

**THE GARDENS AT NORTH
CAREFREE
PRELIMINARY DRAINAGE REPORT
EL PASO COUNTY, COLORADO**

PROJECT NO. 187608744



Prepared for:
MULE DEER INVESTMENTS, LLC
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COLORADO SPRINGS, CO 80124

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Added

PUDSP-18-004

August 3, 2018

PUD-

CERTIFICATIONS

Design Engineer's Statement:

The attached drainage plan and report were prepared under my direction and supervision and are correct to the best of my knowledge and belief. Said drainage report has been prepared according to the criteria established by the County for drainage reports and said report is in conformity with the applicable master plan of the drainage basin. I accept responsibility for any liability caused by any negligent acts, errors or omissions on my part in preparing this report.

Charlene. M. Durham, P.E. #36727

Seal

Owner/Developer's Statement:

I, the owner/developer have read and will comply with all of the requirements specified in this drainage report and plan.

By (signature): _____

Date: _____

Title: _____

Address: _____ 8375 Willow Street, Suite 500

Lone Tree, CO 80124

El Paso County:

Filed in accordance with the requirements of the El Paso County Land Development Code, Drainage Criteria Manual Volumes 1 and 2, and the Engineering Criteria Manual, as amended.

Jennifer Irvine, P.E.,
County Engineer / ECM Administrator

Date

Table of Contents

GENERAL LOCATION & DESCRIPTION	4
DESCRIPTION OF PROPERTY	4
CLIMATE	4
FLOODPLAIN STATEMENT	4
UTILITIES & OTHER ENCUMBERANCES	4
DRAINAGE DESIGN CRITERIA.....	5
DEVELOPMENT CRITERIA REFERENCE	5
HYDROLOGIC CRITERIA	5
Rational Method	5
Storm Sewer Design	5
Detention Storage Criteria	5
Waivers	5
DRAINAGE BASINS.....	5
OFFSITE BASINS	5
EXISTING DRAINAGE ANALYSIS	6
Design Points.....	6
PROPOSED DRAINAGE ANALYSIS	7
Design Points.....	9
DRAINAGE FACILITY DESIGN	10
GENERAL CONCEPT	10
STORM SEWER SYSTEM	10
ON-SITE WATER QUALITY.....	10
FOUR STEP PROCESS	11
MAINTENANCE.....	11
SUMMARY.....	11
REFERENCE MATERIALS	12

List of Figures

Figure 1: Vicinity Map.....	13
Figure 2: Existing Drainage Map	BACK POCKET
Figure 3: Proposed Drainage Map	BACK POCKET

Appendix

Appendix A: NRCS Soil Report
Appendix B: Existing Hydrology Calculations
Appendix C: Proposed Hydrology Calculations
Appendix D: Water Quality Pond Calculations

GENERAL LOCATION & DESCRIPTION

The Gardens at North Carefree is approximately 11.6 acres of single family development. Site will include the construction of 3 public roads, 71 single family and 5 tracts. The project is bounded by North Carefree Circle to the north, Akers Drive to the west, Sika Deer Place to the south and open land to the east. The project is located in the eastern portion of Section 29, Township 13 South, Range 65 West.

The Gardens at North Carefree development site is located within the northern end of the Sand Creek Basin.

Design, phasing, responsibility and maintenance of any proposed improvements will be discussed in the final drainage report. Fees will be assessed and paid according to the current rates at the time of platting for each filing. All easements for utilities and drainage features will be provided with the final plat process.

Description of Property

The project site is 11.6 acres of vegetation, consisting of short grasses and weeds. The average slope of the site is between 3 and 9%.

The site is composed of a single soil type. From the NRCS report in Appendix A, the site falls into the following soil type:

97 – Truckton sandy loam (3-9%) – Type A Soil

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms. Group A soil is defined by:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Climate

The climate of the site is typical of a sub-humid to semiarid climate with mild summers and winters. The average temperature is 31 degrees F in the winter and 68.4 degrees in the summer. Total annual precipitation is 15.21 inches.

Floodplain Statement

The Flood Insurance Rate Map (FIRM No. 08041C0539-F dated 3/17/99) indicates that there is no floodplain in the vicinity of the proposed site.

Utilities & Other Encumbrances

The site is currently undeveloped and there are no known utilities on site.

DRAINAGE DESIGN CRITERIA

Development Criteria Reference

Resolution No. 15-042, Adoption for portions of the City of Colorado Springs Drainage Criteria Manual (DCM), El Paso County Engineering Criteria Manual (ECM) and Urban Storm Drainage Criteria Manual (USDCM) by Urban Drainage & Flood Control District was used in preparation of this report. Additional preliminary and final drainage plans, master development drainage plans, and drainage basin planning studies used in the preparation of the report are listed in the References Section.

Hydrologic Criteria

Rational Method

The rational method was used to determine onsite flows, as required by the current City of Colorado Springs Drainage Criteria Manual (DCM). Both the 5-year and 100-year storm events were considered in this analysis. Runoff coefficients appropriate to the existing and proposed land uses were selected for an SCS type "B" soil from Table 6-6 of the DCM even though the existing soil type is designated as a type "A" soil. The time of concentration was calculated per DCM requirements. Rational Method results are shown in the Appendix B & C. USDCM spreadsheets were used to design the detention and water quality pond features.

Storm Sewer Design

Storm Sewer systems will be designed to the 100-year storm and checked with the 5-year storm. Inlets will be placed at sump areas and intersections where street flow is larger than street capacity. UDFCD Inlet spreadsheet will be used to determine the size of all at-grade and sump inlets. Onsite flow captured within the storm system will be released into one of the two water quality facilities. Final design of these facilities will be included in the Final Drainage Report for the development.

Detention Storage Criteria

This report addresses the preliminary design stage of the 2 detention/water quality features within the proposed development. Water quality requirements were determined from the UDFCD Volume 3 spreadsheet for an Extended Detention Basin.

Preliminary storage volumes and outflows have been calculated for both detention facilities. A copy of these designs has been included in the appendix. Final calculations will be completed at the time of final platting for these facilities.

Waivers

No variances are being requested for this development.

DRAINAGE BASINS

Offsite Basins

There is one off site basin contributing flows to the proposed development. It is located on the east side of the property along the southern half. The basin is 2.25 acres and is currently undeveloped. Flows from the basin are 0.59 cfs and 4.3 cfs for the minor and major storms. If this parcel develops, it will need to provide its own on site water quality.

Existing Drainage Analysis

Historic drainage analysis was determined by analyzing runoff quantities and patterns for the site. There are 9 existing basins for the proposed site.

- Basin E-1 (5.41 acres) is the top north half of the site between North Carefree Circle and Akers Drive. Flows are diverted through existing drainage swales to where they will release into Akers Drive. Flows for this basin are 1.41 cfs for the 5-year storm and 10.33 cfs for the 100-year storm.
- Basin E-2 (0.61 acres) is located south of Basin E-1. Existing drainage swales will divert this flow to an existing low point/detention area. Flows for this basin are 0.23 cfs for the 5-year storm and 1.72 cfs for the 100-year storm.
- Basin E-3 (1.59 acres) is south of Basin E-2. Flows are diverted to the west through existing drainage swales to an existing low point. Flows for this basin are 0.56 cfs for the 5-year storm and 4.11 cfs for the 100-year storm.
- Basin E-4 (1.28 acres) is south of Basin E-3. Existing drainage swales direct flows to the west to an existing low area. Flows for this basin are 0.46 cfs for the 5-year storm and 3.35 cfs for the 100-year storm.
- Basin E-5 (0.36 acres) is south of Basin E-12 and west of Basin E-2. Flows for this basin are 0.15 cfs for the 5-year storm and 1.08 cfs for the 100-year storm.
- Basin E-6 (1.55 acres) is south of Basin E-4. Existing drainage swales direct flows towards the west, where they will release into Akers Drive. Flows for this basin are 0.55 cfs for the 5-year storm and 4.03 cfs for the 100-year storm.
- Basin E-7 (0.10 acres) is south of Basin E-5 and west of Basin E-3. Flows for this basin are 0.04 cfs for the 5-year storm and 0.29 cfs for the 100-year storm.
- Basin E-9 (0.05 acres) is located between Basin E-7 and Akers Drive. This area is the low area/detention where an existing 30" rcp collects runoff. Flows for this basin are 0.02 cfs for the 5-year storm and 0.14 cfs for the 100-year storm.
- Basin E-10 (0.51 acres) is along the south boundary of the project, along the private driveway. Flows for this basin are 0.21 cfs for the 5-year storm and 1.52 cfs for the 100-year storm.

Basin Reference changed

Basin E-12 is not on the existing drainage plan. It appears this is a typo.

Design Points

- Design Point Z ($Q_5=0.6$, $Q_{100}=4.4$) consists of flow from Basin OS-1. Flow from this basin release on site and combine with other on site basins.
- Design Point A ($Q_5=1.4$, $Q_{100}=10.6$) consists of flow from Basin E-1. Flow from this basin is released directly into Akers Drive where it is intercepted by an existing Type R inlet.
- Design Point B ($Q_5=0.2$, $Q_{100}=1.8$) consists of flow from Basin E-2. It is a natural low point on the site. Flows will release from this location via an existing culvert and continue to DP E.

- Design Point D ($Q_5=0.5$, $Q_{100}=3.5$) consists of flow from Basin E-4. Flows will continue over existing ground to combine at DP C.
- Design Point C ($Q_5=1.2$, $Q_{100}=9.4$) consists of flow from Basins, OS-1 and E-3 and DP D. Flows will continue to the north where they will combine with other flows at DP H.
- Design Point E ($Q_5=0.4$, $Q_{100}=2.9$) consists of flow from Basin E-5 and DP B. This is a naturally occurring low spot on site. Flows will continue via an existing pipe to DP G.
- Design Point F ($Q_5=0.6$, $Q_{100}=4.2$) consists of flow from Basin E-6. These flows are released directly into Akers Drive where they are intercepted by an existing Type R inlet.
- Design Point G ($Q_5=0.4$, $Q_{100}=3.22$) consists of flow from Basin E-7 and DP E. This is a sump area which has an existing culvert for flows to continue to DP H.
- Design Point H ($Q_5=1.5$, $Q_{100}=11.4$) consists of flow from Basin E-9 and DP C and DP G. This is the final low point where flows are collected and via a 30" RCP, exit the site and combine with flows from Akers Drive and the Mule Deer development to the west.
- Design Point I ($Q_5=0.2$, $Q_{100}=1.6$) consists of flow from Basin E-10. Flow will be collected in the curb and gutter of the existing driveway and flow west to Akers Drive.

