Final Drainage Report
The Glen at Widefield Filing No. 11
El Paso County, Colorado

Prepared for:
Widefield Investment Group
3 Widefield Boulevard
Colorado Springs, Colorado 80911

Prepared by:

Kiowa
Engineering Corporation
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Ph: (719)630-7342

Kiowa Project No. 19016

December 2, 2019

PCD Project No. SF-____-_____

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List of Figures and Tables (Refer to the Appendix Table of Contents)

STATEMENTS AND APPROVALS

ENGINEER'S STATEMENT:

The attached drainage plan and report were prepared under my direction and supervision and are correct to the best of my knowledge and belief. Said drainage report has been prepared according to the criteria established by the County for drainage reports and said report is in conformity with the 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.

Kiowa Engineering Corporation, 1604 South 21st Street, Colorado Springs, Colorado 80904

_____ _____

Andrew W. McCord (PE #25057) Date

For and on Behalf of Kiowa Engineering Corporation

DEVELOPER'S STATEMENT:

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

By: _____ _____

Date

Print Name: J. Ryan Watson, Glen Development Company

Address: 3 Widefield Boulevard
Colorado Springs, Colorado 80911

EL PASO COUNTY:

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

_____ _____

Jennifer Irvine, P.E. Date

El Paso County Engineer/ECM Administrator

I. GENERAL LOCATION AND DESCRIPTION

The Glen at Widefield Filing No. 11 (Filing 11) subdivision will be developed as a single-family residential subdivision located in the Widefield area of El Paso County. The subject property is located to the west of Marksheffel Road and north of Mesa Ridge Parkway. The site is located in the southwest portion of Section 22, Township 15 South, Range 65 West of the 6th Principal Meridian, in El Paso County, Colorado. The site is bounded on east by Marksheffel Road, the south and west by the Glen at Widefield Filing No. 8-10, to the northwest by the Glen at Widefield Future Filing No. 12 (preliminarily platted), and the north by undeveloped raw land, currently unplatted. The property covers approximately 50.0 acres and is currently overlot-graded under early grading permit to approximate finished grade conditions. The property has previously been rough graded as a part of the Glen at Widefield East. Extended Detention Basin 'D' is partially constructed in the southern portion of the site. The detention basin was originally graded under early permit as a sedimentation basin. As a part of Filing No. 10, the basin is planned to be fitted with a 3-stage outlet structure, emergency spillway and access road for maintenance. With Filing No. 11, The Basin is to receive final grading, slope contouring, and perimeter maintenance roads, along with a low-flow trickle channel. Some outlet plate modification is expected within the outlet structure to accommodate final calculated values for the tributary and undetained areas impacted by development. A vicinity map of the site is shown on Figure 1 included in the Appendix.

The existing vegetative cover within the development is in poor to fair condition with minimal grasses throughout the site. The existing ground slopes within the property range from 0.2 to 25 percent. Soils within the subject site are classified to be within Hydrologic Soils Group B and C as shown in the *El Paso County Soils Survey*. For the purposes of computing the existing and proposed hydrology for the site, both Hydrologic Soil Groups were used with weighted coefficients.

Existing utilities within or adjacent to the site include a pair of thirty-inch (30") Colorado Interstate Gas (CIG) mains that run along portions of the westerly property boundary (See Maps in Appendix D).

Poa Annua Street will be extended west into the site from Marksheffel Road and will be improved further with this development with sidewalks and pedestrian ramps.

II. MAJOR DRAINAGE BASINS AND SUBBASINS

The site lies within the West Fork Jimmy Camp Creek drainage basin. The majority of the overall site presently drains towards the south and southeast by a combination of overlot sheet flow along with curb, gutter, pipe and open channel conveyances to the West Fork Jimmy Camp Creek just upstream of Mesa Ridge Parkway (Sub-basins EX-1 through EX-4 - See Drainage Map Sheet 1 of 3). The north portion of the site drains east and south within proposed roadway corridors to proposed Extended Detention Basin 'D'. The south portion of the site is conveyed north to proposed Extended Detention Basin 'D'. The tributary basins to Basin 'D' are prefaced with the letter 'D' and are numbered sequentially D1 to D24.

The remaining portions of the site consist of rear lot margins which cannot be captured due to topography. These marginal areas are expected to consist of lawn and rear slope areas which will substantially match Historic Conditions. The existing drainage patterns for the site are shown on Drainage Plan Sheet 1 provided in a map pocket at the end of this report, and developed flows are compared on Sheets 2 & 3 to reflect pre- and post-development impacts.

The drainage reports that were reviewed in the process of preparing this drainage report are included in the References section. The Glen at Widefield East area was studied as a part of the *Master Development Drainage Plan (MDDP) for the Glen at Widefield* and the *West Fork Jimmy Camp Creek*

Drainage Basin Planning Study (DBPS). A detention basin shown on the west side of the creek (DP 3101) was designed and constructed as part of the Filing No. 6 improvements. Two additional regional detention basins were identified for the site in the *MDDP*: one to serve the westerly side of the site with flows released west to the West Fork Jimmy Camp Creek (DP 3091), and the other to serve the easterly side of the site with flows released east across Marksheffel Road to a channel along the north side of Peaceful Valley Road and ultimately to the Jimmy Camp Creek main branch (DP 4021). The detention basin shown in the *MDDP* and *DBPS* at DP 3091 was designed and constructed as part of the Glen at Widefield Filing No. 7 improvements as Basin C. However, due to the proposed grading and drainage patterns north of Filing No. 7, two additional detention basins to serve the westerly side of the site were planned and constructed: one for Filing No. 8 (Basin B) and one for Filing No. 9 (Basin A), which is located just north of the Filing No. 8 area. The detention basin shown in the *MDDP* and *DBPS* at DP 4021 (Basin D) is designed herein and will be constructed to serve Filing 10, Filing 11, and Future Filing 12 within the Glen at Widefield master planned area.

The subject property limits are shown on Flood Insurance Rate Maps (FIRMs) 08041C0956G and 08041C0957G (both with effective dates of December 7, 2018) that are included in the Appendix. The FIRMs also show that the property to be developed with buildable lots is located outside of the FEMA regulated floodplain in an unshaded Zone X area, which is described as "Area of Minimal Flood Hazard."

III. DRAINAGE DESIGN CRITERIA

Hydrologic and hydraulic calculations for the site were performed using the methods outlined in the *El Paso County Drainage Criteria Manual*. Topography for the site was compiled using a two-foot contour interval and is presented on the Historic Conditions map. The hydrologic calculations were made for the historic and proposed site conditions. The Drainage Plan presents the drainage patterns for the site, including the 'D'-series sub-basins. The peak flow rates for the sub-basins were estimated using the Rational Method. The 5-year (Minor storm) and 100-year (Major storm) recurrence intervals were determined. The one-hour rainfall depth was determined from Table 6-2 of the *Drainage Criteria Manual*. These depths are shown in the runoff calculations spreadsheet. The peak flow data generated using the rational method was used to verify street capacities and to size inlets and storm sewers within the subdivision. The drainage basin area, time of concentration, and rainfall intensity were determined for each of the sub-basins within the property. The onsite soils were assumed to be mostly Hydrologic Soil Group C, based on the *Soil Survey* and the result of earth-moving operations. For existing conditions, runoff coefficients were determined using a land use of pasture/meadow. The land use for the proposed development will be residential with a density of approximately 4 lots per acre.

The onsite hydraulic structures were sized using the methods outlined in the *El Paso County Drainage Criteria Manual*. The hydraulic capacities of the streets and curb inlets were determined using the UD-Inlet spreadsheet developed by the Urban Drainage and Flood Control District (UDFCD), considering the County criteria for the Minor (5-year) and Major (100-year) storms. Ramp curbs will be used throughout the development, except for curb returns, where a 6-inch vertical curb will be used. Hydraulic calculations are provided in Appendix C for the proposed streets, pipe outlet erosion protection and open channel capacities.

The on-site detention basin is planned to be an Extended Detention Basin that uses Full Spectrum Detention. The UD-Detention spreadsheets created by UDFCD were used to size and design the detention basin with water quality enhancement, per the County's recommendation. The supporting calculations associated with the sizing of the hydraulic facility for this development are included in Appendix B of this report.

IV. DRAINAGE FACILITY DESIGN

The drainage of the site will be accomplished through a combination of sheet flow, gutter flow and pipe conveyance systems which will outlet directly to the planned extended detention basin (Basin 'D'). Two inflow points are identified with this development, and each will terminate within a pre-sedimentation forebay (Inflows 'H' & 'J') (See Map Exhibit Sheet 2).

The proposed drainage patterns for the site are shown on the Final Drainage Plan for the developed condition (Sheets 2 and 3) provided in the map pocket at the end of this report. The hydrologic and hydraulic calculations are provided in the Appendix. Refer to the Drainage Design Criteria section for additional information on the hydrologic and hydraulic calculations.

Evaluations related to sizing of onsite drainage improvements was carried out in accordance with the *County Storm Drainage Criteria Manual*. The capacities of the proposed onsite facilities were calculated in accordance with the *Criteria Manual* and current UDFCD supporting software.

Offsite runoff is directed east to the existing roadside ditch along Marksheffel Road and conveyed within open channel sections and culvert sections (by others). These flows accumulate and increase as the channel travels south along the east margin of the site. Ultimately these flows will combine with flows discharged at Basin 'D'. Undetained on-site areas will be accounted for to ensure pre- and post-development discharges are similar, and so that downstream elements are not adversely impacted (See Sheets 2 and 3).

The detention basin will include two pre-sedimentation forebays along with trickle channel to a planned three-stage outlet structure (part of Filing 10).

Under Fully Developed Conditions, Basin D will incorporate, additional pond shaping for storage, a perimeter maintenance trail, inflow sedimentation forebays, and concrete trickle channel. The detention basin will be a private facility and will be maintained by the Glen at Widefield Filing No. 10 and 11 Homeowner's Associations.

The following is a description of the on-site storm sewer system:

The system will begin with sheet flow at the lot areas. Some sheet flow will reach the sedimentation basin in historic fashion across unplatted and undeveloped land. However, most of the flows will begin as sheet flow on the lot areas and will be directed via overlot grades to existing and proposed street corridors. Inlets and pipes planned with this filing will convey the Minor event (5-year) and most of the Major event (100-year) directly to the planned detention basin.

Two principal storm trunklines are planned, at Pennycress Drive and at Golden Buffs Drive that will convey captured flow to 100-year capacity curb inlets in a sump condition at DP 79, DP 81, DP 89 and DP 93, and ultimately to proposed Detention Basin 'D' (DP 94) located to the west of Pennycress Drive. Runoff from Sub-basins D19.1, D20, D-21, D-22 and D-23 will be captured in new curb and gutter of Pennycress Drive and conveyed to Detention Basin 'D' from the south. The flows from the south rely on surface conveyance, and inflow to Basin 'D' at a low point along Pennycress Drive identified as 'Inflow J'. An inlet pair at this location (Inlets J-1 & J-2) capture both Minor storm event (5yr) and Major storm event (100yr) flows.

The fully completed extended detention basin will occupy the location of partially constructed extended detention basin D planned with Filing No. 10, and currently in review with the County at the time of this report. The basin is proposed to fully accommodate water quality separation and the emergency conveyance of flow associated with Filing 10, Filing 11, and Future Filing No. 12.

The storm sewer system will provide storage and intercept most of the flows with some 100-year flows exceeding and by-passing inlets in the Major event. The Minor event is fully intercepted by the inlet and pipe systems.

Basin D

Sub-basins D-1 thru D-24 are not all located within Filing No. 11 but are all tributary to Detention Basin 'D'. Basins D1-D24 comprise approximately 60 acres. Some edge areas are released undetained and these are accounted for in the B-Series and E-Series of sub-basins discussed later in this report. The E-Series 'edge area' basins are substantially unchanged from their historic condition and flowrate.

The Sub-basins herein are generally organized and map-labeled in the order they sit from highest in elevation to lowest.

Detained flows released from Detention Basin 'D' will be conveyed to the existing roadside ditch along Marksheffel Road.

Sub-basins D-1 thru D-19 have similar characteristics with a mix of street, and residential lot area. Refer to Map Sheet 3 of 3 (D-2). The Following is a description of these sub-basins:

Sub-basin D-1 is approximately 2.53 acres in area and is located north and west of the subject property (Future Filing 12). Runoff from this basin will sheet flow south and concentrate in rough-cut street sections. This basin combines with Sub-basin D-2.

Sub-basin D-2 is approximately 1.46 acres in area and is located west of the subject property (Future Filing 12) with the exception of its extreme southeast corner which is on-site. Runoff from this basin will sheet flow south and concentrate in rough-cut street sections until reaching a 12 ft curb inlet at DP69 (Inlet E-2).

Sub-basin D-3 is approximately 1.62 acres in area and is located north and west of the subject property (Future Filing 12). Runoff from this basin will sheet flow south and concentrate in rough-cut street sections. This basin combines with Sub-basin D-4.

