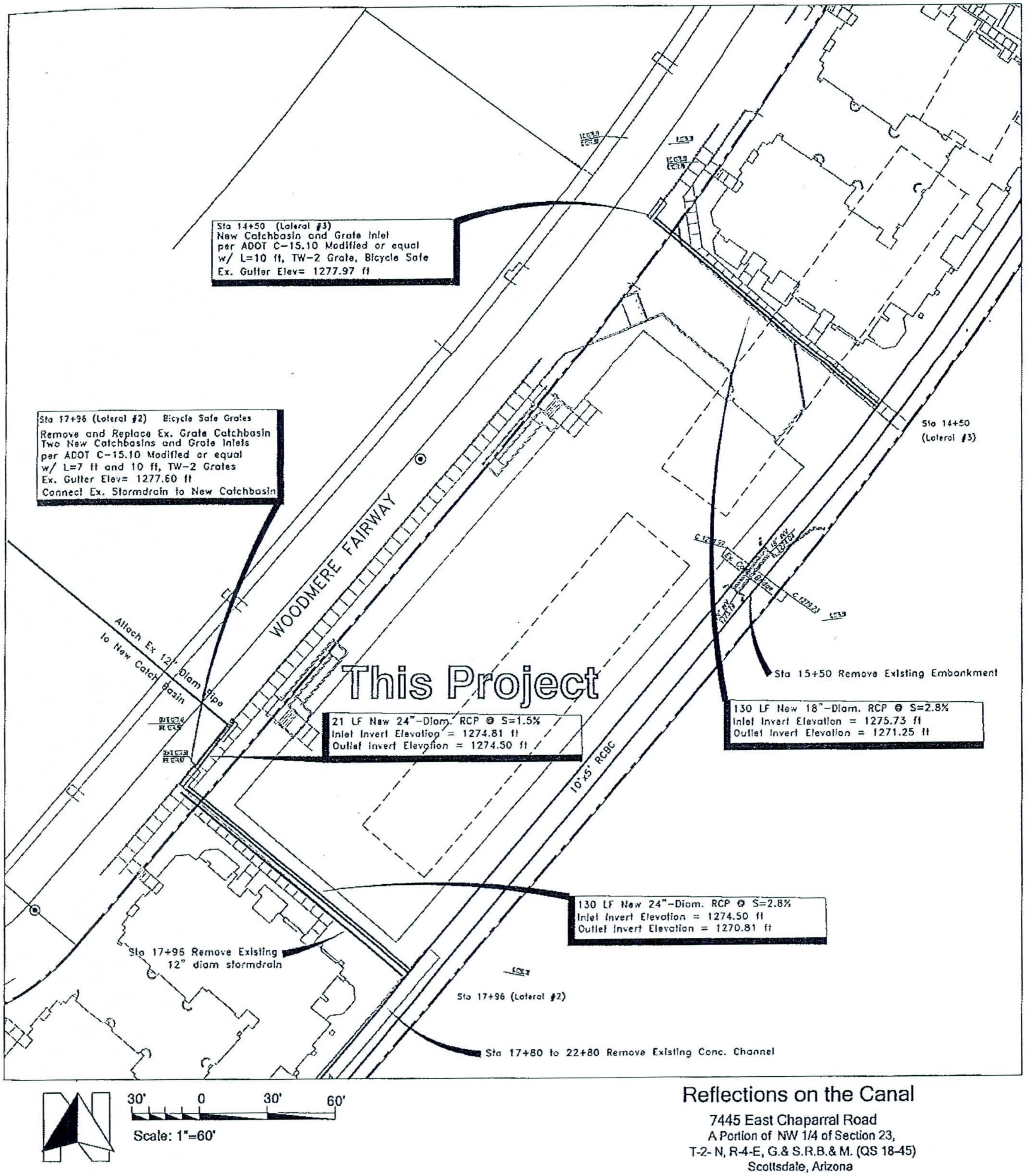

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Figure 7.
Location of Proposed Drainage Improvements

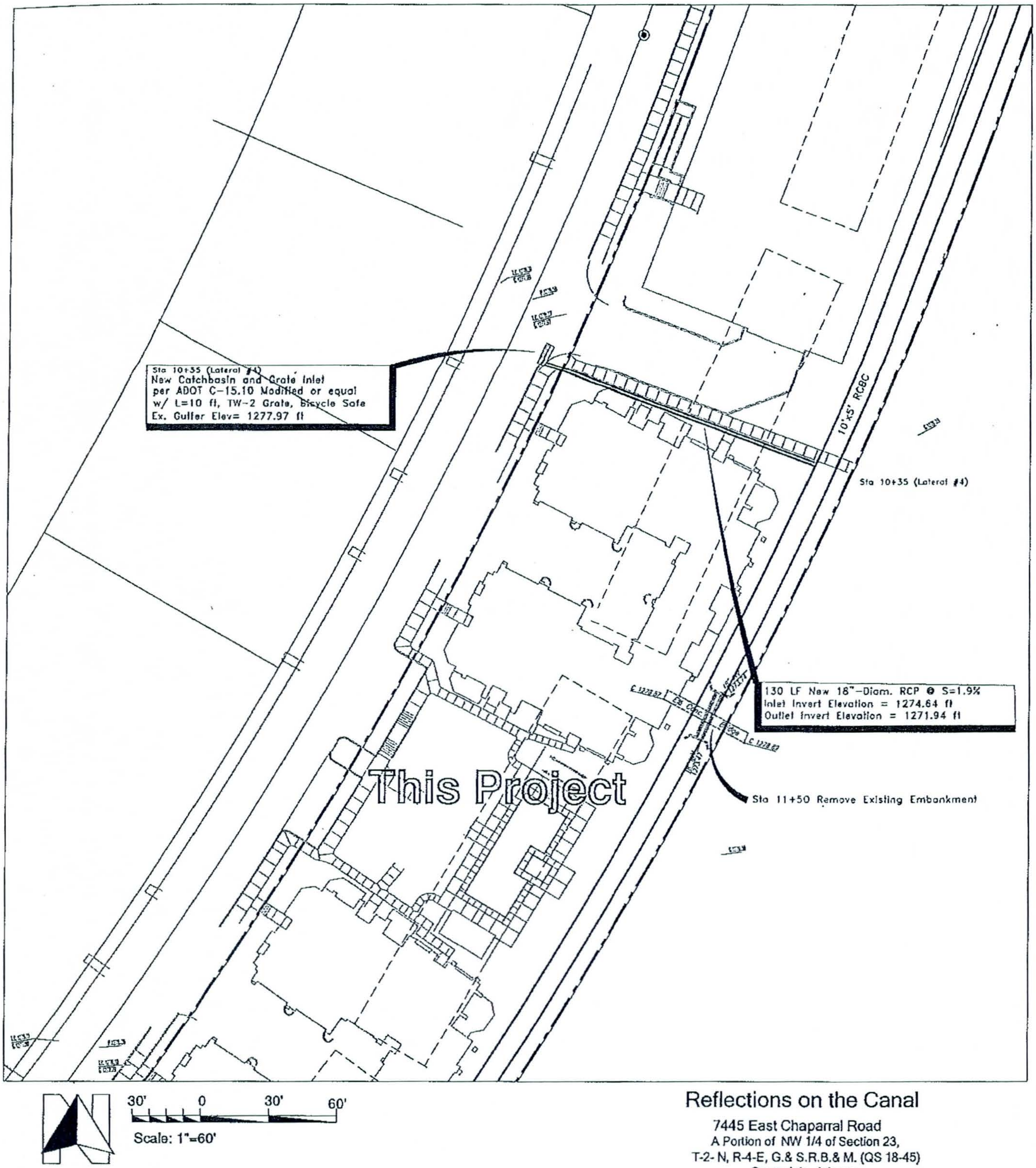

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Figure 8
Location of Proposed
Drainage Improvements

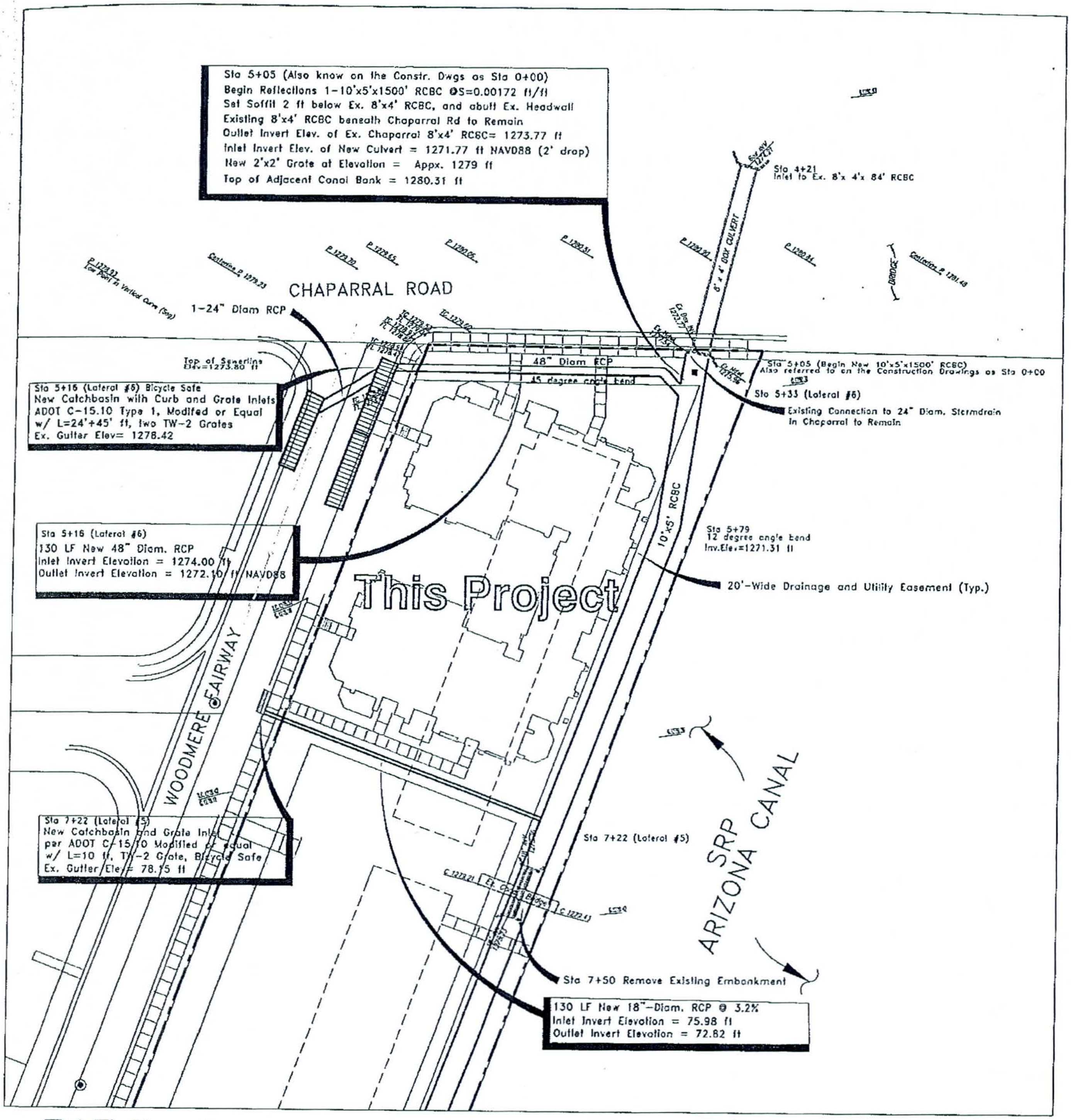

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Figure 9
Location of Proposed Drainage Improvements

3.2 Stormwater Storage Requirements

In accordance with Section 37-42.1 of the Scottsdale City Code (Stormwater Storage Facilities), this project must provide a minimum stormwater storage volume of 0.53 acre feet or 22,912 cubic feet. Therefore, some of the landscaped areas located along the Arizona Canal have been designed as stormwater detention basins, with a total combined storage volume of 25,000 cubic feet. This planned storage volume exceeds the minimum required. Refer to Sheet C1.1 (Overall Civil Site Plan) found in Appendix E of this report for a map showing the areas to be flooded along with their calculated storage volumes. Furthermore, these basins have outlet orifices that have been designed to provide a minimum drain time of 12, per Sec. 4.402.B.13 of the City of Scottsdale Design Standards and Policy Manual.

3.3 Project Phasing

The construction of this project will not be phased.

3.4 Stormdrain Segments

Centerline stationing proceeds in a downstream direction, starting with Station 0+00 located about 400 feet upstream or north of Chaparral Road. Station 20+00 is located at the south property line of the subject property, and Station 35+70 is located farther south near Scottsdale Road.

Note that the centerline stationing shown on the construction drawings differ from those given in this drainage report. See for example, Sheets C2-10 through C2-12. The equation to convert stationing used in the Construction Drawings to those given in this report is as follows:

Stationing on Construction Drawings = Stationing on Drainage Report - 505 feet

The description of stormdrain segments will go from downstream to upstream, as follows.

