Exterior Building Color & Material Samples (Photo)
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Parking Study
Parking Master Plan
Water Study
Wastewater Study
Stormwater Waiver Application

TROON NORTH TRACT V

APN 216-72-648A

Located at

10299 E. WHITE FEATHER LANE

SCOTTSDALE, AZ

COMMENT RESPONSE

CITY OF SCOTTSDALE TRACKING NO: 878-PA-2015

Stormwater Review By:
Mohammad Rahman, PE, PH, CFM
Phone 480-312-2563 Fax 480-312-7781
e-mail: mrahman@ScottsdaleAZ.gov
Review Cycle #2 Date 5/23/16

April 19, 2016

Jesus Murillo
Senior Planner
City of Scottsdale

RE: Troon North Tract V- Comment Response
City of Scottsdale Reference # 10-PP-2015

Dear Mr. Murillo,

Following are the comments and their responses for the drainage report for Troon North Tract V project that was previously prepared by Cano and Associates, Inc in December 14, 2015 and submitted to the City of Scottsdale. Everest Consulting Services, PC revised the previous report prepared by Cano and Associates to address all the review comments received from the City on January 21, 2016. City of Scottsdale review comments are reproduced and presented in the *italicized fonts.*

Zoning Ordinance and Scottsdale Revise Code Significant Issues Comment and Response

Legal:

Comment #1*: Provide Complete and updated Commitment for Title within the last 30 days, for both subject parcels. The "Proposed Insured" shall be the City of Scottsdale and the "Amount" shall be the estimated value of the property. Commitment for Title must be within 30 days of resubmittal date. Commitment for Title shall have all sections and paragraphs completed (DSPM Chapter 1, Section 1-1.403.G).*

Response: Client is aware about the requirement for the Commitment for Title Insurance and will provide the required document to the City separately.

Drainage:

Comment #2*: Please submit two (2) copies of the revised Drainage Report with the original red-lined copy of the report to your Project Coordinator with the rest of the resubmittal material identified in Attachment A.*

Response: Owner will submit two copies of the revised Drainage Report with the original red lined copy. A revised Storm water waiver will also be submitted with the revised documents.

Comment #3 *:As provided in the attached Improvement Plan sheets for 'On the Green at Troon North' subdivision (COS Case #: 51-PP-1994), the existing Tract 'V' not only carries the 122 cfs offsite wash through it, but also carries the flow over a low point across E. White Feather Lane, with a curb opening along the northwest side of the road (located immediate southeast of the existing roadway divider along E. White Feather Lane) to ensure the passage of runoff through Tract 'V' into the golf course across E. White Feather Lane. This assumption (argument) is also supported by the onsite sub-watersheds and hydrologic divides generated by the ArcHydro program which can be seen in the attached 11"X17" color ArcGIS printout. Therefore, it appears that the entire Tract 'V' may have been intended to be utilized as a 'drainage corridor' when this subdivision was originally developed. Please verify the Master Drainage Study to see if that was the case and clarify it in the Case Drainage Report. Please certify 'no adverse impact' by stating in the Case Drainage Report that developing the intended part of the existing Tract 'V' will not have any 'adverse impact' in terms of flooding in*

this subdivision (COS Stormwater Ordinance: Section 37-32(c) & 37-43(b); DSPM Section 4-1.800, Section 4-1A & Section 4-1B).

Response: Please note that the existing culvert at the White Feather Lane consists of 2-36-inch diameter Reinforced Concrete Pipes. HEC-RAS analysis was performed at this culvert crossing and the results show that the culvert is significantly undersized and has capacity of only 60 cfs (which may be less than 10-year storm runoff). As such, the 2-36-inch RCP culvert is overtopped during 100-year storm event with head water depth of 3-inches across White Feather Lane at the culvert location. As per the Design Standards and Policies Manual for City of Scottsdale, for local and minor collector street culverts, the allowable overtopping depths are 6-inches and 12-inches respectively during the 25-year and 100-year storm events. As such, the overtopping depth for both conditions remain within permissible limits. As mentioned in *Section 7.0 Onsite Detention Requirement*, Master Drainage Study for Troon North Resort Site prepared by Gilbertson Associates, Inc. in February 1994 was reviewed. The report indicates that storm water management for the entire Troon North Resort will be handled at regional facilities located downstream of the property (golf course). A Developed Conditions Flood Routing Map form the 1994 Master Drainage Study shows that at the location of the Troon North Tract V project site resort amenities such as tennis court, basketball court and guard house were initially proposed. This indicates that the Master Drainage Study for Troon North Resort Site considered the future development of 0.689 acres Tract V project site and the proposed conditions runoff volume from the site is considered at regional facilities as indicated in the report. Excerpt from the 1994 Master Drainage Study and the Developed Conditions Flood Routing Map is provided in Exhibit-8 of the revised report..it is also worth noting that the flow concentration points for the "after" condition remain same as those for the "before" condition (EXHIBIT 2 and EXHIBIT 5), thereby indicating that the historic flow path is not altered due to the proposed improvement and thus there is no adverse impact in terms of flooding in the subdivision.

Comment #4 *Regional stormwater storage is usually required when a major subdivision is developed based on the pervious area being transformed into impervious area. The tracts are usually open spaces, corridors, etc. that are purposefully left undeveloped and they do not count towards the total stormwater storage capacity provided as a part of the regional stormwater storage requirement. Turning the major portion of this undeveloped area into an impervious area may overburden the total capacity of the regional stormwater storage and must be verified in terms of quantifiable volume under the existing and proposed conditions. The Engineer must calculate the pre- vs. post- stormwater storage volume requirement for the 100-year, 2-hour storm event using the FCDMC equation V = ΔCRA for the project site. The ΔC should be calculated using the methodology outlined in Comment #6 above. Please note that the 100-year, 2-hour precipitation depth is 2.69 inch at this project site based on the NOAA 14 rainfall data. The Engineer must clearly state in the Case Drainage Report that the existing regional stormwater storage basins for this subdivision have the capacity to handle the calculated additional runoff volume* ***OR*** *that the calculated runoff volume is so insignificant that it will not have any 'adverse impact' in terms of flooding in this subdivision, if that is the case (COS Stormwater Ordinance: Section 37-32(c) & 37-43(b); DSPM Section 4-1.402 & Section 4-1.800).*

Response: As mentioned in *Section 7.0 Onsite Detention Requirement, The runoff volume were calculated for pre and post development conditions considering parameters suggested in the comments.* The runoff volume calculated for pre and post developed conditions are 3,028 ft^3 and 3,887 ft^3 respectively. The difference in the run off volume due to the proposed development is approximately 858 ft^3, Review of the 1994 Master Drainage Study for Troon North Resort Site prepared by Gilbertson Associates, Inc. indicates that storm water management for the entire Troon North Resort will be handled at regional facilities located

downstream of the property (golf course). A Developed Conditions Flood Routing Map form the 1994 Master Drainage Study also shows that at the location of the Troon North Tract V project site resort amenities such as tennis court, basketball court and guard house were initially proposed. This indicates that the Master Drainage Study for Troon North Resort Site considered the future development of 0.689 acres Tract V project site and the proposed conditions runoff volume from the site is considered at regional facilities as indicated in the report. It is our opinion that the increased overall imperviousness or the weighted runoff coefficient in the site due to currently proposed developments are very similar to those due to the amenities stipulated in the original Master Plan. Based on this information, it is our conclusion that on-site retention/detention facilities are not necessary for this development.

Significant Policy Related Issues Comment and Response

Drainage:

Comment #5: Please submit two (2) copies of the Case Drainage Report with the next submittal. Please also submit a CD with the Case Drainage Report containing a PDF file of the complete sealed and signed drainage report (DSPM Section 4-1.800).
Response: Two copies of the revised Drainage Report with the original red lined copy of the report as well as a CD of the report will be submitted with the new submittal.

Comment #6: The 24"x36" exhibits were difficult to read due to the background aerial. Please take out the aerial photos from all 24"X36" exhibits which show the existing and the proposed conditions for the project. Please continue to provide the aerial photo on the exhibits for the 8"X11" color map in the drainage report, (DSPM Section 4-1.900 & Section 4-1B).
Response: The exhibits are revised and aerial from the background are excluded. Revised Exhibits depicting drainage areas for the before and after conditions as well as limits of 100 year water surface elevations are provided in color for the convenience of the reviewer.

Comment #7: *The 24"X36" exhibits which show the existing condition survey topo. Please update the exhibit to identify the upstream and the downstream invert elevations: for the existing 24" pipe culverts located under N. 103rd Street, and for the existing 2-36" pipe culvert under E. White Feather Lane, in the XXXX.XX ft. format. Please also identify all Q_{100} (from existing approved study or calculated) on the project site on this exhibit. Cite the source of the Q_{100} of 122 cfs below the Q_{100} value within parenthesis on this exhibit, which is COS Case #: 51-PP-1994 (DSPM Section 4-1.900 & Section 4-1B).*
Response: Exhibits are revised to include culvert's inlet and outlet elevation and 100-year offsite flow. Please refer to Exhibit 1, 2 and 5. Source for the offsite flow are discussed in Section 3 of the revised Drainage Report.

Comment #8: *Update the case drainage reports to certify the validity of the Q_{100} of 122 cfs for the offsite wash by stating in in the provided Case Drainage Report that he engineer has reviewed the originally approved Master Drainage Study for the subdivision (COS Case #: 409-PA-1993 and COS Case #: 51-PP-1994). The report should show the Q_{100} value, with comfort that even though the upstream watershed may have changed and that the FCDMC methodology for the hydrologic analysis of the watershed. Provide evidence that the NOAA rainfall data have significantly changed since 1994. Include a copy of the originally approved Improvement Plan from COS Case #: 51-PP-1994 on 11"X17" papers in his Case Drainage Report as well (DSPM Section 4-1.800 & 4-1A).*
Response: The offsite flow considered in the previous drainage report (by Cano in December 2015) is review and revised. The offsite flow of 155 cfs was based on the recently completed regional drainage study namely Pinnacle Peak West Area Drainage Master Study (PPW

ADMS) by the Flood Control District of Maricopa County (FCDMC) and made available by the City of Scottsdale. Please refer to *Section 3 Existing Offsite Conditions* for detail description about offsite flow and Exhibit 3 for supporting FLO-2D Map.

Comment #9: The FCDMC has recently carried out a regional drainage study in this area namely Pinnacle Peak West Area Drainage Master Study (PPW ADMS) using the Flo 2D model. The results are officially published and are available from the FCDMC website. Please see that attached 11"X17" Flo 2D printout. The report calls out 155 cfs flows through the site (Tract 'V"), as can been seen in the attached 11"X17" Flo 2D printout (individual grid flow along a perpendicular line are added up as shown in yellow). The report must include this 11"X17" Flo 2D printout in his Case Drainage Report and must explain why he prefers to use the old Q_{100} of 122 cfs from a study which was done back in 1994 over the PPW ADMS Flo 2D results. Alternatively, the case drainage report may utilize the PPW ADMS Flo 2D results (155.0 cfs) for the design, or may choose to do design the hydrology based on the MCDMC DDMSW Rational Method or HEC-1 program (DSPM Section 4-1.800 & 4-1A).
Response: The revised offsite flow of 155 cfs was considered for the analysis as narrated in *Section 3 Existing Offsite Conditions* of the revised report. The FLO-2D printout provided by the City of Scottsdale is included as EXHIBIT-3 of the revised drainage report. .

Comment #10: *On the 24"X36" "Existing Condition" Exhibit, please identify, and label, the existing condition 'base floodplain' based on the headwater elevation calculated in HY-8 for the existing 2-36" pipe culvert under E. White Feather Lane (which is 2548.08'). Please identify, and label, the weir location on this map which is used to generate the station-elevation data in HY-8 for the roadway weir to calculate the culvert headwater elevation, so that the roadway profile data provided, in the HY-8 section of the Case Drainage Report, can be verifiable (DSPM Section 4-1.900 & Section 4-1B).*
Response: Please refer to revised Exhibit 6 that identifies 100-year base floodplain and water surface elevation for before and after development conditions based on HEC-RAS analysis. The 2-36" pipe culvert are already modeled in the HEC_RAS analysis, therefore, we did not perform a separate HY-8 analysis.

