

**FINAL DRAINAGE REPORT  
FOR  
RESERVE AT NORTHCREEK  
AND  
ADDENDUM TO “THE MASTER DEVELOPMENT  
DRAINAGE PLAN FOR MARKETPLACE AT  
INTERQUEST AND FINAL DRAINAGE REPORT FOR  
MARKETPLACE AT INTERQUEST FILING NO. 1 AND  
FILING NO. 2”**

June 13, 2017

Prepared for:

Challenger Homes  
13630 Northgate Estates Drive  
Colorado Springs, CO 80921  
(719) 598-5191

Prepared By:



1115 US HWY 24  
SUITE 2D  
Divide, CO 80814  
719-426-2124


FINAL DRAINAGE REPORT  
RESERVE AT NORTHCREEK

**Engineer's Statement:**

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

**Certification Statement:**

This report and plan for the preliminary drainage design for the Reserve at Northcreek was prepared by me (or under my direct supervision) in accordance with the provisions of City of Colorado Springs Drainage Criteria Manual Volumes 1 and 2 Drainage Design and Technical Criteria for the owners thereof. I understand that the City of Colorado Springs does not and will not assume liability for drainage facilities designed by others.

  
\_\_\_\_\_  
David L. Mijares, Colorado PE #40510  
For and on behalf of Catamount Engineering

Date 6-17-17

**Developer's Statement:**

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

Challenger Homes hereby certifies that the drainage facilities for Reserve at Northcreek 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 the City of Colorado Springs reviews drainage plans pursuant to Colorado Revised Statutes, Title 30, Article 28; but cannot, on behalf of Reserve at Northcreek, guarantee that final drainage design review will absolve Challenger Homes 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.

\_\_\_\_\_  
Challenger Homes  
Business Name  
By: [Signature]  
Title: V.P. Land Development  
Address: 13630 Northgate Estates Drive  
Colorado Springs, CO 80921

**City of Colorado Springs Only:**

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

[Signature]  
\_\_\_\_\_  
For the City Engineer

6-16-17  
\_\_\_\_\_  
Date

Conditions:

# **FINAL DRAINAGE REPORT for RESERVE AT NORTHCREEK**

## **PURPOSE**

The purpose of this drainage report is to identify existing drainage patterns, quantify developed storm water runoff, and establish outfall scenarios from the proposed development. Additionally this analysis will establish compliance with previous drainage studies and provide for water quality and detention of developed runoff from the development.

## **GENERAL LOCATION AND DESCRIPTION**

The subject 10.4 acres is proposed to be platted into approximately 80 single family attached residential lots and is located within Section 21, Township 12 South, Range 66 West of the 6<sup>th</sup> principal meridian in the city of Colorado Springs, county of El Paso.

With annexation of the development parcel the City of Colorado Springs required reconstruction of the existing New Life Drive industrial collector from Jet Stream Drive intersection to the easterly boundary of the development. Roadway reconstruction will require utility corridor development, addition of westbound and eastbound bike lanes, development of curb and gutter, and construction of a 10' wide concrete trail along the projects frontage.

The parcel is bound to the north and east by unplatted land planned for residential development within City of Colorado Springs, to the south by New Life Drive, and to the west by International Bible Society Filing No. 1 (Biblica) zoned PIP 1.

The site is divided by a predominant ridge running east to west in the northern portion of the property. The northern portion of the site slopes at 6:1 or greater to the northwest and is within the Black Squirrel Creek Drainage Basin boundary. The remainder of the site drains to the southwest and New Life Drive within the Elkhorn Basin. Vegetative cover consists of sparse native grasses and shrubs. Existing soils on the site consist of Stapelton sandy loam (Hydrologic Group 'B') as determined by the Natural Resources Conservation Service Web Soil Survey.

No portion of the development lies within an F.E.M.A. designated floodplain per FIRM 08041C0506 F, effective March 17, 1997. The F.E.M.A. Flood Insurance Rate Map has been provided.

## **EXISTING DRAINAGE BASINS**

Historic runoff from the subject site is split by the major basin boundary for Black Squirrel Creek Basin A consisting of the northerly portion of the site draining to Black Squirrel Creek generates a historic runoff of  $Q_2=0.2$  cfs,  $Q_5=0.7$  cfs,  $Q_{10}=1.4$  cfs,  $Q_{25}=2.5$  cfs,  $Q_{50}=3.4$  cfs, and  $Q_{100}=4.4$  cfs.

The southern portion of the site originally tributary to the Elkhorn Basin was diverted to the Black Squirrel Creek Basin with development of the Marketplace at Interquest Master Development Drainage Report. This portion of the site collects within the roadside swale along the north side of New Life Drive was identified as two basins. Basin B-1 generates a historic runoff of  $Q_2=0.1$  cfs,  $Q_5=0.5$  cfs,  $Q_{10}=1.0$  cfs,  $Q_{25}=1.8$  cfs,  $Q_{50}=2.4$  cfs, and  $Q_{100}=3.2$  cfs and is the portion of the site tributary to improvements constructed with the Biblica development directly west of the site. The “Final Drainage Report for International Bible Society Filing No. 1”, by URS Consultants states that “In the future when the site to the east is developed, flow will no longer be accepted and that owner will be responsible for directing his flow to the south”. Basin B-2 ( $Q_2=0.4$  cfs,  $Q_5=1.6$  cfs,  $Q_{10}=3.6$  cfs,  $Q_{25}=6.2$  cfs,  $Q_{50}=8.3$  cfs, and  $Q_{100}=10.8$  cfs) is directly tributary to the roadside ditch north of New Life Drive. Runoff from basins B-1 and B-2 is conveyed in the roadside ditch with flows from the Biblica development to the west to an existing 36” RCP crossing of Jet Stream Drive.

Basin B-3 ( $Q_2=0.3$  cfs,  $Q_5=1.1$  cfs,  $Q_{10}=2.4$  cfs,  $Q_{25}=4.3$  cfs,  $Q_{50}=5.7$  cfs, and  $Q_{100}=10.6$  cfs) represents interim condition for undeveloped land east of the parcel tributary to the northern roadside ditch. The MDDP for marketplace and Interquest Final Drainage Report indicate that this basin identified as “Basin O2B” is to be conveyed in the existing 24” culvert across New Life Drive and remain in the Elkhorn Basin. Upon site development the parcel will be required to outfall to the Elkhorn Basin and eliminate outfall to the roadside ditch.

Basin B-4 ( $Q_2=1.7$  cfs,  $Q_5=2.5$  cfs,  $Q_{10}=3.5$  cfs,  $Q_{25}=4.8$  cfs,  $Q_{50}=5.9$  cfs, and  $Q_{100}=7.1$  cfs) is the portion of New Life Drive right-of-way north of the crowned centerline and tributary to the northern roadside ditch. All B designated basins are tributary to the northern roadside ditch and converge at the 36” RCP crossing of Jet Stream Drive at Design Point 3 ( $Q_2=1.4$  cfs,  $Q_5=3.4$  cfs,  $Q_{10}=6.4$  cfs,  $Q_{25}=10.5$  cfs,  $Q_{50}=13.9$  cfs, and  $Q_{100}=17.7$  cfs).

According to the “Final Drainage Report for International Bible Society Filing No. 1” the pond releases developed flows to design point 3 (36” RCP crossing of Jet Stream Drive) of  $Q_5=5.9$  cfs and  $Q_{100}=10.3$  cfs. The pond release combined with historic flow from Basins B-1, B-2, B-3, and B-4 at design point 3 are  $Q_5=9.2$  cfs,  $Q_{100}= 23.0$  cfs. This is analyzed in the MDDP for marketplace as Design point C-3 exhibiting a  $Q_{100}= 24.02$  cfs and a  $C_{capacity}= 66.69$  cfs. Downstream improvements developed in the MDDP have conveyed these areas into the Black Squirrel Creek Drainage Basin with ultimate outfall being Black Squirrel Detention Basin BS-1 (MDDP).

Basin C ( $Q_2=1.6$  cfs,  $Q_5=2.4$  cfs,  $Q_{10}=3.4$  cfs,  $Q_{25}=4.7$  cfs,  $Q_{50}=5.8$  cfs, and  $Q_{100}=7.0$  cfs) is the portion of the New Life Drive right-of-way south of the crowned centerline and tributary to the southern roadside ditch and Elkhorn Basin. Basin C is conveyed in the roadside ditch to an existing 24” RCP culvert crossing of Jet Stream Drive. Basin C remains in the Elkhorn basin and is tributary to improvements installed with the New Life Church development.

## **DEVELOPED DRAINAGE BASINS**

Developed basins have been separated into 3 major basins. A basins and design points located within the northern portion of the development are tributary to the Black Squirrel Creek Drainage Basin, B basins are tributary to the existing roadside ditch along the north side of New Life Drive, and C basins are tributary to the roadside ditch along the south side of New Life Drive and Elkhorn Basin.

### **BASIN A**

Basin 1A consists of a landscape tract and the rear portions of walkout and garden units along the northern property boundary. Proposed grading has reduced the area draining towards Black Squirrel Creek and anticipated runoff has been reduced from historic levels. Basin 1A containing 0.99 acres generates runoff of ( $Q_2=0.7$  cfs,  $Q_5=1.1$  cfs,  $Q_{10}=1.5$  cfs,  $Q_{25}=2.0$  cfs,  $Q_{50}=2.5$  cfs, and  $Q_{100}=2.9$  cfs) compared to the historic runoff amounts of  $Q_2=0.2$  cfs,  $Q_5=0.7$  cfs,  $Q_{10}=1.4$  cfs,  $Q_{25}=2.5$  cfs,  $Q_{50}=3.4$  cfs, and  $Q_{100}=4.4$  cfs.

### **BASIN B**

Basin 1B containing 0.42 Acres consists of a landscape tract and the rear yards of front draining lots along the Western property line. Runoff generated within basin 1B will be collected in a private inlet and pipe system within the rear yard easement and conveyed to EDB 'B' within the development. Basin 1B generates runoff of  $Q_2=0.0$  cfs,  $Q_5=0.1$  cfs,  $Q_{10}=0.3$  cfs,  $Q_{25}=0.5$  cfs,  $Q_{50}=0.7$  cfs, and  $Q_{100}=0.9$  cfs. The pipe system will be owned and maintained by the Home Owners Association.

Basins 2B, 3B, 4B, 5B, 6B, and 7B consisting of residential single family lots, streets, and landscape tracts will have runoff collected within the internal inverted crown concrete street system and conveyed directly to proposed EDB 'B' at design point 3C. Basin 8B consists of rear portions of buildings and landscape tract adjacent to Running Water Drive (public residential street) and New Life Drive Right of Way. Runoff from Basin 8B will be collected in a swale adjacent to property lines and conveyed to EDB 'B' at design point 3C.

The inverted crown roadway maintain a minimum 1% longitudinal slope and consist of a 24' concrete mat with either 2% or 3% cross slopes. The roadway capacity at a 1% slope with a 2% cross slope is 9.6 cfs and is 18.84 cfs with a 3% cross slope. The 3% cross slope is proposed in the southwest corner of the site between design points 3D and 3F. Roadway capacities were derived from formulas 7-1 and 7-13 in Urban Drainage Criteria Manual Volume 1.

Basin 2B (2.00 Acres,  $Q_2=2.4$  cfs,  $Q_5=3.3$  cfs,  $Q_{10}=4.2$  cfs,  $Q_{25}=5.2$  cfs,  $Q_{50}=6.2$  cfs, and  $Q_{100}=7.2$  cfs) is conveyed within the roadway to the 7'-6" D-9 inlet at Design Point 3E.

Basin 3B (0.82 Acres,  $Q_2=0.7$  cfs,  $Q_5=1.0$  cfs,  $Q_{10}=1.3$  cfs,  $Q_{25}= 1.7$ cfs,  $Q_{50}= 2.1$  cfs, and  $Q_{100}=2.5$  cfs) is conveyed within the roadway to the 7'-6" D-9 inlet at Design Point 3E. The inlet intercepts 2.5 cfs in the minor event and 3.9 cfs in the major event. Bypass flows are conveyed in the roadway section to Design Point 3G.

Design Point 3F consists of runoff from the following basins:

- Basin 4B (1.20 Acres,  $Q_2=1.7$  cfs,  $Q_5=2.3$  cfs,  $Q_{10}=2.9$  cfs,  $Q_{25}=3.7$  cfs,  $Q_{50}=4.4$  cfs, and  $Q_{100}=5.1$  cfs)
- Basin 5B (0.84 Acres,  $Q_2=0.3$  cfs,  $Q_5=0.5$  cfs,  $Q_{10}=0.8$  cfs,  $Q_{25}=1.2$  cfs,  $Q_{50}=1.5$  cfs, and  $Q_{100}=1.8$  cfs)
- Basin 6B (1.88 Acres,  $Q_2=2.4$  cfs,  $Q_5=3.3$  cfs,  $Q_{10}=4.2$  cfs,  $Q_{25}=5.3$  cfs,  $Q_{50}=6.2$  cfs, and  $Q_{100}=7.2$  cfs)

Combined runoff at design point 3F of  $Q_2=3.5$  cfs,  $Q_5=4.9$  cfs,  $Q_{10}=6.3$  cfs,  $Q_{25}=8.1$  cfs,  $Q_{50}=9.7$  cfs, and  $Q_{100}=11.3$  cfs is conveyed in a 3% cross slope roadway section to the 7'6" D-9 inlet at Design Point 3E. The inlet intercepts 3.4 cfs in the minor event and 5.5 cfs in the major event.

Bypass flows are conveyed in the roadway section to Design Point 3G.

Design point 3G consists of a 7'-6" D-9 inlet in a sump condition accepting bypass flows of  $Q_5=2.9$  cfs and  $Q_{100}=10.8$  cfs. Flows collected within the private storm system are conveyed directly to the Extended Detention Basin. In the case of inlet failure runoff will overtop the southwest corner at the roadway lowpoint and be conveyed directly to the EDB.

Proposed EDB 'B' will require a WQCV of 0.186 acre-feet and provides 0.254 acre-ft of storage. The EDB will be designed to meet current Urban Drainage design criteria for forebay, outfall structure, and micropool to be presented in final construction drawings for the development. Proposed EDB 'B' will outfall through a 24" HDPE storm sewer directly to the existing roadside swale along the north side of New Life Drive. The Basin outfalls developed runoff of ( $Q_2=4.9$  cfs,  $Q_5=7.6$  cfs,  $Q_{10}=10.7$  cfs,  $Q_{25}=14.0$  cfs,  $Q_{50}=16.7$  cfs, and  $Q_{100}=19.8$  cfs) to Design Point 3B. The emergency spillway will consist of a 20' wide trapezoidal weir constructed of soil riprap conveying the undetained 100-YR flow from Design Point 3C of 23.1 cfs at a maximum depth of 0.5'. Emergency overflow will be collected in the existing roadside ditch adjacent to New Life Drive Improvements and conveyed to the existing 36" culvert at Design Point 3. See Appendix for calculations.

The area of the development tributary to proposed EDB 'B' includes the following:

Tract/Use	Area	% Impervious
Lots	6.356	63%
Tract 'A'/Roadways	1.607	81%
Tract 'C'/Landscape	.109	7%
Tract 'D'/Landscape	.572	7%
Tract 'E'/Landscape and pond	.261	7%
Tract 'F'/Landscape and walk	.060	20%
Tract 'G'/Landscape	.034	7%
Tract 'H'	.022	7%
Total Area	9.016	59.8% Ave % Impervious

Basin 10B consists of undeveloped land tributary to Running Water Drive improvements in the interim condition. The MDDP for marketplace and Interquest Final Drainage Report indicate that this basin identified as "Basin O2B" is to be conveyed in the existing 24" culvert across

New Life Drive and remain in the Elkhorn Basin. Upon site development the parcel will be required to outfall to the Elkhorn Basin and eliminate outfall to the roadside ditch. Runoff from Basin 10B will be collected in the curb line for running water drive and conveyed to a crossspan to the Westerly side of Running Water Drive. Runoff will be conveyed in the northerly curb line of New Life Drive to design point 3A. Runoff tributary to the roadside ditch east of Basin 10B is intercepted by the existing 24" CMP crossing New Life Drive and conveyed south. The culvert will be extended and ditch reconstructed to allow for intersection construction.

Basin 9B consists of Public roadway and right-of-way for Running Water Drive and New Life Drive captured in the northerly New Life Drive curb and gutter and conveyed to design point 3A. Design Point 3A ( $Q_2=1.1$  cfs,  $Q_5=2.9$  cfs,  $Q_{10}=5.7$  cfs,  $Q_{25}=9.6$  cfs,  $Q_{50}=12.8$  cfs, and  $Q_{100}=16.4$  cfs) consists of Basins 9B and 10B and will be conveyed by a 4' curb chase to the existing 36" RCP at design point 3.

Design point 3 consists of combined runoff from Design Point 3A, Basin 11B, Design Point 3B, and the existing Biblica Pond. Combined flows of  $Q_5=16.5$  cfs,  $Q_{100}=47.5$  cfs are less than the capacity of the existing 36" culvert at Jet Stream Drive of  $Q_{100}=66.69$  cfs as identified in the MDDP for Marketplace and Interquest. Downstream improvements developed in the MDDP have conveyed these areas into the Black Squirrel Creek Drainage Basin with ultimate outfall being Black Squirrel Detention Basin BS-1 (MDDP). Flows at Design Point 3 will be reduced upon redirection of the tributary portion of Basin 10B into the Elkhorn Basin.

## **BASIN C**

Basin 1C consists of the portion of historic basin C that will be conveyed west in the proposed curb and gutter constructed with New Life Drive. Runoff will be conveyed to a 4' curb cut and rip rap swale to the existing 24" RCP crossing of Jet Stream Drive. Basin 2C consists of the portion of historic basin C beyond the curb line and conveyed in the existing roadside swale to the 24" RCP at design point 4.

Design Point 4 ( $Q_2=1.7$  cfs,  $Q_5=2.5$  cfs,  $Q_{10}=3.3$  cfs,  $Q_{25}=4.6$  cfs,  $Q_{50}=5.6$  cfs, and  $Q_{100}=6.7$  cfs) exceeds historic outfall at the design point due to requirement of curb conveyance reducing time of concentration. Historic flow rates at design point 4 are ( $Q_2=1.5$  cfs,  $Q_5=2.3$  cfs,  $Q_{10}=3.2$  cfs,  $Q_{25}=4.4$  cfs,  $Q_{50}=5.4$  cfs, and  $Q_{100}=6.5$  cfs). Flows will be collected in a 4' curb chase and conveyed to the existing 24" culvert crossing of Jet Stream Drive.

## **WATER QUALITY/4-STEP PROCESS**

The development addresses Low Impact Development strategies primarily through the utilization of landscape swales within rear lots directing runoff from rooflines and patios through swales with minimal longitudinal grade prior to outfall to the inverted crown street system. On-site flow is directed to a proposed extended detention basin providing water quality capture volume and attenuated release rates prior to release off-site. Site release is directly to an existing grass swale outside and parallel to the proposed new life drive curb line and is conveyed in the grass swale to existing 36" crossing of Jet Stream Drive. Flows generated within the site and Northerly half of

new live drive will be conveyed in a combination of swales and pipe systems to the existing Public Detention and Water Quality pond BS-1. Pond BS-1 will again provide water quality capture volume and detained release of 2-YR, 5-YR, 10-YR, 50-YR, and 100-YR storm events. Release from Pond BS-1 will have no impacts on Black Squirrel Creek.

A Grading, Erosion Control, and Stormwater Quality Plan and narrative have been approved by the city prior to any soil disturbance. The erosion control plan included specific source control BMP's as well defined overall site management practices for the construction period.

### **MDDP/FDR COMPARISON-POND BS-1 ANALYSIS**

Pond BS-1 was developed in conjunction with the Marketplace at Interquest Development Filings No. 1 and 2 and reconstructed the Farm Final Design Report for the Farm Apartments Filing No. 1 Off-Site Detention Facility BS-1. The 8.88 acre-ft pond is intended to provide water quality and EURV for portions of the tributary Black Squirrel Creek Basin and portions of the diverted Elkhorn Basin prior to release to Black Squirrel Creek.

The original MDDP developed a model based on the SCS unit hydrograph procedure utilizing the 24 hour storm and Type IIA rainfall distribution. The final design report for basin BS-1 provided only a summary of inflow and release from the pond and was based on modified rational methodology. Pond sizing developed in the final design report was based on modified rational hydrograph development producing conservative values.

This report models the upstream basin tributary to pond BS-1 utilizing the SCS unit hydrograph procedure and data available in the MDDP. The model modified basin that have developed or are in development based on final drainage reports submitted after MDDP Development. Basins 02B, EX-B, EX-C1, EX-C2, PR-D, EX-G, EX-H, BS-1B were modeled as in the original MDDP.

Basin EX-A consists of the Reserve at NorthCreek development and was modeled based on data developed with this final drainage report. The basin consists of 10.6 acres of townhome lots, roadway infrastructure, and landscape areas. The original MDDP modeled this area as undeveloped (2%) impervious although the northern portion of New Life Drive (old highway 83) was included in the basin area. This analysis models basin EX-A as 10.6 acres, 65% impervious, with a time of concentration of 0.463 hours.

Basin BS-1A was reduced with the development of the Market at Interquest Filing No. 9. 5.25 acres previously proposed as tributary to pond BS-1 were diverted south to Elkhorn Basin 3. Basin BS-1A was modeled to reflect the reduced area.

Basin BS-1C was revised to reflect development of The Farm Apartments Filing No. 1. The Basin has been revised to reflect reduction in impervious area from commercial to apartment site development and time of concentration developed in the Final Drainage Report were utilized.

The conveyance system utilized in the MDDP were preliminary at the time of MDDP Development and were updated based on current topography and as-built surveys of constructed



facilities as available. The system is sized to safely convey the revised storm event to pond BS-1. Calculations are provided in the appendix and a comparison to the original MDDP analysis is provided in the drainage map.

Pond BS-1 is adequately sized to contain the 2-yr through 100-yr storm events and maintain allowable release rates to Black Squirrel Creek as constructed. A summary and comparison of models is provided in the drainage map.

**COST ESTIMATE**

Private Improvements Non-reimbursable

7.5' D-9 INLET	3 EA	@\$ 4,800/EA	\$ 14,400
15" HDPE	206 LF	@\$ 28/LF	\$ 5,768
24" HDPE	225 LF	@\$ 40/LF	\$ 9,000
24" OUTFALL	1 EA	@\$ 400/EA	\$ 400
8" HDPE	477 LF	@\$ 15/LF	\$ 7,155
8" INLET	7 EA	@\$ 100/EA	\$ 700
Extended Detention Basin	1 LS	@\$ 15,000/LS	\$ 15,000
<b>SUBTOTAL</b>			<b>\$ 52,423</b>
<i>15% CONTINGENCY</i>			<i>\$ 7,863</i>
<b>TOTAL</b>			<b>\$ 60,286</b>

Public Improvements Non-reimbursable

4' CURB CHASE	2 EA	@\$ 5,400/EA	\$ 10,800
<b>SUBTOTAL</b>			<b>\$ 10,800</b>
<i>15% CONTINGENCY</i>			<i>\$ 1,620</i>
<b>TOTAL</b>			<b>\$ 12,420</b>

**DRAINAGE FEE CALCULATION**

The Reserve at Northcreek residential development proposes to plat 10.40 acres within the Black Squirrel Creek Drainage Basin.

**Reserve at Northcreek (Black Squirrel Creek)**

Drainage Fee:  
 (10.40 acres X \$12,442/ac) = \$ 129,396.80

Bridge Fee:

(10.40 acres X \$1,421/ac) = \$ 14,778.40

Pond Land Fee:

(10.40 acres X \$789/ac) = \$ 8,205.60

## **DRAINAGE METHODOLOGY**

This drainage report was prepared in accordance to the criteria established in the City of Colorado Springs Drainage Criteria Manual Volumes 1 and 2, as revised May 2014.

The rational method for drainage basin study areas of less than 100 acres was utilized in the analysis. For the Rational Method, flows were calculated for the 2, 5, 10, 25, 50, and 100-year recurrence intervals. The average runoff coefficients, 'C' values, are taken from Table 6-6 and the Intensity-Duration-Frequency curves are taken from Figure 6-5 of the City Drainage Criteria Manual. Time of concentration for overland flow and storm drain or gutter flow are calculated per Section 3.2 of the City Drainage Criteria Manual. Calculations for the Rational Method are shown in the Appendix of this report.