Station 35+43:

Referring to Figure 5, the Safari project is currently constructing 1-8'x6'x1263' RCBC, starting at the existing USACE catchbasin located near the intersection of Scottsdale Road and Camelback Road. This connection point is referred to as Station 35+43, and it represents the downstream end of the Safari project.

Station 34+70:

Refer to Figure 5. The Safari box culvert has a sharp bend and abrupt change in grade at Sta 34+70. In the absence of large-scale regional flooding, it will be this sharp, vertical grade break that will be the downstream hydraulic control (Critical Depth of 4.20 ft).

Station 22+80:

Referring to Figure 6, the Safari project will begin constructing a 1-8'x6'x1263' RCBC starting at Station 22+80, and proceed in a downstream direction. The Reflections on the Canal project will connect a new reinforced concrete rectangular open channel (8'w x 6'd) at this location and proceed upstream. The invert of the Open Channel will match that of the Safari 8'x6' RCBC. The new Reflections Open Channel will have an open top which will allow floodwaters from the adjoining properties to enter this channel as needed. Pedestrian barriers will be built along the entire perimeter of this 280-foot-long open channel segment.

Station 20+00:

Referring to Figure 6, the Reflections project will begin with a 1-8'x6'x 280' Open Channel, starting at Station 20+00, and proceed in a downstream direction and connecting with the Safari RCBC. This station represents the south property boundary of the Reflections project.

Upstream of Station 20+00 will be a new 10'x5'x1500' RCBC. The invert of this new Reflections box culvert will match the invert of the new Reflections open channel. In addition, this junction will also require a gradual transition in width, from 10 feet to 8 feet.

Station 19+84:

Referring to Figure 6, a new 48" diameter lateral will connect to the new Reflection RCBC at Station 19+84 (Lateral #1). Floodwaters accumulating in Woodmere Fairway will be intercepted by a new catchbasin and grate located in the existing alleyway and carried to the new 10'x5' RCBC via this 48" diameter RCP. This grate and lateral will have a 100-year design capacity of 72 cfs, and the total peak discharge downstream from this location will be 400 cfs.

Station 17+96:

Referring to Figure 7, the existing 1'x2' grated catchbasin in Woodmere will be removed and replaced with two new larger grated catchbasins. The existing 12" diameter drain pipe (that goes westward across Woodmere Fairway) will be reconnected to this new catchbasin and together these will connect to a new 24" RCP (Lateral #2) and then go to the new

Reflection RCBC at Station 17+96. Floodwaters accumulating in Woodmere Fairway will be intercepted by a new catchbasin and grate and carried to the new 10'x5' RCBC via this 24" diameter RCP. This grate and lateral will have a 100-year design discharge of 2 cfs.

Station 14+50:

Referring to Figure 7, at new 18" diameter lateral (#3) will connect to the new Reflection RCBC at Station 14+50. Floodwaters accumulating in Woodmere Fairway will be intercepted by a new catchbasin and grate and carried to the new 10'x5' RCBC via this new 18" diameter RCP. This grate and lateral will have a 100-year design discharge of 1 cfs.

Station 10+35:

Referring to Figure 8, at new 18" diameter lateral will connect to the new Reflection RCBC at Station 10+35 (Lateral #4). Floodwaters accumulating in Woodmere Fairway will be intercepted by a new catchbasin and grate and carried to the new 10'x5' RCBC via this 18" diameter RCP. This grate and lateral will have a 100-year design discharge of 1 cfs.

Station 7+22

Referring to Figure 9, at new 18" diameter lateral will connect to the new Reflection RCBC at Station 7+22 (Lateral #5). Floodwaters accumulating in Woodmere Fairway will be intercepted by a new catchbasin and grate and carried to the new 10'x5' RCBC via this 18" diameter RCP. This grate and lateral will have a 100-year design discharge of 1 cfs.

Station 5+79:

Refer to Figure 9. The Reflections box culvert has a 12-degree bend at Sta 5+79. This change in alignment allows the new RCBC to be directed straight to the outlet of the existing 8'x4' RCBC located beneath Chaparral Road.

Station 5+33:

Referring to Figure 9, at new 48" diameter lateral will connect to the new Reflection RCBC at Station 5+33 (Lateral #6). Floodwaters accumulating in Woodmere Fairway will be intercepted by two new catchbasins and grates and carried to the new 10'x5' RCBC via this 8'x4' RCBC. These grates and lateral will have a 100-year design discharge of 103 cfs.

Station 5+05:

Referring to Figure 9, the Reflections 1-10'x5'x1500' RCBC will begin at Station 5+05. The new Reflections RCBC will abut the existing 8'x4' RCBC beneath Chaparral Road. This new junction will have a 100-year design discharge of 224 cfs. Furthermore, this planned connection will replace the existing pedestrian walkways currently blocking floodwaters from flowing through the existing culvert. Additionally, this connection will also replace the earth berm seen on Plate 15 of Design Memorandum 5, and marked "plug existing ditch." and "clear and grade existing ditch to drain N.E.

Note that the modified ADOT Standard catchbasins identified on Figure 5 through 9 this report have been included because of their hydraulic properties, primarily their waterway openings. These specific catchbasins may not be constructed because of limitations related to curb lengths and vehicular access routes. Therefore, any differences seen between the catchbasins seen on Figures 5 through 9 with those shown on the construction drawings are hydraulically equivalent, and were otherwise revised as a result of additional construction-related considerations.

IV. SPECIAL CONDITIONS

4.1 Project Stipulations

In accordance with the DRB Stipulations (47-DR-2005), this project will satisfy the following conditions.

1. Development will maintain historic flow patterns. This development will maintain the historic flow patterns in which floodwaters generally flow from northeast to southwest. This project accepts flows at Chaparral Road and then releases them at or near the southern property boundary. With this design, historic flow patterns will be maintained.

2. Improvements will not adversely affect other properties.

   When compared to existing conditions, this project will not obstruct or impede floodwaters. The planned building outline is smaller than the existing building footprint and thus offers less flow obstruction. Furthermore, this project has more landscaped areas than before, and about one-half of these new landscaped areas will be depressed below grade for stormwater detention purposes. Floodwater crossing over Chaparral Road will be intercepted by a new grated catchbasin and taken to the new 10'x 5' RCBC for disposal. Site improvements will not adversely affect other properties.

3. The Final Drainage Report will demonstrate a public benefit to the area as a function of the storm water improvements.

The Reflections on the Canal project is committed to provide local and regional public benefits by constructing stormwater improvements. These improvements include: (1) constructing 1500 linear feet of new 10'x 5' Reinforced Concrete Box Culvert between Chaparral Road and the south boundary of the subject property; (2) constructing 280 linear feet of new 8'x 6' Reinforced Concrete Rectangular Open Channel between the south boundary of the subject property and the inlet to a new stormdrain being constructed by the adjoining Safari project; (3) constructing lateral stormdrains from Woodmere Fairway to the new 10'x 5' Reinforced Concrete Box Culvert, and which will have the capacity to intercept 100-year peak discharges; (4) constructing onsite stormwater detention basins that will reduce onsite flows to less than that which are produced under existing conditions; (5) construct a series of roof-drain pipes that will take roof drainage directly to the new stormwater detention basins for disposal. Under existing conditions, subject property and surrounding areas are floodprone and subject to sheetflow and shallow flooding. Additionally, the existing Army Corps of Engineers constructed a Side Channel system with a 25-year design capacity, whereas the planned regional stormdrain system planned for construction with this project, will have a 100-year design capacity.

These new storm water improvements have been designed to intercept and convey the 100-year peak discharge, and its overall efficiency is only controlled by offsite conditions. Upon completion, the Reflections on the Canal project will provide significant public benefits as a result of the construction of a new regional stormdrain system.

4. Approval will be obtained from the Flood Plain Administrator to measure the building height one (1) foot above the nearest adjacent Arizona Canal bank.

Mr. Erickson, the Floodplain Administrator, has written this letter, and a copy of it can be seen in Appendix E of this report.

4.2 CLOMR-F

A CLOMR-F (Case # 07-09-0635C) for this project was issued on March 13, 2007, and it has reclassified the to-be-developed portions of subject property as being outside of the existing Flood Hazard Zone A. As-built drawings and soil-compaction certifications shall be prepared after the site has been filled, and these documents shall be then given to the City of Scottsdale's Floodplain Administrator for Community Acknowledgment, and then afterwards given to LOMA Depot/ FEMA for issuance of a final LOMR-F.

4.3 Stormwater Storage

The subject property will have about 24,721 cubic feet of onsite stormwater storage upon completion. And this exceeds the minimum 22,912 cubic feet required. Drain times of about 12 hours, and maximum ponding depths of 1 foot.

4.4 Connection to the FCDMC System

Coordination with, and approval by the Flood Control District of Maricopa County and the US

Army Corps of Engineers is required for all segments of stormdrain to be constructed adjacent to the Arizona Canal. Approval by Ms. Shelby Brown (FCDMC, personal communication) has been given by the US Army Corps and the District. A use permit is pending.

4.5 Coordination with adjoining projects

This project includes the construction of a new 8'x6' RCBC along the 280 LF of new 8'x 6' open channel downstream from the subject property. This project must coordinate with the owners and engineers for these affected properties.

4.6 AZNPDES

A Stormwater Pollution Prevention Plan (SWPPP) will be prepared by M3 Engineering along with the Grading Plan.

V. DATA ANALYSIS METHODS

5.1 Methodology Used for Hydrology and Hydraulics

The hydrologic design of this project was done in accordance with the methodologies set forth in the City of Scottsdale's Design Standards and Policy Manual (Chapter 4, 2006 and updates), Floodplain and Stormwater Regulations (Chapter 37 of the Scottsdale City Code), and the Drainage Design Manual for Maricopa County (Volumes 1, 2, and 3).

This study uses the U.S. Army Corps of Engineers HEC-1 program to evaluate rainfall-runoff relationships within the upstream watersheds and to use this information to help predict 100-year flood peaks at selected locations near the subject property. This program uses one-dimensional, steady flow, water-surface profile calculations.

Hydraulic calculations for evaluating the planned box culverts and open channel segment were based on widely accepted procedures presented in the Flood Control District of Maricopa County's *Drainage Design Manual, Volume II, Hydraulics* (January 1996, with updates), and the *Design and Construction of Urban Stormwater Management Systems* (ASCE, 1992).

5.2 Hydrology

Hydrologic analysis of Reach 3 and Reach 4 of the Side Channel System (the study area), was facilitated using the U.S. Army Corps of Engineers HEC-1 computer program or software. This program was used to model the precipitation-runoff processes within this highly urbanized watershed.

In accordance with Sections 4.706.D.3 of the City of Scottsdale's Design Standards and Policies Manual (2006 update), rainfall losses were represented using the SCS Curve Number Method, and by applying Runoff Curve Numbers appropriate to soils and land-use classifications of this community. Likewise, the Kinematic Wave Model was used to transform or numerically convey the computed storm runoff from each hydrologic subbasin to the downstream collector or main channel. Routing of the accumulated main-channel flow was numerically represented using the Muskingum-Cunge method and applying four-point hydraulic cross sections.

This general modeling approach was chosen because of two important, limiting factors. First, the upstream watershed is highly urbanized without major drainage systems, and the topographic maps of the area were believed inadequate to precisely represent the existing underfit flow paths, or to identify areas of stormwater retention. Secondly, much of the watershed is impervious, although not directly connected, and thus other more complex rainfall/runoff estimation procedures, such as Green and Ampt, for example, were considered unnecessary. It was believed that deficits in the ability to characterize the watershed exceed the advantage in applying other analytical methodologies.

The HEC-1 modeling method is described in the User's Manual (September 1990). Additional information concerning the local approach to using HEC-1 was given in City of Scottsdale's Design Standards and Policies Manual (2006 update), mentioned previously, as well as in the Flood Control District of Maricopa County's Drainage Design Manual, Volume 1, Hydrology (January 1995, with updates).

5.2.1 Hydrologic Parameter Estimation

5.2.1.1 Drainage Area Boundaries

The watershed contributing the study area is approximately 0.8 square miles (520 acres) and is generally bounded on the north by McDonald Road, on the west by Camelback Mountain, on the south by Vista Drive, Chaparral Road, and Camelback Road, and on the east by the Arizona Canal.

For the purposes of hydrologic modeling, this watershed was divided into 14 subbasins based on topographic maps and aerial photographs described previously. Watershed delineations were field checked.

Six of these subbasins are located north of Jackrabbit Road and are designated Subbasins 10 through 15. These all drain eastward to the Arizona Canal where flows are impounded behind the existing levee and then flow southward by gravity towards the subject property.

Subbasins 20 through 24 are located north of Vista Drive and south of Jackrabbit Road. And runoff from these subbasins also drain eastward to the Arizona Canal, where it is joined by runoff from uphill Subbasins 10 through 15.

Likewise, Subbasins 30 and 31 are located north of Chaparral Road and south of Vista Drive. Runoff from these two subbasins flow eastward to the Arizona Canal, and are joined by runoff from the uphill subbasins.