Proposed Drainage Analysis

The proposed development consists of 20 developed basins. The majority of the runoff from the site will be collected via inlets and pipes and diverted to one of two water quality ponds for the development. The ponds will then release into the existing inlets in Akers Drive and continue through the existing storm system to the existing drainage channel to the west.

- Basin D-1 (1.23 acres) is the north half of the site along the east boundary to the east leg of Vineyard Circle. This flow is directed towards a sump inlet on the east side of Vineyard Circle. Flows for this basin are 2.07 cfs for the 5-year storm and 4.57 cfs for the 100-year storm.
- Basin D-2 (0.86 acres) is the south half of the site along the east boundary to the east leg of Vineyard Circle. Runoff is directed towards a sump inlet on the west side of Vineyard Circle. Flows for this basin are 1.46 cfs for the 5-year storm and 3.22 cfs for the 100-year storm.
- Basin D-3 (0.49 acres) is the southeast half of the area inside of Vineyard Circle. Runoff is directed towards a sump inlet on the west side of the east leg of Vineyard Circle. Flows for this basin are 0.95 cfs for the 5-year storm and 2.09 cfs for the 100-year storm.
- Basin D-4 (0.72 acres) is the northeast half of the area inside of Vineyard Circle. Runoff is directed towards a sump inlet on the west side of the east leg of Vineyard Circle. Flows for this basin are 1.29 cfs for the 5-year storm and 2.84 cfs for the 100-year storm.
- Basin D-5 (2.03 acres) is along the north boundary of the site, along North Carefree and along Akers Drive, north of Fallow Lane. Runoff continues to a sump inlet on the west side of the west

leg of Vineyard Circle. Flows for this basin are 3.44 cfs for the 5-year storm and 7.57 cfs for the 100-year storm.

- Basin D-6 (0.12 acres) is the north half of Fallow Lane. Flows for this basin are 0.55 cfs for the 5-year storm and 0.99 cfs for the 100-year storm.
- Basin D-7 (0.07 acres) is the south half of Fallow Lane. Flows for this basin are 0.30 cfs for the 5-year storm and 0.54 cfs for the 100-year storm. east side Text Changed
- Basin D-8 (1.13 acres) is the northwest half of the area inside of Vineyard Circle. Runoff is released into the west side of the west leg of Vineyard Circle to a sump inlet. Flows for this basin are 2.06 cfs for the 5-year storm and 4.53 cfs for the 100-year storm.
- Basin D-9 (0.49 acres) is the area between the west leg of Vineyard Circle, Fallow Lane and Akers Drive. Runoff releases to a sump inlet on the west side of Vineyard Circle. Flows for this basin are 1.02 cfs for the 5-year storm and 2.24 cfs for the 100-year storm.
- Basin D-10 (0.12 acres) is the North Pond area. Flows for this basin are 0.33 cfs for the 5-year storm and 0.89 cfs for the 100-year storm.
- Basin D-11 (0.12 acres) is the north half of Running Deer Way. Flows for this basin are 0.55 cfs for the 5-year storm and 0.99 cfs for the 100-year storm.
- Basin D-12 (0.64 acres) is the south half of the area in between the two legs of Vineyard Circle. Runoff will release to a sump inlet in the east side of Vineyard Circle. Flows for this basin are 1.30 cfs for the 5-year storm and 2.86 cfs for the 100-year storm.
- Basin D-13 (1.36 acres) is the south portion of the site. Runoff is directed towards a sump inlet on the west half of Vineyard Circle. Flows for this basin are 2.34 cfs and 5.16 cfs for the minor and major storms, respectively.
- Basin D-14 (0.32 acres) is the middle area on the west half of the area between the two legs of Vineyard Circle, across from the North Pond. Flows are 0.72 cfs for the 5-year storm and 1.59 cfs for the 100-year storm.
- Basin D-15 (0.24 acres) is the middle area on the west half of the area between the two legs of Vineyard Circle, south of Basin D-14 and across from the South Pond. Flows are 0.56 cfs for the 5-year storm and 1.23 cfs for the 100-year storm.
- Basin D-16 (0.15 acres) is the South Pond area. Flows for this basin are 0.24 cfs for the minor storm and 0.64 cfs for the major storm.
- Basin D-17 (0.11 acres) is the south half of Running Deer Way. Flows are 0.51 cfs and 0.91 cfs for the minor and major storms respectively.
- Basin D-18 (0.33 acres) is the area north of Fallow Land and south of North Carefree which flows towards Akers Drive. Runoff for this basin is 0.74 cfs for the 5-year storm and 1.64 cfs for the 100-year storm.

- Basin D-19 (0.22 acres) is the area between Fallow Land and Running Deer Way which flows towards Akers Drive. Flows are 0.50 cfs and 1.09 cfs for the minor and major storms, respectively.
- Basin D-20 (0.75 acres) is the area south of Running Deer Way, along the western boundary, which flows towards Akers Drive. Flows are 1.60 cfs for the minor storm and 3.52 cfs for them major storm.

Design Points

- Design Point Z ($Q_5=0.6$, $Q_{100}=4.4$) consists of flow from Basin OS-1. Flow from this basin release on site and will combine with other on site basins.
- Design Point A ($Q_5=3.4$, $Q_{100}=10.6$) consists of flow from Basins D-1 and D-2. A sump inlet will be installed on the east side of the east leg of Vineyard Circle to intercept this flow. This will connect with the storm system which will release into the North Pond.
- Design Point B ($Q_5=2.2$, $Q_{100}=5.0$) consists of flow from Basins D-3 and D-4. A sump inlet will be installed on west side of the east leg of Vineyard Circle to intercept the street flow. The inlet will connect with a storm system which releases into the North Pond.
- Design Point C ($Q_5=2.6$, $Q_{100}=6.0$) consists of flow from Basins D-8 and D-14. A sump inlet will be installed on the east side of the west leg of Vineyard Circle to intercept gutter flow. The inlet will be part of a storm system which releases into he the North Pond.
- Design Point D ($Q_5=4.5$, $Q_{100}=10.4$) consists of flow from Basins D-5, D-9 and D-10. This sump inlet will intercept the flows from the west half of the west leg of Vineyard Circle. The inlet will connect to the system which will release into the North Pond.
- Design Point E ($Q_5=1.8$, $Q_{100}=4.1$) consists of flow from Basins D-12 and D-15. This is street flow at the east half of Vineyard Circle beginning at the southeast knuckle. Flows will direct towards a sump inlet on the east half of the west leg of Vineyard Circle, which releases into the South Pond.
- Design Point F ($Q_5=3.4$, $Q_{100}=7.9$) consists of flow from Basins D-13 and D-16. This is street flow at the west half of Vineyard Circle beginning at the southeast knuckle. Flows will direct towards a sump inlet on the west half of the west leg of Vineyard Circle, which releases into the South Pond.
- Design Point G ($Q_5=0.8$, $Q_{100}=1.7$) consists of flow from Basin D-18. This is the street flow which has been released into Akers Drive north of Fallow Lane. Flow is intercepted by an existing type R inlet, north of the Fallow Lane Intersection.
- Design Point H ($Q_5=0.9$, $Q_{100}=1.6$) consists of flow from Basins D-6, D-7 and D-19. This is flow from Fallow Lane and street flow from Akers Drive, between Fallow Lane and Running Deer Way. Runoff is intercepted by an existing type R inlet in Akers Drive, north of the Running Deer Way intersection.

Revise. Calculations indicate $Q_{100}=5.6$

Flows updated

- Design Point I ($Q_5=2.6$, $Q_{100}=5.0$) consists of flow Basins D-11, D-16 and D-20. This is the flow from Running Deer Way and the flow released onto Akers Drive from the site south of Running Deer Way. An existing type R inlet, south of the Running Deer Way intersection will intercept these flows.
- Design Point NP ($Q_5=10.5$, $Q_{100}=27.0$) consists of flow from DP A, DP B, DP C and DP D. This is the flow being released into the North Pond.
- Design Point SP ($Q_5=4.7$, $Q_{100}=10.9$) consists of flow from DP E and DP F. This is the flow being released into the South Pond.

MS4 permit

Basins D-6, D-7, D-11 and D-17 thru D-20 all release into Akers Drive and are intercepted by existing inlets. These basins account for approximately 15% of the overall site area. The remaining 85% of the development area is treated through 1 of the 2 proposed water quality facilities.



Elaborate. Is the plan to directly tie into the existing inlets on Akers Dr or to release at the surface which will then drain into the existing inlet.

DRAINAGE FACILITY DESIGN

cept

North Carefree is located in the Sand Creek

Storm Sewer System

A deviation request is required since 100% of storm water is not captured in the detention pond. CDPS General Permit COR090000 (MS4 permit) Part I section E.4.iv.(A), page 29 of 63, may be used for justification of the deviation. Note that changes to the basins and grading will be required to comply with section E.4.iv.(A).

All development is anticipated to be urban and will include storm sewer and street inlets. Storm sewers collect storm water runoff and convey the runoff to the proposed water quality facilities prior to discharging into the existing storm system offsite.

Deviation request submitted
- Copy included in Appendix

Final Plat submittals will include details concerning inlet location, storm sewer sizing and locations as part of the Final Drainage Report for each submittal.

On-Site Water Quality

There are two proposed water quality ponds on site that will provide water quality for the proposed improvements. Flows will pass through the outlet structures of one of the two proposed ponds. The existing storm system was designed to account for a 100-year flow of 55 cfs from this development. The two water quality ponds, based on the UDFCD pond spreadsheets, have a release rate of 33.5 cfs (South Pond is 6.0 cfs and North Pond is 27.5 cfs). The basins releasing offsite have a combined flow of 8.9 cfs. Flows in Akers Drive and the two ponds have a total combined flow of 42.4 cfs being captured in the existing storm system. The existing storm system will be analyzed with the developed flows at time of final platting. Preliminary pond sizing calculations are provided in Appendix D. Complete design details for the ponds will be included in the Final Drainage Report for the site. Such items to be finalized will be pond forebays, micropools, outlet configuration and emergency spillways. Also, at the time of final design, a geotechnical report may be required for the design of pond embankments.

The WQCV is treated through two proposed extended detention basins, North Pond and South Pond. There are no proposed major drainageways for the site that would need to be stabilized. Some site specific source control BMPs that will be implemented include, but are not limited to, silt fencing placed

around downstream areas of disturbance, construction vehicle tracking pads at the entrances, designated concrete truck washout basin, designated vehicle fueling areas, covered storage areas, spill containment and control, etc.

List each step of the four step process as a subheader. Within each subheader provide the narrative.

Added

Four Step Process

In accordance with the El Paso County Engineering Criteria Manual, Appendix I, this site has implemented the four step process to minimize adverse impacts of urbanization and helps with the management of smaller, frequently occurring events. The four step process includes reducing runoff volumes, treating and slowly releasing the water quality capture volume (WQCV), stabilizing drainageways, and implementing long-term source controls.

