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PRELIMINARY DRAINAGE REPORT

Chauncey Lane Marketplace

Scottsdale, Arizona

Prepared For:

JLB Partners, LP

Expires: 9/30/17

191447014
October 2016

Kimley»Horn

PRELIMINARY DRAINAGE REPORT

Chauncey Lane Marketplace

Scottsdale, Arizona

Prepared For:

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191447014
October 2016

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1.0 Introduction

1.1 Project Description

JLB Partners is proposing to construct a mixed-use development on a portion of Crossroads East Planning Unit IV (Planning Unit IV) at the southeast corner of Scottsdale Road and Chauncey Lane. The project is anticipated to consist of apartment buildings and restaurant/retail buildings with associated parking and infrastructure improvements.

1.2 Site Location

The proposed development encompasses approximately 11.3± net acres in a portion of the Northwest Quarter of Section 35, Township 4 North, Range 4 East of the Gila and Salt River Base and Meridian in Maricopa County, Arizona. The site is a portion of Planning Unit IV (138± acres), and is currently zoned PCD. More specifically, the parcel is bounded by Chauncey Lane to the north, vacant undeveloped land to the east and south, and Scottsdale Road to the west. See Appendix A for the site location map and legal description. See Figure 1 in Appendix E for a Context Aerial Map.

1.3 Purpose

This Preliminary Drainage Report is intended to satisfy City of Scottsdale requirements and demonstrate conformance to the Master Drainage Report for Crossroads East Planning Unit IV. This report provides a description of the current storm water drainage patterns and systems and a description of the required and proposed drainage improvements.

1.4 Objectives

This report provides a drainage plan for the site that is intended to meet the drainage standards and guidelines of the City of Scottsdale and the Flood Control District of Maricopa County (FCDMC). In particular, this report will demonstrate the following:

1. Off-site flows entering the site include discharge from an existing surface detention basin at the northwest corner of Chauncey Lane and 73rd Place, discharge from an existing box culvert at the southeast corner of Scottsdale Road and Chauncey Lane, and overland sheet flow from areas to the north and east of the site.

2. The site drainage patterns will remain consistent with the existing hydrologic divide that bisects the site.

3. Permanent drainage facilities will have a positive outfall and any detained storm water will be disposed of within 36 hours.

4. Storm water detention will be provided for the adjacent half-street roadways.

5. Drainage facilities will be designed such that the 100-year post-development flows are collected and conveyed in such a manner so as to not cause damage to buildings and property.

6. Building finished floor elevations have been set a minimum of two feet above the highest adjacent natural grade.

7. Building finished floor elevations have been set a minimum of 14 inches above the site outfall.

2.0 Description of Existing Drainage Conditions and Characteristics

2.1 Existing On-Site Drainage Conditions

The site currently consists of vacant, undeveloped land with sparse desert vegetation throughout the site. The parcel is bounded by Chauncey Lane to the north, vacant undeveloped land to the east and south, and Scottsdale Road to the west.

The site generally slopes from the northeast to the southwest at approximately 1.5%. An existing hydrologic divide bisects the site and directs the drainage to two separate facilities. Storm water from areas to the west of the hydrologic divide ultimately outfalls to Reach 11 (Dike 2) in the City of Phoenix. Storm water from areas to the east of the hydrologic divide ultimately outfalls to the TPC golf course (Dike 3), in the City of Scottsdale, as outlined in the Final Drainage Report for the Improvement Plans for Scottsdale Road and Chauncey Lane and Crossroads East Planning Unit IV (Kimley-Horn and Associates, August 2012).

Storm water from areas west of the hydrologic divide flows southwest towards an existing earthen channel along the east side of Scottsdale Road. This channel continues to the south, where it enters a box culvert under the intersection of Scottsdale Road and Princess Boulevard before outfalling to Reach 11.

For the 100-year, 2-hour rainfall event, approximately 28 cfs exits the site along the south property line west of the hydrologic divide and approximately 17 cfs exits the site east of the hydrologic divide. These flows reflect the pre-development site-generated flows, and do not include additional off-site contributing flows discussed in Section 2.2 and Section 4.4.

Refer to Figure 3 in Appendix E for the Existing Conditions Exhibit.

2.2 Existing Off-Site Drainage Conditions

A double-barrel 3-foot by 8-foot concrete box culvert discharges off-site storm water into an existing channel at the northwest corner of the property. The earthen channel conveys the storm water to the south at a slope of approximately 0.8%, with rip-rap drop structures placed at approximately 150-foot intervals to control channel velocity. The earthen channel has a bottom width of approximately 17 feet and side slopes of 4:1. According to the Crossroads East Planning Unit IV Drainage Report (COS Plan Check #2519-2, 1442-12), the existing box culvert discharges 317 cfs into the earthen channel in the 100-year event. The channel velocity is approximately 6 fps at a depth of approximately 2.4 feet.

Off-site storm water from areas to the north and east of the site enter the site as sheet flow across the eastern property line and flow towards an existing drainage path. A detailed discussion of these flows is provided in Section 4.2 of this report.

The adjacent portion of Scottsdale Road is crowned at the center, with storm water from the eastern half-street flowing to curb openings which discharge through rip-rap spillways to the existing earthen channel.

Storm water from areas east of the hydrologic divide flows southerly across undeveloped land and is intercepted by an earthen channel along the north side of Princess Boulevard. This channel continues to the TPC via an existing box culvert under Princess Boulevard.

The site is primarily located west of the hydrologic divide mentioned above, with the eastern portion of the site on the east side of the hydrologic divide. A surface detention basin was installed at the northwest corner of Chauncey Lane and 73rd Place. This detention basin discharges to an 18-inch RCP culvert under Chauncey Lane that outfalls to the northeast corner of the site. According to the Final Drainage Report for the Improvement Plans for Scottsdale Road and Chauncey Lane, a four-inch orifice plate is installed on the upstream headwall, thereby limiting flows to 0.7 cfs.

The adjacent portion of Chauncey Lane is crowned, with the southern half of the roadway draining towards the subject parcel. Storm water from the portion of the roadway located west of the hydrologic divide is captured by an existing curb inlet and conveyed to the box culvert under Chauncey Lane. Storm water from the portion of the roadway located east of the hydrologic divide currently discharges to the subject parcel via a curb opening and a rip-rap spillway. According to the Final Drainage Report for the Improvement Plans for Scottsdale Road and Chauncey Lane, the 10-year and 100-year discharges at this location are 1.7 cfs and 1.9 cfs, respectively. The 100-year storm water volume generated by the contributing area of Chauncey Lane is 2,170 cf.

Refer to Figure 3 in Appendix E for the Existing Conditions Exhibit.

2.3 Context Relative to Adjacent Projects and Improvements

The site is located south of Chauncey Lane and the Chauncey Crossroads development, east of Scottsdale Road, north of Chauncey Lane. See Figure 1 in Appendix E for Context Aerial of the site.

2.4 FEMA Flood Hazard Areas

The site is located in Flood Zone "AO" according to the Flood Insurance Rate Map 04013C1320L, dated October 16, 2013. Zone "AO" is designated by FEMA as "areas of flood depths of 1 foot (usually sheet flow on sloping terrain) average depths determined for areas of alluvial fan flooding, velocities also determined." Refer to Appendix B for the FEMA FIRMette map for the site. An elevation certificate will be required for each of the proposed buildings to be constructed in this flood hazard designation.

3.0 Proposed Drainage Plan

3.1 General Description

In the analysis of the proposed drainage conditions the following items are considered:

- Area Types (concrete pavement, building, and desert landscaping)
- Magnitude of areas
- Slopes
- Storm Drain
- Detention Basins

3.2 Proposed Site Conditions

The site proposes a combination of previously approved in-kind contribution and detention for the 100-year, 2-hour storm event. The previously approved in-kind contribution, in the form of a regional drainage channel along Scottsdale Road, will be used to convey off-site flows around the site and for direct drainage of site-generated storm water from areas west of the hydrologic divide. Detention will be used for site-generated storm water from areas east of the hydrologic divide.

West of Hydrologic Divide

Site-generated storm water from areas west of the hydrologic divide is proposed to be conveyed to the regional drainage channel along Scottsdale Road via underground storm drain pipes. No permanent surface or underground detention is required or proposed for this area due to the in-kind contribution agreement and construction of a regional drainage channel along Scottsdale Road.

The existing curb openings and rip-rap spillways along Scottsdale Road will be replaced with sidewalk scuppers and rip-rap spillways. Storm water from the adjacent portion of Scottsdale Road will continue to flow to the earthen channel.

The existing earthen channel will be relocated to allow for a new right-turn lane and sidewalk along Scottsdale Road. The new channel will remain an earthen channel with native landscaping. Rip-rap drop structures similar to the existing structures will be installed to control channel velocity. The bottom of the channel will remain 17 feet wide with 4:1 side slope on the west side of the channel. The eastern side of the channel will consist of two tiered retaining walls with an eight-foot wide multi-use path between the two retaining walls. Each retaining wall will be approximately three feet tall with a screening barrier. The channel flow depth will be approximately two feet, which leaves one foot of freeboard between the water surface elevation and the multi-use trail.

East of Hydrologic Divide

Site-generated storm water from areas east of the hydrologic divide will be detained in multiple surface detention basins and underground StormTech chambers along the west side of 73rd Place. Storm water from these surface basins and underground chambers will be routed south to discharge to the vacant undeveloped land to the south, in accordance with current drainage patterns. The surface basins and underground chambers will provide detention volume for the 100-year, 2-hour storm event.