In the 1980s, the U.S. Army Corps of Engineers constructed a 96-inch-diameter reinforced concrete pipe culvert to divert stormwater accumulating at the junction where Subbasins 10 through 15, 20 through 24, and 30 and 31 combine. This existing stormdrain was designed to intercept 670 cfs (equivalent to the Corp's 25-year design flood), and is described in the Indian Bend Wash Design Memorandum #5 "Feature Design for Side Channels System," (Los Angeles District, U.S. Army Corps of Engineers, July 1981).

Subbasins 40 and 41 and the subject property are located downstream from this diversion stormdrain.

5.2.2 Watershed Work Maps

Appendix B of this report contains a watershed boundary map of this watershed, including its 14 subbasins.

5.2.3 Precipitation

A 6-hour 100-year rainfall of 3.19 inches was used. NOAA Atlas 2 and the Isopluvial Maps in the 2006 DSPM were the sources for this rainfall frequency information . This rainfall was temporally distributed using the Maricopa County Type 1 dimensionless rainfall pattern, as described in Section 2.4.2 of the Flood Control District of Maricopa County's Drainage Design Manual, Volume 1, Hydrology (January 1995, with updates).

5.2.4 Physical Parameters

Soil classifications and their corresponding Hydrologic Soil Group were obtained from the

NRCS Web Soil Survey (http://websoilsurvey.nrcs.usda.gov/app/) and were based on the Soil Survey of Eastern Maricopa County and Northern Pinal Counties Area, Arizona. All of the soils in the study area, with the exception of Rough Broken Land (Ru) located in Subbasin 10, are classified as Type B Hydrologic Soil Group, whereas, the Rough Broken Land does not have a classification, and was assumed to be Type D.

Runoff Curve Numbers for these soil types were obtained from Figure 4-7 Runoff Curve Numbers for Urban Areas in City of Scottsdale's Design Standards and Policies Manual (2006 update).

Impervious Cover was estimated in the field, and then adjusted to conform with the average percent impervious area listed by land use classification in Figure 4-7 Runoff Curve Numbers for Urban Areas in City of Scottsdale's Design Standards and Policies Manual (2006 update).

Initial abstraction was conservatively assumed to be zero (0.0).

The representative dimensions for flow planes were visually estimated in the field, and were found to be reasonably uniform at 200 feet long. Slopes varied depending on locations. Representative values for flow-plane roughness were taken from Table 6-1 Overland Flow Roughness Coefficients for Sheet-Flow Modeling (USCE, HEC-HMS Technical Reference Manual), as well as Table 3.5 Resistance Factor for Overland Flow (USCE HEC-1 Flood Hydrograph Package, User's Manual, September 1990). The amount of directly connected impervious area was visually estimated (most properties are walled in), and was deemed negligible for the purposes of hydrologic modeling.

The representative dimensions for subcollector, collector and main channels were visually estimated in the field. Slopes varied depending on locations. Representative values for channel roughness were taken from Table 6.11 Manning's Roughness Coefficients (Flood Control District of Maricopa County's *Drainage Design Manual, Volume 3, Hydraulics*, January 1996, with updates).

The rate of floodwater diversion by the existing Chaparral Road storm drain varied up to 670 cfs, and was based on the Indian Bend Wash Design Memorandum #5 "Feature Design for Side Channels System," (Los Angeles District, U.S. Army Corps of Engineers, July 1981).

5.2.5 Final Hydrologic Results

The final results from the hydrologic modeling are tabulated in Appendix B of this report, including the calculated 100-year peak discharges arriving at Chaparral Road and the Arizona Canal (1299 cfs), being diverted into the Arizona Canal (302 cfs), being diverted into the IBW diversion stormdrain at Chaparral Road (670 cfs), being delivered to Woodmere Fairway adjacent to the subject property (327 cfs), and being discharged at the downstream end of the study area (399 cfs). A discussion regarding the quantities of flow arriving and being diverted as selected locations can also be found in the "splitflow discussion" in Appendix A of this report.

The results of this investigation were compared to those of KVL Consultants, Inc, and described in the Design Concept Report, Arizona Canal, 64th Street to Scottsdale Road, Flood Mitigation Study (a consulting report prepared for the City of Scottsdale, June 6, 2002). This comparison included the calculated discharges arriving at Chaparral Road and the Arizona Canal (1727 cfs), being diverted at Chaparral Road (670 cfs), being delivered to Woodmere Fairway adjacent to the subject property (471 cfs), and being discharged at the downstream end of the study area (92 cfs at Node 170910).

5.3 Hydraulics

During this investigation, it was learned that flows within the Side Channel become divided immediately downstream from Chaparral Road. Some flows go through the existing 8'x4'x 84' RCBC beneath Chaparral Road (although most of these are blocked from going farther downstream by three sets of pedestrian walkways and their earthen embankments), and the remaining flows overtop the low point in Chaparral Road. One HEC-RAS model was formulated to examine the hydraulic characteristics of the existing Chaparral box culvert and the relationship it has with blockage caused by the existing pedestrian bridge, and with the overtopping of the low point in Chaparral Road. This first HEC-RAS model also examined the flow depths upstream from Chaparral Road, and when the computed WSELs exceed the adjacent canal bank, to calculate the sideweir spillages.

The second HEC-RAS model was formulated to examine the divided flow within and along Woodmere Fairway, downstream from Chaparral Road. The outflow quantities obtained from the first HEC-RAS model were used as input into this second HEC-RAS model. Likewise, the splitflow quantities determined from both HEC-RAS models were used as input into the HEC-1 model to account for diversion losses. This iterative process was done until the results from these three models were stable and converged on a nearly consent set of answers.

5.3.1 Method Description

Hydraulic modeling for Reach 4 of the Side Channel System was performed using the U.S. Army Corps of Engineers HEC-RAS River Analysis System Program, version 3.1. This computer program uses one-dimensional, steady-flow, water-surface profile calculations and it is based on standard step-backwater methods using cross sections to describe the channel system. An assumed water-surface elevation, based on critical depth, was entered into the model at the downstream cross section to initialize model computations.

5.3.2 Work Study Maps

Work maps for the study area were prepared using geographical information, such as section lines, approximate property boundaries, and topography, obtained from the City of Scottsdale. In general these maps were plotted and used at a scale of 1" = 100', and with 1-foot topographic contour intervals (COS, Geographical Information Systems).

5.3.3 Parameter Estimation

Field reconnaissance was performed as a part of the modeling effort to observe and document channel and flood plain conditions, in including Manning n-values. In general, Manning n-values were evaluated using the methodology in "Guide to Selecting Manning Roughness Coefficients for Natural Channels and Floodplains (USGS WSP-2339). In addition, representative values for channel roughness were also taken from Table 6.11 Manning's Roughness Coefficients (Flood Control District of Maricopa County's Drainage Design Manual, Volume 3, Hydraulics, January 1996, with updates).

5.3.4 Cross Section Description

The Upper Woodmere HEC-RAS model used twenty-five hydraulic cross sections to represent the 1100-foot-long segment of the Side Channel, between Chaparral Road and the first or upstream-most of four existing pedestrian bridges. This model was intended to examine two conditions. First, existing conditions and the quantification of the amounts of floodwater that will pass through the Chaparral Box Culvert, across Chaparral Road low point. And second, it was used to quantify the amounts of floodwater lost by diversions upstream from Chaparral Road.

The Lower Woodmere HEC-RAS model used seventeen hydraulic cross sections to represent the 2000-foot-long segment of the Side Channel, between Chaparral Road and the Safari project located near Scottsdale Road. This model was intended to examine only one condition, and that was to see whether or not floodwaters will overtop the banks of the Arizona Canal downstream from Chaparral Road (they do but just slightly).

These cross sectional data were developed from a digital terrain model based on 2002 phototopographic coverage, which was provided by the City of Scottsdale, GIS Division. Hydraulic cross sections were generated directly from the digital terrain model using BOSS RiverCAD and exported to a HEC-RAS file format. Cross sections were reviewed for consistency relative to the 1-foot contour interval topography developed from the digital terrain model.

5.3.5 Modeling Considerations

The floodplain analysis was conducted according to FEMA criteria for natural and constructed waterways. These criteria are presented in "Managing Floodplain Development in Approximate Zone A Areas: A Guide For Obtaining and Developing Base (100-Year) Flood Elevations" (FEMA Guide 265, July 1995) and in "Guidelines and Specifications for Flood Hazard Mapping Partners, Volume 2: Map Revision and Amendments; and Appendix C: Guidance for Riverine Flooding Analyses" (FEMA, April 2003, with amendments).

Areas of ineffective flow were added throughout the hydraulic model and were used to represent the blockages created by the existing pedestrian bridges, existing and proposed building and walls.

In addition, the second HEC-RAS model included ineffective flow boundaries along the left-hand or east sides of all cross sections. This was done for two reasons. First, this tool was used to help evaluate the divided flow conditions, while simultaneously being able to visualize the canal bank. Secondly, it was also used to represent the proposed conditions that will exist when the low segments of the existing Side Channel (and between the blockages between the existing pedestrian bridges).

Thus, with the exception of flood discharges, the second HEC-RAS model for Lower Woodmere Fairway represents both existing and proposed conditions. Furthermore, this HEC-RAS model was not run using future 100-year flood peaks because it is believe that the two new grated catchbasins in Woodmere Fairway will intercept all floodwaters and take them to the new 10'x 5' RCBC for disposal, and therefore obviating the need for a post-construction HEC-RAS model with zero discharges within the areas of detailed study.

5.3.6 Problems Encountered During the Study

Only one significant problem was encountered during this study, and this was the absence of reliable, detailed survey and topographic information offsite from the subject property. Field survey was used to help supplement this need, although there are still areas where detailed topography is missing, and which were conservatively treated by the model as ineffective flow boundaries. Other than this, there were no other problems encountered.

There are no model error messages. The model warning messages regarding conveyance ratio, energy loss, and velocity head changes between cross sections were reviewed. These messages usually indicate the possible need for additional cross sections. It was concluded that additional cross sections were not needed. The model warning messages regarding divided flow were reviewed. It was concluded that no modeling adjustments were necessary.

5.3.7 Final Hydraulic Results

Appendix A and Appendix B to this report contain the final results and maps for this study for existing conditions, including the calculated 100-year peak discharges at Chaparral Road (Q100=327 cfs), going beneath Chaparral Road in the existing box culvert (Q100=17 cfs), going over the low point in Chaparral Road and flowing into Woodmere Fairway (Q100= 310 cfs).

The hydraulic gradeline calculations for the new 10'x5'x1500' RCBC were evaluated using the peak discharges predicted to go through the Chaparral Box Culvert and weir across Chaparral Road. These hydraulic gradeline calculations can be found in Appendix C of this report.

Appendix C of this report also contains a floodplain boundary map for proposed, post-construction conditions (based on the construction of new 100-year grated catchbasins in Woodmere Fairway). And it was based on the assumption that the planned regional stormdrain system were completed, and its interception and conveyance capacities were not limited by offsite influences, and thus resulting in no surface runoff in the segment of Woodmere Fairway located between Chaparral Road and Thornwood Avenue. This future-conditions map shows the limits of detailed study.

VI. CONCLUSIONS

6.1 General

From the results of this study, it is concluded that:

1. The site has been designed and developed in accordance with the City of Scottsdale's Design Standards and Policy Manual and the FCDMC Drainage Design Manuals.
2. The lowest finished floors for the residential portions of this project will be at least one (1) foot above the Base Flood Elevations listed on CLOMR-F Case No. 07-09-0635C (see Appendix F).
3. The lowest finished floors for the below-grade parking areas for this project will be engineered and will be a dry flood proofed. Additionally, the driveway entrances will be set at or above 0.50 ft above the base flood, as required for flood proofing.
4. This project has been designed so it does not obstruct or divert flood waters onto the upstream or downstream properties. Furthermore, this project provides a public benefit as a result of construction of drainage and flood-control improvements. The new stormdrain system has been designed to convey a 100-year flood, and it replaces a 30-year-old open-channel system designed to convey only a 25-year flood.
5. A CLOMR-F has been obtained from FEMA and it removes the Unnumbered Flood Hazard Zone A designation from the to-be-developed portions of the subject property.
6. The ultimate outfall for this project is located at the boundary with the Safari/ Riverwalk project. Coordination will be required with the owners of the Safari project, as well as the 280-foot-long segment of property separating the subject property from the Safari.

VII. WARNING AND DISCLAIMER OF LIABILITY

7.1 General

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 manmade 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

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ADDENDUM #2 TO

THE FINAL DRAINAGE REPORT FOR

SAGE CONDOMINIUMS-PHASE I

WOODMERE FAIRWAY AND CHAPARRAL ROAD

SCOTTSDALE, ARIZONA

C.O.S. Project 47-DR-2005

Portion of the NW 1/4 Section 23, T-2-N, R-4-E
7445 East Chaparral Road

Prepared in Conjunction with:

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Registered Professional Engineer (Civil)
CERTIFICATE NO. 15293
JUSTIN M. TURNER
Date Signed 7·12·12
ARIZONA U.S.A.