In order to reduce runoff volume, the new impervious area for the site was minimized. Existing features will be preserved as all of the offsite basins which are undeveloped open space will continue to be so, and all developable areas will be required to release existing flows and handle their own detention and water quality needs. Existing drainage paths have been maintained as much as possible to also help reduce overall impacts from the site. The WQCV is treated through extended detention basins. The outlet structures for both ponds have been designed according to the FSD spreadsheet by UDFCD to ensure the release times of the facilities meet the requirements.

There are no proposed major drainageways for the site that would need to be stabilized. Downstream of the project, all flows enter into existing storm systems, which are adequate to handle existing released flows, which will be the case as both ponds are designed to release less than existing flows. Therefore, those downstream channel/facilities would also, not see any increase or adverse effects to their functionality.

Some site-specific source control BMPs that will be implemented include, but are not limited to, silt fencing placed around downstream areas of disturbance, construction vehicle tracking pads at the entrances, sediment ponds, designated concrete truck washout basin, designated vehicle fueling areas, covered storage areas, spill containment and control, etc.

Maintenance

The water quality ponds will be maintained by the Home Owners Association. Facilities located within the project boundary will be private facilities and will also be maintained by Home Owners Association. All facilities located outside of the project boundary and within public right-of-way, will be maintained by the county. A BMP maintenance agreement and easement will be provided for the ponds, as well as an Operations and Maintenance manual.

All easements will be provided as part of the Final Plat process.

SUMMARY

Development within the site is to be single family residential. The existing storm sewer will connect to the new water quality facilities, allowing flows to continue as they currently are.

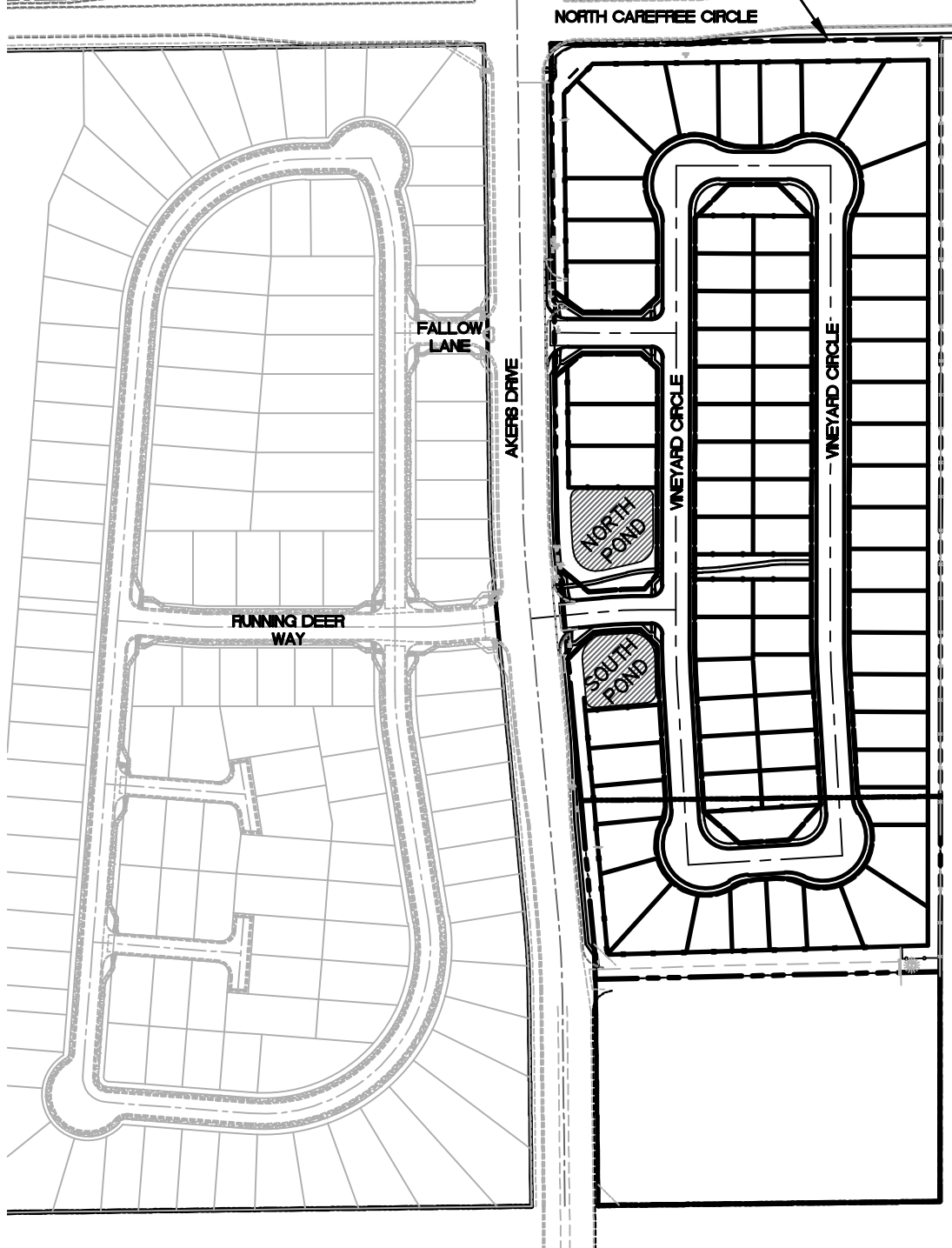
REFERENCE MATERIALS

1. "City of Colorado Springs Drainage Criteria Manual Volume 1" May 2014.
2. "Sand Creek Drainage Basin Planning Study Preliminary Design Report", Kiowa Engineering Corporation.
3. Soils Survey of El Paso County Area, Natural Resources Conservation Services of Colorado.
4. Flood Insurance Rate Study for El Paso County, Colorado and Incorporated Areas. Federal Emergency Management Agency, Revised March 17, 1997.
5. "City of Colorado Springs Drainage Criteria Manual, Volume 2: Stormwater Quality Policies, Procedures and Best Management Practices (BMPs)" May 2014.
6. "Engineering Criteria Manual El Paso County" January 9, 2006, Revised December, 2016.
7. "Urban Storm Drainage Criteria Manual, Volume 1: Management, Hydrology & Hydraulics" Original September 1969, Updated January 2016.
8. "Urban Storm Drainage Criteria Manual, Volume 2: Structures, Storage & Recreation" Original September 1969, Updated January 2016.
9. "Urban Storm Drainage Criteria Manual, Volume 3: Stormwater Quality" Original September 1992, Updated November 2010.
10. "Final Drainage Report for Mule Deer Crossing" December 2005. Prepared by URS.

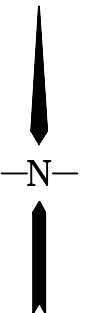
Figure 1: Vicinity Map

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GARDENS AT NORTH CAREFREE BOUNDARY



JUNE, 2017
181710214



5725 MARK DABLING BLVD, SUITE 190
COLORADO SPRINGS, CO 80919
www.stantec.com

Client/Project

MULE DEER INVESTMENTS, LLC
GARDENS AT NORTH CAREFREE

Figure No.

1.0

Title

VICINITY MAP

Appendix A: NRCS Soil Report



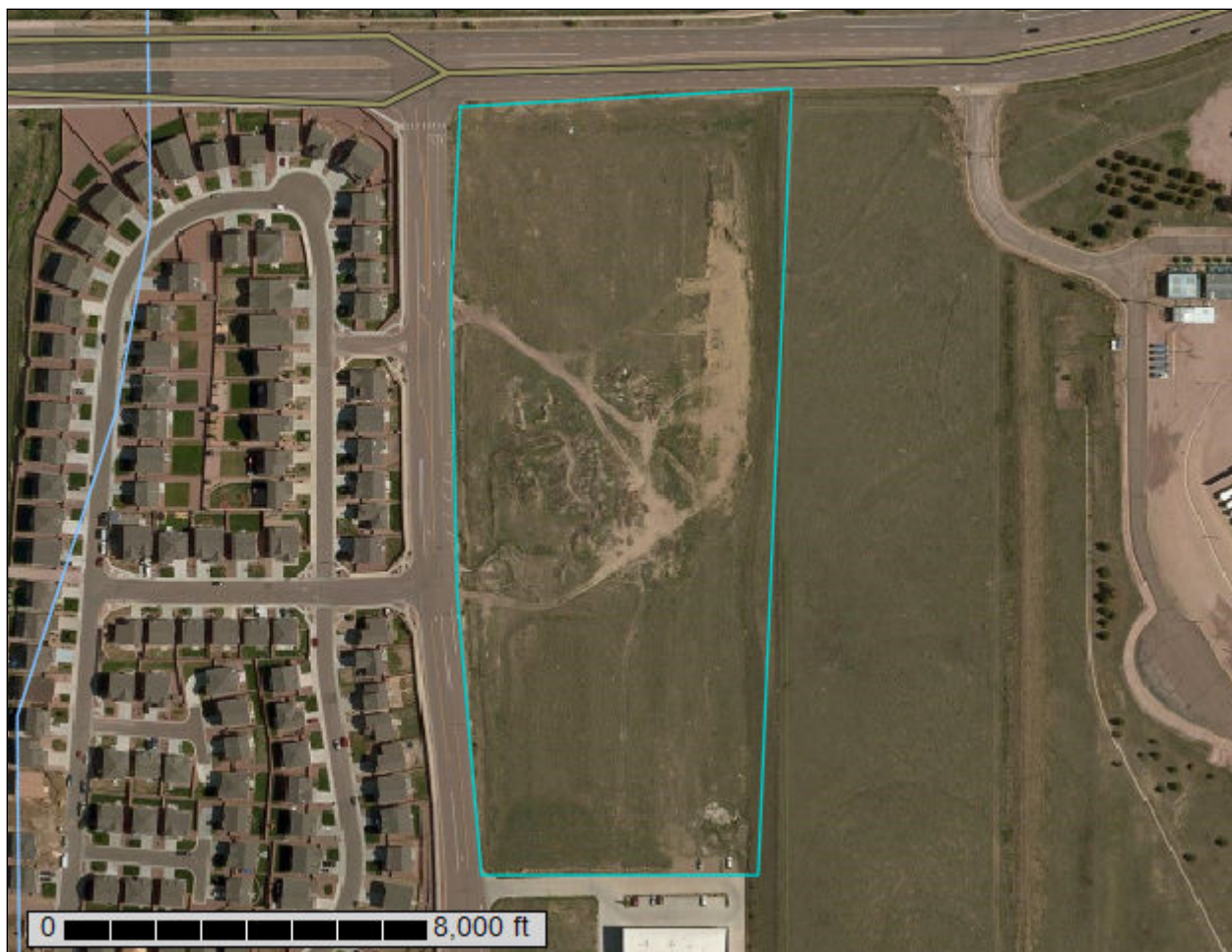
United States
Department of
Agriculture

NRCS

Natural
Resources
Conservation
Service

A product of the National
Cooperative Soil Survey,
a joint effort of the United
States Department of
Agriculture and other
Federal agencies, State
agencies including the
Agricultural Experiment
Stations, and local
participants

Custom Soil Resource Report for El Paso County Area, Colorado



June 8, 2017

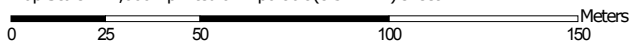
Custom Soil Resource Report Soil Map



Soil Map may not be valid at this scale.