Comment #11: *The increase in the Q_{100}, due to the development, must be quantified using the Rational Method (Q = CIA), and must be added to the existing Q_{100} of 122 cfs in order to reanalyze the existing 2-36" pipe culvert under E. White Feather Lane, in HY-8. Please see the attached 11"X17" color ArcGIS printout to see how the onsite sub-watersheds will be affected by the proposed development. Please use a 'C' value (Runoff Coefficient) of 0.45 for the pre-development onsite peak discharge calculation and a weighted average 'C' value (0.94 for the proposed four (4) lots and 0.45 for the remaining onsite area) for the post-development onsite peak discharge calculation. Please use an 'I' value (Rainfall Intensity) of 9.14 for a Tc of 5 minutes which can be directly obtained from the NOAA website as attached. The attached NOAA information must also be included in the Case Drainage Report (DSPM Section 4-1.800 & Section 4-1A).*
Response: Onsite hydrology for this report is based on the Rational Method and in accordance with Flood Control District of Maricopa County Drainage Design Hydrology Manual and City of Scottsdale. As suggested, C' value (Runoff Coefficient) of 0.45 for the pre-development onsite peak discharge calculation and a weighted average 'C' value (0.94 for the proposed four (4) lots and 0.45 for the remaining onsite area) were used for the post-development onsite peak discharge calculation. Since this is a very small drainage area with time of concentration less than 5 minutes, a minimum time of concentration (Tc) of 5 minutes and the maximum rainfall intensity of 9.14 inches are selected from NOAA 14. Please refer to Section 6 Onsite Hydrology for detail discussion about the onsite flow in the pre and post

development conditions. Please note that the drainage area of the project site is very small with time of concentration approximately equal to 5 minutes; therefore, by the time the offsite peak flow of 155 cfs attenuates at White Feather Lane culvert the 100-year peak flows from onsite would have already exited the site. As such the 100-year onsite peak discharge is not added to the offsite peak discharge. Furthermore the FLO-2D output shows the 155 CFS to be near the exit boundary of the site. Hence, we considered the on-site flow to be included in the 155 CFS.

Comment #12: *The case drainage report identifies 2.0 cfs to come into Tract 'V,' from the south, by crossing E. Dynamite Boulevard, under the existing condition. Please include the Rational Method peak discharge calculation for this flow in the Case Drainage Report. Please provide an 11"X17" Watershed Map in the Case Drainage Report. The watershed delineation should be based on the COS 2005 1.0 ft. contours (quarter section topography maps). Please refer to the attached 11"X17" color ArcGIS printout (ArcHydro watersheds) to verify your watershed delineation (DSPM Section 4-1.800).*

Response: Please note that the Pinnacle Peak West Area Drainage Master Study (PPW ADMS) FLO-2D model shows that offsite flows coming from the south (local street flow from Dynamite Blvd) and the east (east of 103rd Place) combines within the project site and approximately 155 cfs exits the project site during 100-year storm event. As such a separate calculation for the flow from Dynamite Blvd is not required. Please refer to *Section 3 Existing Offsite Conditions* for the detail discussion regarding offsite flow entering the site.

Comment #13: *As provided in the attached 11"X17" color ArcGIS printout, the existing condition 'base floodplain' extends into the area where the site plan proposes new developments, which will result in an increase in the BFE (Base Floodplain Elevation). Proposed grading (i.e. proposed contours) must be shown on the Proposed Condition Exhibit to demonstrate the revised floodplain. The HY-8 headwater elevation from the proposed condition must be utilized to delineate the proposed condition 'base floodplain'. If it is found that the outlet of the existing 24" pipe culvert under 103rd St is completely submerged under the existing and/or the proposed condition, then HY-8 will no longer will be acceptable for culvert analysis anymore since the existing 24" pipe culvert under 103rd St will become 'outlet controlled' and the backwater calculation through the two interconnected culverts must be analyzed using the HEC-RAS models. In case a HEC-RAS model is used to calculate the backwater, then a CD containing the digital HEC-RAS files should be included in the Case Drainage Report (DSPM Section 4-1.800 & Section 4-1A).*

Response: Hydraulic analysis of the existing onsite wash along with White Feather Ln culvert downstream and 103rd Place culvert upstream was modeled in USACE HEC-RAS software. Please refer to *Section 8 Hydraulics* for the detail discussion of hydraulic analysis of the existing wash and 100-year water surface elevation comparison during existing and proposed conditions. Please refer to **EXHIBIT-9** for HEC-RAS output and **EXHIBIT-6** for limits of Existing and Proposed 100-year water surface delineation map during the existing and proposed conditions. A compact Disc (CD) containing the HEC-RAS analysis files and pdf version of the drainage report, calculations and exhibits is also provided to the client for inclusion with the submittal of the revised documents.

Comment #14: *If the PPW ADMS Flo 2D results (155.0 cfs) are to be used for this design, versus using a hydrology based on the MCDMC DDMSW Rational Method - or HEC-1 program, and the results are calculated with a higher Q_{100} than 122 cfs, or if it is found that flow is overtopping E. White Feather Lane, based on the HY-8 analysis; then the use of a HEC-RAS model may become essential to demonstrate 'no adverse impact,' since the proposed development encroaches into the base floodplain and the flow overtopping (weir*

flow) elevation on E. White Feather Lane, the flow cannot be increased (COS Stormwater Ordinance: Section 37-32(c) & 37-43(b); DSPM Section 4-1.800 & Section 4-1A).

Response: Hydraulic analysis using HEC-RAS was performed for both existing and proposed conditions to evaluate the water surface elevations in the analysis area for each scenario. Please refer *Section 8 Hydraulics* for the discussion regarding hydraulic analysis using HEC-RAS. Also refer to Table 2 from *Section 8.2 Hydraulic Analysis Results* that compares the 100-year water surface elevation (WS_{100}) between the existing and proposed conditions hydraulic model. The result show that the increase in the WS_{100} due to the proposed development ranges from a minimum of 0.00 ft. to a maximum of 0.07 ft depending on the location of the river station used for the analysis. It is clear that the increase in the WSE_{100} is limited within the project site. It can also be safely deduced that the increase in the water surface elevation which is mainly due to the obstruction provided by the proposed buildings is practically insignificant and therefore, does not impose any adverse impact to the adjacent properties. In fact, the 100-year water surface elevation matches between the existing and proposed conditions at the adjacent properties located just west of White Feather Ln and east .of 103rd Place Culvert. The proposed lowest finished floor elevation for the North Troon Tract V development is at 2552-feet which is approximately 2.3-feet above the adjacent WSE_{100} and minimum 1 foot above the highest adjacent grade.

Comment #15: Please show and label the approximate limit of the 'drainage tract' covering the proposed base floodplain on the 24"X36" Proposed Condition Exhibit (DSPM Section 4-1.700 & Section 4-1A).

Response: Please refer to *Exhibit 6 Limits of 100 Year Water Surface Elevations for "Before" and "After" Conditions* that depicts approximate limit of the 'drainage tract' covering the proposed base floodplain.

Respectfully Submitted:

Punya P. Khanal

Digitally signed by Punya P Khanal
DN: cn=Punya P Khanal, o=Everest Consulting Services, ou, email=everestconsult@cox.net, c=US
Reason: I am the author of this document
Date: 2016.04.19 18:23:43 -07'00'

Punya P. Khanal, Ph.D., P.E.
Everest Consulting Services, PC

REVISED
DRAINAGE REPORT

FOR

TROON NORTH TRACT V
APN 216-72-648A

Located at

10299 E. WHITE FEATHER LANE
SCOTTSDALE, ARIZONA

CITY OF SCOTTSDALE TRACKING NO: 878-PA-2015

Original Report Prepared by:
CANO & ASSOCIATED, INC. ENGINEERS

Revised Report
PREPARED BY:

Everest Consulting Services, PC
6874 W. Blackhawk Drive
Glendale, AZ 85308

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EXPIRES 6-30-2018

First Submittal: December, 2015
Revision Submittal: April, 2016

ECS Ref # 09-008

Table of Contents

EXECUTIVE SUMMARY

This drainage report for Troon North Tract V project was previously prepared by Cano and Associates, Inc in December 14, 2015 and submitted to the City of Scottsdale. This report revises the previous report prepared by Cano and Associates to address all the review comments received from the City on January 12, 2016.

The subject site is in a low-density residential resort community and undeveloped desert. The project site is currently vacant, however, the site has public infrastructure such as improved streets, golf path, and other pathways. The site is bounded by Dynamite Boulevard to the south, White Feather Lane to the west, golf cart path to the north, and 103rd Street to the east. The entire site is within an existing golf course and resort community.

The proposed improvements consists of the re-platting of the existing 0.689 acre site into 4 single family residential lots and construction of two duplex buildings within these 4 lots. The proposed improvements also consist of the associated grading works and minor work on the street right of way to provide access to the new buildings. The proposed disturbance area is 0.31 acres, of which building structures and drive ways will cover 0.180 acres and the remaining 0.13 acres will be desert landscape.

The existing topography of the site is generally flat from the South to North with elevation ranging from approximately 2547 to 2555 feet above sea level. The existing onsite runoff sheet flows from the south towards north and drains into the existing wash that runs east to west along the northern portion of the project site. Currently, there are two pipe culverts located along the eastern and western property boundary. 2 - 36-inch diameter Reinforced Concrete Pipe (RCP) Culvert is located along White Feather Lane that receives flow from existing onsite wash and conveys west towards the golf course, and 1 – 24-inch diameter High Density Polyethylene Pipe (HDPE) Culvert is located along 103rd Street that receives offsite flows and conveys to the existing onsite wash. Offsite flow for the project site is estimated from the Pinnacle Peak West Area Drainage Master Study (PPW ADMS) Flo-2D model. The ADMS shows the site receives majority of offsite flow from the east and minor street flow coming from the south (Dynamite Boulevard). The offsite flows coming from the south and the east combines within the project site and approximately 155 cfs exits the project site during 100-year storm event.

The site has been designed so that individual lots from the developed area will drain onto the White Feather Lane, while the flow from the undeveloped area follow the historical flow path. Onsite hydrology for the existing and the proposed conditions is based on the Rational Method. The hydrologic analysis results increase in 100-year discharge due to the proposed development. However, the increase in 100-year discharge is minimal or practically insignificant and does not adversely affect the adjacent properties. Onsite detention basin is not designed in the proposed conditions for Troon North Tract V site because the difference in storm runoff volume between the pre and post developed conditions is approximately 859 cubic feet. We propose to provide a 1 foot deep, retention basin in the SE quarter of the proposed development. The basin will have a very gentle slope of 5(H):1(V) and a retention capacity of a500 cubic feet. This will make up for the increased runoff volume due to proposed construction. In addition, it can also accommodate

approximately 650 Cubic feet of additional volume to the existing regional retention provided in the original development. As such, the onsite runoff in the proposed conditions follow the historical flow path except for the portion of developed area which drains onto White Feather Lane.

The USACE software program HEC-RAS was used for the hydraulic analysis of the offsite flow through the project site under the (i) "before" or "existing" condition and (ii) "after" or "proposed" condition to evaluate the impact of the proposed development to the 100-year water surface elevation (WS_{100}) within the project site and its effect on adjacent properties, The results show that the proposed development causes an increase of 0.07 feet or 0.84 inches in the water surface elevation due to a 100-year storm event The increase in the water surface elevation is practically insignificant and mainly due to the obstruction provided by the proposed building. The increase in the WS_{100} is also limited within the project site and does not cause any adverse impact to the adjacent properties. The proposed finished floor elevation for the North Troon Tract V development will be 2552-feet which is approximately 2.3-feet higher than the adjacent WSE_{100} and minimum 1 foot above the highest adjacent grade. The projects are at least 14 inches above the ultimate site outfall and all hydrologic and hydraulic calculations and designs for this project will comply with the Maricopa County Flood Control District's and City of Scottsdale Drainage Design Manuals

1 Introduction

1.1 Project Description

This drainage report for the property of 'Troon North Tract V' was completed under a contract with White Feather lane LLC and under request from the Planning & Development Department of City of Scottsdale. The drainage report was previously prepared by Cano and Associates, Inc in December 14, 2015 and submitted to the City of Scottsdale. This drainage report revises the report prepared by Cano and Associates to address all the comments received from the City on January 12, 2016. In order to maintain continuity of the review and submittal process from the previous submittal, majority of the content and structure of the original report is retained in this revised report with permission from Cano and Associates.