The MDDP/FDR Comparison was completed using Unit Hydrograph analysis for routing and comparison to the existing MDDP analysis. The Type IIA Storm Distribution and AMC II were modeled in the analysis. HYDROCAD Version 7.0 software was utilized to develop the hydrologic model. Rainfall data, basin areas, times of concentration, and Curve Numbers were utilized from the Classic Engineering MDDP. The analysis was performed to update overall characteristics of Basin BS-1 based on current development and verify pond BS-1 capacity and outfall rates.

## **SUMMARY**

The Reserve at North Creek Development exhibits drainage patterns consistent with those anticipated in the MDDP. On-Site Water quality facilities are proposed to provide water quality in accordance with current City criteria. Private Storm system is designed to intercept the full 100-year runoff event and convey to existing public facilities. Pond BS-1 is adequately sized to contain the 2-yr through 100-yr storm events and maintain allowable release rates to Black Squirrel Creek as constructed. Development of the parcel is in conformance of current city of Colorado Springs criteria and will not adversely affect downstream properties or facilities.

## **REFERENCES:**

City of Colorado Springs Engineering Division Drainage Criteria Manual Volumes 1 and 2, revised May 2014

“Master Drainage Plan for Marketplace and InterQuest and Final Drainage Report for Marketplace at Interquest Filing No. 1 and Filing No. 2” by Classic Engineering dated April 2007

“Preliminary and Final Drainage Report for International Bible Society Filing No. 1” prepared by URS Consultants, dated August, 1988.

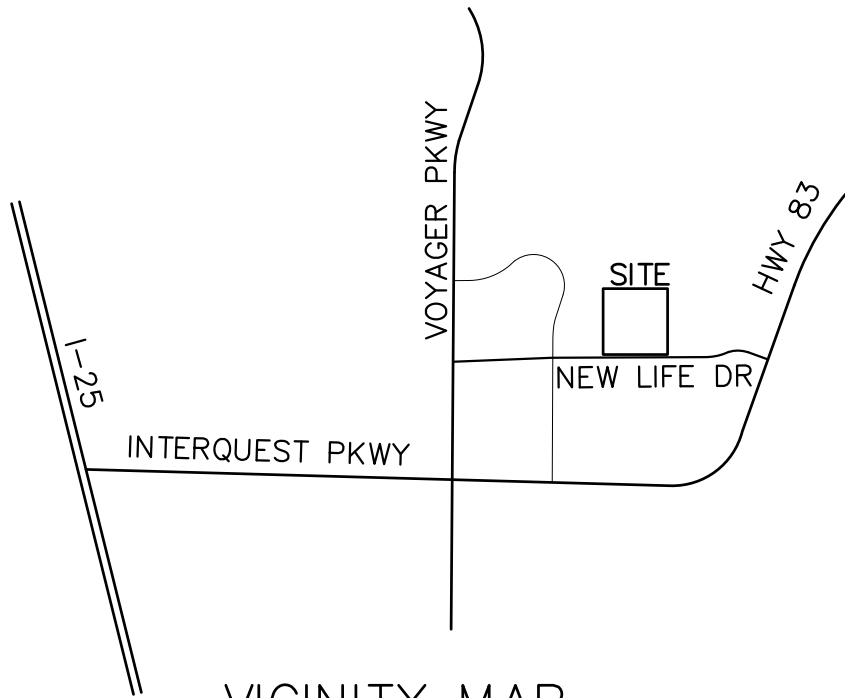
“Final Design Report for the Farm Apartments Filing No. 1 Off-Site Detention Facility BS-1 (City of Colorado Springs Facility” prepared by Classic Consulting Engineers and Surveyors, LLC, dated September 2016

“Final Drainage Report for Marketplace at Interquest Filing No. 9”, prepared by Classic Consulting Engineers and Surveyors, LLC, dated January 29, 2016

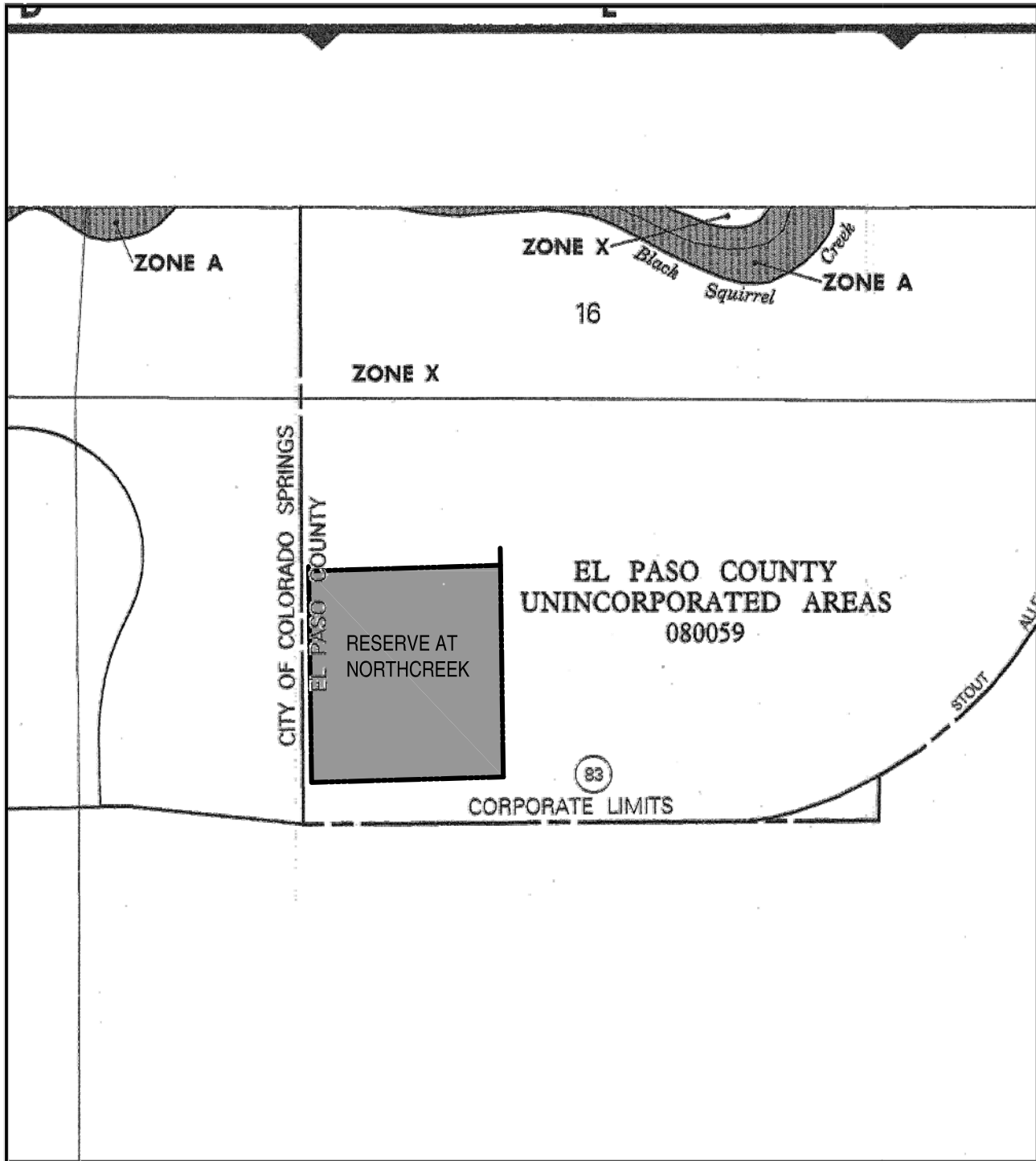
Flood Insurance Rate Map Number 08041C0506 F, effective date march 17, 1997

Natural Resources Conservation Service Web Soil Survey

## **APPENDIX**



VICINITY MAP  
NTS



NATIONAL FLOOD INSURANCE PROGRAM

**FIRM**  
**FLOOD INSURANCE RATE MAP**  
 EL PASO COUNTY,  
 COLORADO AND  
 INCORPORATED AREAS

PANEL 506 OF 1300  
 (SEE MAP INDEX FOR PANELS NOT PRINTED)

CONTAINS:

COMMUNITY	MAPS	DATE	STATUS
COLORADO SPRINGS, CITY OF	08000	0800	2
EL PASO COUNTY UNINCORPORATED AREAS	08000	0800	2

MAP NUMBER  
 08041C0506 F

EFFECTIVE DATE:  
 MARCH 17, 1997



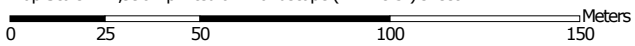
Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at [www.msc.fema.gov](http://www.msc.fema.gov)

Soil Map—El Paso County Area, Colorado  
(Reserve at Northcreek)



Map Scale: 1:1,990 if printed on A landscape (11" x 8.5") sheet.




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



## MAP LEGEND

### Area of Interest (AOI)

 Area of Interest (AOI)

### Soils

 Soil Map Unit Polygons

 Soil Map Unit Lines

 Soil Map Unit Points

### Special Point Features



Blowout



Borrow Pit



Clay Spot



Closed Depression



Gravel Pit



Gravelly Spot



Landfill



Lava Flow



Marsh or swamp



Mine or Quarry



Miscellaneous Water



Perennial Water



Rock Outcrop



Saline Spot



Sandy Spot



Severely Eroded Spot



Sinkhole



Slide or Slip



Sodic Spot



Spoil Area



Stony Spot



Very Stony Spot



Wet Spot



Other



Special Line Features

### Water Features



Streams and Canals

### Transportation



Rails



Interstate Highways



US Routes



Major Roads



Local Roads

### Background



Aerial Photography

## MAP INFORMATION

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

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

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

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

Source of Map: Natural Resources Conservation Service  
Web Soil Survey URL: <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 13, Sep 22, 2015

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

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

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



## Map Unit Legend

El Paso County Area, Colorado (CO625)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
83	Stapleton sandy loam, 3 to 8 percent slopes	11.0	77.3%
84	Stapleton sandy loam, 8 to 15 percent slopes	3.2	22.7%
<b>Totals for Area of Interest</b>		<b>14.2</b>	<b>100.0%</b>

**HISTORIC  
CALCULATIONS**

BASIN	AREA TOTAL  (Acres)	CONVEYANCE TC															TT	INTENSITY						TOTAL FLOWS					
		C <sub>2</sub>	C <sub>5</sub>	C <sub>10</sub>	C <sub>25</sub>	C <sub>50</sub>	C <sub>100</sub>	Length	Height	TI	Length	Height	C <sub>v</sub>	Slope	Velocity	TC	TOTAL	I <sub>2</sub>	I <sub>5</sub>	I <sub>10</sub>	I <sub>25</sub>	I <sub>50</sub>	I <sub>100</sub>	Q <sub>2</sub>	Q <sub>5</sub>	Q <sub>10</sub>	Q <sub>25</sub>	Q <sub>50</sub>	Q <sub>100</sub>
		(ft)	(ft)	(min)	(ft)	(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	1.66	0.03	0.09	0.17	0.26	0.31	0.36	100	14.5	8.0	67	9.5	5	14.2%	1.9	0.6	8.6	3.5	4.4	5.1	5.8	6.5	7.3	0.2	0.7	1.4	2.5	3.4	4.4
B-1	1.94	0.03	0.09	0.17	0.26	0.31	0.36	100	2.5	14.3	596	15.5	5	2.6%	0.8	12.3	26.6	2.1	2.7	3.1	3.5	4.0	4.5	0.1	0.5	1.0	1.8	2.4	3.1
B-2	6.40	0.03	0.09	0.17	0.26	0.31	0.36	100	3	13.4	641	20.5	5	3.2%	0.9	11.9	25.4	2.2	2.7	3.2	3.6	4.1	4.6	0.4	1.6	3.5	6.1	8.1	10.6
B-3	5.26	0.03	0.09	0.17	0.26	0.31	0.36	100	3	13.4 DP-3	1046 1062	33 20	5 15	3.2% 1.9%	0.9 2.1	19.6 8.6	33.1 41.7	1.9	2.3	2.7	3.1	3.5	3.9	0.3	1.1	2.4	4.3	5.7	7.4
B-4	2.15	0.26	0.30	0.37	0.44	0.48	0.52	50	3.5	5.7	1005	15	15	1.5%	1.8	9.1	14.8	2.8	3.5	4.1	4.7	5.3	5.9	1.6	2.3	3.3	4.5	5.5	6.6
HISTORIC	1.58	0.03	0.09	0.17	0.26	0.31	0.36																						
PAVED	0.57	0.89	0.90	0.92	0.94	0.95	0.96																						
C	2.19	0.26	0.30	0.37	0.44	0.48	0.52	50	5	5.0	1247	20	15	1.6%	1.9	10.9	16.0	2.7	3.4	4.0	4.6	5.1	5.8	1.5	2.3	3.2	4.4	5.4	6.5
HISTORIC	1.70	0.03	0.09	0.17	0.26	0.31	0.36																						
PAVED	0.49	0.89	0.90	0.92	0.94	0.95	0.96																						

Calculated by: DLM  
Date: 3/5/2016

DESIGN POINT	AREA TOTAL (Acres)	WEIGHTED						TT	INTENSITY						TOTAL FLOWS					
		C <sub>2</sub>	C <sub>5</sub>	C <sub>10</sub>	C <sub>25</sub>	C <sub>50</sub>	C <sub>100</sub>	TOTAL	I <sub>2</sub>	I <sub>5</sub>	I <sub>10</sub>	I <sub>25</sub>	I <sub>50</sub>	I <sub>100</sub>	Q <sub>2</sub>	Q <sub>5</sub>	Q <sub>10</sub>	Q <sub>25</sub>	Q <sub>50</sub>	Q <sub>100</sub>
								(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.)
<b>1</b> BASIN A	1.66	<b>0.03</b>	<b>0.09</b>	<b>0.17</b>	<b>0.26</b>	<b>0.31</b>	<b>0.36</b>	8.6	3.5	4.4	5.1	5.8	6.5	7.3	<b>0.2</b>	<b>0.7</b>	<b>1.4</b>	<b>2.5</b>	<b>3.4</b>	<b>4.4</b>
<b>2</b> BASIN B-1	1.94	<b>0.03</b>	<b>0.09</b>	<b>0.17</b>	<b>0.26</b>	<b>0.31</b>	<b>0.36</b>	26.6	2.1	2.7	3.1	3.5	4.0	4.5	<b>0.1</b>	<b>0.5</b>	<b>1.0</b>	<b>1.8</b>	<b>2.4</b>	<b>3.1</b>
<b>3</b> BASIN B-2	13.81	<b>0.07</b>	<b>0.12</b>	<b>0.20</b>	<b>0.29</b>	<b>0.34</b>	<b>0.38</b>	41.7	1.6	2.0	2.3	2.7	3.0	3.3	<b>1.4</b>	<b>3.4</b>	<b>6.4</b>	<b>10.5</b>	<b>13.9</b>	<b>17.7</b>
BASIN B-3	6.40	0.03	0.09	0.17	0.26	0.31	0.36													
BASIN B-4	5.26	0.03	0.09	0.17	0.26	0.31	0.36													
	2.15	0.26	0.30	0.37	0.44	0.48	0.52													
<b>4</b> BASIN C	2.19	<b>0.26</b>	<b>0.30</b>	<b>0.37</b>	<b>0.44</b>	<b>0.48</b>	<b>0.52</b>	16.0	2.7	3.4	4.0	4.6	5.1	5.8	<b>1.5</b>	<b>2.3</b>	<b>3.2</b>	<b>4.4</b>	<b>5.4</b>	<b>6.5</b>
<b>2A</b> BASIN B-1	8.34	<b>0.03</b>	<b>0.09</b>	<b>0.17</b>	<b>0.26</b>	<b>0.31</b>	<b>0.36</b>	25.4	2.2	2.7	3.2	3.6	4.1	4.6	<b>0.5</b>	<b>2.1</b>	<b>4.5</b>	<b>7.9</b>	<b>10.6</b>	<b>13.8</b>
BASIN B-2	1.94	0.03	0.09	0.17	0.26	0.31	0.36													
	6.40	0.03	0.09	0.17	0.26	0.31	0.36													

Calculated by: DLM  
Date: 3/6/2015

**PROPOSED  
CALCULATIONS**

BASIN	AREA TOTAL (Acres)	CONVEYANCE TC							TT			INTENSITY						TOTAL FLOWS												
		C <sub>2</sub>	C <sub>5</sub>	C <sub>10</sub>	C <sub>25</sub>	C <sub>50</sub>	C <sub>100</sub>	Length (ft)	Height (ft)	TI (min)	Length (ft)	Height (ft)	C <sub>v</sub>	Slope (%)	Velocity (fps)	TC (min)	TOTAL (min)	I <sub>2</sub> (in/hr)	I <sub>5</sub> (in/hr)	I <sub>10</sub> (in/hr)	I <sub>25</sub> (in/hr)	I <sub>50</sub> (in/hr)	I <sub>100</sub> (in/hr)	Q <sub>2</sub> (c.f.s.)	Q <sub>5</sub> (c.f.s.)	Q <sub>10</sub> (c.f.s.)	Q <sub>25</sub> (c.f.s.)	Q <sub>50</sub> (c.f.s.)	Q <sub>100</sub> (c.f.s.)	
<b>1A</b> LOTS LANDSCAPED	0.99 0.62 0.37	<b>0.26</b> 0.41 0.02	<b>0.31</b> 0.45 0.08	<b>0.36</b> 0.49 0.15	<b>0.43</b> 0.54 0.25	<b>0.47</b> 0.57 0.30	<b>0.50</b> 0.59 0.35	100	3	10.5	462	29	7	6.3%	1.8	4.4	14.9	2.8	3.5	4.1	4.7	5.3	5.9	<b>0.7</b>	<b>1.1</b>	<b>1.5</b>	<b>2.0</b>	<b>2.5</b>	<b>2.9</b>	
<b>1B</b> REAR YARD	0.42	<b>0.02</b>	<b>0.08</b>	<b>0.15</b>	<b>0.25</b>	<b>0.30</b>	<b>0.35</b>	26	2	5.1	456	10	7	2.2%	1.0	7.3	12.4	3.0	3.8	4.4	5.1	5.7	6.4	<b>0.0</b>	<b>0.1</b>	<b>0.3</b>	<b>0.5</b>	<b>0.7</b>	<b>0.9</b>	
<b>2B</b> LOTS	2.00	<b>0.41</b>	<b>0.45</b>	<b>0.49</b>	<b>0.54</b>	<b>0.57</b>	<b>0.59</b>	76	1.5	8.7	737	10	20	1.4%	2.3	5.3	14.0	2.9	3.6	4.2	4.8	5.4	6.1	<b>2.4</b>	<b>3.3</b>	<b>4.2</b>	<b>5.2</b>	<b>6.2</b>	<b>7.2</b>	
<b>3B</b> LOTS REAR YARD	0.82 0.66 0.16	<b>0.33</b> 0.41 0.02	<b>0.38</b> 0.45 0.08	<b>0.42</b> 0.49 0.15	<b>0.48</b> 0.54 0.25	<b>0.52</b> 0.57 0.30	<b>0.54</b> 0.59 0.35	83	2	9.4	382	5	7	1.3%	0.8	7.9	17.4	2.6	3.3	3.9	4.4	5.0	5.5	<b>0.7</b>	<b>1.0</b>	<b>1.3</b>	<b>1.7</b>	<b>2.1</b>	<b>2.5</b>	
<b>4B</b> LOTS	1.20	<b>0.41</b>	<b>0.45</b>	<b>0.49</b>	<b>0.54</b>	<b>0.57</b>	<b>0.59</b>	57	2	6.2	422	6	20	1.4%	2.4	2.9	9.2	3.4	4.3	5.0	5.7	6.4	7.2	<b>1.7</b>	<b>2.3</b>	<b>2.9</b>	<b>3.7</b>	<b>4.4</b>	<b>5.1</b>	
<b>5B</b> LOTS LANDSCAPED	0.84 0.36 0.48	<b>0.16</b> 0.41 0.02	<b>0.21</b> 0.45 0.08	<b>0.26</b> 0.49 0.15	<b>0.34</b> 0.54 0.25	<b>0.38</b> 0.57 0.30	<b>0.41</b> 0.59 0.35	100	2.5	12.6	353	5	7	1.4%	0.8	7.1	19.6	2.5	3.1	3.6	4.2	4.7	5.2	<b>0.3</b>	<b>0.5</b>	<b>0.8</b>	<b>1.2</b>	<b>1.5</b>	<b>1.8</b>	
<b>6B</b> LOTS	1.88	<b>0.41</b>	<b>0.45</b>	<b>0.49</b>	<b>0.54</b>	<b>0.57</b>	<b>0.59</b>	88	3	7.8	611	10	20	1.6%	2.6	4.0	11.8	3.1	3.9	4.5	5.2	5.8	6.5	<b>2.4</b>	<b>3.3</b>	<b>4.2</b>	<b>5.3</b>	<b>6.2</b>	<b>7.2</b>	
<b>7B</b> LANDSCAPED LOTS	0.53 0.18 0.35	<b>0.28</b> 0.02 0.41	<b>0.32</b> 0.08 0.45	<b>0.37</b> 0.15 0.49	<b>0.44</b> 0.25 0.54	<b>0.48</b> 0.30 0.57	<b>0.51</b> 0.35 0.59	40	1	6.9	75	1	20	1.3%	2.3	0.5	7.5	3.6	4.6	5.3	6.1	6.8	7.7	<b>0.5</b>	<b>0.8</b>	<b>1.1</b>	<b>1.4</b>	<b>1.7</b>	<b>2.1</b>	
<b>8B</b> LOTS REAR YARD	1.08 0.63 0.45	<b>0.25</b> 0.41 0.02	<b>0.30</b> 0.45 0.08	<b>0.35</b> 0.49 0.15	<b>0.42</b> 0.54 0.25	<b>0.46</b> 0.57 0.30	<b>0.49</b> 0.59 0.35	59	3	6.9	603	10	15	1.7%	1.9	5.2	12.1	3.1	3.8	4.5	5.1	5.8	6.4	<b>0.8</b>	<b>1.2</b>	<b>1.7</b>	<b>2.3</b>	<b>2.8</b>	<b>3.4</b>	
<b>9B</b> PAVED LANDSCAPED	1.60 1.15 0.45	<b>0.65</b> 0.89 0.02	<b>0.67</b> 0.90 0.08	<b>0.70</b> 0.92 0.15	<b>0.75</b> 0.94 0.25	<b>0.77</b> 0.95 0.30	<b>0.79</b> 0.96 0.35	24	0.5	3.2	1850	28	20	1.5%	2.5	12.5	15.7	2.8	3.5	4.0	4.6	5.2	5.8	<b>2.8</b>	<b>3.7</b>	<b>4.5</b>	<b>5.5</b>	<b>6.4</b>	<b>7.3</b>	
<b>10B</b> HISTORIC PAVED	5.31 5.04 0.27	<b>0.07</b> 0.03 0.89	<b>0.13</b> 0.09 0.90	<b>0.21</b> 0.17 0.92	<b>0.29</b> 0.26 0.94	<b>0.34</b> 0.31 0.95	<b>0.39</b> 0.36 0.96	100	3	12.9	1046	33	5	3.2%	0.9	19.6	32.5	1.9	2.4	2.8	3.1	3.5	4.0	<b>0.7</b>	<b>1.6</b>	<b>3.0</b>	<b>4.9</b>	<b>6.4</b>	<b>8.2</b>	