Map Scale: 1:2,000 if printed on A portrait (8.5" x 11") sheet.



Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 13N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Map Unit Polygons

Soil Map Unit Lines

Soil Map Unit Points

Special Point Features

Blowout

Borrow Pit

Clay Spot

Closed Depression

Gravel Pit

Gravelly Spot

Landfill

Lava Flow

Marsh or swamp

Mine or Quarry

Miscellaneous Water

Perennial Water

Rock Outcrop

Saline Spot

Sandy Spot

Severely Eroded Spot

Sinkhole

Slide or Slip

Sodic Spot

Spoil Area

Stony Spot

Very Stony Spot

Wet Spot

Other

Special Line Features

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 14, Sep 23, 2016

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jun 3, 2014—Jun 17, 2014

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

El Paso County Area, Colorado (CO625)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
97	Truckton sandy loam, 3 to 9 percent slopes	11.5	100.0%
Totals for Area of Interest		11.5	100.0%

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however,

onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

El Paso County Area, Colorado

97—Truckton sandy loam, 3 to 9 percent slopes

Map Unit Setting

National map unit symbol: 36bg
Elevation: 6,000 to 7,000 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 46 to 50 degrees F
Frost-free period: 125 to 145 days
Farmland classification: Not prime farmland

Map Unit Composition

Truckton and similar soils: 80 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Truckton

Setting

Landform: Hills
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Arkosic alluvium derived from sedimentary rock and/or arkosic residuum weathered from sedimentary rock

Typical profile

A - 0 to 8 inches: sandy loam
Bt - 8 to 24 inches: sandy loam
C - 24 to 60 inches: coarse sandy loam

Properties and qualities

Slope: 3 to 9 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 5.7 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: A
Ecological site: Sandy Foothill (R049BY210CO)
Hydric soil rating: No

Minor Components

Pleasant

Percent of map unit:
Landform: Depressions
Hydric soil rating: Yes

Custom Soil Resource Report

Haplaquolls

Percent of map unit:

Landform: Marshes

Hydric soil rating: Yes

Other soils

Percent of map unit:

Hydric soil rating: No

Appendix B: Existing Hydrology Calculations

Standard Form SF-1 . Time of Concentration

Project: Gardens at North Carefree
Section: Existing Conditions

Created by: CMD
Checked by: CKC
Date: 1/13/2017

Urban TOC_{min} = 5 min
Rural TOC_{min} = 10 min

SUB-BASIN DATA				INITIAL/OVERLAND FLOW				TRAVEL TIME					Tc CHECK				FINAL Tc
				(t _i)				(t _t)					(Urbanized basins)				(min)
Basin ID	Description	C _s	Area (ac)	Length, L (ft)	Slope, s (ft/ft)	t _i (min)	t _i (1)										
OS-1	Offsite Basin @ East Side	0.08	2.25	100	0.035	12.18											
E-1	North portion of site	0.08	5.41	45	0.333333	3.88											
E-2	South of E-1	0.08	0.61	30	0.33333	3.17											
E-3	South of E-2	0.08	1.59	40	0.333333	3.66											
E-4	South of E-3	0.08	1.28	50	0.333333	4.09											
E-5	South of E-1 and West of E-2	0.08	0.36	5	0.5	1.13											
E-6	South of E-4 and along Akers Dr	0.08	1.55	55	0.333333	4.29											
E-7	South of E-5 and West of E-3	0.08	0.10	5	0.5	1.13											
E-9	West of E-7	0.08	0.05	5	0.3333	1.29											
E-10	South portion of Site along Private Driveway	0.08	0.51	15	0.5	1.96											

Notes:

- All Equations are from UDFCD Drainage Criteria Manual/Runoff
 (1) $t_t = (0.395 \cdot (1.1 - C_s) \cdot (L \cdot 0.5)) / (S \cdot 0.33)$, from UDFCD Equation RO-3
 (2) C_v from UDFCD Table RO-2
 (3) Velocity from $V = C_s \cdot S_w \cdot 0.5$, from UDFCD Equation RO-4
 (4) $t_t = L / 60V$
 (5) $t_t \text{ max} = 10 + L / 180$, from UDFCD Eqn RO-5

UDFCD Table RO-2 Land Surface Coefficients		
Code	Description	Cv
1	Heavy meadow	2.5
2	Tillage/field	5
3	Short pasture and lawns	7
4	Nearly bare ground	10
5	Grassed waterway	15
6	Paved areas and shallow paved swales	20
*7	Riprap (not buried)	7.0

* determined for the project based on UDFCD equations (Equation RO-4)

Standard Form SF-2 . Storm Drainage System Design (Rational Method Procedure)

Project: Gardens at North Carefree
 Section: Existing Conditions

Created by: CMD Date: 1/13/2017
 Checked by: CKC Date:

Design Storm: 5-yr P = 1.50 in

LOCATION	AREA DESIGN	DIRECT RUNOFF						TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			REMARKS
		AREA (A) (AC)	RUNOFF COEFF (C)	t _r (MIN)	C.A. (AC)	I (IN / HR)	Q (CFS)	t _r (MIN)	SUM (C*A) (AC)	I (IN / HR)	Q (CFS)	SLOPE (%)	STREET FLOW (CFS)	DESIGN FLOW (CFS)	SLOPE (%)	PIPE SIZE (INCHES)	LENGTH (FT)	VELOCITY (FPS)	t _r (MIN)	
(1)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
Offsite Basin @ East Side	OS-1	2.25	0.08	16.52	0.18	3.25	0.59													
North portion of site	E-1	5.41	0.08	16.57	0.43	3.25	1.41													
South of E-1	E-2	0.61	0.08	6.13	0.05	4.81	0.23													
South of E-2	E-3	1.59	0.08	8.05	0.13	4.40	0.56													
South of E-3	E-4	1.28	0.08	7.85	0.10	4.44	0.46													
South of E-1 and West of E-2	E-5	0.36	0.08	5.00	0.03	5.09	0.15													
South of E-4 and along Akers Dr	E-6	1.55	0.08	7.87	0.12	4.43	0.55													
South of E-5 and West of E-3	E-7	0.10	0.08	5.00	0.01	5.09	0.04													
West of E-7	E-9	0.05	0.08	5.00	0.00	5.09	0.02													
South portion of Site along Private Driveway	E-10	0.51	0.08	5.00	0.04	5.09	0.21													

Standard Form SF-2 . Storm Drainage System Design (Rational Method Procedure)

Project: Gardens at North Carefree
 Section: Existing Conditions

Created by: CMD Date: 1/13/2017
 Checked by: CKC Date:

Design Storm: 100-yr P = 2.52 in

LOCATION	BASIN ID	DIRECT RUNOFF				TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			REMARKS			
		AREA (A)	RUNOFF COEFF (C)	t _r (MIN)	C.A. (AC)	I (IN / HR)	Q (CFS)	t _r (MIN)	SUM (C*A) (AC)	I (IN / HR)	Q (CFS)	SLOPE (%)	STREET FLOW (CFS)	DESIGN FLOW (CFS)	SLOPE (%)	PIPE SIZE (INCHES)	LENGTH (FT)		VELOCITY (FPS)	t _r (MIN)	
	(1)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
	Offsite Basin @ East Side	OS-1	2.25	0.35	16.52	0.79	5.46	4.30													
	North portion of site	E-1	5.41	0.35	16.57	1.89	5.45	10.33													
	South of E-1	E-2	0.61	0.35	6.13	0.21	8.07	1.72													
	South of E-2	E-3	1.59	0.35	8.05	0.56	7.39	4.11													
	South of E-3	E-4	1.28	0.35	7.85	0.45	7.46	3.35													
	South of E-1 and West of E-2	E-5	0.36	0.35	5.00	0.13	8.55	1.08													
	South of E-4 and along Akers Dr	E-6	1.55	0.35	7.87	0.54	7.45	4.03													
	South of E-5 and West of E-3	E-7	0.10	0.35	5.00	0.03	8.55	0.29													
	West of E-7	E-9	0.05	0.35	5.00	0.02	8.55	0.14													
	South portion of Site along Private Driveway	E-10	0.51	0.35	5.00	0.18	8.55	1.52													