Sub-basin D-4 is approximately 2.07 acres in area and is located north and west of the subject property (Future Filing 12) with the exception of its extreme eastern corner which is on-site. Runoff from this basin will sheet flow south and concentrate in rough-cut street sections. It will also combine with concentrated runoff from upstream Sub-basin D-3 until reaching a 12 ft curb inlet at DP71 (Inlet E-1).

Sub-basin D-5 is approximately 2.41 acres in area and is located west of the subject property (Future Filing 12) with the exception of its extreme eastern corner which is on-site. Runoff from this basin will sheet flow north and concentrate in the south half of a rough-cut street section until reaching an interim storm inlet at DP72 (Inlet A-4). A-4 is actually a future storm manhole which is planned to be left as an area inlet until the time of future development (Filing No. 12).

Sub-basin D-6 is approximately 0.41 acres in area and is located in the north and west portion of the subject property. Runoff from this basin will sheet flow south and concentrate in Pennycress Drive and be conveyed by curb and gutter to the south (DP73) where it will continue across a crosspan at the intersection of Lance Leaf Drive and combine with additional surface flows from Sub-basin D-7.

Sub-basin D-7 is approximately 3.12 acres in area and is located along the westerly margin of the subject property. Some of the northwesterly margins of this sub-basin lie within Future Filing No. 12. Runoff from this basin will sheet flow south and east and concentrate in Pennycress Drive and be conveyed by curb and gutter to the south to on-grade inlet E-6 (DP75). In the Major storm event, 2.0 cfs of bypass flow will continue across a crosspan at the intersection of Lance Leaf Drive and combine with additional surface flows from Sub-basin D-8.

Sub-basin D-8 is approximately 1.76 acres in area and is located along the westerly margin of the subject property. Some of the northwesterly margins of this sub-basin lie within Future Filing No.

12. Runoff from this basin will sheet flow south and east and concentrate within The Marsh Elder Place cul-de-sac and within Pennycress Drive and be further conveyed by curb and gutter to the south within the Pennycress roadway corridor at DP76. In the Minor event, 2.2 cfs of bypass flow will continue south as gutter flow. In the Major storm event, 9.7 cfs of bypass flow will continue south as gutter flow (at DP 78) and combine with additional surface flows from Sub-basin D-10.

Sub-basin D-9 is approximately 2.16 acres in area and is located west of the subject property. Runoff from this basin will sheet flow south and concentrate in Pennycress Drive and be conveyed by curb and gutter to the south (DP73) where it will continue across a crosspan at the intersection of Lance Leaf Drive and combine with additional surface flows from Sub-basin D-7.

Sub-basin D-10 is approximately 2.00 acres in area and is located along the westerly margin of the subject property. Runoff from this basin will sheet flow south and east and concentrate within Pennycress Drive and be further conveyed by curb and gutter to the south within the Pennycress roadway corridor to a 16-foot curb inlet (Inlet H-2) at DP79. In the Minor event, 2.2 cfs of bypassed flow from upstream sub-basins D7 & D-8 will combine with flows from this sub-basin and continue south as gutter flow. In the Major storm event, 9.7 cfs of bypassed flow is received and will continue south as gutter flow to DP 79. Inlet H-2 lies in a sump condition along with a series of other inlets at this intersection which are all hydraulically connected. These inlets collectively intercept one hundred percent (100%) of the Major storm event.

Sub-basin D-11 is approximately 3.96 acres in area and is located in the central area of the subject property. Runoff from this basin will sheet flow south and west and concentrate in Pennycress Drive and be conveyed by curb and gutter to the south (DP80) where it will continue across a crosspan at a knuckle cul-de-sac (See Sub-basin D-12).

Sub-basin D-12 is approximately 1.39 in area and is located in the central area of the subject property. Runoff from this basin will sheet flow south and west and concentrate in Pennycress Drive and be combined with gutter flow from Sub-basin D-11. 4.50 cfs in the Minor event, and 13.0 cfs in the Major event will combine with sub-basin flows and be conveyed by curb and gutter to the south to Inlet G-4 (DP81). Inlet G-4 lies in a sump condition along with a series of other inlets at this intersection which are all hydraulically connected. These inlets collectively intercept one hundred percent (100%) of the Major storm event.

Sub-basin D-13 is approximately 2.07 acres in area and is located in the central area of the subject property. Runoff from this basin will sheet flow south and east and concentrate in Golden Buffs Drive and be conveyed by curb and gutter to the south to on-grade curb inlet D-4 at DP82.

Sub-basin D-14 is approximately 3.30 acres in area and is located in the central area of the subject property. Runoff from this basin will sheet flow south and east and concentrate in Golden Buffs Drive and be conveyed by curb and gutter to the south to on-grade curb inlet G-3 at DP83. Some bypass flows (2.3 cfs) from Sub-basin D-13 will combine within the street's gutter section in the Major storm event.

Sub-basin D-15 is approximately 2.80 acres in area and is located north and west of the subject property (Future Filing 12). Runoff from this basin will sheet flow south and east and concentrate in rough-cut street sections at DP84. This basin combines with Sub-basin D-16 via future crosspan.

Sub-basin D-16 is approximately 2.14 acres in area and is located north and west of the subject property (Future Filing 12) excepting a very small portion of its easternmost edge. Runoff from this basin will sheet flow south and concentrate in rough-cut street sections. This basin combines with upstream Sub-basin D-15 at the point of a planned future crosspan. Combined flows continue east in the north half of the rough-cut street section (Future Golden Buffs Drive) to the subject property and the beginning of improved street Golden Buffs Drive. Combined flows continue east about another

80 feet to Inlet B-1 (DP84.1). Some bypass flow will continue east (5.2 cfs) to Sub-basin D-16.1 in the Major storm event.

Sub-basin D-16.1 is approximately 1.69 acres in area and is located in the north margins of the subject property. Runoff from this basin will sheet flow southwest and concentrate within Golden Buffs Drive. Flows from this basin combine with concentrated gutter flow from upstream Sub-basin D-16 at the point of a planned crosspan (DP84.1). Combined flows continue east in the north half of Golden Buffs Drive to Mouse Ear Place cul-de-sac (DP85) and the location of Inlet C-1. Some bypass flow will continue southeast (2.2 cfs) to Sub-basin D-17 in the Major storm event.

Sub-basin D-17 is approximately 2.29 acres in area and is located in the northeast area of the subject property. Runoff from this basin will sheet flow west and concentrate in Golden Buffs Drive, and within cul-de-sac gutter sections at Mouse Ear Place, and Kitten Tail Court. These flows combine at Inlet D-1 (DP86). Some bypass flow will continue south (1.7 cfs) to Sub-basin D-18 in the Major storm event.

Sub-basin D-18 is approximately 1.98 acres in area and is located in the east area of the subject property. Runoff from this basin will sheet flow west and concentrate in Golden Buffs Drive, and within cul-de-sac gutter sections at Horse Mint Trail. These flows combine at the east half of Golden Buffs Drive within the gutter section and ahead of an unnamed knuckle cul-de-sac (DP87). Some bypass flow will continue south to Sub-basin D-19; 2.3 cfs in the Minor storm event, and 8.2 cfs in the Major event.

Sub-basin D-19 is approximately 2.02 acres in area and is located in the southeast area of the subject property. Runoff from this basin will sheet flow west and concentrate in Golden Buffs Drive, and within an unnamed knuckle cul-de-sac. Concentrated gutter flows will combine with upstream bypassed flows from Sub-basin D-18. These combined flows will continue south (1.7 cfs) to Inlet G2 (DP88). Bypassing flows from Inlet G-2 are expected to overtop to Inlet G-1 in the Minor storm event and overtop to inlet G-1 and H-1 and J-2 in the Major storm event.

Sub-basin D-19.1 is approximately 0.15 acres in area and is located in the southeasterly corner of the subject property. Runoff from this basin will sheet flow west and concentrate in Pennycress Drive. These flows combine at Inlet G-1 (DP89). Some bypass flows will contribute to this inlet in both the Minor storm (0.1 cfs) and the Major storm event (5.7 cfs).

Sub-basins D20-24 have varying surface characteristics, and these are reflected in the weighted coefficients assigned to each basin through Rational methodology. These basins comprise the tributary areas inflowing to Basin 'D' from the south. Refer to Map Sheet 2 of 3 (D-1). The Following is a description of the southerly sub-basins:

Sub-basin D-20 is approximately 0.90 acres in area and is located south of the subject property. It is comprised of Pennycress Drive and some captured landscape areas. Runoff from this basin will sheet flow west and concentrate in Pennycress Drive at Inlet J-1 (DP92a). These flows combine at Inlet J-2 with flows from Sub-basin D-23 and inflow directly to Detention basin 'D'. There are no bypass flows.

Sub-basin D-21 is approximately 4.02 acres in area and is located south of the subject property within Filing No. 10. Sub-basin D-21 has similar surface characteristics to Sub-basins D-1 thru D-19. Runoff from this basin will sheet flow south and east and concentrate first within Peaceful Valley Road, and Buffalo Bur Trail, and then within Pennycress Drive existing street sections (DP90). These flows currently combine with flows from Sub-basin D-22 and are conveyed to the intersection of Pennycress Drive and Peaceful Valley Road. A crosspan conveys the flows to a point where the existing street terminates. From the street's terminus, a temporary outfall ditch, planned for construction with Filing No. 10 conveys these flows directly to Basin 'D'. Under proposed conditions, the temporary outfall ditch is eliminated in favor of extending Pennycress Drive north.

Sub-basin D-22 is approximately 1.15 acres in area and is located south of the subject property within Filing No. 10. It is comprised of existing sections of Peaceful Valley Road and some captured overlot areas. Runoff from this basin will sheet flow southwest and concentrate in Peaceful Valley Road (DP91). These flows combine with flows from Sub-basin D-21 and inflow directly to Detention Basin 'D'. There are no inlets. All flows from this sub-basin contribute to the north side gutter section of Pennycress Drive and are no longer ditch flow, but rather gutter flow within Sub-basin D-23.

Sub-basin D-23 is approximately 0.52 acres in area and is located south of the subject property. It is comprised of Pennycress Drive and some captured landscape areas. Runoff from this basin will sheet flow east and concentrate in Pennycress Drive at Inlet J-2 (DP92b). These flows combine at Inlet J-1 with flows from Sub-basin D-23 and inflow directly to Detention basin 'D'. There are no bypass flows.

Sub-basin D-24 is approximately 9.79 acres in area and is located along the west side of the subject property. This sub-basin encompasses all of the planned detention basin area, as well as off-site flows received from the west which traverse the Colorado Interstate Gas Pipeline Easement (C.I.G. Easement). These flows will remain unchanged from historic condition excepting roadway improvements. Flows from this sub-basin accumulate within rear lot areas north and west of the detention basin and are conveyed along shallow slopes with minimal velocity. There are no bypass flows, or inlets.

Basin E

The 'E' Basins are located along the easterly edge of the site between the property and Marksheffel Road. Sub-basins E-1 through E-5 drain offsite to the existing roadside ditch along Marksheffel Road.

WATER QUALITY

Storm water quality measures are required by the County in Volume 2 of the County's *Drainage Criteria Manual*. The water quality measures to be instituted for the development will include:

1. Water quality enhancement of the detention basin. Existing Sedimentation Basin D has been operating as a temporary sedimentation basin prior to construction of the Extended Detention Basin. Final improvements at this sedimentation basin will impact water quality through the addition of pre-sedimentation forebays, trickle channel, and perimeter surface treatments.
2. The outlet structure will include a water quality orifice plate and a micropool.

A. COST OF PROPOSED DRAINAGE FACILITIES

Table 2 presents a cost estimate for the construction of drainage improvements (Public) for The Glen at Widefield Filing No. 11 development.

B. DRAINAGE AND BRIDGE FEES

The site lies within the West Fork Jimmy Camp Creek Drainage Basin. The current drainage basin fee associated with the West Fork Jimmy Camp Creek Drainage Basin is $12,564 per impervious acre. The current bridge fee associated with the West Fork Jimmy Camp Creek Drainage Basin is $3,717 per impervious acre. The Glen at Widefield Filing No. 11 subdivision encompasses 50.00 acres. Table 1 details the fees due as part of this development.

V. CONCLUSIONS

The Glen at Widefield Filing No. 11 will be a single-lot family residential subdivision covering approximately 50.00 acres. Onsite drainage will include the use of surface conveyance elements such as gutter, crosspan, and inlets to route the runoff from the site to Detention Basin 'D'.

Basin D serves Filing 10 along with northern tributary area Filing 11 and Future Filing 12 (See Maps). Detained runoff from the site will be conveyed to the West Fork Jimmy Camp Creek. With detention serving the site and existing downstream conveyance elements in place, the development of the Glen at Widefield Filing No. 11 property will not adversely impact or deteriorate improvements or natural drainageways downstream of the property.