The adjacent portion of 73rd Place will be constructed as part of these improvements. This roadway will be crowned at the centerline with the western half of the roadway draining to the subject parcel. Storm water from adjacent portions of 73rd Place will be collected in surface detention basins and underground chambers along with the on-site storm water for areas east of the hydrologic divide. Storm water from the east half of 73rd Place will be discharged to the adjacent undeveloped vacant land, in accordance with current drainage patterns. Drainage easements will be provided for the detention basins.

Per the Planning Unit IV Master Drainage Report, flows from areas east of the hydrologic divide will continue on their current path to the box culvert that crosses south under Princess Boulevard and outfalls into the TPC golf course. See Figure 3 in Appendix E for the Existing Conditions Exhibit.

Future development along the east side of 73rd Place and south of the subject parcel will be responsible for detaining storm water generated by the 100-year, 2-hour storm for their site and the adjacent half streets.

3.3 Proposed Off-Site Conditions

Regional off-site storm water runoff from north of the Loop 101 onto Planning Unit IV is proposed to be handled in accordance with the Crossroads East Planning Unit IV Master Drainage Report. Off-site storm water impacts beyond those discussed above are not anticipated due to the built-out condition of the upstream areas adjacent to the site.

3.4 Future Conditions

No future drainage impacts are anticipated for the site due to the previous development of areas upstream of the subject parcel. It is anticipated that undeveloped areas adjacent to the site will be developed in accordance with the Planning Unit IV Master Drainage Report and City of Scottsdale standards.

3.5 Storm Water Storage Requirements

As previously noted, surface detention basins and underground StormTech chambers will be provided to detain the 100-year, 2-hour storm event for areas east of the hydrologic divide. No storm water storage is required for areas west of the hydrologic divide.

Table 1 below summarizes the required and provided detention volumes for areas east of the hydrologic divide.

Table 1: On-Site Detention Volume Required

Basin	Land Use	Runoff Coefficient	Drainage Area (ft^2)	Required Volume (ft^3)	Provided Volume (ft^3)	Surplus (ft^3)
Basin A	Landscaping	0.45	19,138	1,643		
	Building	0.95	39,231	7,112		
	Pavement	0.95	8,886	1,611		
			58,369	10,367	12,078	1,711

Basin	Land Use	Runoff Coefficient	Drainage Area (ft^2)	Required Volume (ft^3)	Provided Volume (ft^3)	Surplus (ft^3)
Basin B	Landscaping	0.45	10,892	935		
	Building	0.95	0	0		
	Pavement	0.95	2,059	373		
			12,951	1,309	1,766	457

Basin	Land Use	Runoff Coefficient	Drainage Area (ft^2)	Required Volume (ft^3)	Provided Volume (ft^3)	Surplus (ft^3)
Basin C	Landscaping	0.45	4,093	351		
	Building	0.95	0	0		
	Pavement	0.95	0	0		
			4,093	351	455	104

Basin	Land Use	Runoff Coefficient	Drainage Area (ft^2)	Required Volume (ft^3)	Provided Volume (ft^3)	Surplus (ft^3)
Basin OS1	Landscaping	0.45	8,793	755		
	Building	0.95	0	0		
	Pavement	0.95	4,917	891		
			13,710	1,647	1,652	5

Basin	Land Use	Runoff Coefficient	Drainage Area (ft^2)	Required Volume (ft^3)	Provided Volume (ft^3)	Surplus (ft^3)
Basin UG	Landscaping	0.45	17,585	1,510		
	Building	0.95	38,663	7,009		
	Pavement	0.95	13,301	2,411		
			69,549	10,931	10,943	12

No permanent storm water storage will be provided for areas west of the hydrologic divide due to the approved in-kind contribution in the form of a regional drainage channel along the east side of Scottsdale Road. A Kri-Star Dual-Vortex Hydrodynamic Separator will be installed at each outfall to the channel to maintain storm water quality. See Appendix C for information regarding the Kri-Star storm water quality units and Figure 2 in Appendix E for the Preliminary Grading and Drainage Plans. Refer to Figure 4 in Appendix E for the Drainage Basin Delineation Map.

3.6 Pre- and Post-Development Runoff Characteristics at Concentration Points

The existing site consists of vacant, undeveloped land that drains from northeast to southwest. Upon site development, the site-generated storm water west of the hydrologic divide will sheet flow to catch basins and then be conveyed through underground storm drain to the earthen channel along the east side Scottsdale Road.

Storm water east of the hydrologic divide will be conveyed to the surface detention basins and underground chambers and discharged at the southeast corner of the parcel, after which it will flow south to the existing channel along the north side of Princess Boulevard, consistent with the current drainage patterns and the Crossroads East Planning Unit IV Master Drainage Report. Storm water discharge from the surface detention basins and underground chambers will be controlled using pipe sizing and orifice plates. Post-development storm water discharge will be limited to the pre-development flow at this location. Detailed discharge calculations will be included with the Final Drainage Report.

3.7 Proposed Drainage Structures or Special Drainage Facilities

As previously noted, a Kri-Star Dual-Vortex Hydrodynamic Separator is proposed to be installed immediately upstream of the connection to the earthen channel to maintain storm water quality.

One new driveway entrance is proposed along Scottsdale Road. This driveway entrance will cross the existing earthen channel, and a double-barrel 3-foot by 8-foot concrete box culvert will be installed at this crossing. Headwalls and rip-rap will be provided both ends of the culvert. Refer to Appendix C for the HY-8 analysis of the proposed culvert.

The existing earthen channel will be relocated to allow for a new right-turn lane and sidewalk along Scottsdale Road. The new channel will remain an earthen channel with native landscaping. Rip-rap drop structures similar to the existing structures will be installed to control channel velocity. The bottom of the channel will remain 17 feet wide with 4:1 side slope on the west side of the channel. The eastern side of the channel will consist of two tiered retaining walls with an eight-foot wide multi-use path between the two retaining walls. Each retaining wall will be approximately three feet tall with a screening barrier. The channel flow depth will be approximately two feet, which leaves one foot of freeboard between the water surface elevation and the multi-use trail.

A StormTech underground detention basin is proposed for the site to accommodate site-generated storm water for the 100-year, 2-hour storm event. An orifice plate will be installed to regulate disposal of the underground system. Access manholes will be provided on the header rows to allow for regular maintenance. The StormTech system includes isolator rows to maintain storm water quality prior to discharge. The final design will include a drainage easement to be dedicated to the City of Scottsdale for the proposed surface and underground detention basins. See Appendix C for the StormTech cut sheets.

The building finished floor elevations have been set at a minimum of two feet above natural grade to satisfy construction requirements within the floodplain area of Zone AO. Per the FEMA map, this area is subject to a one-foot depth of sheet flow. FEMA requires that buildings placed within Zone AO have finished floor elevations placed above the depth of sheet flow, and the City of Scottsdale requires that buildings in Zone AO have one additional foot of freeboard above the depth of sheet flow. Therefore, the building finished floor elevation needs to be at least two feet above the highest adjacent natural grade. Table 2 below shows the proposed building finished floor elevations relative to the highest adjacent grade (HAG) elevations.

Table 2: Proposed Building Finished Floor Elevations

	Highest Adjacent Grade	Proposed Finish Floor Elevation	Elevation Difference
North Retail/Restaurant	71.30	73.35	2.05
Center Retail/Restaurant	69.48	72.15	2.67
South Retail/Restaurant	68.33	70.65	2.32
North Residential	72.72	74.75	2.03
Center Residential	69.82	72.75	2.93
South Residential	67.92	70.75	2.83

As previously noted, the site is currently vacant, undeveloped land. A topographical survey of the site was conducted in October 2014 and the ground elevations provided with this survey are determined to be the natural grade of the site. A review of historical aerials dating back to 1963 indicates no prior development in this area.

See Appendix B for the Natural Grade Exhibit.

3.8 ADEQ AZPDES requirements

Prior to construction an executed Notice of Intent (NOI) shall be submitted to Arizona Department of Environmental Quality (ADEQ) in conformance with the Arizona Pollution Discharge Elimination System Permit (AZPDES) permit. The NOI and associated storm water management best management practices will remain active on the site until construction is complete and a Notice of Termination is filed with ADEQ in conformance with AZPDES permit.

3.9 Project Phasing

This project will be constructed in a single phase.

4.0 Special Conditions

4.1 404 Discussion

Per correspondence with the U.S. Army Corp of Engineers 404 jurisdictional washes are impacted by the proposed Regional Channel improvements, roadway improvements, and temporary drainage basins. A Nationwide permit with the Corp of Engineers has been obtained for the disturbance of the existing 404 jurisdictional wash on-site. See Appendix D for Corp of Engineers Letter of Compliance for Nationwide Permit No. 39.

4.2 50 CFS Wash

According to the City of Scottsdale GIS maps, the apex of a 50 cfs wash is located near the southeast corner of the subject parcel. Per City of Scottsdale requirements, contributing off-site upstream flows must be maintained in the post-development condition. These drainage areas and resulting flows have been delineated on Figure 3 in Appendix E, and the flows are calculated using the Rational method as shown in Appendix C. The location of the 50 cfs wash is shown on Figure 5 in Appendix E.

Two upstream off-site areas contribute to the 50 cfs wash. Drainage area OS-1 consists of undeveloped land that generally slopes to the south and southwest. Drainage area OS-2 includes the eastern half of 73rd Place that is located north of Chauncey Lane. The existing 100-year, 2-hour flows from these drainage areas are 18.0 cfs and 5.2 cfs, respectively.