All Equations follow UDFCD Rational Method

- (1) Basin Description linked to C-Value Sheet

(2) Basin Design Point

(3) Enter the Basin Name from C-Value Sheet

(4) Basin Area linked to C-Value Sheet

(5) Composite C linked to C-Value Sheet

(6) Time of Concentration linked to SF-1 Sheet
- (7) =Column 4 x Column 5

(8) =28.5*P/(10+Column 6)*0.786

(9) =Column 7 x Column 8

(10) =Column 6 + Column 21

(11) Add the C.A. Values Column 7 to get the cumulative C.A. Values

(12) =28.5*P/(10+Column 10)*0.786
- (13) Sum of Qs

(14) Additional Street Longitudinal Slope

(15) Additional Street Overland Flow

(16) Additional Pipe Design Flow

(17) Additional Pipe Slope

(18) Additional Pipe Size
- (19) Additional Flow Length

(20) Street or Pipe Velocity

(21) =Column 15 OR Column 16 OR Column 20 / 60

GARDENS AT NORTH CAREFREE

SURFACE ROUTING

DESIGN POINT	CONTRIBUTING BASINS	CA (equivalent)		Tc (min.)	INTENSITY		TOTAL FLOWS	
		CA(5)	CA(100)		I(5) (in/hr)	I(100) (in/hr)	Q(5) (cfs)	Q(100) (cfs)
Z	OS-1	0.18	0.79	16.5	3.2	5.6	0.6	4.4
		TRAVEL TIME						
		0.18	0.79	Type/flow	Length (ft)	Velocity (fps)	d. Time (min)	T. Time (min)
				Channel	510	3.5	2.4	18.9
A	E-1	0.43	1.89	16.6	3.2	5.6	1.4	10.6
		TRAVEL TIME						
		0.43	1.89	Type/flow	Length (ft)	Velocity (fps)	d. Time (min)	T. Time (min)
						3.5	0.0	16.6
B	E-2	0.05	0.21	6.1	4.9	8.5	0.2	1.8
		TRAVEL TIME						
		0.05	0.21	Type/flow	Length (ft)	Velocity (fps)	d. Time (min)	T. Time (min)
				PIPE	25	4.4	0.1	6.2
D	E-4	0.10	0.45	7.8	4.5	7.8	0.5	3.5
		TRAVEL TIME						
		0.10	0.45	Type/flow	Length (ft)	Velocity (fps)	d. Time (min)	T. Time (min)
				CHANNEL	65	2.8	0.4	8.2
C	E-3 DP D DP Z	0.13	0.56	18.9	3.0	5.2	1.2	9.4
		0.10	0.45	TRAVEL TIME				
		0.18	0.79					
		0.41	1.79	Type/flow	Length (ft)	Velocity (fps)	d. Time (min)	T. Time (min)
E	E-5 DP B				0	4.4	0.0	18.9
		0.03	0.13	6.2	4.8	8.5	0.4	2.9
		0.05	0.21	TRAVEL TIME				
		0.08	0.34	Type/flow	Length (ft)	Velocity (fps)	d. Time (min)	T. Time (min)
F	E-6			PIPE	15	5.0	0.1	6.3
		0.12	0.54	7.9	4.5	7.8	0.6	4.2
		TRAVEL TIME						
		0.12	0.54	Type/flow	Length (ft)	Velocity (fps)	d. Time (min)	T. Time (min)
G	E-7 DP E				270	4.4	1.0	8.9
		0.01	0.03	6.3	4.8	8.4	0.4	3.2
		0.08	0.34	TRAVEL TIME				
		0.09	0.37	Type/flow	Length (ft)	Velocity (fps)	d. Time (min)	T. Time (min)
H	D-9 DP C DP G			PIPE	15	5.0	0.1	6.3
		0.00	0.02	18.9	3.0	5.2	1.5	11.4
		0.41	1.79	TRAVEL TIME				
		0.09	0.37					
I	E-10	0.50	2.18	Type/flow	Length (ft)	Velocity (fps)	d. Time (min)	T. Time (min)
				PIPE	15	5.0	0.1	19.0
		0.04	0.18	5.0	5.2	9.1	0.2	1.6
		TRAVEL TIME						
		0.04	0.18	Type/flow	Length (ft)	Velocity (fps)	d. Time (min)	T. Time (min)
				PIPE	15	5.0	0.1	5.1

Appendix C: Proposed Hydrology Calculations

Standard Form SF-1 . Time of Concentration

Project: Gardens at North Carefree
Section: Proposed Conditions

Created by: CMD
Checked by: CKC

Date: 7/31/2018
Date:

Urban TOC_{min} = 5 min
Rural TOC_{min} = 10 min

SUB-BASIN DATA				INITIAL/OVERLAND FLOW				TRAVEL TIME					Tc CHECK				FINAL Tc			
Basin ID	Description	C _s	Area (ac)	(t _i)				(t _t)					(Urbanized basins)				(min)			
				Length, L (ft)	Slope, s (ft/ft)	t _i (min)	t _i	Length (ft)	S _w (ft/ft)	Type of Land Surface	Convey Coef (C _u) (2)	Velocity (V) (ft/s) (3)	t _t Travel Time (min) (4)	TOTAL	t _c = t _i + t _t (min)	Urban (Yes /No)	Length (ft)	T _c max (min) (5)	T _c max > t _c	
OS-1	Offsite Basin @ East Side	0.08	2.25	100	0.035	12.18		555	0.0455	4	Nearly bare ground	10.00	2.13	4.34	16.52	YES	655.00	13.64	Check	16.5
D-1	East portion of Site btwn North half of Vineyard and East Boundary	0.45	1.23	100	0.020	9.34		383	0.0119	6	Paved areas and shallow paved swales	20.00	2.18	2.93	12.26	YES	483.00	12.68	Check	12.3
D-2	East portion of Site btwn South half of Vineyard and East Boundary	0.45	0.86	100	0.020	9.34		283	0.0075	6	Paved areas and shallow paved swales	20.00	1.74	2.72	12.05	YES	383.00	12.13	Check	12.1
D-3	South/Middle portion of Site inside of Vineyard Circle which drains to east	0.45	0.49	42	0.020	6.05		284	0.0075	6	Paved areas and shallow paved swales	20.00	1.73	2.73	8.78	YES	326.00	11.81	Check	8.8
D-4	North/Middle portion of Site inside of Vineyard Circle which drains to east	0.45	0.72	64	0.020	7.47		385	0.0119	6	Paved areas and shallow paved swales	20.00	2.18	2.94	10.41	YES	449.00	12.49	Check	10.4
D-5	North portion of site, along Carefree Circle	0.45	2.03	100	0.020	9.34		468	0.0217	6	Paved areas and shallow paved swales	20.00	2.95	2.65	11.98	YES	568.00	13.16	Check	12.0
D-6	North Half of Fallow Lane	0.90	0.12	5	0.020	0.64		115	0.0449	6	Paved areas and shallow paved swales	20.00	4.24	0.45	1.09	YES	120.00	10.67	Check	5.0
D-7	South Half of Fallow Lane	0.90	0.07	5	0.020	0.64		115	0.0449	6	Paved areas and shallow paved swales	20.00	4.24	0.45	1.09	YES	120.00	10.67	Check	5.0
D-8	North/Middle portion of Site inside of Vineyard Circle which drains to west	0.45	1.13	58	0.020	7.11		490	0.0198	6	Paved areas and shallow paved swales	20.00	2.81	2.90	10.01	YES	549.00	13.04	Check	10.0
D-9	Portion of site south of Fallow and btwn Akers and Vineyard	0.45	0.49	40	0.020	5.90		150	0.0198	6	Paved areas and shallow paved swales	20.00	2.81	0.89	6.79	YES	190.00	11.06	Check	6.8
D-10	North Pond	0.32	0.20	5	0.020	2.51			0.0357	6	Paved areas and shallow paved swales	20.00	3.78	0.00	2.51	YES	5.00	10.03	Check	5.0
D-11	North half of Running Deer Way	0.90	0.12	5	0.020	0.64		105	0.0599	6	Paved areas and shallow paved swales	20.00	4.89	0.36	1.00	YES	110.00	10.61	Check	5.0
D-12	South/Middle portion of Site inside of Vineyard Circle which drains to west	0.45	0.64	65	0.033	6.36		233	0.0322	6	Paved areas and shallow paved swales	20.00	3.59	1.08	7.44	YES	298.00	11.66	Check	7.4
D-13	Southern portion of site along Sika Deer Place and Akers	0.45	1.36	95	0.020	9.10		510	0.0322	6	Paved areas and shallow paved swales	20.00	3.59	2.37	11.47	YES	605.00	13.36	Check	11.5
D-14	Along eastern Edge of Vineyard (West Side) opposite North Pond	0.45	0.32	95	0.250	3.95		120	0.0100	6	Paved areas and shallow paved swales	20.00	2.00	1.00	4.95	YES	215.00	11.19	Check	5.0
D-15	Along eastern Edge of Vineyard (West Side) opposite South Pond	0.45	0.24	95	0.250	3.95		90	0.0100	6	Paved areas and shallow paved swales	20.00	2.00	0.75	4.70	YES	185.00	11.03	Check	5.0
D-16	South Pond	0.32	0.15	5	0.020	2.51			0.0100	6	Paved areas and shallow paved swales	20.00	2.00	0.00	2.51	YES	5.00	10.03	Check	5.0
D-17	South half of Running Deer Way	0.90	0.11	5	0.020	0.64		90	0.0599	6	Paved areas and shallow paved swales	20.00	4.89	0.31	0.95	YES	95.00	10.53	Check	5.0
D-18	ROW north of Fallow which drains towards Akers	0.45	0.33	55	0.091	4.20		285	0.0309	6	Paved areas and shallow paved swales	20.00	3.51	1.35	5.55	YES	340.00	11.89	Check	5.6

SUB-BASIN DATA				INITIAL/OVERLAND FLOW (t _i)			TRAVEL TIME (t _t)						Tc CHECK (Urbanized basins)			FINAL Tc (min)					
							Type of Land Surface														
				Length, L (ft)	Slope, s (ft/ft)	t _i (min)		Length (ft)	S _w (ft/ft)	Code	Description	Convey Coef (C _u) (2)	Velocity (V) (ft/s) (3)	t _i Travel Time (min) (4)	TOTAL t _c = t _i + t _t (min)	Urban (Yes /No)	Length (ft)	T _c max (min) (5)	T _c max > t _c		
Basin ID	Description	C _s	Area (ac)																		
D-19	ROW btwn Fallow & Running Deer which drains towards Akers	0.45	0.22	36	0.125	3.06		250	0.0220	6	Paved areas and shallow paved swales	20.00	2.97	1.40	4.46		YES	286.00	11.59	Check	5.0
D-20	ROW south of Running Deer which drains towards Akers	0.45	0.75	45	0.333	2.47		720	0.0236	6	Paved areas and shallow paved swales	20.00	3.07	3.90	6.38		YES	765.00	14.25	Check	6.4

Notes:

All Equations are from UDFCD Drainage Criteria Manual/Runoff

(1) $t_i = (0.395 * (1.1 - C_s) * (L^{0.5})) / (S^{0.33})$, from UDFCD Equation RO-3

(2) Cv from UDFCD Table RO-2

(3) Velocity from $V = C_u * S_w^{0.5}$, from UDFCD Equation RO-4

(4) $t_t = L / 60V$

(5) $t_t \text{ max} = 10 * L / 180$, from UDFCD Eqn RO-5

UDFCD Table RO-2		Land Surface Coefficients	
Code	Description		Cv
1	Heavy meadow		2.5
2	Tillage/field		5
3	Short pasture and lawns		7
4	Nearly bare ground		10
5	Grassed waterway		15
6	Paved areas and shallow paved swales		20
*7	Riprap (not buried)		7.0

* determined for the project based on UDFCD equations (Equation RO-4)

Standard Form SF-2 . Storm Drainage System Design (Rational Method Procedure)

Project: Gardens at North Carefree
 Section: Proposed Conditions

Created by: CMD Date: 7/31/2018
 Checked by: CKC Date:

