ADDENDUM TO MASTER DEVELOPMENT DRAINAGE PLAN FOR COPPER RIDGE CROSSING AT NORTHGATE
&
FINAL DRAINAGE REPORT FOR POLARIS POINTE SHOPS FILING NO. 3

October 2014
Revised October 2018

Prepared for:

NORTHGATE PROPERTIES, LLC/Copper Ridge Development, Inc.
13540 Meadowgrass Drive. Suite 200
Colorado Springs, CO 80921

Prepared by:

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JOB NO. 1810

23824-4

Signature Page

ENGINEER'S STATEMENT:

This report and plan for the drainage design of Copper Ridge Crossing at Northgate & Polaris Pointe Shops Filing no. 3 was prepared by me (or under my direct supervision) and is correct to the best of my knowledge and belief. Said report and plan has been prepared in accordance with the City of Colorado Springs Drainage Criteria Manual and is in conformity with the master plan of the drainage basin. I understand that the City of Colorado Springs does not and will not assume liability for drainage facilities designed by others. I accept responsibility for any liability caused by any negligent acts, errors or omissions on my part in preparing this report.

B. Yoo — Nov. 28, 2018

Bob H. Yoo, Colorado P.E. #36793 — Date

COLORADO REGISTERED BOB HYUNG-BAE YOO 36793 PROFESSIONAL ENGINEER

DEVELOPER'S STATEMENT:

Northgate Properties, LLC and/or Copper Ridge Development, Inc. hereby certifies that the drainage facilities for Copper Ridge Crossing at Northgate shall be constructed according to the design presented in this report. I understand that the City of Colorado Springs does not and will not assume liability for the drainage facilities designed and/or certified by my engineer and that are submitted to the City of Colorado Springs pursuant to section 7.7.906 of the City Code; and cannot, on behalf of Copper Ridge Crossing at Northgate , guarantee that final drainage design review will absolve Northgate Properties, LLC and/or Copper Ridge Development, Inc. and/or their successors and/or assigns of future liability for improper design. I further understand that approval of the final plat does not imply approval of my engineer's drainage design.

Northgate Properties, LLC.
Name of Developer

11/29/18

Authorized Signature — Date

Gary Erickson — Manager
Printed Name — Title:

Address: 13540 Meadowgrass Drive, Suite 200, Colorado Springs, CO 80921

CITY OF COLORADO SPRINGS STATEMENT:

Filed in accordance with Section 7.7.906 of the Code of the City of Colorado Springs, 2001, as amended.

Anna Bergmark — 12/6/18

For City Engineer — Date

Conditions:

1.

2.

MDDP FOR COPPER RIDGE CROSSING AT NORTHGATE & FDR FOR POLARIS POINTE SHOPS FILING NO. 3

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1. Introduction

This document is the Master Development Drainage Plan (herein referred to as "M.D.D.P.") for Copper Ridge Crossing at Northgate and Final Drainage Report (herein referred to as "F.D.R.") for Polaris Pointe shops Filing no. 3 in the City of Colorado Springs, Colorado.

1.1 Purpose and scope of study

The purpose of this Master Development Drainage Plan is implement the concepts identified in the overall basin plan for Copper Ridge Crossing at Northgate and the Final Drainage Report plan for Polaris Pointe Shops Filing no. 3 development. This study is to identify major drainageways, detention areas, locations of culverts, bridges, open channels and drainage areas contained within the proposed development. In addition, this study is to estimate anticipated storm water runoff quantities, recommend specific solutions for on-site and off-site drainage problems resulting from development, and identify necessary improvements to safely route storm water runoff to adequate outfall facilities. The addendum to previously approved M.D.D.P. study is required with changed on-site drainage areas, revisions to the Private Regional Detention Pond facility structures and to update latest Agencies' correspondences and permits.

1.2 D.B.P.S. and Past Studies

Copper Ridge Crossing at Northgate is located within the Monument Branch Drainage Basin Planning Study by URS Corporation, last revised date August 6, 1987. Additionally, Northgate Master Development Drainage Plan by URS Consultants, Inc., dated June 27, 1988.
Several drainage studies have been completed for the vicinity of the site. A list of drainage studies reviewed and considered in the preparation of this report is as follows:

- "Preliminary/Final Drainage Report for Northgate Filing No. 6 (Voyager Parkway Phase 1)" by JR Engineering, last October 1998.
- "Preliminary/Final Drainage Report for Northgate Filing no. 7 Voyager Parkway, Phase 2 (2,200 feet north of Middle Creek Parkway to Northgate Road" by JR Engineering, last revised date September 1999.

1.3 Agency Jurisdictions

The drainage improvements proposed in this study are located within the City of Colorado city limits within El Paso County. It is anticipated that the City of Colorado Springs will be the sole agency for review and approval of this study. Other agencies such as United States Air Force Academy, Colorado Springs Utilities, Colorado Department of Transportation and U.S. Army Corps of Engineers will have involvement in review and approval process with City of Colorado Springs. Peak discharge criteria as required by the United States Air Force Academy has been utilized in the preparation of this study.

1.4 General Project Description

The development area is located in the northeast and northwest quarter of Section 7, northwest quarter of Section 17 and southeast quarter of Section 8, Township 12 South, Range 66 West of the Sixth Principal Meridian, El Paso County, Colorado.
The proposed Copper Ridge Crossing at Northgate M.D.D.P. development is a 30.42 acre tract of future commercial use land development. Copper Ridge Crossing at Northgate Filing no. 1 (carwash facility) development, located on the northeast corner of the development was approved on May 2, 2014 prior to this study, and M.D.D.P. will be consistent with the drainage characteristic as described in that report. An existing temporary sediment pond exists on-site due to outflows from the existing FedEx pond. These flows will be routed via proposed storm sewer lines and will be routed off-site bypassing proposed permanent BMPs.
The proposed Polaris Pointe Shops Filing no. 3 development is an 11.51 acre tract with two (2) lots proposed for a driving range and a trampoline center.
Copper Ridge Crossing at Northgate is located within the Polaris Pointe at Northgate Master Plan area. The site is bordered by Spectrum Loop to the north and west, Voyager Parkway to the east and Powers Boulevard Right-of-Way to the south.

1.5 Data Sources

A detailed review of all available studies, mapping and data pertinent to this study was conducted. The information included but was not limited to existing drainage criteria, existing drainage studies, pertinent soils, rainfall and runoff data, available mapping and utility records.
Specifically, existing boundary information was taken from the survey prepared by Edward and James Surveying, Inc. Also, Colorado Springs Utilities' FIMS maps were utilized for the base mapping including the existing facilities. Existing topographic information was also taken from the field surveys prepared by Edward James Surveying, Inc.
There is no existence of the wetland in the vicinity of the site.

1.5.1 Soil

The National Resources Conservation Service (NRCS) Web Soil Survey has been utilized to determine the existing soil types within and tributary to the area impacting the study area. Per Web Soil Survey, two different soil types are found in the study area.
The on-site soils are classified as the "71", Pring coarse sandy loam with 3 to 8 percent slopes and as the "92", Tomah-Crowfoot loamy sands with 3 to 8 percent slopes.
Group B soils exhibit a moderate infiltration rate when thoroughly wet and consist chiefly of moderately deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

1.6 Drainage Design Criteria and Standards

The "City of Colorado Springs Drainage Criteria Manual, Volume 1 and 2" dated May 2014 are the primary basis of this study. In addition to the City Criteria Manual, the Urban Storm Drainage Criteria

Manuals Volume 1 and 2, latest update January 2016 and Volume 3, latest update November 2015, published by Urban Drainage and Flood Control District (UDFCD) are also used for this study. Storm runoff rates for all onsite basins are calculated based on the following criteria found in the manual. The initial storm (5-year event) and the major storm (100-year event) are considered to size drainage facilities and verify conformance with drainage criteria. Additionally, per El Paso County and City's policy for flows upstream of the Air Force Academy, developed peak flows for 2-, 5-, 10-, 25-, 50- and 100- year storm frequencies are released at below the historical "undeveloped" flows. Runoff rates are calculated using the Rational Method Equation Q=CIA as required for basins up to and including 130 acres in size and when hydrologic routing is relatively simple. The Rational Method is most typically applied for inlet and storm drain sizing.

1.6.1 Rainfall Characteristics

Per the "City of Colorado Springs Drainage Criteria Manual, Volume 1" (DCM Volume 1), dated 2014, for Colorado Springs areas, 1-hour depth are fairly uniform and released the Table 6-2 , which summarized the rainfall depths for Colorado Springs below:

Table 6-2. Rainfall Depths for Colorado Springs

Return Period	1-Hour Depth	6-Hour Depth	24-Hour Depth
2	1.19	1.70	2.10
5	1.50	2.10	2.70
10	1.75	2.40	3.20
25	2.00	2.90	3.60
50	2.25	3.20	4.20
100	2.52	3.50	4.60

Where Z= 6,840 ft/100

Depending on the location of the project, rainfall depths may be calculated using the method outlined in Chapter 6, section 2.0 Rainfall and the National Oceanic and Atmospheric Administration (NOAA), Precipitation-Frequency Atlas of the Western United States, Volume III-Colorado (NOAA Atlas 2), published in 1973.

1.6.2 Rational Method

Runoff rates are calculated using the Rational Method Equation Q=CIA as required for basins up to 130 acres where:

Q = the maximum runoff rate (cubic feet per second [cfs])

C = the runoff coefficient that is the ratio between the runoff volume from an area and the average rainfall depth over a given duration for that area

I = the average intensity of rainfall for a duration equal to the time of concentration (in/hr)

A = drainage basin area (acres)

1.6.2.1 Runoff Coefficients

Runoff coefficients are based on the imperviousness of a particular land use and the hydrologic soil type of the area and are to be selected in accordance with Table 6-6 in DCM Volume 1.

1.6.2.2 Time of Concentration (tc)

For urban areas, the time of concentration (*tc*) consists of an initial time or overland flow time (*ti*) plus the travel time (*tt*) in the storm sewer, paved gutter, roadside drainage ditch, or drainage channel. For nonurban areas, the time of concentration consists of an overland flow time (*ti*) plus the time of travel in a concentrated form, such as a swale or drainageway. The travel portion (*tt*) of the time of concentration can be estimated from the hydraulic properties of the storm sewer, gutter, swale, ditch, or drainageway.

It is recommended that a minimum value of 5 minutes to be used for urbanized areas and 10 minutes for the undeveloped conditions.

1.6.2.3 Rainfall Intensity (I)

The average rainfall intensity, in inches per hour, values as provided in the DCM volume 1, section 3.3, and are used for the study. IDF Equation for 2-year, 5-year, 10-year, 25-year, 50-year and 100-year storms are outlined below:

I100 = -2.52 ln (D) + 12.735
I50 = -2.25 ln (D) + 11.375
I25 = -2.00 ln (D) + 10.111
I10 = -1.75 ln (D) + 8.847
I5 = -1.50 ln (D) + 7.583
I2 = -1.19 ln (D) + 6.035

1.6.3. Runoff Reduction Methods

Runoff reduction methods are generally be referred to as Best Management Practice (BMPs), Low Impact Development (LID) and Green Infrastructure (GI). Utilizing and implementation of BMPs, LID and GI methods, increased runoff volume and peak flows associated with urbanization can be reduced. DCM Volume 2 – Stormwater Quality Policies, Procedures and Best Management Prices (BMPs) outlined in detail with stormwater quality requirements for drainage planning and design relating to new development or significant redevelopment and construction activities.

UDFCD recommends a "Four Step Process" for receiving water protection that focuses on reducing runoff volumes, treating the water quality capture volume (WQCV), stabilizing drainageways, and implementing long-term source controls. The Four Step Process as outlined below shall be implemented to smaller individual developments within the M.D.D.P. drainage basin area:

Step 1:

1.6.3.1 Employ Runoff Reduction Practices

Any size of the land developments within the Copper Ridge Crossing at Northgate drainage study area are required to implement Low Impact Development (LID) practices where ever potentially to reduce runoff peaks, volumes and pollutant loads.

Because of the site constraints, each development may have the limitation of which LID techniques to be implemented for the site, but the following techniques are suggested.

- Provide **Grass Buffers** next to impervious areas to provide filtration, infiltration and settling to reduce runoff pollutants.

- Provide **Grass Swale**, where ever possible in lieu of uses of concreted channels or storm sewers to have the impervious flows at low flow rates so that flows are infiltrate to the ground and reduce the effects of imperviousness.
- One other technique suggested in the DCM Volume 2 manual is the use of the **various permeable pavement** with gravel and sand layers beneath the pavement for the parking lots, pedestrian walkways and low traffic areas to reduce site imperviousness. In the past, this technique was utilized in some of the areas, but settling of pavers caused higher cost of maintenance cost. Therefore, this technique is recommended with good compaction of the layer of gravel and sand layer as underlain material in the non-vehicle use areas such as pedestrian walkways.

Polaris Pointe Shops Filing no. 3: Grass swale/landscaped areas are provided in the parking lot to provide impervious flows from the buildings, parking and concrete sidewalks to infiltrate to the ground and reduce the effects of imperviousness before enter into proposed storm sewer inlets as a first step process. Additionally, strip of grass buffer/setback is provided in between of Spectrum Loop, proposed building and parking lots and to the property lines for additional infiltration and slowing runoff. Rest of runoff from on-site is captured via inlets and carried into the Private Water Quality/Underground Detention facility, where flows are captured and released at slower rates as step two process.

Step 2:

1.6.3.2 Implement BMPs that Provide a Water Quality Capture Volume with Slow Release
With first step of employing runoff reduction practices, the remaining runoff is treated through capture and slow release of the Water Quality Capture Volume (WQCV). The entire Copper Ridge Crossing at Northgate is provided with WQCV with Underground Stormtech Chamber by Advanced Drainage System, Inc. (herein referred to as "ADS"). Therefore, no separate WQCV facility for individual parcel within the Copper Ridge Crossing at Northgate area is required.

Step 3:

1.6.3.3 Stabilize Drainageways
No major or minor natural drainageways exists or stream stabilization is required on-site. Therefore, no new engineered channel is needed for the Copper Ridge Crossing at Northgate and the Polaris Pointe South Filing no. 3 area.

Should individual development requires or in need of engineered channels, either Grass channels or Rock lined low-flow channels are recommended in lieu of rip-rap or concrete lined channels.

Per Monument Branch D.B.P.S., this study calls out for the eight (8) partially lined channel drop structures for Monument Branch from Voyager Parkway to the United States Air Force Academy boundary line (Phase 1 and 2) at Monument Branch D.B.P.S. Design Point 8.

Per a letter of commitment from Mr. Richard Mulledy, City of Colorado Springs Water Resources Engineering Division Manager & Stormwater Enterprise, the City designed and constructed Phase 1 in 2016-2017 and has completed design of Phase II with construction planned in 2019. Monument Branch Channel Restoration Phase III on the United States Air Force Academy's land is an approximately 2,100 linear feet of restoration area in the west side of south bound I-25. Recently, the City completed a 30% design of Phase III and agreed to fund and manage the design, and the Copper Ridge Metro District agreed to fund and manage the construction of Phase III. Phase III construction will be included with the Powers Boulevard/I-25 interchange project and is planned for construction in 2019.

Step 4:

1.6.3.4 Implement Site Specific and Other Source Control BMPs

Copper Ridge Crossing at Northgate is proposed for commercial use site. Each site needs to implement for specialized BMPs such as covering of Storage/Handling areas and Spill containment and Control. At all time, developer/contractor shall implement site specific and source control BMPs to protect receiving waters.

Polaris Pointe Shops Filing no. 3: Contractor shall implement temporary/ permanent seeding on all disturbed slopes and areas with finished grading. Additionally, compost blankets will be implemented on the slopes to promote vegetation growth. Perimeter of the disturbed areas shall be either fenced with the silt fence or with sediment control logs to prevent sediment leaving the site. All proposed inlets shall be protected with a means of inlet protection devices to prevent sediment to enter the storm sewer system. Prior to the construction of Spectrum Loop road, contractor shall provide the adequate concrete washout area and the stockpile area as a material management. Throughout the construction days, all BMPs shall be repaired and cleaned out as necessary to maintain capacity of each BMPs.

A detailed description of the Four Step Process is provided in DCM Volume 2, providing BMP selection tools and quantitative procedures for completing these steps.

1.6.4 Urban Drainage and Flood Control District Criteria

Adhere to Urban Drainage and Flood Control District criteria, UDFCD released hydrologic and hydraulic software to develop hydrology. "UD-Detention v3.07" last update February 2017 was utilized for Full Spectrum Detention sizing needs.

1.6.5 Hydraulic Criteria

1.6.5.1 Street Drainage

As outlined in the "City of Colorado Springs Drainage Criteria Manual, Volume 1 and 2" dated May 2014, Chapter 7, hydraulic calculations must be completed to determine the capacity of the streets and encroachment onto the street section for minor (Q_5) and major (Q_{100}) storm events. The storm sewer

system must be located and sized so that the allowable flow limits are not exceeded. All street capacity and encroachment calculations shall conform to DCM Volume 1, figures 7-1 through 7-9.

1.6.5.2 Inlets

Criteria and methodology for design and evaluation of storm sewer inlets are outlined in DCM Volume 1, Chapter 8. Application for inlet types and the acceptable standard inlets are detailed out in Chapter 8, section 2. Hydraulic capacity charts for the inlets on continuous grades and in a sump conditions are provided in Figures 8-1 through 8-9 and Figures 8-10 through 8-12. The maximum length of an inlet in a specific location should not exceed 9 feet for Type 16 inlets, 15 feet for Type R and 16 feet for Type D-10-R inlets.

1.6.5.3 Storm Sewers

Criteria and methodology for design and evaluation of storm sewers are outlined in DCM Volume 1, Chapter 9. Designing storm sewers should be considered for both the "minor" and "major" storm events.

Currently, City allow for use of reinforced concrete pipe (RCP) for all pipe sizes, HDPE pipe for pipe diameters of 36 inches or less and Polypro pipe diameters up to 60 inches. The minimum allowable pipe size for storm sewers located within rights-of-way, public easements or tracts shall be 15-inch for laterals and 18-inch for trunk lines.

Buried depth for the storm sewers shall be not be less than 1 foot to the exterior pipe wall and no deeper than 15 feet unless an extended service life installation is provided. Generally, a minimum vertical clearance of 18 inches is required between a storm sewer and a water main or a sanitary sewer, above or below.

Manholes are required whenever there is a change in size, direction, material type, or grade of storm sewer pipe to provide a hydraulic transition and maintenance and inspection access, except for the special conditions allow for use of prefabricated fittings or bends.

Hydraulic Grade Line calculation is required in the Final Drainage Report for the individual development with the final plat.

1.6.5.4 Hydraulic Design

1.6.5.4.1 Allowable Velocity and Slope

- Maximum Velocity: 18 feet per second for all design flows
- Minimum Velocity: 3 feet per second for the minor design storm flow rate
- Minimum Slope: 0.003 ft/ft (0.30 percent) for pipes 36 inches in diameter and greater
  0.005 ft/ft (0.50 percent) for pipes 30 inches in diameter and smaller

1.6.5.4.2 Minor Storm Event Hydraulic Evaluation

- The Rational Method is common method used to determine the peak flow for storm sewers.

- The pipe capacity shall convey minor storm flows without surcharging at no greater than to 80 percent of the pipe height.
- Hydraulic grade line for the minor storm calculation must be performed to account for energy losses and to ensure that the system is not surcharged.

1.6.5.4.3 Major Storm Event Hydraulic Evaluation

- As for the minor storm event, the Rational Method is used to determine the peak flow for storm sewers.
- Surcharge in the system is allowed for the major storm event. The Hazen-Williams equation for pressurized flow conditions and the Manning's equation for the non-surcharged system are used for the pipe capacity.
- Hydraulic grade line elevation shall be at least 1 foot below the final grade. HGL shall be plotted on the construction drawings for each design flow, and the design flow and design frequency shall be noted on the drawing.

1.6.5.4.4. Hydraulic Calculations

Computer programs such as UD-sewer published by UDFCD is an approved computer program for storm sewer analysis. Other computer programs such as StormCAD, EPA SWMM, HydroCAD and others may be used, if program documentation can be provided to show that the methodology and parameters applied in the program are similar to those recommended in the UDFCD Manual.
UDFCD UD-sewer will be used for the hydraulic calculations within the M.D.D.P. area.
UD-sewer report will be submitted to City with the construction plans.

2 Project Characteristics

2.1 Basin Location and Size

The proposed development area is the second large undeveloped parcel developed within the Polaris Pointe Master Plan area located in the north end of City of Colorado Spring. Contributing area is approximately 31 acres on-site and 26 acres off-site in resulting of total 57 acres in its size. As shown on the vicinity map, the site is bordered by Spectrum Loop to the north and west, Voyager Parkway to the east and Powers Boulevard Right-of-Way to the south.
Polaris Pointe Shops Filing no. 3 project area is 9.09 acres, located on the west corner of the Copper Ridge Crossing at Northgate parcel, adjacent to Spectrum Loop and north to Powers Boulevard corridor.

2.2 Compliance with Monument Branch Drainage Basin Planning Study

As mentioned in the earlier part of this report, this site was originally studied within the "Monument Branch Drainage Basin Planning Study" by URS Corporation, last revised date August 6, 1987. The proposed development area is entirely within Basin Q2 of the D.B.P.S. Basin Q2 in D.B.P.S. historically drain to the existing concrete box (6'x7') culvert crossing beneath Interstate 25 northbound at D.B.P.S.

Design Point 11 (M.D.D.P. Design Point EX8). Flows then channelized to the existing double box (12'x10') concrete culvert under southbound I-25 at D.B.P.S. Design Point 13.
The results of this Drainage Study show that the proposed development complies with City criteria and the expected developed drainage patterns as discussed in the Monument Branch Drainage Basin Planning Study and Northgate Master Development Drainage Plan.

2.3 Geology, Vegetation, Soils, Environmental Features

2.3.1 Soil borings/Tests and groundwater

Per Geologic Hazard Study Exemption Request study, dated December 15, 2008, prepared by Entech Engineering Inc., the soils encountered on the site consisted of silty, fine to coarse grained sands. The upper materials were encountered at loose to medium dense states, very stiff consistencies and at moist conditions. The soils are associated with the Slocum Alluvium of Pleistocene Age and residual soils derived from the Sandy stream terrace deposits. The bedrock was not encountered at the depth of 20 feet. The claystone bedrock on-site is also expansive. A swell of 2.6% was measured on the claystone in the Swell/Consolidation Test. This swell is in the moderate to high expansion range. A copy of test boring logs is included in the Appendix.

2.3.2 Vegetation

Most of M.D.D.P. site remained undeveloped and covered with natural vegetation, trees and shrubs. It is our understanding that during the earthwork operation in Powers Boulevard Right-Of-Way, excess fill material was transported to the site as a fill area couple of years ago. The disturbed areas are now covered with natural grasses.

2.3.3 Environmental Features and Evaluation

With proposed and future planned construction of stormwater management facilities, Stormwater Discharge and/or construction dewatering permit is required from the Colorado Department of Public Health and Environment Water Quality Control Division during the construction. Individual development shall require such permit prior to the construction.
No wetland exists on-site and no further evaluation is needed.
Stormwater quality considerations for the project area are described under section 1.6.4 Runoff Reduction Methods through 4-step process.

2.4 Existing Major Drainageways and Facilities

An existing drainage facility map was also prepared for the study. Please refer to the map included in the appendix.
No major drainageways exist for the site. A conceptual storm sewer collection system has been developed for the site and will be submitted to City for the review and approval with the construction plans.

An existing Water Quality/Extended Detention Pond facility exists on-site, located approximately 400 feet easterly direction from the Spectrum Loop and Kaycee Case Place intersection. Flows from existing carwash facility and two restaurant pad sites are then detained and released through this existing pond and flows into future Powers Boulevard corridor via existing storm sewer system at Design Point 20.
Approximately 26 acres of off-site flows are contributing to the discussion of this Drainage Study based off drainage studies from upstream area, Northgate Campus Filing no. 1.
Individual onsite and offsite drainage characteristics are described in details in the later section of the report.

2.5 Irrigation Facilities

It is our understanding that no known irrigation facilities exist onsite and immediate vicinity of the site that could interfere with local drainage facilities.

2.6 Utilities

Existing dry utilities such as gas, electric, fiber optic and cables exist along Spectrum Loop Street. With Powers Boulevard grading by Colorado Department of Transportation couple of years ago, sanitary sewer line was relocated and buried per Powers Boulevard grading for the portion in the Powers Boulevard corridor and rest of sanitary sewer line remain in place. None of these existing utilities impact drainage patterns.

2.7 Existing and Proposed Land Use

Proposed land is currently undeveloped and has been Planned Use Development Commercial land use. Current land uses for the area is for a mixed uses including a major mall, entertainment Center, offices, Restaurants and multi-family residential.

3 Hydrologic and Hydraulic Analysis

3.1 Major Basins and Sub-Basins

Copper Ridge Crossing at Northgate is located within Monument Branch Drainage Basin. 2,379 acres of D.B.P.S. land in unincorporated El Paso County encompasses the entire Monument Branch Drainage Basin upstream of the outfall into Monument Creek. The basin generally slopes from east to west and outfalls into Monument Creek on the Air Force Academy property west of Interstate 25. The Monument Branch Drainage Basin Study was completed to provide basin's hydrology, to evaluate the conditions of the major channels along with providing recommendations for future fully developed conditions with sub-regional and onsite detention facilities. Monument Branch D.B.P.S. study calls out for the eight (8) partially lined channel drop structures for Monument Branch from Voyager Parkway to the United States Air Force Academy boundary line at Monument Branch D.B.P.S. Design Point 8

(Monument D.B.P.S. referred "Reach 5"). It is our understanding that City has been constructing drainage improvements for this section of Monument Branch.
A regional Water Quality/ Extended Detention Pond was constructed in 2016 and is providing the adequate Water Quality and detention volume for the existing carwash facility (Copper Ridge Crossing at Northgate Filing no. 1) and two fast food restaurant developments (Copper Ridge Crossing at Northgate Filing no. 2) adjacent to Voyager Parkway. Proposed Water Quality/Underground Detention facility will replace the existing Water Quality/Extended Detention Pond with construction of Polaris Pointe Shops Filing no. 3 developments.
This M.D.D.P. study will re-evaluate all drainage characteristics of the development site and any other off-sites impacted by this site.

3.1.1 Existing Drainage Condition

Majority Copper Ridge Crossing at Northgate site is currently vacant, and the area has been graded. It is our understanding that during the earthwork operation in Powers Boulevard Right-Of-Way, excess fill material was transported to the site as a fill area. It is also our understanding that cut/fill operation was monitored by Entech Engineering, Inc., a geotechnical firm. The topography of the site shows that general drainage is to the southwesterly direction and onto the Powers Boulevard corridor to the existing ditch line at Design Point EX4, then flows will travel in Powers Boulevard Right-of-Way to the westerly direction toward Interstate-25.

The following is a detailed description of the existing drainage characteristics of the proposed sub-basins for the project area.

Basin EX-A (Design Point E1)
Basin EX-A is 3.36 acres of undeveloped land located in the eastern portion of the project area adjacent to Voyager Parkway. Historic flows of Q_5=3.49 cfs and Q_{100}=9.86 cfs are traveling overland to the design point E1. Then these flows travels in Powers Boulevard Right-of-Way to the westerly direction to the design point E4.

Basin EX-B (Design Point E2)
Basin EX-B is 7.16 acres of undeveloped land located west to the basin EX-A and in the central portion of the project area. Historic flows of Q_5=1.77 cfs and Q_{100}=12.81 cfs are traveling overland to the design point E2. Then, as did for flows from the Basin EX-A, these flows travels in Powers Boulevard Right-of-Way to the westerly direction to the design point E4.

Basin EX-C (Design Point E4)
Basin EX-C is 17.77 acres of undeveloped land and is the largest tract of land in the project area. Historic flows of Q_5=4.06 cfs and Q_{100}=29.82 cfs are traveling overland in the southwesterly direction to a low point in the basin EX-C, then flows drain into an existing 18" HDPE pipe (constructed by Colorado Department of Transportation as a temporary measure) and released westerly direction overland. The design point E4 will serve as a check point to determine the on-site drainage flows are released at or below historical flows.

Basin EX-D (Design Point E3)

Basin EX-D is 1.80 acres of undeveloped land located in the western portion of the project area adjacent to Spectrum Loop. Design point E3 (Q_5=21.00 cfs and Q_{100}=48.00 cfs) is the existing temporary sediment basin where routed flows from the existing Federal Express Development's (OS-B) detention pond are released via an existing 36" RCP pipe. Flows from this basin and with flows from the existing sediment pond area are then travel in the natural drainage ditch and onto the Powers Boulevard corridor. The existing 36" RCP serving the Federal Express Development will be re-routed and into the proposed Water Quality/Underground Detention Pond.

Basin OS-A

Basin OS-A is 0.34 acre of undeveloped land adjacent to Voyager Parkway next to the Basin EX-A. This area is owned by Colorado Department of Transportation as an on-ramp easement and will not be developed and will remain as a landscape area. Flows (Q_5=0.28 cfs and Q_{100}=0.90 cfs) are travelling overland in an existing ditch running along with Voyager Parkway and into Powers Boulevard Right-of-Way. Flows are then carried in the existing ditch to the westerly direction to the design point E4.

3.1.2 Developed Drainage Condition

The project area is proposed to be entirely of commercial level of developments.
The general developed drainage patterns are similar to the existing drainage patterns and according to the Monument Branch D.B.P.S. and Northgate M.D.D.P. Developed runoff is to be collected in the proposed and future storm sewer systems and routed into the proposed Storm Water Quality/Underground Detention Basin in Basin N.
Per approved Colorado Department of Transportation's plan, Construction Project Code no. 18221, Powers Boulevard grading was over lot graded approximately 24 feet to 30 feet below the existing grade during the year of 2014. Because of future planned for the construction for Powers Boulevard, Copper Ridge at Northgate Storm Water Quality/Extended Detention Basin was designed and constructed in year 2016.
As required by City of Colorado Springs Drainage Manual and per El Paso County and City's policy for flows upstream of the Air Force Academy, outfall from the Storm Water Quality/Extended Detention Basin is released at below historic.

A detailed description of the developed flows for all sub-basins is as follows:

Design Point 1 (Q_5=1.79 cfs, Q_{100}=3.30 cfs) is a private 18" storm sewer pipe stub (pipe run 1) for the connection for deloped flows from Basin B. Basin B (Q_5=1.79 cfs, Q_{100}=3.30 cfs) is a 0.43 acre tract consisting of the existing restaurant with a drive-thru development to include buildings, parking lots and drives. Developed flows then carried to a storm sewer manhole (Design Point 4), where flows from Design Points 2 and 3 are merged, then flows are conveyed via existing priate 18" storm sewer pipe (pipe run 4) to Design Point 5A.