As previously noted, a hydrologic divide bisects the site. A portion of the site that is located to the east of the hydrologic divide contributes flow to the 50 cfs wash, and the remainder of the flow discharges across the southern property line as sheet flow. Drainage area DA-1 contributes 9.9 cfs to the wash, and drainage area DA-2 generates 7.1 cfs that exits the site along the southern property line as sheet flow.

As previously noted, the existing development to the north of Chauncey Lane discharges 0.7 cfs onto the subject parcel. Therefore, the total pre-development flow in the 50 cfs wash at the discharge from the site will be 34.1 cfs. The post-development discharge at this location will be 34.1 cfs or less. Refer to Appendix C for the Rational calculations, and to Figure 3 in Appendix E for the drainage area boundaries.

Post-development flows to the 50 cfs wash will be maintained by providing a drainage swale and berm along the east side of 73rd Place. The drainage swale will collect storm water runoff from the eastern half of the 73rd Place and will convey the water south along the west side of 73rd Place, discharging to the 50 cfs wash. The swale is designed to convey the flows from the existing eastern half of 73rd Place located north of Chauncey Lane (5.2 cfs), as well as the proposed eastern half of 73rd Place that is located south of Chauncey Lane (1.9 cfs). This will be a triangular channel with 3:1 side slopes, and will have a normal depth of 0.76 feet and a velocity of 4.1 cfs for the 100-year flow. FlowMaster analysis of this swale are provided in Appendix C.

water before it enters the box culvert. The first flush flow rate will be calculated based on the following equation from Section 6.8.3 of the City of Phoenix Storm Water Policies and Standards (December 2013):

$Q_{FF} = C*I*A$

Where: Q_{FF} = minimum first flush discharge in cfs

C = runoff coefficient (set to 1.00 for first flush condition)

A = area in acres

I = 0.5 inches/hour rainfall excess intensity divided by the time of concentration

For the preliminary analysis, a conservative Time of Concentration of 10 minutes was assumed. This resulted in a first flush flow of 18.9 cfs. Based on this first flush flow rate, the Kri-Star model DVS-144 will be required for this site. Flows in excess of the first flush will be bypassed through the structure.

See Appendix C for cut sheet for Kri-Star Dual-Vortex Hydrodynamic Separator.

5.3 Storm Water Storage Calculation Methods and Assumptions

Due to the existing in-kind contribution (storm water waiver) storm water storage is not required for the area west of the hydrologic divide. Storm water storage requirements for area east of the hydrologic divide were calculated per City of Scottsdale and Flood Control District of Maricopa County design standards. The standard formula for determining the required storage volumes for the 100-year, 2-hour storm is as follows:

$$V_R = CPA/12$$

Where: V_R = storage volume required (cubic feet)

C = weighted runoff coefficient

P = precipitation depth for 100-year, 2-hour event = 2.29 inches

A = contributing drainage area to basin (square feet)

6.0 Conclusion

6.1 Overall Project

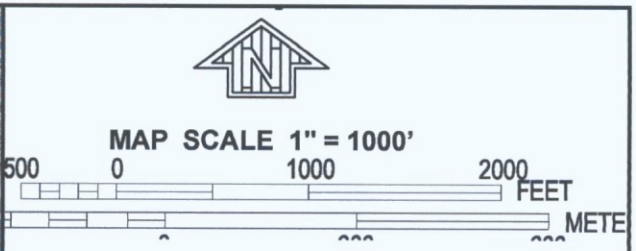
Based on the results of this final drainage report, the following can be concluded:

- Storm water west of the hydrologic divide will be conveyed to the earthen channel along the east side of Scottsdale Road.
- Storm water east of the hydrologic divide will be detained in surface basins and underground StormTech chambers and discharged near the southeast corner of the parcel.
- Discharge from the surface detention basins and underground StormTech Chambers will be controlled using pipe sizing and orifice plates, and will be limited to the pre-development flow or less.
- Surface detention basins east of the hydrologic divide will continue to overland flow towards the channel along Princess Boulevard, in accordance with existing drainage conditions.
- Storm drainage systems consisting of catch basins, storm drain, and water quality devices will be provided to collect and convey drainage west of the hydrologic divide to the existing earthen channel along Scottsdale Road.
- The building finish floor elevations have been designed to be at least fourteen inches above the ultimate site outfall elevation and at least two feet above the highest adjacent natural grade.
- Off-site storm water from areas upstream of the site will be routed around the site and discharged at their historical flow path.
- Based on the current Flood Insurance Rate Map (FIRM), the site is located in the Zone "AO".
- Drainage easements will be provided for the permanent detention basins.

This drainage report is intended to provide a level of assurance that the site will adhere to all appropriate reviewing agency guidelines with respect to drainage and flood protection.

Appendix B

FEMA Flood Insurance Rate Map (FIRM) and Natural Grade Exhibit



NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 1320L

FIRM

FLOOD INSURANCE RATE MAP

MARICOPA COUNTY, ARIZONA

AND INCORPORATED AREAS

PANEL 1320 OF 4425

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

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

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

MAP NUMBER
04013C1320L

MAP REVISED
OCTOBER 16, 2013

Federal Emergency Management Agency

CHAUNCEY LANE

SCOTTSDALE ROAD

73RD PLACE

HAG: 71.30

PROP. RETAIL / RESTAURANT
LF=73.35
HAG=71.30

HAG: 69.48

PROP. RETAIL / RESTAURANT
LF=72.15
HAG=69.48

HAG: 68.33

PROP. RETAIL / RESTAURANT
LF=71.53
HAG=68.33

HAG: 72.72

HYDROLOGIC DIVIDE

PROP. MULTI-FAMILY
LF=74.75
HAG=72.72

HAG: 69.82

BUILDING SEPARATION LINE

PROP. MULTI-FAMILY
LF=72.75
HAG=69.82

HAG: 67.92

BUILDING SEPARATION LINE

PROP. MULTI-FAMILY
LF=70.75
HAG=67.92

NOTE: CONTOURS SHOWN HEREON ARE BASED ON A TOPOGRAPHIC SURVEY DATED 10/17/2014 AND REFLECT THE NATURAL UNDISTURBED GROUND SURFACE.

NORTH

GRAPHIC SCALE IN FEET
0 40 80 160

LEGEND

- PROPERTY LINE
- RIGHT OF WAY LINE
- STREET CENTERLINE
- EASEMENT LINE
- 12 PRE-DEVELOPMENT NATURAL CONTOURS

NATURAL GRADE EXHIBIT

Kimley»Horn

K:\PHX_Civil\191447014 - JLB Crossroads South\CADD\Exhibits\2016-10-25 HAG Exhibit.dwg Oct 25, 2016 Garrett.Frame
XREFS: X447014BM X447014VF X447014BM1 X447014BM2 X447014BM3

Appendix C

Hydrologic/Hydraulic Calculations

Worksheet for Irregular Section - 1

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	1.25	%
Discharge	320.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	10.00
0+40	0.00
0+57	0.00
0+60	0.75
0+60	10.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 10.00)	(0+60, 0.75)	0.035
(0+60, 0.75)	(0+60, 10.00)	0.015

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	2.04	ft
Elevation Range	0.00 to 10.00 ft	
Flow Area	48.12	ft²
Wetted Perimeter	29.82	ft
Hydraulic Radius	1.61	ft
Top Width	28.18	ft
Normal Depth	2.04	ft

Worksheet for Irregular Section - 1

Results

Critical Depth		1.91	ft
Critical Slope		0.01576	ft/ft
Velocity		6.65	ft/s
Velocity Head		0.69	ft
Specific Energy		2.73	ft
Froude Number		0.90	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	2.04	ft
Critical Depth	1.91	ft
Channel Slope	1.25	%
Critical Slope	0.01576	ft/ft

Cross Section for Irregular Section - 1

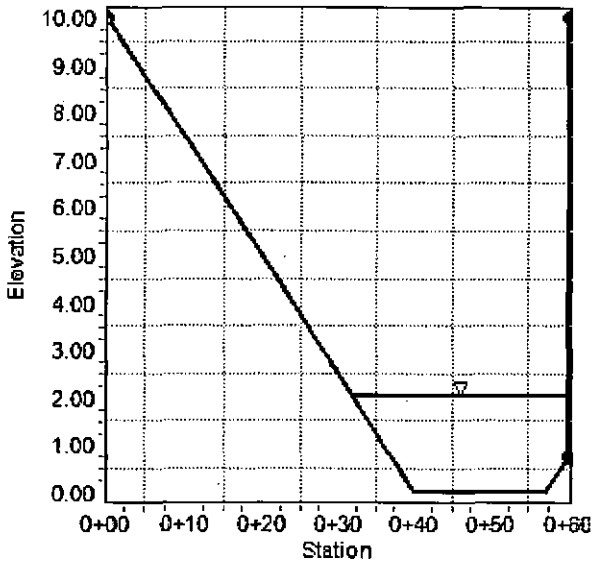
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	1.25	%
Normal Depth	2.04	ft
Discharge	320.00	ft³/s

Cross Section Image



73rd Place Channel

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.020	
Channel Slope	0.01200	ft/ft
Left Side Slope	3.00	ft/ft (H:V)
Right Side Slope	3.00	ft/ft (H:V)
Discharge	7.10	ft^3/s