The property is 0.689 acres of natural desert landscape area and existing public infrastructure. The proposed development is to provide two duplex buildings on four lots. The project site is currently vacant, however, the site has public infrastructure such as improved streets, golf path, and other pathways. The site is also adjacent to three roadways, Dynamite Boulevard, White Feather Lane, and 103rd Street, which is west of Alma School Road. The entire site is within an existing golf course and resort community. This site is the last vacant area to be developed within the resort community. The community has existing improvements, utilities and drainage infrastructure. This report will identify the amount of storm water flows conveyed within the site boundaries, proposed drainage plan, and proposed finish floors of the buildings, which will be safe from inundation by storm runoff due to a 100-year storm event. Also, this report will provide the property's existing surrounding drainage conditions and proposed drainage improvements.

1.2 Scope of Work

This project is a 0.689-acre and proposed four single-family development that comprises of vacant natural ground and desert vegetation. As mentioned, the subject property is bounded by Dynamite Boulevard to the South, 103rd Street to the East, White Feather Lane to the west, and a golf cart path to the North. The site proposal is to provide two buildings, which are two duplex houses with driveways. Also, the improvements will modify the existing community's landscape, which will be per the City of Scottsdale development requirements. The proposed development will only disturb approximately half of the 0.689 acres and will leave the rest to existing conditions.

1.3 Project Location:

The proposed development is located at 10299 E. White Feather Lane in Scottsdale, Arizona. More specifically, the property lies between 103rd Street, the entrance road to the Troon North community and the Troon North Golf Clubhouse, and White Feather Lane. Project site and Vicinity Map is shown in Figure 1.

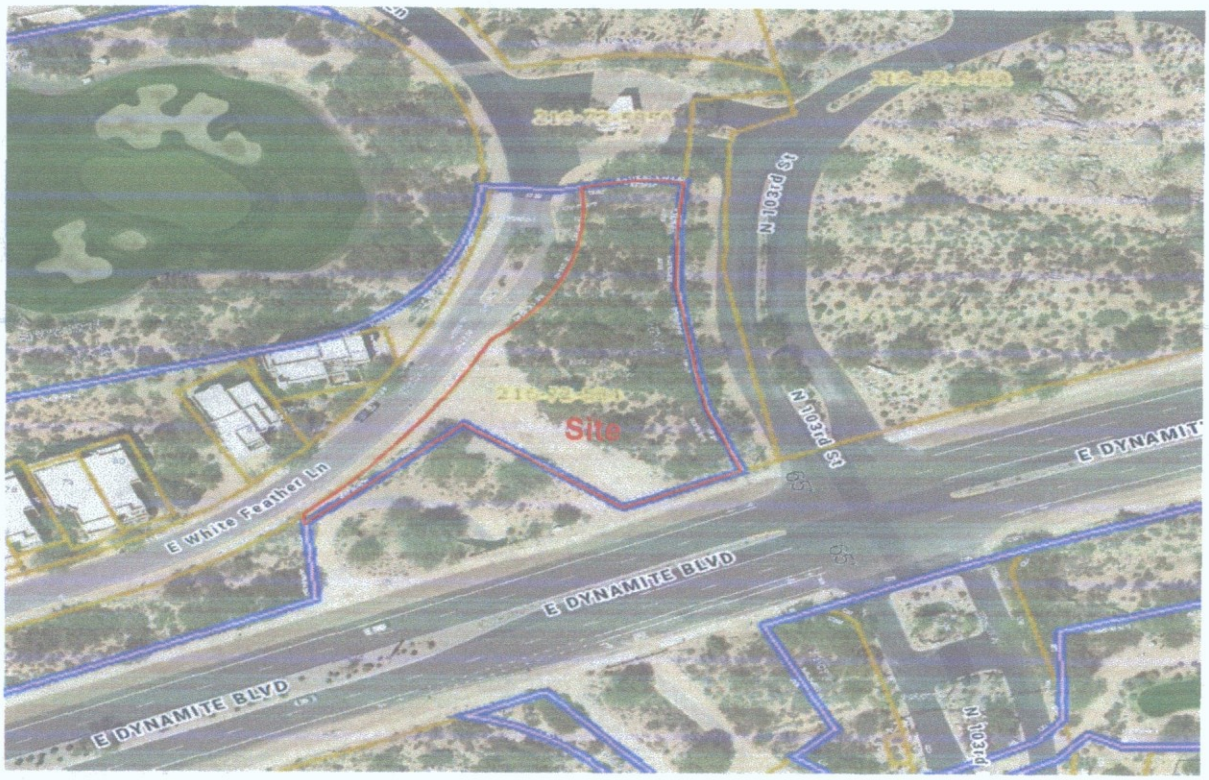


Figure 1: Vicinity Map

2 Existing Onsite Conditions

2.1 Topography

The existing topography of the site is generally flat from the South to North, but with significant grades towards the northern portion of the project site, as shown in **EXHIBIT-1**. Currently, the property is in an existing low-density residential area with natural desert vegetation. The project area elevations range from approximately 2547 to 2555 feet above sea level. Parcels north and east of the site are undeveloped desert land, while residential buildings plus golf course boarders the project to the west and south. The existing topography around the single-family home area is more prominently shown in **EXHIBIT-1.**

2.2 Existing Runoff

In existing conditions, the adjacent storm water flows from the South and Southeast towards the north part of the site and conveyed by existing adjacent improved streets and drainage structures, as shown in **EXHIBIT-2**. Majority of onsite runoff also sheet flows from the south towards north and drains into the existing onsite wash, while a portions of onsite area drains onto White Feather Lane and into the box culvert underneath Dynamite Blvd, located southwest of the project site. There are two pipe culverts located along the eastern and

western property boundary. A 2-barrel 36-inch diameter Reinforced Concrete Pipe (RCP) Culvert is located along White Feather Lane that receives both on-site and off-site flows through the existing onsite wash and conveys west towards the golf course. A single pipe 24-inch diameter High Density Polyethylene Pipe (HDPE) Culvert is located across 103rd Street that receives offsite flows and conveys part of it into the existing onsite wash.

3 Existing Offsite Conditions

Existing drainage infrastructure and roadways within the entire development surround the property. The offsite flows that enter the project site are minor street flow coming from the south (Dynamite Boulevard) and major flow coming from the watershed east of 103rd Place. Offsite flow from watershed south of Dynamite Boulevard drains from the South to the North and conveyed by a box culvert underneath Dynamite Boulevard. Since the existing culverts convey the storm water, the offsite flows do not affect the project area or the proposed buildings. The Pinnacle Peak West Area Drainage Master Study (PPW ADMS) recently completed by the Flood Control District of Maricopa County (FCDMC) was reviewed to estimate the offsite flows that enter the project site along the southern and eastern property boundary. The PPW ADMS was performed using Flo-2D software and the model shows that offsite flows coming from the south and the east combines within and exits the project site with an estimated flow of 155 CFS during 100-year storm event. A printout of the Flo-2D flow output showing the individual element flows resulting in a cumulative estimated flow of 155 CFS made available by the City of Scottsdale is included as **EXHIBIT-3.** This 100-year offsite flow (155 cfs) was used for the hydraulic analysis of the existing onsite wash and also to determine the 100-year flood water elevation during the existing and developed conditions.

4 FEMA Flood Plain Classification

This site is not located in a Federal Emergency Management Agency (FEMA) Special Flood Hazard Area, per Flood Insurance Rate Map (FIRM) number 04013C1330L (FIRM Zone X); therefore, it is not located in a 100-Yr floodplain. The FEMA FIRM Panel is included as **EXHIBIT-4** in this drainage report.

5 Proposed Drainage Plan

The site has been designed so that individual lots from the developed area will drain onto the White Feather Lane. The difference in storm runoff volume between the pre and post developed conditions is approximately 858 cubic feet as shown in section 7 of this report. Onsite detention basin is not designed in the proposed conditions for Troon North Tract V site as explained in section 7. As such, the proposed improvement will maintain the remaining portion of the undeveloped area as in the existing conditions following the historical flow pattern.

6 Onsite Hydrology

Onsite hydrology for this report is based on the Rational Method and in accordance with Flood Control District of Maricopa County Drainage Design Hydrology Manual and City of Scottsdale Design Standards and Policies Manual. Since this is a very small drainage area with time of concentration less than 5 minutes, a minimum time of concentration (Tc) of 5 minutes and the maximum rainfall intensity of 9.14 inches are selected from NOAA 14.

Based on the average lot size (3,500 sq.ft.) of the proposed Troon North Tract V, Townhouse (R-2, R-4) land use is selected to estimate runoff coefficient (C) of 0.94 for proposed residential area. Similarly, runoff coefficient of 0.45 was selected for undisturbed natural desert and desert landscaping per Figure 4.1-4 of City of Scottsdale, Design Standards and Policies Manual. The project site was divided into three distinct drainage areas E-1, E-2 and E-3 for the existing conditions and P-1, P-2 and P-3 for proposed conditions with corresponding flow concentration points C-1, C-2 and C-3 as shown in **EXHIBIT-2** and **EXHIBIT-5** respectively. .A weighted runoff coefficient value of 0.73 was computed for the developed area to account the existing and proposed land use type. A spreadsheet showing detailed calculations of the weighted runoff coefficient and estimated flow values for each area is included as **EXHIBIT-7.** The estimated on-site flows for both existing and proposed conditions are summarized in the flowing Table.

Table 1 Estimated Onsite Existing and Proposed Conditions 100-year Discharge

Concentration Point	Q_{100} Existing	Q_{100} Proposed
C-1	0.2	0.2
C-2*	0.6	2.1
C-3	2.0	1.3

*Concentration point at White Feather Lane

The estimated existing conditions onsite run off due to a 100-year storm event ranges from as low as 0.2 cfs to 2 cfs. Similarly in the proposed conditions, the 100-year runoff also ranges from 0.2 cfs to 2.1 cfs. Due to the proposed development, the 100-year discharge at concentration point C-2 (at White Feather Lane) increased by 1.5 cfs. The increase in 100-year discharge in the proposed conditions is minimal and does not impose any adverse impact of any practical significance to the adjacent properties. The proposed 100-year discharge of 2.1 cfs at White Feather Lane will follow the similar flow path as in the existing condition, which crosses the White Feather Lane and eventually gets into the golf course. The drainage area of the project site is very small with time of concentration approximately equal to 5 minutes; therefore, by the time when offsite peak flow of 155 cfs concentrates at White Feather Lane culvert the 100-year peak flows from onsite would have already exited the site. Refer to **EXHIBIT-2** "Existing Conditions Drainage Map" and **EXHIBIT-5** "Proposed Conditions Drainage Map".

7 Onsite Detention Requirement

As state earlier, onsite detention basin is not designed for the developed conditions due to the small increase in runoff volume (858 cubic feet) between the pre and post developed conditions. However, a detail calculation was performed to compute the runoff volume during the pre and post development conditions.

Runoff volume are computed for the 100-year 2 hour rainfall depth as per City of Scottsdale Design Standards and Policies Manual. The existing and proposed conditions runoff volume is calculated using the rational method as described in Section 3.4 of Maricopa County DDM-Volume I.

Volume of Runoff (V) = C* (P/12) * A
Where,
A – Drainage Area (Sq.ft.)
P – 100-year 2 hour rainfall depth (2.69 inches)
C- Runoff Coefficient

The runoff volume calculated for pre and post developed conditions are 3,028 ft^3 and 3,886 ft^3 respectively. The difference in the run off volume due to the proposed development is approximately 858 cubic feet. Based upon the review of the previous Master Drainage Study, for Troon North Resort, we propose that no retention basin be provided for this increased runoff volume and therefore, runoff from the proposed developed areas are designed to sheet flow into the existing onsite wash and onto White Feather Lane as in the existing conditions. *Master Drainage Study for Troon North Resort Site prepared by Gilbertson Associates, Inc. in February 1994 was reviewed during the hydrologic analysis of this project. The report indicates that storm water management for the entire Troon North Resort will be handled at regional facilities located downstream of the property (golf course). A Developed Conditions Flood Routing Map form the 1994 Master Drainage Study shows that at the location of the Troon North Tract V project site, resort amenities such as tennis court, basketball court and guard house were initially proposed. This indicates that the Master Drainage Study for Troon North Resort Site considered the future development in the 0.689 acres Tract V project site and the proposed conditions runoff volume from the site is considered at regional facilities as indicated in the report.* Excerpt from the 1994 Master Drainage Study and the Developed Conditions Flood Routing Map is provided as **EXHIBIT-8.**

8 Hydraulics

We developed an independent water-surface profile models for the onsite north wash using U.S. Army Corps of Engineers' Software River Analysis System (HEC-RAS) version 4.1.0. The intent of this analysis was to verify that the proposed North Troon Tract V does not adversely impact adjacent property and to confirm that finished grade and pad elevations will be elevated one-foot above the adjacent base flood elevation within the Zone X floodplain.