Design Point 2 (Q_5=3.72 cfs, Q_{100}=7.20 cfs) is a future private 6' D10-R sump inlet that will intercept developed flows from Basin E. Basin E (Q_5=3.72 cfs, Q_{100}=7.20 cfs) is a 1.01 acre tract consisting of the future commercial use development to include portion of the building, parking lots and drives. Developed flows from Basin E then carried in the gutter line and capture by the inlet at Design Point 2, then carried via existing private 15" storm sewer pipe (pipe run 2) to a private storm sewer manhole (Design Point 4). The emergency overflow route for this design point will be to overtop the high point in the drive and flow to Design Point 5.

Design Point 3 (Q_5=5.97 cfs, Q_{100}=11.80 cfs) is a future private 8' D10-R sump inlet that will intercept developed flows from Basin A. Basin A (Q_5=5.97 cfs, Q_{100}=11.80 cfs) is a 1.72 acre tract consisting of the existing commercial use developments including building, parking lots and drives. Developed flows then carried in the gutter line and capture by the inlet at Design Point 3, then carried via existing private 15" storm sewer pipe (pipe run 3) to Design Point 4. The emergency overflow route for this design point will be to overtop the curb and sheet flow into Basin D and flow to Design Point 5.

Design Point 4 (Q_5=11.48 cfs, Q_{100}=22.31 cfs) represents a future private storm sewer manhole where flows from pipe run 1, 2 and 3 are merged. Flows (Q_5=11.48 cfs, Q_{100}=22.31 cfs) then carried via existing private 18" storm sewer pipe (Pipe Run 4) and the existing private 24" storm sewer pipe (Pipe Run 4A) to Design Point 5A.

Design Point 5 (Q_5=13.71 cfs, Q_{100}=24.98 cfs) is a future private sump inlet and/or connection point where developed flows from Basin D will enter the storm sewer system. Size of the inlet(s) shall be determined with the Basin D's construction plan. Basin D (Q_5=13.71 cfs, Q_{100}=24.98 cfs) is a 3.12 acre tract consisting of future commercial use developments to include buildings, parking lots and drives. Developed flows then carried via future private 24" storm sewer pipe (pipe run 4B) to Design Point 5A. The emergency overflow route for this design point will be to overtop the curb and sheet flow into the Powers Boulevard corridor and sheet flow to Design Point 21.

Design 5A is a future storm sewer manhole, where flows from Pipe Run 4A and Pipe Run 4B merge. Combined flows (Q_5=25.19 cfs, Q_{100}=47.29 cfs) then carried via existing private 24" storm sewer pipe to Design Point 6A.

Design Point 6 (Q_5=9.66 cfs, Q_{100}=17.49 cfs) is a future private sump inlet and/or connection point where developed flows from Basin F will enter the storm sewer system. Size of the inlet(s) shall be determined with the Basin F's construction plan. Basin F (Q_5=9.66 cfs, Q_{100}=17.49 cfs) is a 2.15 acre tract consisting of future commercial use developments to include buildings, parking lots and drives. Developed flows then carried via future private 18" storm sewer pipe (pipe run 4C) to Design Point 6A. The emergency overflow route for this design point will be to overtop the curb and sheet flow into the Powers Boulevard corridor and sheet flow to Design Point 21.

Design 6A is a future storm sewer manhole, where flows from Design Points 5, 5A and 6 merge. Combined flows (Q_5=34.85 cfs, Q_{100}=64.78 cfs) then carried via existing private 24" and then via 30"storm sewer pipe to Design Point 8.

Design Point 7 (Q_5=9.58 cfs, Q_{100}=17.40 cfs) is a future private sump inlet and/or connection point where developed flows from Basin G will enter the storm sewer system. Size of the inlet(s) shall be determined with the Basin G's construction plan. Basin G (Q_5=9.58 cfs, Q_{100}=17.40 cfs) is a 2.16 acre tract consisting of future commercial use developments to include buildings, parking lots and drives. Developed flows then carried via future private 18" storm sewer pipe (pipe run 5A) to Design Point 8. The emergency overflow route for this design point will be to overtop the curb and sheet flow into Basin L and flow to Design Point 15.

Design 8 is a future storm sewer manhole, where flows from Design Point 5 and Pipe Run 5 merge. Combined flows (Q_5=42.21 cfs, Q_{100}=78.08 cfs) then carried via existing private 36" storm sewer pipe (Pipe Run 6) to Design Point 8A. **Design Point 8A** is a connection point to the underground Water Quality Chamber/Detention Chamber where developed flows from Design Point 8 (Q_5=40.72 cfs, Q_{100}=75.31 cfs) enter the ADS Water Quality Chambers and will be detained in the ADS underground detention system (See plans and calculations in the Appendix section of the report).

Design Point 9 (Q_5=22.70 cfs, Q_{100}=41.63 cfs) is a future private 36" HDPE storm pipe stub for future connection for developed flows from Basin H. Basin H (Q_5=22.70 cfs, Q_{100}=41.63 cfs) is a 6.10 acre tract consisting of future commercial use developments to include buildings, parking lots, drives including future delivery docks. Future internal private storm sewer system will be designed to collect developed flows from Basin H area and will make a connection at Design Point 9. Developed flows then carried via proposed private 36" storm sewer pipe (Pipe Run 7) to Design Point 10, where a future private 6' D10-R sump inlet is planned.

Design Point 10 (Q_5=3.93 cfs, Q_{100}=7.17 cfs) is a proposed private 6' D10-R at-grade inlet that will intercept developed flows from Basin I. Basin I (Q_5=3.93 cfs, Q_{100}=7.17 cfs) is a 0.90 acre tract consisting of future commercial use developments to include building, parking lots and drives. Developed flows then carried via future private 36" storm sewer pipe (Pipe Run 8) to Design Point 11. Proposed private 6' D10-R at-grade inlet at Design Point 10 will be constructed with the Polaris Pointe Shops Filing no. 3 development. A portion of flows (Q_5=0.4 cfs, Q_{100}=2.2 cfs) will bypass this inlet and will continue flow to Design Point 15, where proposed 12' D10-R at-grade inlet will capture these flows.

Design Point 11 is a connection point to the underground Water Quality Chamber/Detention Chamber where developed flows from Design Points 9 and 10 (Q_5=26.0 cfs, Q_{100}=50.5 cfs) enter the ADS Water Quality Chambers and will be detained in the ADS underground detention system.

Design Point 12 (Q_5=21.00 cfs, Q_{100}=48.00 cfs) represents a proposed storm sewer manhole, where an existing 36"storm sewer flared end section releases routed flows from the existing Federal Express Development into an temporary sediment basin. Flows (Q_5=21.00 cfs, Q_{100}=48.00 cfs) then carried via proposed private 36" storm sewer pipe (Pipe Run 9) to a proposed private 4' D10-R sump inlet at Design Point 13.

Design Point 13 (Q_5=5.04 cfs, Q_{100}=9.37 cfs) is a proposed private 8' D10-R at-grade inlet that will intercept developed flows from Basin K. Basin K (Q_5=5.04 cfs, Q_{100}=9.37 cfs) is a 1.22 acre tract consisting of future commercial use building, parking lot and proposed parking lot for the Lot 1 Polaris Pointe Shops Filing no. 3 development. Developed flows (Q_5=5.04 cfs, Q_{100}=9.37 cfs) then carried via proposed private 36" storm sewer pipe (Pipe Run 10) to Design Point 16. A portion of flows (Q_5=0.9 cfs, Q_{100}=3.7 cfs) will bypass this inlet and will continue flow to Design Point 18, where proposed 10' D10-R sump inlet will capture these flows.

Design Point 14 (Q_5=2.11 cfs, Q_{100}=3.88 cfs) is a proposed private 8' D10-R at-grade inlet that will intercept developed flows from Basin J. Basin J (Q_5=2.11 cfs, Q_{100}=3.88 cfs) is a 0.49 acre tract consisting the parking lot for the Lot 1 Polaris Pointe Shops Filing no. 3. Developed flows (Q_5=2.11 cfs, Q_{100}=3.88 cfs) then carried via proposed private 15" storm sewer pipe (Pipe Run 11) to Design Point 15. A portion of flows (Q_5=0.0 cfs, Q_{100}=0.4 cfs) will bypass this inlet and will continue flow to Design Point 18, where proposed 10' D10-R sump inlet will capture these flows.

Design Point 15 (Q_5=9.89 cfs, Q_{100}=18.41 cfs) is a private 12' D10-R sump inlet that intercepts developed flows from Basin L. Basin L (Q_5=9.89 cfs, Q_{100}=18.41 cfs) is a 2.40 acre tract consisting of portion of future Lot 2 Polaris Pointe Shops Filing no. 3's building, parking lots and proposed parking lots from Lot 1 Polaris Pointe Shops Filing no. 3. Developed flows from Basin L are carried in the gutter line and capture by the inlet at Design Point 15, then carried via proposed private 18" storm sewer pipe (pipe run 12) to Design Point 16. A portion of flows (Q_5=1.7 cfs, Q_{100}=8.2 cfs) will bypass this inlet and will continue flow to Design Point 18, where proposed 10' D10-R sump inlet will capture these flows.

Design Point 16 represents a proposed private storm sewer manhole where flows from pipe run 10 and 12 are merged. Combined flows (Q_5=17.04 cfs, Q_{100}=31.66 cfs) then carried via proposed private 30" storm sewer pipe (pipe run 13) to **Design Point 17**, where developed flows (Q_5=16.91 cfs, Q_{100}=31.40 cfs) enter the ADS Water Quality Chambers and will be detained in the ADS underground detention system.

Design Point 18 (Q_5=6.56 cfs, Q_{100}=12.81 cfs) is a proposed private 6' D10-R sump inlet and consists of developed flows from Basin M. Basin M (Q_5=6.56 cfs, Q_{100}=12.81 cfs) is a 1.83 acre tract consisting of portion of proposed building and parking lots for Lot 1 Polaris Pointe Shops Filing no. 3. Combined bypass flows from Design Points 13, 14 and 15 (Q_5=2.3 cfs, Q_{100}=11.2 cfs) also contribute surface flows at this Design Point 18. Combined flows of Q_5=8.9 cfs, Q_{100}=24.0 cfs are carried in the gutter line and capture by the inlet at Design Point 18, then carried via proposed private 24" storm sewer pipe (Pipe Run 14) to **Design Point 19**, where developed flows enter the ADS Water Quality Chambers and will be detained in the ADS underground detention system. The emergency overflow route for this design point will be to overtop the curb and sheet flow into the Powers Boulevard corridor and sheet flow to the westerly direction.

Design Point 20 (Q_2=31.1 cfs, Q_5=41.0 cfs Q_{10}=51.5 cfs, Q_{25}=64.1 cfs Q_{50}=73.5 cfs, Q_{100}=85.6 cfs) is the point where total inflows from the Copper Ridge Crossing at Northgate area to the private Water Quality/ ADS Underground Detention facility (See UD-Detention spreadsheet for calculated Peak

Inflows in the Appendix). Flows then routed through an outlet structure, where flows are restricted and released and carried to Design Point 21 via a public 30" storm sewer system.

Design Point 21 (Q_2=10.95 cfs, Q_5=14.59 cfs Q_{10}=19.89 cfs, Q_{25}=37.06 cfs Q_{50}=51.27 cfs, Q_{100}=62.26 cfs) represents proposed 30" storm sewer pipe outfall location, where inflows are controlled and released through proposed outlet structure.
Public Water Quality and Extended Detention Basin facility proposed with the approved M.D.D.P. for Copper Ridge Crossing at Northgate was constructed in the year of 2016 and is currently providing the required Water Quality and detention volume for the developed carwash facility in Basin A, two separate restaurant sites in Basin B and D. The existing Public Water Quality/Extended Detention Basin facility and its appurtenances will be removed and will be replaced with the Private Water Quality/ADS Underground system. This underground system is designed with ADS Stormtech MC-3500 system and provides adequate Water Quality Captured Volume and required Detention Volume for the entire Copper Ridge Crossing at Northgate drainage areas (See ADS Plans and Specifications in the Appendix).

3.1.3 Private Advanced Drainage System Storm Water Quality and Detention Basin Facility

Per Urban Drainage and Flood Control District's UD-Detention, Version 3.07, Detention Basin Design Worksheet, released February 2017, 2.152 acre-feet is required for the Excess Urban Runoff Volume (EURV) per City's requirements of Full Spectrum Detention methodology. Also meeting the outfalls from the proposed Private ADS Storm Water Quality/ Detention Basin Facility are released at or below historical "undeveloped" flows for 2-, 5-, 10-, 25-, 50- and 100-year storm frequencies City's policy for flows upstream of the Air Force Academy.
According to the Storm Water Quality/Extended Detention Basin Facility calculations using the UD-Detention spreadsheet (included in the Appendix), detention pond and its appurtenances are required as follows:

- Total Acreage contributing to facility — 30.43 acres
- Site Imperviousness: — 72.39%
- EURV Required: — 1.700 acre-feet
- Outlet Structure Information:
  - Outlet Type: — Orifice Plate
  - Depth of Design Volume: — H = 3.20 feet
  - Orifice area: — (1) 8.50 sq. inches, (1) 8.50 sq. inches & (1) 10 sq. inches
  - Number of Columns: — 1
  - Number of Rows: — 3

The outlet box for the facility is a 5' x 5' inside dimensioned riser box with a top of box elevation at 6710.25 with grated top. The inside face of the box contains a minimum dimensioned 2'-0" wide x 3.6' high orifice plate with (1) column with 8.50, 8.50 and 10.00 square inches orifices at the stage height of 0.00', 0.99' and 1.99' on center to center vertical spacing with lowest square orifice elevation on center at 6704.83. A 30" diameter storm sewer pipe is required as an outlet pipe with minimum 1.0% slope. With proposed outlet structure with a Flow Restriction Plate (54" wide x 24" high) at 15.00 inches

above invert elevation of 6703.50 in front of 30" diameter storm sewer pipe, this Flow Restriction Plate with the vertical orifice plate restrict the release rates to Q_2=1.0 cfs, Q_5=1.3 cfs Q_{10}=4.3 cfs, Q_{25}=19.0 cfs Q_{50}=28.2 cfs, Q_{100}=29.9 cfs. See Urban Drainage and Flood Control District's UD-Detention basin design workbook, released date of February 2017 included in the Appendix.
Per UD-Detention basin design workbook, 100-year storage volume of 3.785 acre-feet is required for the 100-year storm. The 100-year water surface elevation is at 6709.95. The emergency spillway is a 29 feet wide by 12" high broad crested weir set at 6710.33 with minimum size of Type M rip-rap buried with 6" thickness of top soil for vegetation planting.

3.1.4 Major Drainageways Hydraulics

3.1.4.1 Floodplains

No portion of the site is located within a FEMA delineated floodplain as determined by Flood Insurance Rate Map Number 08041C 0290F, effective date, March 17, 1997.

4. Maintenance Requirements

All roadways and major drainage facilities proposed and constructed within the public right-of-way will be maintained by the City of Colorado Springs upon final acceptance after the warranty period.

Ultimately, final built-out of the Private ADS Underground Storm Water Quality/ Detention Chambers will be owned and will be maintained by Polaris Pointe District's Business Owners Association. This includes all storm appurtenances in the ADS Underground Storm Water Quality/ Detention Chambers, outlet structure and outlet pipe.

5. Fee Development

5.1 Drainage and Bridge Fees

The proposed platted area is entirely within the Monument Branch Drainage Basin. This drainage basin was closed as approved by the Drainage Board and City Council at the October 12, 2010 Council meeting (reference Resolution #177-10). Therefore, there is no Drainage or Bridge fee due with the proposed development.

5.2 Construction Cost Opinion

Below is the cost opinion of the proposed public and private storm sewer systems. Because, the project area is at the early stage of planning/development, we cannot determine the accurate storm sewer facilities and its costs. As this project progresses in the future and more accurate plan(s) can be generated, the cost of opinion of the public and private drainage facilities is our best educated opinion of costs. More definite construction cost of opinion will be submitted to City with individual Final Drainage Report or an addendum to this drainage study at later time.

5.2.1 Private Drainage Facilities for Copper Ridge Crossing at Northgate (Non-reimbursable)

	Description	Quantity	Unit	Unit Cost	Cost
1	4' D-10-R Inlet	1	EA	$2,500	$2,500
2	6' D-10-R Inlet	3	EA	$3,050	$9,150
3	8' D-10-R Inlet	1	EA	$5,000	$5,000
4	10' D-10-R Inlet	1	EA	$6,200	$6,200
5	12' D-10-R Inlet	1	EA	$6,950	$6,950
6	Storm Sewer MH (type 1)	6	EA	$7,950	$47,700
7	15" HDPE pipe	124	LF	$24	$2,957
8	18" HDPE pipe	133	LF	$29	$3,824
9	24" HDPE pipe	126	LF	$47	$5,859
10	36" HDPE pipe	487	LF	$75	$36,403
11	48" HDPE pipe	130	LF	$136	$17,646
12	Outlet Structure	1	EA	$5,000	$5,000
13	ADS Stormtech Package	1	LS	$522,073	$522,073
		Sub-Total			$654,613
	15% Engineering & Contingency				$98,192
		TOTAL			**$752,805**

5.2.2 Private Drainage Facilities for Polaris Pointe Shops Filing no. 3 (Non-reimbursable)

	Description	Quantity	Unit	Unit Cost	Cost
1	4' D-10-R Inlet	1	EA	$2,500	$2,500
2	6' D-10-R Inlet	2	EA	$3,050	$6,100
3	8' D-10-R Inlet	1	EA	$5,000	$5,000
4	10' D-10-R Inlet	1	EA	$6,200	$6,200
5	12' D-10-R Inlet	1	EA	$6,950	$6,950

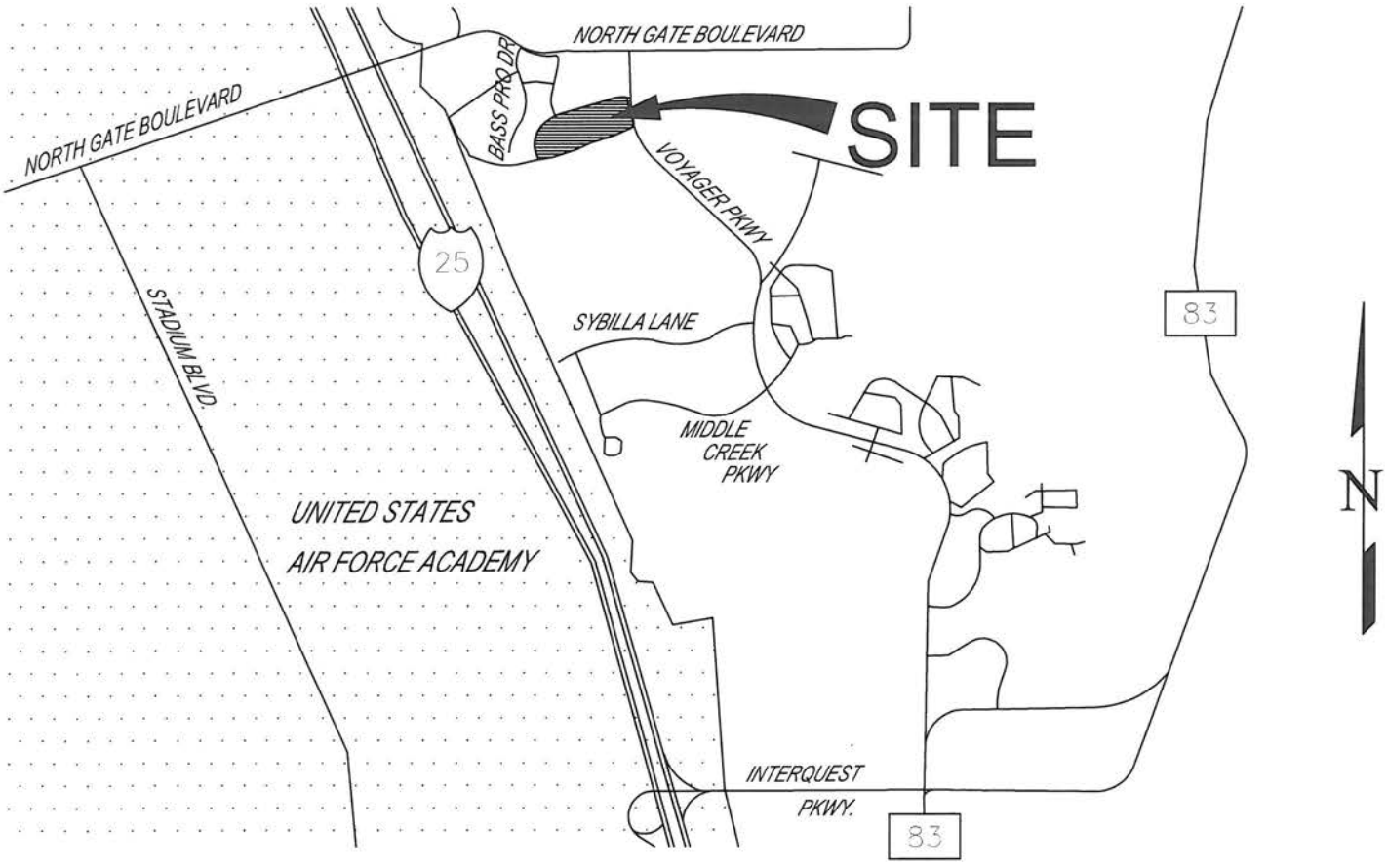
6	Storm Sewer MH (type 1)	2	EA	$7,950	$15,900
7	18" HDPE pipe	103	LF	$29	$2,961
8	24" HDPE pipe	116	LF	$47	$5,394
9	36" HDPE pipe	437	LF	$75	$32,666
10	48" HDPE pipe	130	LF	$136	$17,646
		Sub-Total			$101,317
	15% Engineering & Contingency				$15,198
		TOTAL			**$116,515**

6. Summary

The Copper Ridge Crossing at Northgate is a proposed master plan consisting of commercial uses to include retail, office, restaurants and recreation uses bordered by Spectrum Loop, Voyager Parkway and Powers Boulevard Right-of-Way. The development will include construction of private streets and drainage improvements. Developed flows from the proposed areas will be routed into the new private ADS MC-3500 Underground Storm Water Quality/ Detention Chamber system. This facility will restrict the flows well below historical flows for all six-storms per El Paso County/City's policy for upstream development of the Air Force Academy and will also provide required stormwater quality measures, and the proposed drainage characteristics will remain consistent with historical conditions and with the overall drainage plan for the area. This underground system and drainage facilities are adequately designed per the City of Colorado Springs Drainage Criteria and the Urban Drainage and Flood Control District Criteria, and with construction of the drainage facilities, proposed development will not adversely affect downstream or surrounding developments. General outfall locations are in accordance with the Monument Branch D.B.P.S. and Northgate M.D.D.P.

7. Appendices

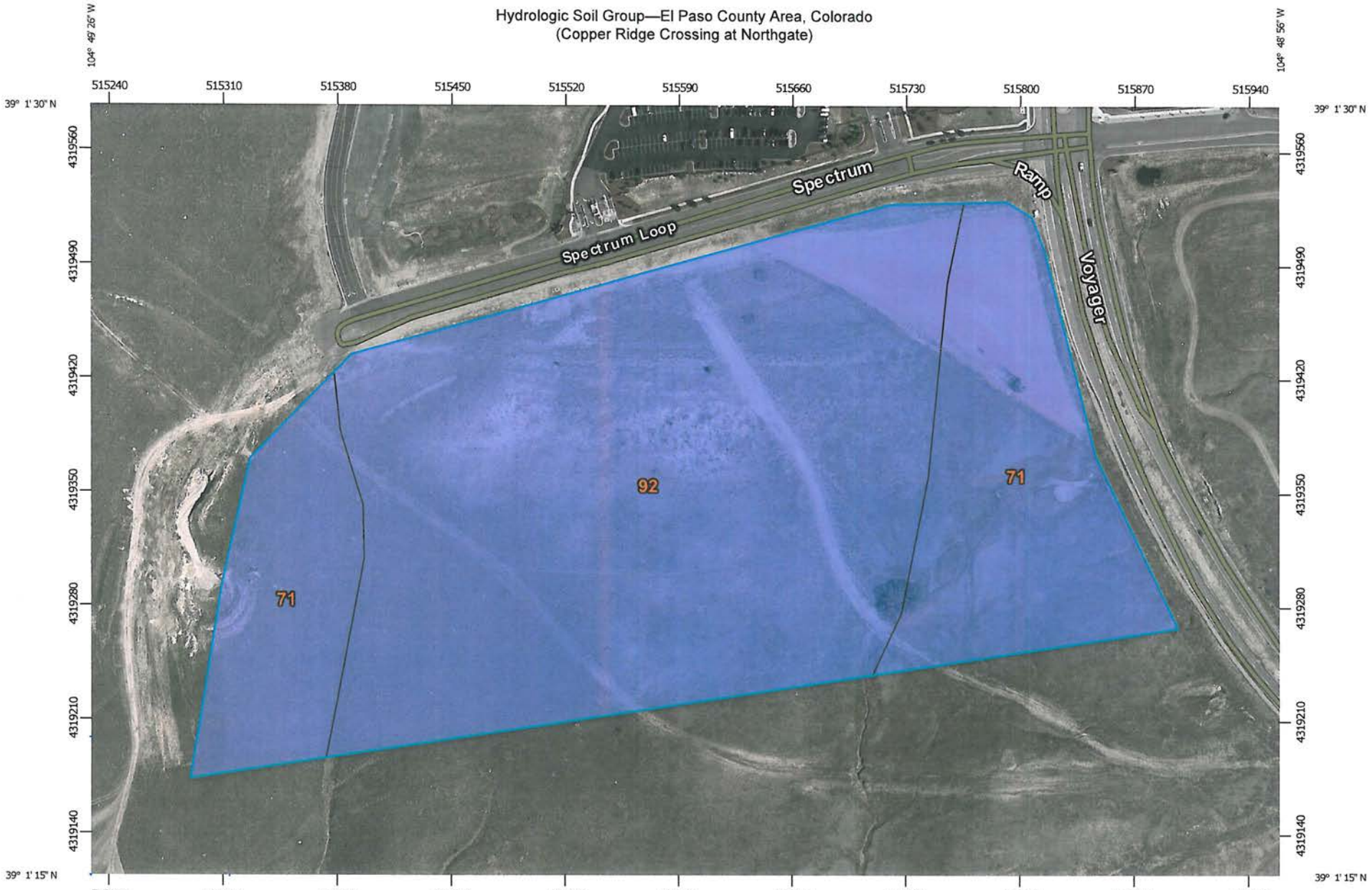
Appendix A
Location Map
SCS Soils Information
FEMA map
Geo-technical engineering boring logs



VICINITY MAP

NOT TO SCALE

Hydrologic Soil Group—El Paso County Area, Colorado
(Copper Ridge Crossing at Northgate)



Map Scale: 1:3,340 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 45 90 180 270

Feet
0 150 300 600 900

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 Rating Polygons
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

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: http://websoilsurvey.nrcs.usda.gov
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 10, Dec 23, 2013

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

Date(s) aerial images were photographed: Apr 15, 2011—Sep 22, 2011

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.

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — El Paso County Area, Colorado (CO625)				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
71	Pring coarse sandy loam, 3 to 8 percent slopes	B	11.2	32.0%
92	Tomah-Crowfoot loamy sands, 3 to 8 percent slopes	B	23.8	68.0%
Totals for Area of Interest			**35.0**	**100.0%**

Description

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.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

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.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

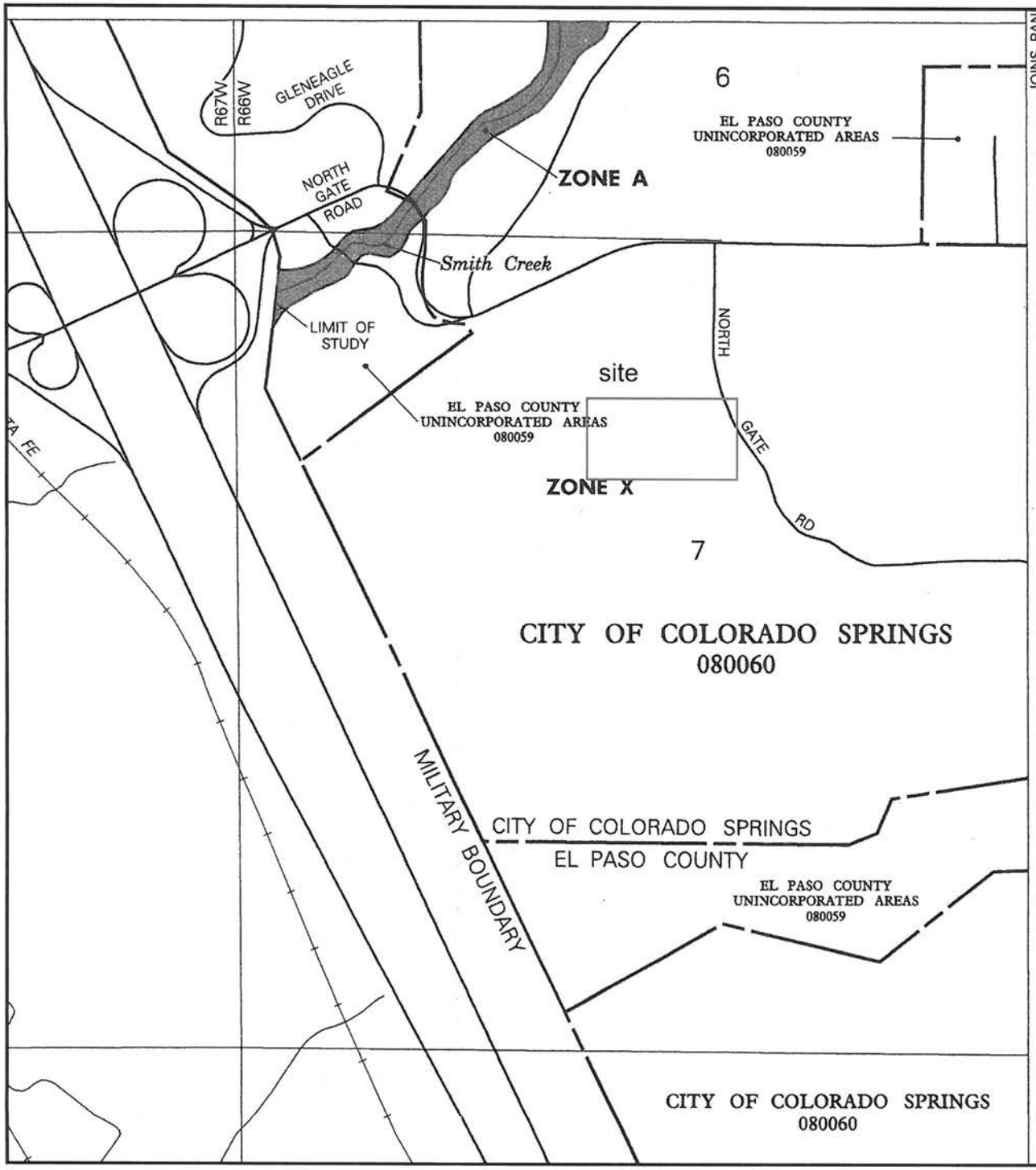
If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: *None Specified*

Tie-break Rule: Higher



APPROXIMATE SCALE IN FEET

1000 0 1000

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

EL PASO COUNTY, COLORADO AND INCORPORATED AREAS

PANEL 290 OF 1300

(SEE MAP INDEX FOR PANELS NOT PRINTED)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
COLORADO SPRINGS, CITY OF	080060	0290	F
EL PASO COUNTY, UNINCORPORATED AREAS	080059	0290	F

MAP NUMBER
08041C0290 F

EFFECTIVE DATE:
MARCH 17, 1997

Federal Emergency Management Agency

ENTECH
ENGINEERING, INC.