VI. REFERENCES

1) Preliminary Drainage Report, The Glen at Widefield East, prepared by Kiowa Engineering Corporation, dated December 16, 2015.

2) Final Drainage Report, The Glen at Widefield Filing No. 7, prepared by Kiowa Engineering Corporation, dated January 11, 2016.

3) Amended Master Development Drainage Plan, The Glen at Widefield, prepared by Kiowa Engineering Corporation, dated June 21, 2007.

4) Final Drainage Report, The Glen at Widefield Filing No. 6, prepared by Kiowa Engineering Corporation, dated December 6, 2007.

5) Preliminary and Final Drainage Report, Mesa Ridge Parkway Final Design, prepared by Kiowa Engineering Corporation, dated November 29, 2010.

6) Mesa Ridge Parkway Roadway Design, Autumn Glen Avenue to Marksheffel Road and Widening from Powers Boulevard to Autumn Glen Avenue, prepared by Kiowa Engineering Corporation, dated December 8, 2010.

7) Master Development Drainage Plan for the Glen at Widefield, prepared by Kiowa Engineering Corporation, dated December 10, 1999.

8) West Fork Jimmy Camp Creek Drainage Basin Planning Study, prepared by Kiowa Engineering Corporation, dated October 17, 2003.

9) City of Colorado Springs and El Paso County Flood Insurance Study, prepared by the Federal Emergency Management Agency, dated March 1997.

10) El Paso County Drainage Criteria Manual (Volumes 1 and 2) and Engineering Criteria Manual, current editions.

11) Soil Survey of El Paso County Area, Colorado, prepared by United States Department of Agriculture Soil Conservation Service, dated June 1981.

12) Final Drainage Report Marksheffel Road South - Link Road to US-24, El Paso County, CO, HDR Engineering, August 2015.

13) Final Drainage Report The Glen Filing No 10 Kiowa Engineering, September 2019 (Pending Review)

APPENDIX TABLE OF CONTENTS

APPENDIX

Figure 1: Vicinity Map

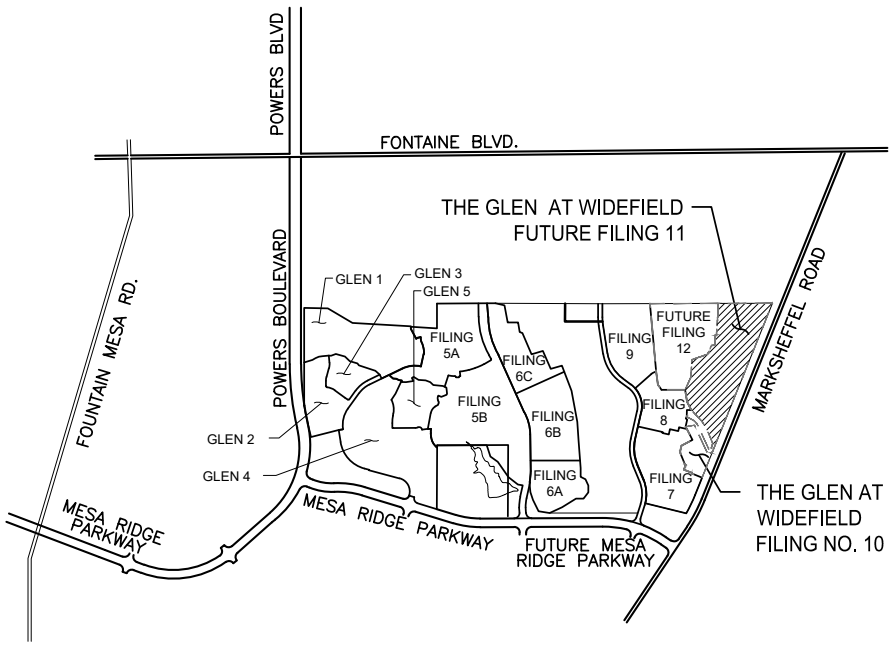
Figure 2: Soils Map

FEMA Flood Insurance Rate Map (Panels 956 and 957)

Table 1: Impervious Area and Drainage Basin & Bridge Fee Calc

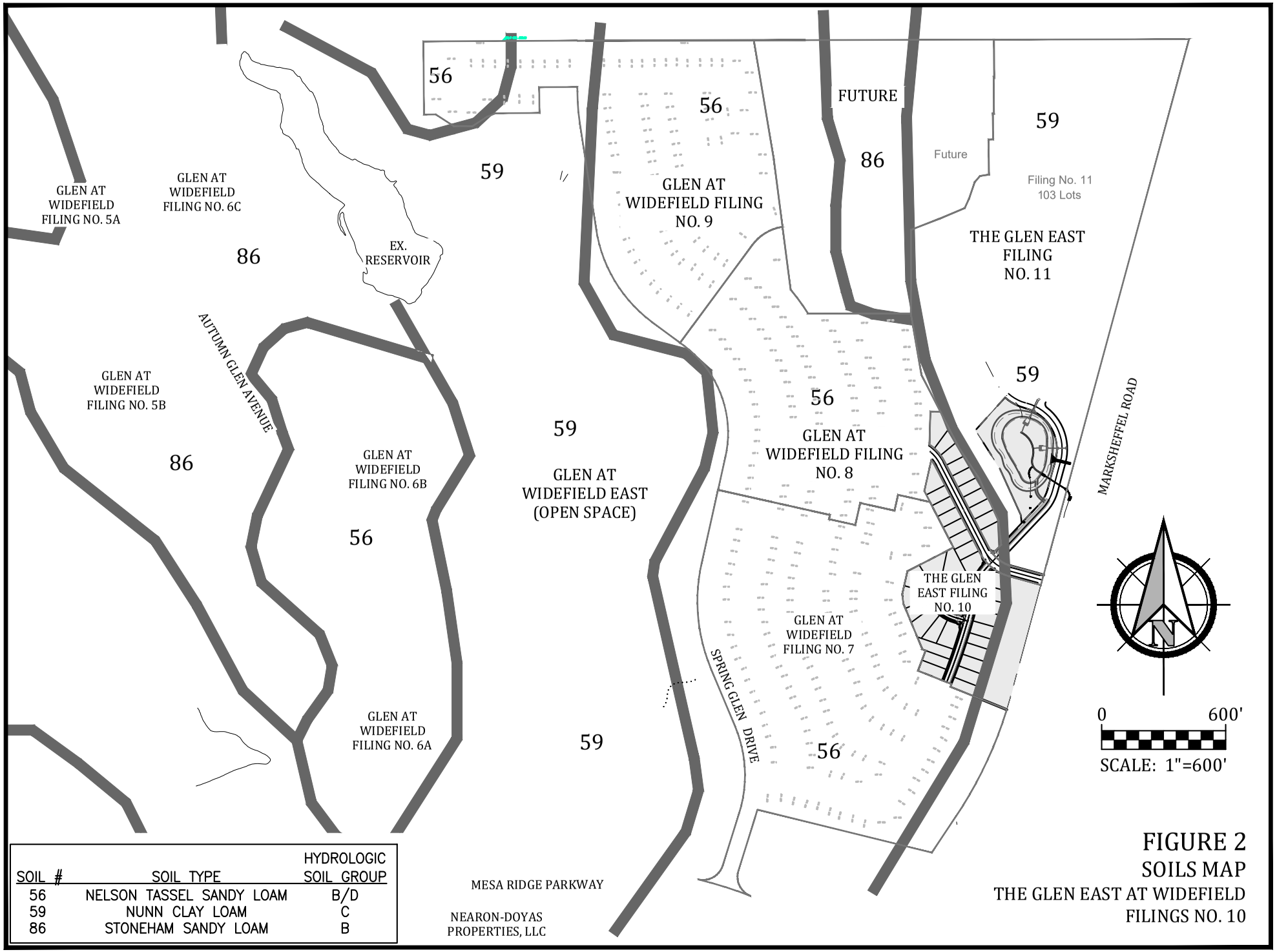
Table 2: Opinion of Cost – Drainage Facilities

SCALE: NTS



VICINITY MAP
SCALE: N.T.S.

FIGURE 1
VICINITY MAP
THE GLEN AT WIDEFIELD FILING NO. 10



SOIL #	SOIL TYPE	HYDROLOGIC SOIL GROUP
56	NELSON TASSEL SANDY LOAM	B/D
59	NUNN CLAY LOAM	C
86	STONEHAM SANDY LOAM	B

FIGURE 2
SOILS MAP
THE GLEN EAST AT WIDEFIELD FILINGS NO. 10

National Flood Hazard Layer FIRMette

FEMA

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN — Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 / 17.5 — Cross Sections with 1% Annual Chance Water Surface Elevation
- Coastal Transect
- 513 — Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 9/26/2019 at 12:16:52 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

Glen at Widefield Filing No. 11
Drainage Basin and Bridge Fees

Table 1: Impervious Area and Drainage Basin & Bridge Fee Calculation

Total Lots =	103 lots
Total Development Area =	44.996 ac
Total Undeveloped Acres =	11.800 ac
Total Developed Area =	**33.2 ac**
Building/Patio/Drive Per Lot =	2,500 sf
Total Building/Patio/Drive Area =	5.911 ac
Total Street/Sidewalk Area =	6.700 ac
Total Impervious Area =	12.611 ac
% Impervious Area =	**37.99 %**

West Fork Jimmy Camp Creek Drainage Basin

Drainage Basin Fee and Bridge Fee Calculations			
Drainage Basin Fee =	$12,564 / ac	**Drainage Basin Fee =**	**$ 158,449.46**
Bridge Fee =	$3,717 / ac	**Bridge Fee =**	**$ 46,876.52**

Less Previous Drainage Fee Credit (Carry Over from Glen at Widefield Filing No. 7)	**$0.00**	$ 0.00
Drainage Basin Fee Reimbursement	**$0.00**	
Total Drainage Basin Fee Credit Available	**$0.00**	

	Drainage Basin	Bridge
Total Fees Due for the Glen at Widefield Filing No. 10	**$158,449.46**	**$ 46,876.52**

Table 2: Opinion of Cost - Public Drainage Facilities

Item	Quantity	Unit	Unit Cost	**Item Total**
18" RCP Class III	74	LF	$ 72.00	$ 5,328.00
24" RCP Class III	1,025	LF	$ 96.00	$ 98,352.00
30" RCP Class III	1,111	LF	$ 101.00	$ 112,231.20
36" RCP Class III	1,401	LF	$ 136.00	$ 190,549.60
Curb Inlet 12' (D-10-R)	12	EA	$ 7,500.00	$ 90,000.00
Curb Inlet 16' (D-10-R)	2	EA	$ 8,000.00	$ 16,000.00
Storm Manhole 4ft Diameter	7	EA	$ 4,575.00	$ 32,025.00
Storm Manhole 5ft Diameter	19	EA	$ 4,925.00	$ 93,575.00
Trickle Channel 2'x6"	246	LF	$ 9.00	$ 2,214.00
Geotextile (Erosion Control)	2,416	SY	$ 6.00	$ 14,496.00
Rip Rap, d50 Size from 6" to 24"	6	CY	$ 95.00	$ 570.00
Channel Lining, Rip Rap	8	CY	$ 112.00	$ 896.00
Presedimentation Forebay	2	EA	$ 7,000.00	$ 14,000.00
Gravel Maintenance Access Trail	1,925	SY	$ 20.00	$ 38,500.00
Type II Bedding	112	CY	$ 35.00	$ 3,920.00
Detention Basin Seeding and Mulch	4	AC	$ 520.00	$ 1,955.20
			Estimated Storm Drainage Facilities Cost:	**$ 781,898.80**

APPENDIX A

Hydrologic Calculations

Existing Condition – Runoff Co-eff, Time of Concentration and Runoff Calcs
Excerpts from Markscheffel Road Improvements Project South - Link Road to US-24
Developed Condition – Runoff Co-eff, Time of Concentration and Runoff Calcs

KIOWA ENGINEERING CORPORATION

JOB 14044 - GLEN AT WIDEFIELD EAST

SHEET NO. 1 OF 2

CALCULATED BY CJC DATE 4/24/15

CHECKED BY _____ DATE _____

SCALE _____

RUNOFF COEFF. CALC'S. – EXISTING CONDITION

USE UNDEVELOPED - "PASTURE/MEADOW" LAND USE :

B SOILS -	$C_5 = 0.08$	$C_{100} = 0.35$	
B/D SOILS -	$C_5 = 0.15$	$C_{100} = 0.50$	(ASSUME C/D SOILS)
C SOILS -	$C_5 = 0.15$	$C_{100} = 0.50$	

BASIN EX-1 : TYPE C AND B/D SOILS

AREA = 48.60 Ac (AREAS FROM CAD, TYP.)