Two HEC-RAS water-surface profile models were created to reflect the existing and proposed conditions. The existing conditions model uses the latest field survey data of the onsite wash

and proposed conditions was created incorporating the proposed development finish grading elevations with the existing survey data. Results from the models were then compared with base-flood elevation which are discussed in detail in following sections.

8.1 Parameter Estimation

Manning's Roughness Coefficients:

The Manning's roughness "n" of 0.035 was used for the main channel and 0.1 was used for the overbanks. High manning's n value for an over bank area is mainly due to presence of dense and extremely large vegetation. Refer to Figure 2 and Figure 3 below that shows photos of existing onsite wash we took during the recent site visit..

Fig 2. Looking West, Downstream view from White Feather Ln Culvert.

Fig 3. Looking West, Downstream view from 103rd Place Culvert.

Expansion and Contraction Coefficients

Coefficient of expansion and contraction of 0.1 and 0.3 respectively were used throughout the study reach. For the cross-section defining the upstream and downstream faces of roadway culvert, coefficient for expansion and contraction of 0.3 and 0.5, respectively were used.

Cross Section Description

Channel cross sections for the hydraulic analysis were generated from ground survey performed on April, 2016. Survey elevations were in National American Vertical Datum 1988 (NAVD). It is to be noted that cross sections were also created at the inlet and outlet locations of the existing culverts for the HEC-RAS analysis.

100-Year Design Flow

The 100-year design discharge for this analysis was taken directly from Pinnacle Peak West Area Drainage Master Study (PPW ADMS) described previously elsewhere in this report. The model shows 100-year design discharge of 155 CFS exits the project site, along the western property boundary. As stated earlier, the onsite drainage areas are very small with time of concentration approximately equal to 5 minutes; therefore, coincident of occurring peaks from onsite and offsite at same time at White Feather Lane is highly unlikely. As such, onsite flow were not considered with offsite during hydraulic analysis. Further it should be noted that the FLO-2D printout made available by the City **(EXHIBIT-3)** shows the 155 CFS to be at the downstream side of the project site. Hence, it ca be safely assumed that the on-site runoff within the project site is already a part of the 155 CFS. It is also worth noting that this value (155 CFS) was used for the entire stream reach for the HEC-RAs analysis.

8.2 Hydraulic Analysis Results

Hydraulic analysis using HEC-RAS was performed for both existing and proposed conditions to evaluate the water surface elevations in the analysis area for each scenario. Please refer to Table 2 below for the comparison of 100-year water surface elevation (WS_{100}) between the existing and proposed conditions hydraulic model. The result show that the increase in the WS_{100} due to the proposed development ranges from a minimum of 0.00 ft. to a maximum of 0.07 ft depending on the location of the river station used for the analysis. It is clear that the increase in the WSE_{100} is limited within the project site. It can also be safely deduced that the increase in the water surface elevation which is mainly due to the obstruction provided by the proposed buildings is practically insignificant and therefore, does not impose any adverse impact to the adjacent properties. In fact, the 100-year water surface elevation matches between the existing and proposed conditions at the adjacent properties located just west of White Feather Ln and east .of 103rd Place Culvert. The proposed lowest finished floor elevation for the North Troon Tract V development is at 2552-feet which is approximately 2.3-feet above the adjacent WSE_{100} and minimum 1 foot above the highest adjacent grade.

It is to be noted that the existing 2-36-inch diameter RCP culvert along the White Feather Lane and 1-24-inch diameter HDPE culvert along 103rd Place will be significantly overtopped during the existing and proposed 100-year storm runoff event. Approximate limit of the 100-year water surface elevation is delineated for the onsite wash for both the existing and proposed conditions. The WS_{100} limit delineation shows that there is not any adverse impact due to the proposed development on and off the site. Please refer to **EXHIBIT-9** for HEC-RAS output and **EXHIBIT-6** for limits of Existing and Proposed 100-year water surface delineation map during the existing and proposed conditions.
A compact Disc (CD) containing the HEC-RAS analysis files and pdf version of the drainage report, calculations and exhibits is also provided to the client for inclusion with the submittal of the revised documents.

Table 2. 100-year WSE Comparison between Existing and Proposed Conditions

HEC-RAS Cross Section ID	Existing Conditions WSEL 100-Yr	Proposed Conditions WSEL 100-Yr	Difference WSEL 100-Yr (ft)
600	2554.56	2554.56	0.00
549	2553.98	2553.98	0.00
522	2554.00	2554.00	0.00
504	2554.00	2554.00	0.00
450	103rd Place Culvert (1-24-inch diameter HDPE)		
423	2549.65	2549.66	+0.01
405	2549.32	2549.35	+0.03
376	2549.01	2549.08	+0.07
348	2548.98	2549.05	+0.07
300	White Feather Lane Culvert (2-36-inch diameter RCP)		
283	2545.19	2545.19	0.00
158	2544.04	2544.04	0.00
100	2543.53	2543.53	0.00

9 Conclusions and Recommendations:

The following conclusions are derived from the drainage study on this parcel:

i. Offsite flow for the project site is estimated from the Pinnacle Peak West Area Drainage Master Study (PPW ADMS) Flo-2D model. The ADMS shows the site receives offsite runoff of approximately 155 CFS coming from the east.

ii. The offsite runoff is conveyed through the property along the existing onsite wash designated as Wash-1 in the report.

iii. The proposed development does not encroach into the existing drainage ways and only adds negligible amount of flows.

iv. The proposed grades will direct the offsite and onsite flows to the historical locations. The proposed development has no adverse impact to the entire community drainage system or the adjacent properties.

v. The proposed finished floor elevation for the North Troon Tract V development will be 2552-feet which is approximately 2.3-feet higher than the adjacent $WSE_{100\,yr}$ and minimum 1 foot above the highest adjacent grade.

vi. Onsite detention basin is not considered necessary for the developed conditions due to the small increase in runoff volume (858 cubic feet) between the pre and post developed conditions and due to the fact that the original Master Drainage Plan stipulated future construction of tennis courts and a club house in the project site and already accounted for the on-site runoff due to these facilities within the regional facilities as indicated in the referenced Master Drainage Plan. Runoff from the proposed development will sheet flow into the existing onsite wash.

vii. The maximum increase in the 100 year water surface elevation due to the proposed development is only 0.07 ft, which is less than 1 inch. This increase in the WS_{100}

is limited within the project site and does not result in any adverse impact to the adjacent properties.

viii. All hydrologic and hydraulic calculations and designs for this project will comply with the Maricopa County Flood Control District's and City of Scottsdale Drainage Design Manual.

The following are Engineer's recommendations to the developers/homeowners:

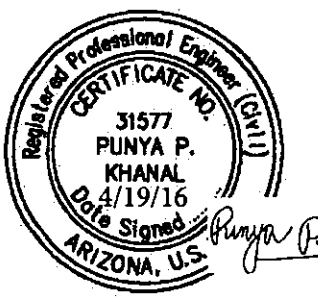
i. Keep the wash and the surrounding areas clean. Do not dump any loose dirt in the wash channel.

ii. Inspect wash and both inlet and outlet side of the existing culverts during and immediately after a major storm event. Clean any sediment deposit on the upstream side of the culverts immediately following a major storm event.

Report Prepared & Submitted

Punya P. Khanal

Punya P. Khanal, Ph.D., P.E.
Everest Consulting Services, PC



Digitally signed by Punya P Khanal
DN: cn=Punya P Khanal, o=Everest Consulting Services, ou, email=everestconsult@cox.net, c=US
Date: 2016.04.19 18:08:40 -07'00'

EXPIRES 6-30-2018

10 References:

1. Drainage Design Manual of Maricopa County, Volume I Hydrology, August 15, 2013
2. Drainage Design Manual of Maricopa County, Volume II Hydraulics, August 15, 2013
3. City of Scottsdale Design Standards and Policies Manual, January 2010.
4. Preliminary Hydrology for Troon North resort Site, Case 409-PA-93, by Gilbertson Associates, Inc., February 1994.

11 EXHIBITS

EXHIBIT-1 Existing Site Topography.

EXHIBIT-2 Existing Drainage Area Delineation and Flow Pattern.

EXHIBIT-3 FLO-2D 100 YR Flow Printout from Pinnacle Peak West Master Drainage Study.

EXHIBIT-4 FEMA FIRM Panel for Project Site.

EXHIBIT-5 Proposed Drainage Area Delineation and Flow Pattern.

EXHIBIT-6 Limits of 100 Year Water Surface Elevations for Before and After Conditions.

EXHIBIT-7 Details On-Site Runoff Calculation from EXCEL Worksheet.

EXHIBIT-8 Excerpts from 1994 Master Drainage Study by Gilbertsons and Associates.

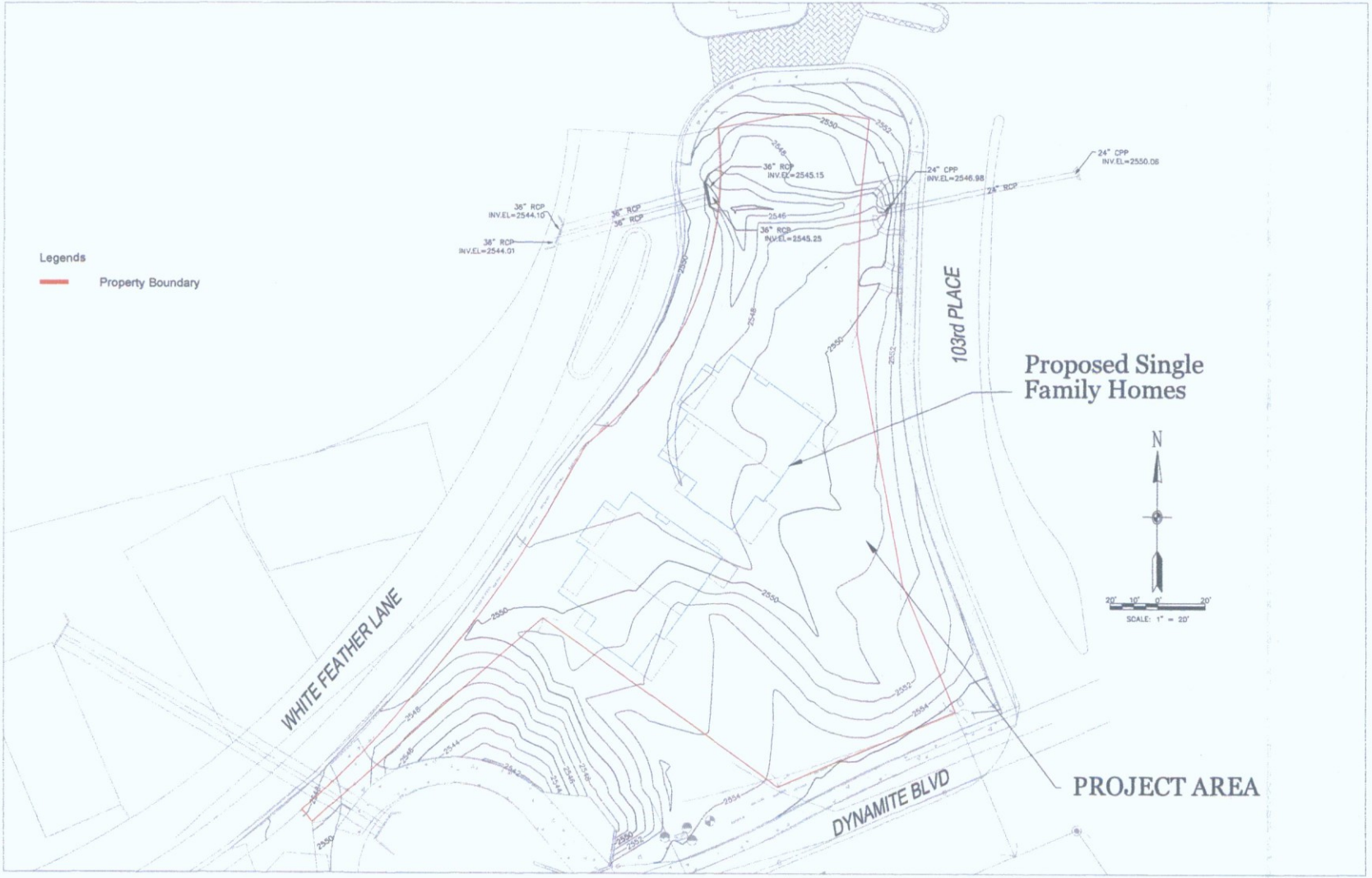
EXHIBIT-9 HEC-RAS Analysis Selected Output Pages.