505 ELKTON DRIVE
COLORADO SPRINGS, CO 80907
PHONE (719) 531-5599
FAX (719) 531-5238

December 15, 2008

City of Colorado Springs
City Engineering
101 W. Costilla #122
Colorado Springs, Colorado 80901

Re: **Geologic Hazard Study Exemption Request**
Tax Schedule Nos. 62072-00-011 and 62074-00-011
Copper Ridge Center
Voyager Parkway and Spectrum Loop
Colorado Springs, Colorado

Gentlemen:

This letter is to request an exemption from the Geologic Hazard Study for the above-referenced project. The project is to consist of commercial development on a 190-acre site. The site is located in a portion of Section 7, Township 12 South, Range 66 West of the 6th Principal Meridian, in the City of Colorado Springs. The location of the site is shown on the Vicinity Map, Figure 1.

The site does not lie in the Hillside Overlay Zone (Reference 1). No unstable slopes exist on the site, however, unstable slopes associated with the Monument Branch drainage exist immediately south of the site. These slopes have also been identified as susceptible to landslides according to the *Map of Potential Areas of Landslide Susceptibility in Colorado Springs* by White and Wait in 2003 (Reference 2). These slopes are indicated on the Geology/Engineering Geology Map, Figure 2. It is our understanding the proposed development will be a minimum of 200 feet away from these slopes to avoid Preble's Jumping Mouse habitat. It is our opinion the proposed development is at sufficient distance from the unstable slopes that it would not be affected. The site is not located in any area of past underground mining or subsidence activity (References 3 and 4). Site photographs, taken December 11, 2008, are included in Appendix A.

The conditions on the site were investigated during a Preliminary Subsurface Soil Investigation by Entech Engineering, Inc. The investigation by Entech Engineering, Inc. consisted of drilling 6 test borings on the site. The approximate locations of the test borings are shown on the Geology/Engineering Geology Map, Figure 2. Copies of the Test Boring Logs are presented in Appendix B. Laboratory Testing is presented in Appendix C. A Summary of Laboratory Test Results is presented in Table 1.

The soils encountered on the site consisted of silty to clayey sands and sandy clays overlying sandstone and claystone. The upper materials were encountered at loose to dense states, very stiff consistencies and at moist conditions. The soils are associated with the Slocum Alluvium of Quaternary Age and residual soils derived from the in-situ weathering of the bedrock materials. The bedrock underlying the site is the Dawson Formation of Tertiary to Cretaceous Age. (References 5 through 7).

The clayey soils on-site are expansive. A FHA Swell pressure of 1212 psf was measured on the sandy clay. This swell is in the moderate expansion range. A swell of 2.1 % was measured in the Swell/Consolidation Test on the clayey sand. This swell is in the moderate expansion range. Bedrock was encountered at depths ranging from 14 to 19 feet in Test Boring Nos. 4 through 6. Bedrock was not encountered in Test Boring Nos. 1 through 3 which were drilled to 20 feet. The claystone bedrock on-site is also expansive. A swell of 2.6% was measured on the claystone in the Swell/Consolidation Test. This swell is in the moderate to high expansion range.

Up to 14 feet of possible fill was encountered in Test Boring No. 4. The soil in TB 4 was at dense states. Test pits should be excavated to determine the depth of fill. Records should be obtained to verify if the fill is controlled. Additionally, fill piles were observed on-site that would be considered uncontrolled. It is anticipated that these would be removed prior to construction. Any uncontrolled fill encountered beneath foundations must be recompacted at a minimum of 92% of its maximum Modified Proctor Dry Density, ASTM D-1557. An alternative in areas of deeper fill or with heavy foundation loads is the use of drilled pier foundation systems.

Clayey soils and bedrock encountered on-site are moderately to highly expansive. The site is mapped in an area of low to moderate swell potential according to the *Map of Potentially Swelling Soil and Rock in the Front Range Urban Corridor, Colorado* by Hart in 1974 (Reference 8). Should expansive soils be encountered within 3 to 5 feet of the foundation, mitigation will be necessary. Mitigation of expansive soils typically involves overexcavation of 3 to 5 feet of soil beneath the foundation level and replacement with non-expansive structural fill, compacted at a minimum of 92% of its maximum Modified Proctor Dry Density, ASTM D-1557. Other alternatives include drilled piers or post-tensioned slabs.

Groundwater was encountered at 13.5 to 16 feet in Test Boring Nos. 4 through 6. Groundwater was not encountered in Test Boring Nos. 1 through 3 which were drilled to 20 feet. A drainage with ponds bisects the southern portion of the site. It is anticipated this area would either be avoided by development or regraded. If the area is to be filled, all soft or unstable soils should be removed prior to fill placement. Groundwater could also affect the installation of drilled piers, should they be used. Casing of drill holes may be necessary. The site does not lie in any floodplain zones according to the FEMA Map No. 08041CO290F (Reference 9).

Grading and development plans were not available at the time of this investigation. Any unretained slopes created on site should be graded at no steeper than 3:1 unless specific analysis is completed.

In our opinion, the site is suitable for the proposed development. Geologic conditions on-site can be mitigated through proper engineering design and construction practices. Further investigation is recommended when development and grading plans are finalized to provide specific construction and foundation recommendations. A copy of the Geologic Hazard Study Exemption request form is attached with this letter.

We trust that this has provided you with the information required regarding the Geologic Hazard Study Exemption. If you have any questions or need additional information, please do not hesitate to contact us.

Respectfully Submitted,

ENTECH ENGINEERING, INC.

Kristen A. Andrew-Hoeser, P.G.
Engineering Geologist

Reviewed by:

Joseph C. Goode, Jr., P.E.
President

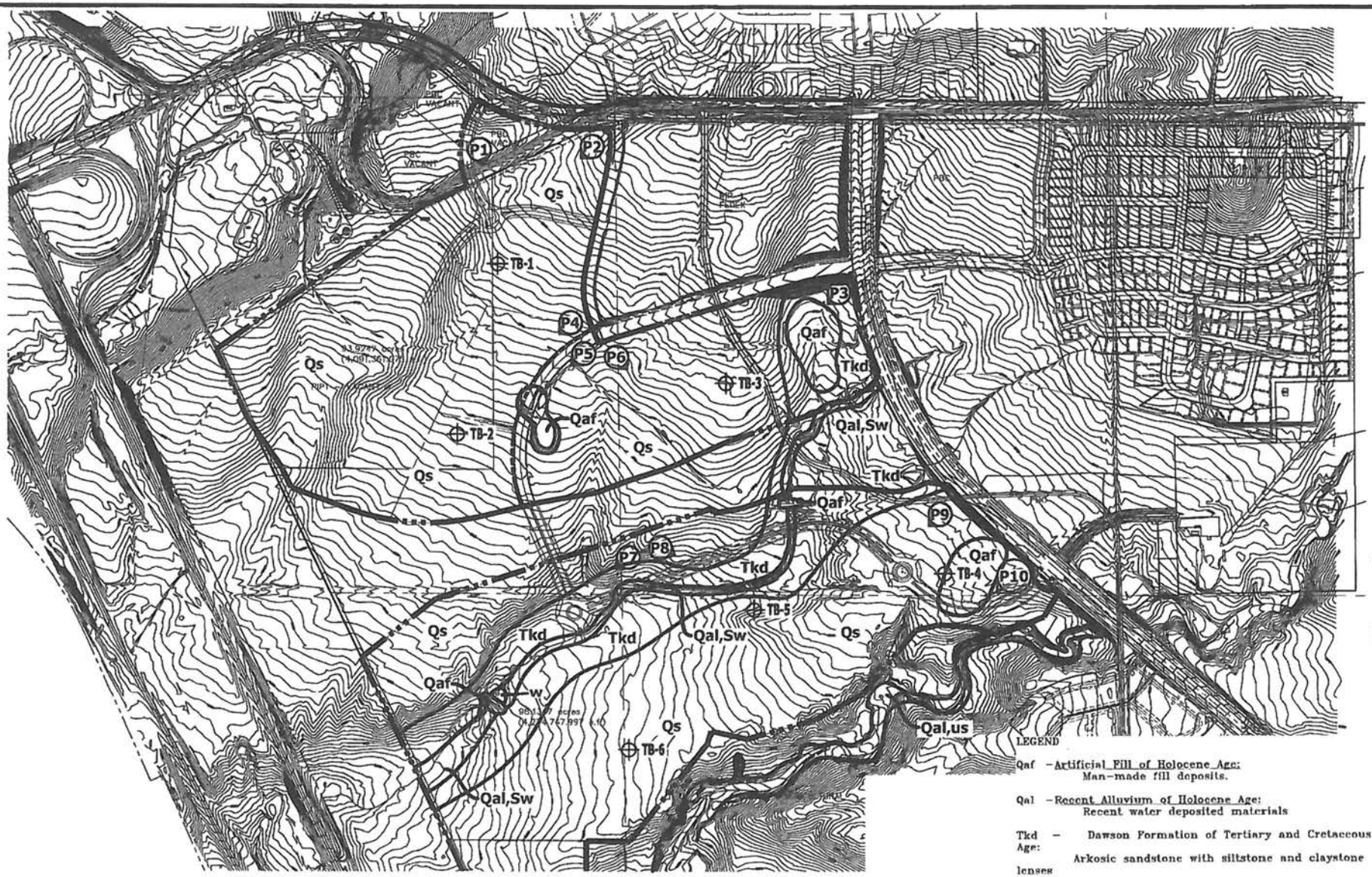
COLORADO REGISTERED
JOSEPH COLLIN GOODE JR.
23725
12-16-21
PROFESSIONAL ENGINEER

KAH/mf

Encl.

Entech Job No. 31428
2MSWltrs/2008/31428/City-Color Springs GHSExR Letter

cc: Executive Custom Construction



LEGEND

Qaf – Artificial Fill of Holocene Age: Man-made fill deposits.

Qal – Recent Alluvium of Holocene Age: Recent water deposited materials

Tkd – Dawson Formation of Tertiary and Cretaceous Age: Arkosic sandstone with siltstone and claystone lenses

Qs – Slocum Alluvium of Pleistocene Age: Sandy stream terrace deposits

us – unstable slope

w – water

sw – seasonal shallow groundwater area

P1 – Approximate location and direction of photos

TB-2 – Approximate location and number of test borings

REVISIONS	BY:

ENTECH ENGINEERING, INC.
395 ELKTON DRIVE
COLORADO SPRINGS, CO 80907 (719) 531-5599

GEOLOGY/ENGINEERING GEOLOGY MAP
COPPER RIDGE CENTER
COLORADO SPRINGS, CO
FOR: EXECUTIVE CUSTOM CONSTRUCTION

DRAWN BY: M. WELLS	
DESIGNED BY: RJB	
CHECKED BY:	
DATE: 12/16/08	
SCALE: 1"=500'	
JOB NO.: 31428	
SHEET NO.: 2	

TEST BORING NO. 3
DATE DRILLED 12/4/2008
Job # 31428

REMARKS	Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
DRY TO 20', 12/5/2008						
SAND, FINE TO COARSE GRAINED, LIGHT BROWN, LOOSE TO MEDIUM DENSE, MOIST				8	18.6	1
	5			9	8.4	1
	10			20	9.2	1
	15			26	6.3	1
SAND, SILTY, FINE TO MEDIUM GRAINED, GRAYISH TAN, MEDIUM DENSE, MOIST	20			25	4.2	1

TEST BORING NO. 4
DATE DRILLED 12/4/2008
CLIENT EXECUTIVE CUSTOM CONST
LOCATION COPPER RIDGE CTR

REMARKS	Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
WATER @ 13.5', 12/5/2008						
POSS. FILL 0-14', CLAY, SANDY, STIFF. MOIST						2A
POSS FILL, SAND, CLAYEY, FINE TO COARSE GRAINED, LIGHT				25	10.9	1A
GRAYISH BROWN, MEDIUM DENSI	5			22	1.9	1A
POSS. FILL, SAND, SILTY, FINE TO COARSE GRAINED, TAN, MEDIUM DENSE, DRY						
CLAY LENSE, DARK BROWN						2A
POSS. FILL, SAND, CLAYEY, FINE TO COARSE GRAINED, BROWN, MEDIUM DENSE, MOIST	10			24	5.2	1A
CLAYSTONE, SANDY, RUSTY BROWN, HARD, MOIST	15			50/10"	18.4	4
SANDSTONE, SILTY, FINE TO COARSE GRAINED, LIGHT GRAY, VERY DENSE, MOIST TO WET						
	20			50/4"	12.1	3

ENTECH
ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

TEST BORING LOG

DRAWN:	DATE:	CHECKED:	DATE:
		DMH	12/12/08

JOB NO.:

FIG NO.

Appendix B
Hydrologic Calculations & Hydraulic Calculations

M.D.D.P. for Copper Ridge Crossing & Final Drainage Plan
For Polaris Pointe Shops Filing no. 3

Land Use or Surface Characteristics	Percent Impervious	Acreage (Ac.)	Impervious area	
Business				
Commercial Areas	95		0.00	
Neighborhood Areas	70		0.00	
Residential				
1/8 Acre or less	65		0.00	
1/4 Acre	40		0.00	
1/3 Acre	30		0.00	
1/2 Acre	25		0.00	
1 Acre	20		0.00	
Industrial				
Light Areas	80		0.00	
Heavy Areas	90		0.00	
Parks and Cemeteries	7		0.00	
Playgrounds	13		0.00	
Railroad Yard Areas	40		0.00	
Undeveloped Areas				
Historical Flow Anaysis--Greenbelts, Agriculture	2		0.00	
Pasture/Meadow	0		0.00	
Forest	0		0.00	
Exposed Rock	100		0.00	
Offsite Flow Analysis (when landuse is undefined)	45		0.00	
Streets				
Paved	100		0.00	
Gravel	80		0.00	
Drive and Walks	100	16.35	16.35	
Roofs	90	4.95	4.46	
Lawns	0	4.24	0.00	
Landscaped	25	4.89	1.22	
Total		30.43	22.03	
Weighted Avergage			72.39%	

M.D.D.P. for Copper Ridge Crossing & Final Drainage Plan
For Polaris Pointe Shops Filing no. 3
(Area Runoff Coefficient Summary for Developed on-site condition with historical Conditions for off-sites)

		STREETS / DEVELOPED							LAWNS							WEIGHTED						WEIGHTED CA					
BASIN	TOTAL AREA (Acres)	AREA (Acres)	C_2	C_5	C_{10}	C_{25}	C_{50}	C_{100}	AREA (Acres)	C_2	C_5	C_{10}	C_{25}	C_{50}	C_{100}	C_2	C_5	C_{10}	C_{25}	C_{50}	C_{100}	CA_2	CA_5	CA_{10}	CA_{25}	CA_{50}	CA_{100}
A	1.72	1.24	0.89	0.90	0.92	0.94	0.95	0.96	0.48	0.02	0.08	0.15	0.25	0.30	0.35	0.65	0.67	0.70	0.75	0.77	0.79	*1.11*	*1.15*	*1.21*	*1.29*	*1.32*	*1.36*
B	0.43	0.38	0.89	0.90	0.92	0.94	0.95	0.96	0.05	0.02	0.08	0.15	0.25	0.30	0.35	0.80	0.81	0.84	0.87	0.88	0.90	*0.34*	*0.35*	*0.36*	*0.37*	*0.37*	*0.38*
C	0.53	0.07	0.89	0.90	0.92	0.94	0.95	0.96	0.46	0.02	0.08	0.15	0.25	0.30	0.35	0.13	0.19	0.25	0.34	0.39	0.43	*0.07*	*0.10*	*0.13*	*0.18*	*0.21*	*0.23*
D	3.12	2.93	0.89	0.90	0.92	0.94	0.95	0.96	0.19	0.02	0.08	0.15	0.25	0.30	0.35	0.84	0.85	0.87	0.90	0.91	0.92	*2.61*	*2.65*	*2.72*	*2.80*	*2.84*	*2.88*
E	1.01	0.78	0.89	0.90	0.92	0.94	0.95	0.96	0.23	0.02	0.08	0.15	0.25	0.30	0.35	0.69	0.71	0.74	0.78	0.80	0.82	*0.70*	*0.72*	*0.75*	*0.79*	*0.81*	*0.83*
F	2.15	2.07	0.89	0.90	0.92	0.94	0.95	0.96	0.08	0.02	0.08	0.15	0.25	0.30	0.35	0.86	0.87	0.89	0.91	0.93	0.94	*1.84*	*1.87*	*1.92*	*1.97*	*1.99*	*2.01*
G	2.16	2.05	0.89	0.90	0.92	0.94	0.95	0.96	0.11	0.02	0.08	0.15	0.25	0.30	0.35	0.85	0.86	0.88	0.91	0.92	0.93	*1.83*	*1.85*	*1.90*	*1.95*	*1.98*	*2.01*
H	6.10	5.60	0.89	0.90	0.92	0.94	0.95	0.96	0.50	0.02	0.08	0.15	0.25	0.30	0.35	0.82	0.83	0.86	0.88	0.90	0.91	*4.99*	*5.08*	*5.23*	*5.39*	*5.47*	*5.55*
I	0.90	0.84	0.89	0.90	0.92	0.94	0.95	0.96	0.06	0.02	0.08	0.15	0.25	0.30	0.35	0.84	0.85	0.87	0.90	0.91	0.92	*0.75*	*0.76*	*0.78*	*0.80*	*0.81*	*0.83*
J	0.49	0.45	0.89	0.90	0.92	0.94	0.95	0.96	0.04	0.02	0.08	0.15	0.25	0.30	0.35	0.82	0.83	0.85	0.88	0.89	0.91	*0.40*	*0.41*	*0.42*	*0.43*	*0.44*	*0.45*
K	1.22	1.07	0.89	0.90	0.92	0.94	0.95	0.96	0.15	0.02	0.08	0.15	0.25	0.30	0.35	0.78	0.80	0.82	0.85	0.87	0.88	*0.96*	*0.98*	*1.01*	*1.04*	*1.06*	*1.08*
L	2.40	2.10	0.89	0.90	0.92	0.94	0.95	0.96	0.30	0.02	0.08	0.15	0.25	0.30	0.35	0.78	0.80	0.82	0.85	0.87	0.88	*1.87*	*1.91*	*1.98*	*2.05*	*2.08*	*2.12*
M	1.83	1.37	0.89	0.90	0.92	0.94	0.95	0.96	0.46	0.02	0.08	0.15	0.25	0.30	0.35	0.67	0.69	0.73	0.77	0.79	0.81	*1.23*	*1.27*	*1.33*	*1.40*	*1.44*	*1.48*
N	4.43	0.19	0.89	0.90	0.92	0.94	0.95	0.96	4.24	0.02	0.08	0.15	0.25	0.30	0.35	0.06	0.12	0.18	0.28	0.33	0.38	*0.25*	*0.51*	*0.81*	*1.24*	*1.45*	*1.67*
O	1.26	0.00	0.89	0.90	0.92	0.94	0.95	0.96	1.26	0.02	0.08	0.15	0.25	0.30	0.35	0.02	0.08	0.15	0.25	0.30	0.35	*0.03*	*0.10*	*0.19*	*0.32*	*0.38*	*0.44*
P	0.35	0.16	0.89	0.90	0.92	0.94	0.95	0.96	0.19	0.02	0.08	0.15	0.25	0.30	0.35	0.42	0.45	0.50	0.56	0.60	0.63	*0.15*	*0.16*	*0.18*	*0.20*	*0.21*	*0.22*
EX-A	3.36	0.94	0.89	0.90	0.92	0.94	0.95	0.96	2.42	0.02	0.08	0.15	0.25	0.30	0.35	0.26	0.31	0.37	0.44	0.48	0.52	*0.89*	*1.04*	*1.23*	*1.49*	*1.62*	*1.75*
EX-B	7.16	0.01	0.89	0.90	0.92	0.94	0.95	0.96	7.15	0.02	0.08	0.15	0.25	0.30	0.35	0.02	0.08	0.15	0.25	0.30	0.35	*0.15*	*0.58*	*1.08*	*1.80*	*2.15*	*2.51*
EX-C	17.77	0.00	0.89	0.90	0.92	0.94	0.95	0.96	17.77	0.02	0.08	0.15	0.25	0.30	0.35	0.02	0.08	0.15	0.25	0.30	0.35	*0.36*	*1.42*	*2.67*	*4.44*	*5.33*	*6.22*
EX-D	1.80	0.09	0.89	0.90	0.92	0.94	0.95	0.96	1.71	0.02	0.08	0.15	0.25	0.30	0.35	0.06	0.12	0.19	0.28	0.33	0.38	*0.11*	*0.22*	*0.34*	*0.51*	*0.60*	*0.68*
OS-A	0.34	0.07	0.89	0.90	0.92	0.94	0.95	0.96	0.27	0.02	0.08	0.15	0.25	0.30	0.35	0.20	0.25	0.31	0.39	0.43	0.48	*0.07*	*0.08*	*0.10*	*0.13*	*0.15*	*0.16*
OS-B	26.56	12.20	0.89	0.90	0.92	0.94	0.95	0.96	14.36	0.02	0.08	0.15	0.25	0.30	0.35	0.42	0.46	0.50	0.57	0.60	0.63	*11.15*	*12.13*	*13.38*	*15.06*	*15.90*	*16.74*

Note: OS-B (Existing FedEX site) values re-generated with hydrological data provided in the Preliminary/Final Drainage Report for Northgate Campus Filing no. 1

Calculated by: BHY
Date: 9/4/18
Checked by:

M.D.D.P. for Copper Ridge Crossing & Final Drainage Plan

For Polaris Pointe Shops Filing no. 3

(Area Drainage Summary for Developed on-site condition & historical Conditions for on-sites)

	From Area Runoff Coefficient Summary							OVERLAND				STREET / CHANNEL FLOW					Time of Travel (T_t)	INTENSITY *						TOTAL FLOWS					
BASIN	AREA TOTAL	C_2	C_5	C_{10}	C_{25}	C_{50}	C_{100}	C_5	Length	Height	T_C	STREET	Length	Slope	Velocity	T_t	TOTAL	I_2	I_5	I_{10}	I_{10}	I_{50}	I_{100}	Q_2	Q_5	Q_{10}	Q_{25}	Q_{50}	Q_{100}
	(Acres)	From DCM Table 6-6							(ft)	(ft)	(min)	(Y/N)	(ft)	(%)	(fps)	(min)	(min)	(in/hr)	(in/hr)	(in/hr)	(in/hr)	(in/hr)	(in/hr)	(c.f.s.)	(c.f.s.)	(c.f.s.)	(c.f.s.)	(c.f.s.)	(c.f.s.)
A	1.72	0.65	0.67	0.70	0.75	0.77	0.79	0.67	13	2	1.1	y	511	2.4%	3.1	2.8	5.0	4.12	5.17	6.03	6.89	7.75	8.68	4.59	5.97	7.32	8.87	10.26	11.80
B	0.43	0.80	0.81	0.84	0.87	0.88	0.90	0.81	10	1	0.8	Y	213	1.2%	2.2	1.6	5.0	4.12	5.17	6.03	6.89	7.75	8.68	1.40	1.79	2.15	2.54	2.90	3.30
C	0.53	0.13	0.19	0.25	0.34	0.39	0.43	0.19	44	4.5	5.1	Y	0	2.7%	3.3	0.0	5.1	4.10	5.15	6.00	6.86	7.72	8.64	0.29	0.52	0.80	1.25	1.59	1.98
D	3.12	0.84	0.85	0.87	0.90	0.91	0.92	0.85	0	0	0.0	Y	737	1.8%	2.7	4.6	5.0	4.12	5.17	6.03	6.89	7.75	8.68	10.76	13.71	16.42	19.30	22.02	24.98
E	1.01	0.69	0.71	0.74	0.78	0.80	0.82	0.71	0	0	0.0	Y	165	1.5%	2.5	1.1	5.0	4.12	5.17	6.03	6.89	7.75	8.68	2.88	3.72	4.54	5.45	6.29	7.20
F	2.15	0.86	0.87	0.89	0.91	0.93	0.94	0.87	0	0	0.0	Y	600	2.3%	3.0	3.3	5.0	4.12	5.17	6.03	6.89	7.75	8.68	7.60	9.66	11.56	13.55	15.43	17.49
G	2.16	0.85	0.86	0.88	0.91	0.92	0.93	0.86	0	0	0.0	Y	608	2.4%	3.1	3.3	5.0	4.12	5.17	6.03	6.89	7.75	8.68	7.53	9.58	11.47	13.46	15.35	17.40
H	6.10	0.82	0.83	0.86	0.88	0.90	0.91	0.83	0	0	0.0	Y	1354	2.0%	2.8	8.0	8.0	3.56	4.47	5.21	5.96	6.70	7.50	17.80	22.70	27.24	32.10	36.66	41.63
I	0.90	0.84	0.85	0.87	0.90	0.91	0.92	0.85	0	0	0.0	Y	645	3.1%	3.5	3.1	5.0	4.12	5.17	6.03	6.89	7.75	8.68	3.08	3.93	4.71	5.54	6.32	7.17
J	0.49	0.82	0.83	0.85	0.88	0.89	0.91	0.83	0	0	0.0	Y	416	3.3%	3.6	1.9	5.0	4.12	5.17	6.03	6.89	7.75	8.68	1.65	2.11	2.53	2.99	3.41	3.88
K	1.22	0.78	0.80	0.82	0.85	0.87	0.88	0.80	0	0	0.0	Y	515	2.1%	2.9	3.0	5.0	4.12	5.17	6.03	6.89	7.75	8.68	3.94	5.04	6.07	7.19	8.23	9.37
L	2.40	0.78	0.80	0.82	0.85	0.87	0.88	0.80	0	0	0.0	Y	825	2.6%	3.2	4.3	5.0	4.12	5.17	6.03	6.89	7.75	8.68	7.72	9.89	11.92	14.12	16.16	18.41
M	1.83	0.67	0.69	0.73	0.77	0.79	0.81	0.69	0	0	0.0	Y	545	3.6%	3.8	2.4	5.0	4.12	5.17	6.03	6.89	7.75	8.68	5.06	6.56	8.02	9.67	11.16	12.81
N	4.43	0.06	0.12	0.18	0.28	0.33	0.38	0.12	0	0	0.0	Y	477	2.0%	2.8	2.8	5.0	4.12	5.17	6.03	6.89	7.75	8.68	1.05	2.64	4.89	8.53	11.26	14.46
O	1.26	0.02	0.08	0.15	0.25	0.30	0.35	0.08	0	0	0.0	Y	0	0.0%	0.0	0.0	5.0	4.12	5.17	6.03	6.89	7.75	8.68	0.10	0.52	1.14	2.17	2.93	3.83
P	0.35	0.42	0.45	0.50	0.56	0.60	0.63	0.45	48	1.8	5.2	Y	0	0.0%	0.0	0.0	5.2	4.07	5.10	5.95	6.80	7.65	8.57	0.59	0.81	1.05	1.35	1.60	1.89
EX-A	3.36	0.26	0.31	0.37	0.44	0.48	0.52	0.31	250	9.78	14.4	N	415	3.9%	3.0	2.3	16.7	2.68	3.36	3.92	4.48	5.04	5.64	2.37	3.49	4.81	6.67	8.16	9.86
EX-B	7.16	0.02	0.08	0.15	0.25	0.30	0.35	0.08	250	10.1	18.3	Y	567	4.0%	4.0	2.4	20.7	2.43	3.04	3.54	4.05	4.56	5.10	0.37	1.77	3.83	7.28	9.82	12.81
EX-C	17.77	0.02	0.08	0.15	0.25	0.30	0.35	0.08	250	9.92	18.5	Y	1166	4.0%	4.0	4.9	23.4	2.29	2.86	3.33	3.81	4.29	4.80	0.81	4.06	8.88	16.92	22.85	29.82
EX-D	1.80	0.06	0.12	0.19	0.28	0.33	0.38	0.12	250	7.88	19.1	Y	734	3.2%	3.5	3.4	22.6	2.33	2.91	3.39	3.88	4.36	4.88	0.27	0.63	1.15	1.99	2.61	3.34
OS-A	0.34	0.20	0.25	0.31	0.39	0.43	0.48	0.25	250	7.96	16.6	Y	64	3.2%	3.6	0.3	16.9	2.67	3.35	3.90	4.46	5.02	5.62	0.18	0.28	0.41	0.59	0.74	0.90
OS-B	26.56	0.42	0.46	0.50	0.57	0.60	0.63	0.46			0.0	Y			0.0	0.0	49.8	1.38	1.72	2.01	2.29	2.58	2.89	15.43	20.87	26.86	34.55	41.04	48.31

* Intensity equations assume a minimum travel time of 5 minutes.

OS-B' FLOWS AND Tc ARE TAKEN FROM THE FDR FOR NORTHGATE CAMPUS FILING NO. 1 REPORT.