$C_5 = 0.15$

$C_{100} = 0.50$

BASIN EX-2 : TYPE C AND B/D SOILS

AREA = 33.12 Ac

$C_5 = 0.15$

$C_{100} = 0.50$

BASIN EX-3 : TYPE C AND B/D SOILS

AREA = 61.01 Ac

$C_5 = 0.15$

$C_{100} = 0.50$

BASIN EX-4 : TYPE C AND B/D SOILS

AREA = 10.51 Ac

$C_5 = 0.15$

$C_{100} = 0.50$

BASIN EX-5 : TYPE B SOIL – 12.2 Ac ± } FROM SOILS MAP
TYPE C SOIL – 39.3 Ac ± } FROM SOILS MAP
TYPE B/D SOIL – 23.2 Ac ± } FROM SOILS MAP

AREA = 74.74 Ac

$$C_{5,WTD} = \frac{0.08(12.2) + 0.15(39.3 + 23.2)}{74.74} = 0.14$$

$$C_{100,WTD} = \frac{0.35(12.2) + 0.50(39.3 + 23.2)}{74.74} = 0.48$$

KIOWA ENGINEERING CORPORATION

JOB 14044 - GLEN AT WIDEFIELD EAST

SHEET NO. 2 OF 2

CALCULATED BY CJC DATE 4/24/15

CHECKED BY _____ DATE _____

SCALE _____

BASIN EX-6 : TYPE C AND B/D SOILS

AREA = 8.83 AC

C_5 = 0.15

C_{100} = 0.50

TIME OF CONCENTRATION CALC'S. – EXISTING CONDITION

BASIN OS-1 : FROM MDDP, NEC-1 MODEL INPUT : BASIN 3060

BASIN AREA (BA) = 0.119 SQ.MI. × 640 = 76.2 AC

SCS CURVE NO. (LS) = 79

SCS LAG TIME (UD) = 0.257 HRS. = 0.6 t_c

t_c = 1.6 (0.257)(60 MIN/HR) = 24.7 MIN.

BASIN OS-2 : BA = 0.19 SQ.MI. × 640 = 121.6 AC (BASIN 4010)

LS = 86

UD = 0.497 HRS.

t_c = 1.6 (0.497)(60) = 47.7 MIN.

The Glen at Widefield
Existing Condition
Runoff Coefficient and Percent Impervious Calculation

Basin / DP	Basin or DP Area (DP contributing basins)		Soil Type	PV % Imperv	Area 1 Land Use: Land Use Area	Area 1 Land Use: % Area	Area 1 Land Use: Comp Land Use % Imp	HI % Imperv	Area 2 Land Use: Land Use Area	Area 2 Land Use: % Area	Area 2 Land Use: Comp Land Use % Imp	US1 % Imperv	Area 3 Land Use: Land Use Area	Area 3 Land Use: % Area	Area 3 Land Use: Comp Land Use % Imp	US2 % Imperv	Area 4 Land Use: Land Use Area	Area 4 Land Use: % Area	Area 4 Land Use: Comp Land Use % Imp	RO % Imperv	Area 5 Land Use: Land Use Area	Area 5 Land Use: % Area	Area 5 Land Use: Comp Land Use % Imp	Basin % Imperv	Basin Runoff C_5	Basin Runoff C_{100}
EX-1	2,117,068 sf	48.60ac	C	100%		0%	0%	0%	48.60ac	100%	0%	85%		0%	0%	78%		0%	0%	90%		0%	0%	**0.0%**	**0.15**	**0.50**
EX-2	1,442,826 sf	33.12ac	C	100%		0%	0%	0%	33.12ac	100%	0%	85%		0%	0%	78%		0%	0%	90%		0%	0%	**0.0%**	**0.15**	**0.50**
EX-3	2,657,513 sf	61.01ac	C	100%		0%	0%	0%	61.01ac	100%	0%	85%		0%	0%	78%		0%	0%	90%		0%	0%	**0.0%**	**0.15**	**0.50**
EX-4	457,877 sf	10.51ac	C	100%		0%	0%	0%	10.51ac	100%	0%	85%		0%	0%	78%		0%	0%	90%		0%	0%	**0.0%**	**0.15**	**0.50**
EX-5	3,255,509 sf	74.74ac	C	100%		0%	0%	0%	74.74ac	100%	0%	85%		0%	0%	78%		0%	0%	90%		0%	0%	**0.0%**	**0.14**	**0.48**
EX-6	384,815 sf	8.83ac	C	100%		0%	0%	0%	8.83ac	100%	0%	85%		0%	0%	78%		0%	0%	90%		0%	0%	**0.0%**	**0.15**	**0.50**

Basin Runoff Coefficient is based on UDFCD % Imperviousness Calculation

Runoff Coefficients and Percents Impervious

Hydrologic Soil Type:	**C**		**Runoff Coef Calc Method**					%Imp
Land Use	Abb	%	C_2	C_5	C_{10}	C_{25}	C_{50}	C_{100}
Commercial Area	CO	95%	0.80	0.82	0.84	0.87	0.89	0.89
Drives and Walks	DR	90%	0.73	0.75	0.77	0.80	0.83	0.83
Streets - Gravel (Packed)	GR	40%	0.28	0.35	0.42	0.50	0.55	0.58
Undevelop-Pasture/Meadow	HI	0%	0.04	0.15	0.25	0.37	0.44	0.50
Lawns	LA	0%	0.04	0.15	0.25	0.37	0.44	0.50
Off-site flow-Undeveloped	OF	45%	0.31	0.37	0.44	0.51	0.56	0.59
Park	PA	7%	0.09	0.19	0.29	0.40	0.47	0.52
Playground	PL	13%	0.13	0.23	0.32	0.42	0.49	0.54
Streets - Paved	PV	100%	0.89	0.90	0.92	0.94	0.96	0.96
Roofs	RO	90%	0.73	0.75	0.77	0.80	0.83	0.83
User Input 1	US1	85%	0.66	0.68	0.71	0.75	0.78	0.79
User Input 2	US2	78%	0.57	0.60	0.64	0.68	0.72	0.73

Weighted %Imp
A
B
C
D

Equations (% Impervious Calculation):

$C_A = K_A + (1.31\,i^3 - 1.44\,i^2 + 1.135\,i - 0.12)$ [Eqn RO-6]

$C_{CD} = K_{CD} + (0.858\,i^3 - 0.786\,i^2 + 0.774\,i + 0.04)$ [Eqn RO-7]

$C_B = (C_A + C_{CD}) / 2$

I = % imperviousness/100 as a decimal (See Table RO-3)

C_A = Runoff coefficient for NRCS Type A Soils

C_B = Runoff coefficient for NRCS Type B Soils

C_{CD} = Runoff coefficient for NRCS Type C and D Soils

Correction Factors - Table RO-4

K_A = For Type A Soils

- K_A (2-yr)= 0
- K_A (5-yr)= -0.08i + 0.09
- K_A (10-yr)= -0.14i + 0.17
- K_A (25-yr)= -0.19i + 0.24
- K_A (50-yr)= -0.22i + 0.28
- K_A (100-yr)= -0.25i + 0.32

K_{CD}=For Type C & D Soils

- K_{CD} (2-yr)= 0
- K_{CD} (5-yr)= -0.10i + 0.11
- K_{CD} (10-yr)= -0.18i + 0.21
- K_{CD} (25-yr)= -0.28i + 0.33
- K_{CD} (50-yr)= -0.33i + 0.40
- K_{CD} (100-yr)= -0.39i + 0.46

The Glen at Widefield
Existing Condition
Time of Concentration Calculation

Sub-Basin Data				Time of Concentration Estimate										Final t_c	Notes
Basin / Design Point	Contributing Basins	Area	C_5	Initial/Overland Time (t_i)			Travel Time (t_t)						Comp.		
				Length	Slope	t_i	Length	Slope	Land Type	Cv	Velocity	t_t	t_c		
EX-1		48.60ac	0.15	300lf	5.3%	17.3 min.	2200lf	1.9%	GW	15	2.1 ft/sec	17.7 min.	35.0 min.	**35.0 min.**	
EX-2		33.12ac	0.15	300lf	4.8%	17.9 min.	1370lf	3.2%	GW	15	2.7 ft/sec	8.5 min.	26.4 min.	**26.4 min.**	
EX-3		61.01ac	0.15			0.0 min.	2500lf	0.9%	GW	15	1.4 ft/sec	29.3 min.	29.3 min.	**29.3 min.**	
EX-4		10.51ac	0.15	300lf	4.0%	19.0 min.	900lf	4.9%	GW	15	3.3 ft/sec	4.5 min.	23.5 min.	**23.5 min.**	
EX-5		74.74ac	0.14	300lf	5.7%	17.0 min.	3250lf	1.0%	GW	15	1.5 ft/sec	36.1 min.	53.2 min.	**53.2 min.**	
EX-6		8.83ac	0.15	150lf	0.5%	26.8 min.	630lf	5.5%	GW	15	3.5 ft/sec	3.0 min.	29.8 min.	**29.8 min.**	
DP 1	OS-1	76.20ac	--	--	--	--	--	--		--	--	--	24.7 min.	**24.7 min.**	DP 3060 from MDDP
DP 2	OS-1, EX-1	124.80ac	0.15			0.0 min.	1000lf	1.0%	GW	15	1.5 ft/sec	11.1 min.	11.1 min.	**35.8 min.**	DP 1 routed to DP 2
DP 3	EX-2	33.12ac	0.15	300lf	4.8%	17.9 min.	1370lf	3.2%	GW	15	2.7 ft/sec	8.5 min.	26.4 min.	**26.4 min.**	
DP 4	OS-1, EX-1, EX-2	157.92ac	0.15			0.0 min.	300lf	0.5%	GW	15	1.1 ft/sec	4.7 min.	5.0 min.	**40.8 min.**	DP 2 and DP 3 routed to DP 4
DP 5	OS-1, EX-1, EX-2, EX-3	218.93ac	0.15			0.0 min.	800lf	1.3%	GW	15	1.7 ft/sec	7.8 min.	7.8 min.	**48.6 min.**	DP 4 routed to DP 5
DP 6	EX-4	10.51ac	0.15	300lf	4.0%	19.0 min.	900lf	4.9%	GW	15	3.3 ft/sec	4.5 min.	23.5 min.	**23.5 min.**	
DP 7	OS-1, EX-1, EX-2, EX-3, EX-4	229.44ac	0.15			0.0 min.	200lf	0.3%	GW	15	0.8 ft/sec	4.1 min.	5.0 min.	**53.6 min.**	DP 5 and DP 6 routed to DP 7
DP 8	OS-2	121.60ac	--	--	--	--	--	--		--	--	--	47.7 min.	**47.7 min.**	DP 4011 from MDDP
DP 9	OS-2, EX-5	196.34ac	0.15			0.0 min.	1550lf	0.6%	GW	15	1.1 ft/sec	23.2 min.	23.2 min.	**70.9 min.**	DP 8 routed to DP 9
DP 10	EX-6	8.83ac	0.15	150lf	0.5%	26.8 min.	630lf	5.5%	GW	15	3.5 ft/sec	3.0 min.	29.8 min.	**29.8 min.**	

Equations:

t_i (Overland) = $0.395(1.1-C_5)L^{0.5} S^{-0.333}$

C_5 = Runoff coefficient for 5-year

L = Length of overland flow (ft)

S = Slope of flow path (ft/ft)

tc Check = (L/180)+10 (Developed Cond. Only)

L = Overall Length

Velocity (Travel Time) = $CvS^{0.5}$

Cv = Conveyance Coef (see Table)

S = Watercourse slope (ft/ft)

Land Surface Type	Land Type
Grassed Waterway	GW
Heavy Meadow	HM
Nearly Bare Ground	NBG
Paved Area	PV
Riprap (Not Buried)	RR
Short Pasture/Lawns	SP
Tillage/Fields	TF