Expires 09-30-2013

July 6, 2011
Rev. April 2, 2012 Phase I
Rev. May 3, 2012 Phase II
Rev. July 12, 2010 Phase II

ARROYO ENGINEERING, LLC

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LIST OF ATTACHMENTS

Registered Professional Engineer (Civil)
CERTIFICATE NO.
15293
JUSTIN M.
TURNER
Date Signed 7-12-12
ARIZONA, U.S.A.

Expires 09-30-2013

I. INTRODUCTION

1.1 Background and Purpose of Report Addendum

This is the second Addendum to the Final Drainage Report for the Sage Condominium project (formerly Reflections on the Canal) which was previously approved by the City of Scottsdale in August 2007 (Larry Tritz, written communication, Aug. 30, 2007). Furthermore, this second Addendum pertains to the proposed changes to the layout of the southwest end of the project and the corresponding changes to the approved site drainage and infrastructure. The first Addendum to the Final Drainage Report is dated April 2, 2012, and it was written in order to describe changes made to the drainage plan necessitated by the splitting of the development into two separate phases, leaving the southwest Phase II area of the project vacant for the time being. Our client now wishes to continue building the Phase II area, but with a revised building layout. They wish to replace three buildings with two. The revised Phase II layout will consist of the two condominiums (Buildings D and E), and the remaining unfinished drainage infrastructure (Stormdrain Laterals #1, #2, and #3 or their equivalent replacements) and stormwater storage basins (new Phase II Basins #1 through #6).

The purpose of this Drainage Report Addendum is to describe the final drainage conditions (post Phase II) for submittal to the City of Scottsdale and the Flood Control District of Maricopa County.

By way of background, the Final Drainage Report, dated August 27, 2007, described how the design of the planned drainage infrastructure was intended to comply with floodplain regulations, design standards and policies, and four specific DRB Stipulations (47-DR-2005). Consisting of: (1) the development will maintain historic flow patterns; (2) site improvements will not adversely affect other properties; (3) demonstrate a public benefit to the area as a function of the stormwater improvements; and (4) receive approval by Scottsdale's Floodplain Administrator to measure the building height one foot above the nearest adjacent Arizona Canal bank. The purpose of this second Addendum and accompanying construction drawings is to show continued compliance with these original DRB Stipulations and Floodplain Regulations.

1.2 Final Letter of Map Revision Required for Phase II

Prior to construction of developed Phase II, a final Letter of Map Revision for the planned building pad shall be required, similar to the one obtained earlier for Phase I of this project. In order to obtain this second LOMR, an as-built drawing of the planned building pads, along with the results of soil compaction tests, will be required for submittal to FEMA.

II. PHASE II DRAINAGE PLAN

The original approved drainage plan included: (1) 1500 LF of new 10'x5' RCBC between Chaparral Road and the southern end of the subject property; (2) 280 LF of new 8'x 6' rectangular open channel between the outlet of the new 10'x5' RCBC and the new 8'x6 RCBC built on the nearby Safari Riverwalk project; and (3) six sets of catch basins and laterals to be built between Woodmere Fairway and the new 10'x5' RCBC. For the purpose of this second report Addendum, these stormdrain laterals were numbered one (1) through six (6) going from downstream to upstream (south to north). Phase I consisted of the construction of the main box culvert, Laterals #4 through #6, and two sets of stormwater storage basins (Phase I Basins #4 through #7 and undeveloped Phase II Basin "A"). This new Phase II includes the construction of the remaining Laterals #1, #2, and #3, along with six (6) new stormwater detention basins, referred to as Phase II Basins #1, #2, #3, #4, #5, and #6, which will replace Basin "A" constructed under Phase I. A brief description of these drainage improvements and design considerations follow.

2.1 Lowest Finished Floor and Parking Ramp Elevations

Section 37-42.f.2 of the Scottsdale City Code (Development Requirements) says that all new residential structures shall have its lowest floor constructed at least one (1) foot above the base-flood elevation. For this project, the lowest finished floors shall be set so they are one foot or more above the top of the highest adjacent Arizona Canal bank. Refer to Sheet C1.1 for a listing of these base-flood (canal bank) elevations and finished-floor elevations. The proposed finished-floor elevations for new Phase II meet this design criterion.

Further, each of the two condominiums buildings to be constructed as part of this revised Phase II plan will have underground parking. This is similar to the design of the two condominium buildings built under Phase I. From a design standpoint, and as seen on Sheet C2.3 Detail 3, the crest of the single parking ramp serving both new underground parking garages, as well as the tops of the nearby walls located adjacent to this parking ramp, have elevations that exceed the adjacent baseflood elevation of 1279.94 ft (NAVD-1988) by at least 0.5 feet. Therefore, this updated design remains in compliance with this stipulated design requirement.

2.2 Lateral #1 at Station 14+93

Lateral #1 is a single 38"x60" HERCP pipe and two catch basins (refer to Sheet C2.0 and Sheet C2.3, Detail 2). These are located at Culvert Centerline Station 14+93. Lateral #1 and the largest of the two new catch basins were designed to intercept 72 cfs from Woodmere Fairway and take it directly to the box culvert for disposal. Although there were no known flooding problems in this specific area, the original purpose of Lateral #1 and equivalent catch basin were to provide a second stormwater outlet for the area. This revised Lateral #1 will do three things. First, it will convey stormwater collected by a new catch basin with grate (ADOT Std. C-15.10, L=56 ft), located in the alley, to the nearby box culvert for disposal. From a hydraulic standpoint, new Lateral #1 and catch basin are substantially identical in size and locations to those shown in the approved construction drawings. Second, new Lateral #1 will have a second catchbasin located near the center of Phase II Stormwater Basin #1 (MAG Std. Dtl. 538, Type H) which will allow this new stormwater basin to freely drain by gravity. And third, new Lateral #1 will connect to another 12" diameter HDPE stormdrain that will replace the original Lateral #2. This will allow local runoff collected in Woodmere Fairway and the alleyway to the west to drain.

2.3 Lateral #2 at Station 13+06

Lateral #2 is to be deleted with new Phase II and replaced by a new 12"-diameter HDPE stormdrain extension to new Lateral #1 (refer to Sheets C2.0, C2.1, and C2.3 Detail 2). A new street catch basin in Woodmere Fairway, as well as the existing 10" diameter stormdrain crossing Woodmere Fairway near Sta 11+50, will connect to this new extension and then into new Lateral #1. This is a relatively minor modification to the approved plans (it only redirects 1 cfs from the street and another 1 cfs from this existing stormdrain pipe), and will be of no consequence to local drainage.

2.4 Lateral #3 at Station 9+78

Lateral #3 is a single 12" diameter HDPE pipe and catchbasin (refer to Sheet C2.2). This new lateral and catchbasin were designed to intercept 1 cfs from Woodmere Fairway and take it directly to the box culvert for disposal. This is a relatively minor change to the approved plans (it only has a single 1 cfs inlet), and will be of no consequence to local drainage.

2.5 Stormwater Storage

Stormwater storage for developed Phase I and Phase II will be provided by two sets of shallow basins, as shown on Sheet C1.1 (Overall Surface Grading Site Plan).

As part of the earlier Phase I construction, five stormwater detention basins were constructed and are referred to as Phase I Detention Basins #4, #5, #6, #7, plus undeveloped Phase II Basin "A." As mentioned in Addendum #1, the purpose of Basin "A" was to provide stormwater storage for the undeveloped area of Phase II (about 7,799 CF), as well as the deficit in storage resulting from the construction of undersized Basins #4, #5, #6, and #7 (about 9,400 CF).

Under developed Phase II, Basin "A" will be eliminated and replaced by six (6) new stormwater basins named Basins #1, #2, #3, #4, #5, and #6. Admittedly, the naming of these new Phase II basins is somewhat confusing, but nonetheless, the required storage volumes will be provided.

Refer to Attachment #1 in Addendum #2 for a summary of the stormwater storage requirements for this project. These calculations show that 14,849 CF of storage is required for developed Phase I, and an additional 12,959 CF is required for developed Phase II. The total storage required for this project is 27,808 CF. The existing Phase I basins will provide 3,805 CF, and the proposed Phase II basin will provide an additional 24,065 CF, for a total of 27,870 CF, thus balancing the total site requirements.

As an earlier administrative control over the use of, and maintenance requirements for, Basin "A", a temporary approximately 40-foot-wide drainage easement was placed over Basin "A", and granted to the City of Scottsdale. By way of this submittal, this temporary easement will no longer be required, and therefore eliminated, unless otherwise required by the City of Scottsdale.

The original approved Final Drainage Report showed drainage easements between former buildings D and E, as well as between buildings E and F. The project configuration calls for the new buildings to be placed over these original drainage easements. Likewise, the original local drainage pipes will be replaced by equivalent pipes that follow Woodmere Fairway until reaching the revised outflow locations, as described earlier in this report. As a consequence, the existing drainage easements between buildings D and E as well as buildings E and F will be eliminated and replaced by new easements along Woodmere Fairway, as shown on the new construction drawings.

2.6 Stormwater Quality Controls

The Phase I and Phase II drainage improvements have been designed to help protect water quality. Onsite runoff is directed into the stormwater detention basins where it is then metered slowly into the new box culvert. This design effectively treats the first one-half inch (½") of stormwater runoff. Street runoff will be collected and directly taken to the box culvert for disposal, and is the same as existing conditions.

III. CONCLUSIONS

3.1 Overall Project

From the results of this study, it is concluded that:

1. Drainage improvements for Phase I and Phase II of the Sage Condominium project have been designed in accordance with the City of Scottsdale's Design Standards and Policy Manual and the FCDMC Drainage Design Manuals. In addition, the new drainage improvements for Phase I and Phase II of the Sage Condominium project currently meet the four specific DRB Stipulations (47-DR-2005) required for development.
2. The Phase I and Phase II stormwater improvements have been designed to intercept and convey the 100-year peak discharge, and its overall efficiency is only controlled by offsite conditions. Upon completion, the Sage Condominium project will provide significant public benefits as a result of the construction of a new regional stormdrain system.
3. A final Letter of Map Revision will be required for Phase II prior to construction.
4. New stormdrain Lateral #1 (Station 14+93), Lateral #2 (Station 13+06) and Lateral #3 (Station 9+78) will be constructed per the submitted Phase II plans.
5. Stormwater storage for the project will be provided by two sets of basins, all of which have a combined storage volume that exceeds the minimum required. The temporary maintenance easement for Basin "A" is no longer required and will be eliminated.
6. Accompanying this report are the revised (Phase II) Civil Surface Grading and Drainage drawings (Sheets C2.0 through C 2.3) prepared by *M3 Engineering and Technology Corp.*,

dated March 13, 2012, or as modified. These new drawings show the site improvements that are, or will be, constructed by the end of Phase II activities. Later on, these same drawings will be marked "As-Built" following completion of construction and final field certification.

7. Upon completion, these "As-Built" drawings will be submitted to the City of Scottsdale for issuance of Certificates of Occupancy, and to the Flood Control District of Maricopa County for release of assurances.

8. After completion of Phase II construction, including the submittal of approved As-Built Drawings, no further construction will be allowed within the Right-of-Way for the Arizona Canal (Book 173, Page 38). Any new construction will require a new permit from the Flood Control District of Maricopa County. Contact Shelby Brown at 602-506-4583 (sjb@mail.maricopa.gov) or Mike Jones at 602-506-4718 (mjj@mail.maricopa.gov) for information about obtaining new permits, as needed.

9. Onsite runoff is directed into the new stormwater detention basins where it will be metered slowly into the new box culvert. This design effectively treats the first one-half inch (½") of stormwater runoff.

3.2 Project Phasing

The construction of the Sage Condominium project has been split into two phases. The first phase, Phase I, is now complete, and Phase II, as described in this report addendum, will be constructed when permits are issued.

Attachment #1
Site Plan and Storage Calculations

ARROYO ENGINEERING, LLC

ARROYO ENGINEERING, LLC
Water Resources & Civil Engineering Consultants

STORMWATER CALCULATION SHEET

Client: M3 Engineering		Job No. M3-3	Page 2/--
Project: Sage Condominium Project		Date Checked 03/22/12	Date 03/22/2012
Detail: Stormwater Storage Requirement		Checked by RJS	Computed by JMT

Standard Formula for Runoff Volumes for Phase II Development

1. Section 4-1.807 of the 2010 COS Design Standards and Policies Manual provides a method for calculating the total volume of stormwater runoff produced by a given area during a 100-year 2-hour frequency storm. This formula is:

$V_r = (P/12)\ A\ C$ {Equation 4-1.807.A , 2010 DS&PM}

where,

V_r = Required storage volume, in acre-feet
P = 100-year 2-hour precipitation, equal to 2.17 inches, from NOAA Atlas 14
A = Developed area, in acres, for With-Project Phase I (2.46 ac) and With-Project Phase II (2.15 ac)
C = Runoff Coefficients, from Figure 4.1-4 for Apartments & Condos (0.94) and desert landscaping (0.45)

Thus, for this project, under proposed Phase I conditions,

P = 2.17 inches of precipitation
A_I = 2.44 acres for Developed Phase I, with 1.61 acres hardscape and 0.83 acres pervious Open Space; and,
A_{II} = 2.17 acres for Undeveloped Phase II, with 1.36 acres hardscape and 0.81 acres pervious Open Space
C_I = 0.94 for hardscaped part of Developed Phase I
C_I = 0.45 for landscaped part of Developed Phase I
C_{II} = 0.94 for hardscaped part of Developed Phase II
C_{II} = 0.45 for landscaped part of Undeveloped Phase II

Substituting these values into Equation 4-1.807.A for Phase I, yields:

Vr = (P/12) A C = (2.17" / 12) x (1.61 acres hardscape) x 0.94
= 0.2733 acre-feet for hardscape areas
and Vr = (P/12) A C = (2.17" / 12) x (0.83 acres landscaped) x 0.45
= 0.0676 acre-feet for landscaped area
or Vr (sub-total) = 0.3409 acre-feet (14,849 cubic feet) required storage volume for the developed Phase I part (2.44 acres) of the project.