Results

Normal Depth	0.76	ft
Flow Area	1.73	ft^2
Wetted Perimeter	4.80	ft
Hydraulic Radius	0.36	ft
Top Width	4.55	ft
Critical Depth	0.81	ft
Critical Slope	0.00845	ft/ft
Velocity	4.11	ft/s
Velocity Head	0.26	ft
Specific Energy	1.02	ft
Froude Number	1.18	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.76	ft
Critical Depth	0.81	ft
Channel Slope	0.01200	ft/ft
Critical Slope	0.00845	ft/ft

Conceptual Overall Retention Summary								
Drainage Area	Land Use	Area [A]		Runoff Coefficient [C]	Precipitation Depth [P]	Required Storage (V_{REQ} = CPA/12)		Retention Basin
		sf	ac		in	cf	ac-ft	
5	Pavement	19,319	0.444	0.95	2.29	3,502	0.080	Channel
6	Pavement	17,358	0.398	0.95	2.29	3,147	0.072	Channel
10	Pavement	6,317	0.145	0.95	2.29	1,145	0.026	Channel
11	Landscaping	38,193	0.877	0.45	2.29	3,280	0.075	Channel
12	Pavement	10,812	0.248	0.95	2.29	1,960	0.045	Channel
15	Building	9,052	0.208	0.95	2.29	1,641	0.038	Channel
20	Building	7,564	0.174	0.95	2.29	1,371	0.031	Channel
25	Pavement	28,313	0.650	0.95	2.29	5,133	0.118	Channel
30	Pavement	12,805	0.294	0.95	2.29	2,321	0.053	Channel
31	Landscaping	20,237	0.465	0.45	2.29	1,738	0.040	Channel
32	Pavement	6,184	0.142	0.95	2.29	1,121	0.026	Channel
35	Pavement	15,894	0.365	0.95	2.29	2,881	0.066	Channel
40	Building	17,457	0.401	0.95	2.29	3,165	0.073	Channel
45	Pavement	44,492	1.021	0.95	2.29	8,066	0.185	Channel
50	Pavement	2,841	0.065	0.95	2.29	515	0.012	Channel
55	Pavement	20,078	0.461	0.95	2.29	3,640	0.084	Channel
56	Building	18,592	0.427	0.95	2.29	3,371	0.077	Channel
57	Building	8,782	0.202	0.95	2.29	1,592	0.037	Channel
58	Building	12,080	0.277	0.95	2.29	2,190	0.050	Channel
59	Building	39,231	0.901	0.95	2.29	7,112	0.163	Basin A
60	Building	9,757	0.224	0.95	2.29	1,769	0.041	UG
61	Landscaping	8,793	0.202	0.45	2.29	755	0.017	Basin OS1
62	Landscaping	19,138	0.439	0.45	2.29	1,643	0.038	Basin A
63	Pavement	2,059	0.047	0.95	2.29	373	0.009	Basin B
64	Landscaping	10,892	0.250	0.45	2.29	935	0.021	Basin B
65	Pavement	5,114	0.117	0.95	2.29	927	0.021	UG
66	Building	22,563	0.518	0.95	2.29	4,090	0.094	UG
67	Landscaping	5,768	0.132	0.45	2.29	495	0.011	UG
68	Building	6,343	0.146	0.95	2.29	1,150	0.026	UG
70	Landscaping	4,093	0.094	0.45	2.29	351	0.008	Basin C
71	Landscaping	2,536	0.058	0.45	2.29	218	0.005	UG
75	Landscaping	12,276	0.282	0.45	2.29	1,054	0.024	Channel
80	Landscaping	9,281	0.213	0.45	2.29	797	0.018	UG
OS1	Pavement	4,917	0.113	0.95	2.29	891	0.020	Basin OS1
OS2	Pavement	8,886	0.204	0.95	2.29	1,611	0.037	Basin A
OS3	Pavement	3,903	0.090	0.95	2.29	708	0.016	UG
OS4	Pavement	4,284	0.098	0.95	2.29	777	0.018	UG
TOTAL	-	**496,204**	**11.391**	-	-	**77,438**	**1.778**	-

Basin	Land Use	Runoff Coefficient	Drainage Area (ft^2)	Required Volume (ft^3)	Provided Volume (ft^3)	Surplus (ft^3)
Basin A	Landscaping	0.45	19,138	1,643		
	Building	0.95	39,231	7,112		
	Pavement	0.95	8,886	1,611		
			58,369	10,367	12,078	1,711

Basin	Land Use	Runoff Coefficient	Drainage Area (ft^2)	Required Volume (ft^3)	Provided Volume (ft^3)	Surplus (ft^3)
Basin B	Landscaping	0.45	10,892	935		
	Building	0.95	0	0		
	Pavement	0.95	2,059	373		
			12,951	1,309	1,766	457

Basin	Land Use	Runoff Coefficient	Drainage Area (ft^2)	Required Volume (ft^3)	Provided Volume (ft^3)	Surplus (ft^3)
Basin C	Landscaping	0.45	4,093	351		
	Building	0.95	0	0		
	Pavement	0.95	0	0		
			4,093	351	455	104

Basin	Land Use	Runoff Coefficient	Drainage Area (ft^2)	Required Volume (ft^3)	Provided Volume (ft^3)	Surplus (ft^3)
Basin OS1	Landscaping	0.45	8,793	755		
	Building	0.95	0	0		
	Pavement	0.95	4,917	891		
			13,710	1,647	1,652	5

Basin	Land Use	Runoff Coefficient	Drainage Area (ft^2)	Required Volume (ft^3)	Provided Volume (ft^3)	Surplus (ft^3)
UG	Landscaping	0.45	17,585	1,510		
	Building	0.95	38,663	7,009		
	Pavement	0.95	13,301	2,411		
			69,549	10,931	10,943	12

HY-8 Culvert Analysis Report

Table 1 - Summary of Culvert Flows at Crossing: Scottsdale Road Culvert

Headwater Elevation (ft)	Total Discharge (cfs)	Culvert 1 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
61.80	0.00	0.00	0.00	1
62.55	31.70	31.70	0.00	1
63.00	63.40	63.40	0.00	1
63.37	95.10	95.10	0.00	1
63.71	126.80	126.80	0.00	1
64.02	158.50	158.50	0.00	1
64.31	190.20	190.20	0.00	1
64.60	221.90	221.90	0.00	1
64.89	253.60	253.60	0.00	1
65.19	285.30	285.30	0.00	1
65.51	317.00	317.00	0.00	1
69.50	588.27	588.27	0.00	Overtopping