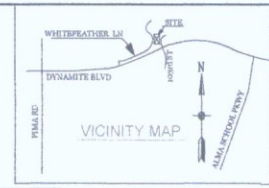
EXISTING SITE TOPOGRAPHY

AT

TROON NORTH TRACT V

10299 EAST WHITE FEATHER LANE SCOTTSDALE, AZ 85262





REVISIONS	BY
1	PPK
2	PPK
3	PPK
4	PPK

EXHIBIT - 1

EXISTING SITE TOPOGRAPHY

EVEREST CONSULTING SERVICES, PC
CONSULTING ENGINEERS
6874 W. BLACKHAWK DR., GLENDALE, AZ. 85308
TEL: (623) 533-0334, Email: everestconsult1@gmail.com

DATE:	04-18-2016
SCALE:	1" = 20 FT.
DRAWN:	GMS
CHECKED:	PPK
JOB #	16-08
SHEET TITLE	EXISTING SITE TOPOGRAPHY
SHEET #	DA1
	SHEET 1 OF 1

COS# 878-PA-2015

COS# 878-PA-2015

EXISTING DRAINAGE AREA DELINEATION & FLOW PATTERN

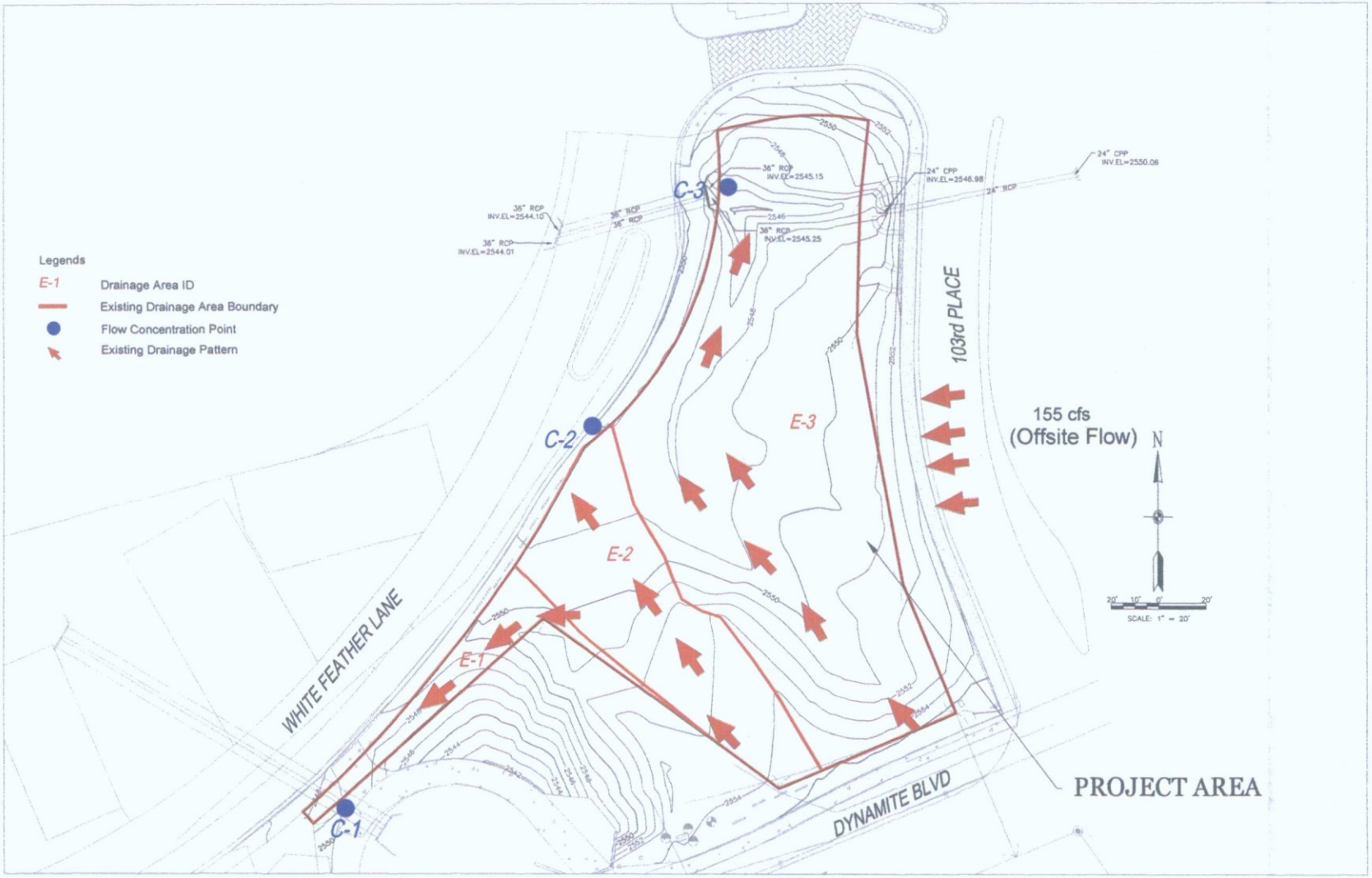
AT

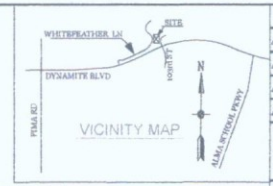
TROON NORTH TRACT V

10299 EAST WHITE FEATHER LANE SCOTTSDALE, AZ 85262

Existing Conditions 100-year Discharge Calculations

Drainage Area ID	Land Use Type	Drainage Area		Runoff Coefficient	A X C	Rainfall Intensity	Flow Concentration Point	Q100
		ft²	acres	C		(in/hr)		(cfs)
E-1	Undisturbed Natural Desert	7990	0.18	0.45			C-1	5.2
E-2	Undisturbed Natural Desert	6549	0.15	0.45		5.14	C-2	8.6
E-3	Undisturbed Natural Desert	25456	0.58	0.45			C-3	2.9
			0.895					





REVISIONS	BY
1	PPK
2	PPK
3	PPK
4	PPK

EXHIBIT - 2
EXISTING CONDITIONS

EVEREST CONSULTING SERVICES, PC
CONSULTING ENGINEERS
6874 W. BLACKHAWK DR., GLENDALE, AZ. 85308
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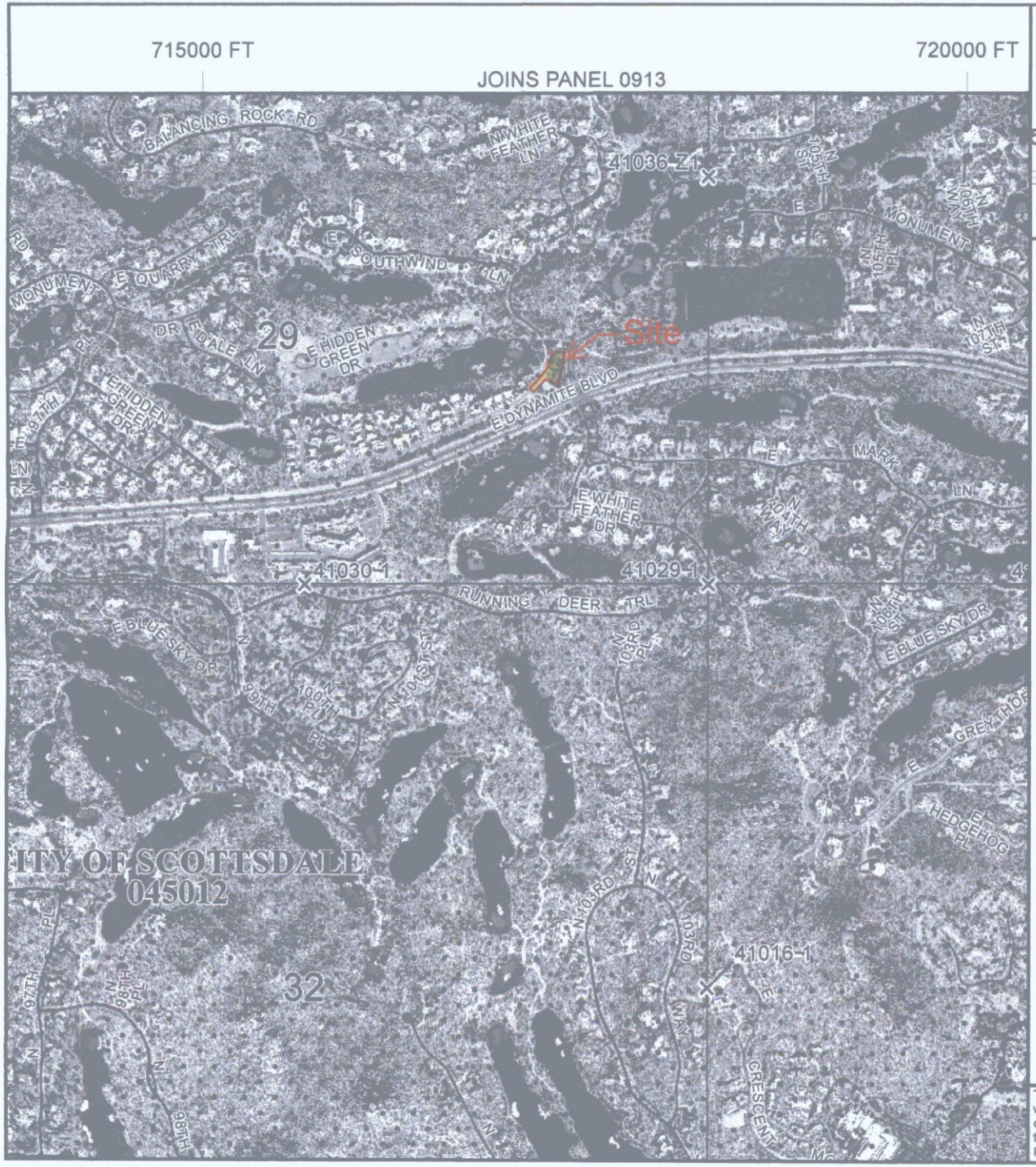
EXPIRES 9-30-2018

DATE:	04-18-2016
SCALE:	1" = 20 FT.
DRAWN:	GMS
CHECKED:	PPK
JOB #	16-08
SHEET TITLE	DRAINAGE AREA DELINEATION & FLOW ANALYSIS
SHEET #	DA1
SHEET	1 OF 1

COS# 878-PA-2015

COS# 878-PA-2015

EXHIBIT 3: FLO-2D 100-yr Flow PPW ADMS



MAP SCALE 1" = 1000'

500 0 1000 2000 FEET

METE

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 1330L

FIRM

FLOOD INSURANCE RATE MAP

MARICOPA COUNTY, ARIZONA

AND INCORPORATED AREAS

PANEL 1330 OF 4425

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
SCOTTSDALE, CITY OF	045012	1330	L