Also substituting these values into Equation 4-1.807.A for developed Phase II, yields:

V_r = (P/12) A C = (2.17" / 12) x (1.36 acres hardscape) x 0.94
= 0.2316 acre-feet for hardscape areas
and V_r = (P/12) A C = (2.17" / 12) x (0.81 acres landscaped) x 0.45
= 0.0659 acre-feet for landscaped area
or V_r (sub-total) = 0.2975 acre-feet (12,959cf) required storage volume for the developed imperv. + pervious Phase II parts (2.17 acres) of the project.

say, 27,810 cubic feet of total stormwater storage required for Phase I developed and Phase II developed (4.61 acres). OK

ARROYO ENGINEERING, LLC

BASE FLOOD & FINISH FLOOR ELEVATION

LOT NUMBER	BUILDING NAME	BASEFLOOD ELEV., FT (NGVD-1929)	BASEFLOOD ELEV., FT (NAVD-1988)	LOWEST LOT ELEV., FT (NGVD-1929)	LOWEST LOT ELEV., FT (NAVD-1988) (REQUIRED)	LOWEST LOT ELEV., FT (NAVD-1988) (PROVIDED)	LOWEST FINISHED FLOOR ELEV., FT (NGVD-1929)	LOWEST FINISHED FLOOR ELEV., FT (NAVD-1988) (REQUIRED)	LOWEST FINISHED FLOOR ELEV., FT (NAVD-1988) (PROVIDED)
4	CLUBHOUSE	1278.0	1279.8	1276.2	1280.0	1280.30	1279.0	1280.8	1280.8
5	BUILDING C	1277.8	1279.6	1278.3	1280.1	1280.13	1278.8	1280.6	1280.6
6	BUILDING B	1277.6	1279.4	1277.9	1279.7	1279.90	1278.6	1280.4	1280.4
7	BUILDING A	1278.5	1280.3	1279.0	1280.8	1280.80	1279.5	1281.3	1281.3

**NOTE: THE ABOVE TABLE IS USED TO CONVERT THE NGVD 1929 TO NAVD 1988 TO SHOW THE MIN. REQ'D FINISHED FLOOR ELEVATION BASE ON THE FEMA FLOOD CONTROL DOCUMENT.

RETENTION AREA DATA

BASIN	RETENTION CAPACITY (CF)	BASIN VOLUME (TRAPEZOID+TRIANGLE) VOLUME = Length * [(Top width+bot. width)*ave. depth/2+bott width*depth/2] (CF)	BLEED-OFF ORIFICE COUNT, SIZE & RATE (12 TO 24 HRS)
A	21490	-	-
4	3450	=(178)*((20+12)*0.9/2+12*0.83/2)	2 EA, 0.92", 15.8 HRS
5	4670	=(85+190)*((20+12)*0.75/2+12*0.83/2)	3 EA, 0.85", 12.5 HRS
6	2450	=(146+85)*((20+12)*0.5/2+12*0.22/2)	3 EA, 0.63", 12.8 HRS
7	1320	=120*((20+12)*0.5/2+12*0.5/2)	1 EA, 0.85", 12.8 HRS
TOTAL	33382		

*4:1 MAX. SIDE-SLOPE USED.

SITE AREA DATA

LOT AREA:
- GROSS AREA: ±5.38 ACRES (234,546 SQ. FT.)
- NET AREA: ±4.61 ACRES (200,840 SQ. FT.)
  - -PHASE I ±2.44 ACRES (106,221 SQ. FT.)
  - -PHASE II ±2.17 ACRES (94,619 SQ. FT.)

OPEN SPACE: (MINIMUM)
- REQUIRED: 28% 56,240 SQ. FT.
- PROVIDED: ± 65% 131,116 SQ. FT.
- PHASE I BLDG. AREA: ± 34% 36,525 SQ. FT.

STORMWATER CAPACITY IN PROPOSED SWALES AND BASIN "A":
- PROVIDED INSIDE PROPERTY: 33,382± CU. FT.
- RETENTION AREA REQUIRMENT: 22,555± CU. FT.

DRAINAGE CALCULATIONS:

RUNOFF VOLUMES:

$V_R = (P/12)*A*C$

WHERE... V_R = REQUIRED STORAGE VOLUME (AC-FT)
P = 100-YR, 2-HR PRECIPITATION (INCHES)
A = DEVELOPED AREA (ACRES)
C = RUNOFF COEFFICIENT

HARDSCAPE/BUILDINGS:

$V_{R1} = (2.17/12)*1.61*0.94$
$= 0.274$ AC-FT
$V_{R1} = 11,921$ CF

LANDSCAPE:

$V_{R2} = (2.17/12)*.83*0.45$
$= 0.068$ AC-FT
$V_{R2} = 2,942$ CF

PHASE II AREA OPEN SPACE:

$V_{R3} = (2.17/12)*2.17*0.45$
$= 0.177$ AC-FT
$V_{R3} = 7,692$ CF

TOTAL REQUIRED VOLUME:

$V_T = 11,921+2,942+7,692$
$= 22,555$ CF
$V_T = 836$ CY

"AS-BUILT" BASIN VOLUMES:

BASIN 4–	686 CF
BASIN 5–	1,114 CF
BASIN 6–	987 CF
BASIN 7–	288 CF
TOTAL–	3,075 CF
ORIGINAL DESIGN–	12,500 CF
VOLUME SHORTAGE–	9,425 CF

BASIN "A" CALCULATIONS:

VOLUME REQUIRED–

$V_R = 22,555-3,075$
$= 19,480$ CF
$V_R = 722$ CY

VOLUME PROVIDED–

$V_P = 21,490$ CF
$V_P = 796$ CY

VOLUME OF EARTHWORK

EXCAVATION	BACKFILL	NET
2,030 CY	2,030 CY	0 CY

ESTIMATED QUANTITY TABLE

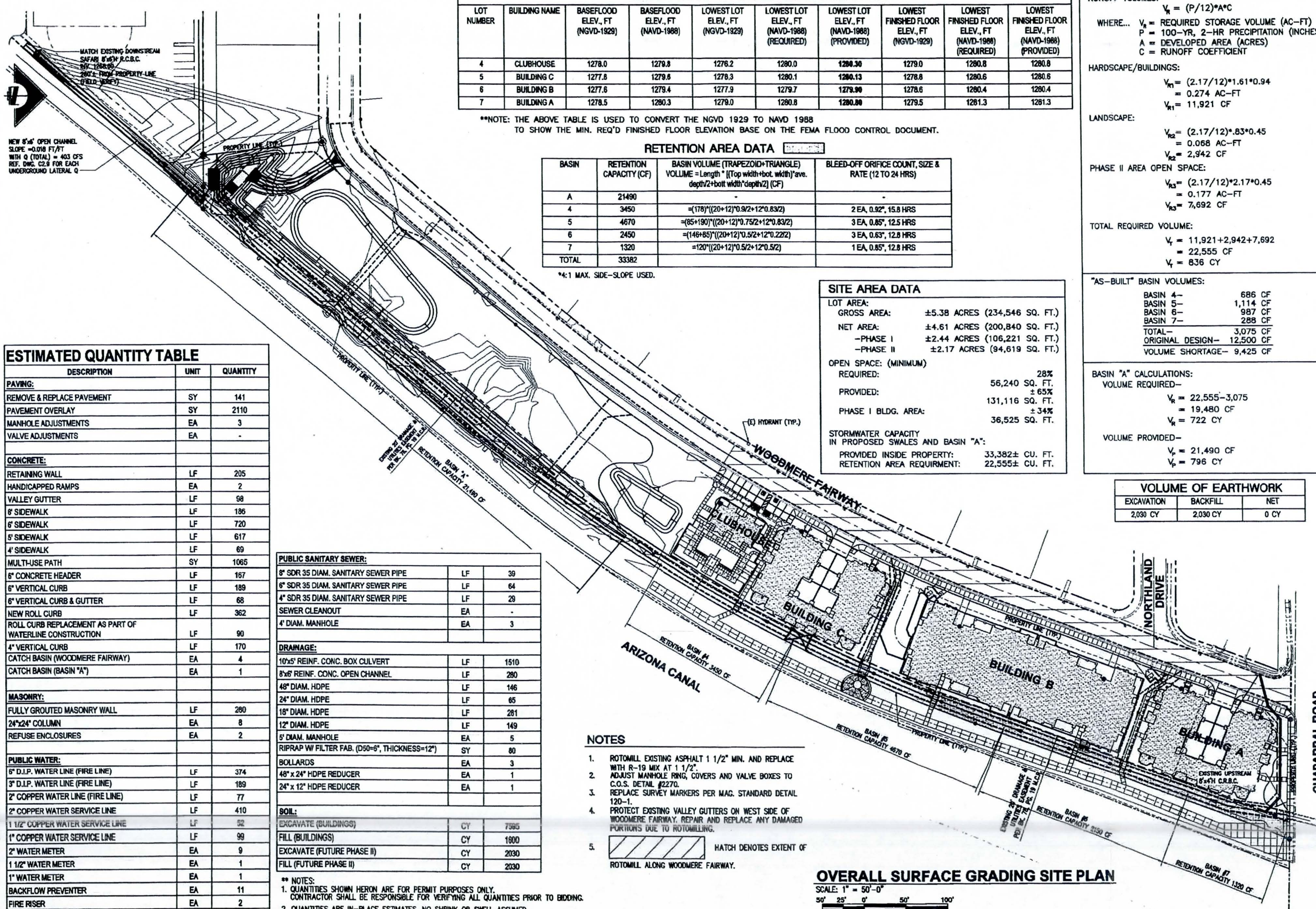
DESCRIPTION	UNIT	QUANTITY
PAVING:		
REMOVE & REPLACE PAVEMENT	SY	141
PAVEMENT OVERLAY	SY	2110
MANHOLE ADJUSTMENTS	EA	3
VALVE ADJUSTMENTS	EA	-
CONCRETE:		
RETAINING WALL	LF	205
HANDICAPPED RAMPS	EA	2
VALLEY GUTTER	LF	98
8' SIDEWALK	LF	186
6' SIDEWALK	LF	720
5' SIDEWALK	LF	617
4' SIDEWALK	LF	69
MULTI-USE PATH	SY	1065
6" CONCRETE HEADER	LF	167
6" VERTICAL CURB	LF	189
6" VERTICAL CURB & GUTTER	LF	68
NEW ROLL CURB	LF	362
ROLL CURB REPLACEMENT AS PART OF WATERLINE CONSTRUCTION	LF	90
4" VERTICAL CURB	LF	170
CATCH BASIN (WOODMERE FAIRWAY)	EA	4
CATCH BASIN (BASIN "A")	EA	1
MASONRY:		
FULLY GROUTED MASONRY WALL	LF	280
24"x24" COLUMN	EA	8
REFUSE ENCLOSURES	EA	2
PUBLIC WATER:		
6" D.I.P. WATER LINE (FIRE LINE)	LF	374
3" D.I.P. WATER LINE (FIRE LINE)	LF	189
2" COPPER WATER LINE (FIRE LINE)	LF	77
2" COPPER WATER SERVICE LINE	LF	410
1 1/2" COPPER WATER SERVICE LINE	LF	52
1" COPPER WATER SERVICE LINE	LF	99
2" WATER METER	EA	9
1 1/2" WATER METER	EA	1
1" WATER METER	EA	1
BACKFLOW PREVENTER	EA	11
FIRE RISER	EA	2
6" x 6" TAPPING SLEEVE	EA	2

DESCRIPTION	UNIT	QUANTITY
PUBLIC SANITARY SEWER:		
8" SDR 35 DIAM. SANITARY SEWER PIPE	LF	39
6" SDR 35 DIAM. SANITARY SEWER PIPE	LF	64
4" SDR 35 DIAM. SANITARY SEWER PIPE	LF	29
SEWER CLEANOUT	EA	-
4' DIAM. MANHOLE	EA	3
DRAINAGE:		
10'x5' REINF. CONC. BOX CULVERT	LF	1510
8'x6' REINF. CONC. OPEN CHANNEL	LF	280
48" DIAM. HDPE	LF	146
24" DIAM. HDPE	LF	65
18" DIAM. HDPE	LF	281
12" DIAM. HDPE	LF	149
5' DIAM. MANHOLE	EA	5
RIPRAP W/ FILTER FAB. (D50=6", THICKNESS=12")	SY	80
BOLLARDS	EA	3
48" x 24" HDPE REDUCER	EA	1
24" x 12" HDPE REDUCER	EA	1
SOIL:		
EXCAVATE (BUILDINGS)	CY	7595
FILL (BUILDINGS)	CY	1600
EXCAVATE (FUTURE PHASE II)	CY	2030
FILL (FUTURE PHASE II)	CY	2030

** NOTES:
1. QUANTITIES SHOWN HERON ARE FOR PERMIT PURPOSES ONLY. CONTRACTOR SHALL BE RESPONSIBLE FOR VERIFYING ALL QUANTITIES PRIOR TO BIDDING.
2. QUANTITIES ARE IN-PLACE ESTIMATES, NO SHRINK OR SWELL ASSUMED.