Calculated by: BHY

Date: 9/4/18

Checked by:

M.D.D.P. for Copper Ridge Crossing & Final Drainage Plan
For Polaris Pointe Shops Filing no. 3
(Design Point Routing Summary for Undeveloped on-site condition)

Design Point(s)	Contributing Basins/Design Points	CA_2	CA_5	CA_{10}	CA_{25}	CA_{50}	CA_{100}	T_c	I_2 (in/hr)	I_5 (in/hr)	I_{10} (in/hr)	I_{25} (in/hr)	I_{50} (in/hr)	I_{100} (in/hr)	Q_2 (c.f.s.)	Q_5 (c.f.s.)	Q_{10} (c.f.s.)	Q_{25} (c.f.s.)	Q_{50} (c.f.s.)	Q_{100} (c.f.s.)	Inlet sizes/ Notes
E1	EX-A	0.89	1.04	1.23	1.49	1.62	1.75	16.7	2.68	3.36	3.92	4.48	5.04	5.64	***2.37***	***3.49***	***4.81***	***6.67***	***8.16***	***9.86***	
E2	EX-B	0.15	0.58	1.08	1.80	2.15	2.51	20.7	2.43	3.04	3.54	4.05	4.56	5.10	***0.37***	***1.77***	***3.83***	***7.28***	***9.82***	***12.81***	
E3	FLOWS FROM EX. FEDEX POND	11.15	12.13	13.38	15.06	15.90	16.74	49.8	1.38	1.72	2.01	2.29	2.58	2.89	***15.43***	***20.87***	***26.86***	***34.55***	***41.04***	***48.31***	
E4	EX-C	0.36	1.42	2.67	4.44	5.33	6.22	23.4	2.29	2.86	3.33	3.81	4.29	4.80	***0.81***	***4.06***	***8.88***	***16.92***	***22.85***	***29.82***	

* Intensity equations assume a minimum travel time of 5 minutes.

DP - Design Point FB- Flow By from Design Point

EX - Existing Design Point INT- Intercepted Flow from Design Point

Calculated by: BHY

Date: 9/4/18

Checked by:

M.D.D.P. for Copper Ridge Crossing & Final Drainage Plan
For Polaris Pointe Shops Filing no. 3
(Design Point Routing Summary for Developed on-site condition)

Design Point(s)	Contributing Basins/Design Points	CA_2	CA_5	CA_{10}	CA_{25}	CA_{50}	CA_{100}	T_C	I_2 (in/hr)	I_5 (in/hr)	I_{10} (in/hr)	I_{25} (in/hr)	I_{50} (in/hr)	I_{100} (in/hr)	Q_2 (c.f.s.)	Q_5 (c.f.s.)	Q_{10} (c.f.s.)	Q_{25} (c.f.s.)	Q_{50} (c.f.s.)	Q_{100} (c.f.s.)	Inlet sizes/ Notes
1	B	0.34	0.35	0.36	0.37	0.37	0.38	5.0	4.12	5.17	6.03	6.89	7.75	8.68	1.40	1.79	2.15	2.54	2.90	3.30	
2	E	0.70	0.72	0.75	0.79	0.81	0.83	5.0	4.12	5.17	6.03	6.89	7.75	8.68	2.88	3.72	4.54	5.45	6.29	7.20	
3	A	1.11	1.15	1.21	1.29	1.32	1.36	5.0	4.12	5.17	6.03	6.89	7.75	8.68	4.59	5.97	7.32	8.87	10.26	11.80	
4	DP 1, 2, 3	2.15	2.22	2.32	2.45	2.51	2.57	5.0	4.12	5.17	6.03	6.89	7.75	8.68	8.86	11.48	14.00	16.86	19.45	22.31	
5	D	2.61	2.65	2.72	2.80	2.84	2.88	5.0	4.12	5.17	6.03	6.89	7.75	8.68	10.76	13.71	16.42	19.30	22.02	24.98	
5A	DP 4, 5	4.76	4.87	5.05	5.25	5.35	5.45	5.0	4.12	5.17	6.03	6.89	7.75	8.68	19.62	25.19	30.43	36.16	41.47	47.29	
6	F	1.84	1.87	1.92	1.97	1.99	2.01	5.0	4.12	5.17	6.03	6.89	7.75	8.68	7.60	9.66	11.56	13.55	15.43	17.49	
6A	5A, 6	6.61	6.74	6.96	7.21	7.34	7.46	5.0	4.12	5.17	6.03	6.89	7.75	8.68	27.22	34.85	41.98	49.71	56.90	64.78	
7	G	1.83	1.85	1.90	1.95	1.98	2.01	5.0	4.12	5.17	6.03	6.89	7.75	8.68	7.53	9.58	11.47	13.46	15.35	17.40	
8	DP 1 THRU 7	8.43	8.60	8.86	9.17	9.32	9.47	5.9	3.92	4.91	5.73	6.55	7.37	8.25	33.02	42.21	50.79	60.02	68.64	78.08	
8A	DP8	8.43	8.60	8.86	9.17	9.32	9.47	6.7	3.78	4.74	5.53	6.32	7.11	7.95	31.85	40.72	48.99	57.90	66.21	75.31	
9	H	4.99	5.08	5.23	5.39	5.47	5.55	8.0	3.56	4.47	5.21	5.96	6.70	7.50	17.80	22.70	27.24	32.10	36.66	41.63	
10	I	0.75	0.76	0.78	0.80	0.81	0.83	5.0	4.12	5.17	6.03	6.89	7.75	8.68	3.08	3.93	4.71	5.54	6.32	7.17	
11	DP 9, 10	5.74	5.84	6.01	6.19	6.28	6.38	8.0	3.56	4.47	5.21	5.96	6.70	7.50	20.46	26.09	31.32	36.89	42.11	47.83	
12	FLOWS FROM EX. FEDEX POND	11.15	12.13	13.38	15.06	15.90	16.74	49.8	1.38	1.72	2.01	2.29	2.58	2.89	15.43	20.87	26.86	34.55	41.04	48.31	
13	K	0.96	0.98	1.01	1.04	1.06	1.08	5.0	4.12	5.17	6.03	6.89	7.75	8.68	3.94	5.04	6.07	7.19	8.23	9.37	
14	J	0.40	0.41	0.42	0.43	0.44	0.45	5.0	4.12	5.17	6.03	6.89	7.75	8.68	1.65	2.11	2.53	2.99	3.41	3.88	
15	L	1.87	1.91	1.98	2.05	2.08	2.12	5.0	4.12	5.17	6.03	6.89	7.75	8.68	7.72	9.89	11.92	14.12	16.16	18.41	
16	DP 13,14,15	3.23	3.30	3.40	3.53	3.59	3.65	5.0	4.12	5.17	6.03	6.89	7.75	8.68	13.31	17.04	20.53	24.30	27.81	31.66	
17	DP16	3.23	3.30	3.40	3.53	3.59	3.65	5.1	4.09	5.13	5.98	6.84	7.69	8.61	13.21	16.91	20.36	24.10	27.59	31.40	
18	M	1.23	1.27	1.33	1.40	1.44	1.48	5.0	4.12	5.17	6.03	6.89	7.75	8.68	5.06	6.56	8.02	9.67	11.16	12.81	
19	DP18	1.23	1.27	1.33	1.40	1.44	1.48	5.0	4.12	5.17	6.03	6.89	7.75	8.68	5.06	6.56	8.02	9.67	11.16	12.81	
20	DP8A, 11, 17, 19 and Basin N	Data from UD-Detention spreadsheet													31.1	41.0	51.5	64.1	73.5	85.6	Peak Inflow from UD-Detention
20A	Routed Flows from Pond	1.11	1.11	2.09	10.16	15.11	18.60	75.0	0.90	1.11	1.29	1.48	1.66	1.85	1.00	1.23	2.70	15.00	25.10	34.50	Data from UD-Detention
20B	Routed Flows+DP12	12.26	13.24	15.47	25.22	31.01	35.34	75.1	0.90	1.11	1.29	1.47	1.66	1.85	10.99	14.64	19.95	37.18	51.44	65.47	
21	RELEASE POINT	12.26	13.24	15.47	25.22	31.01	35.34	75.2	0.89	1.10	1.29	1.47	1.65	1.85	10.95	14.59	19.89	37.06	51.27	65.26	

* Intensity equations assume a minimum travel time of 5 minutes.
DP - Design Point FB- Flow By from Design Point
EX - Existing Design Point INT- Intercepted Flow from Design Point

Calculated by: BHY
Date: 9/4/18
Checked by:

M.D.D.P. for Copper Ridge Crossing & Final Drainage Plan
For Polaris Pointe Shops Filing no. 3
(Pipe Routing Summary for Developed Condition)

Pipe Run	Contributing Basins/Design Points	Equivalent CA_5	Equivalent CA_{100}	Maximum T_C	Intensity *		Flow		Pipe Size (Inches)	Pipe material	PUBLIC OR PRIVATE SYSTEM
					I_5	I_{100}	Q_5	Q_{100}			
1	DP1	0.35	0.38	5.0	5.2	8.7	1.79	3.30	18	HDPE	PRIVATE
2	DP2	0.72	0.83	5.0	5.2	8.7	3.72	7.20	15	HDPE	PRIVATE
3	DP3	1.15	1.36	5.0	5.2	8.7	5.97	11.80	15	HDPE	PRIVATE
4	DP4	2.22	2.57	5.0	5.2	8.7	11.48	22.31	18	HDPE	PRIVATE
4A	DP4	2.22	2.57	5.0	5.2	8.7	11.48	22.31	24	HDPE	PRIVATE
4B	DP5	2.65	2.88	5.0	5.2	8.7	13.71	24.98	24	HDPE	PRIVATE
4C	DP6	1.87	2.01	5.0	5.2	8.7	9.66	17.49	18	HDPE	PRIVATE
5	DP6A	6.74	7.46	5.0	5.2	8.7	34.85	64.78	30	HDPE	PRIVATE
5	DP6A	6.74	7.46	5.0	5.2	8.7	34.85	64.78	30	HDPE	PRIVATE
5	DP6A	6.74	7.46	5.0	5.2	8.7	34.85	64.78	36	HDPE	PRIVATE
6	DP8	8.60	9.47	5.9	4.9	8.2	42.21	78.08	36	HDPE	PRIVATE
6	DP8	8.60	9.47	5.9	4.9	8.2	42.21	78.08	42	HDPE	PRIVATE
7	DP9	5.08	5.55	8.0	4.5	7.5	22.70	41.63	36	HDPE	PRIVATE
8	DP9, 10	5.84	6.38	8.0	4.5	7.5	26.09	47.83	36	HDPE	PRIVATE
9A	OS-B	12.13	16.74	49.8	1.7	2.9	20.87	48.31	36	RCP	PRIVATE
9	DP12	12.13	16.74	49.8	1.7	2.9	20.87	48.31	36	HDPE	PRIVATE
9B	DP12	12.13	16.74	50.3	1.7	2.9	20.71	47.94	36	HDPE	PRIVATE
10	DP13	0.98	1.08	5.0	5.2	8.7	5.04	9.37	15	HDPE	PRIVATE
11	DP14	0.41	0.45	5.0	5.2	8.7	2.11	3.88	15	HDPE	PRIVATE
12	DP14, 15	2.32	2.57	5.0	5.2	8.7	12.00	22.28	24	HDPE	PRIVATE
13	DP16	3.30	3.65	5.0	5.2	8.7	17.04	31.66	30	HDPE	PRIVATE
14	DP18	1.27	1.48	5.0	5.2	8.7	6.56	12.81	24	HDPE	PRIVATE
15	OUTLET FROM POND	From UD-Detention					1.30	29.90	30	HDPE	PRIVATE
16	DP20B	13.24	35.34	75.1	1.1	1.9	14.64	65.47	36	HDPE	PRIVATE

* Intensity equations assume a minimum travel time of 5 minutes.

DP - Design Point
EX - Existing Design Point
FB- Flow By from Design Point
INT- Intercepted Flow from Design Point

Calculated by: BHY
Date: 7/21/2016
Checked by: _____

Final Drainage Report for

(Pipe Travel Time)

Pipe Run	100 year Flow (cfs)	Length (ft)	Pipe size (in.)	Pipe slope (ft.ft)	n	Velocity (fps)	T_t (min)	TOTAL (min)
1	*3.30*	98	18	0.057	0.012	15.43	0.11	0.11
2	*7.20*	112	15	0.015	0.012	7.04	0.27	0.27
3	*11.80*	0	15	0.015	0.012	7.04	0.00	0.00
4	*22.31*	264	18	0.036	0.012	12.31	0.36	0.36
4A	*22.31*	197	24	0.019	0.012	10.76	0.31	0.31
4B	*24.98*	8	24	0.020	0.012	11.04	0.01	0.01
4C	*17.49*	8	18	0.020	0.012	9.15	0.01	0.01
5	*64.78*	154	24	0.019	0.012	10.76	0.24	0.24
5	*64.78*	215	30	0.020	0.012	12.79	0.28	0.28
5	*64.78*	51	36	0.027	0.012	16.87	0.05	0.05
6	*78.08*	680	36	0.027	0.012	16.87	0.67	0.67
6	*78.08*	56	42	0.020	0.012	16.06	0.06	0.06
7	*41.63*	51	36	0.015	0.012	12.58	0.07	0.07
8	*48.80*	148	36	0.015	0.012	12.58	0.20	0.20
9A	*48.31*	756	36	0.027	0.012	16.87	0.75	0.75
9	*48.31*	467	36	0.015	0.012	12.58	0.62	0.62
9B	*48.31*	300	36	0.015	0.012	11.32	0.44	0.44
10	*57.68*	44	36	0.015	0.012	12.58	0.06	0.06
11	*3.88*	104	15	0.015	0.012	7.04	0.25	0.25
12	*22.28*	20	18	0.015	0.012	7.92	0.04	0.04
13	*31.66*	128	48	0.015	0.012	15.18	0.14	0.14
14	*12.81*	102	24	0.015	0.012	13.17	0.13	0.13
15	*34.50*	41	36	0.015	0.012	10.27	0.07	0.07
16	*100.05*	100	36	0.015	0.012	9.25	0.18	0.18

Version 4.05 Released March 2017

INLET MANAGEMENT

Worksheet Protected

INLET NAME	DP2	DP3	DP10	DP15	DP13	DP14
Site Type (Urban or Rural)	URBAN	URBAN	URBAN	URBAN	URBAN	URBAN
Inlet Application (Street or Area)	STREET	STREET	STREET	STREET	STREET	STREET
Hydraulic Condition	In Sump	On Grade	On Grade	On Grade	On Grade	On Grade
Inlet Type	Colorado Springs D-10-R	Colorado Springs D-10-R	Colorado Springs D-10-R	Colorado Springs D-10-R	Colorado Springs D-10-R	Colorado Springs D-10-R

USER-DEFINED INPUT

User-Defined Design Flows

Minor Q_{Known} (cfs)	3.7	6.0	3.9	9.9	5.0	2.1
Major Q_{Known} (cfs)	7.2	11.8	7.2	18.4	9.4	3.9

Bypass (Carry-Over) Flow from Upstream

Receive Bypass Flow from:	No Bypass Flow Received	No Bypass Flow Received	No Bypass Flow Received	User-Defined	No Bypass Flow Received	No Bypass Flow Received
Minor Bypass Flow Received, Q_b (cfs)	0.0	0.0	0.0	0.4	0.0	0.0
Major Bypass Flow Received, Q_b (cfs)	0.0	0.0	0.0	2.2	0.0	0.0

Watershed Characteristics

Subcatchment Area (acres)						
Percent Impervious						
NRCS Soil Type						

Watershed Profile

Overland Slope (ft/ft)						
Overland Length (ft)						
Channel Slope (ft/ft)						
Channel Length (ft)						

Minor Storm Rainfall Input

Design Storm Return Period, T_r (years)						
One-Hour Precipitation, P_1 (inches)						

Major Storm Rainfall Input

Design Storm Return Period, T_r (years)						
One-Hour Precipitation, P_1 (inches)						

CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	**3.7**	**6.0**	**3.9**	**10.3**	**5.0**	**2.1**
Major Total Design Peak Flow, Q (cfs)	**7.2**	**11.8**	**7.2**	**20.6**	**9.4**	**3.9**
Minor Flow Bypassed Downstream, Q_b (cfs)	N/A	1.2	0.4	1.7	0.9	0.0
Major Flow Bypassed Downstream, Q_b (cfs)	N/A	4.9	2.2	8.2	3.7	0.4

Minor Storm (Calculated) Analysis of Flow Time

C	N/A	N/A	N/A	N/A	N/A	N/A
C_5	N/A	N/A	N/A	N/A	N/A	N/A
Overland Flow Velocity, Vi	N/A	N/A	N/A	N/A	N/A	N/A
Channel Flow Velocity, Vt	N/A	N/A	N/A	N/A	N/A	N/A
Overland Flow Time, Ti	N/A	N/A	N/A	N/A	N/A	N/A
Channel Travel Time, Tt	N/A	N/A	N/A	N/A	N/A	N/A
Calculated Time of Concentration, T_c	N/A	N/A	N/A	N/A	N/A	N/A
Regional T_c	N/A	N/A	N/A	N/A	N/A	N/A
Recommended T_c	N/A	N/A	N/A	N/A	N/A	N/A
T_c selected by User	N/A	N/A	N/A	N/A	N/A	N/A
Design Rainfall Intensity, I	N/A	N/A	N/A	N/A	N/A	N/A
Calculated Local Peak Flow, Q_p	N/A	N/A	N/A	N/A	N/A	N/A

Major Storm (Calculated) Analysis of Flow Time

C	N/A	N/A	N/A	N/A	N/A	N/A
C_5	N/A	N/A	N/A	N/A	N/A	N/A
Overland Flow Velocity, Vi	N/A	N/A	N/A	N/A	N/A	N/A
Channel Flow Velocity, Vt	N/A	N/A	N/A	N/A	N/A	N/A
Overland Flow Time, Ti	N/A	N/A	N/A	N/A	N/A	N/A
Channel Travel Time, Tt	N/A	N/A	N/A	N/A	N/A	N/A
Calculated Time of Concentration, T_c	N/A	N/A	N/A	N/A	N/A	N/A
Regional T_c	N/A	N/A	N/A	N/A	N/A	N/A
Recommended T_c	N/A	N/A	N/A	N/A	N/A	N/A
T_c selected by User	N/A	N/A	N/A	N/A	N/A	N/A
Design Rainfall Intensity, I	N/A	N/A	N/A	N/A	N/A	N/A
Calculated Local Peak Flow, Q_p	N/A	N/A	N/A	N/A	N/A	N/A

Version 4.05 Released March 2017

INLET MANAGEMENT

INLET NAME	DP18
Site Type (Urban or Rural)	URBAN
Inlet Application (Street or Area)	STREET
Hydraulic Condition	In Sump
Inlet Type	Colorado Springs D-10-R

USER-DEFINED INPUT

User-Defined Design Flows

Minor Q_{known} (cfs)	6.6
Major Q_{known} (cfs)	12.8

Bypass (Carry-Over) Flow from Upstream

Receive Bypass Flow from:	User-Defined
Minor Bypass Flow Received, Q_b (cfs)	2.3
Major Bypass Flow Received, Q_b (cfs)	11.2

Watershed Characteristics

Subcatchment Area (acres)	
Percent Impervious	
NRCS Soil Type	

Watershed Profile

Overland Slope (ft/ft)	
Overland Length (ft)	
Channel Slope (ft/ft)	
Channel Length (ft)	

Minor Storm Rainfall Input

Design Storm Return Period, T_r (years)	
One-Hour Precipitation, P_1 (inches)	

Major Storm Rainfall Input

Design Storm Return Period, T_r (years)	
One-Hour Precipitation, P_1 (inches)	

CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	**8.9**
Major Total Design Peak Flow, Q (cfs)	**24.0**
Minor Flow Bypassed Downstream, Q_b (cfs)	N/A
Major Flow Bypassed Downstream, Q_b (cfs)	N/A

Minor Storm (Calculated) Analysis of Flow T

C	N/A
C_5	N/A
Overland Flow Velocity, Vi	N/A
Channel Flow Velocity, Vt	N/A
Overland Flow Time, Ti	N/A
Channel Travel Time, Tt	N/A
Calculated Time of Concentration, T_c	N/A
Regional T_c	N/A
Recommended T_c	N/A
T_c selected by User	N/A
Design Rainfall Intensity, I	N/A
Calculated Local Peak Flow, Q_p	N/A

Major Storm (Calculated) Analysis of Flow T

C	N/A
C_5	N/A
Overland Flow Velocity, Vi	N/A
Channel Flow Velocity, Vt	N/A
Overland Flow Time, Ti	N/A
Channel Travel Time, Tt	N/A
Calculated Time of Concentration, T_c	N/A
Regional T_c	N/A
Recommended T_c	N/A
T_c selected by User	N/A
Design Rainfall Intensity, I	N/A
Calculated Local Peak Flow, Q_p	N/A

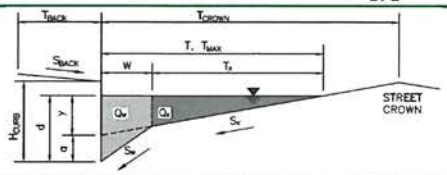
Version 4.05 Released March 2017

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: Enter Your Project Name Here

Inlet ID: DP2



Gutter Geometry (Enter data in the blue cells)

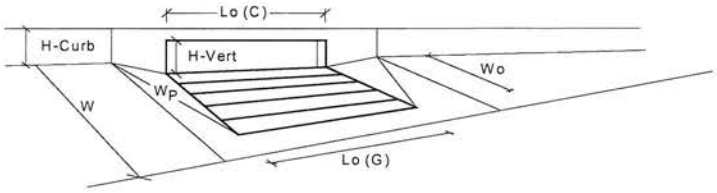
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	16.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.060	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	66.0	ft
Gutter Width	W =	1.50	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.012	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	18.0	66.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	18.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	SUMP	SUMP	cfs

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



Design Information (Input)	Colorado Springs D-10-R		MINOR	MAJOR	
Type of Inlet		Type =	Colorado Springs D-10-R		
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	4.00	4.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	1	1	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	5.5	17.0	inches
Grate Information			MINOR	MAJOR	☐ Override Depths
Length of a Unit Grate		L_o (G) =	N/A	N/A	feet
Width of a Unit Grate		W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	N/A	N/A	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		L_o (C) =	6.00	6.00	feet
Height of Vertical Curb Opening in Inches		H_{vert} =	8.00	8.00	inches
Height of Curb Orifice Throat in Inches		H_{throat} =	8.00	8.00	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	81.00	81.00	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)		W_p =	1.50	1.50	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)			MINOR	MAJOR	
Depth for Grate Midwidth		d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation		d_{Curb} =	0.33	1.29	ft
Combination Inlet Performance Reduction Factor for Long Inlets		$RF_{Combination}$ =	0.64	1.00	
Curb Opening Performance Reduction Factor for Long Inlets		RF_{Curb} =	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets		RF_{Grate} =	N/A	N/A	
			MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)		**Q_a =**	**5.4**	**23.5**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)		$Q_{PEAK\ REQUIRED}$ =	3.7	7.2	cfs

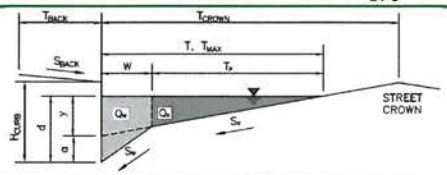
Version 4.05 Released March 2017

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: Enter Your Project Name Here

Inlet ID: DP3



Gutter Geometry (Enter data in the blue cells)			
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	11.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	21.0	ft
Gutter Width	W =	1.50	ft
Street Transverse Slope	S_X =	0.038	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.042	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.012	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	11.0	11.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	9.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

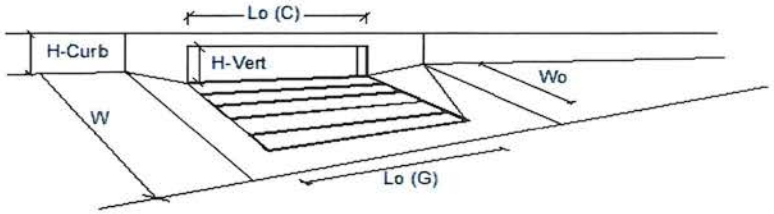
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	Q_{allow} =	16.0	25.8	cfs

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	Colorado Springs D-10-R		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	4.0	4.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	8.00	8.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	

Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**4.8**	**6.9**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**1.2**	**4.9**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**80**	**58**	**%**

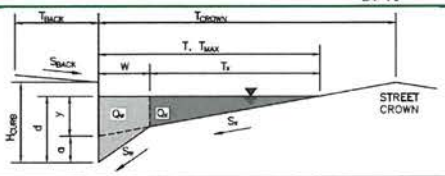
Version 4.05 Released March 2017

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: Enter Your Project Name Here

Inlet ID: DP10



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	6.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	18.0	ft
Gutter Width	W =	1.50	ft
Street Transverse Slope	S_x =	0.018	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_w =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_o =	0.033	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.012	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	18.0	18.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	7.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

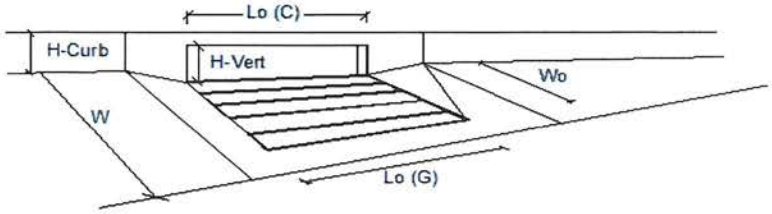
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	Q_{allow} =	25.6	25.6	cfs

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	Colorado Springs D-10-R		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	4.0	4.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	2	2	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	4.00	4.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_fG =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_fC =	0.10	0.10	

Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**3.5**	**4.9**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.4**	**2.2**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**90**	**69**	**%**

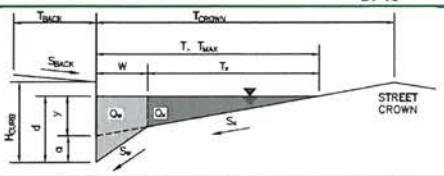
Version 4.05 Released March 2017

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: Enter Your Project Name Here

Inlet ID: DP13



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	5.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	18.0	ft
Gutter Width	W =	1.50	ft
Street Transverse Slope	S_X =	0.018	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.042	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.012	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	18.0	18.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

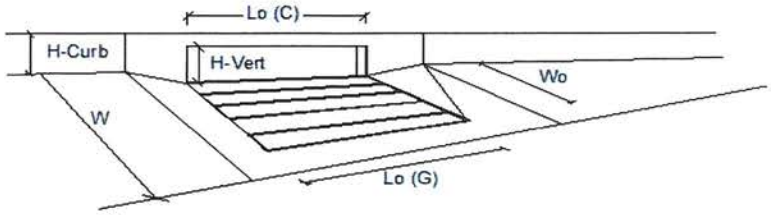
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	27.4	27.4	cfs

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



Design Information (Input)	Colorado Springs D-10-R		MINOR	MAJOR	
Type of Inlet		Type =	Colorado Springs D-10-R		
Local Depression (additional to continuous gutter depression 'a')		a_{LOCAL} =	4.0	4.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)		No =	2	2	
Length of a Single Unit Inlet (Grate or Curb Opening)		L_o =	4.00	4.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)		W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)		C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)		C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'			MINOR	MAJOR	
Total Inlet Interception Capacity		**Q =**	**4.1**	**5.6**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)		**Q_b =**	**0.9**	**3.7**	**cfs**
Capture Percentage = Q_a/Q_o =		**C% =**	**81**	**60**	**%**

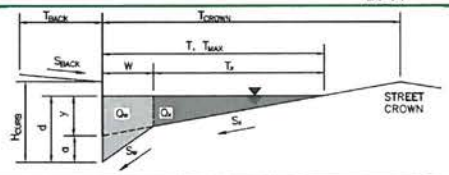
Version 4.05 Released March 2017

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: Enter Your Project Name Here

Inlet ID: DP14



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	5.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	18.0	ft
Gutter Width	W =	1.50	ft
Street Transverse Slope	S_X =	0.019	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.041	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.012	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	18.0	18.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	7.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

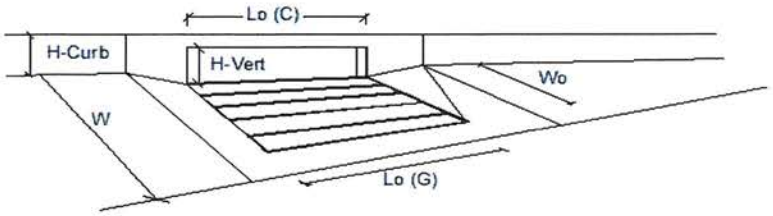
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	Q_{allow} =	26.8	29.4	cfs

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



Design Information (Input)	Colorado Springs D-10-R		MINOR	MAJOR	
Type of Inlet		Type =	Colorado Springs D-10-R		
Local Depression (additional to continuous gutter depression 'a')		a_{LOCAL} =	4.0	4.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)		No =	2	2	
Length of a Single Unit Inlet (Grate or Curb Opening)		L_o =	4.00	4.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)		W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)		C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)		C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'			MINOR	MAJOR	
Total Inlet Interception Capacity		**Q =**	**2.1**	**3.5**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)		**Q_b =**	**0.0**	**0.4**	**cfs**
Capture Percentage = Q_a/Q_o =		**C% =**	**100**	**90**	**%**

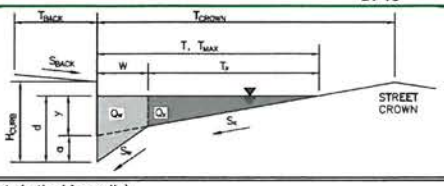
Version 4.05 Released March 2017

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: Enter Your Project Name Here

Inlet ID: DP15



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	10.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	18.0	ft
Gutter Width	W =	1.50	ft
Street Transverse Slope	S_X =	0.031	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.018	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.012	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	18.0	18.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	7.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

MINOR STORM Allowable Capacity is based on Depth Criterion

MAJOR STORM Allowable Capacity is based on Depth Criterion

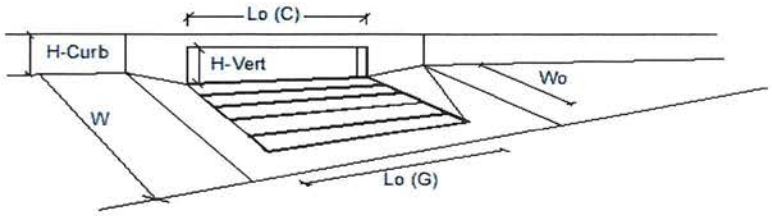
	Minor Storm	Major Storm	
Q_{allow} =	21.6	31.1	cfs