The Glen at Widefield
Existing Condition
Runoff Calculation

Basin / Design Point	Contributing Basins	Drainage Area	C_5	C_{100}	Time of Concentration	Rainfall Intensity i_5	Rainfall Intensity i_{100}	**Runoff Q_5**	**Runoff Q_{100}**	**Basin / DP**	Notes
EX-1		48.60 ac	0.15	0.50	35.0 min.	2.2 in/hr	3.8 in/hr	**16.4 cfs**	**91.7 cfs**	EX-1	
EX-2		33.12 ac	0.15	0.50	26.4 min.	2.7 in/hr	4.5 in/hr	**13.3 cfs**	**74.3 cfs**	EX-2	
EX-3		61.01 ac	0.15	0.50	29.3 min.	2.5 in/hr	4.2 in/hr	**23.0 cfs**	**128.9 cfs**	EX-3	
EX-4		10.51 ac	0.15	0.50	23.5 min.	2.8 in/hr	4.8 in/hr	**4.5 cfs**	**25.1 cfs**	EX-4	
EX-5		74.74 ac	0.14	0.48	53.2 min.	1.6 in/hr	2.7 in/hr	**17.0 cfs**	**97.7 cfs**	EX-5	
EX-6		8.83 ac	0.15	0.50	29.8 min.	2.5 in/hr	4.2 in/hr	**3.3 cfs**	**18.5 cfs**	EX-6	
DP 1	OS-1	76.20 ac	--	--	24.7 min.	2.8 in/hr	4.7 in/hr	**48 cfs**	**163 cfs**	DP 1	DP 3060 from MDDP
DP 2	OS-1, EX-1	124.80 ac	0.15	0.50	35.8 min.	2.2 in/hr	3.7 in/hr	**41 cfs**	**232 cfs**	DP 2	
DP 3	EX-2	33.12 ac	0.15	0.50	26.4 min.	2.7 in/hr	4.5 in/hr	**13 cfs**	**74 cfs**	DP 3	
DP 4	OS-1, EX-1, EX-2	157.92 ac	0.15	0.50	40.8 min.	2.0 in/hr	3.4 in/hr	**48 cfs**	**268 cfs**	DP 4	
DP 5	OS-1, EX-1, EX-2, EX-3	218.93 ac	0.15	0.50	48.6 min.	1.8 in/hr	2.9 in/hr	**58 cfs**	**323 cfs**	DP 5	
DP 6	EX-4	10.51 ac	0.15	0.50	23.5 min.	2.8 in/hr	4.8 in/hr	**4 cfs**	**25 cfs**	DP 6	
DP 7	OS-1, EX-1, EX-2, EX-3, EX-4	229.44 ac	0.15	0.50	53.6 min.	1.6 in/hr	2.7 in/hr	**55 cfs**	**310 cfs**	DP 7	
DP 8	OS-2	121.60 ac	--	--	47.7 min.	1.8 in/hr	3.0 in/hr	**38 cfs**	**153 cfs**	DP 8	DP 4011 from MDDP
DP 9	OS-2, EX-5	196.34 ac	0.15	0.50	70.9 min.	1.2 in/hr	2.0 in/hr	**35 cfs**	**196 cfs**	DP 9	
DP 10	EX-6	8.83 ac	0.15	0.50	29.8 min.	2.5 in/hr	4.2 in/hr	**3 cfs**	**18 cfs**	DP 10	

Equations (taken from Fig 6-5, City of Colorado Springs DCM):

i_2=-1.19 ln(T_c) + 6.035

i_5=-1.50 ln(T_c) + 7.583

i_{10}=-1.75 ln(T_c) + 8.847

i_{25}=-2.00 ln(T_c) + 10.111

i_{50}=-2.25 ln(T_c) + 11.375

i_{100}=-2.52 ln(T_c) + 12.735

Q = CiA

Q = Peak Runoff Rate (cubic feet/second)

C = Runoff coef representing a ration of peak runoff rate to ave rainfall intensity for a duration equal to the runoff time of concentration.

i = average rainfall intensity in inches per hour

A = Drainage area in acres

P1	Inches
WQCV	0.60 in
2 yr	1.19 in
5 yr	1.50 in
10 yr	1.75 in
25 yr	2.00 in
50 yr	2.25 in
100 yr	2.52 in

KIOWA ENGINEERING CORPORATION

JOB 14044 - GLEN AT WIDEFIELD EAST

SHEET NO. 1 OF 2

CALCULATED BY CJC DATE 5/19/15

CHECKED BY _____ DATE _____

SCALE _____

RUNOFF COEFFICIENT CALC'S. - DEVELOPED CONDITION (RESIDENTIAL AREAS)

A-BASINS: A = 10.17 AC. / 33 LOTS > 3.24 LOTS/AC.

A = 7.98 AC. / 30 LOTS > 3.76 LOTS/AC.

> 3.5 LOTS/AC.

BY INTERPOLATING FROM TABLE 6-6, I = 35%

⇨ C_5 = 0.33

C_{100} = 0.57

> SOIL GROUP C

B-BASINS: A = 20.05 AC. / 81 LOTS > 4.04 LOTS/AC.

A = 6.86 AC. / 30 LOTS > 4.37 LOTS/AC.

> 4.2 LOTS/AC.

FROM TABLE 6-6, I = 41%

⇨ C_5 = 0.35

C_{100} = 0.58

> SOIL GROUP C

C-BASINS: A = 46.12 AC. / 200 LOTS > 4.34 LOTS/AC.

A = 35.29 AC. / 148 LOTS > 4.19 LOTS/AC.

> 4.3 LOTS/AC.

FROM TABLE 6-6, I = 42%

⇨ C_5 = 0.31

C_{100} = 0.50

> SOIL GROUP B

KIOWA ENGINEERING CORPORATION

JOB 14044 - GLEN AT WIDEFIELD EAST

SHEET NO. 2 OF 2

CALCULATED BY CJC DATE 5/19/15

CHECKED BY _____ DATE _____

SCALE _____

RUNOFF COEFFICIENT CALC'S. - DEVELOPED CONDITION (CONT'D.):

(RESIDENTIAL AREAS)

D- BASINS: A = 38.97 AC. / 147 LOTS > 3.77 LOTS/AC.

A = 3.52 AC. / 13 LOTS > 3.69 LOTS/AC.

> 3.7 LOTS/AC.

FROM TABLE 6-6, I = 37%

⇒ C_5 = 0.34

C_{100} = 0.58

> SOIL GROUP C

E- BASINS: A = 2.81 AC. / 7 LOTS > 2.49 LOTS/AC.

A = 1.6 AC. / 4 LOTS > 2.5 LOTS/AC.

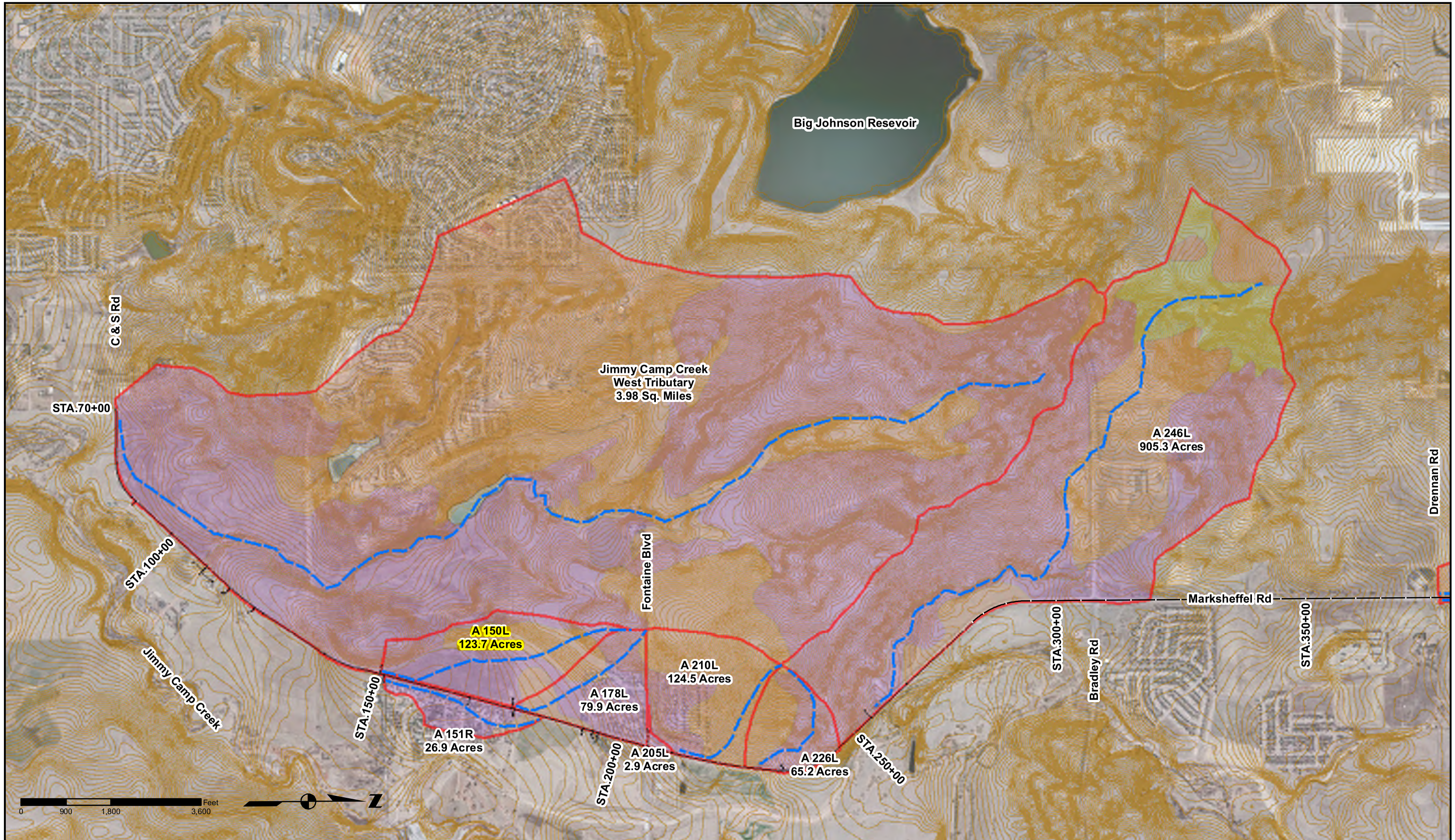
> 2.5 LOTS/AC.

FROM TABLE 6-6, I = 28%

⇒ C_5 = 0.30

C_{100} = 0.56

> SOIL GROUP C



Print Date:	10/14/2014
File Name:	Basins_BL_20141009.mxd
Horiz. Scale:	Vert. Scale: None
Unit Information	Unit Leader Initials

HDR Engineering, Inc. PARSONS BRINCKERHOFF

Basin Boundary
Flowpath
Water
Hydrologic Soils Group A
Hydrologic Soils Group B
Hydrologic Soils Group C
Hydrologic Soils Group D

EL PASO COUNTY COLORADO

PPRTA

As Constructed	
No Revisions:	
Revised:	
Void:	

MARKSHEFFEL ROAD DRAINAGE BASIN

Designer:	E. Staten	Structure Numbers	
Detailer:	M.Johnson		
Sheet Subset:	BASIN	Subset Sheets:	1 of 3

Project No./Code	
Sheet Number	1

LEGEND

A# / Area / C5 / C100 — BASIN LABEL

OFFSITE BASIN BOUNDARY

PAVEMENT BASIN BOUNDARY

FLOW DIRECTION

BASIN 'A 150 L'