NOTES

1. ROTOMILL EXISTING ASPHALT 1 1/2" MIN. AND REPLACE WITH R-19 MIX AT 1 1/2".
2. ADJUST MANHOLE RING, COVERS AND VALVE BOXES TO C.O.S. DETAIL #2270.
3. REPLACE SURVEY MARKERS PER MAG. STANDARD DETAIL 120-1.
4. PROTECT EXISTING VALLEY GUTTERS ON WEST SIDE OF WOODMERE FAIRWAY. REPAIR AND REPLACE ANY DAMAGED PORTIONS DUE TO ROTOMILLING.
5. HATCH DENOTES EXTENT OF ROTOMILL ALONG WOODMERE FAIRWAY.



OVERALL SURFACE GRADING SITE PLAN

SCALE: 1" = 50'-0"

50' 25' 0' 50' 100'

1"=50'-0"

SAGE CONDOMINIUMS - PHASE I

7445 EAST CHAPARRAL ROAD
SCOTTSDALE, ARIZONA 85251

M3 Engineering & Technology Corp.
Tucson, Arizona Tel.(520)293-1488 Fax.(520)293-8349
Chandler, Arizona Tel.(480)753-3607 Fax.(480)753-3617
Hermosillo, Sonora Mexico Tel. 011-52-622-2105400 Fax. 011-52-622-2105404
M3-PN115005

Revisions

Description	Date

Drawn: RWB
Checked: MWO
Date: 04/03/12

Drawing Title: OVERALL SURF. GRADING SITE PLAN

Sheet Number: C1.1

PLAN CHECK #6850-06-5

APPENDIX E

Exhibits

1"=400'

EXHIBIT A

P:\STR00000001\0400CAD\HY\HY-001-STR0001-Offsite Drainage.dwg fmk Nov 07, 2013 4:30:37pm

		REVISION	BY
DATE			

DRAWN BY: GSM
DESIGN BY:
CHECKED BY: FMK
DATE: 9/2013

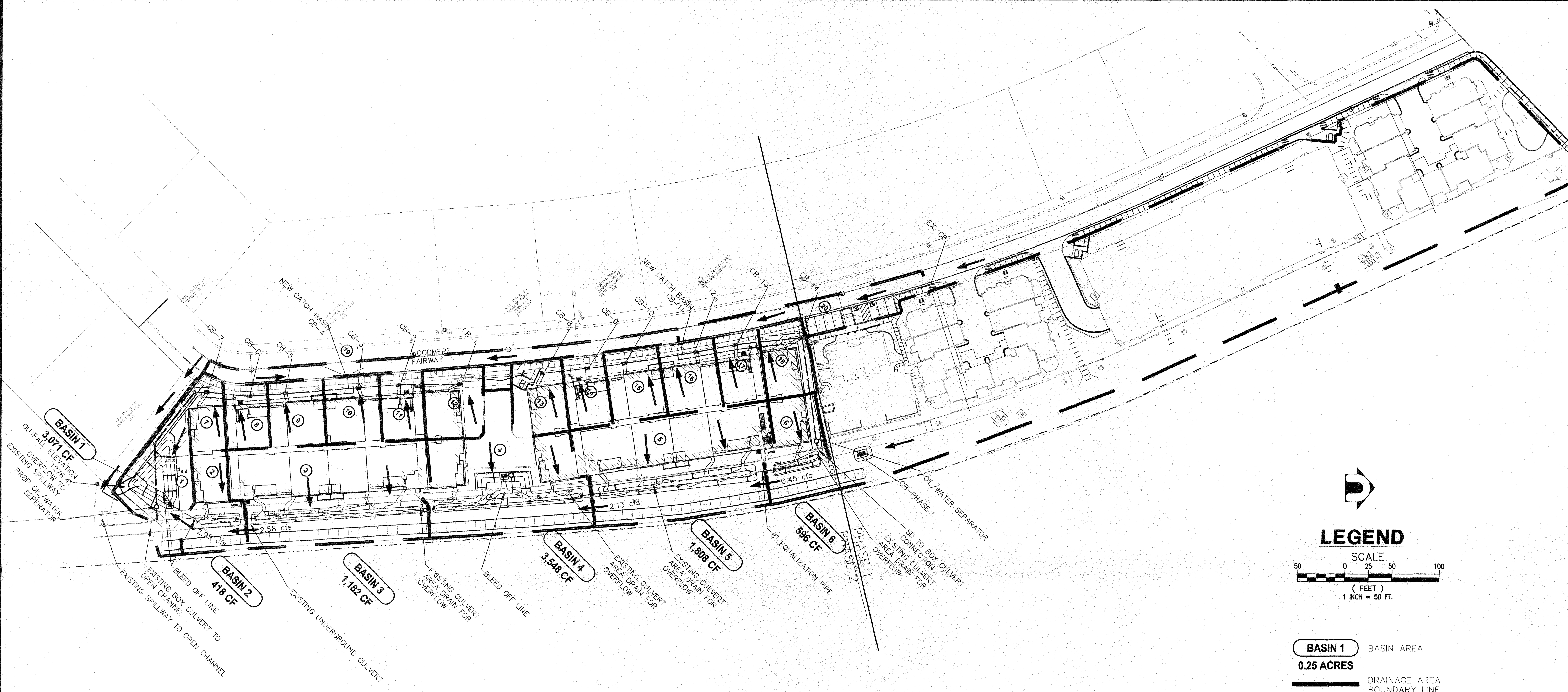
DAVID EVANS AND ASSOCIATES INC.
4600 East Washington Street, Suite 430
Phoenix Arizona 85034
Phone: 602.678.5151

OFFSITE DRAINAGE MAP
SAGE RESIDENTIAL - PHASE II
SCOTTSDALE, ARIZONA

SECTION: 23
TWNSHP: 2N
RANGE: 4E

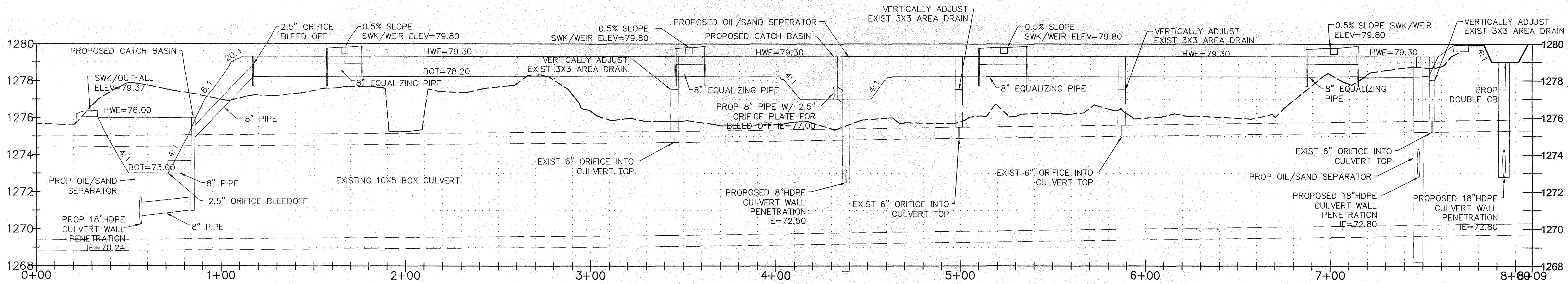
SHEET 1 OF 1

JOB NO.: STRS0001



11/11/13

ULTIMATE WEIR ELEVATION ALONG CANAL IS AT ELEVATION 1279.50 BLUE SKY DEVELOPMENT. TOP OF BANK ELEVATION 1279.20 NEAR THE SOUTHEAST CORNER OF BLUE SKY.



RETENTION BASIN PROFILE SECTION
SCALE 1:30H
1:3V

P:\ISTR00000001\0400CAD\HY\HY-001-ISTR0001.dwg vrr Nov 12, 2013 10:35:25am

DESIGNED BY: VRR
DRAWN BY: JCF/VRR
CHECKED BY: RYG
DATE: 11-11-2013
PROJECT MANAGER: BOYCE O'BRIEN

DATE	REVISION	BY

PROMPT PAYMENT NOTICE
The Owner is familiar with the "Arizona Prompt Payment Law" and payments will comply with the 30-day billing cycle, 14-day approval provision and the 7-day payment cycle.

DAVID EVANS AND ASSOCIATES INC.
4600 East Washington Street, Suite 430
Phoenix, Arizona 85034
Phone: 602.678.5151

EXHIBIT B. DRAINAGE MAP
SAGE RESIDENTIAL
7445 EAST CHAPARRAL ROAD
SCOTTSDALE, ARIZONA

PLAN CHECK # 6850-06-08 QS 18-45

SCALE: 1"=30'
SECTION: 23
TWNSHP: 2N
RANGE: 4E
JOB NO.: ISTR0001
SHEET 1 OF 1

APPENDIX F

Storm Water Pollution Prevention Plan
ADEQ NOI Certificate

STORM WATER MANAGEMENT PLAN
SAGE RESIDENTIAL

LOTS 22 THROUGH 35 OF PARADISE VILLAGE,
SITUATED IN THE NORTHWEST QUARTER OF SECTION 23,
TOWNSHIP 2 NORTH, RANGE 4 EAST OF THE GILA AND SALT RIVER MERIDIAN,
MARICOPA COUNTY, ARIZONA

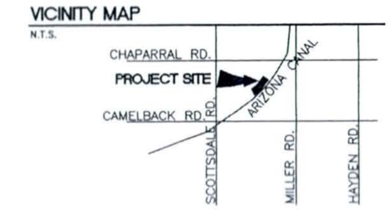
OWNER
7445 EAST CHAPARRAL ROAD, SCOTTSDALE, LLC
1501 EAST ORANGETHORPE AVE,
SUITE 200
FULLTERTON, CA 92831

ADDRESS
7445 EAST CHAPARRAL ROAD
SCOTTSDALE, ARIZONA 85251

SITE ARCHITECT
TODD AND ASSOCIATES ARCHITECTURE
4019 NORTH 44TH STREET,
PHOENIX, AZ 85018
CONTACT: BRENT BIESER
602-952-8280

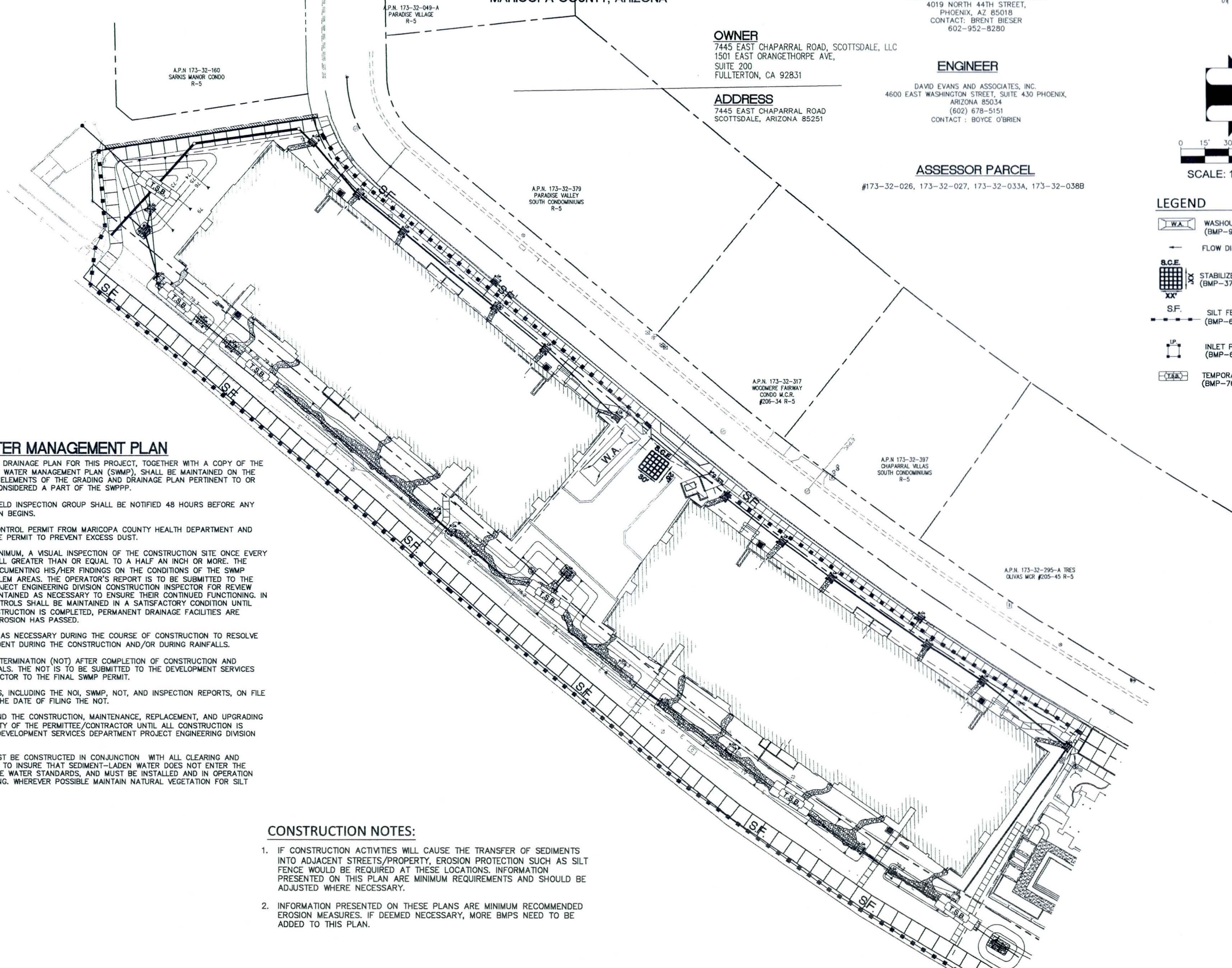
ENGINEER
DAVID EVANS AND ASSOCIATES, INC.
4600 EAST WASHINGTON STREET, SUITE 430 PHOENIX,
ARIZONA 85034
(602) 678-5151
CONTACT : BOYCE O'BRIEN