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



Design Information (Input)	Colorado Springs D-10-R		MINOR	MAJOR	
Type of Inlet		Type =	Colorado Springs D-10-R		
Local Depression (additional to continuous gutter depression 'a')		a_{LOCAL} =	4.0	4.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)		No =	3	3	
Length of a Single Unit Inlet (Grate or Curb Opening)		L_o =	4.00	4.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)		W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)		C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)		C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'			MINOR	MAJOR	
Total Inlet Interception Capacity		**Q =**	**8.5**	**12.4**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)		**Q_b =**	**1.7**	**8.2**	**cfs**
Capture Percentage = Q_a/Q_o =		**C% =**	**83**	**60**	**%**

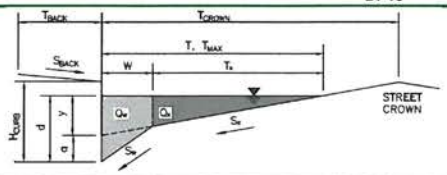
Version 4.05 Released March 2017

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: Enter Your Project Name Here

Inlet ID: DP18



Gutter Geometry (Enter data in the blue cells)

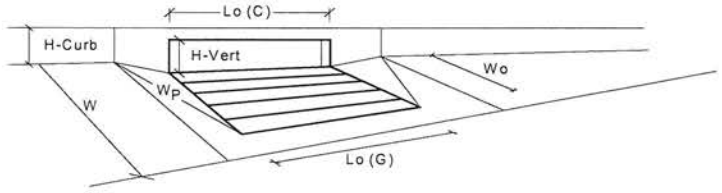
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	25.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	60.0	ft
Gutter Width	W =	1.50	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.012	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	25.0	60.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	18.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



Design Information (Input)	Colorado Springs D-10-R			
		MINOR	MAJOR	
Type of Inlet	Type =	Colorado Springs D-10-R		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	4.00	4.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	6.0	15.5	inches
Grate Information		MINOR	MAJOR	☐ Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	10.00	10.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	8.00	8.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	8.00	8.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	81.00	81.00	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	1.50	1.50	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.38	1.17	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.57	1.00	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.93	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**9.2**	**38.3**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	8.9	24.0	cfs

Site-Level Low Impact Development (LID) Design Effective Impervious Calculator

LID Credit by Impervious Reduction Factor (IRF) Method

UD-BMP (Version 3.06, November 2016)

User Input

Calculated cells

***Design Storm: 1-Hour Rain Depth	WQCV Event	0.53	inches
***Minor Storm: 1-Hour Rain Depth	10-Year Event	1.50	inches
***Major Storm: 1-Hour Rain Depth	100-Year Event	2.52	inches
Optional User Defined Storm	CUHP		
(CUHP) NOAA 1 Hour Rainfall Depth and Frequency for User Defined Storm	100-Year Event		
Max Intensity for Optional User Defined Storm	0		

Designer:	Bob H. Yoo, P.E.
Company:	ECE
Date:	November 29, 2018
Project:	Lot 1, Polaris Pointe Shops Filing no. 3
Location:	Polaris Pointe Master Plan area

SITE INFORMATION (USER-INPUT)

Sub-basin Identifier	A													
Receiving Pervious Area Soil Type	Loamy Sand													
Total Area (ac., Sum of DCIA, UIA, RPA, & SPA)	9.109													
Directly Connected Impervious Area (DCIA, acres)	0.831													
Unconnected Impervious Area (UIA, acres)	2.651													
Receiving Pervious Area (RPA, acres)	0.171													
Separate Pervious Area (SPA, acres)	5.456													
RPA Treatment Type: Conveyance (C), Volume (V), or Permeable Pavement (PP)	V													

CALCULATED RESULTS (OUTPUT)

Total Calculated Area (ac, check against input)	9.109													
Directly Connected Impervious Area (DCIA, %)	9.1%													
Unconnected Impervious Area (UIA, %)	29.1%													
Receiving Pervious Area (RPA, %)	1.9%													
Separate Pervious Area (SPA, %)	59.9%													
A_R (RPA / UIA)	0.065													
I_a Check	0.940													
f / i for WQCV Event:	3.6													
f / i for 10-Year Event:	0.5													
f / i for 100-Year Event:	0.4													
f / i for Optional User Defined Storm CUHP:														
IRF for WQCV Event:	0.00													
IRF for 10-Year Event:	0.98													
IRF for 100-Year Event:	0.99													
IRF for Optional User Defined Storm CUHP:														
Total Site Imperviousness: I_{total}	38.2%													
Effective Imperviousness for WQCV Event:	9.1%													
Effective Imperviousness for 10-Year Event:	37.7%													
Effective Imperviousness for 100-Year Event:	38.0%													
Effective Imperviousness for Optional User Defined Storm CUHP:														

LID / EFFECTIVE IMPERVIOUSNESS CREDITS

WQCV Event CREDIT: Reduce Detention By:	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10-Year Event CREDIT**: Reduce Detention By:	1.4%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
100-Year Event CREDIT**: Reduce Detention By:	0.5%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
User Defined CUHP CREDIT: Reduce Detention By:														

Total Site Imperviousness:	**38.2%**
Total Site Effective Imperviousness for WQCV Event:	**9.1%**
Total Site Effective Imperviousness for 10-Year Event:	**37.7%**
Total Site Effective Imperviousness for 100-Year Event:	**38.0%**
Total Site Effective Imperviousness for Optional User Defined Storm CUHP:	

Notes:

* Use Green-Ampt average infiltration rate values from Table 3-3.

** Flood control detention volume credits based on empirical equations from Storage Chapter of USDCM.

*** Method assumes that 1-hour rainfall depth is equivalent to 1-hour intensity for calculation purposed

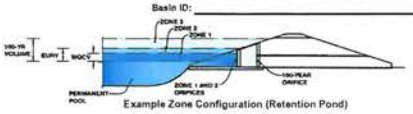
Appendix C
Water Quality/ Extended Detention Basin Facility Calculations
ADS Stormtech MC-3500 Chamber system

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: _____

Basin ID: _____



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	EDB			
Watershed Area =	30.43	acres		
Watershed Length =	2,050	ft		
Watershed Slope =	0.033	ft/ft		
Watershed Imperviousness =	72.39%	percent		
Percentage Hydrologic Soil Group A =	0.0%	percent		
Percentage Hydrologic Soil Group B =	100.0%	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) =	0.726	acre-feet	Optional User Override 1-hr Precipitation	
Excess Urban Runoff Volume (EURV) =	2.426	acre-feet		
2-yr Runoff Volume (P1 = 1.19 in.) =	2.029	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	2.689	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	3.389	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	4.236	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	4.867	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	5.698	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.13 in.) =	7.435	acre-feet	3.13	inches
Approximate 2-yr Detention Volume =	1.902	acre-feet		
Approximate 5-yr Detention Volume =	2.527	acre-feet		
Approximate 10-yr Detention Volume =	3.177	acre-feet		
Approximate 25-yr Detention Volume =	3.410	acre-feet		
Approximate 50-yr Detention Volume =	3.646	acre-feet		
Approximate 100-yr Detention Volume =	3.783	acre-feet		

Stage-Storage Calculation

Zone 1 Volume (WQCV) =	0.726	acre-feet
Zone 2 Volume (EURV - Zone 1) =	1.700	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	1.357	acre-feet
Total Detention Basin Volume =	3.783	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	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_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	user	acre-feet

Depth Increment = 0.25 ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	20,698	0.475		
	--	0.08	--	--	--	20,698	0.475	1,656	0.038
	--	0.17	--	--	--	20,698	0.475	3,312	0.076
	--	0.25	--	--	--	20,698	0.475	5,174	0.119
	--	0.33	--	--	--	20,698	0.475	6,830	0.157
	--	0.42	--	--	--	20,698	0.475	8,486	0.195
	--	0.50	--	--	--	20,698	0.475	10,349	0.238
	--	0.58	--	--	--	20,698	0.475	12,005	0.276
	--	0.67	--	--	--	20,698	0.475	13,660	0.314
	--	0.75	--	--	--	20,698	0.475	15,523	0.356
	--	0.83	--	--	--	43,411	0.997	18,055	0.414
	--	0.92	--	--	--	43,211	0.992	21,521	0.494
	--	1.00	--	--	--	43,074	0.989	25,404	0.583
	--	1.08	--	--	--	42,937	0.986	28,845	0.662
	--	1.17	--	--	--	42,789	0.982	32,274	0.741
	--	1.25	--	--	--	42,644	0.979	36,120	0.829
	--	1.33	--	--	--	42,487	0.975	39,525	0.907
	--	1.42	--	--	--	42,325	0.972	42,918	0.985
	--	1.50	--	--	--	42,152	0.968	46,720	1.073
	--	1.58	--	--	--	41,970	0.963	50,085	1.150
	--	1.67	--	--	--	41,780	0.959	53,436	1.227
	--	1.75	--	--	--	41,580	0.955	57,188	1.313
	--	1.83	--	--	--	41,372	0.950	60,507	1.389
	--	1.92	--	--	--	41,150	0.945	63,809	1.465
	--	2.00	--	--	--	40,919	0.939	67,503	1.550
	--	2.08	--	--	--	40,680	0.934	70,767	1.625
	--	2.17	--	--	--	40,412	0.928	74,012	1.699
	--	2.25	--	--	--	40,144	0.922	77,638	1.782
	--	2.33	--	--	--	39,865	0.915	80,839	1.856
	--	2.42	--	--	--	39,565	0.908	84,017	1.929
	--	2.50	--	--	--	39,247	0.901	87,565	2.010
	--	2.58	--	--	--	38,915	0.893	90,692	2.082
	--	2.67	--	--	--	38,567	0.885	93,793	2.153
	--	2.75	--	--	--	38,200	0.877	97,249	2.233
	--	2.83	--	--	--	37,815	0.868	100,290	2.302
	--	2.92	--	--	--	37,409	0.859	103,301	2.371
	--	3.00	--	--	--	36,983	0.849	106,650	2.448
	--	3.08	--	--	--	36,533	0.839	109,561	2.516
	--	3.17	--	--	--	36,050	0.828	112,497	2.583
	--	3.25	--	--	--	35,544	0.816	115,721	2.657
	--	3.33	--	--	--	35,008	0.804	118,544	2.721
	--	3.42	--	--	--	34,428	0.790	121,324	2.785
	--	3.50	--	--	--	33,819	0.776	124,397	2.856
	--	3.58	--	--	--	33,151	0.761	127,077	2.917
	--	3.67	--	--	--	32,443	0.745	129,704	2.978
	--	3.75	--	--	--	31,658	0.727	132,592	3.044
	--	3.83	--	--	--	30,793	0.707	135,091	3.101
	--	3.92	--	--	--	29,821	0.685	137,520	3.157
	--	4.00	--	--	--	28,710	0.659	140,158	3.218
	--	4.08	--	--	--	27,291	0.627	142,400	3.269
	--	4.17	--	--	--	25,111	0.576	144,506	3.317
	--	4.25	--	--	--	23,300	0.535	146,692	3.368
	--	4.33	--	--	--	22,593	0.519	148,529	3.410
	--	4.42	--	--	--	21,948	0.504	150,313	3.451
	--	4.50	--	--	--	21,066	0.484	152,262	3.495
	--	4.58	--	--	--	20,698	0.475	153,924	3.534
	--	4.67	--	--	--	20,698	0.475	155,579	3.572
	--	4.75	--	--	--	20,698	0.475	157,442	3.614
	--	4.83	--	--	--	20,698	0.475	159,098	3.652
	--	4.92	--	--	--	20,698	0.475	160,754	3.690
	--	5.00	--	--	--	20,698	0.475	162,617	3.733
	--	5.08	--	--	--	20,698	0.475	164,272	3.771
	--	5.17	--	--	--	20,698	0.475	165,928	3.809
	--	5.25	--	--	--	20,698	0.475	167,791	3.852
	--	5.33	--	--	--	20,698	0.475	169,447	3.890
	--	5.42	--	--	--	20,698	0.475	171,103	3.928
	--	5.50	--	--	--	20,698	0.475	172,965	3.971
	--	6.50	--	--	--	160,000	3.673	263,313	6.045
	--	7.00	--	--	--	160,000	3.673	343,313	7.881
	--	8.00	--	--	--	160,000	3.673	503,313	11.554
	--	8.50	--	--	--	160,000	3.673	583,313	13.391
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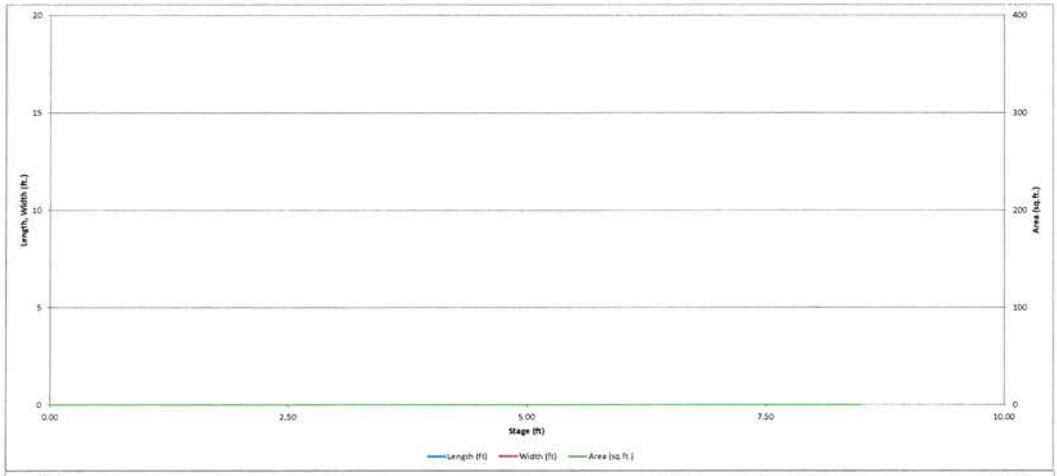
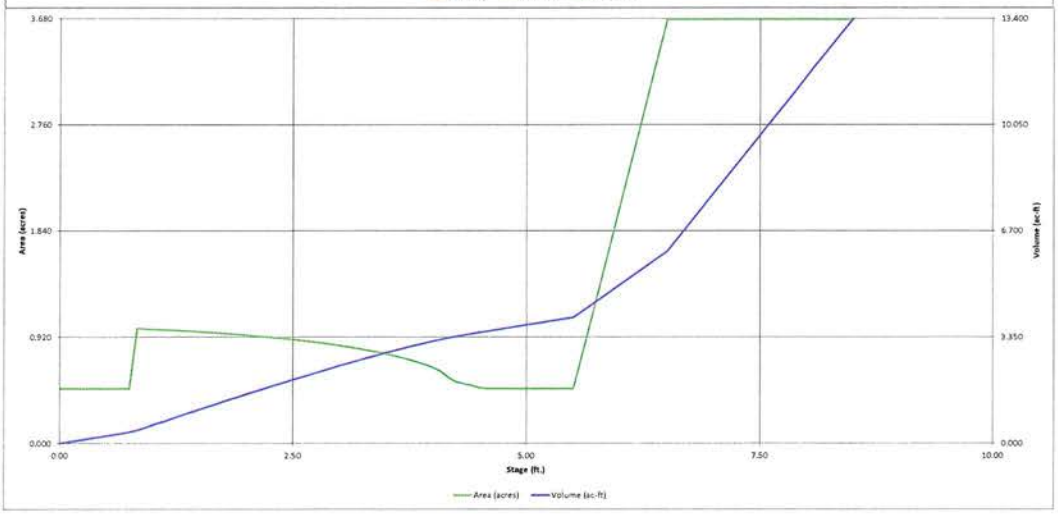
DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)



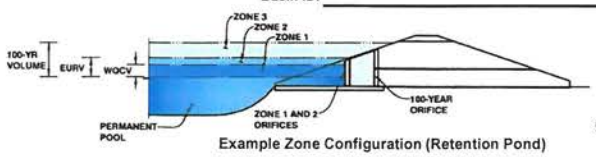


Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project:

Basin ID:



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	1.15	0.726	Orifice Plate
Zone 2 (EURV)	2.98	1.700	Orifice Plate
Zone 3 (100-year)	5.11	1.357	Weir&Pipe (Restrict)
		3.783	Total

User Input: Orifice at Underdrain Outlet (typically used to drain WQCV in a Filtration BMP)

Underdrain Orifice Invert Depth =	N/A	ft (distance below the filtration media surface)
Underdrain Orifice Diameter =	N/A	inches

Calculated Parameters for Underdrain

Underdrain Orifice Area =	N/A	ft^2
Underdrain Orifice Centroid =	N/A	feet

User Input: Orifice Plate with one or more orifices or Elliptical Slot Weir (typically used to drain WQCV and/or EURV in a sedimentation BMP)

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	2.98	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	11.90	inches
Orifice Plate: Orifice Area per Row =	N/A	inches

Calculated Parameters for Plate

WQ Orifice Area per Row =	N/A	ft^2
Elliptical Half-Width =	N/A	feet
Elliptical Slot Centroid =	N/A	feet
Elliptical Slot Area =	N/A	ft^2

User Input: Stage and Total Area of Each Orifice Row (numbered from lowest to highest)

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	0.99	1.99					
Orifice Area (sq. inches)	8.50	8.50	10.00					

	Row 9 (optional)	Row 10 (optional)	Row 11 (optional)	Row 12 (optional)	Row 13 (optional)	Row 14 (optional)	Row 15 (optional)	Row 16 (optional)
Stage of Orifice Centroid (ft)								
Orifice Area (sq. inches)								

User Input: Vertical Orifice (Circular or Rectangular)

	Not Selected	Not Selected	
Invert of Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter =	N/A	N/A	inches

Calculated Parameters for Vertical Orifice

	Not Selected	Not Selected	
Vertical Orifice Area =	N/A	N/A	ft^2
Vertical Orifice Centroid =	N/A	N/A	feet

User Input: Overflow Weir (Dropbox) and Grate (Flat or Sloped)

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	3.60	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	5.00	N/A	feet
Overflow Weir Slope =	0.00	N/A	H:V (enter zero for flat grate)
Horiz. Length of Weir Sides =	5.00	N/A	feet
Overflow Grate Open Area % =	70%	N/A	%, grate open area/total area
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	3.60	N/A	feet
Over Flow Weir Slope Length =	5.00	N/A	feet
Grate Open Area / 100-yr Orifice Area =	7.13	N/A	should be ≥ 4
Overflow Grate Open Area w/o Debris =	17.50	N/A	ft^2
Overflow Grate Open Area w/ Debris =	8.75	N/A	ft^2

User Input: Outlet Pipe w/ Flow Restriction Plate (Circular Orifice, Restrictor Plate, or Rectangular Orifice)

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	2.00	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	30.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	15.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	2.45	N/A	ft^2
Outlet Orifice Centroid =	0.72	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	1.57	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	5.50	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	29.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

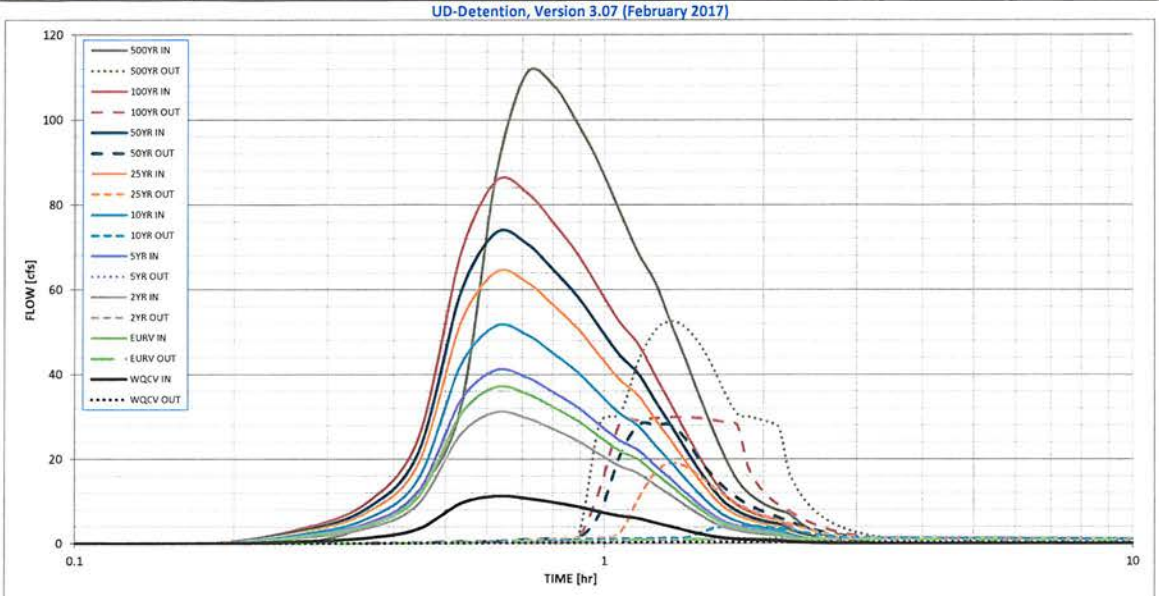
Spillway Design Flow Depth=	0.92	feet
Stage at Top of Freeboard =	7.42	feet
Basin Area at Top of Freeboard =	3.67	acres

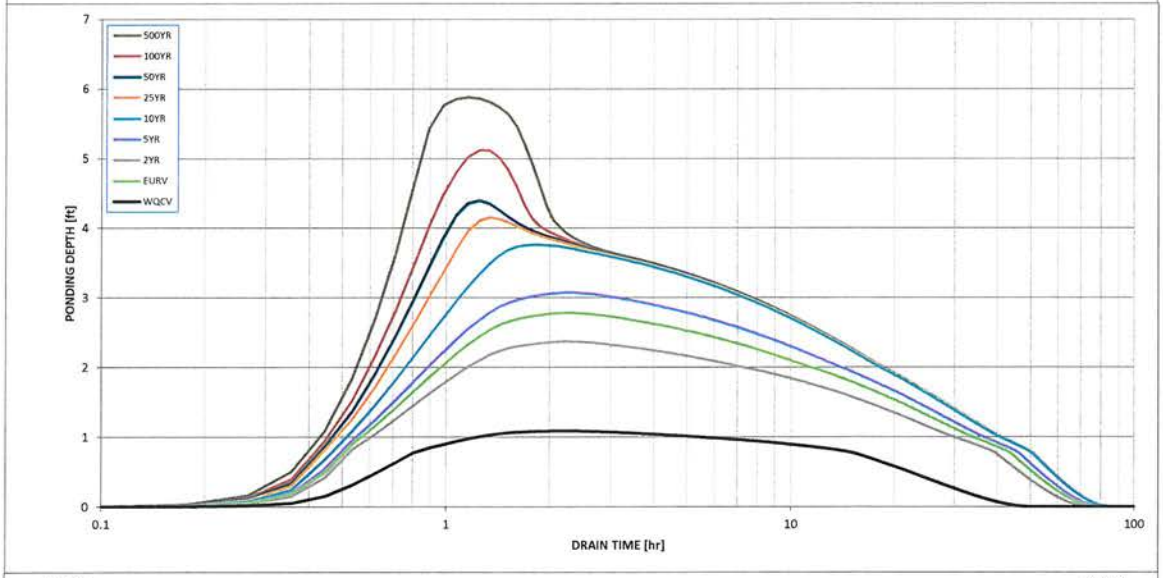
Routed Hydrograph Results

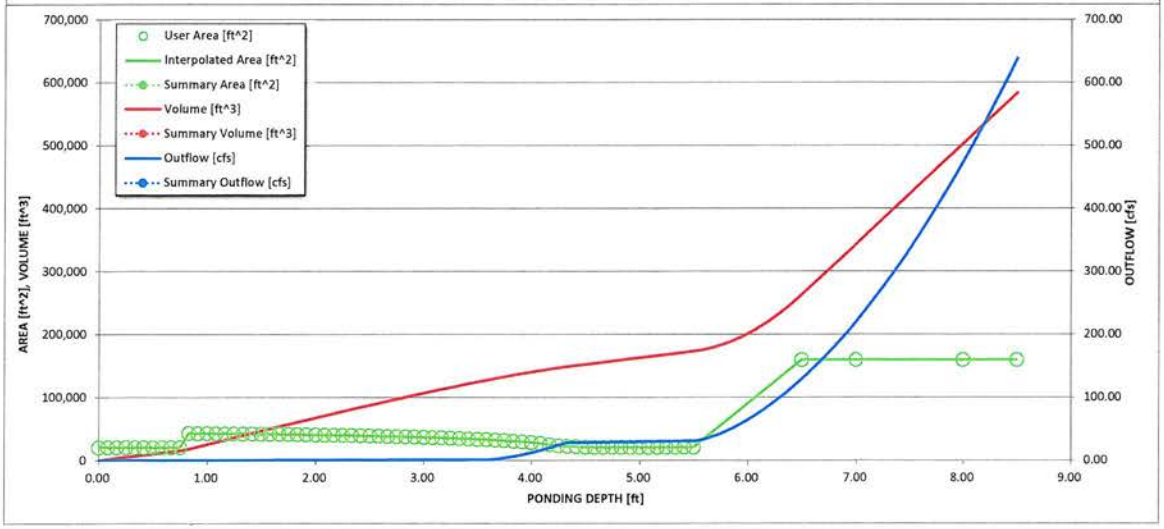
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	3.13
Calculated Runoff Volume (acre-ft) =	0.726	2.426	2.029	2.689	3.389	4.236	4.867	5.698	7.435
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.726	2.426	2.029	2.689	3.389	4.237	4.868	5.693	7.432
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.01	0.02	0.18	0.61	0.84	1.14	1.68
Predevelopment Peak Q (cfs) =	0.0	0.0	0.3	0.6	5.5	18.6	25.7	34.7	51.2
Peak Inflow Q (cfs) =	11.3	37.0	31.1	41.0	51.5	64.1	73.5	85.6	111.0
Peak Outflow Q (cfs) =	0.4	1.2	1.0	1.3	4.3	19.0	28.2	29.9	52.6
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	2.2	0.8	1.0	1.1	0.9	1.0
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Overflow Grate 1	Overflow Grate 1	Outlet Plate 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.2	1.0	1.5	1.6	1.7
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	42	64	61	65	68	65	64	62	59
Time to Drain 99% of Inflow Volume (hours) =	46	70	67	72	75	74	74	73	71
Maximum Ponding Depth (ft) =	1.09	2.79	2.37	3.08	3.76	4.15	4.40	5.12	5.88
Area at Maximum Ponding Depth (acres) =	0.99	0.87	0.91	0.84	0.72	0.59	0.51	0.48	1.66
Maximum Volume Stored (acre-ft) =	0.662	2.259	1.892	2.507	3.051	3.306	3.441	3.785	4.365

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)







S-A-V-D Chart Axis Override	X-axis	Left Y-Axis	Right Y-Axis
minimum bound			
maximum bound			

Detention Basin Outlet Structure Design

Outflow Hydrograph Workbook Filename: _____

Storm Inflow Hydrographs UD-Detention, Version 3.07 (February 2017)

The user can override the calculated inflow hydrographs from this workbook with inflow hydrographs developed in a separate program.