Calculated by: DLM  
Date: 5/10/2017

BASIN	AREA TOTAL (Acres)								CONVEYANCE TC							TT	INTENSITY						TOTAL FLOWS								
		C <sub>2</sub>	C <sub>5</sub>	C <sub>10</sub>	C <sub>25</sub>	C <sub>50</sub>	C <sub>100</sub>	Length (ft)	Height (ft)	TI (min)	Length (ft)	Height (ft)	C <sub>v</sub>	Slope (%)	Velocity (fps)	TC (min)	TOTAL (min)	I <sub>2</sub> (in/hr)	I <sub>5</sub> (in/hr)	I <sub>10</sub> (in/hr)	I <sub>25</sub> (in/hr)	I <sub>50</sub> (in/hr)	I <sub>100</sub> (in/hr)	Q <sub>2</sub> (c.f.s.)	Q <sub>5</sub> (c.f.s.)	Q <sub>10</sub> (c.f.s.)	Q <sub>25</sub> (c.f.s.)	Q <sub>50</sub> (c.f.s.)	Q <sub>100</sub> (c.f.s.)		
<b>11B</b> <i>HISTORIC</i>	0.78	<b>0.03</b>	<b>0.09</b>	<b>0.17</b>	<b>0.26</b>	<b>0.31</b>	<b>0.36</b>	59	3	8.7	603	10	5	1.7%	0.6	15.6	24.3	2.2	2.8	3.3	3.7	4.2	4.7	<b>0.1</b>	<b>0.2</b>	<b>0.4</b>	<b>0.8</b>	<b>1.0</b>	<b>1.3</b>		
<b>1C</b> <i>PAVED</i>	0.69	<b>0.89</b>	<b>0.90</b>	<b>0.92</b>	<b>0.94</b>	<b>0.95</b>	<b>0.96</b>	24	0.5	1.5	1231	20	20	1.6%	2.5	8.0	9.5	3.4	4.2	4.9	5.6	6.3	7.1	<b>2.1</b>	<b>2.6</b>	<b>3.1</b>	<b>3.6</b>	<b>4.1</b>	<b>4.7</b>		
<b>2C</b> <i>LANDSCAPED</i>	1.58	<b>0.02</b>	<b>0.08</b>	<b>0.15</b>	<b>0.25</b>	<b>0.30</b>	<b>0.35</b>	36	2	6.6	1247	20	15	1.6%	1.9	10.9	17.6	2.6	3.3	3.8	4.4	4.9	5.5	<b>0.1</b>	<b>0.4</b>	<b>0.9</b>	<b>1.7</b>	<b>2.3</b>	<b>3.0</b>		

Calculated by: DLM  
Date: 5/10/2017

DESIGN POINT	AREA TOTAL (Acres)	WEIGHTED						TT	INTENSITY						TOTAL FLOWS						
		C <sub>2</sub>	C <sub>5</sub>	C <sub>10</sub>	C <sub>25</sub>	C <sub>50</sub>	C <sub>100</sub>	TOTAL	I <sub>2</sub>	I <sub>5</sub>	I <sub>10</sub>	I <sub>25</sub>	I <sub>50</sub>	I <sub>100</sub>	Q <sub>2</sub>	Q <sub>5</sub>	Q <sub>10</sub>	Q <sub>25</sub>	Q <sub>50</sub>	Q <sub>100</sub>	
								(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.)	
<b>1</b> BASIN 1A	<b>0.99</b>	<b>0.26</b>	<b>0.31</b>	<b>0.36</b>	<b>0.43</b>	<b>0.47</b>	<b>0.50</b>	14.9	2.8	3.5	4.1	4.7	5.3	5.9	<b>0.7</b>	<b>1.1</b>	<b>1.5</b>	<b>2.0</b>	<b>2.5</b>	<b>2.9</b>	
<b>3F</b> BASIN 4B BASIN 5B BASIN 6B	<b>3.92</b> 1.20 0.84 1.88	<b>0.36</b> 0.41 0.16 0.41	<b>0.40</b> 0.45 0.21 0.45	<b>0.44</b> 0.49 0.26 0.49	<b>0.50</b> 0.54 0.34 0.54	<b>0.53</b> 0.57 0.38 0.57	<b>0.55</b> 0.59 0.41 0.59	19.6	2.5	3.1	3.6	4.2	4.7	5.2	<b>3.5</b>	<b>4.9</b>	<b>6.3</b>	<b>8.1</b>	<b>9.7</b>	<b>11.3</b>	
<b>3E</b> BASIN 3B DESIGN PT 3F	4.74 0.82 3.92	<b>0.35</b> 0.33 0.36	<b>0.39</b> 0.38 0.40	<b>0.44</b> 0.42 0.44	<b>0.49</b> 0.48 0.50	<b>0.53</b> 0.52 0.53	<b>0.55</b> 0.54 0.55	21.8	2.4	3.0	3.5	3.9	4.4	5.0	<b>4.0</b>	<b>5.5</b>	<b>7.2</b>	<b>9.2</b>	<b>11.1</b>	<b>13.0</b>	
<b>3D</b> BASIN 2B	<b>2.00</b>	<b>0.41</b>	<b>0.45</b>	<b>0.49</b>	<b>0.54</b>	<b>0.57</b>	<b>0.59</b>	14.0	2.9	3.6	4.2	4.8	5.4	6.1	<b>2.4</b>	<b>3.3</b>	<b>4.2</b>	<b>5.2</b>	<b>6.2</b>	<b>7.2</b>	
<b>3C</b> BASIN 1B BASIN 7B BASIN 8B DESIGN PT 3E DESIGN PT 3D	<b>8.77</b> 0.42 0.53 1.08 4.74 2.00	<b>0.33</b> 0.02 0.28 0.25 0.35 0.41	<b>0.38</b> 0.08 0.32 0.30 0.39 0.45	<b>0.42</b> 0.15 0.37 0.35 0.44 0.49	<b>0.48</b> 0.25 0.44 0.42 0.49 0.54	<b>0.51</b> 0.30 0.48 0.46 0.53 0.57	<b>0.54</b> 0.35 0.51 0.49 0.55 0.59	22.6	2.3	2.9	3.4	3.9	4.4	4.9	<b>6.8</b>	<b>9.6</b>	<b>12.5</b>	<b>16.3</b>	<b>19.7</b>	<b>23.1</b>	
<b>3B</b> POND RELEASE															<b>4.9</b>	<b>7.6</b>	<b>10.7</b>	<b>14.0</b>	<b>16.7</b>	<b>19.8</b>	
<b>3A</b> BASIN 9B BASIN 10B	<b>6.91</b> 1.60 5.31	<b>0.21</b> 0.65 0.07	<b>0.26</b> 0.67 0.13	<b>0.32</b> 0.70 0.21	<b>0.40</b> 0.75 0.29	<b>0.44</b> 0.77 0.34	<b>0.48</b> 0.79 0.39	40.2	1.6	2.0	2.4	2.7	3.1	3.4	<b>1.1</b>	<b>2.9</b>	<b>5.7</b>	<b>9.6</b>	<b>12.8</b>	<b>16.4</b>	
<b>3</b> BASIN 11B DESIGN PT 3B DESIGN PT 3A BIBLICA	<b>0.00</b> 0.78 6.91	<b>0.00</b> 0.03 0.21	<b>0.00</b> 0.09 0.26	<b>0.00</b> 0.17 0.32	<b>0.00</b> 0.26 0.40	<b>0.00</b> 0.31 0.44	<b>0.00</b> 0.36 0.48	40.2 40.2	1.6 1.6	2.0 2.0	2.4 2.4	2.7 2.7	3.1 3.1	3.4 3.4		<b>16.5</b> 0.0 4.9 1.1	<b>16.5</b> 0.1 7.6 2.9	<b>16.5</b> 0.3 10.7 5.7	<b>16.5</b> 0.6 14.0 9.6	<b>16.5</b> 0.7 16.7 12.8	<b>16.5</b> 1.0 19.8 16.4 10.3
<b>4A</b> BASIN 1C	0.69	0.89	0.90	0.92	0.94	0.95	0.96	9.5	3.4	4.2	4.9	5.6	6.3	7.1	<b>2.1</b>	<b>2.6</b>	<b>3.1</b>	<b>3.6</b>	<b>4.1</b>	<b>4.7</b>	
<b>4</b> BASIN 2C DESIGN PT 4A	8.33	0.37	0.41	0.45	0.51	0.54	0.56	39.8	2.6	3.3	3.8	4.4	4.9	5.5	<b>0.5</b>	<b>2.1</b>	<b>4.5</b>	<b>7.9</b>	<b>10.6</b>	<b>13.8</b>	

Calculated by: DLM  
Date: 5/10/2017



DESIGN POINT	AREA TOTAL (Acres)	WEIGHTED						TT	INTENSITY						TOTAL FLOWS					
		C <sub>2</sub>	C <sub>5</sub>	C <sub>10</sub>	C <sub>25</sub>	C <sub>50</sub>	C <sub>100</sub>	TOTAL (min)	I <sub>2</sub> (in/hr)	I <sub>5</sub> (in/hr)	I <sub>10</sub> (in/hr)	I <sub>25</sub> (in/hr)	I <sub>50</sub> (in/hr)	I <sub>100</sub> (in/hr)	Q <sub>2</sub> (c.f.s.)	Q <sub>5</sub> (c.f.s.)	Q <sub>10</sub> (c.f.s.)	Q <sub>25</sub> (c.f.s.)	Q <sub>50</sub> (c.f.s.)	Q <sub>100</sub> (c.f.s.)
<b>3F</b>	<b>3.92</b>	<b>0.36</b>	<b>0.40</b>	<b>0.44</b>	<b>0.50</b>	<b>0.53</b>	<b>0.55</b>	19.6	2.5	3.1	3.6	4.2	4.7	5.2	<b>3.5</b>	<b>4.9</b>	<b>6.3</b>	<b>8.1</b>	<b>9.7</b>	<b>11.3</b>
BASIN 4B	1.20	0.41	0.45	0.49	0.54	0.57	0.59													
BASIN 5B	0.84	0.16	0.21	0.26	0.34	0.38	0.41													
BASIN 6B	1.88	0.41	0.45	0.49	0.54	0.57	0.59													
<b>3E</b>	<b>4.74</b>	<b>0.35</b>	<b>0.39</b>	<b>0.44</b>	<b>0.49</b>	<b>0.53</b>	<b>0.55</b>	21.8	2.4	3.0	3.5	3.9	4.4	5.0	<b>4.0</b>	<b>5.5</b>	<b>7.2</b>	<b>9.2</b>	<b>11.1</b>	<b>13.0</b>
BASIN 3B	0.82	0.33	0.38	0.42	0.48	0.52	0.54													
DESIGN PT 3F	3.92	0.36	0.40	0.44	0.50	0.53	0.55													
<b>3G</b> FLOW BY 3E-3F																<b>2.9</b>				<b>10.8</b>
<b>3H</b> 24" PIPE 3E (INT) 3F (INT) 3G																<b>8.8</b>				<b>20.2</b>

Calculated by: DLM  
Date: 6/13/2017

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

### LID Credit by Impervious Reduction Factor (IRF) Method

**User Input**

Calculated cells

\*\*\*Design Storm: 1-Hour Rain Depth: 2-Year Event: 1.19 inches  
 \*\*\*Minor Storm: 1-Hour Rain Depth: 5-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:

**Designer:** David Mijares  
**Company:** Catamount Engineering  
**Date:** June 13, 2017  
**Project:** Reserve at North Creek  
**Location:** Jet Stream and New Life Drive

**SITE INFORMATION (USER-INPUT)**

Sub-basin Identifier	1A	1B	2B	3B	4B	5B	6B	7B	8B	9B	10B	11B		
Receiving Pervious Area Soil Type	Loamy Sand	Loamy Sand	Loamy Sand	Loamy Sand	Loamy Sand	Loamy Sand	Loamy Sand	Loamy Sand	Loamy Sand	Loamy Sand	Loamy Sand	Loamy Sand		
Total Area (ac., Sum of DCIA, UIA, RPA, & SPA)	0.990	0.420	2.000	0.820	1.200	0.840	1.880	0.530	1.080	1.600	5.310	0.780		
Directly Connected Impervious Area (DCIA, acres)	0.000	0.000	1.750	0.000	0.900	0.000	1.410	0.280	0.000	0.800	0.310	0.000		
Unconnected Impervious Area (UIA, acres)	0.620	0.220	0.000	0.410	0.000	0.300	0.000	0.000	0.400	0.000	0.000	0.000		
Receiving Pervious Area (RPA, acres)	0.370	0.200	0.000	0.410	0.000	0.540	0.000	0.000	0.680	0.000	0.000	0.000		
Separate Pervious Area (SPA, acres)	0.000	0.000	0.250	0.000	0.300	0.000	0.470	0.250	0.000	0.800	5.000	0.780		
RPA Treatment Type: Conveyance (C), Volume (V), or Permeable Pavement (PP)	C	C	C	C	C	C	C	C	C	C	C	C		

**CALCULATED RESULTS (OUTPUT)**

Total Calculated Area (ac, check against input)	0.990	0.420	2.000	0.820	1.200	0.840	1.880	0.530	1.080	1.600	5.310	0.780		
Directly Connected Impervious Area (DCIA, %)	0.0%	0.0%	87.5%	0.0%	75.0%	0.0%	75.0%	52.8%	0.0%	50.0%	5.8%	0.0%		
Unconnected Impervious Area (UIA, %)	62.6%	52.4%	0.0%	50.0%	0.0%	35.7%	0.0%	0.0%	37.0%	0.0%	0.0%	0.0%		
Receiving Pervious Area (RPA, %)	37.4%	47.6%	0.0%	50.0%	0.0%	64.3%	0.0%	0.0%	63.0%	0.0%	0.0%	0.0%		
Separate Pervious Area (SPA, %)	0.0%	0.0%	12.5%	0.0%	25.0%	0.0%	25.0%	47.2%	0.0%	50.0%	94.2%	100.0%		
A <sub>v</sub> (RPA / UIA)	0.597	0.909	0.000	1.000	0.000	1.800	0.000	0.000	1.700	0.000	0.000	0.000		
I <sub>a</sub> Check	0.630	0.520	1.000	0.500	1.000	0.360	1.000	1.000	0.370	1.000	1.000	1.000		
f / i for 2-Year Event:	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6		
f / i for 5-Year Event:	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5		
f / i for 100-Year Event:	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4		
<b>f / i for Optional User Defined Storm CUHP:</b>														
IRF for 2-Year Event:	0.73	0.69	1.00	0.68	1.00	0.62	1.00	1.00	0.63	1.00	1.00	1.00		
IRF for 5-Year Event:	0.91	0.89	1.00	0.89	1.00	0.87	1.00	1.00	0.87	1.00	1.00	1.00		
IRF for 100-Year Event:	0.93	0.92	1.00	0.91	1.00	0.89	1.00	1.00	0.89	1.00	1.00	1.00		
<b>IRF for Optional User Defined Storm CUHP:</b>														
Total Site Imperviousness: I <sub>total</sub>	62.6%	52.4%	87.5%	50.0%	75.0%	35.7%	75.0%	52.8%	37.0%	50.0%	5.8%	0.0%		
Effective Imperviousness for 2-Year Event:	46.0%	36.1%	87.5%	34.0%	75.0%	22.2%	75.0%	52.8%	23.2%	50.0%	5.8%	0.0%		
Effective Imperviousness for 5-Year Event:	57.1%	46.8%	87.5%	44.5%	75.0%	30.9%	75.0%	52.8%	32.1%	50.0%	5.8%	0.0%		
Effective Imperviousness for 100-Year Event:	58.4%	47.9%	87.5%	45.6%	75.0%	31.8%	75.0%	52.8%	33.0%	50.0%	5.8%	0.0%		
<b>Effective Imperviousness for Optional User Defined Storm CUHP:</b>														

**LID / EFFECTIVE IMPERVIOUSNESS CREDITS**

This line only for WQCV Event	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
This line only for 10-Year Event	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
100-Year Event CREDIT**:	6.5%	8.4%	0.0%	8.7%	0.0%	11.3%	0.0%	0.1%	11.1%	0.0%	0.1%	N/A	N/A	N/A
User Defined CUHP CREDIT: Reduce Detention By:														

<b>Total Site Imperviousness:</b>	<b>42.4%</b>
<b>Total Site Effective Imperviousness for 2-Year Event:</b>	<b>38.8%</b>
<b>Total Site Effective Imperviousness for 5-Year Event:</b>	<b>41.2%</b>
<b>Total Site Effective Imperviousness for 100-Year Event:</b>	<b>41.4%</b>
<b>Total Site Effective Imperviousness for Optional User Defined Storm CUHP:</b>	

Notes:

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

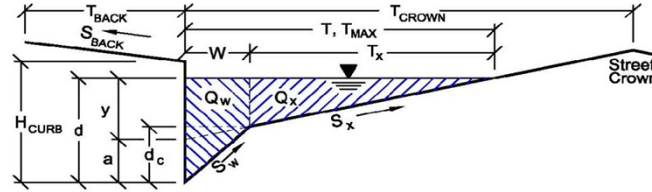
\*\* Flood control detention volume credits based on empirical equations from Storage Chapter of USDCM.

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

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

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

Project: **RESERVE AT NORTH CREEK**  
 Inlet ID: **DESIGN POINT 3A (INTERIM)**



**Gutter Geometry (Enter data in the blue cells)**

Maximum Allowable Width for Spread Behind Curb  
 Side Slope Behind Curb (leave blank for no conveyance credit behind curb)  
 Manning's Roughness Behind Curb (typically between 0.012 and 0.020)  
 Height of Curb at Gutter Flow Line  
 Distance from Curb Face to Street Crown  
 Gutter Width  
 Street Transverse Slope  
 Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)  
 Street Longitudinal Slope - Enter 0 for sump condition  
 Manning's Roughness for Street Section (typically between 0.012 and 0.020)

$T_{BACK} = 10.0$  ft  
 $S_{BACK} = 0.020$  ft/ft  
 $n_{BACK} = 0.015$   
 $H_{CURB} = 8.00$  inches  
 $T_{CROWN} = 22.0$  ft  
 $W = 2.00$  ft  
 $S_x = 0.020$  ft/ft  
 $S_w = 0.083$  ft/ft  
 $S_D = 0.018$  ft/ft  
 $n_{STREET} = 0.016$

Max. Allowable Spread for Minor & Major Storm  
 Max. Allowable Depth at Gutter Flowline for Minor & Major Storm  
 Allow Flow Depth at Street Crown (leave blank for no)

	Minor Storm	Major Storm	
$T_{MAX}$	22.0	22.0	ft
$d_{MAX}$	8.0	8.0	inches
	<input type="checkbox"/>	<input type="checkbox"/>	check = yes

**MINOR STORM Allowable Capacity is based on Spread Criterion**  
**MAJOR STORM Allowable Capacity is based on Spread Criterion**

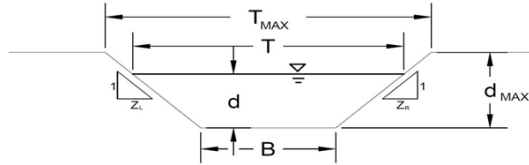
$Q_{allow} =$ 

Minor Storm	Major Storm	
27.5	27.5	cfs

**Minor storm max. allowable capacity GOOD - greater than flow given on sheet 'Q-Peak'**  
**Major storm max. allowable capacity GOOD - greater than flow given on sheet 'Q-Peak'**

## AREA INLET IN A TRAPEZOIDAL GRASS-LINED CHANNEL

RESERVE AT NORTH CREEK  
DESIGN POINT 3D



Grass Type	Limiting Manning's n
A	0.06
B	0.04
C	0.033
D	0.03
E	0.024

### Analysis of Trapezoidal Grass-Lined Channel Using SCS Method

NRCS Vegetal Retardance (A, B, C, D, or E)  
Manning's n (Leave cell D16 blank to manually enter an n value)  
Channel Invert Slope  
Bottom Width  
Left Side Slope  
Right Side Slope

A, B, C, D or E  
n = 0.013  
S<sub>0</sub> = 0.0100 ft/ft  
B = 0.00 ft  
Z<sub>1</sub> = 33.30 ft/ft  
Z<sub>2</sub> = 33.30 ft/ft

Check one of the following soil types:

Soil Type:	Max. Velocity (V <sub>MAX</sub> )	Max Froude No. (F <sub>MAX</sub> )
Sandy	5.0 fps	0.50
Non-Sandy	7.0 fps	0.80

Choose One:  
 Sandy  
 Non-Sandy

Max. Allowable Top Width of Channel for Minor & Major Storm  
Max. Allowable Water Depth in Channel for Minor & Major Storm

	Minor Storm	Major Storm	
T <sub>MAX</sub> =	24.00	30.00	feet
d <sub>MAX</sub> =	0.36	0.50	feet

### Allowable Channel Capacity Based On Channel Geometry

MINOR STORM Allowable Capacity is based on Depth Criterion  
MAJOR STORM Allowable Capacity is based on Top Width Criterion

	Minor Storm	Major Storm	
Q <sub>allow</sub> =	15.76	28.66	cfs
d <sub>allow</sub> =	0.36	0.45	ft

### Water Depth in Channel Based On Design Peak Flow

Design Peak Flow  
Water Depth

Q <sub>p</sub> =	3.30	7.20	cfs
d =	0.20	0.27	feet

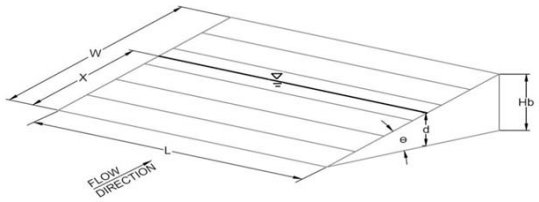
Minor storm max. allowable capacity GOOD - greater than flow given on sheet 'Q-Peak'  
Major storm max. allowable capacity GOOD - greater than flow given on sheet 'Q-Peak'

## AREA INLET IN A TRAPEZOIDAL GRASS-LINED CHANNEL

RESERVE AT NORTH CREEK  
DESIGN POINT 3D

Inlet Design Information (Input)	
Type of Inlet	Inlet Type = <span style="border: 1px solid black; padding: 2px;">User-Defined</span>
Angle of Inclined Grate (must be <= 30 degrees)	$\theta =$ <span style="border: 1px solid black; padding: 2px;">0.00</span> degrees
Width of Grate	$W =$ <span style="border: 1px solid black; padding: 2px;">7.50</span> feet
Length of Grate	$L =$ <span style="border: 1px solid black; padding: 2px;">2.50</span> feet
Open Area Ratio	$A_{RATIO} =$ <span style="border: 1px solid black; padding: 2px;">0.70</span>
Height of Inclined Grate	$H_B =$ <span style="border: 1px solid black; padding: 2px;">0.00</span> feet
Clogging Factor	$C_1 =$ <span style="border: 1px solid black; padding: 2px;">0.50</span>
Grate Discharge Coefficient	$C_d =$ <span style="border: 1px solid black; padding: 2px;">N/A</span>
Orifice Coefficient	$C_o =$ <span style="border: 1px solid black; padding: 2px;">0.64</span>
Weir Coefficient	$C_w =$ <span style="border: 1px solid black; padding: 2px;">2.05</span>



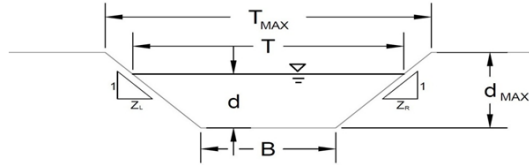
  

Water Depth at Inlet (for depressed inlets, 1 foot is added for depression)	$d =$	MINOR	MAJOR	
<b>Total Inlet Interception Capacity (assumes clogged condition)</b>	$Q_a =$	0.20	0.27	
<b>WARNING: Inlet Capacity less than Q Peak for Minor and Major Storms</b>	Bypassed Flow, $Q_b =$	2.53	3.92	cfs
Capture Percentage = $Q_a/Q_o = C\%$		0.77	3.28	cfs
		77	54	%

Warning 04: Froude No. exceeds USDCM Volume I recommendation.