Rating Curve Plot for Crossing: Scottsdale Road Culvert

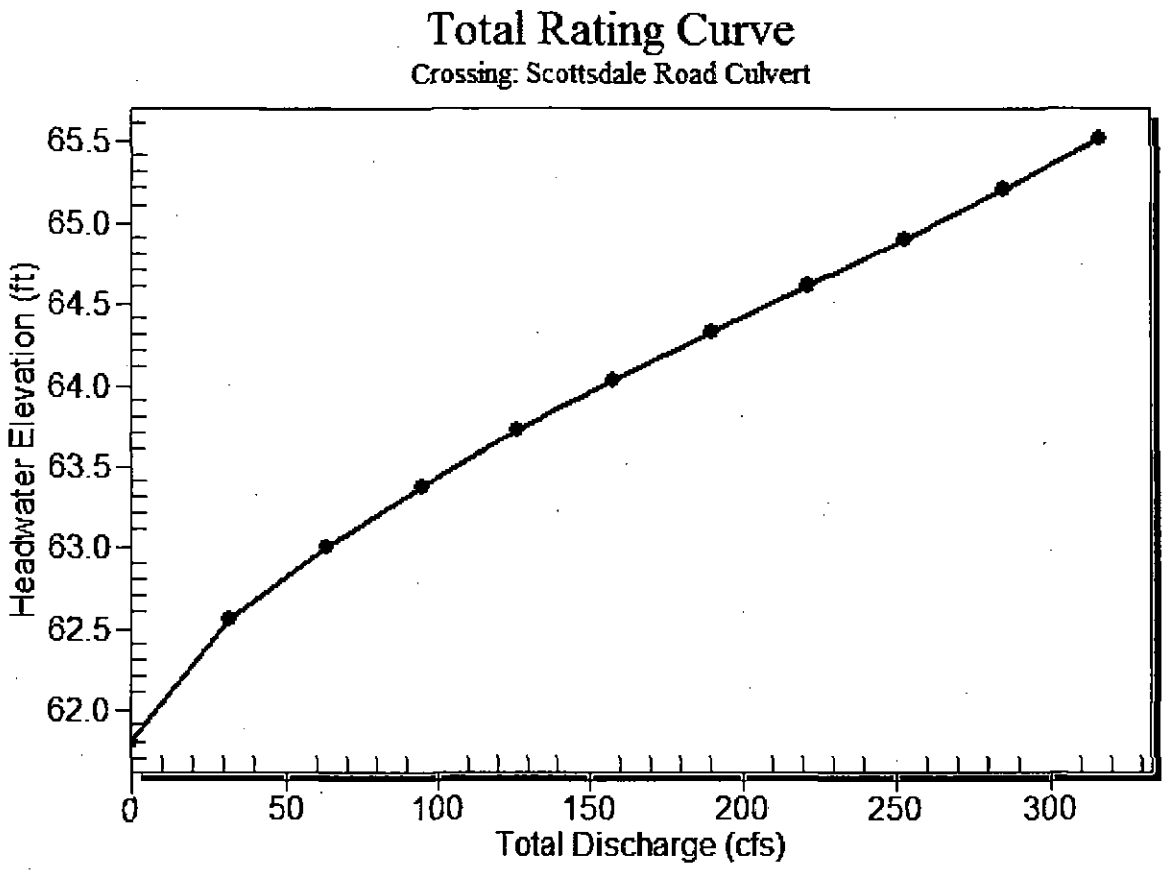


Table 2 - Culvert Summary Table: Culvert 1

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
0.00	0.00	61.80	0.000	0.0*	0-NF	0.000	0.000	0.000	0.000	0.000	0.000
31.70	31.70	62.55	0.754	0.0*	1-S2n	0.313	0.497	0.316	0.578	6.272	2.839
63.40	63.40	63.00	1.195	0.0*	1-S2n	0.474	0.789	0.505	0.862	7.844	3.596
95.10	95.10	63.37	1.569	0.0*	1-S2n	0.627	1.034	0.670	1.085	8.867	4.107
126.80	126.80	63.71	1.911	0.0*	1-S2n	0.749	1.252	0.823	1.275	9.628	4.501
158.50	158.50	64.02	2.222	0.0*	1-S2n	0.871	1.453	0.971	1.443	10.203	4.825
190.20	190.20	64.31	2.515	0.0*	1-S2n	0.979	1.641	1.110	1.594	10.712	5.103
221.90	221.90	64.60	2.801	0.0*	1-S2n	1.082	1.818	1.246	1.734	11.128	5.347
253.60	253.60	64.89	3.090	0.0*	5-S2n	1.186	1.988	1.376	1.863	11.522	5.565
285.30	285.30	65.19	3.390	0.0*	5-S2n	1.280	2.150	1.503	1.985	11.864	5.763
317.00	317.00	65.51	3.709	0.0*	5-S2n	1.373	2.306	1.626	2.100	12.182	5.944

* theoretical depth is impractical. Depth reported is corrected.

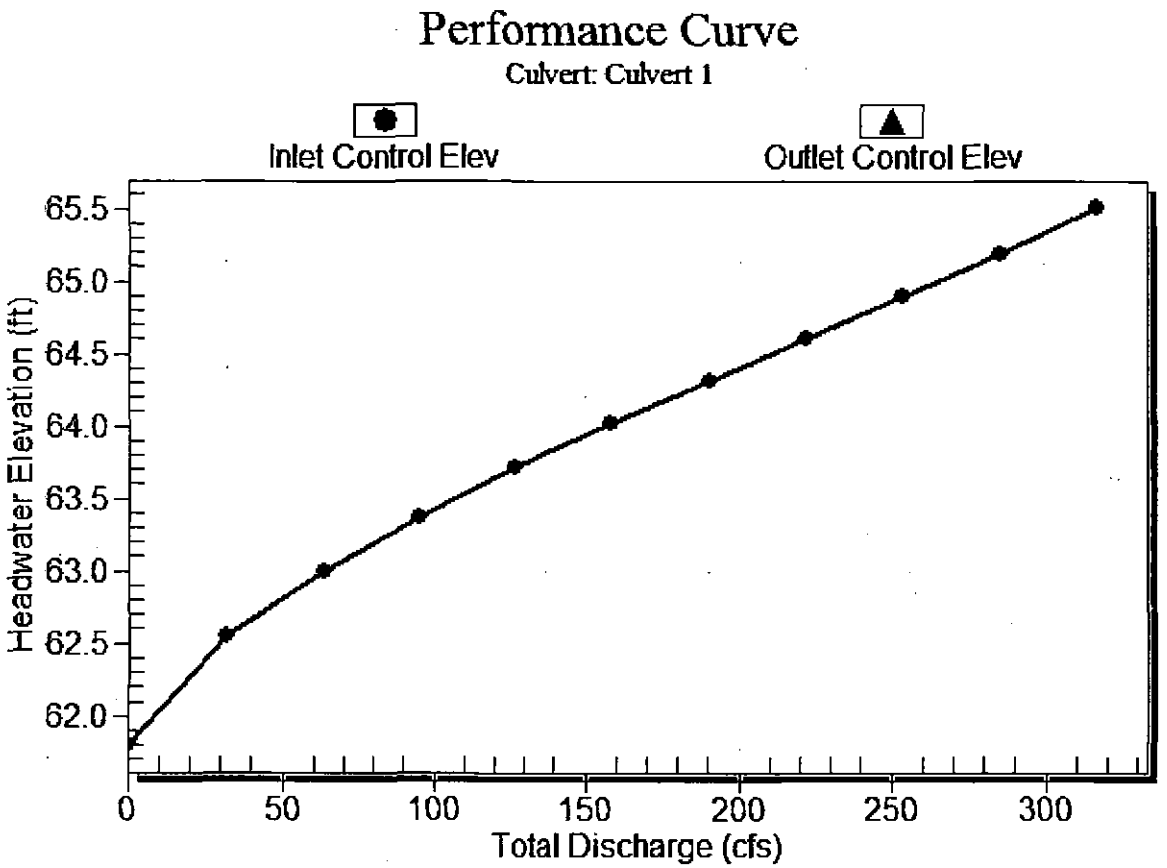
****

Inlet Elevation (invert): 61.80 ft, Outlet Elevation (invert): 60.90 ft

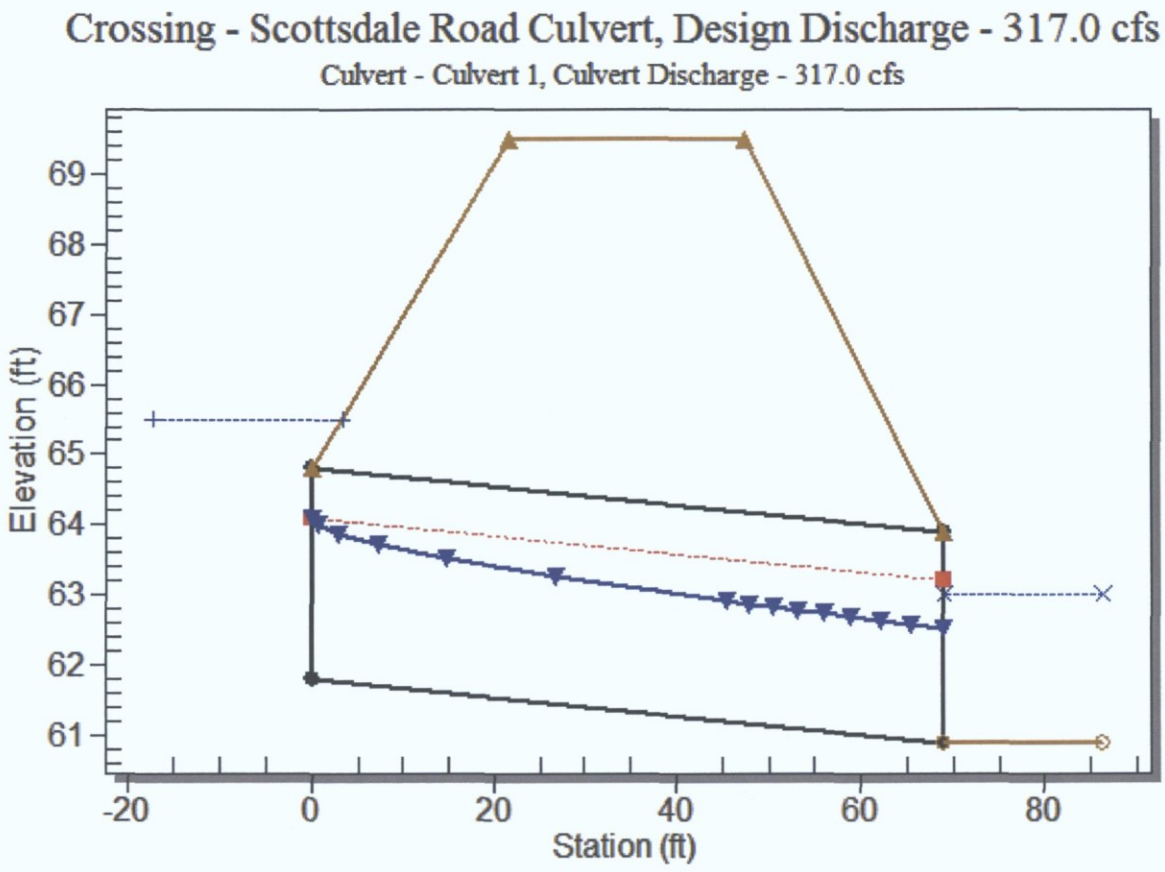
Culvert Length: 69.01 ft, Culvert Slope: 0.0130

****

Culvert Performance Curve Plot: Culvert 1



Water Surface Profile Plot for Culvert: Culvert 1



Site Data - Culvert 1

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 61.80 ft

Outlet Station: 69.00 ft

Outlet Elevation: 60.90 ft

Number of Barrels: 2

Culvert Data Summary - Culvert 1

Barrel Shape: Concrete Box

Barrel Span: 8.00 ft

Barrel Rise: 3.00 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Inlet Type: Conventional

Inlet Edge Condition: Square Edge (30-75° flare) Wingwall

Inlet Depression: NONE

Table 3 - Downstream Channel Rating Curve (Crossing: Scottsdale Road Culvert)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
0.00	60.90	0.00	0.00	0.00	0.00
31.70	61.48	0.58	2.84	0.29	0.70
63.40	61.76	0.86	3.60	0.43	0.74
95.10	61.99	1.09	4.11	0.54	0.76
126.80	62.17	1.27	4.50	0.64	0.78
158.50	62.34	1.44	4.83	0.72	0.79
190.20	62.49	1.59	5.10	0.80	0.80
221.90	62.63	1.73	5.35	0.87	0.81
253.60	62.76	1.86	5.57	0.93	0.82
285.30	62.89	1.99	5.76	0.99	0.83
317.00	63.00	2.10	5.94	1.05	0.83