ASSESSOR PARCEL
#173-32-026, 173-32-027, 173-32-033A, 173-32-038B



SCALE: 1"= 30'

LEGEND
- W.A. WASHOUT AREA (BMP-99)
- FLOW DIRECTION
- S.C.E. STABILIZED CONSTRUCTION ENTRANCE (BMP-37, 38, 39)
- S.F. SILT FENCE (BMP-63, 68)
- I.P. INLET PROTECTION (BMP-69, 72, 73)
- T.S.B. TEMPORARY SETTLING BASIN (BMP-76)



NOTES FOR STORM WATER MANAGEMENT PLAN

1. A COPY OF THE APPROVED GRADING AND DRAINAGE PLAN FOR THIS PROJECT, TOGETHER WITH A COPY OF THE NOTICE OF INTENT (NOI) AND THIS STORM WATER MANAGEMENT PLAN (SWMP), SHALL BE MAINTAINED ON THE SITE AND AVAILABLE FOR REVIEW. THOSE ELEMENTS OF THE GRADING AND DRAINAGE PLAN PERTINENT TO OR REFERENCED ON THE SWPPP SHALL BE CONSIDERED A PART OF THE SWPPP.
2. DEVELOPMENT SERVICES DEPARTMENT'S FIELD INSPECTION GROUP SHALL BE NOTIFIED 48 HOURS BEFORE ANY ON-SITE AND/OR OFF-SITE CONSTRUCTION BEGINS.
3. THE OPERATOR SHALL OBTAIN A DUST CONTROL PERMIT FROM MARICOPA COUNTY HEALTH DEPARTMENT AND PERFORM MEASURES AS REQUIRED BY THE PERMIT TO PREVENT EXCESS DUST.
4. THE OPERATOR SHALL PERFORM, AT A MINIMUM, A VISUAL INSPECTION OF THE CONSTRUCTION SITE ONCE EVERY MONTH AND WITHIN 24 HOURS OF RAINFALL GREATER THAN OR EQUAL TO A HALF AN INCH OR MORE. THE OPERATOR SHALL PREPARE A REPORT DOCUMENTING HIS/HER FINDINGS ON THE CONDITIONS OF THE SWMP CONTROLS AND NOTE ANY EROSION PROBLEM AREAS. THE OPERATOR'S REPORT IS TO BE SUBMITTED TO THE DEVELOPMENT SERVICES DEPARTMENT PROJECT ENGINEERING DIVISION CONSTRUCTION INSPECTOR FOR REVIEW AND APPROVAL. FACILITIES SHALL BE MAINTAINED AS NECESSARY TO ENSURE THEIR CONTINUED FUNCTIONING. IN ADDITION, ALL TEMPORARY SILTATION CONTROLS SHALL BE MAINTAINED IN A SATISFACTORY CONDITION UNTIL SUCH TIME THAT CLEARING AND/OR CONSTRUCTION IS COMPLETED, PERMANENT DRAINAGE FACILITIES ARE OPERATIONAL, AND THE POTENTIAL FOR EROSION HAS PASSED.
5. THE OPERATOR SHALL AMEND THIS PLAN AS NECESSARY DURING THE COURSE OF CONSTRUCTION TO RESOLVE ANY PROBLEM AREAS WHICH BECOME EVIDENT DURING THE CONSTRUCTION AND/OR DURING RAINFALLS.
6. THE PERMITTEE SHALL FILE A NOTICE OF TERMINATION (NOT) AFTER COMPLETION OF CONSTRUCTION AND PLACEMENT OF FINAL LANDSCAPE MATERIALS. THE NOT IS TO BE SUBMITTED TO THE DEVELOPMENT SERVICES DEPARTMENT PROJECT ENGINEERING INSPECTOR TO THE FINAL SWMP PERMIT.
7. THE PERMITTEE SHALL SAVE ALL RECORDS, INCLUDING THE NOI, SWMP, NOT, AND INSPECTION REPORTS, ON FILE FOR A MINIMUM OF THREE YEARS FROM THE DATE OF FILING THE NOT.
8. THE IMPLEMENTATION OF THESE PLANS AND THE CONSTRUCTION, MAINTENANCE, REPLACEMENT, AND UPGRADING OF THESE FACILITIES IS THE RESPONSIBILITY OF THE PERMITTEE/CONTRACTOR UNTIL ALL CONSTRUCTION IS APPROVED AND NOT SUBMITTED TO THE DEVELOPMENT SERVICES DEPARTMENT PROJECT ENGINEERING DIVISION INSPECTOR.
9. THE FACILITIES SHOWN ON THIS PLAN MUST BE CONSTRUCTED IN CONJUNCTION WITH ALL CLEARING AND GRADING ACTIVES IN SUCH A MANNER AS TO INSURE THAT SEDIMENT-LADEN WATER DOES NOT ENTER THE DRAINAGE SYSTEM OR VIOLATE APPLICABLE WATER STANDARDS, AND MUST BE INSTALLED AND IN OPERATION PRIOR TO ANY GRADING OR LAND CLEARING. WHEREVER POSSIBLE MAINTAIN NATURAL VEGETATION FOR SILT CONTROL.

CONSTRUCTION NOTES:

1. IF CONSTRUCTION ACTIVITIES WILL CAUSE THE TRANSFER OF SEDIMENTS INTO ADJACENT STREETS/PROPERTY, EROSION PROTECTION SUCH AS SILT FENCE WOULD BE REQUIRED AT THESE LOCATIONS. INFORMATION PRESENTED ON THIS PLAN ARE MINIMUM REQUIREMENTS AND SHOULD BE ADJUSTED WHERE NECESSARY.
2. INFORMATION PRESENTED ON THESE PLANS ARE MINIMUM RECOMMENDED EROSION MEASURES. IF DEEMED NECESSARY, MORE BMPS NEED TO BE ADDED TO THIS PLAN.

Call at least two full working days before you begin excavation. ARIZONA 811 Arizona Blue Stake, Inc. Dial 8-1-1 or 1-800-STAKE-IT (782-5348) In Maricopa County: (602) 263-1100

P:\VSTR00000001\0400CAD\EC\Sheets\SWMP\EC-001-ISTR0001.dwg vrr Oct 14, 2013 9:21:42am

PROJECT MANAGER: BOYCE O'BRIEN

DATE	REVISION	BY

DESIGNED BY: VRR
DRAWN BY: JCF/VRR
CHECKED BY: RYG
DATE: 10-12-2013

PROMPT PAYMENT NOTICE
The Owner is familiar with the "Arizona Prompt Payment Law" and payments will comply with the 30-day billing cycle, 14-day approval provision and the 7-day payment cycle.

DAVID EVANS AND ASSOCIATES INC.
4600 East Washington Street, Suite 430
Phoenix, Arizona 85034
Phone: 602.678.5151

Registered Professional Engineer (Civil) Certificate No. 54749 VICENTE RUIZ Date Signed 10/14/13 ARIZONA U.S.A.
EXP: 6/30/2016

STORMWATER MANAGEMENT PLAN
SAGE RESIDENTIAL
7445 EAST CHAPARRAL ROAD
SCOTTSDALE, ARIZONA

SCALE:

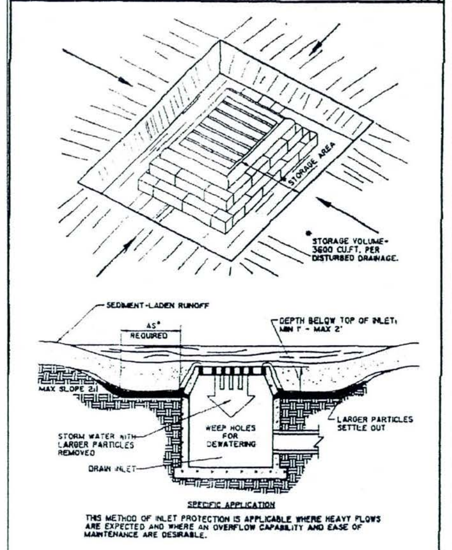
SECTION: 23
TWNSHP: 2N
RANGE: 4E

JOB NO.: ISTR0001

SHEET EC1 OF 7

PLAN CHECK # 6850-06-08 QS 18-45

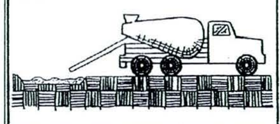
SYMBOL	STORM DRAIN INLET PROTECTION	5 of 6
I.P.		



EXCAVATED DROP INLET SEDIMENT TRAP

SYMBOL	DESIGNATED WASHOUT AREA	1 of 2
W.A.		

DIAGRAM



CONDITIONS WHERE PRACTICE APPLIES
- PERIMETER CONTROL
- SLOPE PROTECTION
- SEDIMENT TRAPPING
- DRAINAGEWAY & STREAM PROTECTION
- TEMPORARY STABILIZATION
- PERMANENT STABILIZATION & EXPOSURE LIMITS
- • NON-SEDIMENT POLLUTION CONTROL

DEFINITION

A temporary pit or bermed area for washout of concrete trucks, tools, mortar mixers, etc.

PURPOSE

Improper washout of concrete trucks, tools, etc. may allow fresh concrete or cement laden mortar to enter a storm drainage system.

APPROPRIATE APPLICATIONS

Effective when vehicles, tools, and mixers can be moved to the pit location. Where this is not practical, temporary ponds may be constructed to allow for settling and hardening of cement and aggregates. Washout area/pits are appropriate for minor amounts of wash water which result from cleaning of aggregate materials or concrete trucks, tools, etc.

PLANNING CONSIDERATIONS

1. Wash out into a slurry pit which will later be backfilled. Do this only with the approval of the property owner.
2. Wash out into a temporary pit where the concrete wash can harden, be broken up, and then properly disposed of off-site.

SYMBOL	DESIGNATED WASHOUT AREA	2 of 2
W.A.		

DESIGN & SIZING CRITERIA

1. Locate wash out pits away from storm drains, open ditches, or stormwater receiving waters.
2. DO NOT wash out concrete trucks into storm drains, sanitary sewers, street gutters, or stormwater channels.

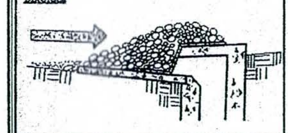
MAINTENANCE REQUIREMENTS

Properly dispose of hardened concrete products on a routine basis to prevent the buildup of waste materials to an unmanageable size and to maintain percolation of water.

Reference (14)

SYMBOL	STORM DRAIN INLET PROTECTION	1 of 6
I.P.		

DIAGRAM



CONDITIONS WHERE PRACTICE APPLIES
- PERIMETER CONTROL
- SLOPE PROTECTION
- • SEDIMENT TRAPPING
- • DRAINAGEWAY & STREAM PROTECTION
- TEMPORARY STABILIZATION
- PERMANENT STABILIZATION & EXPOSURE LIMITS
- NON-SEDIMENT POLLUTION CONTROL

DEFINITION

A sediment filter or an excavated impounding area around a storm drain, drop inlet, or curb inlet.

PURPOSE

To prevent sediment from entering storm drainage systems prior to permanent stabilization of the disturbed area.