## AREA INLET IN A TRAPEZOIDAL GRASS-LINED CHANNEL

RESERVE AT NORTH CREEK  
DESIGN POINT 3E



Grass Type	Limiting Manning's n
A	0.06
B	0.04
C	0.033
D	0.03
E	0.024

### Analysis of Trapezoidal Grass-Lined Channel Using SCS Method

NRCS Vegetal Retardance (A, B, C, D, or E)  
Manning's n (Leave cell D16 blank to manually enter an n value)  
Channel Invert Slope  
Bottom Width  
Left Side Slope  
Right Side Slope

A, B, C, D or E  
n = 0.013  
S<sub>0</sub> = 0.0100 ft/ft  
B = 0.00 ft  
Z<sub>1</sub> = 33.30 ft/ft  
Z<sub>2</sub> = 33.30 ft/ft

Check one of the following soil types:

Soil Type:	Max. Velocity (V <sub>MAX</sub> )	Max Froude No. (F <sub>MAX</sub> )
Sandy	5.0 fps	0.50
Non-Sandy	7.0 fps	0.80

Choose One:  
 Sandy  
 Non-Sandy

Max. Allowable Top Width of Channel for Minor & Major Storm  
Max. Allowable Water Depth in Channel for Minor & Major Storm

	Minor Storm	Major Storm	
T <sub>MAX</sub> =	24.00	30.00	feet
d <sub>MAX</sub> =	0.36	0.50	feet

### Allowable Channel Capacity Based On Channel Geometry

MINOR STORM Allowable Capacity is based on Depth Criterion  
MAJOR STORM Allowable Capacity is based on Top Width Criterion

	Minor Storm	Major Storm	
Q <sub>allow</sub> =	15.76	28.66	cfs
d <sub>allow</sub> =	0.36	0.45	ft

### Water Depth in Channel Based On Design Peak Flow

Design Peak Flow  
Water Depth

Q <sub>p</sub> =	5.50	13.00	cfs
d =	0.24	0.33	feet

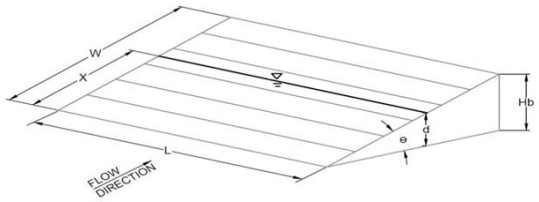
Minor storm max. allowable capacity GOOD - greater than flow given on sheet 'Q-Peak'  
Major storm max. allowable capacity GOOD - greater than flow given on sheet 'Q-Peak'

## AREA INLET IN A TRAPEZOIDAL GRASS-LINED CHANNEL

RESERVE AT NORTH CREEK  
DESIGN POINT 3E

Inlet Design Information (Input)	
Type of Inlet	Inlet Type = <span style="border: 1px solid black; padding: 2px;">User-Defined</span>
Angle of Inclined Gate (must be <= 30 degrees)	$\theta =$ <span style="border: 1px solid black; padding: 2px;">0.00</span> degrees
Width of Gate	$W =$ <span style="border: 1px solid black; padding: 2px;">7.50</span> feet
Length of Gate	$L =$ <span style="border: 1px solid black; padding: 2px;">2.50</span> feet
Open Area Ratio	$A_{RATIO} =$ <span style="border: 1px solid black; padding: 2px;">0.70</span>
Height of Inclined Gate	$H_B =$ <span style="border: 1px solid black; padding: 2px;">0.00</span> feet
Clogging Factor	$C_1 =$ <span style="border: 1px solid black; padding: 2px;">0.50</span>
Grate Discharge Coefficient	$C_d =$ <span style="border: 1px solid black; padding: 2px;">N/A</span>
Orifice Coefficient	$C_o =$ <span style="border: 1px solid black; padding: 2px;">0.64</span>
Weir Coefficient	$C_w =$ <span style="border: 1px solid black; padding: 2px;">2.05</span>



	MINOR	MAJOR	
Water Depth at Inlet (for depressed inlets, 1 foot is added for depression)	$d =$ 0.24	0.33	
<b>Total Inlet Interception Capacity (assumes clogged condition)</b>	$Q_a =$ 3.37	5.46	cfs
<b>WARNING: Inlet Capacity less than Q Peak for Minor and Major Storms</b>	Bypassed Flow, $Q_b =$ 2.13	7.54	cfs
Capture Percentage = $Q_a/Q_o = C\%$	61	42	%

Warning 04: Froude No. exceeds USDCM Volume I recommendation.

## AREA INLET IN A TRAPEZOIDAL GRASS-LINED CHANNEL

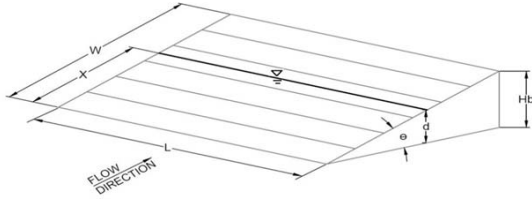
Reserve at NorthCreek  
D9-Inlet DP-3G

### Inlet Design Information (Input)

Type of Inlet

Inlet Type = User-Defined

- Angle of Inclined Grate (must be <= 30 degrees)
- Width of Grate
- Length of Grate
- Open Area Ratio
- Height of Inclined Grate
- Clogging Factor
- Grate Discharge Coefficient
- Orifice Coefficient
- Weir Coefficient



$\theta$ =	0.00	degrees
W =	7.00	feet
L =	2.50	feet
A <sub>RATIO</sub> =	0.80	
H <sub>B</sub> =	0.00	feet
C <sub>i</sub> =	0.42	
C <sub>d</sub> =	N/A	
C <sub>o</sub> =	0.64	
C <sub>w</sub> =	2.05	

Water Depth at Inlet (for depressed inlets, 1 foot is added for depression)

	MINOR	MAJOR
d =	0.29	0.48

**Total Inlet Interception Capacity (assumes clogged condition)**

$Q_a$ =	5.23	10.97	cfs
---------	------	-------	-----

Inlet Capacity IS GOOD for Minor and Major Storms (> Q PEAK)

Bypassed Flow,  $Q_b$  =

0.00	0.00	cfs
------	------	-----

Capture Percentage =  $Q_a/Q_o$  = C%

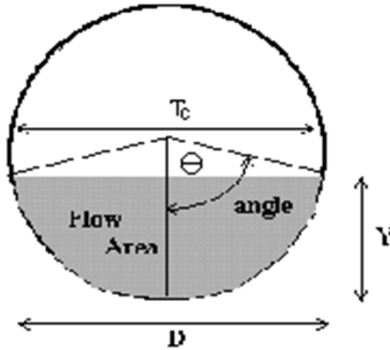
100	100	%
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## CIRCULAR CONDUIT FLOW (Normal & Critical Depth Computation)

Project: Reserve at North Creek

Pipe ID: 15" HDPE DP-3D



### Design Information (Input)

Pipe Invert Slope	So =	0.0100	ft/ft
Pipe Manning's n-value	n =	0.0120	
Pipe Diameter	D =	15.00	inches
<b>Design discharge</b>	<b>Q =</b>	<b>3.92</b>	<b>cfs</b>

### Full-flow Capacity (Calculated)

Full-flow area	Af =	1.23	sq ft
Full-flow wetted perimeter	Pf =	3.93	ft
Half Central Angle	Theta =	3.14	radians
Full-flow capacity	Qf =	7.02	cfs

### Calculation of Normal Flow Condition

Half Central Angle ( $0 < \text{Theta} < 3.14$ )	Theta =	1.64	radians
Flow area	An =	0.67	sq ft
Top width	Tn =	1.25	ft
Wetted perimeter	Pn =	2.05	ft
Flow depth	Yn =	0.67	ft
Flow velocity	Vn =	5.88	fps
Discharge	Qn =	3.92	cfs
Percent Full Flow	Flow =	55.8%	of full flow
Normal Depth Froude Number	Fr <sub>n</sub> =	1.42	supercritical

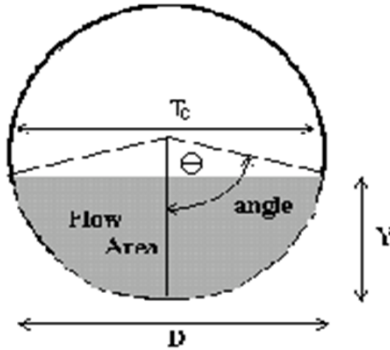
### Calculation of Critical Flow Condition

Half Central Angle ( $0 < \text{Theta-c} < 3.14$ )	Theta-c =	1.86	radians
Critical flow area	Ac =	0.83	sq ft
Critical top width	Tc =	1.20	ft
Critical flow depth	Yc =	0.80	ft
Critical flow velocity	Vc =	4.72	fps
Critical Depth Froude Number	Fr <sub>c</sub> =	1.00	

## CIRCULAR CONDUIT FLOW (Normal & Critical Depth Computation)

Project: Reserve at North Creek

Pipe ID: 15" HDPE DP-3E

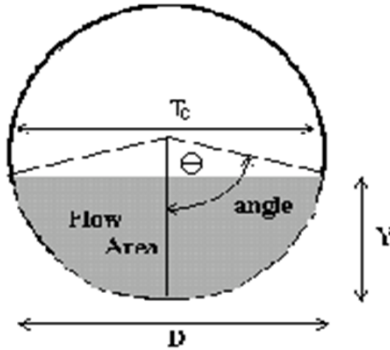


<b>Design Information (Input)</b>	
Pipe Invert Slope	So = 0.0100 ft/ft
Pipe Manning's n-value	n = 0.0120
Pipe Diameter	D = 15.00 inches
<b>Design discharge</b>	<b>Q = 5.46 cfs</b>
<b>Full-flow Capacity (Calculated)</b>	
Full-flow area	Af = 1.23 sq ft
Full-flow wetted perimeter	Pf = 3.93 ft
Half Central Angle	Theta = 3.14 radians
Full-flow capacity	Qf = 7.02 cfs
<b>Calculation of Normal Flow Condition</b>	
Half Central Angle ( $0 < \theta < 3.14$ )	Theta = 1.90 radians
Flow area	An = 0.86 sq ft
Top width	Tn = 1.18 ft
Wetted perimeter	Pn = 2.38 ft
Flow depth	Yn = 0.83 ft
Flow velocity	Vn = 6.32 fps
Discharge	Qn = 5.46 cfs
Percent Full Flow	Flow = 77.8% of full flow
Normal Depth Froude Number	Fr <sub>n</sub> = 1.30 supercritical
<b>Calculation of Critical Flow Condition</b>	
Half Central Angle ( $0 < \theta_c < 3.14$ )	Theta-c = 2.11 radians
Critical flow area	Ac = 1.00 sq ft
Critical top width	Tc = 1.07 ft
Critical flow depth	Yc = 0.95 ft
Critical flow velocity	Vc = 5.47 fps
Critical Depth Froude Number	Fr <sub>c</sub> = 1.00

## CIRCULAR CONDUIT FLOW (Normal & Critical Depth Computation)

Project: Reserve at North Creek

Pipe ID: 15" HDPE DP-3G



### Design Information (Input)

Pipe Invert Slope	So =	0.0320	ft/ft
Pipe Manning's n-value	n =	0.0120	
Pipe Diameter	D =	15.00	inches
<b>Design discharge</b>	<b>Q =</b>	<b>10.80</b>	<b>cfs</b>

### Full-flow Capacity (Calculated)

Full-flow area	Af =	1.23	sq ft
Full-flow wetted perimeter	Pf =	3.93	ft
Half Central Angle	Theta =	3.14	radians
Full-flow capacity	Qf =	12.55	cfs

### Calculation of Normal Flow Condition

Half Central Angle ( $0 < \theta < 3.14$ )	Theta =	2.02	radians
Flow area	An =	0.94	sq ft
Top width	Tn =	1.13	ft
Wetted perimeter	Pn =	2.52	ft
Flow depth	Yn =	0.89	ft
Flow velocity	Vn =	11.50	fps
Discharge	Qn =	10.80	cfs
Percent Full Flow	Flow =	86.1%	of full flow
Normal Depth Froude Number	Fr <sub>n</sub> =	2.22	supercritical

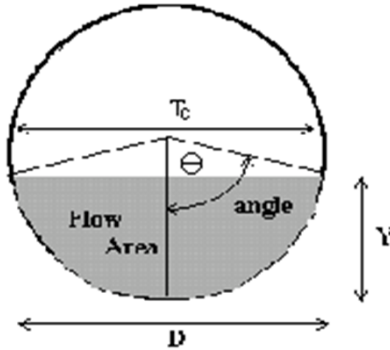
### Calculation of Critical Flow Condition

Half Central Angle ( $0 < \theta_c < 3.14$ )	Theta-c =	2.74	radians
Critical flow area	Ac =	1.21	sq ft
Critical top width	Tc =	0.49	ft
Critical flow depth	Yc =	1.20	ft
Critical flow velocity	Vc =	8.92	fps
Critical Depth Froude Number	Fr <sub>c</sub> =	1.00	

## CIRCULAR CONDUIT FLOW (Normal & Critical Depth Computation)

Project: Reserve at North Creek

Pipe ID: 24" HDPE CONFLUENCE DP-3H



<b>Design Information (Input)</b>	
Pipe Invert Slope	So = 0.0100 ft/ft
Pipe Manning's n-value	n = 0.0120
Pipe Diameter	D = 24.00 inches
<b>Design discharge</b>	<b>Q = 20.18 cfs</b>
<b>Full-flow Capacity (Calculated)</b>	
Full-flow area	Af = 3.14 sq ft
Full-flow wetted perimeter	Pf = 6.28 ft
Half Central Angle	Theta = 3.14 radians
Full-flow capacity	Qf = 24.57 cfs
<b>Calculation of Normal Flow Condition</b>	
Half Central Angle ( $0 < \theta < 3.14$ )	Theta = 1.96 radians
Flow area	An = 2.31 sq ft
Top width	Tn = 1.85 ft
Wetted perimeter	Pn = 3.92 ft
Flow depth	Yn = 1.38 ft
Flow velocity	Vn = 8.73 fps
Discharge	Qn = 20.18 cfs
Percent Full Flow	Flow = 82.1% of full flow
Normal Depth Froude Number	Fr <sub>n</sub> = 1.38 supercritical
<b>Calculation of Critical Flow Condition</b>	
Half Central Angle ( $0 < \theta_c < 3.14$ )	Theta-c = 2.23 radians
Critical flow area	Ac = 2.71 sq ft
Critical top width	Tc = 1.58 ft
Critical flow depth	Yc = 1.61 ft
Critical flow velocity	Vc = 7.43 fps
Critical Depth Froude Number	Fr <sub>c</sub> = 1.00

# DETENTION BASIN DESIGN WORKBOOK

UD-Detention, Version 3.07 (February 2017)

Urban Drainage and Flood Control District  
Denver, Colorado  
[www.udfcd.org](http://www.udfcd.org)

**Purpose:**

This workbook aids in the estimation of stormwater detention basin sizing and outlet routing based on the modified puls routing method for urban watersheds. Several different BMP types and various outlet configurations can be sized.

**Function:**

1. Approximates the stage-area-volume relationship for a detention basin based on watershed parameters and basin geometry parameters. Also evaluates existing user-defined basin stage-area relationships.
2. Sizes filtration media orifice, outlet orifices, elliptical slots, weirs, trash racks, and develops stage-discharge relationships. Uses the Modified Puls method to route a series of hydrographs (i.e., 2-, 5-, 10-, 25-, 50-, 100- and 500-year) and calibrates the peak discharge out of the basin to match the pre-development peak discharges for the watershed.

**Content:**

This workbook consists of the following sheets:

**Basin**

Tabulates stage-area-volume relationship estimates based on watershed parameters

**Outlet Structure**

Tabulates a stage-discharge relationship for the user-defined outlet structure (inlet control).

**Reference**

Provides reference equations and figures.

**User Tips and Tools**

Provides instructions and video links to assist in using this workbook. Includes a stage-area calculator.

**BMP Zone Images**

Provides images of typical BMP zone configurations corresponding with Zone pulldown selections.

**Acknowledgements:**

***Spreadsheet Development Team:***

**Ken MacKenzie, P.E., Holly Piza, P.E.**

Urban Drainage and Flood Control District

**Derek N. Rapp, P.E.**

Peak Stormwater Engineering, LLC

**Dr. James C.Y. Guo, Ph.D., P.E.**

Professor, Department of Civil Engineering, University of Colorado at Denver

**Comments?**

Direct all comments regarding this spreadsheet workbook to:

[UDFCD email](#)

**Revisions?**

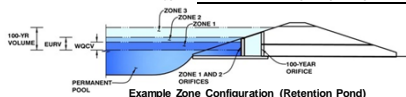
Check for revised versions of this or any other workbook at:

[Downloads](#)

# DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: RESERVE AT NORTH CREEK  
Basin ID: EXTENDED DETENTION BASIN 'BASIN B'



Example Zone Configuration (Retention Pond)

**Required Volume Calculation**

Selected BMP Type =	<b>EDB</b>
Watershed Area =	8.33 acres
Watershed Length =	1,016 ft
Watershed Slope =	0.010 ft/ft
Watershed Imperviousness =	59.80% 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 WOCV Drain Time =	40.0 hours
Location for 1-hr Rainfall Depths =	User Input
Water Quality Capture Volume (WOCV) =	0.163 acre-feet
Excess Urban Runoff Volume (EURV) =	0.540 acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.443 acre-feet
5-yr Runoff Volume (P1 = 1.5 in.) =	0.597 acre-feet
10-yr Runoff Volume (P1 = 1.75 in.) =	0.779 acre-feet
25-yr Runoff Volume (P1 = 2 in.) =	1.027 acre-feet
50-yr Runoff Volume (P1 = 2.25 in.) =	1.205 acre-feet
100-yr Runoff Volume (P1 = 2.52 in.) =	1.438 acre-feet
500-yr Runoff Volume (P1 = 0 in.) =	0.000 acre-feet
Approximate 2-yr Detention Volume =	0.415 acre-feet
Approximate 5-yr Detention Volume =	0.561 acre-feet
Approximate 10-yr Detention Volume =	0.723 acre-feet
Approximate 25-yr Detention Volume =	0.782 acre-feet
Approximate 50-yr Detention Volume =	0.815 acre-feet
Approximate 100-yr Detention Volume =	0.890 acre-feet

Optional User Override 1-hr Precipitation	1.19 inches
	1.50 inches
	1.75 inches
	2.00 inches
	2.25 inches
	2.52 inches
	inches

**Stage-Storage Calculation**

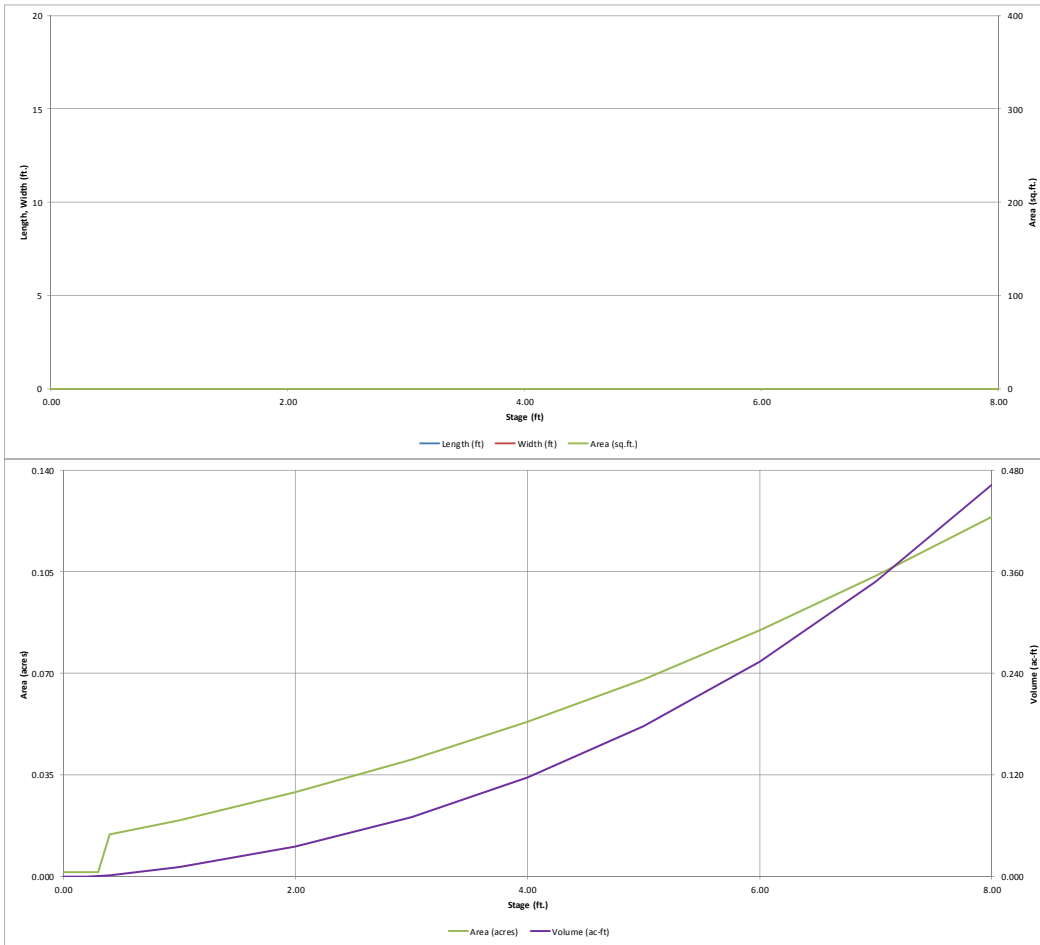
Zone 1 Volume (WOCV) =	0.163 acre-feet
Select Zone 2 Storage Volume (Optional) =	acre-feet
Select Zone 3 Storage Volume (Optional) =	acre-feet
Total Detention Basin Volume =	0.163 acre-feet
Initial Surcharge Volume (SV) =	user ft <sup>3</sup>
Initial Surcharge Depth (SD) =	user ft
Total Available Detention Depth (H <sub>total</sub> ) =	user ft
Depth of Trickle Channel (H <sub>TC</sub> ) =	user ft
Slope of Trickle Channel (S <sub>TC</sub> ) =	user ft/ft
Slopes of Main Basin Sides (S <sub>main</sub> ) =	user ft/V
Basin Length-to-Width Ratio (R <sub>L/W</sub> ) =	user
Initial Surcharge Area (A <sub>sv</sub> ) =	user ft <sup>2</sup>
Surcharge Volume Length (L <sub>sv</sub> ) =	user ft
Surcharge Volume Width (W <sub>sv</sub> ) =	user ft
Depth of Basin Floor (H <sub>bottom</sub> ) =	user ft
Length of Basin Floor (L <sub>bottom</sub> ) =	user ft
Width of Basin Floor (W <sub>bottom</sub> ) =	user ft
Area of Basin Floor (A <sub>bottom</sub> ) =	user ft <sup>2</sup>
Volume of Basin Floor (V <sub>bottom</sub> ) =	user ft <sup>3</sup>
Depth of Main Basin (H <sub>main</sub> ) =	user ft
Length of Main Basin (L <sub>main</sub> ) =	user ft
Width of Main Basin (W <sub>main</sub> ) =	user ft
Area of Main Basin (A <sub>main</sub> ) =	user ft <sup>2</sup>
Volume of Main Basin (V <sub>main</sub> ) =	user ft <sup>3</sup>
Calculated Total Basin Volume (V <sub>total</sub> ) =	user acre-feet

Total detention volume is less than 100-year volume.