	SOURCE	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.35 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hydrograph	0:10:42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Constant	0:16:03	0.50	1.58	1.33	1.74	2.17	2.66	3.01	3.44	4.30
0.935	0:21:24	1.34	4.33	3.65	4.79	5.98	7.39	8.41	9.71	12.35
	0:26:45	3.44	11.13	9.36	12.30	15.36	18.97	21.59	24.93	31.71
	0:32:06	9.46	30.55	25.70	33.75	42.14	52.01	59.17	68.29	86.79
	0:37:27	11.25	37.04	31.06	41.01	51.50	64.13	73.47	85.62	111.02
	0:42:48	10.74	35.49	29.74	39.31	49.44	61.72	70.87	82.85	108.13
	0:48:09	9.78	32.30	27.07	35.78	44.99	56.22	64.63	75.65	98.98
	0:53:30	8.74	29.03	24.31	32.17	40.50	50.65	58.24	68.19	89.27
	0:58:51	7.55	25.29	21.14	28.04	35.37	44.31	51.00	59.78	78.43
	1:04:12	6.58	22.00	18.37	24.42	30.85	38.69	44.56	52.26	68.63
	1:09:33	5.96	19.93	16.65	22.10	27.88	34.92	40.17	47.06	61.66
	1:14:54	4.92	16.63	13.89	18.46	23.33	29.27	33.73	39.59	52.07
	1:20:15	4.03	13.74	11.45	15.26	19.31	24.26	27.97	32.86	43.27
	1:25:36	3.11	10.80	8.98	12.01	15.25	19.23	22.22	26.17	34.60
	1:30:57	2.32	8.26	6.85	9.21	11.74	14.85	17.20	20.30	26.93
	1:36:18	1.68	6.11	5.04	6.82	8.74	11.10	12.88	15.25	20.31
	1:41:39	1.30	4.62	3.82	5.15	6.57	8.32	9.64	11.37	15.09
	1:47:00	1.07	3.75	3.11	4.17	5.30	6.69	7.73	9.10	12.02
	1:52:21	0.91	3.16	2.63	3.52	4.47	5.63	6.50	7.65	10.09
	1:57:42	0.79	2.76	2.29	3.07	3.89	4.90	5.65	6.64	8.74
	2:03:03	0.72	2.47	2.06	2.75	3.48	4.38	5.05	5.93	7.80
	2:08:24	0.66	2.27	1.89	2.52	3.19	4.01	4.62	5.42	7.12
	2:13:45	0.48	1.68	1.39	1.87	2.37	2.99	3.46	4.08	5.41
	2:19:06	0.35	1.22	1.01	1.35	1.72	2.16	2.50	2.95	3.90
	2:24:27	0.26	0.90	0.75	1.00	1.27	1.60	1.85	2.18	2.89
	2:29:48	0.19	0.67	0.55	0.74	0.94	1.19	1.38	1.62	2.15
	2:35:09	0.14	0.48	0.40	0.54	0.69	0.87	1.01	1.19	1.58
	2:40:30	0.10	0.35	0.29	0.39	0.49	0.63	0.73	0.86	1.14
	2:45:51	0.07	0.25	0.21	0.28	0.36	0.45	0.53	0.62	0.83
	2:51:12	0.05	0.17	0.14	0.19	0.25	0.32	0.37	0.44	0.59
	2:56:33	0.03	0.11	0.09	0.12	0.16	0.21	0.24	0.29	0.39
	3:01:54	0.01	0.06	0.05	0.07	0.09	0.12	0.14	0.17	0.23
	3:07:15	0.00	0.03	0.02	0.03	0.04	0.05	0.06	0.08	0.11
	3:12:36	0.00	0.01	0.00	0.01	0.01	0.01	0.02	0.02	0.03
	3:17:57	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:23:18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:28:39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:34:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:39:21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:44:42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:45	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:06:06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:11:27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:16:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:22:09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:27:30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:32:51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:38:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:43:33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:48:54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:54:15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:59:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:04:57	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:21:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:26:21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:31:42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:37:03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:42:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:47:45	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:53:06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:58:27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:03:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:09:09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:14:30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:19:51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:25:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Project:

Chamber Model -	MC-3500	
Units -	Imperial	Click Here for Metric
Number of Chambers -	881	
Number of End Caps -	112	
Voids in the stone (porosity) -	40	%
Base of Stone Elevation -	6704.75	ft
Amount of Stone Above Chambers -	12	in
Amount of Stone Below Chambers -	9	in
Area of system -	51744	sf Min. Area - 47135 sf min. area

StormTech
Detention • Retention • Water Quality
A division of ADS

☑ Include Perimeter Stone in Calculations

StormTech MC-3500 Cumulative Storage Volumes

Height of System (inches)	Incremental Single Chamber (cubic feet)	Incremental Single End Cap (cubic feet)	Incremental Chambers (cubic feet)	Incremental End Cap (cubic feet)	Incremental Stone (cubic feet)	Incremental Ch, EC and Stone (cubic feet)	Cumulative System (cubic feet)	Elevation (feet)
66	0.00	0.00	0.00	0.00	1724.80	1724.80	172959.93	6710.25
65	0.00	0.00	0.00	0.00	1724.80	1724.80	171235.13	6710.17
64	0.00	0.00	0.00	0.00	1724.80	1724.80	169510.33	6710.08
63	0.00	0.00	0.00	0.00	1724.80	1724.80	167785.53	6710.00
62	0.00	0.00	0.00	0.00	1724.80	1724.80	166060.73	6709.92
61	0.00	0.00	0.00	0.00	1724.80	1724.80	164335.93	6709.83
60	0.00	0.00	0.00	0.00	1724.80	1724.80	162611.13	6709.75
59	0.00	0.00	0.00	0.00	1724.80	1724.80	160886.33	6709.67
58	0.00	0.00	0.00	0.00	1724.80	1724.80	159161.53	6709.58
57	0.00	0.00	0.00	0.00	1724.80	1724.80	157436.73	6709.50
56	0.00	0.00	0.00	0.00	1724.80	1724.80	155711.93	6709.42
55	0.00	0.00	0.00	0.00	1724.80	1724.80	153987.13	6709.33
54	0.06	0.00	51.17	0.00	1704.33	1755.50	152262.33	6709.25
53	0.19	0.02	171.00	2.68	1655.33	1829.01	150506.82	6709.17
52	0.29	0.04	258.98	4.21	1619.52	1882.71	148677.81	6709.08
51	0.40	0.05	355.61	5.77	1580.25	1941.63	146795.10	6709.00
50	0.69	0.07	605.41	7.57	1479.61	2092.58	144853.47	6708.92
49	1.03	0.09	905.93	9.88	1358.48	2274.29	142760.88	6708.83
48	1.25	0.11	1100.83	12.00	1279.67	2392.50	140486.60	6708.75
47	1.42	0.13	1252.98	14.15	1217.95	2485.08	138094.10	6708.67
46	1.57	0.14	1385.93	16.18	1163.96	2566.06	135609.01	6708.58
45	1.71	0.16	1504.00	18.24	1115.90	2638.14	133042.95	6708.50
44	1.83	0.18	1610.91	20.35	1072.30	2703.55	130404.81	6708.42
43	1.94	0.20	1707.17	22.46	1032.95	2762.58	127701.25	6708.33
42	2.04	0.22	1797.97	24.45	995.84	2818.25	124938.67	6708.25
41	2.13	0.23	1880.66	26.32	962.01	2868.99	122120.43	6708.17
40	2.22	0.25	1959.54	28.06	929.76	2917.36	119251.44	6708.08
39	2.31	0.27	2032.28	29.74	899.99	2962.02	116334.08	6708.00
38	2.38	0.28	2100.98	31.36	871.86	3004.20	113372.06	6707.92
37	2.46	0.29	2166.46	32.92	845.05	3044.43	110367.86	6707.83
36	2.53	0.31	2227.32	34.48	820.08	3081.88	107323.43	6707.75
35	2.59	0.32	2285.09	35.97	796.38	3117.44	104241.55	6707.67
34	2.66	0.33	2339.99	37.46	773.82	3151.27	101124.12	6707.58
33	2.72	0.35	2392.01	38.86	752.45	3183.32	97972.85	6707.50
32	2.77	0.36	2441.51	40.32	732.07	3213.89	94789.53	6707.42
31	2.82	0.37	2488.52	41.70	712.71	3242.93	91575.63	6707.33
30	2.88	0.38	2533.28	43.04	694.27	3270.59	88332.70	6707.25
29	2.92	0.40	2576.16	44.36	676.59	3297.11	85062.11	6707.17
28	2.97	0.41	2616.47	45.65	659.95	3322.07	81765.00	6707.08
27	3.01	0.42	2653.97	46.89	644.46	3345.32	78442.92	6707.00
26	3.05	0.43	2689.92	48.12	629.58	3367.63	75097.61	6706.92
25	3.09	0.44	2726.06	49.33	614.65	3390.03	71729.98	6706.83
24	3.13	0.45	2758.02	50.49	601.40	3409.91	68339.95	6706.75
23	3.17	0.46	2788.95	51.62	588.57	3429.14	64930.04	6706.67
22	3.20	0.47	2818.72	52.71	576.23	3447.66	61500.91	6706.58
21	3.23	0.48	2846.61	53.77	564.65	3465.03	58053.25	6706.50
20	3.26	0.49	2873.30	54.79	553.56	3481.65	54588.22	6706.42
19	3.29	0.50	2898.72	55.77	543.00	3497.49	51106.56	6706.33
18	3.32	0.51	2923.13	56.72	532.86	3512.71	47609.07	6706.25
17	3.34	0.51	2946.17	57.62	523.28	3527.08	44096.36	6706.17
16	3.37	0.52	2967.75	58.49	514.30	3540.54	40569.28	6706.08
15	3.39	0.53	2988.79	59.31	505.56	3553.66	37028.74	6706.00
14	3.41	0.54	3008.21	60.09	497.48	3565.78	33475.08	6705.92
13	3.44	0.54	3028.01	60.83	489.26	3578.11	29909.29	6705.83
12	3.46	0.55	3046.24	61.53	481.69	3589.47	26331.19	6705.75
11	3.48	0.56	3064.73	62.19	474.03	3600.95	22741.72	6705.67
10	3.51	0.59	3087.99	66.63	462.95	3617.57	19140.77	6705.58
9	0.00	0.00	0.00	0.00	1724.80	1724.80	15523.20	6705.50
8	0.00	0.00	0.00	0.00	1724.80	1724.80	13798.40	6705.42
7	0.00	0.00	0.00	0.00	1724.80	1724.80	12073.60	6705.33
6	0.00	0.00	0.00	0.00	1724.80	1724.80	10348.80	6705.25
5	0.00	0.00	0.00	0.00	1724.80	1724.80	8624.00	6705.17
4	0.00	0.00	0.00	0.00	1724.80	1724.80	6899.20	6705.08
3	0.00	0.00	0.00	0.00	1724.80	1724.80	5174.40	6705.00
2	0.00	0.00	0.00	0.00	1724.80	1724.80	3449.60	6704.92
1	0.00	0.00	0.00	0.00	1724.80	1724.80	1724.80	6704.83

PROJECT INFORMATION	
ENGINEERED PRODUCT MANAGER:	EVAN FISCHGRUND 720-250-8047 EVAN.FISCHGRUND@ADS-PIPE.COM
ADS SALES REP:	JAMES CURRY 303-406-1105 JAMES.CURRY@ADS-PIPE.COM
PROJECT NO:	S096530

ADVANCED DRAINAGE SYSTEMS, INC.

COPPER RIDGE CROSSING

COLORADO SPRINGS, CO

STORMTECH CHAMBER SPECIFICATIONS

1. CHAMBERS SHALL BE STORMTECH MC-3500.
2. CHAMBERS SHALL BE MADE FROM VIRGIN, IMPACT-MODIFIED POLYPROPYLENE COPOLYMERS.
3. CHAMBER ROWS SHALL PROVIDE CONTINUOUS, UNOBSTRUCTED INTERNAL SPACE WITH NO INTERNAL SUPPORT PANELS THAT WOULD IMPEDE FLOW OR LIMIT ACCESS FOR INSPECTION.
4. THE STRUCTURAL DESIGN OF THE CHAMBERS, THE STRUCTURAL BACKFILL, AND THE INSTALLATION REQUIREMENTS SHALL ENSURE THAT THE LOAD FACTORS SPECIFIED IN THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS, SECTION 12.12, ARE MET FOR: 1) LONG-DURATION DEAD LOADS AND 2) SHORT-DURATION LIVE LOADS, BASED ON THE AASHTO DESIGN TRUCK WITH CONSIDERATION FOR IMPACT AND MULTIPLE VEHICLE PRESENCES.
5. CHAMBERS SHALL MEET THE REQUIREMENTS OF ASTM F2418-16, "STANDARD SPECIFICATION FOR POLYPROPYLENE (PP) CORRUGATED WALL STORMWATER COLLECTION CHAMBERS".
6. CHAMBERS SHALL BE DESIGNED AND ALLOWABLE LOADS DETERMINED IN ACCORDANCE WITH ASTM F2787, "STANDARD PRACTICE FOR STRUCTURAL DESIGN OF THERMOPLASTIC CORRUGATED WALL STORMWATER COLLECTION CHAMBERS".
7. ONLY CHAMBERS THAT ARE APPROVED BY THE SITE DESIGN ENGINEER WILL BE ALLOWED. THE CHAMBER MANUFACTURER SHALL SUBMIT THE FOLLOWING UPON REQUEST TO THE SITE DESIGN ENGINEER FOR APPROVAL BEFORE DELIVERING CHAMBERS TO THE PROJECT SITE:
   a. A STRUCTURAL EVALUATION SEALED BY A REGISTERED PROFESSIONAL ENGINEER THAT DEMONSTRATES THAT THE SAFETY FACTORS ARE GREATER THAN OR EQUAL TO 1.95 FOR DEAD LOAD AND 1.75 FOR LIVE LOAD, THE MINIMUM REQUIRED BY ASTM F2787 AND BY AASHTO FOR THERMOPLASTIC PIPE.
   b. A STRUCTURAL EVALUATION SEALED BY A REGISTERED PROFESSIONAL ENGINEER THAT DEMONSTRATES THAT THE LOAD FACTORS SPECIFIED IN THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS, SECTION 12.12, ARE MET. THE 50 YEAR CREEP MODULUS DATA SPECIFIED IN ASTM F2418 MUST BE USED AS PART OF THE AASHTO STRUCTURAL EVALUATION TO VERIFY LONG-TERM PERFORMANCE.
   c. STRUCTURAL CROSS SECTION DETAIL ON WHICH THE STRUCTURAL EVALUATION IS BASED.
8. CHAMBERS AND END CAPS SHALL BE PRODUCED AT AN ISO 9001 CERTIFIED MANUFACTURING FACILITY.

IMPORTANT - NOTES FOR THE BIDDING AND INSTALLATION OF MC-3500 CHAMBER SYSTEM

1. STORMTECH MC-3500 CHAMBERS SHALL NOT BE INSTALLED UNTIL THE MANUFACTURER'S REPRESENTATIVE HAS COMPLETED A PRE-CONSTRUCTION MEETING WITH THE INSTALLERS.
2. STORMTECH MC-3500 CHAMBERS SHALL BE INSTALLED IN ACCORDANCE WITH THE "STORMTECH MC-3500/MC-4500 CONSTRUCTION GUIDE".
3. CHAMBERS ARE NOT TO BE BACKFILLED WITH A DOZER OR AN EXCAVATOR SITUATED OVER THE CHAMBERS. STORMTECH RECOMMENDS 3 BACKFILL METHODS:
   - STONESHOOTER LOCATED OFF THE CHAMBER BED.
   - BACKFILL AS ROWS ARE BUILT USING AN EXCAVATOR ON THE FOUNDATION STONE OR SUBGRADE.
   - BACKFILL FROM OUTSIDE THE EXCAVATION USING A LONG BOOM HOE OR EXCAVATOR.
4. THE FOUNDATION STONE SHALL BE LEVELED AND COMPACTED PRIOR TO PLACING CHAMBERS.
5. JOINTS BETWEEN CHAMBERS SHALL BE PROPERLY SEATED PRIOR TO PLACING STONE.
6. MAINTAIN MINIMUM - 9" (230 mm) SPACING BETWEEN THE CHAMBER ROWS.
7. INLET AND OUTLET MANIFOLDS MUST BE INSERTED A MINIMUM OF 12" (300 mm) INTO CHAMBER END CAPS.
8. EMBEDMENT STONE SURROUNDING CHAMBERS MUST BE A CLEAN, CRUSHED, ANGULAR STONE MEETING THE AASHTO M43 DESIGNATION OF #3 OR #4.
9. STONE MUST BE PLACED ON THE TOP CENTER OF THE CHAMBER TO ANCHOR THE CHAMBERS IN PLACE AND PRESERVE ROW SPACING.
10. THE CONTRACTOR MUST REPORT ANY DISCREPANCIES WITH CHAMBER FOUNDATION MATERIALS BEARING CAPACITIES TO THE SITE DESIGN ENGINEER.
11. ADS RECOMMENDS THE USE OF "FLEXSTORM CATCH IT" INSERTS DURING CONSTRUCTION FOR ALL INLETS TO PROTECT THE SUBSURFACE STORMWATER MANAGEMENT SYSTEM FROM CONSTRUCTION SITE RUNOFF.

NOTES FOR CONSTRUCTION EQUIPMENT

1. STORMTECH MC-3500 CHAMBERS SHALL BE INSTALLED IN ACCORDANCE WITH THE "STORMTECH MC-3500/MC-4500 CONSTRUCTION GUIDE".
2. THE USE OF EQUIPMENT OVER MC-3500 CHAMBERS IS LIMITED:
   - NO EQUIPMENT IS ALLOWED ON BARE CHAMBERS.
   - NO RUBBER TIRED LOADER, DUMP TRUCK, OR EXCAVATORS ARE ALLOWED UNTIL PROPER FILL DEPTHS ARE REACHED IN ACCORDANCE WITH THE "STORMTECH MC-3500/MC-4500 CONSTRUCTION GUIDE".
   - WEIGHT LIMITS FOR CONSTRUCTION EQUIPMENT CAN BE FOUND IN THE "STORMTECH MC-3500/MC-4500 CONSTRUCTION GUIDE".
3. FULL 36" (900 mm) OF STABILIZED COVER MATERIALS OVER THE CHAMBERS IS REQUIRED FOR DUMP TRUCK TRAVEL OR DUMPING.

USE OF A DOZER TO PUSH EMBEDMENT STONE BETWEEN THE ROWS OF CHAMBERS MAY CAUSE DAMAGE TO CHAMBERS AND IS NOT AN ACCEPTABLE BACKFILL METHOD. ANY CHAMBERS DAMAGED BY USING THE "DUMP AND PUSH" METHOD ARE NOT COVERED UNDER THE STORMTECH STANDARD WARRANTY.

CONTACT STORMTECH AT 1-888-892-2694 WITH ANY QUESTIONS ON INSTALLATION REQUIREMENTS OR WEIGHT LIMITS FOR CONSTRUCTION EQUIPMENT.

PROPOSED LAYOUT

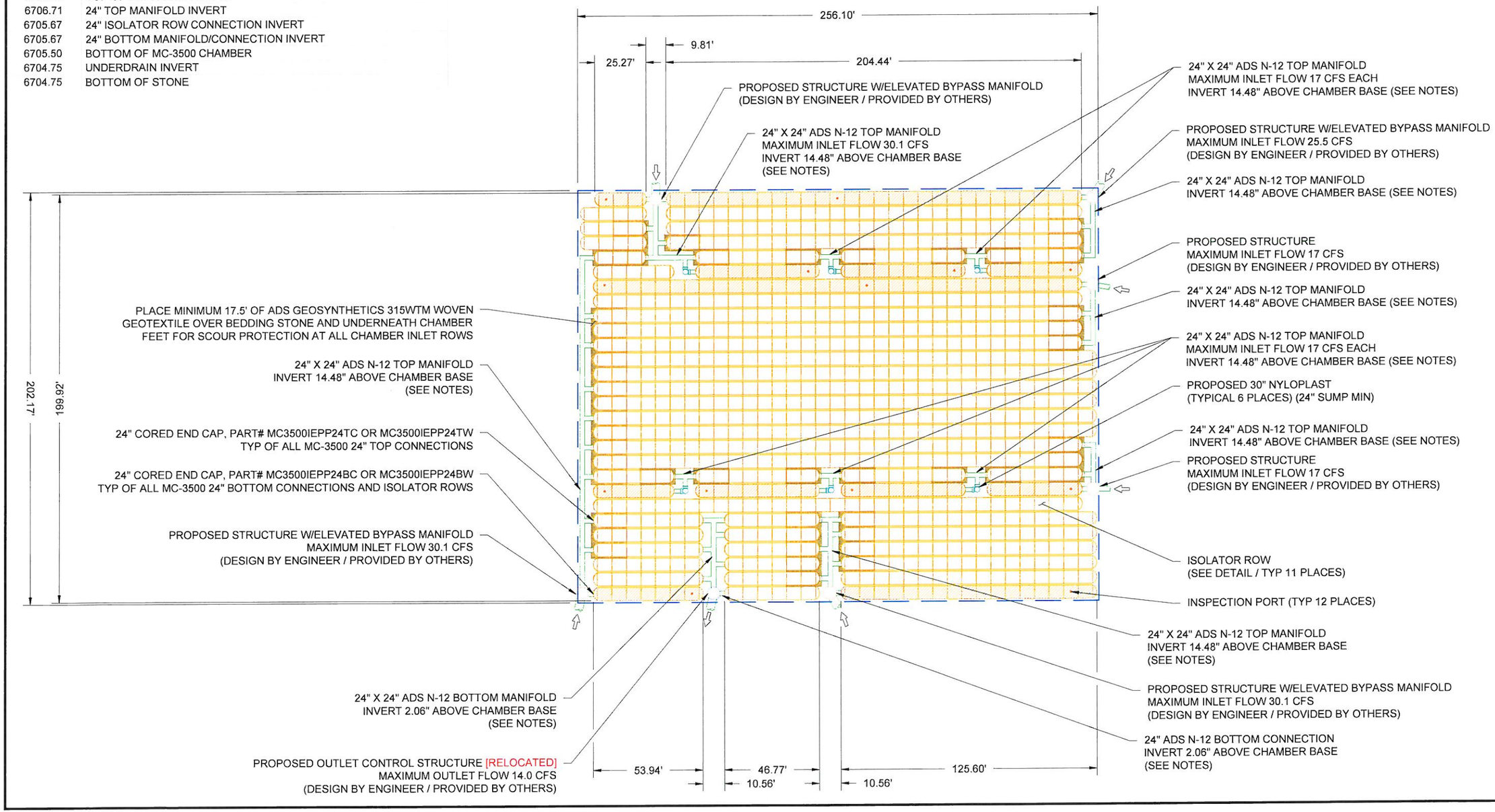
881	STORMTECH MC-3500 CHAMBERS
112	STORMTECH MC-3500 END CAPS
12	STONE ABOVE (in)
9	STONE BELOW (in)
40	% STONE VOID
173,028	**INSTALLED SYSTEM VOLUME (CF) (PERIMETER STONE INCLUDED)**
51,774	SYSTEM AREA (ft²)
917	SYSTEM PERIMETER (ft)

PROPOSED ELEVATIONS

6717.25	MAXIMUM ALLOWABLE GRADE (TOP OF PAVEMENT/UNPAVED)
6711.75	MINIMUM ALLOWABLE GRADE (UNPAVED WITH TRAFFIC)
6711.25	MINIMUM ALLOWABLE GRADE (UNPAVED NO TRAFFIC)
6711.25	MINIMUM ALLOWABLE GRADE (BASE OF FLEXIBLE PAVEMENT)
6711.25	MINIMUM ALLOWABLE GRADE (TOP OF RIGID PAVEMENT)
6710.25	TOP OF STONE
6709.25	TOP OF MC-3500 CHAMBER
6706.71	24" TOP MANIFOLD INVERT
6705.67	24" ISOLATOR ROW CONNECTION INVERT
6705.67	24" BOTTOM MANIFOLD/CONNECTION INVERT
6705.50	BOTTOM OF MC-3500 CHAMBER
6704.75	UNDERDRAIN INVERT
6704.75	BOTTOM OF STONE

NOTES

- MANIFOLD SIZE TO BE DETERMINED BY SITE DESIGN ENGINEER. SEE TECH SHEET #7 FOR MANIFOLD SIZING GUIDANCE.
- DUE TO THE ADAPTATION OF THIS CHAMBER SYSTEM TO SPECIFIC SITE AND DESIGN CONSTRAINTS, IT MAY BE NECESSARY TO CUT AND COUPLE ADDITIONAL PIPE TO STANDARD MANIFOLD COMPONENTS IN THE FIELD.
- THE SITE DESIGN ENGINEER MUST REVIEW ELEVATIONS AND IF NECESSARY ADJUST GRADING TO ENSURE THE CHAMBER COVER REQUIREMENTS ARE MET.
- THIS CHAMBER SYSTEM WAS DESIGNED WITHOUT SITE-SPECIFIC INFORMATION ON SOIL CONDITIONS OR BEARING CAPACITY. THE SITE DESIGN ENGINEER IS RESPONSIBLE FOR DETERMINING THE SUITABILITY OF THE SOIL AND PROVIDING THE BEARING CAPACITY OF THE INSITU SOILS. THE BASE STONE DEPTH MAY BE INCREASED OR DECREASED ONCE THIS INFORMATION IS PROVIDED.



COPPER RIDGE CROSSING
COLORADO SPRINGS, CO

DATE: 08/13/2018 | DRAWN: MFS | CHECKED: RWD | PROJECT #: S096530

DATE	DRWN	CHKD	DESCRIPTION
08/28/18	GDL	ALS	REVISED PER PLAN
08-21-18	LAH	KMS	REMOVED INLET/ISO ROW PER MARKUP
08/17/18	GDL	JM	ADJUST INVERTS PER PLAN

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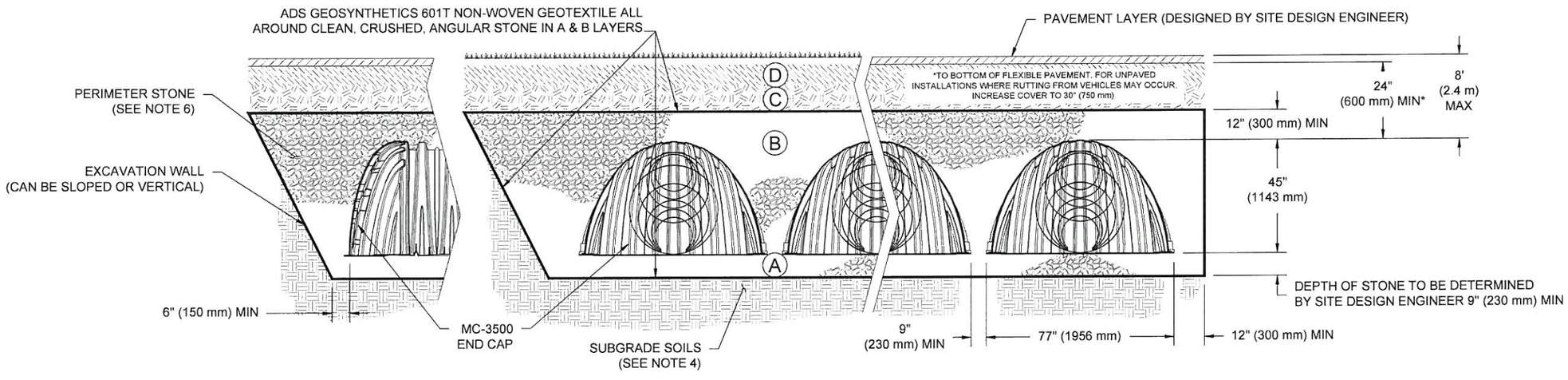
100' / 50' / 0

ACCEPTABLE FILL MATERIALS: STORMTECH MC-3500 CHAMBER SYSTEMS

MATERIAL LOCATION		DESCRIPTION	AASHTO MATERIAL CLASSIFICATIONS	COMPACTION / DENSITY REQUIREMENT
D	**FINAL FILL:** FILL MATERIAL FOR LAYER 'D' STARTS FROM THE TOP OF THE 'C' LAYER TO THE BOTTOM OF FLEXIBLE PAVEMENT OR UNPAVED FINISHED GRADE ABOVE. NOTE THAT PAVEMENT SUBBASE MAY BE PART OF THE 'D' LAYER	ANY SOIL/ROCK MATERIALS, NATIVE SOILS, OR PER ENGINEER'S PLANS. CHECK PLANS FOR PAVEMENT SUBGRADE REQUIREMENTS.	N/A	PREPARE PER SITE DESIGN ENGINEER'S PLANS. PAVED INSTALLATIONS MAY HAVE STRINGENT MATERIAL AND PREPARATION REQUIREMENTS.
C	**INITIAL FILL:** FILL MATERIAL FOR LAYER 'C' STARTS FROM THE TOP OF THE EMBEDMENT STONE ('B' LAYER) TO 24" (600 mm) ABOVE THE TOP OF THE CHAMBER. NOTE THAT PAVEMENT SUBBASE MAY BE A PART OF THE 'C' LAYER.	GRANULAR WELL-GRADED SOIL/AGGREGATE MIXTURES, <35% FINES OR PROCESSED AGGREGATE. MOST PAVEMENT SUBBASE MATERIALS CAN BE USED IN LIEU OF THIS LAYER.	AASHTO M145[1] A-1, A-2-4, A-3 OR AASHTO M43[1] 3, 357, 4, 467, 5, 56, 57, 6, 67, 68, 7, 78, 8, 89, 9, 10	BEGIN COMPACTIONS AFTER 24" (600 mm) OF MATERIAL OVER THE CHAMBERS IS REACHED. COMPACT ADDITIONAL LAYERS IN 12" (300 mm) MAX LIFTS TO A MIN. 95% PROCTOR DENSITY FOR WELL GRADED MATERIAL AND 95% RELATIVE DENSITY FOR PROCESSED AGGREGATE MATERIALS.
B	**EMBEDMENT STONE:** FILL SURROUNDING THE CHAMBERS FROM THE FOUNDATION STONE ('A' LAYER) TO THE 'C' LAYER ABOVE.	CLEAN, CRUSHED, ANGULAR STONE	AASHTO M43[1] 3, 4	NO COMPACTION REQUIRED.
A	**FOUNDATION STONE:** FILL BELOW CHAMBERS FROM THE SUBGRADE UP TO THE FOOT (BOTTOM) OF THE CHAMBER.	CLEAN, CRUSHED, ANGULAR STONE	AASHTO M43[1] 3, 4	PLATE COMPACT OR ROLL TO ACHIEVE A FLAT SURFACE.[2,3]

PLEASE NOTE:
1. THE LISTED AASHTO DESIGNATIONS ARE FOR GRADATIONS ONLY. THE STONE MUST ALSO BE CLEAN, CRUSHED, ANGULAR. FOR EXAMPLE, A SPECIFICATION FOR #4 STONE WOULD STATE: "CLEAN, CRUSHED, ANGULAR NO. 4 (AASHTO M43) STONE".
2. STORMTECH COMPACTION REQUIREMENTS ARE MET FOR 'A' LOCATION MATERIALS WHEN PLACED AND COMPACTED IN 9" (230 mm) (MAX) LIFTS USING TWO FULL COVERAGES WITH A VIBRATORY COMPACTOR.
3. WHERE INFILTRATION SURFACES MAY BE COMPROMISED BY COMPACTION, FOR STANDARD DESIGN LOAD CONDITIONS, A FLAT SURFACE MAY BE ACHIEVED BY RAKING OR DRAGGING WITHOUT COMPACTION EQUIPMENT. FOR SPECIAL LOAD DESIGNS, CONTACT STORMTECH FOR COMPACTION REQUIREMENTS.



NOTES:

1. MC-3500 CHAMBERS SHALL CONFORM TO THE REQUIREMENTS OF ASTM F2418 "STANDARD SPECIFICATION FOR POLYPROPYLENE (PP) CORRUGATED WALL STORMWATER COLLECTION CHAMBERS".
2. MC-3500 CHAMBERS SHALL BE DESIGNED IN ACCORDANCE WITH ASTM F2787 "STANDARD PRACTICE FOR STRUCTURAL DESIGN OF THERMOPLASTIC CORRUGATED WALL STORMWATER COLLECTION CHAMBERS".
3. "ACCEPTABLE FILL MATERIALS" TABLE ABOVE PROVIDES MATERIAL LOCATIONS, DESCRIPTIONS, GRADATIONS, AND COMPACTION REQUIREMENTS FOR FOUNDATION, EMBEDMENT, AND FILL MATERIALS.
4. THE SITE DESIGN ENGINEER IS RESPONSIBLE FOR ASSESSING THE BEARING RESISTANCE (ALLOWABLE BEARING CAPACITY) OF THE SUBGRADE SOILS AND THE DEPTH OF FOUNDATION STONE WITH CONSIDERATION FOR THE RANGE OF EXPECTED SOIL MOISTURE CONDITIONS.
5. ONCE LAYER 'C' IS PLACED, ANY SOIL/MATERIAL CAN BE PLACED IN LAYER 'D' UP TO THE FINISHED GRADE. MOST PAVEMENT SUBBASE SOILS CAN BE USED TO REPLACE THE MATERIAL REQUIREMENTS OF LAYER 'C' OR 'D' AT THE SITE DESIGN ENGINEER'S DISCRETION.
6. PERIMETER STONE MUST BE EXTENDED HORIZONTALLY TO THE EXCAVATION WALL FOR BOTH VERTICAL AND SLOPED EXCAVATION WALLS.