Design Storm: 5-yr P = 1.50 in

LOCATION		AREA DESIGN	AREA (A)	RUNOFF COEFF (C)	DIRECT RUNOFF				TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			REMARKS
					AREA (AC)	COEFF	t _r (MIN)	C.A. (AC)	I (IN / HR)	Q (CFS)	t _r (MIN)	SUM (C+A)	I (IN / HR)	Q (CFS)	SLOPE (%)	STREET FLOW (CFS)	DESIGN FLOW (CFS)	SLOPE (%)	PIPE SIZE (INCHES)	LENGTH (FT)	
	(1)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
	Offsite Basin @ East Side	OS-1	2.25	0.08	16.52	0.18	3.25	0.59													
	East portion of Site btwn North half of Vineyard and East Boundary	D-1	1.23	0.45	12.26	0.56	3.73	2.07													
	East portion of Site btwn South half of Vineyard and East Boundary	D-2	0.86	0.45	12.05	0.39	3.76	1.46													
	South/Middle portion of Site inside of Vineyard Circle which drains to east	D-3	0.49	0.45	8.78	0.22	4.26	0.95													
	North/Middle portion of Site inside of Vineyard Circle which drains to east	D-4	0.72	0.45	10.41	0.32	3.99	1.29													
	North portion of site, along Carefree Circle	D-5	2.03	0.45	11.98	0.91	3.77	3.44													
	North Half of Fallow Lane	D-6	0.12	0.90	5.00	0.11	5.09	0.55													
	South Half of Fallow Lane	D-7	0.07	0.90	5.00	0.06	5.09	0.30													
	North/Middle portion of Site inside of Vineyard Circle which drains to west	D-8	1.13	0.45	10.01	0.51	4.06	2.06													
	Portion of site south of Fallow and btwn Akers and Vineyard	D-9	0.49	0.45	6.79	0.22	4.66	1.02													
	North Pond	D-10	0.20	0.32	5.00	0.07	5.09	0.33													
	North half of Running Deer Way	D-11	0.12	0.90	5.00	0.11	5.09	0.55													
	South/Middle portion of Site inside of Vineyard Circle which drains to west	D-12	0.64	0.45	7.44	0.29	4.52	1.30													
	Southern portion of site along Sika Deer Place and Akers	D-13	1.36	0.45	11.47	0.61	3.84	2.34													
	Along eastern Edge of Vineyard (West Side) opposite North Pond	D-14	0.32	0.45	5.00	0.14	5.09	0.72													
	Along eastern Edge of Vineyard (West Side) opposite South Pond	D-15	0.24	0.45	5.00	0.11	5.09	0.56													
	South Pond	D-16	0.15	0.32	5.00	0.05	5.09	0.24													
	South half of of Running Deer Way	D-17	0.11	0.90	5.00	0.10	5.09	0.51													
	ROW north of Fallow which drains towards Akers	D-18	0.33	0.45	5.55	0.15	4.95	0.74													

Standard Form SF-2 . Storm Drainage System Design (Rational Method Procedure)

Project:		Gardens at North Carefree										Created by: CMD		Date: 7/31/2018	
Section:		Proposed Conditions										Checked by: CKC		Date:	
	ROW btwn Fallow & Running Deer which drains towards Akers	D-19	0.22	0.45	5.00	0.10	5.09	0.50							
	ROW south of Running Deer which drains towards Akers	D-20	0.75	0.45	6.38	0.34	4.75	1.60							

Standard Form SF-2 . Storm Drainage System Design (Rational Method Procedure)

Project: Gardens at North Carefree
 Section: Proposed Conditions

Created by: CMD Date: 7/31/2018
 Checked by: CKC Date:

Design Storm: 100-yr P = 2.52 in

LOCATION		BASIN ID	DIRECT RUNOFF					TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			REMARKS	
			AREA (A)	RUNOFF (C)	t _c (MIN)	C.A. (AC)	I (IN / HR)	Q (CFS)	t _c (MIN)	SUM (C+A)	I (IN / HR)	Q (CFS)	SLOPE (%)	STREET FLOW (CFS)	DESIGN FLOW (CFS)	SLOPE (%)	PIPE SIZE (INCHES)	LENGTH (FT)	VELOCITY (FPS)		t _t (MIN)
	(1)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
	Offsite Basin @ East Side	OS-1	2.25	0.35	16.52	0.79	5.46	4.30													
	East portion of Site btwn North half of Vineyard and East Boundary	D-1	1.23	0.59	12.26	0.73	6.27	4.57													
	East portion of Site btwn South half of Vineyard and East Boundary	D-2	0.86	0.59	12.05	0.51	6.31	3.22													
	South/Middle portion of Site inside of Vineyard Circle which drains to east	D-3	0.49	0.59	8.78	0.29	7.16	2.09													
	North/Middle portion of Site inside of Vineyard Circle which drains to east	D-4	0.72	0.59	10.41	0.42	6.71	2.84													
	North portion of site, along Carefree Circle	D-5	2.03	0.59	11.98	1.20	6.33	7.57													
	North Half of Fallow Lane	D-6	0.12	0.96	5.00	0.12	8.55	0.99													
	South Half of Fallow Lane	D-7	0.07	0.96	5.00	0.06	8.55	0.54													
	North/Middle portion of Site inside of Vineyard Circle which drains to west	D-8	1.13	0.59	10.01	0.66	6.81	4.53													
	Portion of site south of Fallow and btwn Akers and Vineyard	D-9	0.49	0.59	6.79	0.29	7.82	2.24													
	North Pond	D-10	0.20	0.51	5.00	0.10	8.55	0.89													
	North half of Running Deer Way	D-11	0.12	0.96	5.00	0.12	8.55	0.99													
	South/Middle portion of Site inside of Vineyard Circle which drains to west	D-12	0.64	0.59	7.44	0.38	7.59	2.86													
	Southern portion of site along Sika Deer Place and Akers	D-13	1.36	0.59	11.47	0.80	6.45	5.16													
	Along eastern Edge of Vineyard (West Side) opposite North Pond	D-14	0.32	0.59	5.00	0.19	8.55	1.59													
	Along eastern Edge of Vineyard (West Side) opposite South Pond	D-15	0.24	0.59	5.00	0.14	8.55	1.23													
	South Pond	D-16	0.15	0.51	5.00	0.07	8.55	0.64													
	South half of of Running Deer Way	D-17	0.11	0.96	5.00	0.11	8.55	0.91													
	ROW north of Fallow which drains towards Akers	D-18	0.33	0.59	5.55	0.20	8.31	1.64													

GARDENS AT NORTH CAREFREE

SURFACE ROUTING

DESIGN POINT	CONTRIBUTING BASINS	CA (equivalent)		Tc (min.)	INTENSITY		TOTAL FLOWS	
		CA(5)	CA(100)		I(5) (in/hr)	I(100) (in/hr)	Q(5) (cfs)	Q(100) (cfs)
Z	OS-1	0.18	0.79	16.5	3.2	5.6	0.6	4.4
		TRAVEL TIME						
		0.18	0.79	Type/flow	Length (ft)	Velocity (fps)	d. Time (min)	T. Time (min)
				STREET	405	2.9	2.3	18.8
A	D-1 D-2 DP Z	0.56	0.73	18.8	3.0	5.3	3.4	10.6
		0.39	0.51	TRAVEL TIME				
		0.18	0.79					
		1.12	2.03	Type/flow	Length (ft)	Velocity (fps)	d. Time (min)	T. Time (min)
				PIPE	34	2.5	0.2	19.1
B	D-3 D-4	0.22	0.29	10.4	4.0	7.0	2.2	5.0
		0.32	0.42	TRAVEL TIME				
		0.54	0.71	Type/flow	Length (ft)	Velocity (fps)	d. Time (min)	T. Time (min)
				PIPE	210	2.5	1.4	11.8
C	D-8 D-14	0.51	0.66	10.0	4.0	7.1	2.6	6.0
		0.14	0.19	TRAVEL TIME				
		0.65	0.85	Type/flow	Length (ft)	Velocity (fps)	d. Time (min)	T. Time (min)
				CHANNEL	34	2.5	0.2	10.2
D	D-5 D-9 D-10	0.91	1.20	12.0	3.7	6.5	4.5	10.4
		0.22	0.29	TRAVEL TIME				
		0.07	0.10					
		1.20	1.59	Type/flow	Length (ft)	Velocity (fps)	d. Time (min)	T. Time (min)
				PIPE	10	2.5	0.1	12.1
E	D-12 D-15	0.29	0.38	7.4	4.5	7.9	1.8	4.1
		0.11	0.14	TRAVEL TIME				
		0.40	0.52	Type/flow	Length (ft)	Velocity (fps)	d. Time (min)	T. Time (min)
				PIPE	34	2.5	0.2	7.7
F	D-13 D-16	0.61	0.80	5.0	5.2	9.1	3.4	7.9
		0.05	0.07	TRAVEL TIME				
		0.66	0.87	Type/flow	Length (ft)	Velocity (fps)	d. Time (min)	T. Time (min)
				PIPE	10	2.5	0.1	5.1
G	D-18	0.15	0.20	5.6	5.0	8.8	0.8	1.7
		TRAVEL TIME						
		0.15	0.20	Type/flow	Length (ft)	Velocity (fps)	d. Time (min)	T. Time (min)
					25	5.0	0.1	5.6
H	D-6 D-7 D-19	0.11	0.12	5.0	5.2	9.1	0.9	1.6
		0.06	0.06	TRAVEL TIME				
		0.10	0.13					
		0.17	0.18	Type/flow	Length (ft)	Velocity (fps)	d. Time (min)	T. Time (min)
					25	5.0	0.1	5.1
I	D-11 D-17 D-20	0.11	0.12	6.4	4.8	8.4	2.6	5.6
		0.10	0.11	TRAVEL TIME				
		0.34	0.44					
		0.54	0.66	Type/flow	Length (ft)	Velocity (fps)	d. Time (min)	T. Time (min)
						5.0	0.0	6.4

DESIGN POINT	CONTRIBUTING BASINS	CA (equivalent)		Tc (min.)	INTENSITY		TOTAL FLOWS	
		CA(5)	CA(100)		I(5) (in/hr)	I(100) (in/hr)	Q(5) (cfs)	Q(100) (cfs)
NP	DP A	1.12	2.03	19.1	3.0	5.2	10.5	27.0
	DP B	0.54	0.71					
	DP C	0.65	0.85					
	DP D	1.20	1.59	TRAVEL TIME				
		3.51	5.18	Type/flow	Length (ft)	Velocity (fps)	d. Time (min)	T. Time (min)
					80	4.0	0.3	19.4
SP	DP E	0.40	0.52	7.7	4.5	7.9	4.7	10.9
	DP F	0.66	0.87	TRAVEL TIME				
		1.05	1.39	Type/flow	Length (ft)	Velocity (fps)	d. Time (min)	T. Time (min)
						5.0	0.0	7.7