Tailwater Channel Data - Scottsdale Road Culvert

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 17.00 ft

Side Slope (H:V): 4.00 (_:1)

Channel Slope: 0.0080

Channel Manning's n: 0.0300

Channel Invert Elevation: 60.90 ft

Roadway Data for Crossing: Scottsdale Road Culvert

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft

Crest Elevation: 69.50 ft

Roadway Surface: Paved

Roadway Top Width: 26.00 ft

FloGard® Dual-Vortex Hydrodynamic Separator

Characteristics and Capacities (English)

Model	ID	Depth Below Invert	Treated Flow Capacity[1]			Total Flow Capacity[3]	Max. Pipe Size	Sediment Storage	Oil/ Floatable Storage
	ft	*ft*	*67 µm cfs*	*110 µm cfs*	*Peak[2] cfs*	*cfs*	*in*	*yd³*	*gal*
DVS-36	3	3.75	0.12	0.35	0.50	4	12	0.3	18
DVS-48	4	5.00	0.25	0.75	1.25	9	18	0.7	43
DVS-60	5	6.25	0.45	1.30	2.50	16	24	1.3	83
DVS-72	6	8.25	0.70	2.00	4.25	27	36	2.2	141
DVS-84[4]	7	9.50	1.00	3.00	6.50	40	42	3.5	294
DVS-96	8	10.75	1.40	4.20	9.50	57	48	5.3	337
DVS-120[4]	10	13.50	2.50	7.30	16.80	99	48	9.7	917
DVS-144[4]	12	16.00	3.90	11.60	26.40	154	60	15.5	1825

Characteristics and Capacities (Metric)

Model	ID	Depth Below Invert	Treated Flow Capacity[1]			Total Flow Capacity[3]	Max. Pipe Size	Sediment Storage	Oil/ Floatable Storage
	m	*m*	*67 µm L/s*	*110 µm L/s*	*Peak[2] L/s*	*L/s*	*mm*	*m³*	*L*
DVS-36	0.9	1.14	3.5	10	14	113	300	0.23	68
DVS-48	1.2	1.52	7	21	35	255	450	0.54	163
DVS-60	1.5	1.91	13	37	71	453	600	1.00	314
DVS-72	1.8	2.51	20	57	120	765	900	1.70	534
DVS-84[4]	2.1	2.90	30	85	184	1133	1050	2.70	1113
DVS-96	2.4	3.28	40	120	269	1614	1200	4.00	1276
DVS-120[4]	3.0	4.11	70	205	475	2800	1200	7.40	3471
DVS-144[4]	3.7	4.88	110	330	750	4360	1500	11.90	6908

[1]Treated Flow Capacity is based on 80% removal of suspended sediment with the approximate mean particle size shown. The appropriate flow capacity should be selected based on expected site sediment characteristics.

[2] Maximum flow prior to bypass. Correlates approximately to 80% removal of suspended sediment with a 250 µm particle size mean.

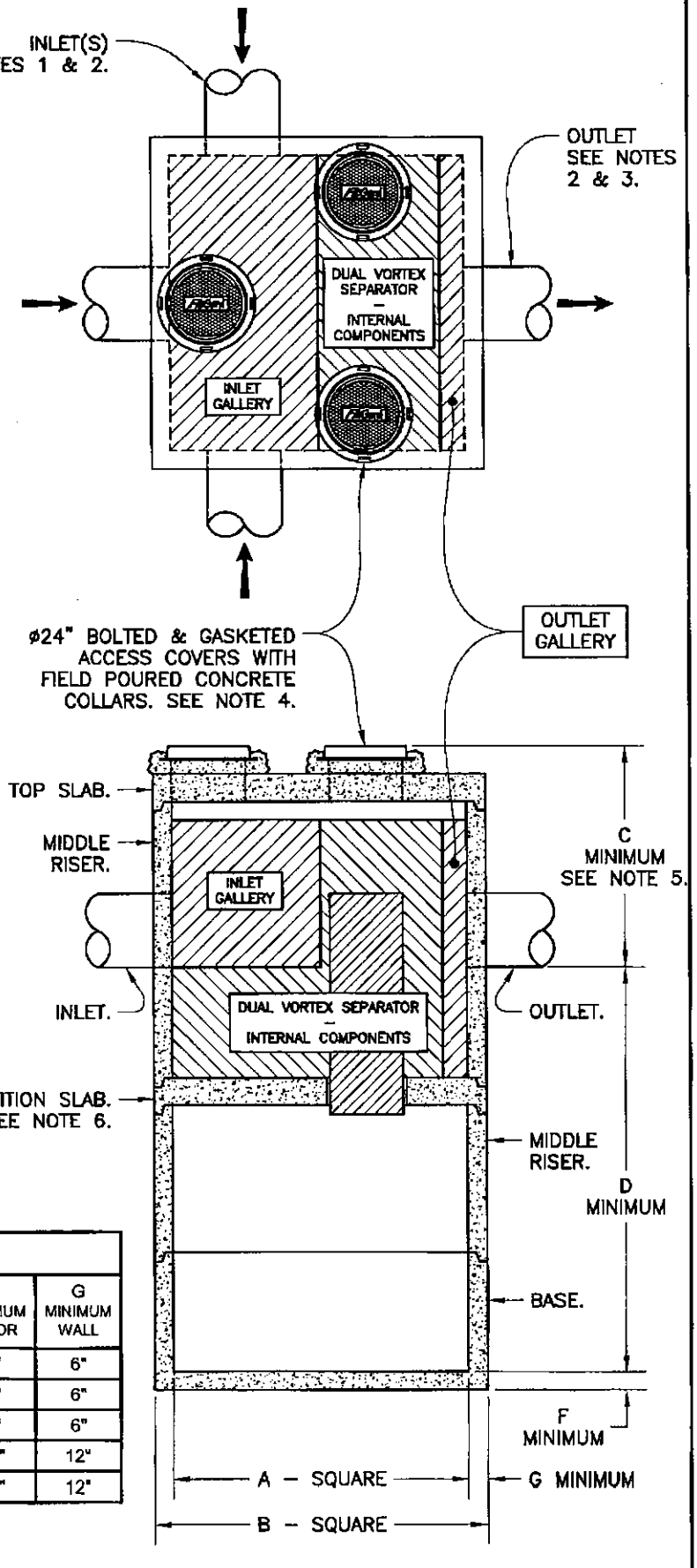
[3] Total design flow to the system should not exceed the Peak Flow Capacity.

[4]Call Kristar representative for availability in your area.

Notes: Systems may be sized based on a water quality flow (i.e. 1-inch design storm) or on net annual sediment load removal depending on local regulatory requirements.
Contact Kristar for the most accurate and cost effective sizing for your project location.

When sizing system based on a water quality flow, the required flow to be treated must be less than or equal to the Treated Flow Capacity for the selected unit.

360 Sutton Place, Santa Rosa, CA, 95407, (800) 579-8819
REV DVCC 020111



NOTES:

1. INLET PIPES MAY ENTER SEPARATOR ON THREE SIDES. POSITION RESTRICTED TO INLET GALLERY.
2. INLET AND OUTLET PIPES MAY JOIN SEPARATOR AT OBLIQUE ANGLES. SPECIFIC MAXIMUM ANGLES & PIPE SIZES APPLY. CONTACT KRISTAR ENTERPRISES FOR ENGINEERING DETAILS.
3. STANDARD OUTLET PIPE CONFIGURATION TO EXIT SEPARATOR AT THE CENTER LINE. CUSTOM ANGLED OUTLET CONFIGURATIONS RESTRICTED TO FACE OF UNIT OPPOSITE INLET GALLERY.
4. BOLTED & GASKETED ACCESS COVERS ADJUSTED TO GRADE, USING GRADE RINGS FIELD POUR CONCRETE COLLAR AS REQUIRED.
5. FOR DEPTHS LESS THAN THE MINIMUM SHOWN AS DIMENSION C IN THE TABULATION CONTACT KRISTAR ENTERPRISES FOR ENGINEERING DESIGN ASSISTANCE.
6. PARTITION SLAB MAY BE MADE AS A CONCRETE SLAB AS SHOWN, OR FROM ALTERNATIVE MATERIALS: e.g. FIBERGLASS COMPOSITE, STAINLESS STEEL, ETC.
7. CONCRETE COMPONENTS SHALL BE MANUFACTURED IN ACCORDANCE WITH ASTM DESIGNATION C858.
8. REMOVABLE INTERNAL COMPONENTS MAY BE AVAILABLE TO FACILITATE MAINTENANCE. SEE DRAWING DVS–R–0001 OR CONTACT KRISTAR ENTERPRISES FOR DETAILS.

TABULATION

MODEL	A ID (SQUARE)	B OD (SQUARE)	C MINIMUM SEE NOTE 5	D MINIMUM SUMP	E MAXIMUM Ø PIPE	F MINIMUM FLOOR	G MINIMUM WALL
DVS-72S	6' [72"]	7' [84"]	4.5' [54"]	8.25' [99"]	36"	6"	6"
DVS-84S	7' [84"]	8' [96"]	5.0' [60"]	9.50 [114"]	42"	6"	6"
DVS-96S	8' [96"]	9' [108"]	5.5' [66"]	10.75' [129"]	48"	6"	6"
DVS-120S	10' [120"]	12' [144"]	7.0' [84"]	13.50' [162"]	48"	12"	12"
DVS-144S	12' [144"]	14' [168"]	8.0' [96"]	16.00' [192"]	60"	12"	12"

* FOR SMALLER SYSTEMS (DVS-36S, DVS-48S & DVS-60S) SEE DRAWING DVS-S-0001.