Depth increment = 0.1 ft									
Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft <sup>2</sup> )	Optional Override Area (ft <sup>2</sup> )	Area (acre)	Volume (ft <sup>3</sup> )	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	--	--	--	--
6791.1	--	0.10	--	--	--	70	0.002	7	0.000
6791.2	--	0.20	--	--	--	70	0.002	13	0.000
6791.3/SV	--	0.30	--	--	--	70	0.002	20	0.000
6791.4	--	0.40	--	--	--	631	0.014	50	0.001
6792	--	1.00	--	--	--	848	0.019	491	0.011
6793	--	2.00	--	--	--	1,266	0.029	1,544	0.035
6794	--	3.00	--	--	--	1,757	0.040	3,068	0.070
6795	--	4.00	--	--	--	2,319	0.053	5,106	0.117
6796	--	5.00	--	--	--	2,952	0.068	7,742	0.178
6797	--	6.00	--	--	--	3,699	0.085	11,067	0.254
6798	--	7.00	--	--	--	4,510	0.104	15,172	0.348
6799	--	8.00	--	--	--	5,396	0.124	20,125	0.462

# DETENTION BASIN STAGE-STORAGE TABLE BUILDER

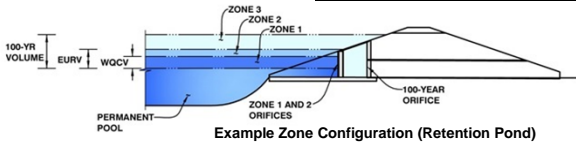
UD-Detention, Version 3.07 (February 2017)



## Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: RESERVE AT NORTH CREEK  
Basin ID: EXTENDED DETENTION BASIN 'BASIN B'



	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	4.79	0.163	Orifice Plate
Zone 2			Weir&Pipe (Circular)
Zone 3			
		0.163	Total

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

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

**Calculated Parameters for Underdrain**

Underdrain Orifice Area =  ft<sup>2</sup>  
Underdrain Orifice Centroid =  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 =  ft (relative to basin bottom at Stage = 0 ft)  
Depth at top of Zone using Orifice Plate =  ft (relative to basin bottom at Stage = 0 ft)  
Orifice Plate: Orifice Vertical Spacing =  inches  
Orifice Plate: Orifice Area per Row =  inches

**Calculated Parameters for Plate**

WQ Orifice Area per Row =  ft<sup>2</sup>  
Elliptical Half-Width =  feet  
Elliptical Slot Centroid =  feet  
Elliptical Slot Area =  ft<sup>2</sup>

**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	1.60	3.19					
Orifice Area (sq. inches)	0.60	0.60	0.60					

	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)**

Invert of Vertical Orifice =  ft (relative to basin bottom at Stage = 0 ft)  
Depth at top of Zone using Vertical Orifice =  ft (relative to basin bottom at Stage = 0 ft)  
Vertical Orifice Diameter =  inches

**Calculated Parameters for Vertical Orifice**

Vertical Orifice Area =  ft<sup>2</sup>  
Vertical Orifice Centroid =  feet

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

	Zone 2 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	5.12		ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	4.00		feet
Overflow Weir Slope =	3.00		H:V (enter zero for flat grate)
Horiz. Length of Weir Sides =	3.00		feet
Overflow Grate Open Area % =	70%		%, grate open area/total area
Debris Clogging % =	50%		%

**Calculated Parameters for Overflow Weir**

	Zone 2 Weir	Not Selected	
Height of Grate Upper Edge, H <sub>1</sub> =	6.12		feet
Over Flow Weir Slope Length =	3.16		feet
Grate Open Area / 100-yr Orifice Area =	2.82		should be ≥ 4
Overflow Grate Open Area w/o Debris =	8.85		ft <sup>2</sup>
Overflow Grate Open Area w/ Debris =	4.43		ft <sup>2</sup>

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

	Zone 2 Circular	Not Selected	
Depth to Invert of Outlet Pipe =	0.25		ft (distance below basin bottom at Stage = 0 ft)
Circular Orifice Diameter =	24.00		inches

**Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate**

	Zone 2 Circular	Not Selected	
Outlet Orifice Area =	3.14		ft <sup>2</sup>
Outlet Orifice Centroid =	1.00		feet
Half-Central Angle of Restrictor Plate on Pipe =	N/A	N/A	radians

**User Input: Emergency Spillway (Rectangular or Trapezoidal)**

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

**Calculated Parameters for Spillway**

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

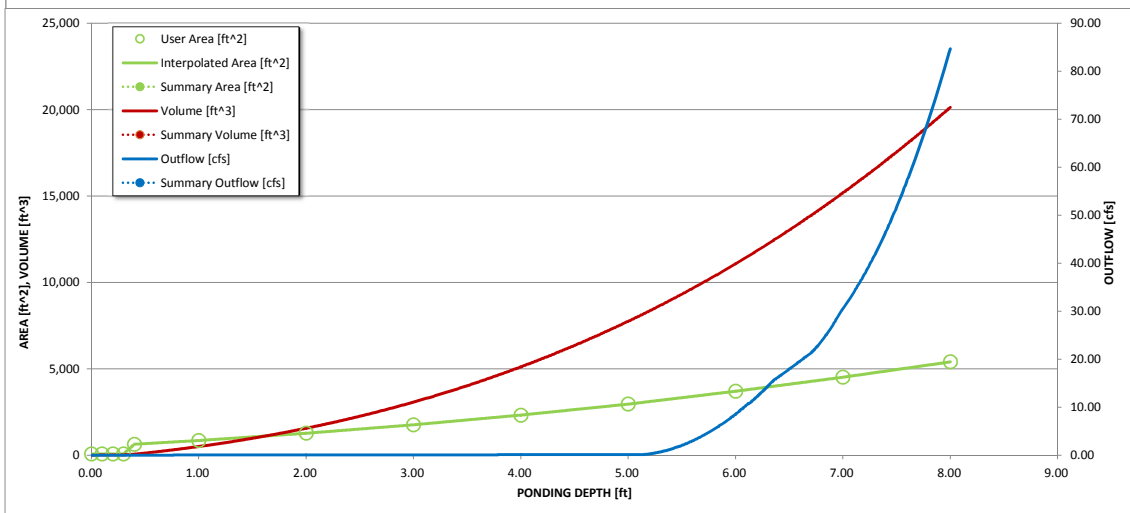
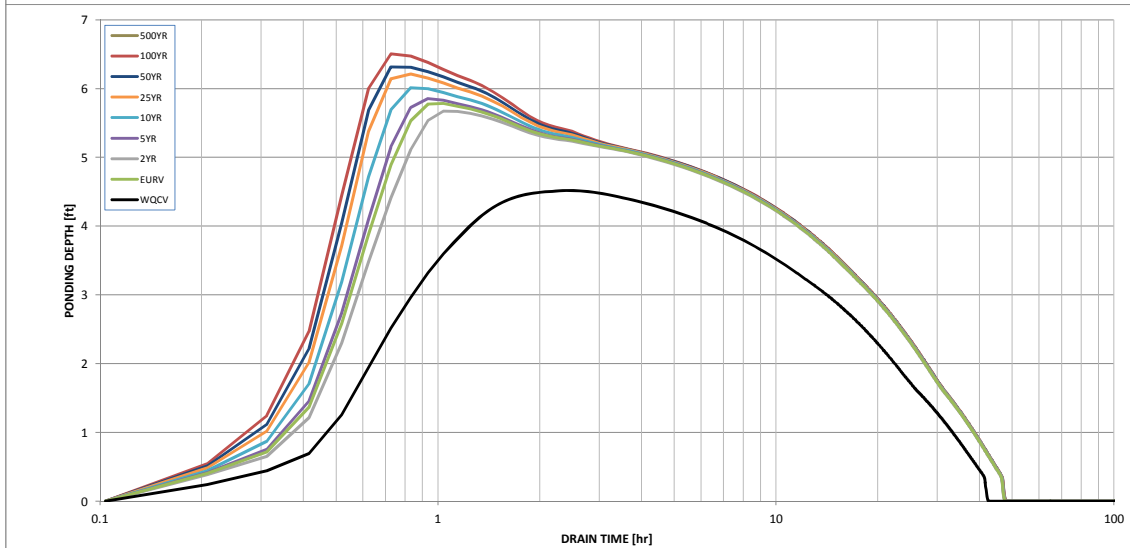
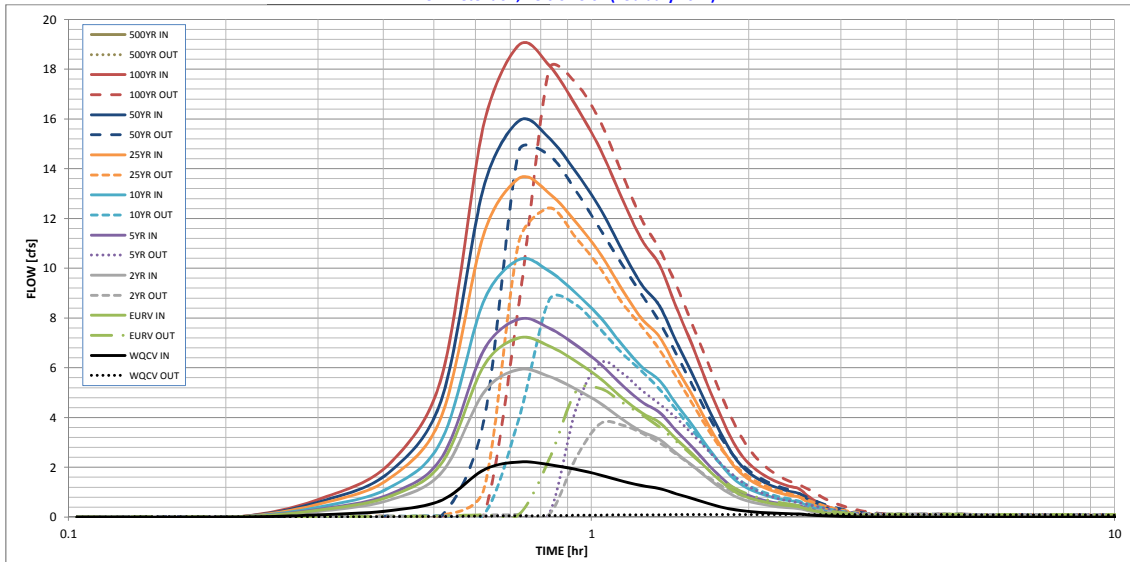
### Routed Hydrograph Results

	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
Design Storm Return Period =									
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	0.00
Calculated Runoff Volume (acre-ft) =	0.163	0.540	0.443	0.597	0.779	1.027	1.205	1.438	0.000
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.163	0.539	0.443	0.596	0.778	1.027	1.204	1.437	#N/A
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.01	0.02	0.15	0.52	0.72	0.97	0.00
Predevelopment Peak Q (cfs) =	0.0	0.0	0.1	0.1	1.2	4.3	6.0	8.1	0.0
Peak Inflow Q (cfs) =	2.2	7.2	5.9	8.0	10.3	13.6	15.9	19.0	#N/A
Peak Outflow Q (cfs) =	0.1	5.2	3.7	6.2	8.7	12.4	14.7	18.0	#N/A
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	46.6	7.0	2.9	2.5	2.2	#N/A
Structure Controlling Flow =	Plate	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	#N/A
Max Velocity through Grate 1 (fps) =	N/A	0.56	0.41	0.7	1.0	1.4	1.7	2.0	#N/A
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) =	38	36	37	35	32	29	28	26	#N/A
Time to Drain 99% of Inflow Volume (hours) =	41	43	43	42	41	40	38	37	#N/A
Maximum Ponding Depth (ft) =	4.52	5.78	5.67	5.86	6.01	6.21	6.32	6.51	#N/A
Area at Maximum Ponding Depth (acres) =	0.06	0.08	0.08	0.08	0.09	0.09	0.09	0.09	#N/A
Maximum Volume Stored (acre-ft) =	0.146	0.236	0.227	0.242	0.255	0.272	0.281	0.299	#N/A



## Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

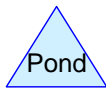
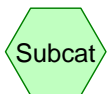
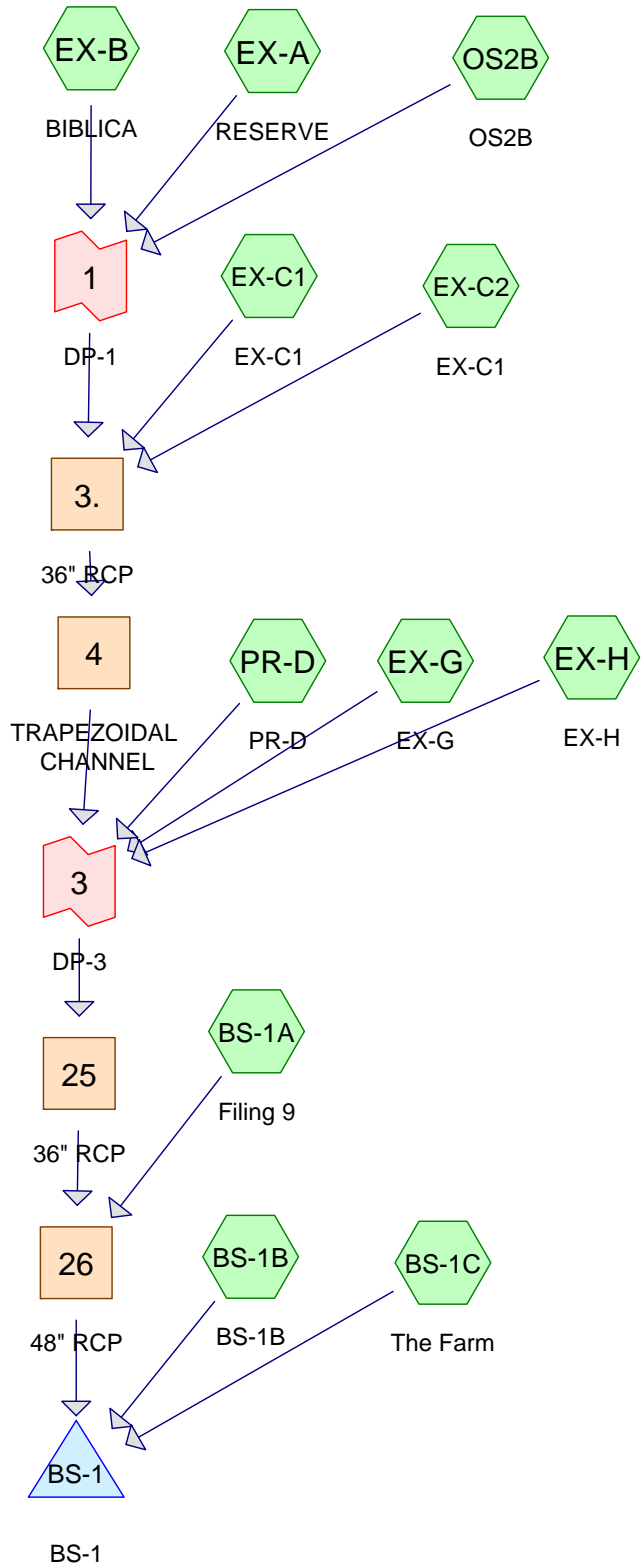


S-A-V-D Chart Axis Override	X-axis	Left Y-Axis	Right Y-Axis
minimum bound			
maximum bound			





**SCS UNIT HYDROGRAPH  
MDDP COMPARISON**



**Drainage Diagram for 17.05.10 pond**  
 Prepared by {enter your company name here} 6/14/2017  
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**17.05.10 pond**

Type IIA 24-hr 2-YR Rainfall=2.10"

Prepared by {enter your company name here}

Page 1

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Time span=0.00-50.00 hrs, dt=0.10 hrs, 501 points

Runoff by SCS TR-20 method, UH=SCS

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment BS-1A: Filing 9**Runoff Area=10.150 ac Runoff Depth=1.41"  
Tc=9.5 min CN=93 Runoff=20.53 cfs 1.190 af**Subcatchment BS-1B: BS-1B**Runoff Area=14.300 ac Runoff Depth=1.41"  
Tc=9.5 min CN=93 Runoff=28.92 cfs 1.676 af**Subcatchment BS-1C: The Farm**Runoff Area=14.800 ac Runoff Depth=1.41"  
Tc=12.3 min CN=93 Runoff=28.41 cfs 1.735 af**Subcatchment EX-A: RESERVE**Runoff Area=10.600 ac Runoff Depth=0.87"  
Tc=27.8 min CN=85 Runoff=9.19 cfs 0.768 af**Subcatchment EX-B: BIBLICA**Runoff Area=7.100 ac Runoff Depth=0.62"  
Tc=6.5 min CN=80 Runoff=7.00 cfs 0.369 af**Subcatchment EX-C1: EX-C1**Runoff Area=0.270 ac Runoff Depth=0.93"  
Tc=5.0 min CN=86 Runoff=0.42 cfs 0.021 af**Subcatchment EX-C2: EX-C1**Runoff Area=0.440 ac Runoff Depth=0.93"  
Tc=5.0 min CN=86 Runoff=0.68 cfs 0.034 af**Subcatchment EX-G: EX-G**Runoff Area=1.000 ac Runoff Depth=1.87"  
Tc=5.0 min CN=98 Runoff=2.46 cfs 0.156 af**Subcatchment EX-H: EX-H**Runoff Area=1.200 ac Runoff Depth=1.87"  
Tc=5.0 min CN=98 Runoff=2.96 cfs 0.187 af**Subcatchment OS2B: OS2B**Runoff Area=12.400 ac Runoff Depth=0.09"  
Tc=40.2 min CN=61 Runoff=0.20 cfs 0.097 af**Subcatchment PR-D: PR-D**Runoff Area=11.400 ac Runoff Depth=0.09"  
Tc=31.9 min CN=61 Runoff=0.20 cfs 0.089 af**Reach 3.: 36" RCP**Peak Depth=0.89' Max Vel=7.2 fps Inflow=13.05 cfs 1.289 af  
D=36.0" n=0.013 L=250.0' S=0.0101 '/' Capacity=66.96 cfs Outflow=12.44 cfs 1.289 af**Reach 4: TRAPEZOIDAL CHANNEL**Peak Depth=0.52' Max Vel=4.2 fps Inflow=12.44 cfs 1.289 af  
n=0.035 L=1,050.0' S=0.0344 '/' Capacity=177.87 cfs Outflow=11.94 cfs 1.289 af**Reach 25: 36" RCP**Peak Depth=0.66' Max Vel=10.8 fps Inflow=12.56 cfs 1.721 af  
D=36.0" n=0.013 L=1,360.0' S=0.0309 '/' Capacity=117.21 cfs Outflow=12.38 cfs 1.721 af**Reach 26: 48" RCP**Peak Depth=0.88' Max Vel=14.2 fps Inflow=29.63 cfs 2.910 af  
D=48.0" n=0.013 L=820.0' S=0.0366 '/' Capacity=274.75 cfs Outflow=29.22 cfs 2.910 af

**17.05.10 pond**

*Type IIA 24-hr 2-YR Rainfall=2.10"*

Prepared by {enter your company name here}

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**Pond BS-1: BS-1**

Peak Elev=6,674.29' Storage=182,842 cf Inflow=85.40 cfs 6.321 af  
Outflow=2.21 cfs 5.723 af

**Link 1: DP-1**

Inflow=12.18 cfs 1.234 af  
Primary=12.18 cfs 1.234 af

**Link 3: DP-3**

Inflow=12.56 cfs 1.721 af  
Primary=12.56 cfs 1.721 af

**17.05.10 pond**

Type IIA 24-hr 5-YR Rainfall=2.70"

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Time span=0.00-50.00 hrs, dt=0.10 hrs, 501 points

Runoff by SCS TR-20 method, UH=SCS

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment BS-1A: Filing 9**Runoff Area=10.150 ac Runoff Depth=1.97"  
Tc=9.5 min CN=93 Runoff=28.41 cfs 1.665 af**Subcatchment BS-1B: BS-1B**Runoff Area=14.300 ac Runoff Depth=1.97"  
Tc=9.5 min CN=93 Runoff=40.03 cfs 2.346 af**Subcatchment BS-1C: The Farm**Runoff Area=14.800 ac Runoff Depth=1.97"  
Tc=12.3 min CN=93 Runoff=39.49 cfs 2.428 af**Subcatchment EX-A: RESERVE**Runoff Area=10.600 ac Runoff Depth=1.34"  
Tc=27.8 min CN=85 Runoff=14.66 cfs 1.183 af**Subcatchment EX-B: BIBLICA**Runoff Area=7.100 ac Runoff Depth=1.03"  
Tc=6.5 min CN=80 Runoff=11.66 cfs 0.609 af**Subcatchment EX-C1: EX-C1**Runoff Area=0.270 ac Runoff Depth=1.41"  
Tc=5.0 min CN=86 Runoff=0.62 cfs 0.032 af**Subcatchment EX-C2: EX-C1**Runoff Area=0.440 ac Runoff Depth=1.41"  
Tc=5.0 min CN=86 Runoff=1.01 cfs 0.052 af**Subcatchment EX-G: EX-G**Runoff Area=1.000 ac Runoff Depth=2.47"  
Tc=5.0 min CN=98 Runoff=3.20 cfs 0.206 af**Subcatchment EX-H: EX-H**Runoff Area=1.200 ac Runoff Depth=2.47"  
Tc=5.0 min CN=98 Runoff=3.84 cfs 0.247 af**Subcatchment OS2B: OS2B**Runoff Area=12.400 ac Runoff Depth=0.26"  
Tc=40.2 min CN=61 Runoff=1.27 cfs 0.267 af**Subcatchment PR-D: PR-D**Runoff Area=11.400 ac Runoff Depth=0.26"  
Tc=31.9 min CN=61 Runoff=1.39 cfs 0.246 af**Reach 3.: 36" RCP**Peak Depth=1.18' Max Vel=8.4 fps Inflow=21.96 cfs 2.143 af  
D=36.0" n=0.013 L=250.0' S=0.0101 '/' Capacity=66.96 cfs Outflow=21.43 cfs 2.143 af**Reach 4: TRAPEZOIDAL CHANNEL**Peak Depth=0.69' Max Vel=5.0 fps Inflow=21.43 cfs 2.143 af  
n=0.035 L=1,050.0' S=0.0344 '/' Capacity=177.87 cfs Outflow=19.99 cfs 2.143 af**Reach 25: 36" RCP**Peak Depth=0.89' Max Vel=12.7 fps Inflow=21.89 cfs 2.842 af  
D=36.0" n=0.013 L=1,360.0' S=0.0309 '/' Capacity=117.21 cfs Outflow=21.69 cfs 2.842 af**Reach 26: 48" RCP**Peak Depth=1.10' Max Vel=16.1 fps Inflow=45.46 cfs 4.506 af  
D=48.0" n=0.013 L=820.0' S=0.0366 '/' Capacity=274.75 cfs Outflow=44.90 cfs 4.506 af



**17.05.10 pond**

*Type IIA 24-hr 5-YR Rainfall=2.70"*

Prepared by {enter your company name here}

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**Pond BS-1: BS-1**

Peak Elev=6,675.50' Storage=275,638 cf Inflow=122.35 cfs 9.280 af  
Outflow=2.93 cfs 7.860 af

**Link 1: DP-1**

Inflow=20.61 cfs 2.060 af  
Primary=20.61 cfs 2.060 af

**Link 3: DP-3**

Inflow=21.89 cfs 2.842 af  
Primary=21.89 cfs 2.842 af

**17.05.10 pond**

Type IIA 24-hr 10-YR Rainfall=3.20"

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Time span=0.00-50.00 hrs, dt=0.10 hrs, 501 points

Runoff by SCS TR-20 method, UH=SCS

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment BS-1A: Filing 9**Runoff Area=10.150 ac Runoff Depth=2.45"  
Tc=9.5 min CN=93 Runoff=35.00 cfs 2.069 af**Subcatchment BS-1B: BS-1B**Runoff Area=14.300 ac Runoff Depth=2.45"  
Tc=9.5 min CN=93 Runoff=49.31 cfs 2.915 af**Subcatchment BS-1C: The Farm**Runoff Area=14.800 ac Runoff Depth=2.45"  
Tc=12.3 min CN=93 Runoff=48.78 cfs 3.016 af**Subcatchment EX-A: RESERVE**Runoff Area=10.600 ac Runoff Depth=1.76"  
Tc=27.8 min CN=85 Runoff=19.57 cfs 1.553 af**Subcatchment EX-B: BIBLICA**Runoff Area=7.100 ac Runoff Depth=1.40"  
Tc=6.5 min CN=80 Runoff=15.85 cfs 0.829 af**Subcatchment EX-C1: EX-C1**Runoff Area=0.270 ac Runoff Depth=1.84"  
Tc=5.0 min CN=86 Runoff=0.80 cfs 0.041 af**Subcatchment EX-C2: EX-C1**Runoff Area=0.440 ac Runoff Depth=1.84"  
Tc=5.0 min CN=86 Runoff=1.31 cfs 0.067 af**Subcatchment EX-G: EX-G**Runoff Area=1.000 ac Runoff Depth=2.97"  
Tc=5.0 min CN=98 Runoff=3.82 cfs 0.247 af**Subcatchment EX-H: EX-H**Runoff Area=1.200 ac Runoff Depth=2.97"  
Tc=5.0 min CN=98 Runoff=4.58 cfs 0.297 af**Subcatchment OS2B: OS2B**Runoff Area=12.400 ac Runoff Depth=0.44"  
Tc=40.2 min CN=61 Runoff=2.79 cfs 0.459 af**Subcatchment PR-D: PR-D**Runoff Area=11.400 ac Runoff Depth=0.44"  
Tc=31.9 min CN=61 Runoff=3.09 cfs 0.422 af**Reach 3.: 36" RCP**Peak Depth=1.41' Max Vel=9.2 fps Inflow=30.26 cfs 2.949 af  
D=36.0" n=0.013 L=250.0' S=0.0101 '/' Capacity=66.96 cfs Outflow=29.62 cfs 2.949 af**Reach 4: TRAPEZOIDAL CHANNEL**Peak Depth=0.82' Max Vel=5.4 fps Inflow=29.62 cfs 2.949 af  
n=0.035 L=1,050.0' S=0.0344 '/' Capacity=177.87 cfs Outflow=27.56 cfs 2.949 af**Reach 25: 36" RCP**Peak Depth=1.06' Max Vel=14.0 fps Inflow=31.14 cfs 3.915 af  
D=36.0" n=0.013 L=1,360.0' S=0.0309 '/' Capacity=117.21 cfs Outflow=30.80 cfs 3.915 af**Reach 26: 48" RCP**Peak Depth=1.27' Max Vel=17.4 fps Inflow=60.05 cfs 5.984 af  
D=48.0" n=0.013 L=820.0' S=0.0366 '/' Capacity=274.75 cfs Outflow=59.32 cfs 5.984 af