EXHIBIT 4: FIRM

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
04013C1330L

MAP REVISED
OCTOBER 16, 2013

Federal Emergency Management Agency

PROPOSED DRAINAGE AREA DELINEATION & FLOW PATTERN

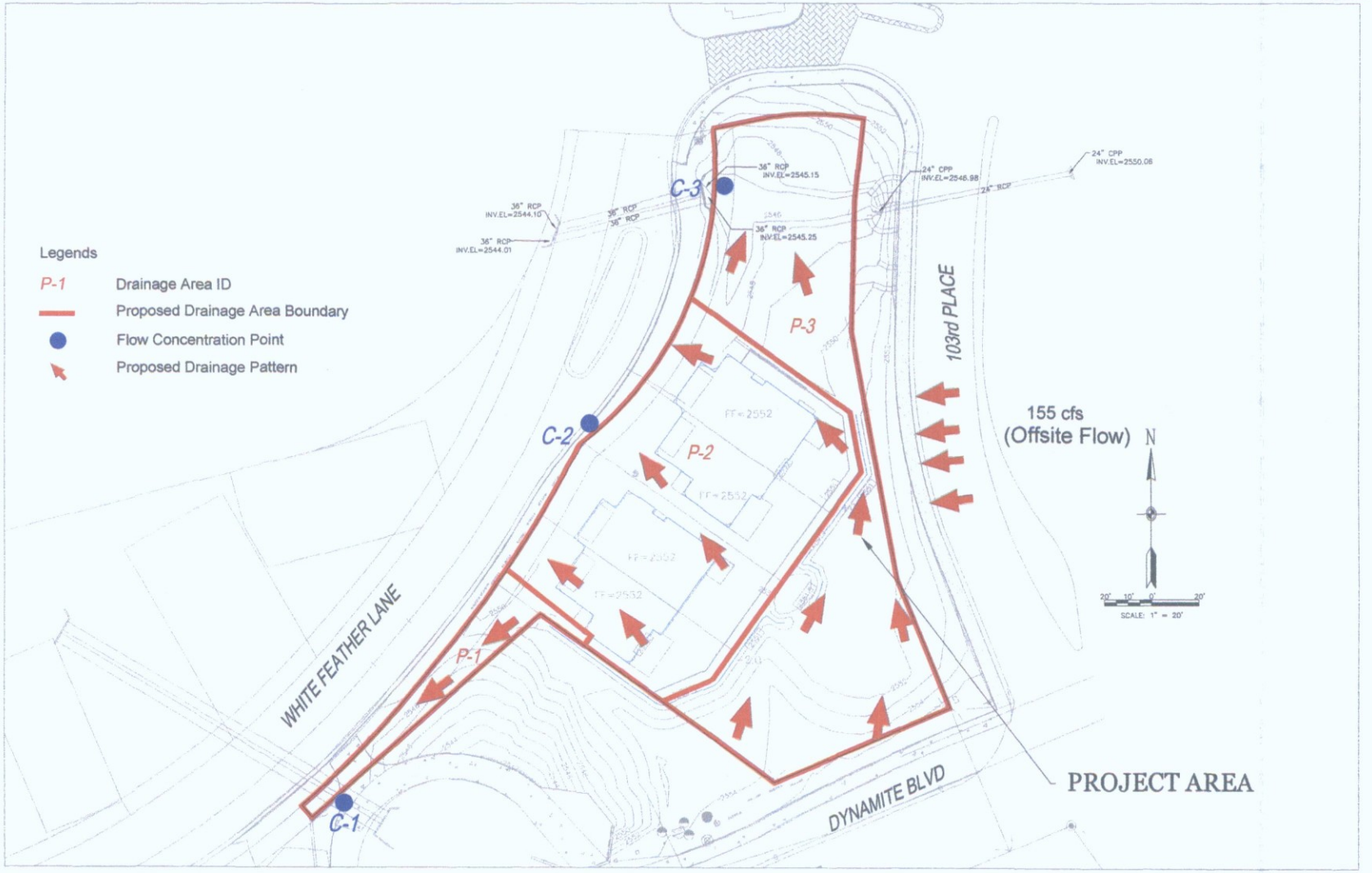
AT

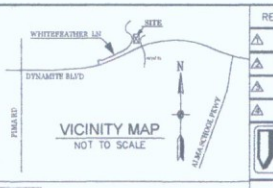
TROON NORTH TRACT V

10299 EAST WHITE FEATHER LANE SCOTTSDALE, AZ 85262

Proposed Conditions 100-year Discharge Calculations

Drainage Area ID	Land Use Type	Drainage Area		Runoff Coefficient	A X C	Weighted Runoff Coefficient C	Rainfall Intensity	Flow Concentration Point	Q100
		ft2	acres	C			(in/hr)		(cfs)
P-1	Undisturbed Natural Desert	1934	0.062	0.45		0.45	9.14	C-1	0.2
P-2	Duplex Building	7932	0.182	0.94		0.72		C-2	2.1
	DLS- Desert Landscaping	9248	0.143	0.45					
P-3	Undisturbed Natural Desert	14107	0.324	0.45		0.45		C-3	1.3
			0.711						





REVISIONS	BY
1	PPK
2	PPK
3	PPK
4	PPK

EXHIBIT - 5
PROPOSED CONDITIONS

EVEREST CONSULTING SERVICES, PC
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EXPIRES 9-30-2018

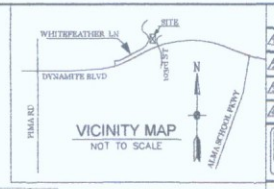
DATE:	04-16-2016
SCALE:	1" = 20 FT.
DRAWN:	GMS
CHECKED:	PPK
JOB #	16-06
SHEET TITLE	PROPOSED DRAINAGE AREA DELINEATION & FLOW PATTERN
SHEET #	DA1
SHEET 1 OF 1	

COS# 878-PA-2015

COS# 878-PA-2015

LIMIT of 100-YEAR WATER SURFACE ELEVATIONS

FOR BEFORE & AFTER CONDITIONS
TROON NORTH TRACT V
10299 EAST WHITE FEATHER LANE SCOTTSDALE, AZ 85262



REVISIONS	BY
1	PPK
2	PPK
3	PPK
4	PPK

EXHIBIT - 6
Before and After Conditions
100-Yr Water Surface Elevations

COS# 878-PA-2015

EVEREST CONSULTING SERVICES, PC
CONSULTING ENGINEERS
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TEL: (623) 533-0334, Email: everestconsult1@gmail.com

EXPIRES 6-30-2018

DATE: 04-16-2016
SCALE: 1" = 20 FT.
DRAWN: GMS
CHECKED: PPK
JOB # 16-06
SHEET TITLE
100-yr WATER SURFACE ELEVATIONS
SHEET # DA1
SHEET 1 OF 1

COS# 878-PA-2015

EXHIBIT-7: Detail On-Site Runoff Calculation from Excel Worksheet

Existing Conditions 100-year Discharge Calculations

Drainage Area ID	Land Use Type	Drainage Area		Runoff Coefficient	Rainfall Intensity	Q100
		ft^2	acres	C	(in/hr)	(cfs)
E-1	Undisturbed Natural Desert	1990	0.046	0.45	9.14	0.2
E-2	Undisturbed Natural Desert	6549	0.150	0.45		0.6
E-3	Undisturbed Natural Desert	21459	0.493	0.45		2.0
			0.689			

Proposed Conditions 100-year Discharge Calculations

Drainage Area ID	Land Use Type	Drainage Area		Runoff Coefficient	Weighted Runoff Coefficient C	Rainfall Intensity	Q100
		ft^2	acres	C		(in/hr)	(cfs)
P-1	Undisturbed Natural Desert	1824	0.042	0.45	**0.45**	9.14	0.2
P-2	Duplex Building	7822	0.180	0.94	**0.72**		2.1
	DL2- Desert Landscaping	6248	0.143	0.45			
P-3	Undisturbed Natural Desert	14107	0.324	0.45	**0.45**		1.3

Existing Conditions Runoff Volume

DA	ft^2	acres
	30019	0.689

Runoff Coefficient

Undisturbed Natural Desert 0.45 Table3.2 Runoff Coefficient for Maricopa County (DDM_Volume1)

100-year 2-hr Rainfall Depth 2.69 inches NOAA-14

Volume calculations should be done by applying the following equation:

$$V = C\left(\frac{P}{12}\right)A$$

where:

- V = **calculated volume, in acre-feet.**
- C = **runoff coefficient from Table 3.2.**
- P = **rainfall depth, in inches.**
- A = **drainage area, in acres.**

Existing Cond Volume (V) **0.070** acre-ft

3028 ft^3

Proposed Conditions Runoff Volume

DA	Land Use Type	Drainage Area		Runoff Coefficient	A X C	Weighted Runoff Coefficient C
		ft^2	acres	C		
P-1	Undisturbed Natural Desert	1824	0.042	0.45	0.019	**0.45**
	Duplex Building	7822	0.180	0.94	0.169	**0.72**
P-2	DL2- Desert Landscaping	6248	0.143	0.45	0.065	
P-3	Undisturbed Natural Desert	14107	0.324	0.45	0.146	**0.45**
			0.689			
		0.000			Cw Total	**0.58**

Runoff Coefficient Figure 4.1-4 Runoof Coefficient for Rationa Method

DL2- Desert Landscaping	**0.45**
Town House (R-2, R-4)	**0.94**
Undisturbed natural desert	**0.45**

100-year 2-hr Rainfall Depth **2.69** inches NOAA-14

Volume calculations should be done by applying the following equation:

$$V = C\left(\frac{P}{12}\right)A$$

where:

V = **calculated volume, in acre-feet.**

C = **runoff coefficient from Table 3.2.**

P = **rainfall depth, in inches.**

A = **drainage area, in acres.**

Existing Cond Volume (V) **0.089** acre-ft

3886 ft^3

NOAA Atlas 14, Volume 1, Version 5
Location name: Scottsdale, Arizona, US*
Latitude: 33.7450°, Longitude: -111.8597°
Elevation: 2551 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