OFFSITE BASIN
150L
A=123.50 AC

PERMANENT EASEMENT

TRAPEZOIDAL CHANNEL

155+00

160+00

165+00

PROPOSED ROW

152L
2.49 | 0.90 | 0.95

MATCH LINE STA. 154+00.00

MATCH LINE STA. 168+00.00

5675

5680

EXISTING ROW

HCL MARKSHEFFEL ROAD

MARKSHEFFEL ROAD

EXISTING ROW

152R
2.53 | 0.90 | 0.95

BLUE GRASS PL

OFFSITE BASIN
151R
A=23.88 AC

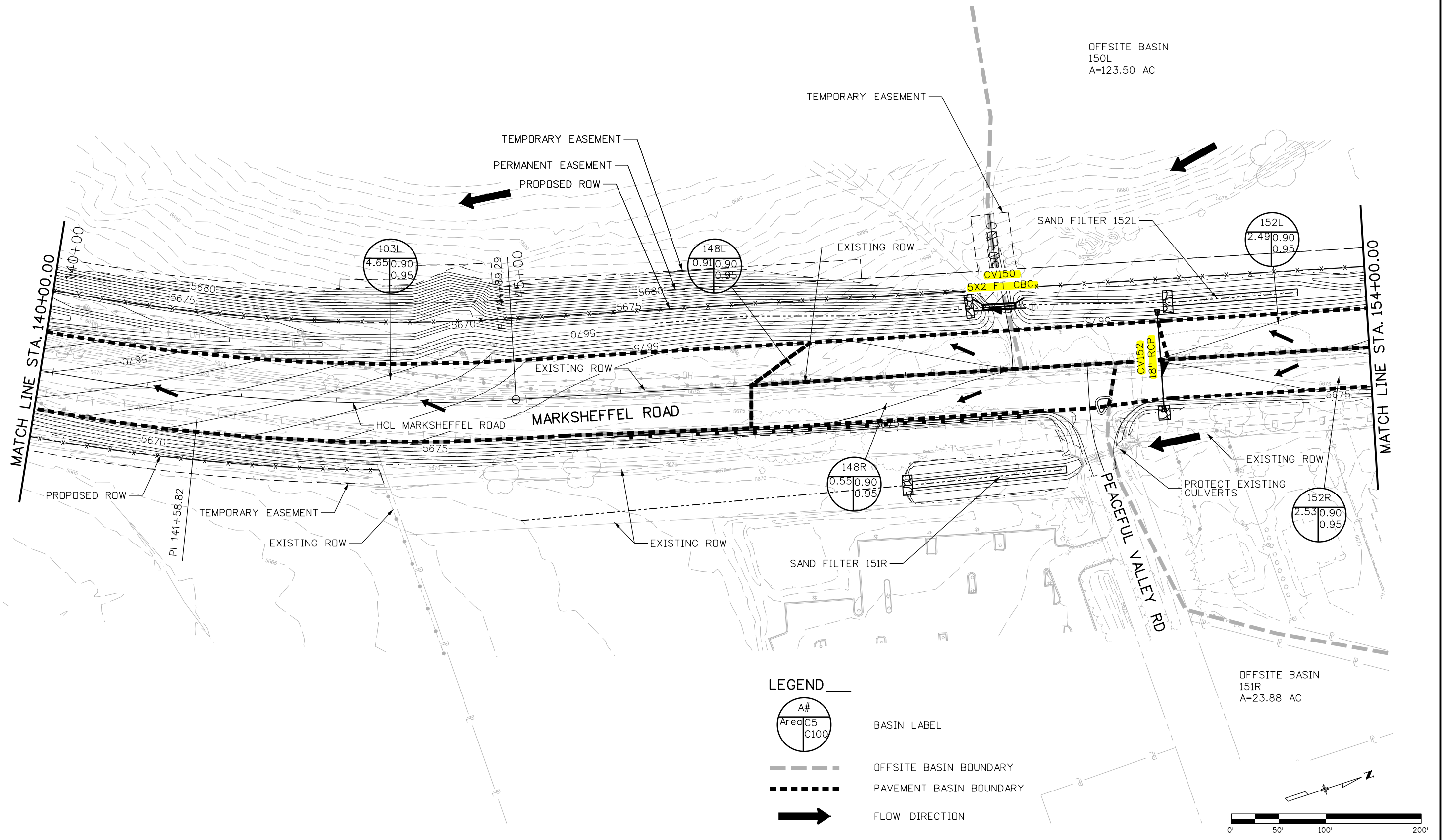
SAND TRAP DR

BENT GRASS PL

0' 50' 100' 200'

saacosta 9:13:55 AM c:\pwworking\oma\d1266573\North-Marksheffel_BASINS_Plan007.dgn

Print Date: 4/2/2015	Sheet Revisions	As Constructed	MARKSHEFFEL ROAD DRAINAGE BASINS PLAN 154+00.00 TO 168+00.00
File Name: North-Marksheffel_BASINS_Plan007.dgn	Date: / Comments / Init.	No Revisions:	Project No./Code ....
Horiz. Scale: 1:100 Vert. Scale: As Noted		Revised:	....
Unit Information Unit Leader Initials		Void:	Designer: E. STATEN; Detailer: D. MADDOCK; Sheet Subset: BASINS; Structure Numbers; Subset Sheets: 7 of 36
HDR PARSONS BRINCKERHOFF		EL PASO COUNTY COLORADO	7



Print Date: 4/2/2015	Sheet Revisions		
File Name: North-Marksheffel_BASINS_Plan006.dgn	Date:	Comments	Init.
Horiz. Scale: 1:100 Vert. Scale: As Noted			
Unit Information Unit Leader Initials			
PARSONS BRINCKERHOFF			

EL PASO COUNTY COLORADO

PPRTA

As Constructed	MARKSHEFFEL ROAD DRAINAGE BASINS PLAN 140+00.00 TO 154+00.00		Project No./Code
No Revisions:			....
Revised:	Designer: E. STATEN	Structure Numbers	....
Void:	Detailer: D. MADDOCK		6
	Sheet Subset: BASINS	Subset Sheets: 6 of 36	

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Culvert Calculator Report
CV150

Solve For: Headwater Elevation

Culvert Summary					
Allowable HW Elevation	5,676.34	ft	Headwater Depth/Height	2.36	
Computed Headwater Elevation	5,676.32	ft	Discharge	118.82	cfs
Inlet Control HW Elev.	5,676.32	ft	Tailwater Elevation	5,671.50	ft
Outlet Control HW Elev.	5,675.71	ft	Control Type	Inlet Control	

Grades					
Upstream Invert	5,671.60	ft	Downstream Invert	5,671.50	ft
Length	35.00	ft	Constructed Slope	0.002857	ft/ft

Hydraulic Profile					
Profile	PressureProfile		Depth, Downstream	2.00	ft
Slope Type	N/A		Normal Depth	N/A	ft
Flow Regime	N/A		Critical Depth	2.00	ft
Velocity Downstream	9.90	ft/s	Critical Slope	0.011013	ft/ft

Section					
Section Shape	Box		Mannings Coefficient	0.013	
Section Material	Concrete		Span	6.00	ft
Section Size	6 x 2 ft		Rise	2.00	ft
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev.	5,675.71	ft	Upstream Velocity Head	1.52	ft
Ke	0.20		Entrance Loss	0.30	ft

Inlet Control Properties					
Inlet Control HW Elev.	5,676.32	ft	Flow Control	Submerged	
Inlet Type	90° headwall w 45° bevels		Area Full	12.0	ft²
K	0.49500		HDS 5 Chart	10	
M	0.66700		HDS 5 Scale	2	
C	0.03140		Equation Form	2	
Y	0.82000				

Culvert Calculator Report
CV152

Solve For: Headwater Elevation

Culvert Summary					
Allowable HW Elevation	5,675.19	ft	Headwater Depth/Height	1.27	
Computed Headwater Elevation	5,673.97	ft	Discharge	8.68	cfs
Inlet Control HW Elev.	5,673.89	ft	Tailwater Elevation	5,671.52	ft
Outlet Control HW Elev.	5,673.97	ft	Control Type	Outlet Control	

Grades					
Upstream Invert	5,672.06	ft	Downstream Invert	5,671.52	ft
Length	108.00	ft	Constructed Slope	0.005000	ft/ft

Hydraulic Profile					
Profile	M2		Depth, Downstream	1.14	ft
Slope Type	Mild		Normal Depth	N/A	ft
Flow Regime	Subcritical		Critical Depth	1.14	ft
Velocity Downstream	6.02	ft/s	Critical Slope	0.007955	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.013	
Section Material	Concrete		Span	1.50	ft
Section Size	18 inch		Rise	1.50	ft
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev.	5,673.97	ft	Upstream Velocity Head	0.38	ft
Ke	0.20		Entrance Loss	0.08	ft

Inlet Control Properties					
Inlet Control HW Elev.	5,673.89	ft	Flow Control	N/A	
Inlet Type	Beveled ring, 33.7° bevels		Area Full	1.8	ft²
K	0.00180		HDS 5 Chart	3	
M	2.50000		HDS 5 Scale	B	
C	0.02430		Equation Form	1	
Y	0.83000				

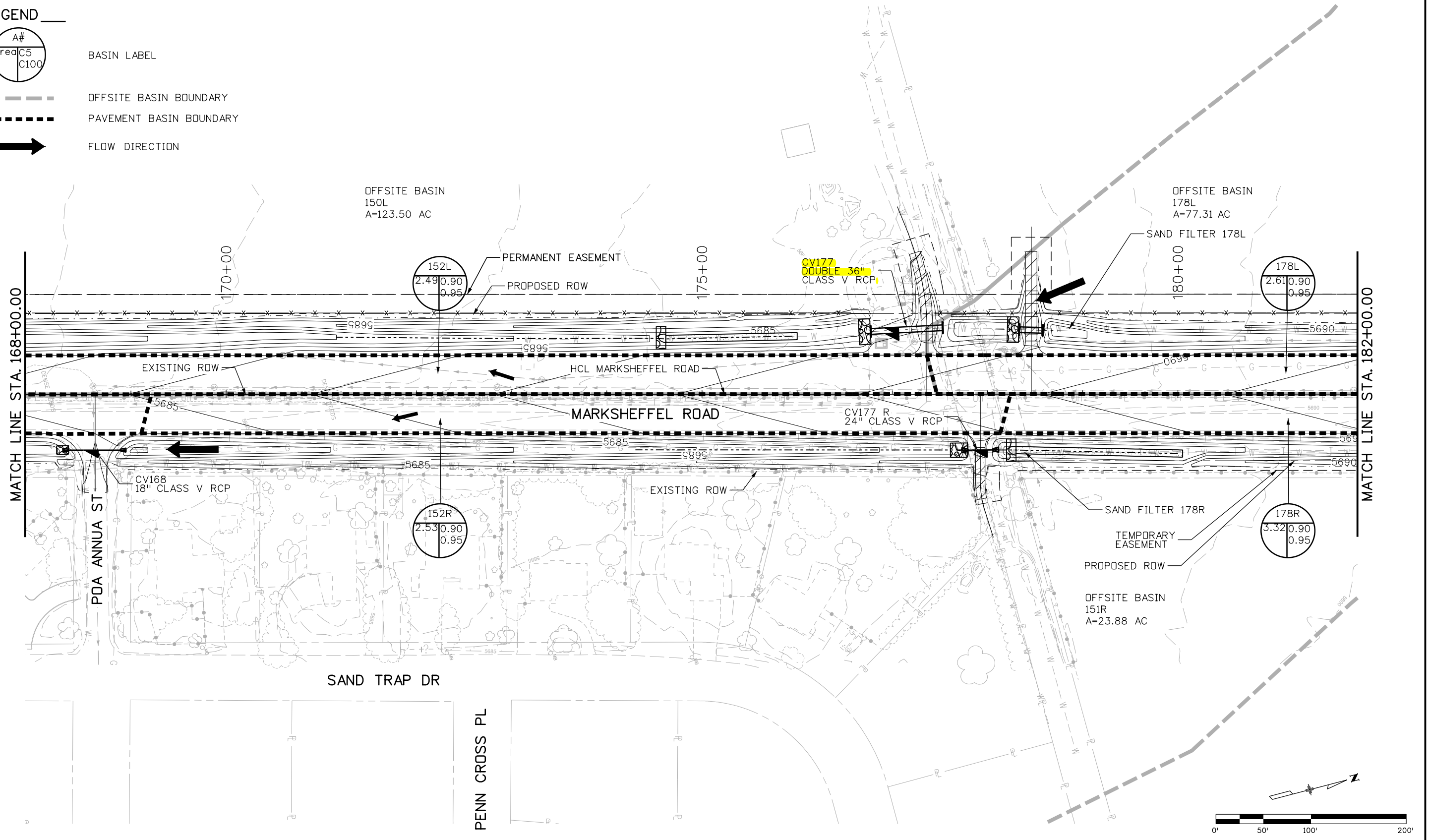
LEGEND

A# / Area | C5 / C100 — BASIN LABEL

OFFSITE BASIN BOUNDARY

PAVEMENT BASIN BOUNDARY

FLOW DIRECTION



Print Date: 4/2/2015		Sheet Revisions		
File Name: North-Marksheffel_BASINS_Plan008.dgn		Date:	Comments	Init.
Horiz. Scale: 1:100 Vert. Scale: As Noted				
Unit Information Unit Leader Initials				
HDR PARSONS BRINCKERHOFF	0000			

EL PASO COUNTY COLORADO

PPRTA

As Constructed

No Revisions:

Revised:

Void:

MARKSHEFFEL ROAD
DRAINAGE BASINS PLAN
168+00.00 TO 182+00.00

Designer: E. STATEN	Structure Numbers		Project No./Code ....
Detailer: D. MADDOCK			....
Sheet Subset: BASINS	Subset Sheets: 8 of 36		8

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Culvert Calculator Report
CV177

Solve For: Headwater Elevation

Culvert Summary					
Allowable HW Elevation	5,688.70	ft	Headwater Depth/Height	1.13	
Computed Headwater Elevation	5,688.17	ft	Discharge	87.06	cfs
Inlet Control HW Elev.	5,688.06	ft	Tailwater Elevation	5,684.52	ft
Outlet Control HW Elev.	5,688.17	ft	Control Type	Outlet Control	

Grades					
Upstream Invert	5,684.78	ft	Downstream Invert	5,684.52	ft
Length	77.00	ft	Constructed Slope	0.003377	ft/ft

Hydraulic Profile					
Profile	M2		Depth, Downstream	2.15	ft
Slope Type	Mild		Normal Depth	N/A	ft
Flow Regime	Subcritical		Critical Depth	2.15	ft
Velocity Downstream	8.03	ft/s	Critical Slope	0.005723	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.013	
Section Material	Concrete		Span	3.00	ft
Section Size	36 inch		Rise	3.00	ft
Number Sections	2				

Outlet Control Properties					
Outlet Control HW Elev.	5,688.17	ft	Upstream Velocity Head	0.74	ft
Ke	0.20		Entrance Loss	0.15	ft

Inlet Control Properties					
Inlet Control HW Elev.	5,688.06	ft	Flow Control	Transition	
Inlet Type	Beveled ring, 33.7° bevels		Area Full	14.1	ft²
K	0.00180		HDS 5 Chart	3	
M	2.50000		HDS 5 Scale	B	
C	0.02430		Equation Form	1	
Y	0.83000				