**17.05.10 pond**

*Type IIA 24-hr 10-YR Rainfall=3.20"*

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**Pond BS-1: BS-1**

Peak Elev=6,676.46' Storage=352,842 cf Inflow=154.68 cfs 11.915 af  
Outflow=5.81 cfs 9.729 af

**Link 1: DP-1**

Inflow=28.49 cfs 2.841 af  
Primary=28.49 cfs 2.841 af

**Link 3: DP-3**

Inflow=31.14 cfs 3.915 af  
Primary=31.14 cfs 3.915 af

**17.05.10 pond**

Type IIA 24-hr 25-YR Rainfall=3.60"

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Time span=0.00-50.00 hrs, dt=0.10 hrs, 501 points

Runoff by SCS TR-20 method, UH=SCS

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment BS-1A: Filing 9**Runoff Area=10.150 ac Runoff Depth=2.83"  
Tc=9.5 min CN=93 Runoff=40.27 cfs 2.395 af**Subcatchment BS-1B: BS-1B**Runoff Area=14.300 ac Runoff Depth=2.83"  
Tc=9.5 min CN=93 Runoff=56.73 cfs 3.374 af**Subcatchment BS-1C: The Farm**Runoff Area=14.800 ac Runoff Depth=2.83"  
Tc=12.3 min CN=93 Runoff=56.22 cfs 3.492 af**Subcatchment EX-A: RESERVE**Runoff Area=10.600 ac Runoff Depth=2.10"  
Tc=27.8 min CN=85 Runoff=23.64 cfs 1.858 af**Subcatchment EX-B: BIBLICA**Runoff Area=7.100 ac Runoff Depth=1.72"  
Tc=6.5 min CN=80 Runoff=19.34 cfs 1.015 af**Subcatchment EX-C1: EX-C1**Runoff Area=0.270 ac Runoff Depth=2.19"  
Tc=5.0 min CN=86 Runoff=0.95 cfs 0.049 af**Subcatchment EX-C2: EX-C1**Runoff Area=0.440 ac Runoff Depth=2.19"  
Tc=5.0 min CN=86 Runoff=1.54 cfs 0.080 af**Subcatchment EX-G: EX-G**Runoff Area=1.000 ac Runoff Depth=3.37"  
Tc=5.0 min CN=98 Runoff=4.31 cfs 0.281 af**Subcatchment EX-H: EX-H**Runoff Area=1.200 ac Runoff Depth=3.37"  
Tc=5.0 min CN=98 Runoff=5.17 cfs 0.337 af**Subcatchment OS2B: OS2B**Runoff Area=12.400 ac Runoff Depth=0.62"  
Tc=40.2 min CN=61 Runoff=4.37 cfs 0.639 af**Subcatchment PR-D: PR-D**Runoff Area=11.400 ac Runoff Depth=0.62"  
Tc=31.9 min CN=61 Runoff=4.81 cfs 0.587 af**Reach 3.: 36" RCP**Peak Depth=1.60' Max Vel=9.7 fps Inflow=37.34 cfs 3.642 af  
D=36.0" n=0.013 L=250.0' S=0.0101 '/' Capacity=66.96 cfs Outflow=36.63 cfs 3.642 af**Reach 4: TRAPEZOIDAL CHANNEL**Peak Depth=0.91' Max Vel=5.8 fps Inflow=36.63 cfs 3.642 af  
n=0.035 L=1,050.0' S=0.0344 '/' Capacity=177.87 cfs Outflow=34.57 cfs 3.642 af**Reach 25: 36" RCP**Peak Depth=1.21' Max Vel=15.0 fps Inflow=39.31 cfs 4.846 af  
D=36.0" n=0.013 L=1,360.0' S=0.0309 '/' Capacity=117.21 cfs Outflow=38.84 cfs 4.846 af**Reach 26: 48" RCP**Peak Depth=1.40' Max Vel=18.3 fps Inflow=72.38 cfs 7.242 af  
D=48.0" n=0.013 L=820.0' S=0.0366 '/' Capacity=274.75 cfs Outflow=71.52 cfs 7.242 af

**17.05.10 pond**

*Type IIA 24-hr 25-YR Rainfall=3.60"*

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**Pond BS-1: BS-1**

Peak Elev=6,676.66' Storage=369,763 cf Inflow=181.22 cfs 14.108 af  
Outflow=21.50 cfs 11.789 af

**Link 1: DP-1**

Inflow=35.25 cfs 3.513 af  
Primary=35.25 cfs 3.513 af

**Link 3: DP-3**

Inflow=39.31 cfs 4.846 af  
Primary=39.31 cfs 4.846 af

**17.05.10 pond**

Type IIA 24-hr 50-YR Rainfall=4.20"

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Time span=0.00-50.00 hrs, dt=0.10 hrs, 501 points

Runoff by SCS TR-20 method, UH=SCS

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment BS-1A: Filing 9**Runoff Area=10.150 ac Runoff Depth=3.41"  
Tc=9.5 min CN=93 Runoff=48.15 cfs 2.888 af**Subcatchment BS-1B: BS-1B**Runoff Area=14.300 ac Runoff Depth=3.41"  
Tc=9.5 min CN=93 Runoff=67.84 cfs 4.069 af**Subcatchment BS-1C: The Farm**Runoff Area=14.800 ac Runoff Depth=3.41"  
Tc=12.3 min CN=93 Runoff=67.37 cfs 4.212 af**Subcatchment EX-A: RESERVE**Runoff Area=10.600 ac Runoff Depth=2.64"  
Tc=27.8 min CN=85 Runoff=29.94 cfs 2.330 af**Subcatchment EX-B: BIBLICA**Runoff Area=7.100 ac Runoff Depth=2.21"  
Tc=6.5 min CN=80 Runoff=24.73 cfs 1.306 af**Subcatchment EX-C1: EX-C1**Runoff Area=0.270 ac Runoff Depth=2.73"  
Tc=5.0 min CN=86 Runoff=1.16 cfs 0.061 af**Subcatchment EX-C2: EX-C1**Runoff Area=0.440 ac Runoff Depth=2.73"  
Tc=5.0 min CN=86 Runoff=1.90 cfs 0.100 af**Subcatchment EX-G: EX-G**Runoff Area=1.000 ac Runoff Depth=3.96"  
Tc=5.0 min CN=98 Runoff=5.04 cfs 0.330 af**Subcatchment EX-H: EX-H**Runoff Area=1.200 ac Runoff Depth=3.96"  
Tc=5.0 min CN=98 Runoff=6.05 cfs 0.396 af**Subcatchment OS2B: OS2B**Runoff Area=12.400 ac Runoff Depth=0.92"  
Tc=40.2 min CN=61 Runoff=7.18 cfs 0.947 af**Subcatchment PR-D: PR-D**Runoff Area=11.400 ac Runoff Depth=0.92"  
Tc=31.9 min CN=61 Runoff=7.87 cfs 0.870 af**Reach 3.: 36" RCP**Peak Depth=1.89' Max Vel=10.3 fps Inflow=48.59 cfs 4.744 af  
D=36.0" n=0.013 L=250.0' S=0.0101 '/' Capacity=66.96 cfs Outflow=47.74 cfs 4.744 af**Reach 4: TRAPEZOIDAL CHANNEL**Peak Depth=1.05' Max Vel=6.2 fps Inflow=47.74 cfs 4.744 af  
n=0.035 L=1,050.0' S=0.0344 '/' Capacity=177.87 cfs Outflow=45.25 cfs 4.744 af**Reach 25: 36" RCP**Peak Depth=1.42' Max Vel=16.2 fps Inflow=52.66 cfs 6.341 af  
D=36.0" n=0.013 L=1,360.0' S=0.0309 '/' Capacity=117.21 cfs Outflow=52.00 cfs 6.341 af**Reach 26: 48" RCP**Peak Depth=1.59' Max Vel=19.6 fps Inflow=91.81 cfs 9.230 af  
D=48.0" n=0.013 L=820.0' S=0.0366 '/' Capacity=274.75 cfs Outflow=90.80 cfs 9.230 af

**17.05.10 pond**

*Type IIA 24-hr 50-YR Rainfall=4.20"*

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**Pond BS-1: BS-1**

Peak Elev=6,677.02' Storage=400,217 cf Inflow=221.90 cfs 17.510 af  
Outflow=47.06 cfs 15.043 af

**Link 1: DP-1**

Inflow=46.02 cfs 4.583 af  
Primary=46.02 cfs 4.583 af

**Link 3: DP-3**

Inflow=52.66 cfs 6.341 af  
Primary=52.66 cfs 6.341 af

**17.05.10 pond**

Type IIA 24-hr 100-YR Rainfall=4.60"

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6/14/2017

Time span=0.00-50.00 hrs, dt=0.10 hrs, 501 points

Runoff by SCS TR-20 method, UH=SCS

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment BS-1A: Filing 9**Runoff Area=10.150 ac Runoff Depth=3.81"  
Tc=9.5 min CN=93 Runoff=53.39 cfs 3.219 af**Subcatchment BS-1B: BS-1B**Runoff Area=14.300 ac Runoff Depth=3.81"  
Tc=9.5 min CN=93 Runoff=75.22 cfs 4.535 af**Subcatchment BS-1C: The Farm**Runoff Area=14.800 ac Runoff Depth=3.81"  
Tc=12.3 min CN=93 Runoff=74.79 cfs 4.694 af**Subcatchment EX-A: RESERVE**Runoff Area=10.600 ac Runoff Depth=3.00"  
Tc=27.8 min CN=85 Runoff=34.22 cfs 2.650 af**Subcatchment EX-B: BIBLICA**Runoff Area=7.100 ac Runoff Depth=2.55"  
Tc=6.5 min CN=80 Runoff=28.39 cfs 1.507 af**Subcatchment EX-C1: EX-C1**Runoff Area=0.270 ac Runoff Depth=3.10"  
Tc=5.0 min CN=86 Runoff=1.31 cfs 0.070 af**Subcatchment EX-C2: EX-C1**Runoff Area=0.440 ac Runoff Depth=3.10"  
Tc=5.0 min CN=86 Runoff=2.14 cfs 0.114 af**Subcatchment EX-G: EX-G**Runoff Area=1.000 ac Runoff Depth=4.36"  
Tc=5.0 min CN=98 Runoff=5.53 cfs 0.364 af**Subcatchment EX-H: EX-H**Runoff Area=1.200 ac Runoff Depth=4.36"  
Tc=5.0 min CN=98 Runoff=6.64 cfs 0.436 af**Subcatchment OS2B: OS2B**Runoff Area=12.400 ac Runoff Depth=1.14"  
Tc=40.2 min CN=61 Runoff=9.32 cfs 1.173 af**Subcatchment PR-D: PR-D**Runoff Area=11.400 ac Runoff Depth=1.14"  
Tc=31.9 min CN=61 Runoff=10.19 cfs 1.079 af**Reach 3.: 36" RCP**Peak Depth=2.10' Max Vel=10.6 fps Inflow=56.42 cfs 5.514 af  
D=36.0" n=0.013 L=250.0' S=0.0101 '/' Capacity=66.96 cfs Outflow=55.46 cfs 5.514 af**Reach 4: TRAPEZOIDAL CHANNEL**Peak Depth=1.13' Max Vel=6.5 fps Inflow=55.46 cfs 5.514 af  
n=0.035 L=1,050.0' S=0.0344 '/' Capacity=177.87 cfs Outflow=52.71 cfs 5.514 af**Reach 25: 36" RCP**Peak Depth=1.56' Max Vel=16.8 fps Inflow=62.19 cfs 7.393 af  
D=36.0" n=0.013 L=1,360.0' S=0.0309 '/' Capacity=117.21 cfs Outflow=61.39 cfs 7.393 af**Reach 26: 48" RCP**Peak Depth=1.72' Max Vel=20.3 fps Inflow=105.27 cfs 10.612 af  
D=48.0" n=0.013 L=820.0' S=0.0366 '/' Capacity=274.75 cfs Outflow=104.18 cfs 10.612 af



**17.05.10 pond**

*Type IIA 24-hr 100-YR Rainfall=4.60"*

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**Pond BS-1: BS-1**

Peak Elev=6,677.55' Storage=445,769 cf Inflow=249.47 cfs 19.840 af  
Outflow=48.69 cfs 17.289 af

**Link 1: DP-1**

Inflow=53.53 cfs 5.331 af  
Primary=53.53 cfs 5.331 af

**Link 3: DP-3**

Inflow=62.19 cfs 7.393 af  
Primary=62.19 cfs 7.393 af

**17.05.10 pond**

Type IIA 24-hr 2-YR Rainfall=2.10"

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Page 1

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**Pond BS-1: BS-1**

Inflow Area = 83.660 ac, Inflow Depth = 0.91" for 2-YR event  
 Inflow = 85.40 cfs @ 6.01 hrs, Volume= 6.321 af  
 Outflow = 2.21 cfs @ 10.01 hrs, Volume= 5.723 af, Atten= 97%, Lag= 240.3 min  
 Primary = 2.21 cfs @ 10.01 hrs, Volume= 5.723 af

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.10 hrs  
 Peak Elev= 6,674.29' @ 10.01 hrs Surf.Area= 72,298 sf Storage= 182,842 cf  
 Plug-Flow detention time= 1,026.2 min calculated for 5.712 af (90% of inflow)  
 Center-of-Mass det. time= 958.4 min ( 1,470.3 - 511.9 )

#	Invert	Avail.Storage	Storage Description
1	6,668.46'	506,224 cf	<b>Custom Stage Data (Prismatic)</b> Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
6,668.46	400	0	0
6,669.00	484	239	239
6,670.00	4,928	2,706	2,945
6,671.00	19,030	11,979	14,924
6,672.00	43,919	31,475	46,398
6,674.00	70,725	114,644	161,042
6,676.00	81,723	152,448	313,490
6,678.00	88,720	170,443	483,933
6,678.25	89,609	22,291	506,224

#	Routing	Invert	Outlet Devices
1	Primary	6,668.36'	<b>36.0" x 100.0' long Culvert</b> Box, headwall w/3 square edges, Ke= 0.500 Outlet Invert= 6,658.00' S= 0.1036 '/' n= 0.013 Cc= 0.900
2	Device 1	6,668.36'	<b>25.5" Vert. Orifice/Grate</b> C= 0.600
3	Device 2	6,668.46'	<b>0.17' x 0.33' Vert. Orifice/Grate</b> C= 0.600
4	Device 2	6,671.05'	<b>0.42' x 0.33' Vert. Orifice/Grate</b> C= 0.600
5	Device 2	6,673.75'	<b>0.42' x 0.33' Vert. Orifice/Grate</b> C= 0.600
6	Device 2	6,676.40'	<b>18.00' x 2.60' Horiz. Orifice/Grate</b> Limited to weir flow C= 0.600

**Primary OutFlow** Max=2.22 cfs @ 10.01 hrs HW=6,674.29' (Free Discharge)

- ↑ 1=Culvert (Passes 2.22 cfs of 71.60 cfs potential flow)
- ↑ 2=Orifice/Grate (Passes 2.22 cfs of 37.66 cfs potential flow)
- ↑ 3=Orifice/Grate (Orifice Controls 0.64 cfs @ 11.5 fps)
- ↑ 4=Orifice/Grate (Orifice Controls 1.17 cfs @ 8.4 fps)
- ↑ 5=Orifice/Grate (Orifice Controls 0.40 cfs @ 2.9 fps)
- ↑ 6=Orifice/Grate ( Controls 0.00 cfs)

**17.05.10 pond**

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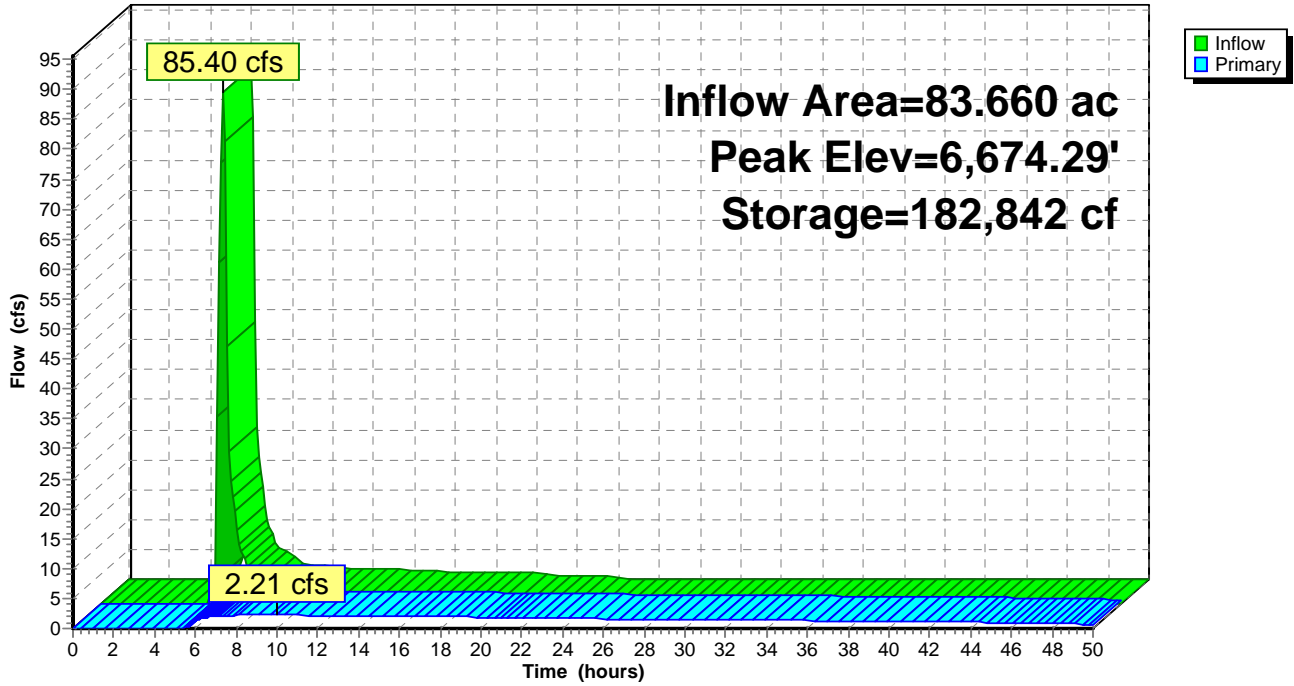
Type IIA 24-hr 2-YR Rainfall=2.10"

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**Pond BS-1: BS-1**

Hydrograph



**17.05.10 pond**

Type IIA 24-hr 5-YR Rainfall=2.70"

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**Pond BS-1: BS-1**

Inflow Area = 83.660 ac, Inflow Depth = 1.33" for 5-YR event  
 Inflow = 122.35 cfs @ 6.01 hrs, Volume= 9.280 af  
 Outflow = 2.93 cfs @ 10.19 hrs, Volume= 7.860 af, Atten= 98%, Lag= 250.9 min  
 Primary = 2.93 cfs @ 10.19 hrs, Volume= 7.860 af

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.10 hrs  
 Peak Elev= 6,675.50' @ 10.19 hrs Surf.Area= 78,992 sf Storage= 275,638 cf  
 Plug-Flow detention time= 1,053.3 min calculated for 7.844 af (85% of inflow)  
 Center-of-Mass det. time= 957.2 min ( 1,463.6 - 506.4 )

#	Invert	Avail.Storage	Storage Description
1	6,668.46'	506,224 cf	<b>Custom Stage Data (Prismatic)</b> Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
6,668.46	400	0	0
6,669.00	484	239	239
6,670.00	4,928	2,706	2,945
6,671.00	19,030	11,979	14,924
6,672.00	43,919	31,475	46,398
6,674.00	70,725	114,644	161,042
6,676.00	81,723	152,448	313,490
6,678.00	88,720	170,443	483,933
6,678.25	89,609	22,291	506,224

#	Routing	Invert	Outlet Devices
1	Primary	6,668.36'	<b>36.0" x 100.0' long Culvert</b> Box, headwall w/3 square edges, Ke= 0.500 Outlet Invert= 6,658.00' S= 0.1036 '/' n= 0.013 Cc= 0.900
2	Device 1	6,668.36'	<b>25.5" Vert. Orifice/Grate</b> C= 0.600
3	Device 2	6,668.46'	<b>0.17' x 0.33' Vert. Orifice/Grate</b> C= 0.600
4	Device 2	6,671.05'	<b>0.42' x 0.33' Vert. Orifice/Grate</b> C= 0.600
5	Device 2	6,673.75'	<b>0.42' x 0.33' Vert. Orifice/Grate</b> C= 0.600
6	Device 2	6,676.40'	<b>18.00' x 2.60' Horiz. Orifice/Grate</b> Limited to weir flow C= 0.600

**Primary OutFlow** Max=2.93 cfs @ 10.19 hrs HW=6,675.50' (Free Discharge)

- ↑ 1=Culvert (Passes 2.93 cfs of 80.85 cfs potential flow)
- ↑ 2=Orifice/Grate (Passes 2.93 cfs of 42.11 cfs potential flow)
- ↑ 3=Orifice/Grate (Orifice Controls 0.71 cfs @ 12.6 fps)
- ↑ 4=Orifice/Grate (Orifice Controls 1.38 cfs @ 10.0 fps)
- ↑ 5=Orifice/Grate (Orifice Controls 0.84 cfs @ 6.1 fps)
- ↑ 6=Orifice/Grate ( Controls 0.00 cfs)

**17.05.10 pond**

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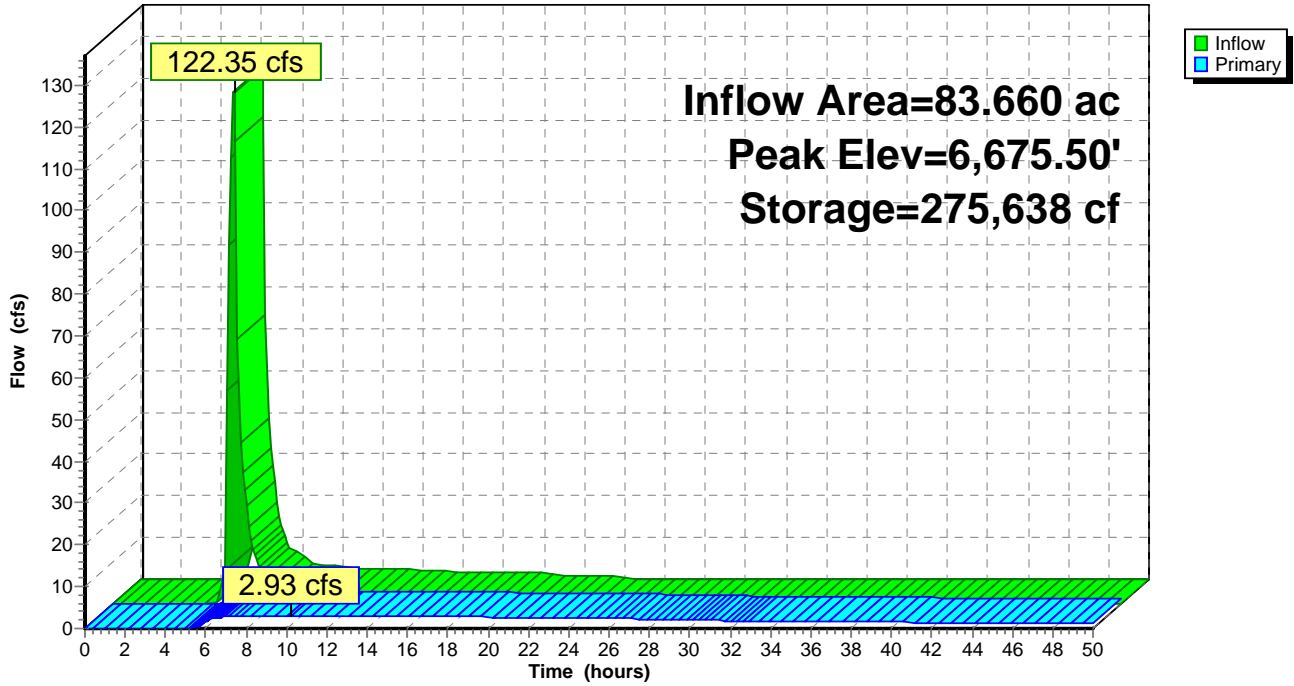
Type IIA 24-hr 5-YR Rainfall=2.70"