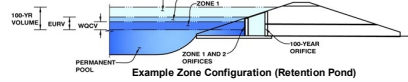
Appendix D: Water Quality Pond Calculations

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Basin ID: North Pond

ZONE 3
ZONE 2



Selected BMP Type =	EDB
Watershed Area =	7.47 acres
Watershed Length =	570 ft
Watershed Slope =	0.022 ft/ft
Watershed Imperviousness =	80.00% percent
Percentage Hydrologic Soil Group A =	100.0% percent
Percentage Hydrologic Soil Group B =	0.0% percent
Percentage Hydrologic Soil Groups C/D =	0.0% percent
Desired WQCV Drain Time =	40.0 hours
Location for 1-hr Rainfall Depths = User Input	

Water Quality Capture Volume (WQCV) =	0.204	acre-feet	Optional User Override
Excess Urban Runoff Volume (EURV) =	0.786	acre-feet	1-hr Precipitation
2-yr Runoff Volume (P1 = 1.19 in.) =	0.544	acre-feet	1.19 inches
5-yr Runoff Volume (P1 = 1.59 in.) =	0.707	acre-feet	1.50 inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.852	acre-feet	1.75 inches
25-yr Runoff Volume (P1 = 2.1 in.) =	1.009	acre-feet	2.00 inches
50-yr Runoff Volume (P1 = 2.25 in.) =	1.163	acre-feet	2.25 inches
100-yr Runoff Volume (P1 = 2.52 in.) =	1.348	acre-feet	2.52 inches
500-yr Runoff Volume (P1 = 3.29 in.) =	1.848	acre-feet	3.29 inches
Approximate 2-yr Detention Volume =	0.516	acre-feet	
Approximate 5-yr Detention Volume =	0.671	acre-feet	
Approximate 10-yr Detention Volume =	0.801	acre-feet	
Approximate 25-yr Detention Volume =	0.951	acre-feet	
Approximate 50-yr Detention Volume =	1.039	acre-feet	
Approximate 100-yr Detention Volume =	1.121	acre-feet	

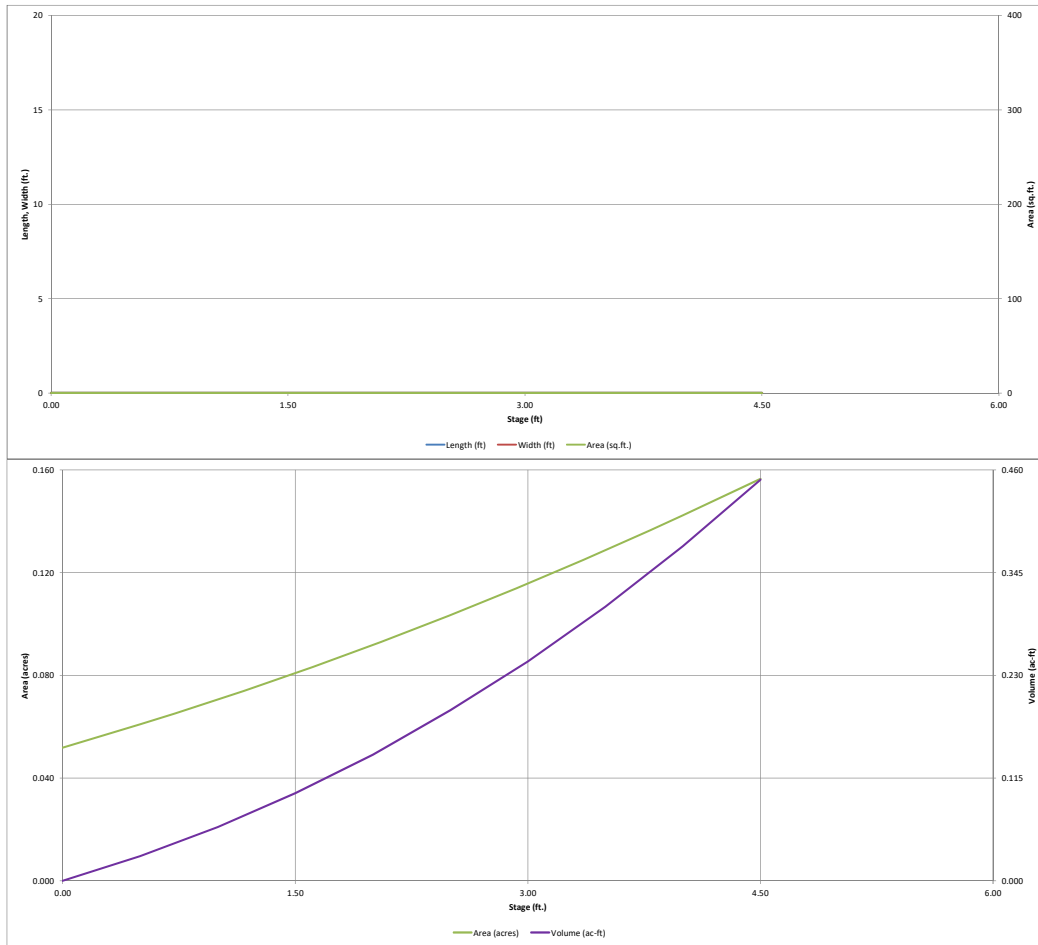
Zone 1 Volume (V_{QCV})	0.204	acre-feet
Select Zone 2 Storage Volume (Optional)		acre-feet
Select Zone 3 Storage Volume (Optional)		acre-feet
Total Detention Basin Volume	0.204	acre-feet
Initial Surcharge Volume (ISV)	user	ft ³
Initial Surcharge Depth (ISD)	user	ft
Total Available Detention Depth (H_{dmax})	user	ft
Depth of Trickle Channel (H_{TC})	user	ft
Slope of Trickle Channel (S_{TC})	user	ft/ft
Slopes of Main Basin Sides (S_{basin})	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$)	user	

Initial Surcharge Area ($A_{0,i}$) =	user	ft ²
Surcharge Volume Length ($L_{0,i}$) =	user	ft
Surcharge Volume Width ($W_{0,i}$) =	user	ft
Depth of Basin Floor ($H_{b,0,i}$) =	user	ft
Length of Basin Floor ($L_{b,0,i}$) =	user	ft
Width of Basin Floor ($W_{b,0,i}$) =	user	ft
Area of Basin Floor ($A_{b,0,i}$) =	user	ft ²
Volume of Basin Floor ($V_{b,0,i}$) =	user	ft ³
Depth of Main Basin ($H_{b,m}$) =	user	ft
Length of Main Basin ($L_{b,m}$) =	user	ft
Width of Main Basin ($W_{b,m}$) =	user	ft
Area of Main Basin ($A_{b,m}$) =	user	ft ²
Volume of Main Basin ($V_{b,m}$) =	user	ft ³
Calculated Total Basin Volume ($V_{b,tot}$) =	user	acre-feet

[illegible]

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)



DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

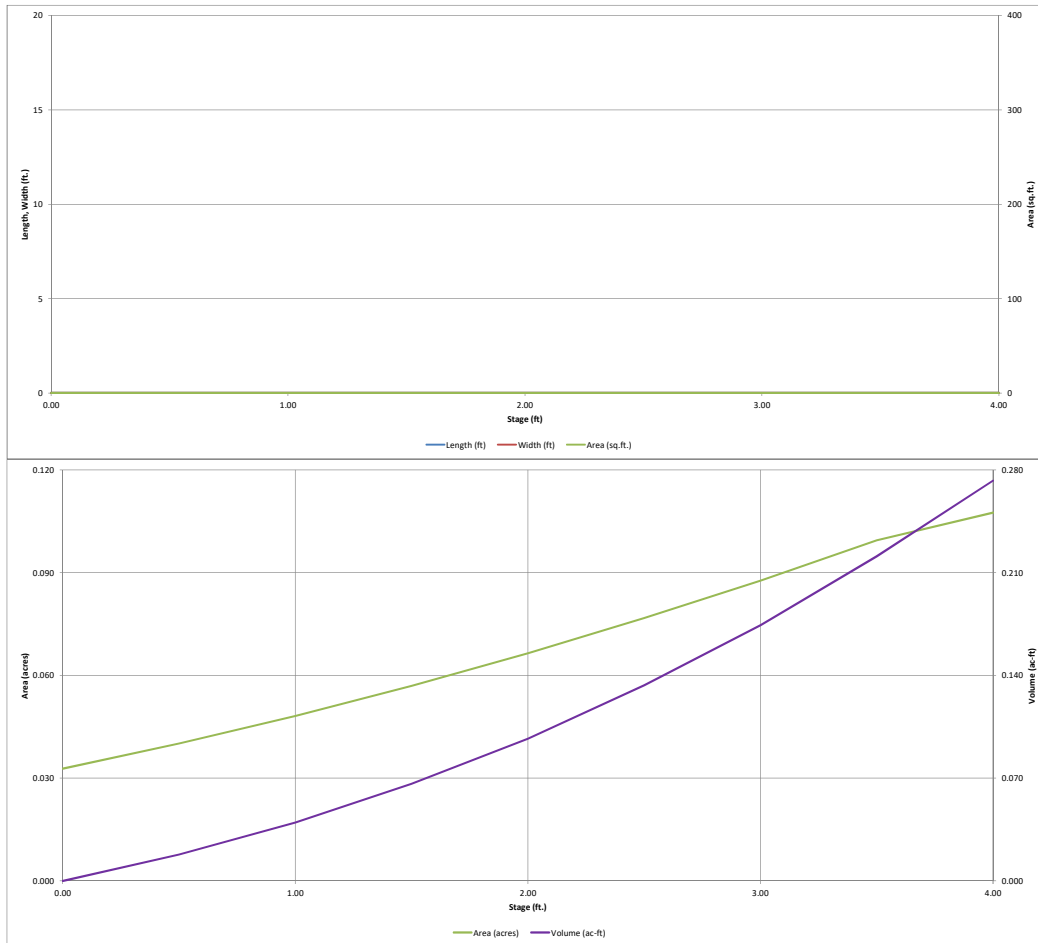
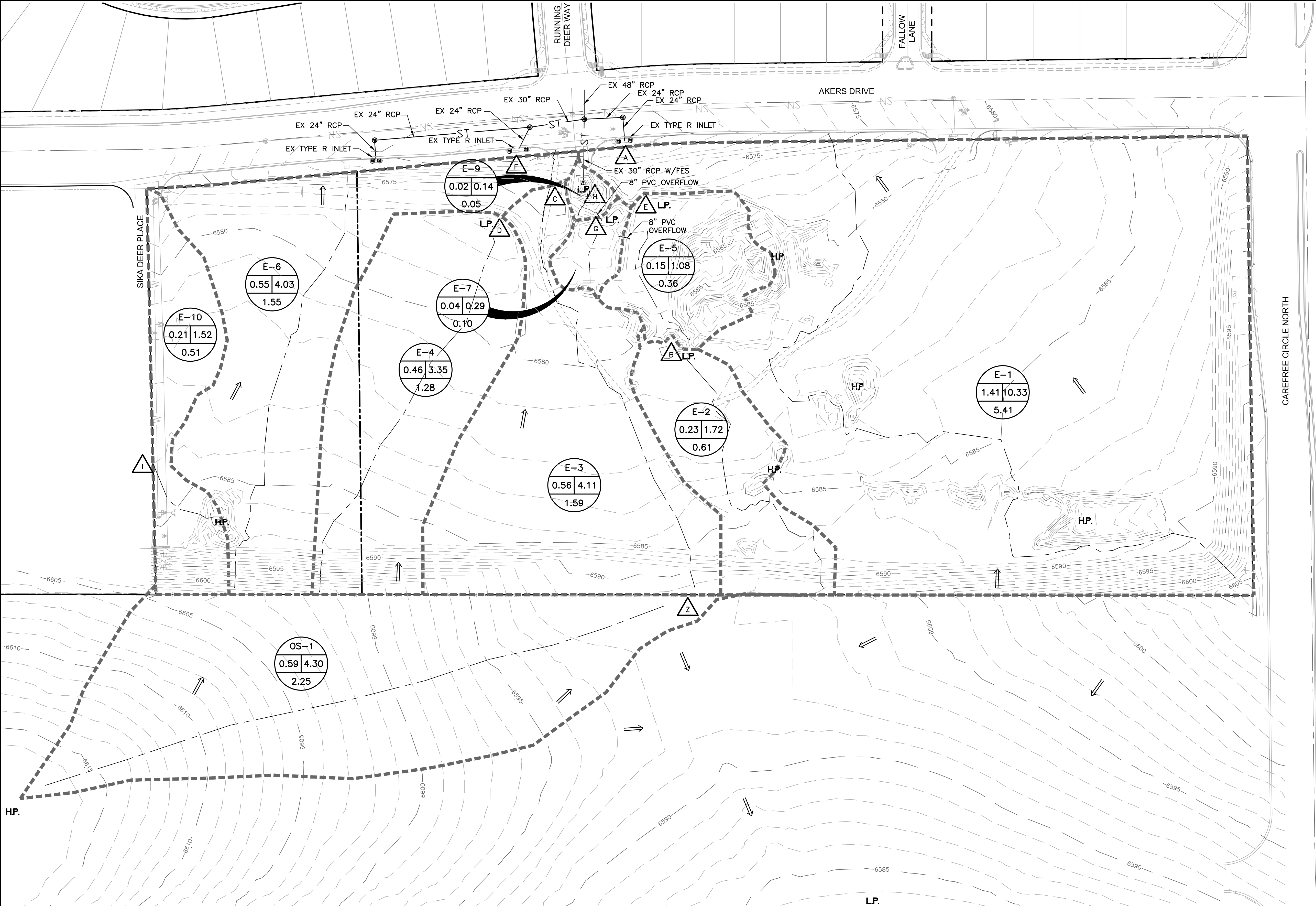