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

Corridor / Design Package: Marksheffel

System Name: South Approach Pipes

Computed: MAJ Date: 6/28/2014

Checked: EVS Date: 6/30/2014

5-YR PIPE CALCULATIONS

Design Storm: 5-yr

	LOCATION	DESIGN POINT	DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			REMARKS
			AREA DESIGN (name)	AREA (AC)	RUNOFF COEFF	t_c (MIN)	C.A. (AC)	I IN / HR	Q (CFS)	t_c (MIN)	SUM (C*A) (AC)	I (IN / HR)	Q (CFS)	SLOPE (%)	STREET FLOW (CFS)	DESIGN FLOW (CFS)	SLOPE (%)	PIPE SIZE	LENGTH (FT)	VELOCITY (FPS)	t_t (MIN)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
	ZONE 3																					
1	Onsite flow from 233+00 to 246+00		CV233	2.37	0.90	9.85	2.13	2.79	5.95													
2	Onsite flow from 207+60 to 212+00		P205	0.44	0.90	6.41	0.40	3.36	1.33													
3	Onsite flow from 205+00 to 212+00		CV205	0.84	0.90	8.74	0.76	2.98	2.25													
4	Onsite flow from 195+00 to 205+00		CV195	1.68	0.90	13.63	1.51	2.31	3.49													
5	Onsite flow from 194+00 to 205+00		CV194	1.79	0.90	14.90	1.61	2.22	3.58													
6	Onsite flow from 192+00 to 205+00		CV192	1.99	0.90	16.82	1.79	2.08	3.73													
7	Onsite & Offisite flow from 177+00 to 205+00		CV177R	5.51	0.64	35.11	3.54	1.48	5.23													
8	Onsite flow from 168+00 to 179+00		CV168	0.95	0.90	16.85	0.86	2.08	1.78													
9	Onsite flow from 152+00 to 177+00		CV152	2.49	0.90	41.33	2.24	1.36	3.05													
	ZONE 4																					
10	Onsite flow from 112+00 to 114+00		CV112	0.12	0.93	5.00	0.11	3.55	0.38													
11	Onsite flow from 109+00 to 114+00		CV109	0.27	0.90	6.61	0.24	3.36	0.82													
12	Onsite flow from 106+00 to 114+00		CV106	0.40	0.90	8.54	0.36	2.98	1.07													
13	Onsite flow from 99+00 to 103+00		CV99	0.20	0.90	5.00	0.18	3.55	0.62													

100-YR PIPE CALCULATIONS

Design Storm: 100-yr

	LOCATION	DESIGN POINT	DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			REMARKS
			AREA DESIGN	AREA (AC)	RUNOFF COEFF	t_c (MIN)	C.A. (AC)	I IN / HR	Q (CFS)	t_c (MIN)	SUM (C*A) (AC)	I (IN / HR)	Q (CFS)	SLOPE (%)	STREET FLOW (CFS)	DESIGN FLOW (CFS)	SLOPE (%)	PIPE SIZE	LENGTH (FT)	VELOCITY (FPS)	t_t (MIN)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
	ZONE 3																					
1	Onsite flow from 233+00 to 246+00		CV233	2.37	0.95	9.85	2.25	7.49	16.87													
2	Onsite flow from 207+60 to 212+00		P205	0.44	0.95	6.41	0.42	9.02	3.77													
3	Onsite flow from 205+00 to 212+00		CV205	0.84	0.95	8.74	0.80	8.00	6.38													
4	Onsite flow from 195+00 to 205+00		CV195	1.68	0.95	13.63	1.59	6.19	9.87													
5	Onsite flow from 194+00 to 205+00		CV194	1.79	0.95	14.90	1.70	5.93	10.08													See TR-55 Peak Flow
6	Onsite flow from 192+00 to 205+00		CV192	1.99	0.95	16.82	1.89	5.57	10.53													
7	Onsite & Offisite flow from 177+00 to 205+00		CV177R	5.51	0.71	35.11	3.92	3.96	15.53													
8	Onsite flow from 168+00 to 179+00		CV168	0.95	0.95	16.85	0.90	5.57	5.03													
9	Onsite flow from 152+00 to 177+00		CV152	2.49	0.95	41.33	2.37	3.67	8.68													
	ZONE 4																					
10	Onsite flow from 112+00 to 114+00		CV112	0.12	0.98	5.00	0.11	9.53	1.07													See TR-55 Peak Flow
11	Onsite flow from 109+00 to 114+00		CV109	0.27	0.95	6.61	0.26	9.02	2.31													
12	Onsite flow from 106+00 to 114+00		CV106	0.40	0.95	8.54	0.38	8.00	3.04													
13	Onsite flow from 99+00 to 103+00		CV99	0.20	0.95	5.00	0.19	9.53	1.77													

(1) Basin Description linked to C-Value Sheet
(2) Basin Design Point
(3) Enter the Basin Name from C Value Sheet
(4) Basin Area linked to C-Value Sheet
(5) Composite C linked to C-Value Sheet
(6) Time of Concentration linked to C-Value Sheet
(7) =Column 4 x Column 5
(8) =28.5*P/(10+Column 6)^0.786
(9) =Column 7 x Column 8
(10) =Column 6 + Column 21
(11) Add the Basin Areas (7) to get the combined basin AC
(12) =28.5*P/(10+Column 10)^0.786
(13) Sum of Qs
(14) Additonal Street Overland Flow
(15) Additonal Street Overland Flow
(16) Design Pipe Flow
(17) Pipe Slope
(18) Pipe Size
(19) Additional Flow Length
(20) Velocity
(21) =Column 19 / Column 20 / 60

Standard Form SF-1 . Time of Concentration

Corridor / Design Package: Marksheffel
System Name: South

Computed: MAJ Date: 6/28/2014
Checked: EVS Date: 6/30/2014

SUB-BASIN DATA				INITIAL/OVERLAND FLOW (t_i)			TRAVEL TIME (t_t)							Total
									Type of Land Surface					
Basin ID	Description	C_5	Area (ac)	Length (ft)	Slope (ft/ft)	t_i (min)	Length (ft)	S_w (ft/ft)	Code	Description	Convey Coef (C_v)	Velocity (ft/s)	Travel Time (min)	$t_c = t_i + t_t$ (min)
ZONE 3														
A 256L	Sta 256+30 to 264+29	0.90	0.77	57	0.05263	1.63	190	0.0090	5	Grassed waterway	15.00	1.42	2.23	5.00
A 256R	Sta 256+30 to 264+30	0.90	0.77	63	0.06349	1.61	190	0.0090	5	Grassed waterway	15.00	1.42	2.23	5.00
A 247L	Sta. 246+00 to 256+30	0.90	0.96	56	0.07143	1.46	1020	0.0199	5	Grassed waterway	15.00	2.11	8.04	9.50
A 246R	Sta. 246+00 to 256+30	0.90	1.01	56	0.07143	1.46	1020	0.0199	5	Grassed waterway	15.00	2.11	8.04	9.50
A 246L	Sta 246+00 to No Work Zone	0.25	905.26	300	0.01667	23.23	9985	0.00951	3	Short pasture and lawns	7.00	0.68	243.73	266.96
A 229R	Sta. 229+00 to 232+00	0.90	0.31	56	0.05357	1.61	300	0.00953	5	Grassed waterway	15.00	1.46	3.41	5.02
A 226L	Sta. 226+00 to 246+00	0.28	65.23	300	0.03667	17.31	2440	0.02254	3	Short pasture and lawns	7.00	1.05	38.69	56.00
A 212L	Sta. 212+00 to 229+00	0.90	1.55	61	0.06557	1.57	1640	0.0083	5	Grassed waterway	15.00	1.37	20.00	21.57
A 212R	Sta. 212+00 to 229+00	0.90	1.55	57	0.07018	1.48	1640	0.0083	5	Grassed waterway	15.00	1.37	20.00	21.49
A 210L	Sta. 210+60 to 226+00	0.31	124.50	300	0.02667	18.43	2868	0.0258	5	Grassed waterway	15.00	2.41	19.84	38.27
A 210L_S1	Sta. 212+00 to 229+00	0.31	56.88	300	0.02667	18.51	2868	0.0258	5	Grassed waterway	15.00	2.41	19.84	38.34
A 208R	Sta. 207+60 to 212+00	0.90	0.44	57	0.07018	1.48	453	0.01044	5	Grassed waterway	15.00	1.53	4.93	6.41
A 206L	Sta. 205+00 to 212+00	0.90	0.74	61	0.06557	1.57	660	0.01045	5	Grassed waterway	15.00	1.53	7.17	8.74
A 205L	Sta 205+00 to 210+60	0.25	2.87	100	0.01	15.90	550	0.00364	5	Grassed waterway	15.00	0.90	10.13	26.03
A 178L	Sta. 179+00 to 205+00	0.34	79.92	300	0.01667	20.79	2880	0.01181	3	Short pasture and lawns	7.00	0.76	63.11	83.90
A 178R	Sta. 178+00 to 207+00	0.90	3.32	54	0.07407	1.42	2865	0.00999	5	Grassed waterway	15.00	1.50	31.86	33.27
A 152L	Sta. 152+00 to 178+00	0.90	2.49	53	0.0566	1.54	2600	0.00527	5	Grassed waterway	15.00	1.09	39.80	41.33
A 152R	Sta. 152+00 to 178+00	0.90	2.53	54	0.05556	1.56	2610	0.00523	5	Grassed waterway	15.00	1.09	40.09	41.65
A 151R	Sta. 152+00 to 170+50	0.42	39.34	300	0.01	22.03	2978	0.00168	5	Grassed waterway	15.00	0.61	80.75	102.78
A 150L	Sta. 150+00 to 179+00	0.25	123.68	300	0.02	21.88	4718	0.00763	3	Short pasture and lawns	7.00	0.61	128.60	150.48
A 148L	Sta. 148+00 to 152+00	0.90	0.41	54	0.05556	1.56	400	0.00183	5	Grassed waterway	15.00	0.64	10.40	11.96
A 148R	Sta. 147+80 to 152+00	0.90	0.55	55	0.07273	1.44	470	0.00145	5	Grassed waterway	15.00	0.57	13.73	15.17
ZONE 4														
A 125R	Sta. 124+50 to 137+50	0.90	1.08	44	0.09091	1.20	1285	0.00987	5	Grassed waterway	15.00	1.49	14.37	15.57
A 103L	Sta. 103+00 to148+00	0.90	4.65	100	0.06	2.07	4386	0.00876	5	Grassed waterway	15.00	1.40	52.06	54.13
A 103R	Sta. 100+00 to 114+00	0.90	0.57	37	0.08108	1.14	1090	0.00758	5	Grassed waterway	15.00	1.31	13.91	15.05
A 92L	Sta. 92+00 to 103+00	0.90	0.53	36	0.11111	1.01	1143	0.00725	5	Grassed waterway	15.00	1.28	14.91	15.93
A 92R	Sta. 92+00 to 103+00	0.90	0.58	36	0.11111	1.01	1150	0.0071	5	Grassed waterway	15.00	1.26	15.16	16.17
A 70L	Sta. 70+38 to 92+00	0.90	1.72	55	0.07273	1.44	2087	0.00631	5	Grassed waterway	15.00	1.19	29.19	30.63
A 70R	Sta. 70+38 to 78+00	0.90	0.27	33	0.12121	0.94	717	0.00904	5	Grassed waterway	15.00	1.43	8.38	9.32

Notes:

$t_i = (1.87*(1.1-C_5)*(L^{0.5}))/(S^{0.33})$, from COS DCM page 5-11

Velocity from $V = C_v*S_w^{0.5}$, from UDFCD Eqn RO-4, C_v from Table R0-2 (See Sheet Design Info)