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	0.234 (0.195-0.288)	0.306 (0.256-0.375)	0.412 (0.341-0.504)	0.492 (0.405-0.601)	0.600 (0.486-0.728)	0.680 (0.545-0.821)	0.762 (0.601-0.918)	0.845 (0.657-1.02)	0.954 (0.725-1.15)	1.04 (0.775-1.26)
10-min	0.357 (0.297-0.438)	0.465 (0.389-0.571)	0.627 (0.519-0.768)	0.750 (0.616-0.915)	0.912 (0.740-1.11)	1.04 (0.830-1.25)	1.16 (0.915-1.40)	1.29 (1.00-1.55)	1.45 (1.10-1.75)	1.59 (1.18-1.92)
15-min	0.443 (0.368-0.543)	0.577 (0.482-0.709)	0.778 (0.643-0.951)	0.930 (0.764-1.13)	1.13 (0.917-1.37)	1.28 (1.03-1.55)	1.44 (1.13-1.73)	1.59 (1.24-1.92)	1.80 (1.37-2.17)	1.97 (1.46-2.38)
30-min	0.596 (0.496-0.731)	0.777 (0.649-0.954)	1.05 (0.866-1.28)	1.25 (1.03-1.53)	1.52 (1.24-1.85)	1.73 (1.39-2.09)	1.94 (1.53-2.33)	2.15 (1.67-2.58)	2.43 (1.84-2.92)	2.65 (1.97-3.20)
60-min	0.737 (0.614-0.905)	0.961 (0.804-1.18)	1.30 (1.07-1.59)	1.55 (1.27-1.89)	1.89 (1.53-2.29)	2.14 (1.71-2.58)	2.40 (1.89-2.89)	2.66 (2.07-3.20)	3.00 (2.28-3.62)	3.28 (2.44-3.96)
2-hr	0.854 (0.720-1.02)	1.10 (0.931-1.33)	1.46 (1.23-1.76)	1.74 (1.45-2.08)	2.12 (1.74-2.52)	2.40 (1.95-2.85)	2.69 (2.15-3.19)	2.99 (2.35-3.54)	3.38 (2.61-4.01)	3.69 (2.79-4.41)
3-hr	0.918 (0.774-1.12)	1.17 (0.994-1.43)	1.53 (1.29-1.86)	1.81 (1.51-2.19)	2.21 (1.81-2.65)	2.52 (2.04-3.02)	2.84 (2.27-3.40)	3.18 (2.50-3.80)	3.64 (2.78-4.35)	4.01 (3.00-4.81)
6-hr	1.10 (0.948-1.29)	1.38 (1.20-1.63)	1.76 (1.51-2.06)	2.05 (1.75-2.40)	2.46 (2.07-2.87)	2.78 (2.31-3.23)	3.12 (2.55-3.62)	3.46 (2.78-4.02)	3.91 (3.07-4.54)	4.26 (3.27-4.96)
12-hr	1.31 (1.14-1.53)	1.65 (1.44-1.93)	2.07 (1.79-2.41)	2.41 (2.07-2.79)	2.86 (2.43-3.31)	3.21 (2.70-3.71)	3.57 (2.96-4.12)	3.93 (3.22-4.54)	4.41 (3.53-5.11)	4.78 (3.76-5.57)
24-hr	1.57 (1.38-1.80)	1.99 (1.76-2.29)	2.60 (2.28-2.98)	3.09 (2.69-3.54)	3.78 (3.26-4.34)	4.34 (3.70-4.99)	4.94 (4.15-5.71)	5.57 (4.60-6.48)	6.46 (5.21-7.61)	7.19 (5.68-8.55)
2-day	1.79 (1.56-2.06)	2.28 (2.00-2.63)	3.02 (2.63-3.46)	3.61 (3.13-4.13)	4.45 (3.81-5.10)	5.12 (4.34-5.90)	5.84 (4.88-6.77)	6.61 (5.45-7.72)	7.69 (6.19-9.08)	8.56 (6.77-10.2)
3-day	1.91 (1.67-2.19)	2.44 (2.14-2.80)	3.25 (2.84-3.72)	3.92 (3.40-4.46)	4.86 (4.18-5.56)	5.64 (4.80-6.47)	6.48 (5.44-7.48)	7.37 (6.10-8.59)	8.66 (7.00-10.2)	9.71 (7.70-11.6)
4-day	2.03 (1.78-2.32)	2.61 (2.29-2.98)	3.49 (3.06-3.98)	4.22 (3.68-4.80)	5.28 (4.55-6.01)	6.15 (5.26-7.05)	7.11 (5.99-8.20)	8.13 (6.75-9.47)	9.63 (7.80-11.3)	10.9 (8.64-13.0)
7-day	2.34 (2.04-2.69)	3.00 (2.62-3.45)	4.03 (3.51-4.63)	4.88 (4.23-5.60)	6.13 (5.25-7.04)	7.17 (6.08-8.27)	8.30 (6.94-9.65)	9.54 (7.85-11.2)	11.3 (9.12-13.5)	12.8 (10.1-15.5)
10-day	2.56 (2.25-2.94)	3.29 (2.89-3.77)	4.40 (3.85-5.04)	5.32 (4.62-6.07)	6.65 (5.72-7.61)	7.76 (6.59-8.90)	8.95 (7.51-10.3)	10.2 (8.47-12.0)	12.1 (9.79-14.4)	13.7 (10.8-16.4)
20-day	3.27 (2.87-3.73)	4.21 (3.70-4.80)	5.60 (4.90-6.37)	6.69 (5.82-7.61)	8.21 (7.09-9.36)	9.41 (8.06-10.8)	10.7 (9.06-12.3)	12.0 (10.1-14.0)	13.9 (11.4-16.4)	15.4 (12.5-18.3)
30-day	3.88 (3.40-4.43)	5.01 (4.40-5.71)	6.66 (5.83-7.56)	7.94 (6.93-9.01)	9.70 (8.41-11.0)	11.1 (9.53-12.7)	12.5 (10.7-14.4)	14.1 (11.8-16.2)	16.1 (13.4-18.9)	17.8 (14.5-21.0)
45-day	4.63 (4.08-5.27)	5.98 (5.27-6.80)	7.95 (6.98-9.02)	9.47 (8.28-10.7)	11.5 (10.0-13.1)	13.2 (11.3-15.0)	14.9 (12.7-17.1)	16.6 (14.0-19.3)	19.1 (15.8-22.4)	21.0 (17.1-24.9)
60-day	5.20 (4.58-5.90)	6.73 (5.94-7.63)	8.91 (7.84-10.1)	10.5 (9.25-11.9)	12.7 (11.1-14.5)	14.4 (12.5-16.5)	16.2 (13.9-18.6)	18.0 (15.2-20.8)	20.4 (17.1-24.0)	22.4 (18.4-26.5)

[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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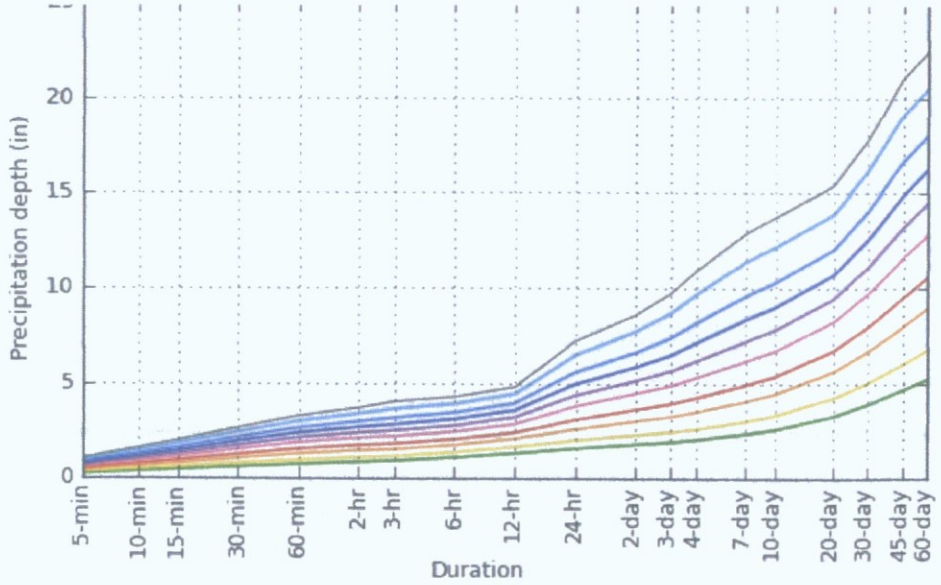
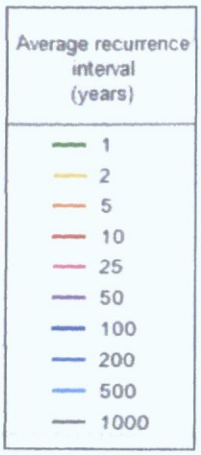
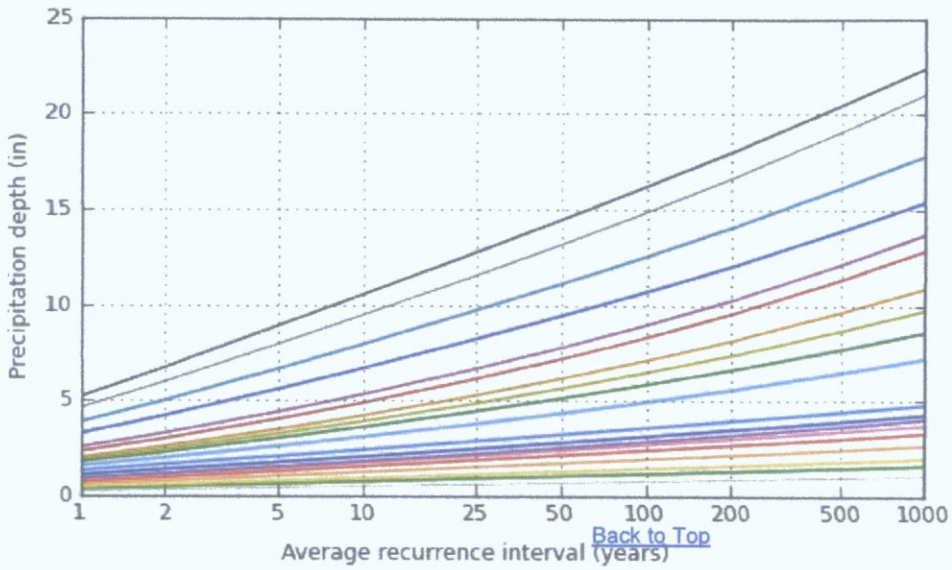
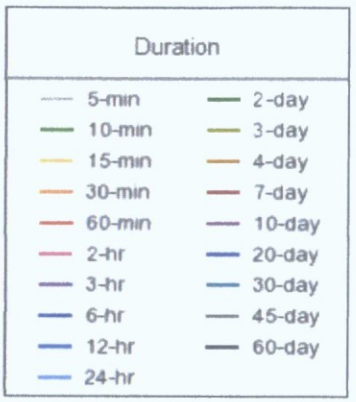
PF graphical









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Maps & aerials

NOAA Atlas 14, Volume 1, Version 5

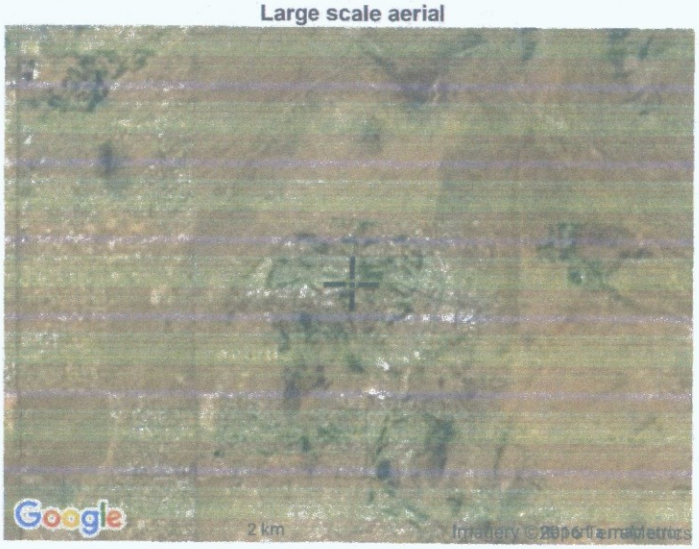
Created (GMT): Wed Apr 13 03:07:44 2016

Small scale terrain

Large scale terrain

Large scale map

Large scale aerial



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NOAA Atlas 14, Volume 1, Version 5
Location name: Scottsdale, Arizona, US*
Latitude: 33.7450°, Longitude: -111.8597°
Elevation: 2551 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