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**Pond BS-1: BS-1**

Hydrograph



**17.05.10 pond**

Type IIA 24-hr 10-YR Rainfall=3.20"

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**Pond BS-1: BS-1**

Inflow Area = 83.660 ac, Inflow Depth = 1.71" for 10-YR event  
 Inflow = 154.68 cfs @ 6.01 hrs, Volume= 11.915 af  
 Outflow = 5.81 cfs @ 8.25 hrs, Volume= 9.729 af, Atten= 96%, Lag= 134.5 min  
 Primary = 5.81 cfs @ 8.25 hrs, Volume= 9.729 af

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.10 hrs  
 Peak Elev= 6,676.46' @ 8.25 hrs Surf.Area= 83,338 sf Storage= 352,842 cf  
 Plug-Flow detention time= 1,054.6 min calculated for 9.729 af (82% of inflow)  
 Center-of-Mass det. time= 945.6 min ( 1,448.3 - 502.7 )

#	Invert	Avail.Storage	Storage Description
1	6,668.46'	506,224 cf	<b>Custom Stage Data (Prismatic)</b> Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
6,668.46	400	0	0
6,669.00	484	239	239
6,670.00	4,928	2,706	2,945
6,671.00	19,030	11,979	14,924
6,672.00	43,919	31,475	46,398
6,674.00	70,725	114,644	161,042
6,676.00	81,723	152,448	313,490
6,678.00	88,720	170,443	483,933
6,678.25	89,609	22,291	506,224

#	Routing	Invert	Outlet Devices
1	Primary	6,668.36'	<b>36.0" x 100.0' long Culvert</b> Box, headwall w/3 square edges, Ke= 0.500 Outlet Invert= 6,658.00' S= 0.1036 '/' n= 0.013 Cc= 0.900
2	Device 1	6,668.36'	<b>25.5" Vert. Orifice/Grate</b> C= 0.600
3	Device 2	6,668.46'	<b>0.17' x 0.33' Vert. Orifice/Grate</b> C= 0.600
4	Device 2	6,671.05'	<b>0.42' x 0.33' Vert. Orifice/Grate</b> C= 0.600
5	Device 2	6,673.75'	<b>0.42' x 0.33' Vert. Orifice/Grate</b> C= 0.600
6	Device 2	6,676.40'	<b>18.00' x 2.60' Horiz. Orifice/Grate</b> Limited to weir flow C= 0.600

**Primary OutFlow** Max=5.39 cfs @ 8.25 hrs HW=6,676.46' (Free Discharge)

- 1=Culvert (Passes 5.39 cfs of 87.45 cfs potential flow)
- 2=Orifice/Grate (Passes 5.39 cfs of 45.31 cfs potential flow)
- 3=Orifice/Grate (Orifice Controls 0.76 cfs @ 13.5 fps)
- 4=Orifice/Grate (Orifice Controls 1.53 cfs @ 11.0 fps)
- 5=Orifice/Grate (Orifice Controls 1.06 cfs @ 7.7 fps)
- 6=Orifice/Grate (Weir Controls 2.04 cfs @ 0.8 fps)

**17.05.10 pond**

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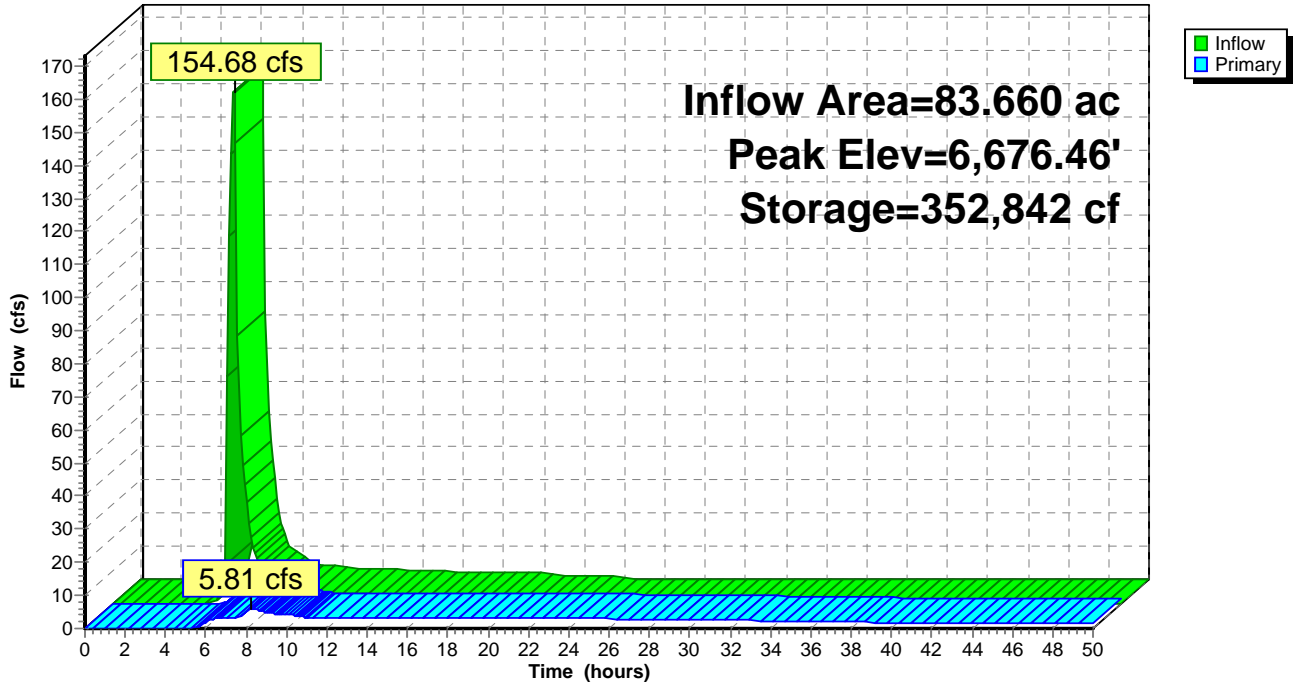
Type IIA 24-hr 10-YR Rainfall=3.20"

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**Pond BS-1: BS-1**

Hydrograph



**17.05.10 pond**

Type IIA 24-hr 25-YR Rainfall=3.60"

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**Pond BS-1: BS-1**

Inflow Area = 83.660 ac, Inflow Depth = 2.02" for 25-YR event  
 Inflow = 181.22 cfs @ 6.00 hrs, Volume= 14.108 af  
 Outflow = 21.50 cfs @ 6.89 hrs, Volume= 11.789 af, Atten= 88%, Lag= 53.0 min  
 Primary = 21.50 cfs @ 6.89 hrs, Volume= 11.789 af

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.10 hrs  
 Peak Elev= 6,676.66' @ 6.89 hrs Surf.Area= 84,033 sf Storage= 369,763 cf  
 Plug-Flow detention time= 897.8 min calculated for 11.766 af (83% of inflow)  
 Center-of-Mass det. time= 799.0 min ( 1,299.3 - 500.2 )

#	Invert	Avail.Storage	Storage Description
1	6,668.46'	506,224 cf	<b>Custom Stage Data (Prismatic)</b> Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
6,668.46	400	0	0
6,669.00	484	239	239
6,670.00	4,928	2,706	2,945
6,671.00	19,030	11,979	14,924
6,672.00	43,919	31,475	46,398
6,674.00	70,725	114,644	161,042
6,676.00	81,723	152,448	313,490
6,678.00	88,720	170,443	483,933
6,678.25	89,609	22,291	506,224

#	Routing	Invert	Outlet Devices
1	Primary	6,668.36'	<b>36.0" x 100.0' long Culvert</b> Box, headwall w/3 square edges, Ke= 0.500 Outlet Invert= 6,658.00' S= 0.1036 '/' n= 0.013 Cc= 0.900
2	Device 1	6,668.36'	<b>25.5" Vert. Orifice/Grate</b> C= 0.600
3	Device 2	6,668.46'	<b>0.17' x 0.33' Vert. Orifice/Grate</b> C= 0.600
4	Device 2	6,671.05'	<b>0.42' x 0.33' Vert. Orifice/Grate</b> C= 0.600
5	Device 2	6,673.75'	<b>0.42' x 0.33' Vert. Orifice/Grate</b> C= 0.600
6	Device 2	6,676.40'	<b>18.00' x 2.60' Horiz. Orifice/Grate</b> Limited to weir flow C= 0.600

**Primary OutFlow** Max=21.26 cfs @ 6.89 hrs HW=6,676.66' (Free Discharge)

- ↑ 1=Culvert (Passes 21.26 cfs of 88.75 cfs potential flow)
- ↑ 2=Orifice/Grate (Passes 21.26 cfs of 45.94 cfs potential flow)
- ↑ 3=Orifice/Grate (Orifice Controls 0.77 cfs @ 13.6 fps)
- ↑ 4=Orifice/Grate (Orifice Controls 1.56 cfs @ 11.2 fps)
- ↑ 5=Orifice/Grate (Orifice Controls 1.11 cfs @ 8.0 fps)
- ↑ 6=Orifice/Grate (Weir Controls 17.83 cfs @ 1.7 fps)



**17.05.10 pond**

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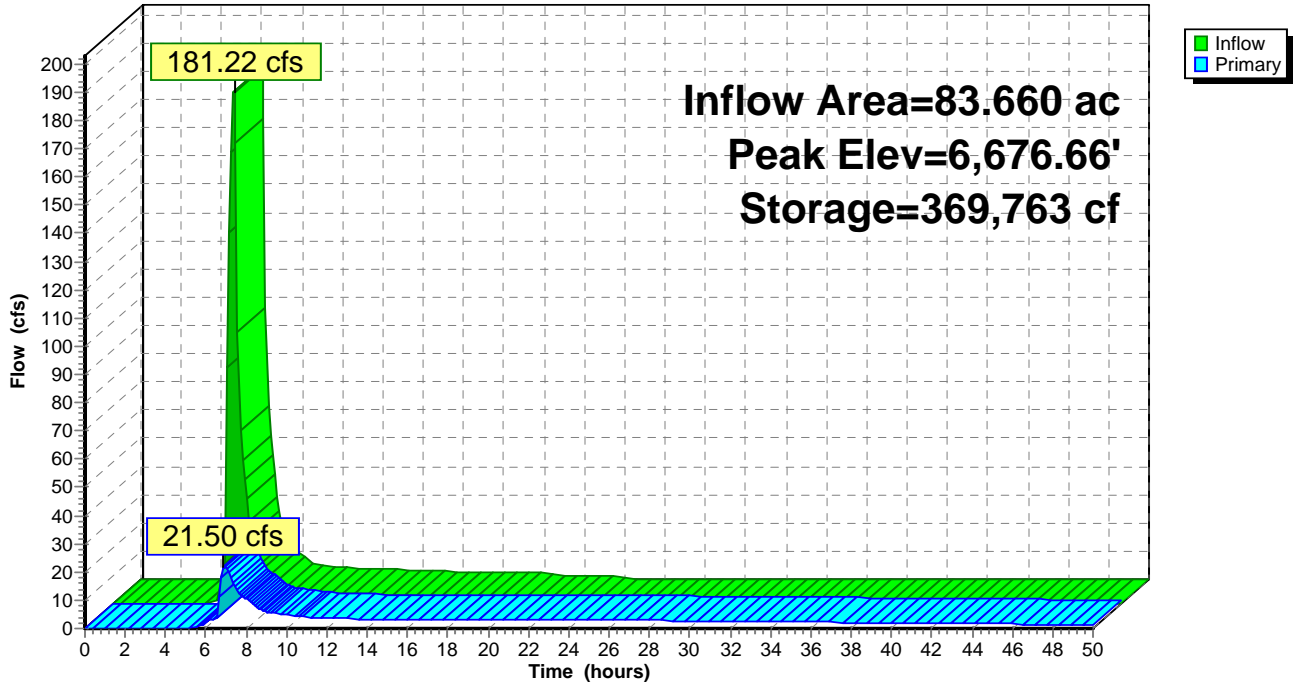
Type IIA 24-hr 25-YR Rainfall=3.60"

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**Pond BS-1: BS-1**

Hydrograph



**17.05.10 pond**

Type IIA 24-hr 50-YR Rainfall=4.20"

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**Pond BS-1: BS-1**

Inflow Area = 83.660 ac, Inflow Depth = 2.51" for 50-YR event  
 Inflow = 221.90 cfs @ 6.00 hrs, Volume= 17.510 af  
 Outflow = 47.06 cfs @ 6.60 hrs, Volume= 15.043 af, Atten= 79%, Lag= 36.0 min  
 Primary = 47.06 cfs @ 6.60 hrs, Volume= 15.043 af

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.10 hrs  
 Peak Elev= 6,677.02' @ 6.60 hrs Surf.Area= 85,283 sf Storage= 400,217 cf  
 Plug-Flow detention time= 726.9 min calculated for 15.013 af (86% of inflow)  
 Center-of-Mass det. time= 638.6 min ( 1,135.7 - 497.1 )

#	Invert	Avail.Storage	Storage Description
1	6,668.46'	506,224 cf	<b>Custom Stage Data (Prismatic)</b> Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
6,668.46	400	0	0
6,669.00	484	239	239
6,670.00	4,928	2,706	2,945
6,671.00	19,030	11,979	14,924
6,672.00	43,919	31,475	46,398
6,674.00	70,725	114,644	161,042
6,676.00	81,723	152,448	313,490
6,678.00	88,720	170,443	483,933
6,678.25	89,609	22,291	506,224

#	Routing	Invert	Outlet Devices
1	Primary	6,668.36'	<b>36.0" x 100.0' long Culvert</b> Box, headwall w/3 square edges, Ke= 0.500 Outlet Invert= 6,658.00' S= 0.1036 '/' n= 0.013 Cc= 0.900
2	Device 1	6,668.36'	<b>25.5" Vert. Orifice/Grate</b> C= 0.600
3	Device 2	6,668.46'	<b>0.17' x 0.33' Vert. Orifice/Grate</b> C= 0.600
4	Device 2	6,671.05'	<b>0.42' x 0.33' Vert. Orifice/Grate</b> C= 0.600
5	Device 2	6,673.75'	<b>0.42' x 0.33' Vert. Orifice/Grate</b> C= 0.600
6	Device 2	6,676.40'	<b>18.00' x 2.60' Horiz. Orifice/Grate</b> Limited to weir flow C= 0.600

**Primary OutFlow** Max=47.06 cfs @ 6.60 hrs HW=6,677.02' (Free Discharge)

- ↑ 1=Culvert (Passes 47.06 cfs of 91.05 cfs potential flow)
- ↑ 2=Orifice/Grate (Orifice Controls 47.06 cfs @ 13.3 fps)
- ↑ 3=Orifice/Grate (Passes < 0.78 cfs potential flow)
- ↑ 4=Orifice/Grate (Passes < 1.61 cfs potential flow)
- ↑ 5=Orifice/Grate (Passes < 1.18 cfs potential flow)
- ↑ 6=Orifice/Grate (Passes < 65.32 cfs potential flow)

**17.05.10 pond**

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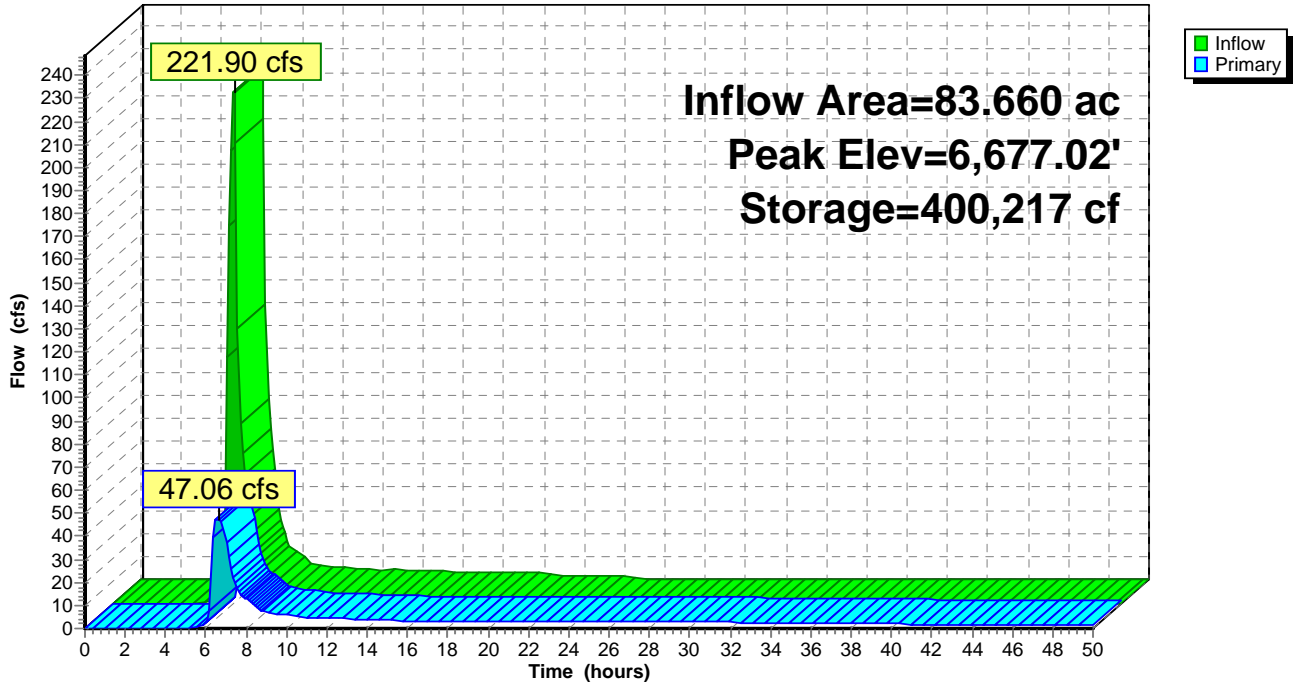
Type IIA 24-hr 50-YR Rainfall=4.20"

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**Pond BS-1: BS-1**

Hydrograph



**17.05.10 pond**

Type IIA 24-hr 100-YR Rainfall=4.60"

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**Pond BS-1: BS-1**

Inflow Area = 83.660 ac, Inflow Depth = 2.85" for 100-YR event  
 Inflow = 249.47 cfs @ 6.00 hrs, Volume= 19.840 af  
 Outflow = 48.69 cfs @ 6.65 hrs, Volume= 17.289 af, Atten= 80%, Lag= 39.0 min  
 Primary = 48.69 cfs @ 6.65 hrs, Volume= 17.289 af

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.10 hrs  
 Peak Elev= 6,677.55' @ 6.65 hrs Surf.Area= 87,153 sf Storage= 445,769 cf  
 Plug-Flow detention time= 646.6 min calculated for 17.255 af (87% of inflow)  
 Center-of-Mass det. time= 564.1 min ( 1,059.4 - 495.3 )

#	Invert	Avail.Storage	Storage Description
1	6,668.46'	506,224 cf	<b>Custom Stage Data (Prismatic)</b> Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
6,668.46	400	0	0
6,669.00	484	239	239
6,670.00	4,928	2,706	2,945
6,671.00	19,030	11,979	14,924
6,672.00	43,919	31,475	46,398
6,674.00	70,725	114,644	161,042
6,676.00	81,723	152,448	313,490
6,678.00	88,720	170,443	483,933
6,678.25	89,609	22,291	506,224

#	Routing	Invert	Outlet Devices
1	Primary	6,668.36'	<b>36.0" x 100.0' long Culvert</b> Box, headwall w/3 square edges, Ke= 0.500 Outlet Invert= 6,658.00' S= 0.1036 '/' n= 0.013 Cc= 0.900
2	Device 1	6,668.36'	<b>25.5" Vert. Orifice/Grate</b> C= 0.600
3	Device 2	6,668.46'	<b>0.17' x 0.33' Vert. Orifice/Grate</b> C= 0.600
4	Device 2	6,671.05'	<b>0.42' x 0.33' Vert. Orifice/Grate</b> C= 0.600
5	Device 2	6,673.75'	<b>0.42' x 0.33' Vert. Orifice/Grate</b> C= 0.600
6	Device 2	6,676.40'	<b>18.00' x 2.60' Horiz. Orifice/Grate</b> Limited to weir flow C= 0.600

**Primary OutFlow** Max=48.67 cfs @ 6.65 hrs HW=6,677.55' (Free Discharge)

- ↑ 1=Culvert (Passes 48.67 cfs of 94.36 cfs potential flow)
- ↑ 2=Orifice/Grate (Orifice Controls 48.67 cfs @ 13.7 fps)
- ↑ 3=Orifice/Grate (Passes < 0.81 cfs potential flow)
- ↑ 4=Orifice/Grate (Passes < 1.68 cfs potential flow)
- ↑ 5=Orifice/Grate (Passes < 1.27 cfs potential flow)
- ↑ 6=Orifice/Grate (Passes < 165.48 cfs potential flow)

**17.05.10 pond**

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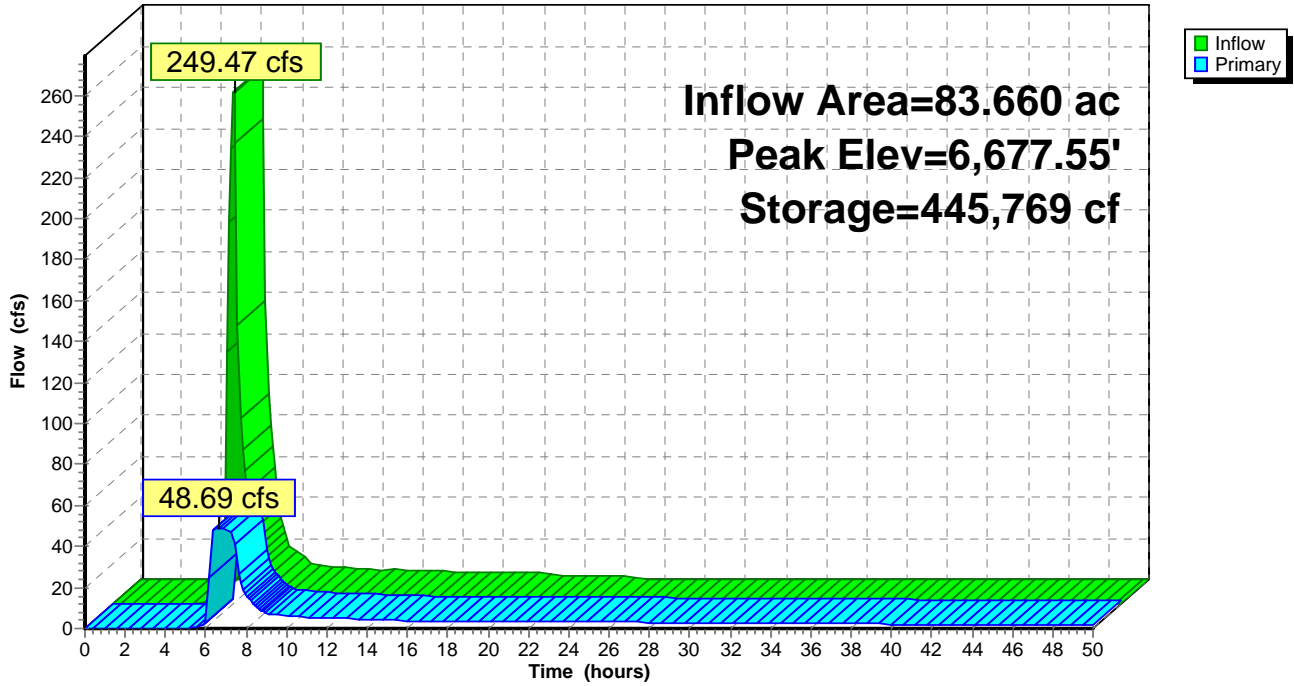
Type IIA 24-hr 100-YR Rainfall=4.60"