TLE

FloGard DUAL-VORTEX

HYDRODYNAMIC SEPARATOR

SQUARE STRUCTURES

DVS-72S, DVS-84S, DVS-96S, DVS-120S, DVS-144S

KriStar Enterprises, Inc.
360 Sutton Place, Santa Rosa, CA 95407
Ph: 800.579.8819, Fax: 707.524.8186, www.kristar.com

DRAWING NO.	REV	ECO	DATE	SHEET
DVS-S-0002	D	0074 JRR 9/16/09	JRR 12/20/07	1 OF 1

StormTech SC-310 Chamber

Designed to meet the most stringent industry performance standards for superior structural integrity while providing designers with a cost-effective method to save valuable land and protect water resources. The StormTech system is designed primarily to be used under parking lots thus maximizing land usage for commercial and municipal applications.

StormTech®
Detention • Retention • Recharge
Subsurface Stormwater Management℠

StormTech SC-310 Chamber
(not to scale)

Nominal Chamber Specifications

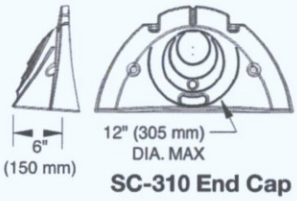
Size (L x W x H)
85.4" x 34.0" x 16.0"
(2170 x 864 x 406 mm)

Chamber Storage
14.7 ft³ (0.42 m³)

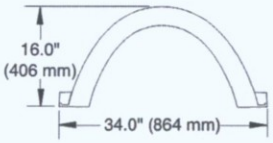
Minimum Installed Storage*
31.0 ft³ (0.88 m³)

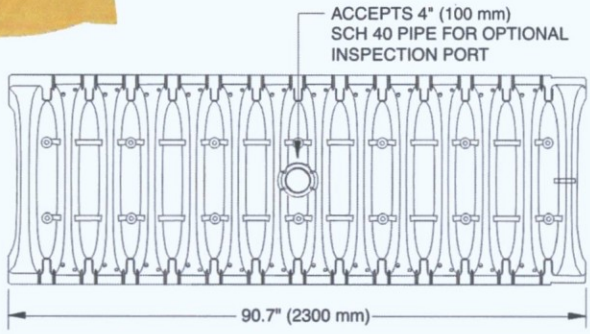
Weight
37.0 lbs (16.8 kg)

Shipping
41 chambers/pallet
108 end caps/pallet
18 pallets/truck

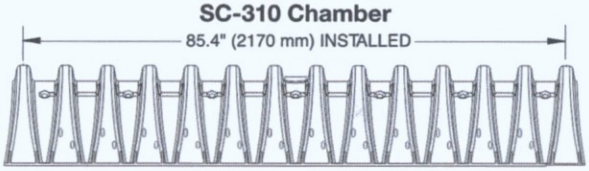


SC-310 End Cap

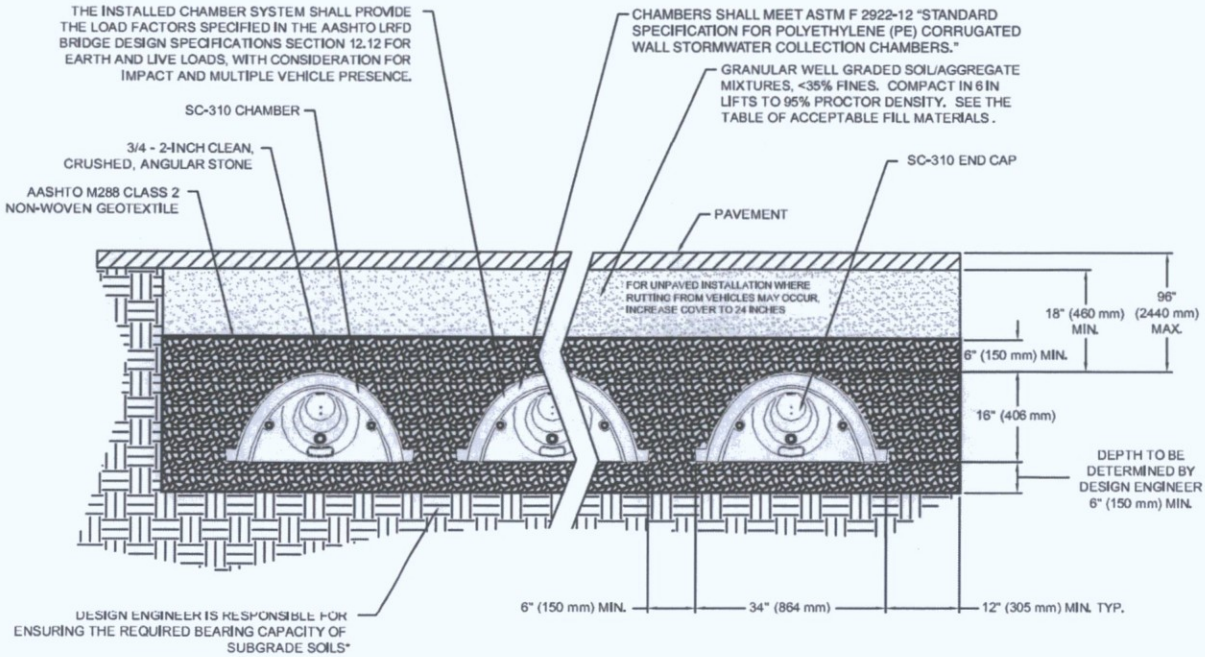




SC-310 Chamber



Typical Cross Section Detail
(not to scale)



MADE IN THE U.S.A.

THIS CROSS SECTION DETAILS THE REQUIREMENTS NECESSARY TO SATISFY THE LOAD FACTORS SPECIFIED IN THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS SECTION 12.12 FOR EARTH AND LIVE LOADS USING STORMTECH CHAMBERS

SC-310 Cumulative Storage Volumes Per Chamber

Assumes 40% Stone Porosity. Calculations are Based Upon a 6" (152 mm) Stone Base Under the Chambers.

Depth of Water in System Inches (mm)	Cumulative Chamber Storage ft³ (m³)	Total System Cumulative Storage ft³ (m³)
28 (711)	14.70 (0.416)	31.00 (0.878)
27 (686)	14.70 (0.416)	30.21 (0.855)
26 (680)	Stone 14.70 (0.416)	29.42 (0.833)
25 (610)	Cover 14.70 (0.416)	28.63 (0.811)
24 (609)	14.70 (0.416)	27.84 (0.788)
23 (584)	14.70 (0.416)	27.05 (0.766)
22 (559)	14.70 (0.416)	26.26 (0.748)
21 (533)	14.64 (0.415)	25.43 (0.720)
20 (508)	14.49 (0.410)	24.54 (0.695)
19 (483)	14.22 (0.403)	23.58 (0.668)
18 (457)	13.68 (0.387)	22.47 (0.636)
17 (432)	12.99 (0.368)	21.25 (0.602)
16 (406)	12.17 (0.345)	19.97 (0.566)
15 (381)	11.25 (0.319)	18.62 (0.528)
14 (356)	10.23 (0.290)	17.22 (0.488)
13 (330)	9.15 (0.260)	15.78 (0.447)
12 (305)	7.99 (0.227)	14.29 (0.425)
11 (279)	6.78 (0.192)	12.77 (0.362)
10 (254)	5.51 (0.156)	11.22 (0.318)
9 (229)	4.19 (0.119)	9.64 (0.278)
8 (203)	2.83 (0.081)	8.03 (0.227)
7 (178)	1.43 (0.041)	6.40 (0.181)
6 (152)	0	4.74 (0.134)
5 (127)	0	3.95 (0.112)
4 (102)	Stone Foundation 0	3.16 (0.090)
3 (76)	0	2.37 (0.067)
2 (51)	0	1.58 (0.046)
1 (25)	0	0.79 (0.022)

Note: Add 0.79 cu. ft. (0.022 m³) of storage for each additional inch (25 mm) of stone foundation.

Storage Volume Per Chamber

	Bare Chamber Storage ft³ (m³)	Chamber and Stone Stone Foundation Depth in. (mm)		
		6 (150)	12 (305)	18 (460)
StormTech SC-310	14.7 (0.4)	31.0 (0.9)	35.7 (1.0)	40.4 (1.1)

Note: Storage volumes are in cubic feet per chamber. Assumes 40% porosity for the stone plus the chamber volume.

Amount of Stone Per Chamber

	Stone Foundation Depth		
ENGLISH TONS (CUBIC YARDS)	6"	12"	18"
StormTech SC-310	2.1 (1.5 yd³)	2.7 (1.9 yd³)	3.4 (2.4 yd³)
METRIC KILOGRAMS (METER³)	**150 mm**	**305 mm**	**460 mm**
StormTech SC-310	1830 (1.1 m³)	2490 (1.5 m³)	2990 (1.8 m³)

Note: Assumes 6" (150 mm) of stone above, and between chambers.