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	2.81 (2.34-3.46)	3.67 (3.07-4.50)	4.94 (4.09-6.05)	5.90 (4.86-7.21)	7.20 (5.83-8.74)	8.16 (6.54-9.85)	9.14 (7.21-11.0)	10.1 (7.88-12.2)	11.4 (8.70-13.8)	12.5 (9.30-15.1)
10-min	2.14 (1.78-2.63)	2.79 (2.33-3.43)	3.76 (3.11-4.61)	4.50 (3.70-5.49)	5.47 (4.44-6.65)	6.21 (4.98-7.50)	6.96 (5.49-8.38)	7.71 (6.00-9.28)	8.71 (6.62-10.5)	9.52 (7.07-11.5)
15-min	1.77 (1.47-2.17)	2.31 (1.93-2.84)	3.11 (2.57-3.80)	3.72 (3.06-4.54)	4.52 (3.67-5.50)	5.13 (4.11-6.20)	5.75 (4.54-6.92)	6.38 (4.96-7.67)	7.20 (5.47-8.69)	7.86 (5.85-9.52)
30-min	1.19 (0.992-1.46)	1.55 (1.30-1.91)	2.09 (1.73-2.56)	2.50 (2.06-3.05)	3.05 (2.47-3.70)	3.46 (2.77-4.17)	3.87 (3.05-4.66)	4.29 (3.34-5.16)	4.85 (3.69-5.85)	5.29 (3.94-6.41)
60-min	0.737 (0.614-0.905)	0.961 (0.804-1.18)	1.30 (1.07-1.59)	1.55 (1.27-1.89)	1.89 (1.53-2.29)	2.14 (1.71-2.58)	2.40 (1.89-2.89)	2.66 (2.07-3.20)	3.00 (2.28-3.62)	3.28 (2.44-3.96)
2-hr	0.427 (0.360-0.512)	0.551 (0.466-0.664)	0.732 (0.614-0.878)	0.870 (0.722-1.04)	1.06 (0.868-1.26)	1.20 (0.974-1.43)	1.35 (1.08-1.60)	1.49 (1.18-1.77)	1.69 (1.31-2.01)	1.85 (1.40-2.20)
3-hr	0.306 (0.258-0.372)	0.391 (0.331-0.477)	0.509 (0.428-0.619)	0.603 (0.503-0.731)	0.734 (0.603-0.883)	0.838 (0.679-1.00)	0.945 (0.754-1.13)	1.06 (0.831-1.27)	1.21 (0.926-1.45)	1.34 (0.998-1.60)
6-hr	0.183 (0.158-0.216)	0.231 (0.200-0.272)	0.293 (0.252-0.344)	0.343 (0.292-0.401)	0.411 (0.346-0.479)	0.465 (0.386-0.540)	0.520 (0.426-0.604)	0.577 (0.464-0.671)	0.652 (0.512-0.758)	0.712 (0.546-0.828)
12-hr	0.109 (0.095-0.127)	0.137 (0.119-0.160)	0.172 (0.149-0.200)	0.200 (0.172-0.232)	0.238 (0.202-0.275)	0.267 (0.224-0.308)	0.296 (0.246-0.342)	0.326 (0.268-0.377)	0.366 (0.293-0.424)	0.396 (0.312-0.463)
24-hr	0.065 (0.058-0.075)	0.083 (0.073-0.095)	0.108 (0.095-0.124)	0.129 (0.112-0.147)	0.157 (0.136-0.181)	0.181 (0.154-0.208)	0.206 (0.173-0.238)	0.232 (0.192-0.270)	0.269 (0.217-0.317)	0.299 (0.237-0.356)
2-day	0.037 (0.033-0.043)	0.048 (0.042-0.055)	0.063 (0.055-0.072)	0.075 (0.065-0.086)	0.093 (0.079-0.106)	0.107 (0.090-0.123)	0.122 (0.102-0.141)	0.138 (0.113-0.161)	0.160 (0.129-0.189)	0.178 (0.141-0.213)
3-day	0.026 (0.023-0.030)	0.034 (0.030-0.039)	0.045 (0.039-0.052)	0.054 (0.047-0.062)	0.068 (0.058-0.077)	0.078 (0.067-0.090)	0.090 (0.076-0.104)	0.102 (0.085-0.119)	0.120 (0.097-0.142)	0.135 (0.107-0.161)
4-day	0.021 (0.019-0.024)	0.027 (0.024-0.031)	0.036 (0.032-0.041)	0.044 (0.038-0.050)	0.055 (0.047-0.063)	0.064 (0.055-0.073)	0.074 (0.062-0.085)	0.085 (0.070-0.099)	0.100 (0.081-0.118)	0.113 (0.090-0.135)
7-day	0.014 (0.012-0.016)	0.018 (0.016-0.021)	0.024 (0.021-0.028)	0.029 (0.025-0.033)	0.036 (0.031-0.042)	0.043 (0.036-0.049)	0.049 (0.041-0.057)	0.057 (0.047-0.067)	0.067 (0.054-0.080)	0.076 (0.060-0.092)
10-day	0.011 (0.009-0.012)	0.014 (0.012-0.016)	0.018 (0.016-0.021)	0.022 (0.019-0.025)	0.028 (0.024-0.032)	0.032 (0.027-0.037)	0.037 (0.031-0.043)	0.043 (0.035-0.050)	0.051 (0.041-0.060)	0.057 (0.045-0.068)
20-day	0.007 (0.006-0.008)	0.009 (0.008-0.010)	0.012 (0.010-0.013)	0.014 (0.012-0.016)	0.017 (0.015-0.020)	0.020 (0.017-0.022)	0.022 (0.019-0.026)	0.025 (0.021-0.029)	0.029 (0.024-0.034)	0.032 (0.026-0.038)
30-day	0.005 (0.005-0.006)	0.007 (0.006-0.008)	0.009 (0.008-0.010)	0.011 (0.010-0.013)	0.013 (0.012-0.015)	0.015 (0.013-0.018)	0.017 (0.015-0.020)	0.020 (0.016-0.022)	0.022 (0.019-0.026)	0.025 (0.020-0.029)
45-day	0.004 (0.004-0.005)	0.006 (0.005-0.006)	0.007 (0.006-0.008)	0.009 (0.008-0.010)	0.011 (0.009-0.012)	0.012 (0.010-0.014)	0.014 (0.012-0.016)	0.015 (0.013-0.018)	0.018 (0.015-0.021)	0.019 (0.016-0.023)
60-day	0.004 (0.003-0.004)	0.005 (0.004-0.005)	0.006 (0.005-0.007)	0.007 (0.006-0.008)	0.009 (0.008-0.010)	0.010 (0.009-0.011)	0.011 (0.010-0.013)	0.012 (0.011-0.014)	0.014 (0.012-0.017)	0.016 (0.013-0.018)

[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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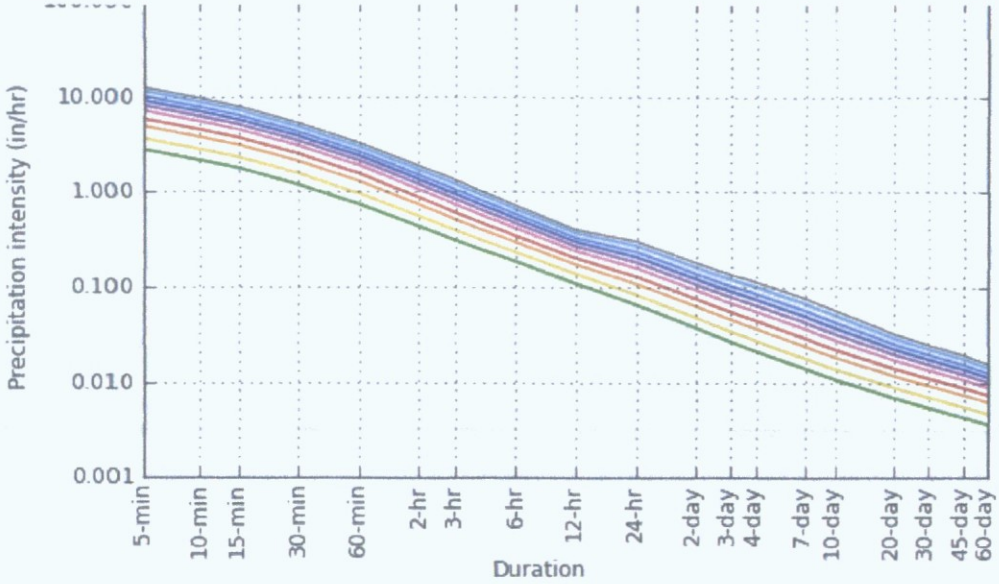
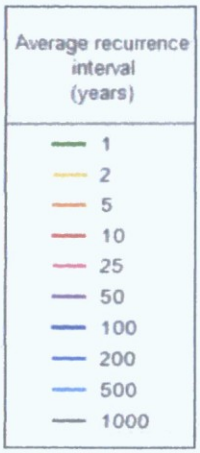
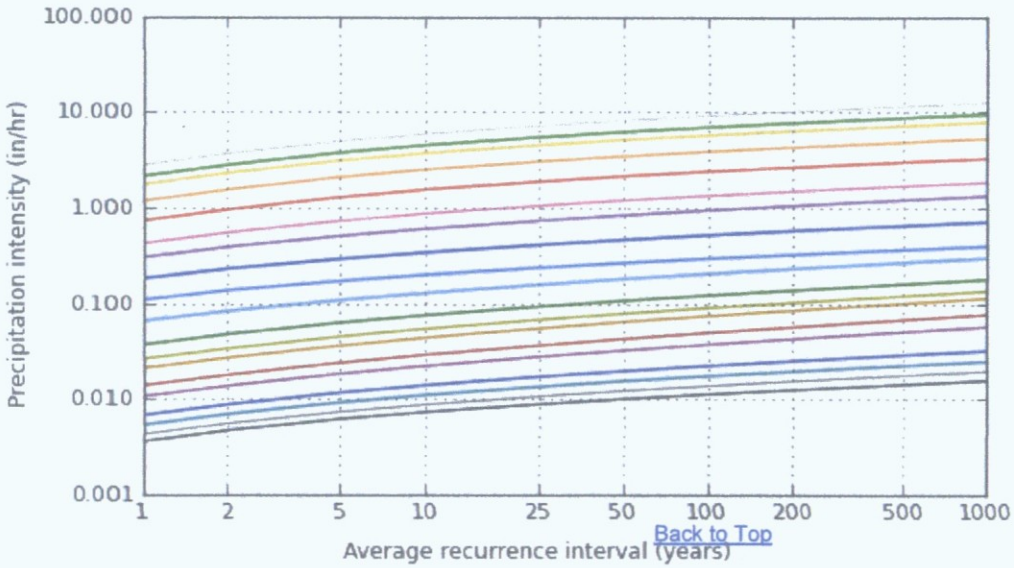
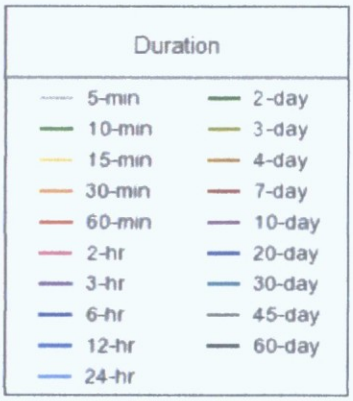
PF graphical









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Maps & aerials

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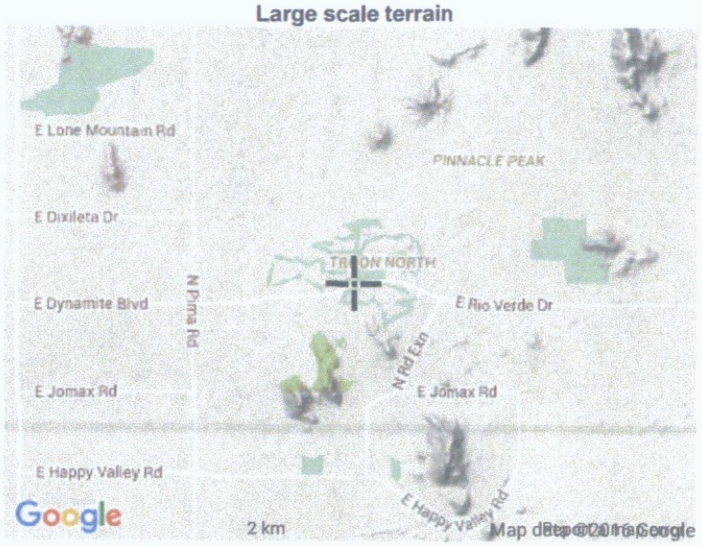
Created (GMT): Wed Apr 13 03:09:09 2016

Small scale terrain

Large scale terrain



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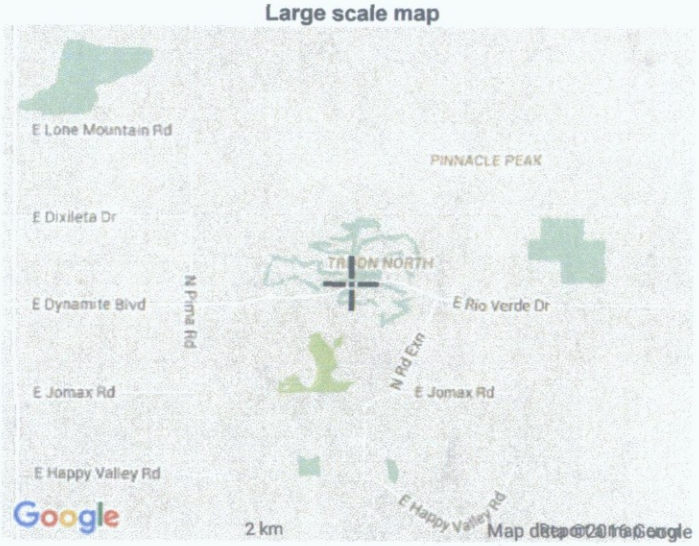

Large scale aerial

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EXHIBIT-8: Excerpts from 1994 Master Drainage Study by Gilbertsons and Associates