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**Pond BS-1: BS-1**

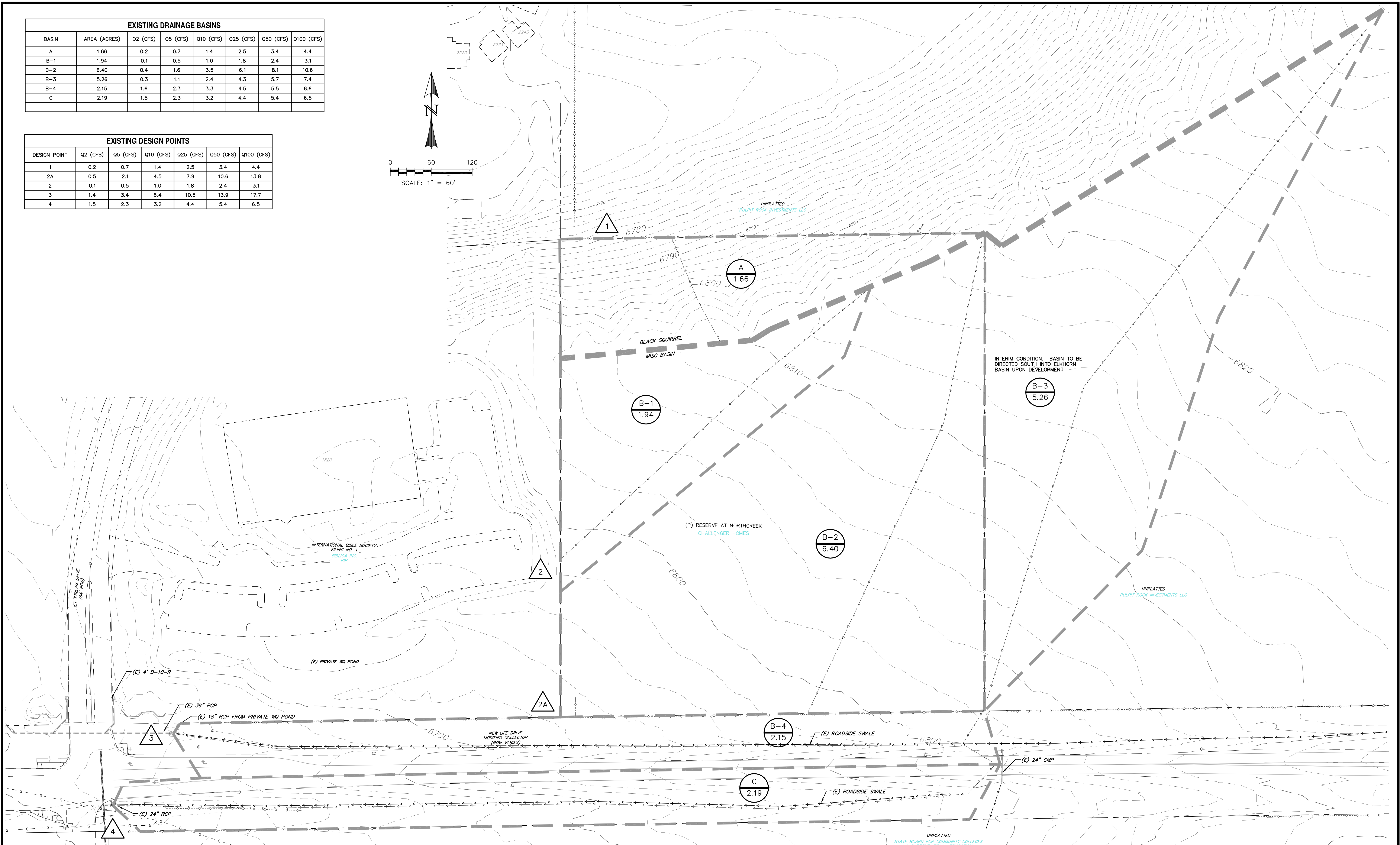
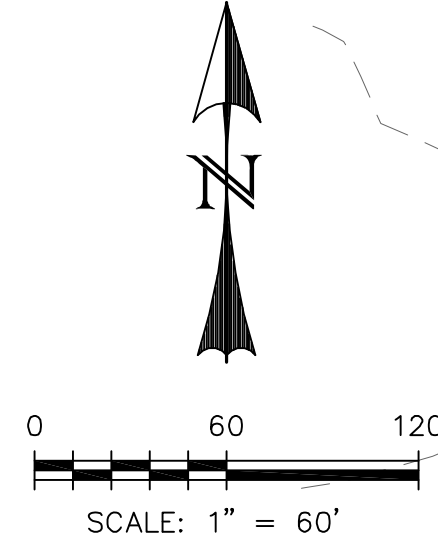
Hydrograph



## **DRAINAGE MAP**

EXISTING DRAINAGE BASINS							
BASIN	AREA (ACRES)	Q2 (CFS)	Q5 (CFS)	Q10 (CFS)	Q25 (CFS)	Q50 (CFS)	Q100 (CFS)
A	1.66	0.2	0.7	1.4	2.5	3.4	4.4
B-1	1.94	0.1	0.5	1.0	1.8	2.4	3.1
B-2	6.40	0.4	1.6	3.5	6.1	8.1	10.6
B-3	5.26	0.3	1.1	2.4	4.3	5.7	7.4
B-4	2.15	1.6	2.3	3.3	4.5	5.5	6.6
C	2.19	1.5	2.3	3.2	4.4	5.4	6.5

EXISTING DESIGN POINTS						
DESIGN POINT	Q2 (CFS)	Q5 (CFS)	Q10 (CFS)	Q25 (CFS)	Q50 (CFS)	Q100 (CFS)
1	0.2	0.7	1.4	2.5	3.4	4.4
2A	0.5	2.1	4.5	7.9	10.6	13.8
2	0.1	0.5	1.0	1.8	2.4	3.1
3	1.4	3.4	6.4	10.5	13.9	17.7
4	1.5	2.3	3.2	4.4	5.4	6.5



REV.	DESCRIPTION	DATE



PREPARED FOR:  
**CHALLENGER HOMES**  
 13530 NORTHGATE ESTATES DRIVE  
 COLORADO SPRINGS, CO 80921  
 (719) 598-5191

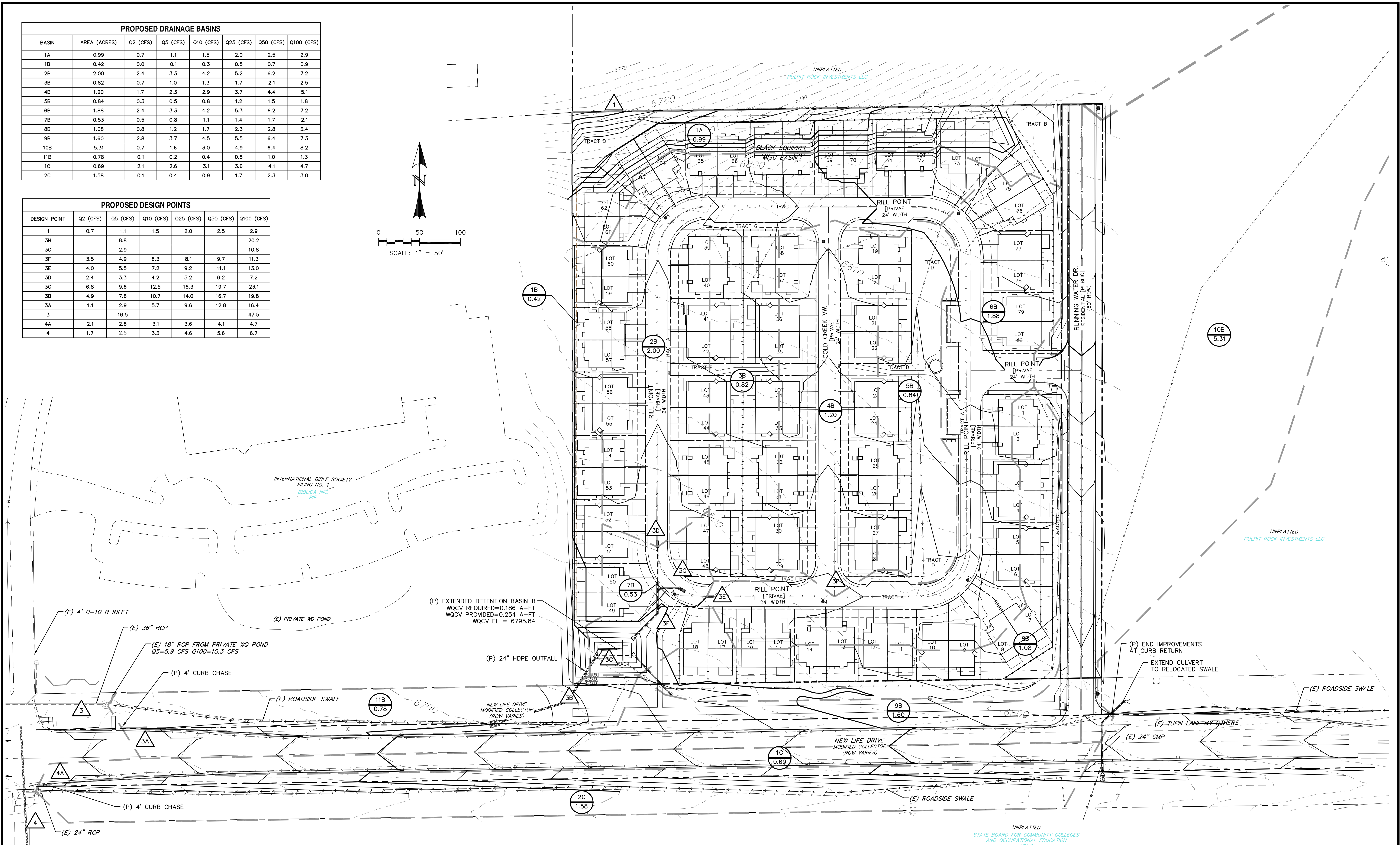
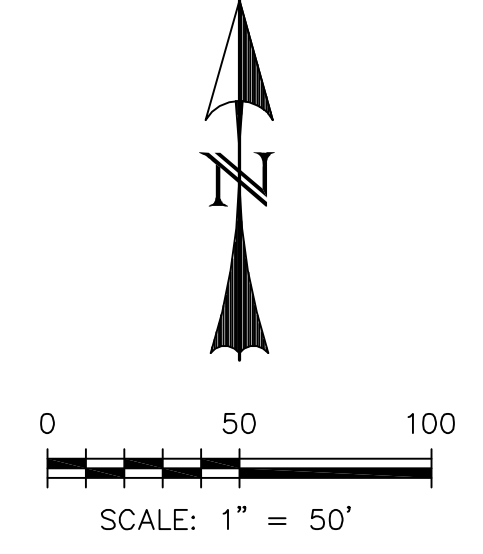


**RESERVE AT NORTHCREEK**  
 EXISTING DRAINAGE MAP

DESIGNED BY: DLM	DRAWN BY: DLM
SCALE: 1"=60'	DATE: 03/06/16
JOB NUMBER: 15-066	SHEET: 1 OF 2

PROPOSED DRAINAGE BASINS							
BASIN	AREA (ACRES)	Q2 (CFS)	Q5 (CFS)	Q10 (CFS)	Q25 (CFS)	Q50 (CFS)	Q100 (CFS)
1A	0.99	0.7	1.1	1.5	2.0	2.5	2.9
1B	0.42	0.0	0.1	0.3	0.5	0.7	0.9
2B	2.00	2.4	3.3	4.2	5.2	6.2	7.2
3B	0.82	0.7	1.0	1.3	1.7	2.1	2.5
4B	1.20	1.7	2.3	2.9	3.7	4.4	5.1
5B	0.84	0.3	0.5	0.8	1.2	1.5	1.8
6B	1.88	2.4	3.3	4.2	5.3	6.2	7.2
7B	0.53	0.5	0.8	1.1	1.4	1.7	2.1
8B	1.08	0.8	1.2	1.7	2.3	2.8	3.4
9B	1.60	2.8	3.7	4.5	5.5	6.4	7.3
10B	5.31	0.7	1.6	3.0	4.9	6.4	8.2
11B	0.78	0.1	0.2	0.4	0.8	1.0	1.3
1C	0.69	2.1	2.6	3.1	3.6	4.1	4.7
2C	1.58	0.1	0.4	0.9	1.7	2.3	3.0

PROPOSED DESIGN POINTS						
DESIGN POINT	Q2 (CFS)	Q5 (CFS)	Q10 (CFS)	Q25 (CFS)	Q50 (CFS)	Q100 (CFS)
1	0.7	1.1	1.5	2.0	2.5	2.9
3H		8.8				20.2
3G		2.9				10.8
3F	3.5	4.9	6.3	8.1	9.7	11.3
3E	4.0	5.5	7.2	9.2	11.1	13.0
3D	2.4	3.3	4.2	5.2	6.2	7.2
3C	6.8	9.6	12.5	16.3	19.7	23.1
3B	4.9	7.6	10.7	14.0	16.7	19.8
3A	1.1	2.9	5.7	9.6	12.8	16.4
3		16.5				47.5
4A	2.1	2.6	3.1	3.6	4.1	4.7
4	1.7	2.5	3.3	4.6	5.6	6.7



REV.	DESCRIPTION	DATE

PREPARED FOR:
CHALLENGER HOMES
13530 NORTHGATE ESTATES DRIVE
COLORADO SPRINGS, CO 80921
(719) 598-5191

DESIGNED BY:	DRAWN BY:
DLM	DLM
SCALE: 1" = 50'	DATE: 05/10/17
JOB NUMBER	SHEET
15-066	2 OF 2

UNPLATTED  
STATE BOARD FOR COMMUNITY COLLEGES  
AND OCCUPATIONAL EDUCATION  
PAGE 1



RESERVE AT NORTHCREEK

PROPOSED DRAINAGE MAP

DESIGNED BY:	DRAWN BY:
DLM	DLM
SCALE: 1" = 50'	DATE: 05/10/17
JOB NUMBER	SHEET
15-066	2 OF 2



MDDP DRAINAGE BASIN COMPARISON																				
ORIGINAL MDDP ANALYSIS					REVISED ANALYSIS															
BASIN	AREA (ACRES)	WEIGHTED CN	TC (hours)	Q2 (CFS)	Q5 (CFS)	Q10 (CFS)	Q25 (CFS)	Q50 (CFS)	Q100 (CFS)	BASIN	REVISED PER	AREA (ACRES)	WEIGHTED CN	TC (hours)	Q2 (CFS)	Q5 (CFS)	Q10 (CFS)	Q25 (CFS)	Q50 (CFS)	Q100 (CFS)
OS2B	12.40	61.0	0.3774	0.14	1.71	3.56	7.19	10.05	13.24	OS2B	MDDP	12.40	61	0.6700	0.20	1.27	2.79	4.37	7.18	9.32
EX-A	10.50	61.0	0.2956	0.13	1.74	3.57	7.09	9.84	12.83	EX-A	RESERVE	10.60	85	0.4630	9.19	14.66	19.57	23.64	29.94	34.22
EX-B	7.10	79.8	0.1091	6.63	11.21	14.48	19.57	23.05	26.58	EX-B	MDDP	7.10	80	0.1080	7.00	11.66	15.85	19.34	24.73	28.39
EX-C1	0.27	85.7	0.0833	0.64	0.84	0.97	1.17	1.30	1.43	EX-C1	MDDP	0.27	86	0.0833	0.42	0.62	0.80	0.95	1.16	1.31
EX-C2	0.44	85.7	0.0833	0.88	1.22	1.44	1.78	2.00	2.22	EX-C2	MDDP	0.44	86	0.0833	0.68	1.01	1.31	1.54	1.90	2.14
PR-D	11.40	61.0	0.5317	0.12	1.21	2.53	5.17	7.30	9.69	PR-D	MDDP	11.40	61	0.5319	0.20	1.39	3.09	4.81	7.87	10.19
EX-G	1.00	98.0	0.0833	0.71	0.93	1.00	1.30	1.44	1.59	EX-G	MDDP	1.00	98	0.0833	2.46	3.20	3.82	4.31	5.04	5.53
EX-H	1.20	98.0	0.0833	1.70	2.23	2.58	3.11	3.46	3.81	EX-H	MDDP	1.20	98	0.0833	2.96	3.84	4.58	5.17	6.05	6.64
BS-1A	15.40	92.5	0.1575	29.77	41.52	49.34	61.02	68.77	76.49	BS-1A	FILING NO. 9	10.15	93	0.1580	20.53	28.41	35.00	40.27	48.15	53.39
BS-1B	14.30	92.5	0.1575	27.64	38.56	45.82	56.66	63.86	71.02	BS-1B	MDDP	14.30	93	0.1580	28.92	40.03	49.31	56.73	67.84	75.22
BS-1C	15.00	92.5	0.1390	29.31	40.76	48.37	59.72	67.25	74.76	BS-1C	THE FARM	14.80	93	0.2050	28.41	39.49	48.78	56.22	67.37	74.79

POND BS-1 COMPARISON				
VALUE COMPARISON	MDDP	FDR THE FARM	FDR RESERVE	ALLOWABLE
Q2 IN (CFS)	90.27	80.98	85.40	-
Q2 OUT (CFS)	0.95	2.27	2.21	2.15
Q2 ELEVATION	6672.61	6674.55	6674.29	-
Q5 IN (CFS)	126.40	125.91	122.35	-
Q5 OUT (CFS)	4.67	3.15	2.93	8.42
Q5 ELEVATION	6673.94	6675.94	6675.50	-
Q10 IN (CFS)	150.56	149.14	154.68	-
Q10 OUT (CFS)	9.00	8.49	5.81	17.34
Q10 ELEVATION	6674.43	6676.60	6676.46	-
Q25 IN (CFS)	-	203.00	181.22	-
Q25 OUT (CFS)	-	45.59	21.50	-
Q25 ELEVATION	-	6677.50	6676.66	-
Q50 IN (CFS)	213.15	216.42	221.90	-
Q50 OUT (CFS)	37.27	46.48	47.06	48.19
Q50 ELEVATION	6675.71	6677.76	6677.02	-
Q100 IN (CFS)	239.38	238.68	249.47	-
Q100 OUT (CFS)	57.62	47.89	48.69	63.10
Q100 ELEVATION	6676.16	6678.20	6677.55	-

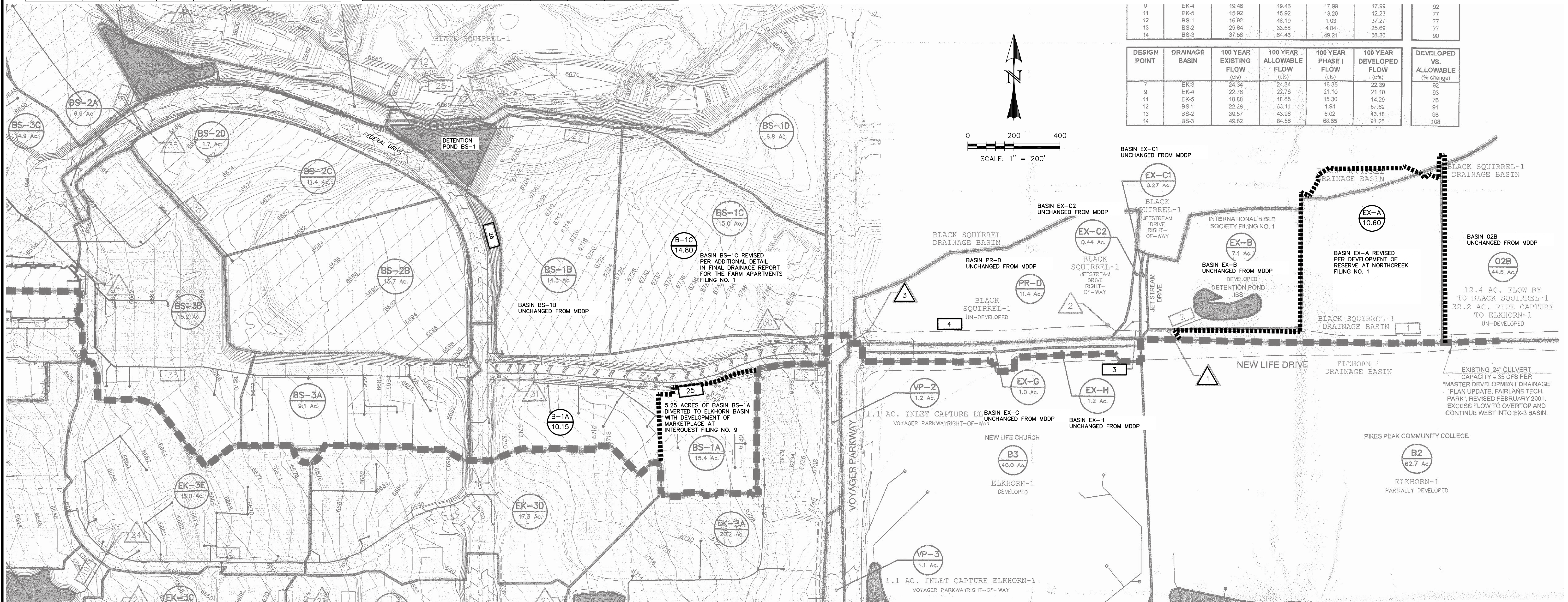
MDDP DESIGN POINT COMPARISON						
ORIGINAL MDDP ANALYSIS						
DESIGN POINT	Q2 (CFS)	Q5 (CFS)	Q10 (CFS)	Q25 (CFS)	Q50 (CFS)	Q100 (CFS)
1	1.94	4.18	7.07	-	18.32	24.00
3-36" PIPE	-	4.18	-	-	-	24.02
4-CHANNEL	-	4.33	-	-	-	23.87
3	3.30	5.58	9.69	-	25.52	33.57
25-48" PIPE	-	6.71	-	-	-	33.25
26-54" PIPE	-	47.59	-	-	-	95.38
BS-1 IN	90.27	126.40	150.56	-	213.15	239.38
BS-1 OUT	0.95	4.67	9.00	-	37.27	57.62

REVISED ANALYSIS						
DESIGN POINT	Q2 (CFS)	Q5 (CFS)	Q10 (CFS)	Q25 (CFS)	Q50 (CFS)	Q100 (CFS)
1	12.18	20.61	28.49	35.25	46.02	53.53
3-36" PIPE	-	21.9600	-	-	-	56.42
4-CHANNEL	-	21.4300	-	-	-	55.46
3	12.56	21.89	31.14	39.31	52.66	62.19
25-36" PIPE	-	21.8900	-	-	-	62.19
26-48" PIPE	-	45.4600	-	-	-	105.27
BS-1 IN	85.40	122.35	154.68	181.22	221.90	249.47
BS-1 OUT	2.21	2.93	5.81	21.50	47.06	48.69

9	EK-4	19.46	19.46	17.99	17.59	92
11	EK-6	15.92	13.29	12.23	12.23	77
12	BS-1	16.92	48.19	1.03	37.27	77
13	BS-2	29.64	33.68	4.84	25.69	77
14	BS-3	37.58	64.46	49.21	58.30	80

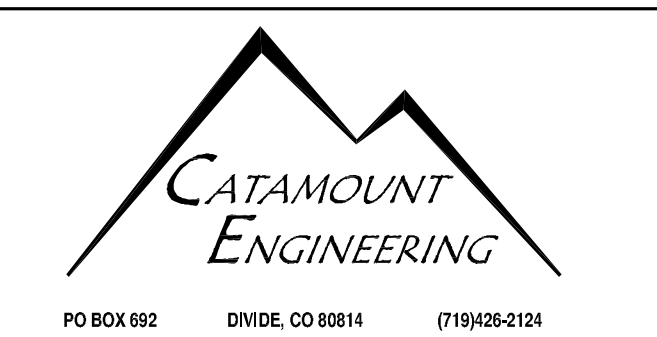
  

DESIGN POINT	DRAINAGE BASIN	100 YEAR EXISTING FLOW (cfs)	100 YEAR ALLOWABLE FLOW (cfs)	100 YEAR PHASE I FLOW (cfs)	100 YEAR DEVELOPED FLOW (cfs)	DEVELOPED VS. ALLOWABLE (% change)
7	EK-3	24.34	24.34	18.35	22.39	92
9	EK-4	22.78	22.78	21.10	21.10	93
11	EK-6	18.89	18.88	15.30	14.29	76
12	BS-1	22.28	63.14	1.94	57.62	91
13	BS-2	39.57	43.98	6.02	43.18	98
14	BS-3	49.62	84.58	68.65	91.25	108



REV.	DESCRIPTION	DATE

PREPARED FOR:  
**CHALLENGER HOMES**  
 13530 NORTHGATE ESTATES DRIVE  
 COLORADO SPRINGS, CO 80921  
 (719) 598-5191



RESERVE AT NORTHCREEK		DESIGNED BY:	DLM	DRAWN BY:	DLM
MDDP COMPARISON		SCALE:	1"=200'	DATE:	6/13/17
		JOB NUMBER	15-066	SHEET	1 OF 1