Volume of Excavation Per Chamber

	Stone Foundation Depth		
	6" (150 mm)	12" (305 mm)	18" (460 mm)
StormTech SC-310	2.9 (2.2)	3.4 (2.6)	3.8 (2.9)

Note: Volumes are in cubic yards (cubic meters) per chamber. Assumes 6" (150 mm) of separation between chamber rows and 18" (460 mm) of cover. The volume of excavation will vary as the depth of the cover increases.

STANDARD LIMITED WARRANTY OF STORMTECH LLC ("STORMTECH"): PRODUCTS

(A) This Limited Warranty applies solely to the StormTech chambers and endplates manufactured by StormTech and sold to the original purchaser (the "Purchaser"). The chambers and endplates are collectively referred to as the "Products."

(B) The structural integrity of the Products, when installed strictly in accordance with StormTech's written installation instructions at the time of installation, are warranted to the Purchaser against defective materials and workmanship for one (1) year from the date of purchase. Should a defect appear in the Limited Warranty period, the Purchaser shall provide StormTech with written notice of the alleged defect at StormTech's corporate headquarters within ten (10) days of the discovery of the defect. The notice shall describe the alleged defect in reasonable detail. StormTech agrees to supply replacements for those Products determined by StormTech to be defective and covered by this Limited Warranty. The supply of replacement products is the sole remedy of the Purchaser for breaches of this Limited Warranty. StormTech's liability specifically excludes the cost of removal and/or installation of the Products.

(C) **THIS LIMITED WARRANTY IS EXCLUSIVE. THERE ARE NO OTHER WARRANTIES WITH RESPECT TO THE PRODUCTS, INCLUDING NO IMPLIED WARRANTIES OF MERCHANT-ABILITY OR OF FITNESS FOR A PARTICULAR PURPOSE.**

(D) This Limited Warranty only applies to the Products when the Products are installed in a single layer. **UNDER NO CIRCUMSTANCES, SHALL THE PRODUCTS BE INSTALLED IN A MULTI-LAYER CONFIGURATION.**

(E) No representative of StormTech has the authority to change this Limited Warranty in any manner or to extend this Limited Warranty. This Limited Warranty does not apply to any person other than to the Purchaser.

(F) Under no circumstances shall StormTech be liable to the Purchaser or to any third party for product liability claims; claims arising from the design, shipment, or installation of the Products, or the cost of other goods or services related to the purchase and installation of the Products. For this Limited Warranty to apply, the Products must be installed in accordance with all site conditions required by state and local codes; all other applicable laws; and StormTech's written installation instructions.

(G) **THE LIMITED WARRANTY DOES NOT EXTEND TO INCIDENTAL, CONSEQUENTIAL, SPECIAL OR INDIRECT DAMAGES. STORMTECH SHALL NOT BE LIABLE FOR PENALTIES OR LIQUIDATED DAMAGES, INCLUDING LOSS OF PRODUCTION AND PROFITS; LABOR AND MATERIALS; OVERHEAD COSTS; OR OTHER LOSS OR EXPENSE INCURRED BY THE PURCHASER OR ANY THIRD PARTY. SPECIFICALLY EXCLUDED FROM LIMITED WARRANTY COVERAGE ARE DAMAGE TO THE PRODUCTS ARISING FROM ORDINARY WEAR AND TEAR; ALTERATION, ACCIDENT, MISUSE, ABUSE OR NEGLECT; THE PRODUCTS BEING SUBJECTED TO VEHICLE TRAFFIC OR OTHER CONDITIONS WHICH ARE NOT PERMITTED BY STORMTECH'S WRITTEN SPECIFICATIONS OR INSTALLATION INSTRUCTIONS; FAILURE TO MAINTAIN THE MINIMUM GROUND COVERS SET FORTH IN THE INSTALLATION INSTRUCTIONS; THE PLACEMENT OF IMPROPER MATERIALS INTO THE PRODUCTS; FAILURE OF THE PRODUCTS DUE TO IMPROPER SITING OR IMPROPER SIZING; OR ANY OTHER EVENT NOT CAUSED BY STORMTECH. THIS LIMITED WARRANTY REPRESENTS STORMTECH'S SOLE LIABILITY TO THE PURCHASER FOR CLAIMS RELATED TO THE PRODUCTS, WHETHER THE CLAIM IS BASED UPON CONTRACT, TORT, OR OTHER LEGAL THEORY.**

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Peak Flow Calculations Using The Rational Method

Project:	Crossroads South
Proj #:	191447014
Date:	6/7/16
Prep by:	TMJ
Check by:	TMJ

Base Sheet Prepared By GA, Version 2

Source of Rainfall Data --->NOAA Atlas 14

Rainfall Depth-Duration-Frequency (D-D-F), (inch)					
Storm Fequency	Time				
	5 min	10 min	15 min	30 min	60 min
10-Yr	0.41	0.63	0.78	1.05	1.29
100-Yr	0.65	0.98	1.22	1.64	2.03
Derived Rainfall Intensity-Duration-Frequency (I-D-F), (in/hr					
10-Yr	4.92	3.78	3.12	2.10	1.29
100-Yr	7.80	5.88	4.88	3.28	2.03

Attach source and supporting data for rainfall depths

AF for Cw per $Cw_{10\text{-}Yr}$		
Freq.	Typical	Applic.
2-Yr	1.00	1.00
5-Yr	1.00	1.00
10-Yr	1.00	1.00
25-Yr	1.10	1.10
50-Yr	1.20	1.20
100-Yr	1.25	1.25

AF=Frequency Adjustment Factor

Drainage Area ID: -----

Tc,calc method: 1=Papadakis and Kazan, 2=Avg Veloc. | 1 | Tc,calc=11.4*L^0.5*Kb^0.52*S^-0.31*i^-0.38

Cw for each frequency is adjusted as a function of the 100-year value per the table above

Concent. Point #	Contributing Sub-basins	Total Area (ac)	Base Cw (2-10 yr)	Flow Path, L (ft)	Approx High pt (ft)	Approx Low pt (ft)	Average Slope ft/ft	K_b Class A-->D	m	b	K_b	Initial/lot Tc (min)	10-Yr Minim allowed Tc,tot =			0.0	Q	100-Yr Minim allowed Tc,tot =			0.0	Q
													Cw AF=1.00	Tc,calc (min)	Tc,tot (min)	i (in/hr)	10-Yr (cfs)	Cw AF=1.25	Tc,calc (min)	Tc,tot (min)	i (in/hr)	100-Yr (cfs)
W of Divide		7.00	0.450	655	73	63.3	0.0148	B	-0.01375	0.08	0.0684	0	0.45	8.9	8.9	4.24	13.3	0.56	7.4	7.4	7.03	27.7
E of Divide		4.32	0.450	606	73	65.1	0.0130	B	-0.01375	0.08	0.0713	0	0.45	9.3	9.3	4.01	7.8	0.56	7.5	7.5	7.03	17.1
OS-1		6.30	0.450	1900	93	67	0.0137	B	-0.01375	0.08	0.0690	0	0.45	17.9	17.9	2.98	8.5	0.56	14.6	14.6	5.08	18.0
OS-2		1.00	0.950	1200	89	73	0.0133	B	-0.01375	0.08	0.0800	0	0.95	15.0	15.0	3.25	3.1	0.95	12.3	12.3	5.48	5.2
DA-1		2.50	0.450	610	72.5	64.8	0.0126	B	-0.01375	0.08	0.0745	0	0.45	9.7	9.7	4.01	4.5	0.56	7.8	7.8	7.03	9.9
DA-2		1.90	0.450	600	72.5	66	0.0108	B	-0.01375	0.08	0.0762	0	0.45	10.4	10.4	3.78	3.2	0.56	8.4	8.4	6.65	7.1

Appendix D

Corp of Engineers Letter of Compliance for Nationwide Permit No. 39

LOS ANGELES DISTRICT
U.S. ARMY CORPS OF ENGINEERS

CERTIFICATION OF COMPLIANCE WITH DEPARTMENT OF THE ARMY NATIONWIDE PERMIT

Permit Number: SPL-2011-375-AP

Date of Issuance: April 16, 2012

Name of Permittee: Maria Baier
Arizona State Land Department
1616 W. Adams Street
Phoenix, Arizona 85007

Upon completion of the activity authorized by this permit, sign this certification and return it with an original signature to the following address:

U.S. Army Corps of Engineers
ATTENTION: Regulatory Division (SPL-2011-375-AP)
3636 North Central Avenue, Suite 900
Phoenix, Arizona 85012-1939

Please note that your permitted activity is subject to a compliance inspection by a Corps of Engineers' representative. If you fail to comply with this Nationwide Permit you may be subject to permit suspension, modification, or revocation.

I hereby certify that the work authorized by the above referenced Nationwide Permit has been completed in accordance with the terms and conditions of said permit.

Signature of Permittee _____ Date 5-18-12

Enclosure 2

Appendix E

Exhibits

Aerials

Aerial transparency of the 2013 aerial photo layer.

ACCE

SDE

DE 12/1104646

12/1104646

CHAUNCEY LANE

SCOTTSDALE ROAD

73RD PLACE

PROPOSED DRAINAGE SWALE

50 CFS WASH PER COS GIS MAPS

NORTH

GRAPHIC SCALE IN FEET

0 40 80 160

FIGURE 5
50 CFS WASH EXHIBIT

Kimley»Horn

K:\PHX_Civil\191447014 - JLB Crossroads South\CADD\Exhibits\2016-10-25 50 CFS Wash.dwg Oct 25, 2016 Garrett.Frame
XREFS: X4470147F X4470148M X4470148M1 X4470148M2 X4470148M3