APPROPRIATE APPLICATIONS

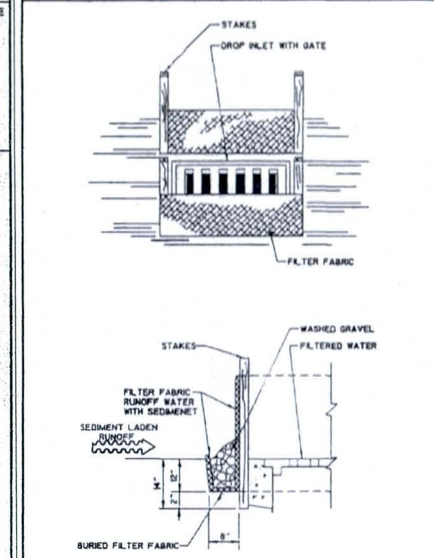
Where storm drain inlets are to be made operational before permanent stabilization of the disturbed drainage area. Different types of structures are applicable to different conditions:

a. Filter Fabric Fence - Applicable where the inlet drains a relatively small (less than 1 acre) flat area (less than 5 percent slope). Do not place fabric under grate as the collected sediment may fall into the drain when the fabric is retrieved.

b. Excavated Drop Inlet Sediment Trap - Protection against sediment entering a storm drain inlet can be provided by excavating an area in the approach to the drain. The drainage area for a drain protected in this manner is one acre. Provide weep holes to drain the shallow pool.

- Advantages:
  - Inlet protection prevents sediment from entering the storm drain system and clogging it.

SYMBOL	STORM DRAIN INLET PROTECTION	4 of 6
I.P.		



FILTER FABRIC FENCE DROP INLET FILTER

SYMBOL	TEMPORARY SEDIMENT BASIN	2 of 6
T.S.B.		

PLANNING CONSIDERATIONS

Sediment traps should be used only for small drainage areas. If the contributing drainage area is greater than 10 acres, refer to Sediment Ponds, or subdivide the catchment area into smaller drainage basins.

Sediment must be removed from the trap after each rainfall event. Plans shall detail how this sediment is to be disposed of, such as by use in fill areas on-site, or removal to an approved off-site dump. Sediment traps, along with other perimeter controls, shall be installed before any land disturbance takes place in the drainage area.

Sediment traps and ponds must be installed only on sites where failure of the structure would not result in loss of life, damage to home or buildings, or interruption of use of or service public roads or utilities. Also, sediment traps and ponds are attractive to children and can be dangerous. The following recommendations should be implemented to reduce risks.

1. Install continuous fencing around the sediment trap or pond. Consult local ordinances regarding requirements for maintaining health and safety.
2. Restrict basin side slopes to 3:1 or flatter.

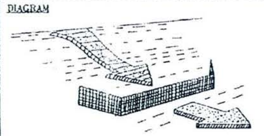
DESIGN & SIZING CRITERIA

The sediment trap may be formed completely by excavation or by construction of a compacted embankment. It shall have a 1.5 foot deep sump for sediment storage. The outlet shall be a weir/spillway section, with the area below the weir acting as a filter for sediment and the upper area as the overflow spillway depth.

The effectiveness of sediment traps is directly related to the size of the trap. In Maricopa County the recommended sediment trap size is 3600 cubic feet per acre of disturbed upstream drainage area for drainage areas of 10 acres or less. This roughly equates to a trap volume necessary to pond the precipitation from a 1 inch rain event.

SYMBOL	SILT FENCE BMP 63	1 of 6
S.F.		

DIAGRAM



CONDITIONS WHERE PRACTICE APPLIES
- • PERIMETER CONTROL
- SLOPE PROTECTION
- • SEDIMENT TRAPPING
- DRAINAGEWAY & STREAM PROTECTION
- TEMPORARY STABILIZATION
- PERMANENT STABILIZATION & EXPOSURE LIMITS
- NON-SEDIMENT POLLUTION CONTROL

DEFINITION

A temporary sediment barrier consisting of a filter fabric stretched across and attached to supporting posts, entrenched, and, depending upon the strength of the fabric used, with wire fence for support.

PURPOSE

1. To intercept and detain small amounts of sediment from disturbed areas during construction operations in order to prevent sediment from leaving the site.
2. To decrease the velocity of sheet flows and low-to-moderate level channel flows.

APPROPRIATE APPLICATIONS

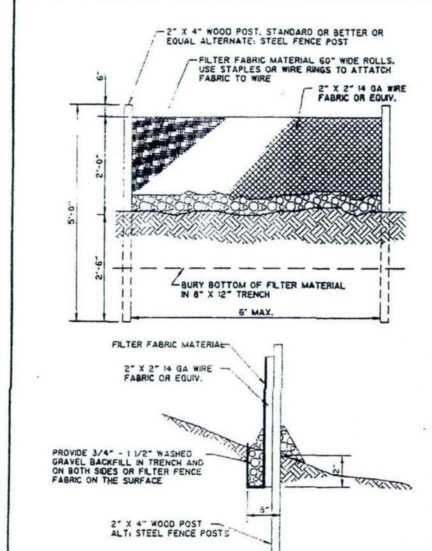
Filter fences must be provided just upstream of the point(s) of discharge of runoff from a site, before the flow becomes concentrated. They may also be used:

1. Below disturbed areas where runoff may occur in the form of sheet and rill erosion; wherever runoff has the potential to impact downstream resources.
2. Perpendicular to minor swales or ditch lines for up to one acre contributing drainage areas.

Not intended for use in detaining concentrated flows.

Synthetic fabric filter fences are only applicable for sheet or overland flows and not the volumes of water in concentrated flows.

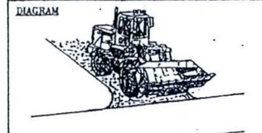
SYMBOL	SILT FENCE BMP 68	6 of 6
S.F.		



SILT FENCE

SYMBOL	STABILIZED CONSTRUCTION ENTRANCE BMP 37	1 of 4
S.C.E.		

DIAGRAM



CONDITIONS WHERE PRACTICE APPLIES
- PERIMETER CONTROL
- SLOPE PROTECTION
- • SEDIMENT TRAPPING
- DRAINAGEWAY & STREAM PROTECTION
- • TEMPORARY STABILIZATION
- PERMANENT STABILIZATION & EXPOSURE LIMITS
- • NON-SEDIMENT POLLUTION CONTROL

DEFINITION

A stabilized pad of aggregate underlain with filter cloth located at any point where traffic will be entering or leaving a construction site to or from a public right-of-way, street, alley, sidewalk or parking area.

PURPOSE

The purpose of a stabilized construction entrance is to reduce or eliminate the tracking of sediment onto public rights-of-way or streets. Reducing trackout of sediments and other pollutants onto paved roads helps prevent deposition of sediments into local storm drains and production of airborne dust.

APPROPRIATE APPLICATIONS

A stabilized construction entrance should be used at all points of construction ingress and egress. NPDES permits require that appropriate measures be implemented to prevent trackout of sediments onto paved roadways.

LIMITATIONS

The stabilized construction entrance plan should be reviewed as part of the project traffic control plan.

- Construct on level ground.
- Stabilized construction entrances are rather expensive to construct and when a wash rack is included, a sediment trap of some kind must also be provided to collect wash water runoff.

SYMBOL	STABILIZED CONSTRUCTION ENTRANCE BMP 38	2 of 4
S.C.E.		

PLANNING CONSIDERATIONS

Stabilized construction entrances are not very effective in removing sediment from equipment leaving a construction site. Efficiency is greatly increased, though when a washing rack is included as part of a stabilized construction entrance. Build on level ground.

- Advantages:
  - Does remove some sediment from equipment and serves to channel construction traffic in and out of the site.

DESIGN & SIZING CONSIDERATIONS

The aggregate for stabilized construction entrance aprons shall be 1 to 3 inches in size, washed, well-graded gravel or crushed rock. The apron dimensions recommended are 30 ft. x 50 ft. and 6 inches deep.

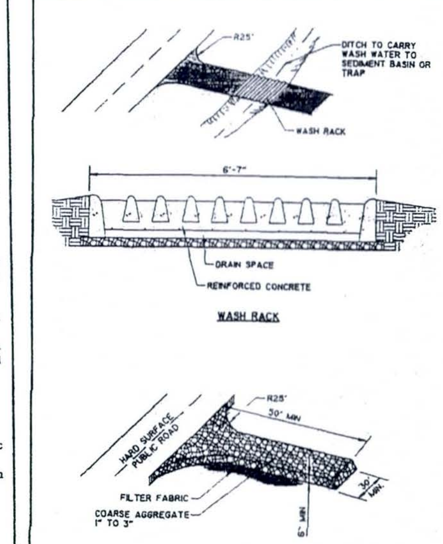
- Entrance must be properly graded to prevent runoff from leaving the construction site.
- When wash areas are provided, washing shall be done on an area stabilized with crushed stone which drains into a properly constructed sediment trap or basin (pond).

MAINTENANCE REQUIREMENTS

- Inspect monthly and after each rainfall.
- Replace gravel mat when surface voids are no longer visible. Periodic top dressing with additional stone will be required.
- All sediments deposited on paved roadways must be removed within 24 hours.
- Remove gravel and filter fabric upon completion of construction.

References (1,2)

SYMBOL	STABILIZED CONSTRUCTION ENTRANCE BMP 39	3 of 4
S.C.E.		



STABILIZED CONSTRUCTION ENTRANCE

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DESIGNED BY: VRR	PROJECT MANAGER: BOYCE O'BRIEN
DRAWN BY: JCF/VRR	
CHECKED BY: RYG	
DATE: 10-12-2013	

DATE	REVISION	BY

PROMPT PAYMENT NOTICE

The Owner is familiar with the "Arizona Prompt Payment Law" and payments will comply with the 30-day billing cycle, 14-day approval provision and the 7-day payment cycle.

DAVID EVANS AND ASSOCIATES INC.
4600 East Washington Street, Suite 430
Phoenix, Arizona 85034
Phone: 602.678.5151

EXP: 6/30/2016

STORM WATER MANAGEMENT PLAN

SAGE RESIDENTIAL
7445 EAST CHAPARRAL ROAD
SCOTTSDALE, ARIZONA

SCALE:

SECTION: 23
TWNSHP: 2N
RANGE: 4E

Call at least two full working days before you begin excavation. ARIZONA 811 Arizona Blue Stake, Inc. Dial 8-1-1 or 1-800-STAKE-IT (782-5348) In Maricopa County: (602) 263-1100

JOB NO.: ISTR0001

SHEET EC2 OF 7

PLAN CHECK # 6850-06-08 QS 18-45

Form# appr031c

ADEQ

Notice of Intent (NOI) for Stormwater Discharges Associated with Construction Activity Under the AZPDES General Permit

Arizona Department of Environmental Quality
1110 West Washington Street, 5415A-1 • Phoenix, Arizona 85007
(Office) 602-771-7614 • (Fax) 602-771-4528

Notice of Intent (NOI) Certificate

Authorization Number: AZCON-531898

Approval Date: 10/16/2013

Application Information:

ID Number:	531898
Name:	SAGE RESIDENTIAL
Received:	10/10/2013
Inventory #:	106375
Type:	GEN-CONST
Prior Permit:	

Owner/Operator:

First:	STEVE
Last	STINSON
Phone:	(714) 961-4774
Business:	7445 E CHAPARRAL ROAD - SCOTTSDALE LLC
Fax:	(714) 961-4701
Address:	4350 VON KARMAN, SUITE 225
City:	NEWPORT BEACH
State:	CA
Zip:	92660

Facility/Site:

Start Date:	11/01/2013
End Date:	11/01/2015
Facility Type:	OTHER
County Parcel No:	173-32-506
Business:	SAGE RESIDENTIAL
Address:	7445 E CHAPPARAL ROAD
City:	SCOTTSDALE, AZ 85250
Access:	
Phone:	(602) 376-1085
County:	MARICOPA

Subdivision/Other Permits:

Subdivision Approval? N

Other IDs:

Latitude:	333024.23
Longitude:	1115517.46
Watershed:	MIDDLE GILA
Closest Water:	ARIZONA CANAL
Perennial Water:	SALT RIVER
1/4 mile of impaired or unique water?	No
Discharge into municipal conveyance?	Yes
System Owner (Conveyance):	BUREAU OF RECLAMATION
Total acres Disturbed – Project	3
Total acres Disturbed – Operations	3.00
Within 2.5 Miles of a perennial or intermittent water?	N
Distance (miles) from perennial water to site:	11.75

Stormwater Pollution Prevention Plan (SWPPP):

First:	KENNY
Last:	GUADIANA
Phone:	(602) 376-1085
Business:	SAGE RESIDENTIAL
SWPPP Confirmation:	Y
Address:	7445 E CHAPPARAL ROAD
City:	SCOTTSDALE
State:	AZ
Zip:	85250
SWPPP Submitted:	N

Certification:

First:	STEVE
Last:	STINSON
Phone:	(714) 961-4774
Business:	7445 EAST CHAPARRAL ROAD - SCOTTSDALE LLC
Certification Signed:	Y
Address:	4350 VON KARMAN, SUITE 225
City:	NEWPORT BEACH
State:	CA
Zip:	92660