Figure 2: Existing Drainage Map



LEGEND

EXISTING 1' CONTOUR

EXISTING 5' CONTOUR

PROPERTY BOUNDARY

DRAINAGE BASIN BOUNDARY

FLOW PATH

DESIGN POINT


BASIN LABEL

1"=50'

DESIGN POINT SUMMARY		
DESIGN POINT	Q ₅	Q ₁₀₀
Z	0.6	4.3
A	1.4	10.6
B	0.2	1.8
C	1.2	9.4
D	0.5	3.5
E	0.4	2.9
F	0.6	4.2
G	0.4	3.2
H	1.5	11.4
I	0.2	1.6

Computer File Information	
Creation Date: 6-5-17	Initials: CMD
Last Modification Date: 6-12-17	Initials: BG
Full Path & Drawing File Name: V:\52876\active\187608744-Mule Deer\Reports\Drainage\Exhibits\Ex Basin Exhibit.dwg	
Acad Ver. 2017	Scale: see plan Units: Feet

Index of Revisions		



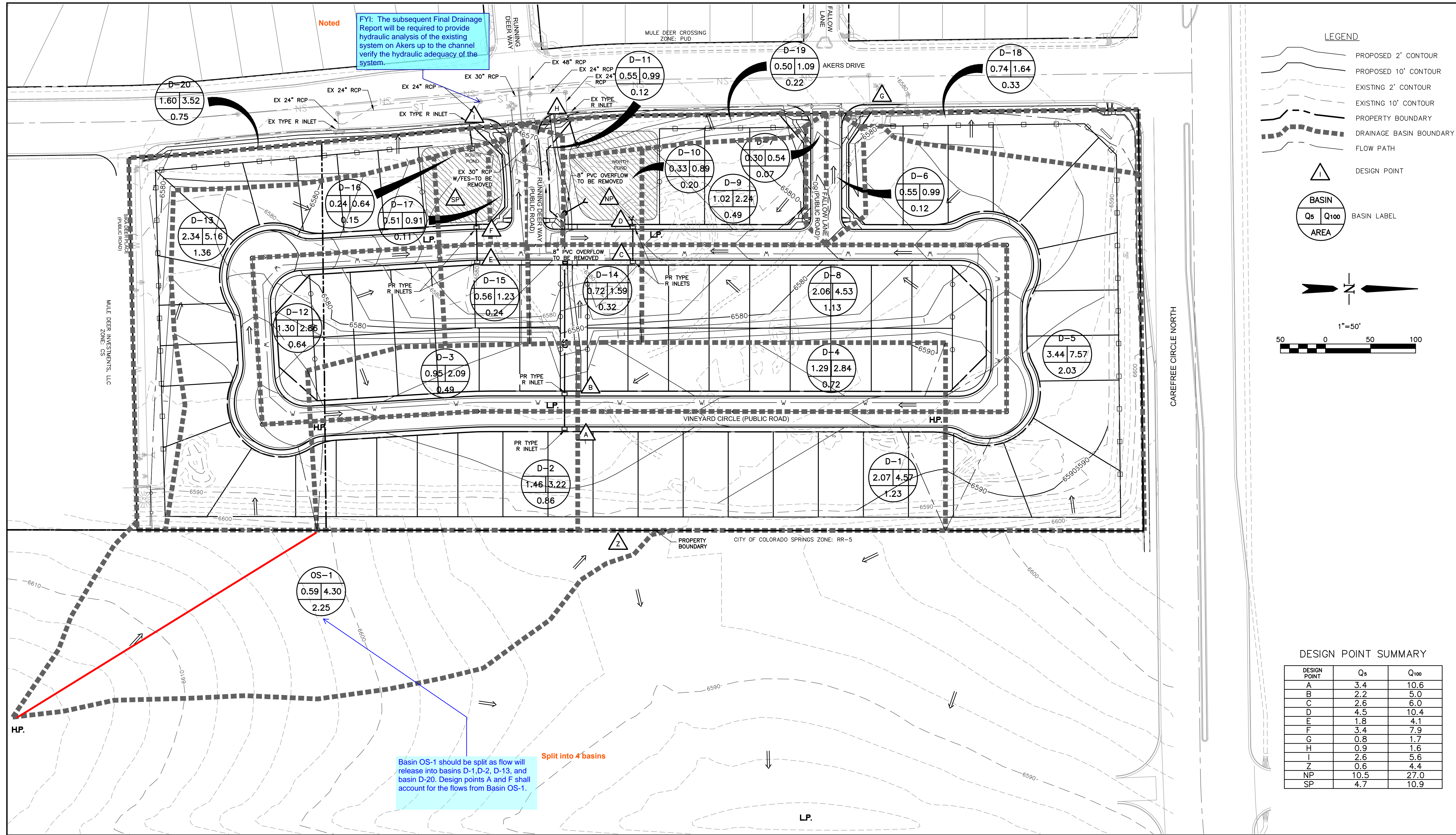
Stantec
Stantec Consulting Inc.
1110 Elton Drive
Suite B
Colorado Springs, CO 80907
Tel. (719) 432-6889
Fax.
www.stantec.com

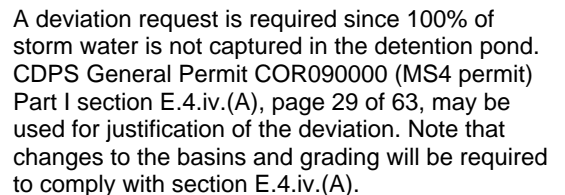
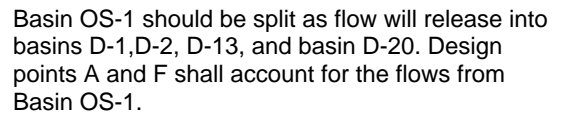
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GARDENS AT NORTH CAREFREE EXISTING DRAINAGE PLAN		
Designer: CMS	Structure Numbers	
Detailer: BG		
Sheet Subset:		


Project No./Code
187608744
Sheet Number 1 of 1

Figure 3: Proposed Drainage Map



Daniel Torres (11)

00=5.0) cc
nd the flow

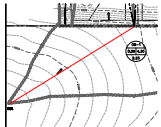
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Author: Daniel Torres
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5.0

acres) in the north half of Fallow Lane. Flows for this basin
10.99 cfs for the 100-year storm.
acres) in the south half of Fallow Lane. Flows for this basin
10.54 cfs for the 100-year storm. [open slide](#)
acres) in the northwest half of the area inside of Vineyard C
west and of the west leg of Vineyard Circle to a pump inlet
for 5-year storm and 4.5 cfs for the 100-year storm.
acres) in the area between the west leg of Vineyard Circle, I
will release to a pump inlet on the west side of Vineyard C
for the 5-year storm and 2.24 cfs for the 100-year storm.

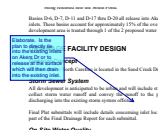
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east side



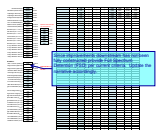
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dsdlaforce (3)



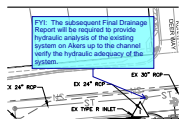
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Elaborate. Is the plan to directly tie into the existing inlets on Akers Dr or to release at the surface which will then drain into the existing inlet.



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Since improvements downstream has not been fully constructed provide Full Spectrum Detention (FSD) per current criteria. Update the narrative accordingly.



Subject: Callout
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Author: dsdlaforce
Date: 9/11/2018 10:23:20 AM
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FYI: The subsequent Final Drainage Report will be required to provide hydraulic analysis of the existing system on Akers up to the channel verify the hydraulic adequacy of the system.