COPPER RIDGE CROSSING
COLORADO SPRINGS, CO
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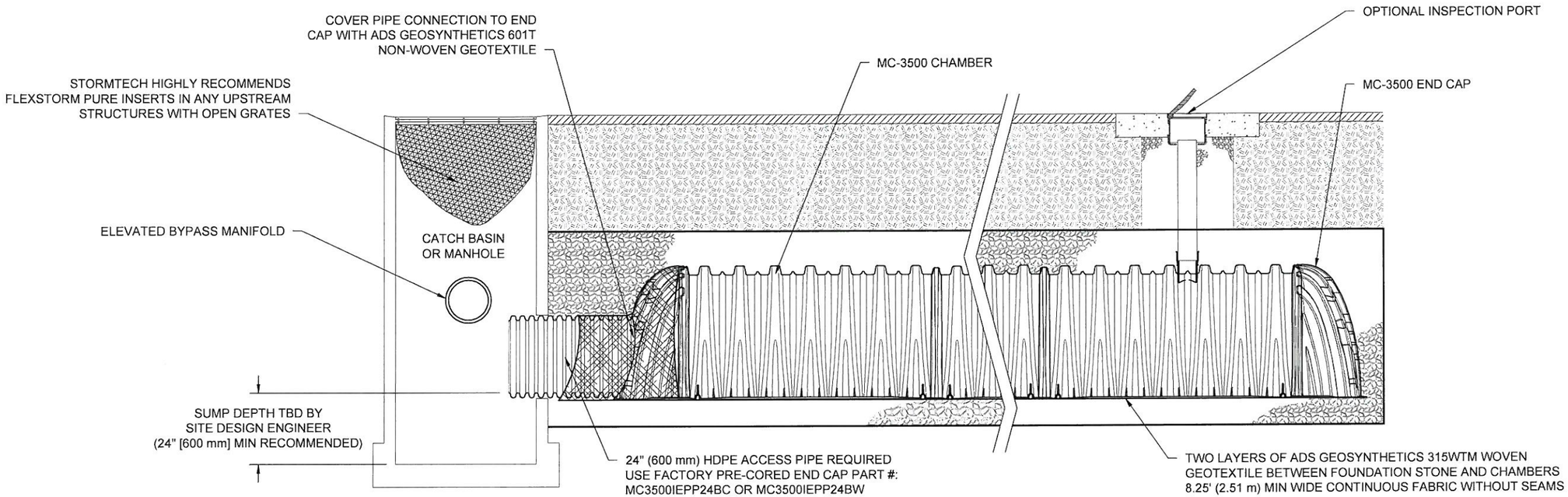


MC-3500 ISOLATOR ROW DETAIL
NTS

INSPECTION & MAINTENANCE

STEP 1) INSPECT ISOLATOR ROW FOR SEDIMENT
- A. INSPECTION PORTS (IF PRESENT)
  - A.1. REMOVE/OPEN LID ON NYLOPLAST INLINE DRAIN
  - A.2. REMOVE AND CLEAN FLEXSTORM FILTER IF INSTALLED
  - A.3. USING A FLASHLIGHT AND STADIA ROD, MEASURE DEPTH OF SEDIMENT AND RECORD ON MAINTENANCE LOG
  - A.4. LOWER A CAMERA INTO ISOLATOR ROW FOR VISUAL INSPECTION OF SEDIMENT LEVELS (OPTIONAL)
  - A.5. IF SEDIMENT IS AT, OR ABOVE, 3" (80 mm) PROCEED TO STEP 2. IF NOT, PROCEED TO STEP 3.
- B. ALL ISOLATOR ROWS
  - B.1. REMOVE COVER FROM STRUCTURE AT UPSTREAM END OF ISOLATOR ROW
  - B.2. USING A FLASHLIGHT, INSPECT DOWN THE ISOLATOR ROW THROUGH OUTLET PIPE
    - i) MIRRORS ON POLES OR CAMERAS MAY BE USED TO AVOID A CONFINED SPACE ENTRY
    - ii) FOLLOW OSHA REGULATIONS FOR CONFINED SPACE ENTRY IF ENTERING MANHOLE
  - B.3. IF SEDIMENT IS AT, OR ABOVE, 3" (80 mm) PROCEED TO STEP 2. IF NOT, PROCEED TO STEP 3.

STEP 2) CLEAN OUT ISOLATOR ROW USING THE JETVAC PROCESS
- A. A FIXED CULVERT CLEANING NOZZLE WITH REAR FACING SPREAD OF 45" (1.1 m) OR MORE IS PREFERRED
- B. APPLY MULTIPLE PASSES OF JETVAC UNTIL BACKFLUSH WATER IS CLEAN
- C. VACUUM STRUCTURE SUMP AS REQUIRED

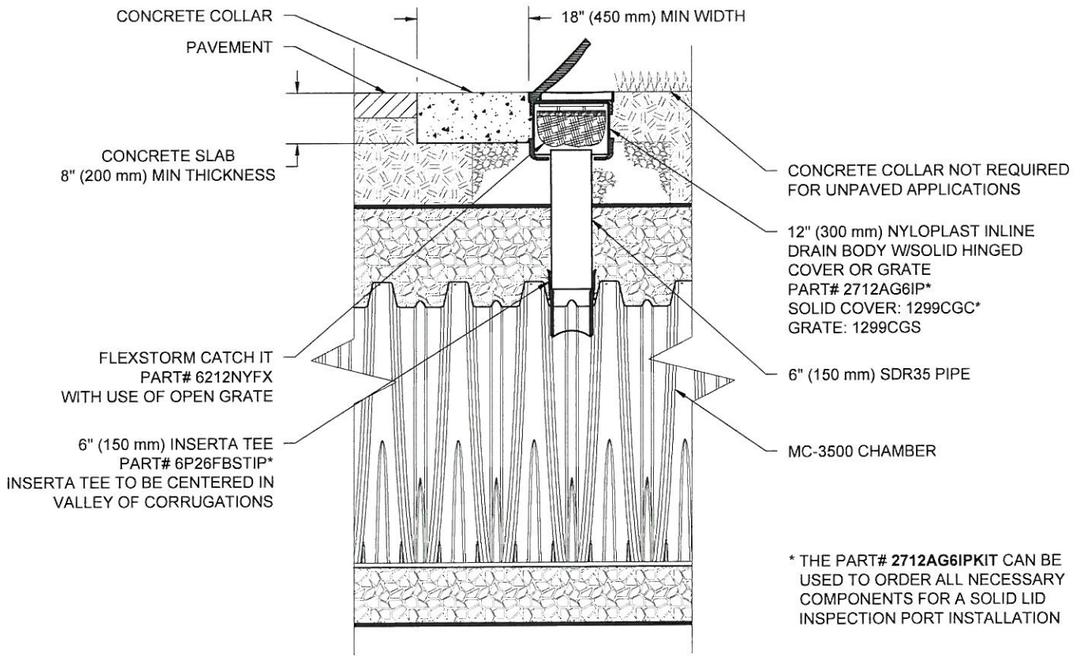
STEP 3) REPLACE ALL COVERS, GRATES, FILTERS, AND LIDS; RECORD OBSERVATIONS AND ACTIONS.

STEP 4) INSPECT AND CLEAN BASINS AND MANHOLES UPSTREAM OF THE STORMTECH SYSTEM.

NOTES

1. INSPECT EVERY 6 MONTHS DURING THE FIRST YEAR OF OPERATION. ADJUST THE INSPECTION INTERVAL BASED ON PREVIOUS OBSERVATIONS OF SEDIMENT ACCUMULATION AND HIGH WATER ELEVATIONS.

2. CONDUCT JETTING AND VACTORING ANNUALLY OR WHEN INSPECTION SHOWS THAT MAINTENANCE IS NECESSARY.



MC-3500 6" INSPECTION PORT DETAIL
NTS

COPPER RIDGE CROSSING
COLORADO SPRINGS, CO

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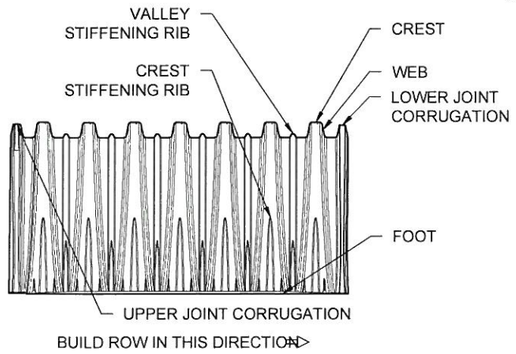
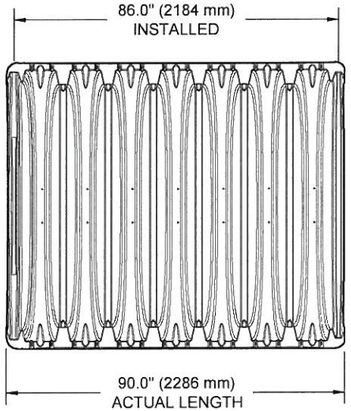
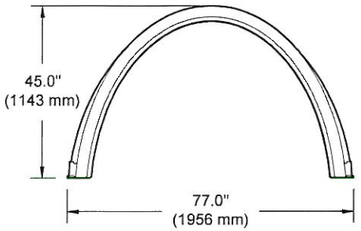
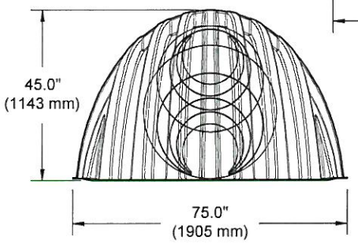
MC-3500 TECHNICAL SPECIFICATION

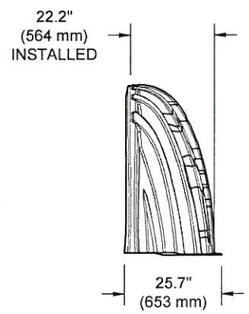
NTS











NOMINAL CHAMBER SPECIFICATIONS

SIZE (W X H X INSTALLED LENGTH)	77.0" X 45.0" X 86.0"	(1956 mm X 1143 mm X 2184 mm)
CHAMBER STORAGE	109.9 CUBIC FEET	(3.11 m³)
MINIMUM INSTALLED STORAGE*	178.9 CUBIC FEET	(5.06 m³)
WEIGHT	134 lbs.	(60.8 kg)

NOMINAL END CAP SPECIFICATIONS

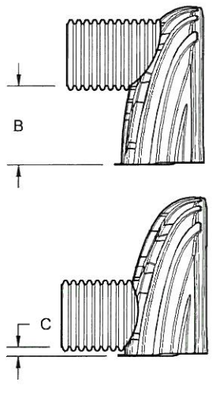
SIZE (W X H X INSTALLED LENGTH)	75.0" X 45.0" X 22.2"	(1905 mm X 1143 mm X 564 mm)
END CAP STORAGE	14.9 CUBIC FEET	(0.42 m³)
MINIMUM INSTALLED STORAGE*	46.0 CUBIC FEET	(1.30 m³)
WEIGHT	49 lbs.	(22.2 kg)

*ASSUMES 12" (305 mm) STONE ABOVE, 9" (229 mm) STONE FOUNDATION AND BETWEEN CHAMBERS, 6" (152 mm) STONE PERIMETER IN FRONT OF END CAPS AND 40% STONE POROSITY

STUBS AT BOTTOM OF END CAP FOR PART NUMBERS ENDING WITH "B"
STUBS AT TOP OF END CAP FOR PART NUMBERS ENDING WITH "T"
END CAPS WITH A WELDED CROWN PLATE END WITH "C"
END CAPS WITH A PREFABRICATED WELDED STUB END WITH "W"

PART #	STUB	B	C
MC3500IEPP06T	6" (150 mm)	33.21" (844 mm)	---
MC3500IEPP06B		---	0.66" (17 mm)
MC3500IEPP08T	8" (200 mm)	31.16" (791 mm)	---
MC3500IEPP08B		---	0.81" (21 mm)
MC3500IEPP10T	10" (250 mm)	29.04" (738 mm)	---
MC3500IEPP10B		---	0.93" (24 mm)
MC3500IEPP12T	12" (300 mm)	26.36" (670 mm)	---
MC3500IEPP12B		---	1.35" (34 mm)
MC3500IEPP15T	15" (375 mm)	23.39" (594 mm)	---
MC3500IEPP15B		---	1.50" (38 mm)
MC3500IEPP18TC	18" (450 mm)	20.03" (509 mm)	---
MC3500IEPP18TW			
MC3500IEPP18BC		---	1.77" (45 mm)
MC3500IEPP18BW			
MC3500IEPP24TC	24" (600 mm)	14.48" (368 mm)	---
MC3500IEPP24TW			
MC3500IEPP24BC		---	2.06" (52 mm)
MC3500IEPP24BW			
MC3500IEPP30BC	30" (750 mm)	---	2.75" (70 mm)

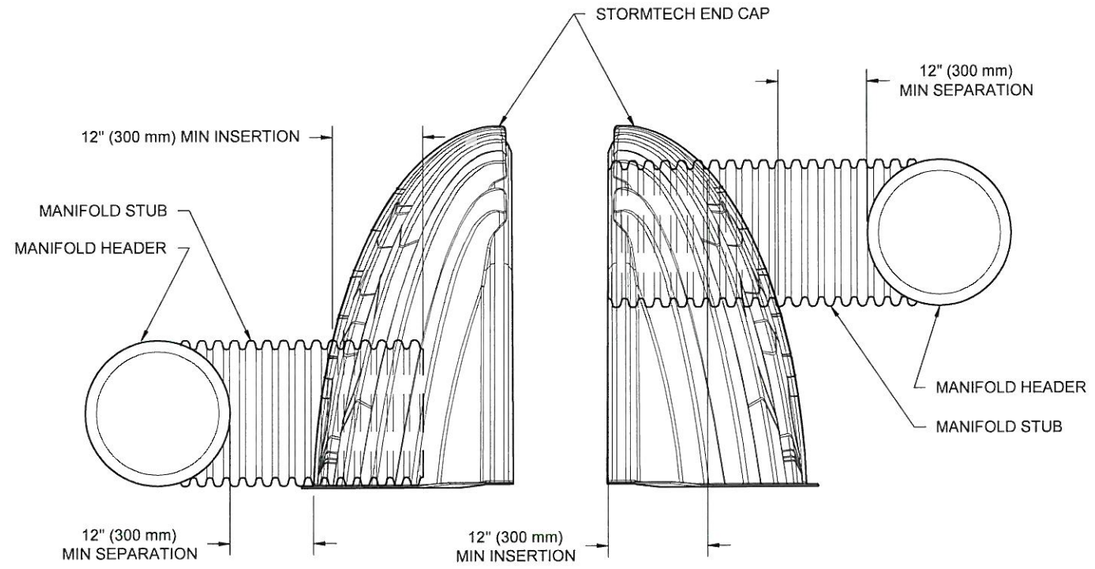
NOTE: ALL DIMENSIONS ARE NOMINAL



CUSTOM PRECORED INVERTS ARE AVAILABLE UPON REQUEST. INVENTORIED MANIFOLDS INCLUDE 12-24" (300-600 mm) SIZE ON SIZE AND 15-48" (375-1200 mm) ECCENTRIC MANIFOLDS. CUSTOM INVERT LOCATIONS ON THE MC-3500 END CAP CUT IN THE FIELD ARE NOT RECOMMENDED FOR PIPE SIZES GREATER THAN 10" (250 mm). THE INVERT LOCATION IN COLUMN 'B' ARE THE HIGHEST POSSIBLE FOR THE PIPE SIZE.

MC-SERIES END CAP INSERTION DETAIL

NTS



NOTE: MANIFOLD STUB MUST BE LAID HORIZONTAL FOR A PROPER FIT IN END CAP OPENING.

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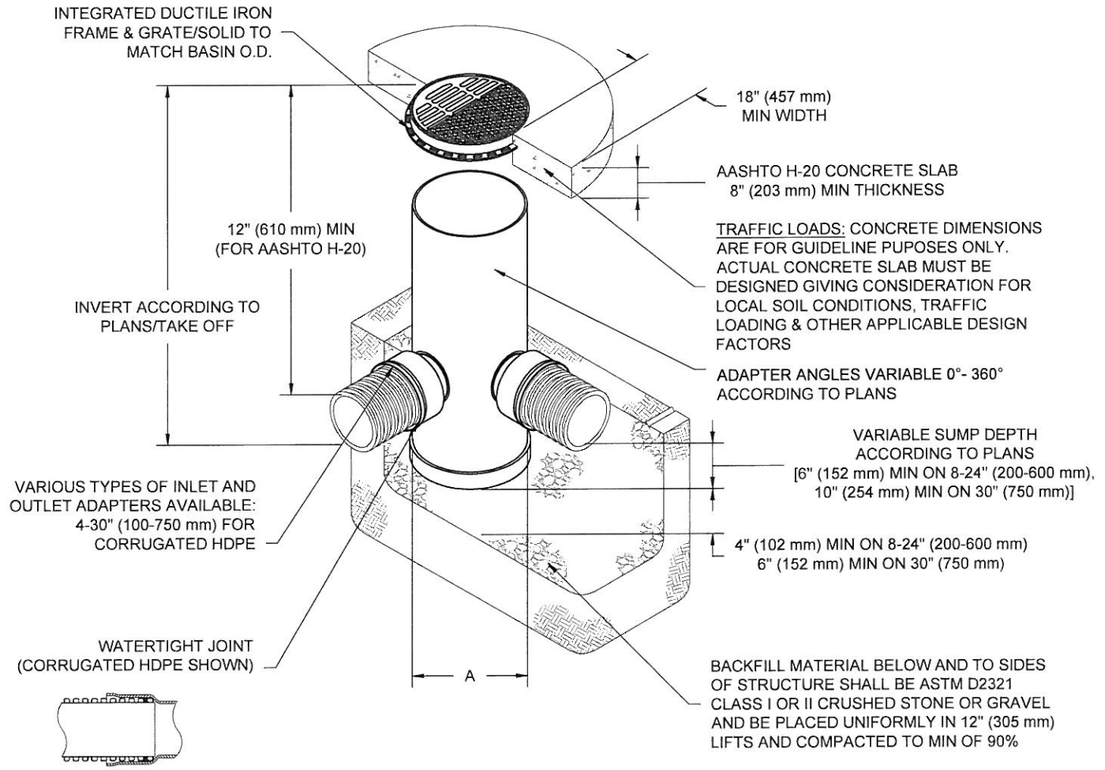

NOTES

1. 8-30" (200-750 mm) GRATES/SOLID COVERS SHALL BE DUCTILE IRON PER ASTM A536 GRADE 70-50-05
2. 12-30" (300-750 mm) FRAMES SHALL BE DUCTILE IRON PER ASTM A536 GRADE 70-50-05
3. DRAIN BASIN TO BE CUSTOM MANUFACTURED ACCORDING TO PLAN DETAILS
4. DRAINAGE CONNECTION STUB JOINT TIGHTNESS SHALL CONFORM TO ASTM D3212 FOR CORRUGATED HDPE (ADS & HANCOR DUAL WALL) & SDR 35 PVC
5. FOR COMPLETE DESIGN AND PRODUCT INFORMATION: **WWW.NYLOPLAST-US.COM**
6. TO ORDER CALL: **800-821-6710**

A	PART #	GRATE/SOLID COVER OPTIONS		
8" (200 mm)	2808AG	PEDESTRIAN LIGHT DUTY	STANDARD LIGHT DUTY	SOLID LIGHT DUTY
10" (250 mm)	2810AG	PEDESTRIAN LIGHT DUTY	STANDARD LIGHT DUTY	SOLID LIGHT DUTY
12" (300 mm)	2812AG	PEDESTRIAN AASHTO H-10	STANDARD AASHTO H-20	SOLID AASHTO H-20
15" (375 mm)	2815AG	PEDESTRIAN AASHTO H-10	STANDARD AASHTO H-20	SOLID AASHTO H-20
18" (450 mm)	2818AG	PEDESTRIAN AASHTO H-10	STANDARD AASHTO H-20	SOLID AASHTO H-20
24" (600 mm)	2824AG	PEDESTRIAN AASHTO H-10	STANDARD AASHTO H-20	SOLID AASHTO H-20
30" (750 mm)	2830AG	PEDESTRIAN AASHTO H-20	STANDARD AASHTO H-20	SOLID AASHTO H-20

COPPER RIDGE CROSSING
COLORADO SPRINGS, CO

DATE: 08/13/2018 DRAWN: MFS
PROJECT #: S096530 CHECKED: RWD

DATE	DRWN	CHKD	DESCRIPTION
08/28/18	GDL	ALS	REVISED PER PLAN
08-21-18	LAH	KMS	REMOVED INLET/ISO ROW PER MARKUP
08/17/18	GDL	JM	ADJUST INVERTS PER PLAN

3130 VERONA AVE
BUFORD, GA 30518
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FAX (770) 932-2490
www.nyloplast-us.com

4640 TRUEMAN BLVD
HILLIARD, OH 43026

Appendix D
Variance Request Letter
Copper Ridge Crossing Variance Request – StormTech Isolator Row letter

EXECUTIVE CONSULTING ENGINEERS, INC

Variance Request

Date: November 9, 2018

Applicant:

Executive Consulting Engineers, Inc.
13540 Meadowgrass Drive, Suite 200
Colorado Springs, CO 80921
Attn: Bob H. Yoo, P.E.

Project:

Copper Ridge Crossing at Northgate including Polaris Pointe Shops Filing no. 3 development area is located in the northeast and northwest quarter of Section 7, northwest quarter of Section 17 and southeast quarter of Section 8, Township 12 South, Range 66 West of the Sixth Principal Meridian, El Paso County, Colorado. Copper Ridge Crossing at Northgate is located within the Polaris Pointe at Northgate Master Plan area. The site is bordered by Spectrum Loop to the north and west, Voyager Parkway to the east and Powers Boulevard Right-of-Way to the south.

The proposed overall development is a 30.42 acre tract of future commercial use land development including the proposed Polaris Pointe Shops Filing no. 3 developments to include a driving range center and a trampoline center. The largest parcel is occupied by the proposed driving range center with approximately 4.2 acres of driving range field. An existing Public Water Quality and Extended Detention Basin facility was constructed in the year of 2016 and is providing the required Water Quality and detention volume for the existing developments, an automatic carwash facility and two separate restaurant sites adjacent to Voyager Parkway. The existing Public Water Quality/Extended Detention Basin facility and its appurtenances will be removed and will be replaced with the Private Water Quality/ADS Underground system. This underground system is designed with ADS Stormtech MC-3500 system and provides adequate Water Quality Captured Volume and required Detention Volume for the entire Copper Ridge Crossing at Northgate drainage areas.

The specified underground system, ADS Stormtech MC-3500 system, will be installed in the place of the existing Public Water Quality/Extended Detention Basin facility. This underground system will be constructed in the proposed driving range field in Polaris Pointe Shops Filing no. 3.

13540 Meadowgrass Drive, Suite 200
Colo. Spgs, CO 80921, U.S.A.
Phone (719) 531-0707
Fax (719) 531-7622

Variance Request:

Requesting for an installation of an Advanced Drainage Systems Underground Detentions System including Water Quality & Detention Structure and seeking a variance from the City of Colorado Springs Drainage Criteria Manual, Volume 2, Chapter 4, Section 4.

Justification:

As noted above, an existing Public Water Quality/Extended Detention Basin facility was designed and was constructed in the year of 2016 to provide adequate Water Quality/Detention Basin for the entire 30.42 acres of commercial use developments. The developer's vision for a driving range project was introduced in early 2018, and the project required a large tract of the land for a driving range field. An underground water quality and detention system was the best fit for the proposed use for a driving range utilizing the driving range field and still provides the required Water Quality/Detention Basin for the entire 30.42 acre tract of land.

The proposed Advanced Drainage Systems Underground Detentions System, ADS Stormtech MC-3500, is designed to provide full release of the EURV full-spectrum detention with a minimum of 72-hour drain time. Attached Advanced Drainage Systems Product Claim and Certification in the Variance Request letter certifies that the ADS Stormtech MC-3500 Chamber System's TSS removal is 80% removal rate to treat the water quality flow rate at a specific flow rate not to exceed 2.5 gpm/sq. ft. of bottom are using two layers of ADS StormPro or approved equal woven geotextile.

In summary, developed flows from the proposed areas will be routed into the new private ADS MC-3500 Underground Storm Water Quality/ Detention Chamber system. This facility will restrict the flows well below historical flows for all six-storms per El Paso County/City's policy for upstream development of the Air Force Academy and will also provide required stormwater quality measures, and the proposed drainage characteristics will remain consistent with historical conditions and with the overall drainage plan for the area. This underground system and drainage facilities are adequately designed per the City of Colorado Springs Drainage Criteria and the Urban Drainage and Flood Control District Criteria, and with construction of the drainage facilities, proposed development will not adversely affect downstream or surrounding developments. This variance will not increase peak flows from the site.

Final built-out of the Private ADS Underground Storm Water Quality/ Detention Chambers will be owned and will be maintained by the Copper Ridge at Northgate District. This includes all storm appurtenances in the ADS Underground Storm Water Quality/ Detention Chambers, outlet structure and outlet pipe. The main access to the facility is the same access for the driving range field equipment. The access is located next to the southeast corner of the building. The exhibits attached show the detail of the access drive and the entrance to the facility.

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Supporting Documentation:

"Copper Ridge Crossing Variance Request – StormTech Isolator Row" supporting document is provided as an attachment in accordance with the requirement set force in the City of Colorado Springs Drainage Criteria Manual, Volume 1, Chapter 1, Section 10.

Sincerely,

EXECUTIVE CONSULTING ENGINEERS, INC.

Bob H. Yoo, P.E

Colorado no. 36793

13540 Meadowgrass Drive, Suite 200
Colo. Spgs, CO 80921, U.S.A.
Phone (719) 531-0707
Fax (719) 531-7622

October 18th, 2018

Subject: Copper Ridge Crossing Variance Request - StormTech Isolator Row

To Whom It May Concern,

StormTech requests your approval for "general use level" of the Isolator™ Row, which is a patented filtration type BMP manufactured by StormTech, LLC for The Copper Ridge Crossing Project in Colorado Springs, CO. The Isolator Row is covered under US Patent No.: US 6,991,734 B1.

1.a. Description:

The Isolator Row is a row or rows of StormTech thermoplastic chambers that are wrapped in filter fabric and installed below grade. Stormwater enters the chambers and must pass through the filter fabric media where sediments and other contaminants are filtered out as stormwater exits the Isolator Row through the fabric.

Some of the unique features of the Isolator Row that contribute to its effectiveness and practicality include:

- Vast filtration area – each MC-3500 chamber has 43.2 square feet of filtration area through the bottom filter fabric
- Large sediment storage volume
- Entire bottom area accessible for cleaning without obstructions within the row
- A state-of-the-art structural design that meets AASHTO safety factors for both live loads and permanent dead loads

1.b. Applicable Sites:

The Isolator Row can be effectively used for essentially all developed sites. The most common applications are highly impervious sites such as paved parking areas, roads as well as developed sites that include grassy or other landscaped areas. It is not intended to be used for construction sediments.

1.c Isolator Row Approvals:

The Isolator Row has been approved on a project by project basis for thousands of projects around the United States. Following are some examples:

- In Massachusetts, approvals for the State DEP requirement of 80% TSS removal on an annual load basis are issued at the Conservation Commission level, and the Isolator Row is commonly used to meet this criteria.
- In 2004 the Maine DEP approved the Isolator Row based on laboratory testing of 110 micron (US Silica OK-110) particle size
- Under the New Environmental Technology Evaluation program, the Ontario (Canada) Ministry of the Environment has evaluated the Isolator row and issued a Certificate of Technology Assessment

1.d. Manufacturer History:

After many years developing and providing chamber systems for both septic and stormwater applications, StormTech owners formed StormTech, LLC in 2003 as a joint venture Company to focus exclusively on stormwater. All StormTech chambers are produced in the United States. As of this date, StormTech has millions of chambers installed, primarily for commercial applications within the United States, but installation locations also include Canada, Europe, Australia and the Middle East.

The Isolator Row was developed in 2003 initially as a maintenance feature, essentially to capture sediments that could otherwise accumulate in the open graded stone that surrounds the chambers. This open graded stone serves two roles; 1) to provide the important structural soil support of the soil–structure interaction system and 2) to provide open porosity to store stormwater. The Isolator Row was found to be so effective at capturing sediments that many regulators began allowing the Isolator Row as a sediment removal BMP for water quality.

StormTech engineering personnel include decades of experience in water quality. Our collective in-house engineering experience includes years with manufacturers of hydrodynamic separators, filter systems, consulting engineering and regulators. For performance evaluations relative to water quality, StormTech has gone too qualified outside researcher institutions such as Tennessee Tech University and the University of New Hampshire Stormwater Center.

History of StormTech Chamber Water Quality Testing:

- February 23, 2005 - Tennessee Tech University summarized laboratory testing on the Isolator Row in accordance with Maine DEP testing protocol. Tests demonstrated the following:
    - 95% TSS overall removal at 8.1 gpm/sqft for US Silica OK-110 (110 micron).
    - 80% captured on fabric, 15% captured in stone

- October 20, 2006 - Tennessee Tech University summarized laboratory testing on the Isolator Row in accordance with New Jersey Center for Advanced Technologies (NJCAT) testing protocol. Tests demonstrated the following:
    - 60% TSS Removal at 3.2 gpm/sqft for Sil-Co-Sil 106 with accumulated fines (D50 = 10 microns)
    - 66% TSS Removal at 3.2 gpm/sqft for Sil-Co-Sil 106 (D50 = 22 microns)
    - 71% TSS Removal at 3.2 gpm/sqft for Sil-Co-Sil 250 (D50 = 45 microns)
    - 88% TSS Removal at 1.7 gpm/sqft for Sil-Co-Sil 250 (D50 = 45 microns)

- August, 2007 – NJCAT summarized its third party evaluation of the Tennessee Tech test results and produced the "NJCAT Technology Verification Report StormTech Isolator Row". Their verification is summarized as follows:

    - **Claim 1:** A StormTech® SC-740 Isolator™ Row, sized at a treatment rate of no more than 2.5 gpm/ft2 of bottom area, using two layers of woven geotextile fabric under the base of the system and one layer of non-woven fabric wrapped over the top of the system and a mean event influent concentration of 270 mg/L (range of 139 – 361 mg/L) has been shown to have a TSS removal efficiency (measured as SSC) of at least 60% for SIL-CO-SIL 106, a manufactured silica product with an average particle size of 22 microns, in laboratory studies using simulated stormwater.

- **Claim 2:** A StormTech® SC-740 Isolator™ Row, sized at a treatment rate of no more than 2.5 gpm/ft2 of bottom area, using two layers of woven geotextile fabric Page 3 under the base of the system and one layer of non-woven fabric wrapped over the top of the system and a mean event influent concentration of 318 mg/L (range of 129 – 441 mg/L) has been shown to have a TSS removal efficiency (measured as SSC) of 84% for SIL-CO-SIL 250, a manufactured silica product with an average particle size of 45 microns, in laboratory studies using simulated stormwater.

- **Claim 3:** A StormTech® SC-740 Isolator™ Row, sized at a treatment rate of no more than 6.5 gpm/ft2 of bottom area, using a single layer of woven geotextile fabric under the base of the system and one layer of non-woven fabric wrapped over the top of the system and a mean event influent concentration of 371 mg/L (range of 116 – 614 mg/L) has been shown to have a TSS removal efficiency (measured as SSC) of greater than 95% for OK-110, a manufactured silica product with an average particle size of 110 microns, in laboratory studies using simulated stormwater.

- September 2010 – The University of New Hampshire Stormwater Center released the Final Report on Field Verification Testing of the StormTech Isolator Row Treatment Unit. Testing consisted of determining the water quality performance for multiple stormwater pollutants in accordance with TARP Tier II protocol. Data was recorded for 23 storm events.
  - TSS median removal efficiency – 83%
  - Petroleum Hydrocarbons median removal efficiency – 91%
  - Zinc median removal efficiency – 57%
  - Phosphorus median removal efficiency – 33%

- July 2013 – The City of Charlotte performed an independent study on the StormTech chambers system for the Cherry Gardens Senior Apartments project in Charlotte, NC. Data was recorded for 14 paired storm events. The results for the event mean concentration reductions of the median values are as follows:
  - TSS – 89%
  - Total nitrogen – 37%
  - Total Phosphorus – 68%
  - Zinc – 76%

1.e. Requested Use Level Designation Approval:

In support of this request, StormTech is providing test results from both laboratory and field studies by others that demonstrate that the "performance requirement" is met.

Product Performance Claim and Certification
80% TSS removal is achieved by sizing Isolator Rows to treat the water quality flow rate at a specific flow rate not to exceed 2.5 gpm/sqft of bottom area using two layers of ADS StormPro or approved equal woven geotextile.

Model	Specific Flow Rate	Bottom Area	Flow Per Model
StormTech SC-310	2.5 gpm/sf	17.7 sf	0.10 cfs
StormTech SC-740	2.5 gpm/sf	27.8 sf	0.15 cfs
StormTech DC-780	2.5 gpm/sf	27.8 sf	0.15 cfs
StormTech RC-310	2.5 gpm/sf	17.7 sf	0.10 cfs
StormTech RC-750	2.5 gpm/sf	27.8 sf	0.15 cfs
StormTech MC-3500	2.5 gpm/sf	43.2 sf	0.24 cfs
StormTech MC-4500	2.5 gpm/sf	30.1 sf	0.16 cfs

We therefore respectfully request that both Colorado Springs and Pueblo County evaluate the Isolator Row based on the required performance requirements. I trust this provides sufficient information on the StormTech Isolator Row to enable your evaluation. However, should you have any questions or require additional information. Please do not hesitate to call us directly.

Sincerely,

Evan Fischgrund

Evan Fischgrund
Engineered Product Manager
Advanced Drainage Systems
Phone: 720-250-8047
e-mail: evan.fischgrund@ads-pipe.com

COPPER RIDGE METROPOLITAN DISTRICT

November 9, 2018

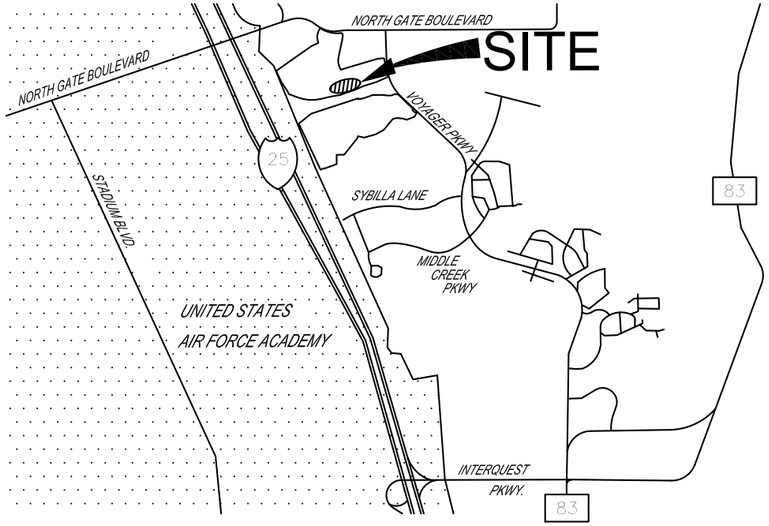
Anna Bergmark
Water Resources Engineering Division
City of Colorado Springs
30 S. Nevada Ave., Suite 401
Colorado Springs, CO 80901

Dear Ms. Bergmark,

The Copper Ridge Metropolitan District will own and maintain the Underground Advanced Drainage System Storm Water Quality and Detention Basin Facility to be located in Polaris Pointe Shops Filing No. 3. This facility is referenced in the Addendum to Master Development Drainage Plan for Copper Ridge Crossing at Northgate & Final Drainage Report for Polaris Pointe Shops Filing No. 3. The District is aware of the maintenance requirements for the system.

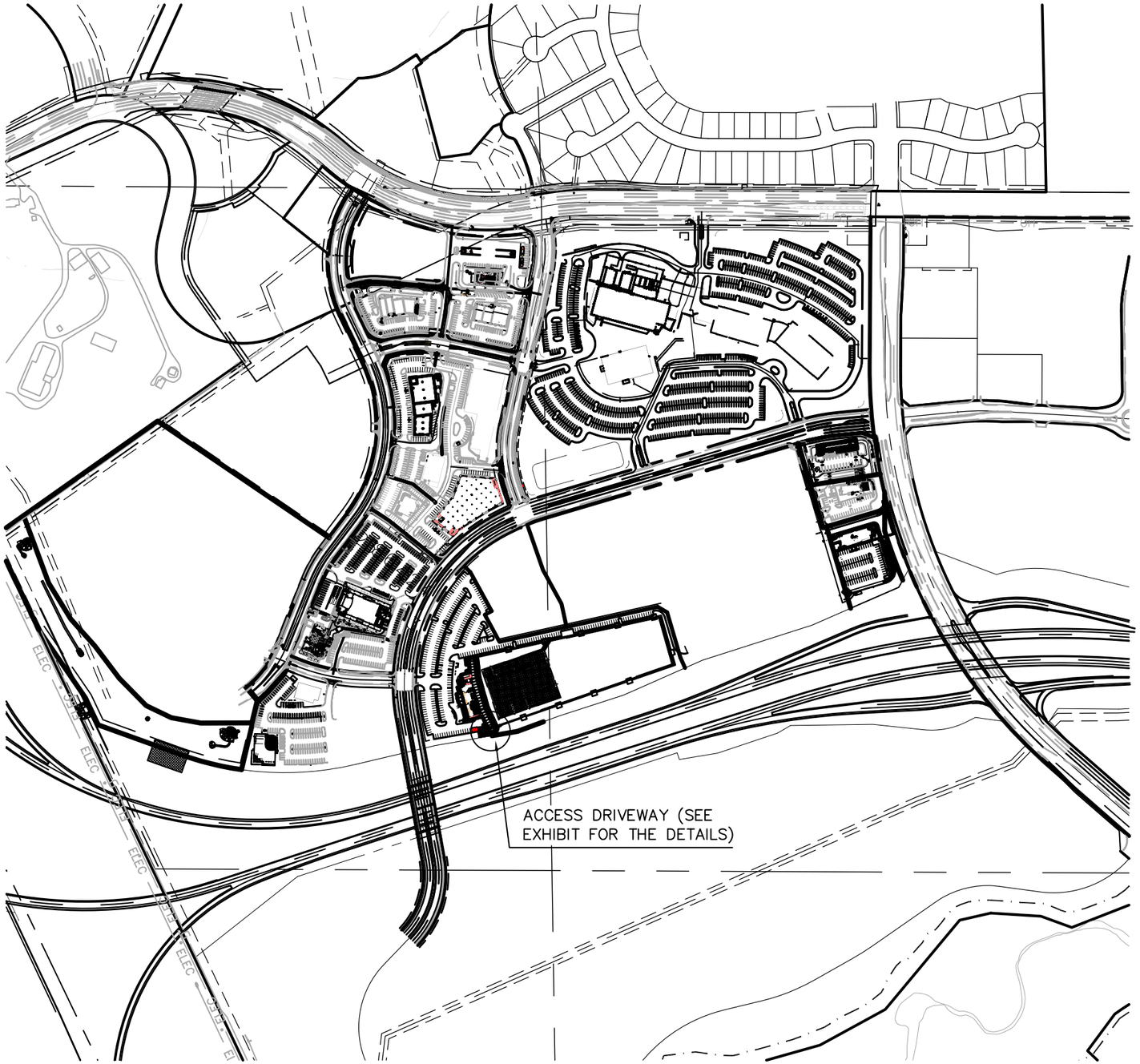
Sincerely,

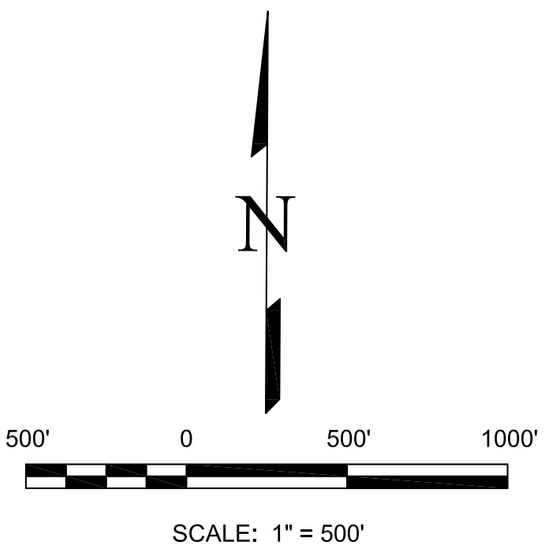
Timothy R. Mitros, P.E.
District Manager
Copper Ridge Metropolitan District
Office: 719-531-0707 Ext 107
Cell/Text: 719-271-0709
Tim@Executive-Company.com
http://polarispointeshops.com/



VICINITY MAP

NOT TO SCALE





SCALE: 1" = 500'

ECE
EXECUTIVE CONSULTING ENGINEERS
13540 Meadowgrass Drive Suite 200
Colorado Springs, Colorado 80921
(719) 531-0707

REVISION DESCRIPTION	BY	DATE

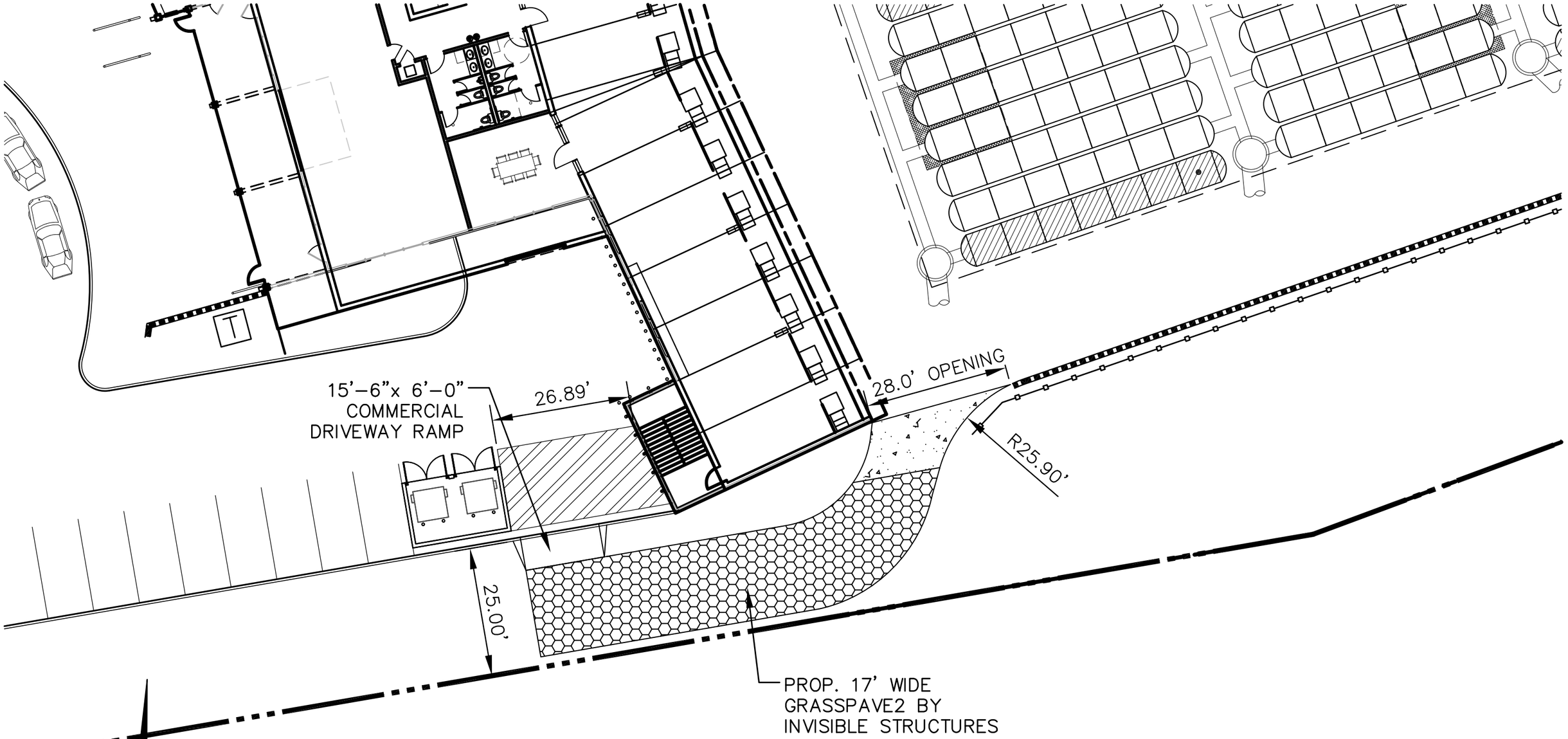
PROJECT NAME

MDDP FOR COPPER RIDGE CROSSING AT NORTHGATE

VARIANCE REQUEST FOR A UNDERGROUND DETENTION

SHEET: 1 OF 2

DRAWING TITLE	OVERALL SITE PLAN & VICINITY MAP			Project No: 1810
H-Scale: 1"=500'	V-Scale: NTS	Designed: BHY	Checked: BHY	Issued date: 11/09/18



SCALE: 1" = 20'

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EXECUTIVE CONSULTING ENGINEERS
13540 Meadowgrass Drive Suite 200
Colorado Springs, Colorado 80921
(719) 531-0707

REVISION DESCRIPTION	BY	DATE

PROJECT NAME

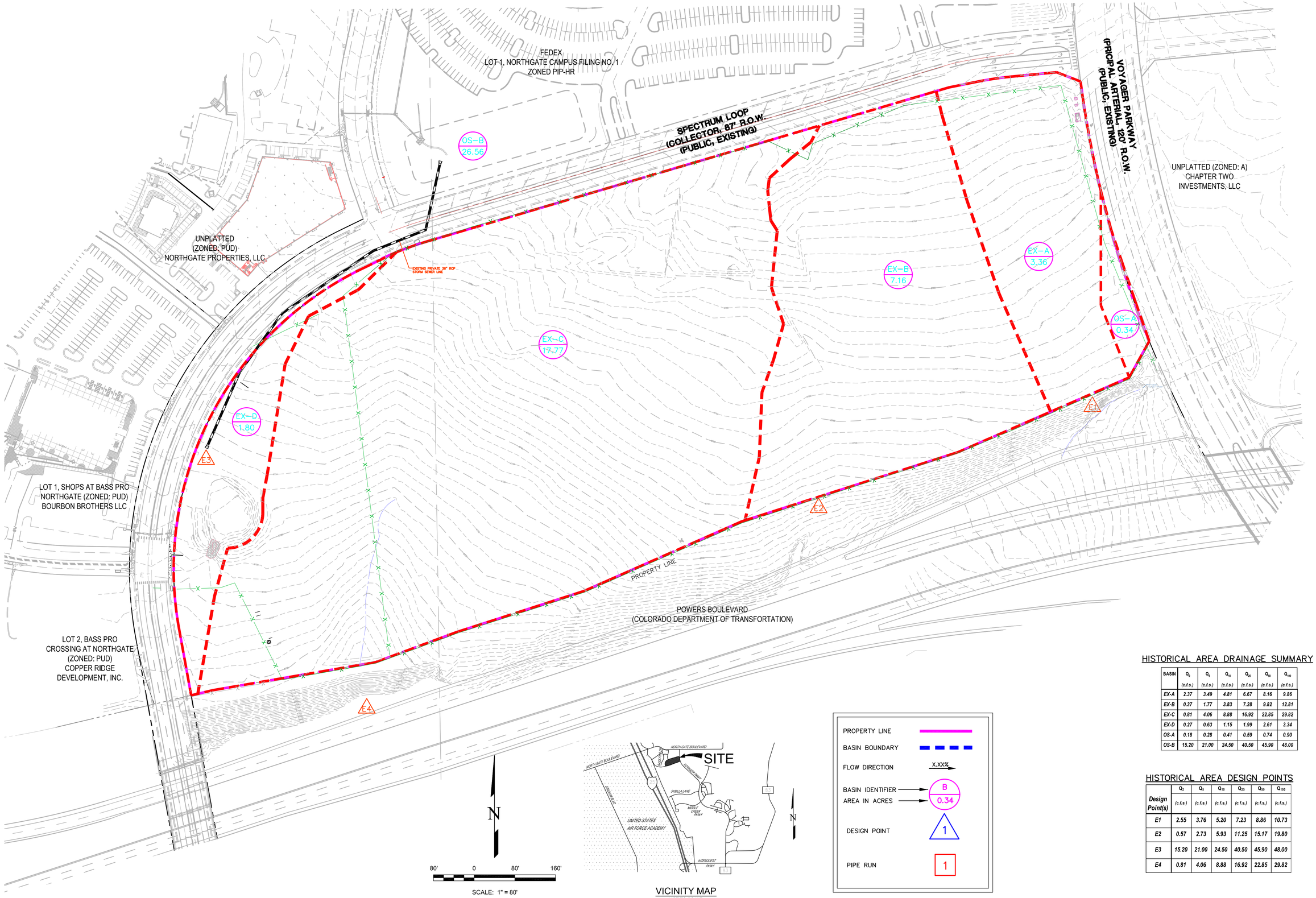
MDDP FOR COPPER RIDGE CROSSING AT NORTHGATE

VARIANCE REQUEST FOR A UNDERGROUND DETENTION

SHEET: 2 OF 2

DRAWING TITLE	ACCESS DRIVE PLAN			Project No: 1810
H-Scale: 1"=20'	V-Scale: NTS	Designed: BHY	Checked: BHY	Issued date: 11/09/18

Appendix E
Existing Drainage Condition Map
Proposed Drainage Condition Map



HISTORICAL AREA DRAINAGE SUMMARY

BASIN	Q_2 (c.f.s.)	Q_5 (c.f.s.)	Q_{10} (c.f.s.)	Q_{25} (c.f.s.)	Q_{50} (c.f.s.)	Q_{100} (c.f.s.)
EX-A	2.37	3.49	4.81	6.67	8.16	9.86
EX-B	0.37	1.77	3.83	7.28	9.82	12.81
EX-C	0.81	4.06	8.88	16.92	22.85	29.82
EX-D	0.27	0.63	1.15	1.99	2.61	3.34
OS-A	0.18	0.28	0.41	0.59	0.74	0.90
OS-B	15.20	21.00	24.50	40.50	45.90	48.00

HISTORICAL AREA DESIGN POINTS

Design Point(s)	Q_2 (c.f.s.)	Q_5 (c.f.s.)	Q_{10} (c.f.s.)	Q_{25} (c.f.s.)	Q_{50} (c.f.s.)	Q_{100} (c.f.s.)
E1	2.55	3.76	5.20	7.23	8.86	10.73
E2	0.57	2.73	5.93	11.25	15.17	19.80
E3	15.20	21.00	24.50	40.50	45.90	48.00
E4	0.81	4.06	8.88	16.92	22.85	29.82

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Suite 200
Colorado Springs, Colorado
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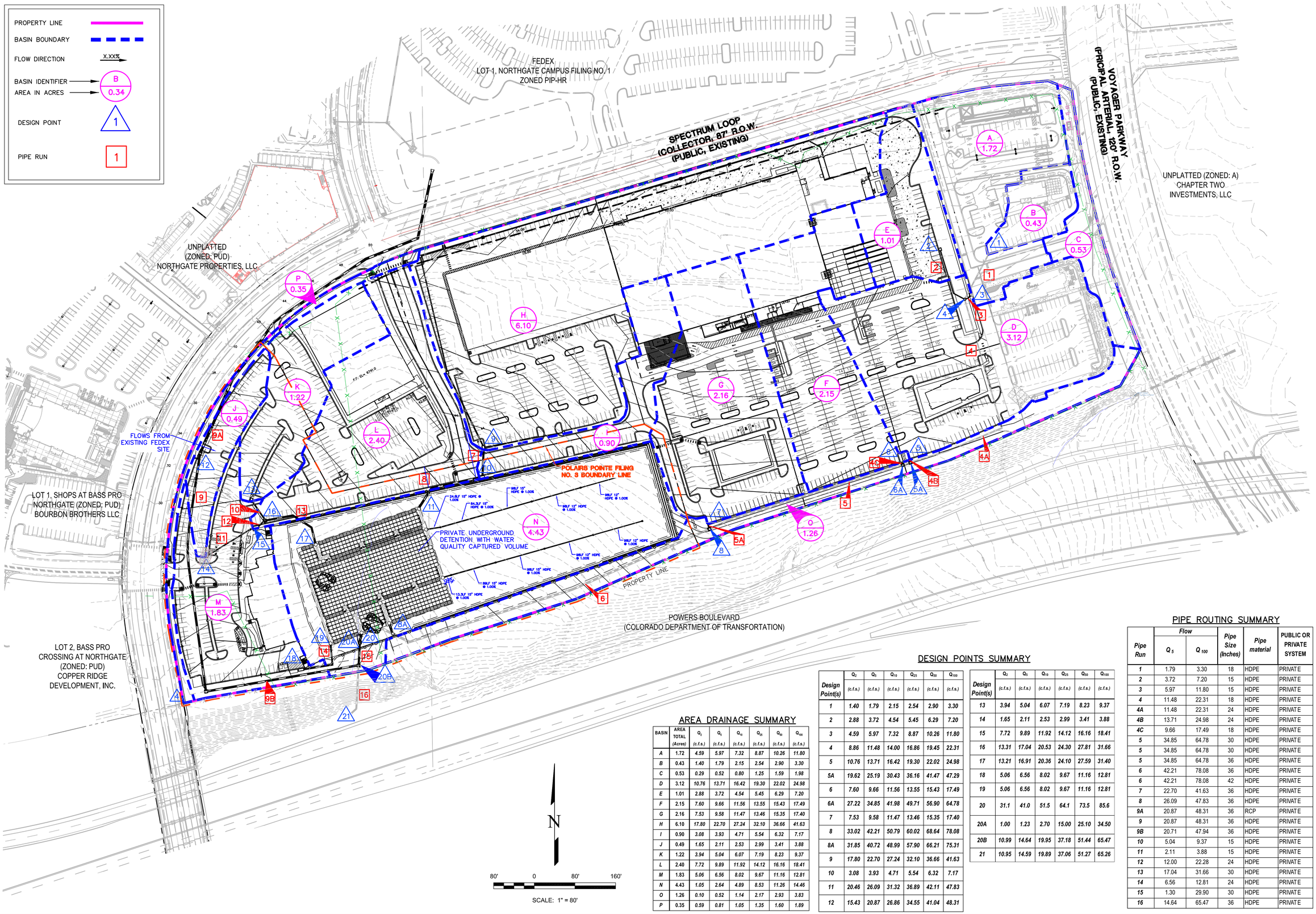
NO.	REVISION DESCRIPTION	BY	DATE
1	1ST CITY COMMENTS	BHY	10/31/18
2	ADDENDUM TO MDDP	BHY	09/04/18

PROJECT NAME
COPPER RIDGE CROSSING AT NORTHGATE
-
COLORADO SPRINGS, COLORADO

DRAWING TITLE
PRE-DEVELOPED CONDITIONS
DRAINAGE MAP

H-Scale	1"=80'
V-Scale	N/A
Date	09/04/2018
Project No.	1810
Drawn by	BHY
Designed by	BHY
Approved by	–
SHEET:	**DM-1**

SHEET 1 OF 2



AREA DRAINAGE SUMMARY

BASIN	AREA TOTAL (Acres)	Q_2 (c.f.s.)	Q_5 (c.f.s.)	Q_{10} (c.f.s.)	Q_{25} (c.f.s.)	Q_{50} (c.f.s.)	Q_{100} (c.f.s.)
A	1.72	4.59	5.97	7.32	8.87	10.26	11.80
B	0.43	1.40	1.79	2.15	2.54	2.90	3.30
C	0.53	0.29	0.52	0.80	1.25	1.59	1.98
D	3.12	10.76	13.71	16.42	19.30	22.02	24.98
E	1.01	2.88	3.72	4.54	5.45	6.29	7.20
F	2.15	7.60	9.66	11.56	13.55	15.43	17.49
G	2.16	7.53	9.58	11.47	13.46	15.35	17.40
H	6.10	17.80	22.70	27.24	32.10	36.66	41.63
I	0.90	3.08	3.93	4.71	5.54	6.32	7.17
J	0.49	1.65	2.11	2.53	2.99	3.41	3.88
K	1.22	3.94	5.04	6.07	7.19	8.23	9.37
L	2.40	7.72	9.89	11.92	14.12	16.16	18.41
M	1.83	5.06	6.56	8.02	9.67	11.16	12.81
N	4.43	1.05	2.64	4.89	8.53	11.26	14.46
O	1.26	0.10	0.52	1.14	2.17	2.93	3.83
P	0.35	0.59	0.81	1.05	1.35	1.60	1.89

DESIGN POINTS SUMMARY

Design Point(s)	Q_2 (c.f.s.)	Q_5 (c.f.s.)	Q_{10} (c.f.s.)	Q_{25} (c.f.s.)	Q_{50} (c.f.s.)	Q_{100} (c.f.s.)
1	1.40	1.79	2.15	2.54	2.90	3.30
2	2.88	3.72	4.54	5.45	6.29	7.20
3	4.59	5.97	7.32	8.87	10.26	11.80
4	8.86	11.48	14.00	16.86	19.45	22.31
5	10.76	13.71	16.42	19.30	22.02	24.98
5A	19.62	25.19	30.43	36.16	41.47	47.29
6	7.60	9.66	11.56	13.55	15.43	17.49
6A	27.22	34.85	41.98	49.71	56.90	64.78
7	7.53	9.58	11.47	13.46	15.35	17.40
8	33.02	42.21	50.79	60.02	68.64	78.08
8A	31.85	40.72	48.99	57.90	66.21	75.31
9	17.80	22.70	27.24	32.10	36.66	41.63
10	3.08	3.93	4.71	5.54	6.32	7.17
11	20.46	26.09	31.32	36.89	42.11	47.83
12	15.43	20.87	26.86	34.55	41.04	48.31

Design Point(s)	Q_2 (c.f.s.)	Q_5 (c.f.s.)	Q_{10} (c.f.s.)	Q_{25} (c.f.s.)	Q_{50} (c.f.s.)	Q_{100} (c.f.s.)
13	3.94	5.04	6.07	7.19	8.23	9.37
14	1.65	2.11	2.53	2.99	3.41	3.88
15	7.72	9.89	11.92	14.12	16.16	18.41
16	13.31	17.04	20.53	24.30	27.81	31.66
17	13.21	16.91	20.36	24.10	27.59	31.40
18	5.06	6.56	8.02	9.67	11.16	12.81
19	5.06	6.56	8.02	9.67	11.16	12.81
20	31.1	41.0	51.5	64.1	73.5	85.6
20A	1.00	1.23	2.70	15.00	25.10	34.50
20B	10.99	14.64	19.95	37.18	51.44	65.47
21	10.95	14.59	19.89	37.06	51.27	65.26

PIPE ROUTING SUMMARY

Pipe Run	Flow Q_5	Flow Q_{100}	Pipe Size (Inches)	Pipe material	PUBLIC OR PRIVATE SYSTEM
1	1.79	3.30	18	HDPE	PRIVATE
2	3.72	7.20	15	HDPE	PRIVATE
3	5.97	11.80	15	HDPE	PRIVATE
4	11.48	22.31	18	HDPE	PRIVATE
4A	11.48	22.31	24	HDPE	PRIVATE
4B	13.71	24.98	24	HDPE	PRIVATE
4C	9.66	17.49	18	HDPE	PRIVATE
5	34.85	64.78	30	HDPE	PRIVATE
5	34.85	64.78	30	HDPE	PRIVATE
5	34.85	64.78	36	HDPE	PRIVATE
6	42.21	78.08	36	HDPE	PRIVATE
6	42.21	78.08	42	HDPE	PRIVATE
7	22.70	41.63	36	HDPE	PRIVATE
8	26.09	47.83	36	HDPE	PRIVATE
9A	20.87	48.31	36	RCP	PRIVATE
9	20.87	48.31	36	HDPE	PRIVATE
9B	20.71	47.94	36	HDPE	PRIVATE
10	5.04	9.37	15	HDPE	PRIVATE
11	2.11	3.88	15	HDPE	PRIVATE
12	12.00	22.28	24	HDPE	PRIVATE
13	17.04	31.66	30	HDPE	PRIVATE
14	6.56	12.81	24	HDPE	PRIVATE
15	1.30	29.90	30	HDPE	PRIVATE
16	14.64	65.47	36	HDPE	PRIVATE

ECE
EXECUTIVE CONSULTING ENGINEERS
13540 Meadowgrass Drive
Suite 200
Colorado Springs, Colorado
80921
(719) 531-0707

NO.	REVISION DESCRIPTION	BY	DATE
1	1ST CITY COMMENTS	BHY	10/31/18
2	ADDENDUM TO MDDP	BHY	09/04/18
3	CITY COMMENTS	BHY	10/8/18
4	CITY COMMENTS	BHY	11/12/18

PROJECT NAME
COPPER RIDGE CROSSING AT NORTHGATE
COLORADO SPRINGS, COLORADO

DRAWING TITLE
DEVELOPED CONDITIONS
DRAINAGE MAP

H-Scale	1"=80'
V-Scale	N/A
Date	09/04/18
Project No.	1810
Drawn by	BHY
Designed by	BHY
Approved by	_
SHEET:	**DM-2**

SHEET 2 OF 2