$t_t = L/60V$

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

Corridor / Design Package: Marksheffel
System Name: South

Computed: MAJ Date: 6/28/2014
Checked: EVS Date: 6/30/2014

Design Storm: 5-yr

	LOCATION	DESIGN POINT	DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			REMARKS
			AREA DESIGN (name)	AREA (AC)	RUNOFF COEFF	t_c (MIN)	C.A. (AC)	I IN / HR	Q (CFS)	t_c (MIN)	SUM (C*A) (AC)	I (IN / HR)	Q (CFS)	SLOPE (%)	STREET FLOW (CFS)	DESIGN FLOW (CFS)	SLOPE (%)	PIPE SIZE	LENGTH (FT)	VELOCITY (FPS)	t_t (MIN)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
ZONE 3																						
1	Sta 256+30 to 264+29		A 256L	0.77	0.90	5.00	0.69	3.55	2.46													
2	Sta 256+30 to 264+30		A 256R	0.77	0.90	5.00	0.69	3.55	2.46													
3	Sta. 246+00 to 256+30		A 247L	0.96	0.90	9.50	0.86	2.79	2.41													
4	Sta. 246+00 to 256+30		A 246R	1.01	0.90	9.50	0.91	2.79	2.54													
5	Sta 246+00 to No Work Zone		A 246L	905.26	0.25	266.96	227.44	0.45	101.89													
6	Sta. 229+00 to 232+00		A 229R	0.31	0.90	5.02	0.28	3.55	0.99													
7	Sta. 226+00 to 246+00		A 226L	65.23	0.28	56.00	18.23	1.08	19.69													
8	Sta. 212+00 to 229+00		A 212L	1.55	0.90	21.57	1.40	1.90	2.65													
9	Sta. 212+00 to 229+00		A 212R	1.55	0.90	21.49	1.40	1.90	2.65													
10	Sta. 210+60 to 226+00		A 210L	124.50	0.31	38.27	39.03	1.42	55.43													
	Sta. 212+00 to 229+00		A 210L_S1	56.88	0.31	38.34	17.65	1.42	25.06													
11	Sta. 207+60 to 212+00		A 208R	0.44	0.90	6.41	0.40	3.36	1.33													
12	Sta. 205+00 to 212+00		A 206L	0.74	0.90	8.74	0.67	2.98	1.99													
13	Sta 205+00 to 210+60		A 205L	2.87	0.25	26.03	0.72	1.72	1.23													
14	Sta. 179+00 to 205+00		A 178L	79.92	0.34	83.90	27.19	0.86	23.38													
15	Sta. 178+00 to 207+00		A 178R	3.32	0.90	33.27	2.99	1.51	4.51													
16	Sta. 152+00 to 178+00		A 152L	2.49	0.90	41.33	2.24	1.36	3.05													
17	Sta. 152+00 to 178+00		A 152R	2.53	0.90	41.65	2.28	1.36	3.10													
18	Sta. 152+00 to 170+50		A 151R	39.34	0.42	102.78	16.52	0.74	12.22													
19	Sta. 150+00 to 179+00		A 150L	123.68	0.25	150.48	31.04	0.53	16.45													
20	Sta. 148+00 to 152+00		A 148L	0.41	0.90	11.96	0.37	2.50	0.92													
21	Sta. 147+80 to 152+00		A 148R	0.55	0.90	15.17	0.50	2.12	1.05													
ZONE 4																						
22	Sta. 124+50 to 137+50		A 125R	1.08	0.90	15.57	0.97	2.12	2.06													
23	Sta. 103+00 to148+00		A 103L	4.65	0.90	54.13	4.19	1.12	4.69													
24	Sta. 100+00 to 114+00		A 103R	0.57	0.90	15.05	0.51	2.12	1.09													
25	Sta. 92+00 to 103+00		A 92L	0.53	0.90	15.93	0.48	2.12	1.01													
26	Sta. 92+00 to 103+00		A 92R	0.58	0.90	16.17	0.52	2.08	1.09													
27	Sta. 70+38 to 92+00		A 70L	1.72	0.90	30.63	1.55	1.57	2.43													
28	Sta. 70+38 to 78+00		A 70R	0.27	0.90	9.32	0.24	2.79	0.68													

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

Corridor / Design Package: Marksheffel
System Name: South

Computed: MAJ Date: 6/28/2014
Checked: EVS Date: 6/30/2014

Design Storm: 100-yr

	LOCATION	DESIGN POINT	DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			REMARKS
			AREA DESIGN	AREA (AC)	RUNOFF COEFF	t_c (MIN)	C.A. (AC)	I IN / HR	Q (CFS)	t_c (MIN)	SUM (C*A) (AC)	I (IN / HR)	Q (CFS)	SLOPE (%)	STREET FLOW (CFS)	DESIGN FLOW (CFS)	SLOPE (%)	PIPE SIZE	LENGTH (FT)	VELOCITY (FPS)	t_t (MIN)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
	ZONE 3																					
1	Sta 256+30 to 264+29		A 256L	0.77	0.95	5.00	0.73	9.53	6.97													
2	Sta 256+30 to 264+30		A 256R	0.77	0.95	5.00	0.73	9.53	6.97													
3	Sta. 246+00 to 256+30		A 247L	0.96	0.95	9.50	0.91	7.49	6.83													
4	Sta. 246+00 to 256+30		A 246R	1.01	0.95	9.50	0.96	7.49	7.19													
5	Sta 246+00 to No Work Zone		A 246L	905.26	0.35	266.96	317.88	1.25	397.35													
6	Sta. 229+00 to 232+00		A 229R	0.31	0.95	5.02	0.29	9.53	2.81													
7	Sta. 226+00 to 246+00		A 226L	65.23	0.38	56.00	24.61	2.95	72.59													
8	Sta. 212+00 to 229+00		A 212L	1.55	0.95	21.57	1.47	5.08	7.48													
9	Sta. 212+00 to 229+00		A 212R	1.55	0.95	21.49	1.47	5.08	7.48													
10	Sta. 210+60 to 226+00		A 210L	124.50	0.43	38.27	53.71	3.82	205.15													
	Sta. 212+00 to 229+00		A 210L_S1	56.88	0.42	38.34	24.11	3.82	92.09													
11	Sta. 207+60 to 212+00		A 208R	0.44	0.95	6.41	0.42	9.02	3.77													
12	Sta. 205+00 to 212+00		A 206L	0.74	0.95	8.74	0.70	8.00	5.63													
13	Sta 205+00 to 210+60		A 205L	2.87	0.35	26.03	1.00	4.59	4.61													
14	Sta. 179+00 to 205+00		A 178L	79.92	0.46	83.90	36.89	2.36	87.06													
										83.90	36.89	2.36	87.06						2753	4.14	11.08	
15	Sta. 178+00 to 207+00		A 178R	3.32	0.95	33.27	3.15	4.06	12.81													
16	Sta. 152+00 to 178+00		A 152L	2.49	0.95	41.33	2.37	3.67	8.68													
17	Sta. 152+00 to 178+00		A 152R	2.53	0.95	41.65	2.40	3.67	8.82													
18	Sta. 152+00 to 170+50		A 151R	39.34	0.56	102.78	21.87	2.03	44.39													
19	Sta. 150+00 to 179+00		A 150L	123.68	0.35	150.48	43.39	1.48	64.22													
		1	150L,178L							150.48	80.28	1.48	118.82									CV150
20	Sta. 148+00 to 152+00		A 148L	0.41	0.95	11.96	0.39	6.72	2.62													
21	Sta. 147+80 to 152+00		A 148R	0.55	0.95	15.17	0.52	5.67	2.96													
	ZONE 4																					
22	Sta. 124+50 to 137+50		A 125R	1.08	0.95	15.57	1.03	5.67	5.82													
23	Sta. 103+00 to148+00		A 103L	4.65	0.95	54.13	4.42	3.05	13.47													
24	Sta. 100+00 to 114+00		A 103R	0.57	0.95	15.05	0.54	5.67	3.07													
25	Sta. 92+00 to 103+00		A 92L	0.53	0.95	15.93	0.50	5.67	2.85													
26	Sta. 92+00 to 103+00		A 92R	0.58	0.95	16.17	0.55	5.57	3.07													
27	Sta. 70+38 to 92+00		A 70L	1.72	0.95	30.63	1.63	4.20	6.86													
28	Sta. 70+38 to 78+00		A 70R	0.27	0.95	9.32	0.26	7.49	1.92													

(1) Basin Description linked to C-Value Sheet
(2) Basin Design Point
(3) Enter the Basin Name from C Value Sheet
(4) Basin Area linked to C-Value Sheet
(5) Composite C linked to C-Value Sheet
(6) Time of Concentration linked to C-Value Sheet
(7) =Column 4 x Column 5
(8) =28.5*P/(10+Column 6)^0.786
(9) =Column 7 x Column 8
(10) =Column 6 + Column 21
(11) Add the Basin Areas (7) to get the combined basin AC
(12) =28.5*P/(10+Column 10)^0.786
(13) Sum of Qs
(14) Additonal Street Overland Flow
(15) Additonal Street Overland Flow
(16) Design Pipe Flow
(17) Pipe Slope
(18) Pipe Size
(19) Additional Flow Length
(20) Velocity
(21) =Column 19 / Column 20 / 60

The Glen at Widefield
Developed Condition
Runoff Coeficient and Percent Impervious Calculation

					PV	Area 1 Land Use			LA	Area 2 Land Use			RS2	Area 3 Land Use			RS1	Area 4 Land Use				Basin Runoff	
Basin	DP	Basin or DP Area (DP contributing basins)		Soil Type	% Imperv	Land Use Area	% Area	Comp Land Use % Imp	% Imperv	Land Use Area	% Area	Comp Land Use % Imp	% Imperv	Land Use Area	% Area	Comp Land Use % Imp	% Imperv	Land Use Area	% Area	Comp Land Use % Imp	Basin % Imperv	C_5	C_{100}
D-1	DP 68	110,205 sf	2.53ac	B	100%		0%	0%	0%		0%	0%	46%		0%	0%	37%	2.53ac	100%	37%	**37.0%**	**0.28**	**0.49**
D-2		63,500 sf	1.46ac	B	100%		0%	0%	0%		0%	0%	46%		0%	0%	37%	1.46ac	100%	37%	**37.0%**	**0.28**	**0.49**
D-3	DP 70	70,426 sf	1.62ac	B	100%		0%	0%	0%		0%	0%	46%		0%	0%	37%	1.62ac	100%	37%	**37.0%**	**0.28**	**0.49**
D-4		90,269 sf	2.07ac	C	100%		0%	0%	0%		0%	0%	46%		0%	0%	37%	2.07ac	100%	37%	**37.0%**	**0.34**	**0.58**
D-5	DP 72	105,072 sf	2.41ac	C	100%		0%	0%	0%		0%	0%	46%		0%	0%	37%	2.41ac	100%	37%	**37.0%**	**0.34**	**0.58**
D-6	DP 73	18,040 sf	0.41ac	C	100%		0%	0%	0%		0%	0%	46%		0%	0%	37%	0.41ac	100%	37%	**37.0%**	**0.34**	**0.58**
D-7		136,071 sf	3.12ac	C	100%		0%	0%	0%		0%	0%	46%		0%	0%	37%	3.12ac	100%	37%	**37.0%**	**0.34**	**0.58**
D-8		76,503 sf	1.76ac	C	100%		0%	0%	0%		0%	0%	46%		0%	0%	37%	1.76ac	100%	37%	**37.0%**	**0.34**	**0.58**
D-9	DP 77	94,027 sf	2.16ac	B	100%		0%	0%	0%		0%	0%	46%		0%	0%	37%	2.16ac	100%	37%	**37.0%**	**0.28**	**0.49**
D-10		87,103 sf	2.00ac	C	100%		0%	0%	0%		0%	0%	46%		0%	0%	37%	2.00ac	100%	37%	**37.0%**	**0.34**	**0.58**
D-11	DP 80	172,355 sf	3.96ac	C	100%		0%	0%	0%		0%	0%	46%		0%	0%	37%	3.96ac	100%	37%	**37.0%**	**0.34**	**0.58**
D-12		60,400 sf	1.39ac	C	100%		0%	0%	0%		0%	0%	46%		0%	0%	37%	1.39ac	100%	37%	**37.0%**	**0.34**	**0.58**
D-13		90,117 sf	2.07ac	C	100%		0%	0%	0%		0%	0%	46%		0%	0%	37%	2.07ac	100%	37%	**37.0%**	**0.34**	**0.58**
D-14		143,954 sf	3.30ac	C	100%		0%	0%	0%		0%	0%	46%		0%	0%	37%	3.30ac	100%	37%	**37.0%**	**0.34**	**0.58**
D-15	DP 84	122,094 sf	2.80ac	B	100%		0%	0%	0%		0%	0%	46%		0%	0%	37%	2.80ac	100%	37%	**37.0%**	**0.28**	**0.49**
D-16		93,201 sf	2.14ac	C	100%		0%	0%	0%		0%	0%	46%		0%	0%	37%	2.14ac	100%	37%	**37.0%**	**0.34**	**0.58**
D-16.1		73,500 sf	1.69ac	C	100%		0%	0%	0%		0%	0%	46%		0%	0%	37%	1.69ac	100%	37%	**37.0%**	**0.34**	**0.58**
D-17		99,898 sf	2.29ac	C	100%		0%	0%	0%		0%	0%	46%		0%	0%	37%	2.29ac	100%	37%	**37.0%**	**0.34**	**0.58**
D-18		76,796 sf	1.76ac	C	100%		0%	0%	0%		0%	0%	46%		0%	0%	37%	1.76ac	100%	37%	**37.0%**	**0.34**	**0.58**
D-19		97,124 sf	2.23ac	C	100%		0%	0%	0%		0%	0%	46%		0%	0%	37%	2.23ac	100%	37%	**37.0%**	**0.34**	**0.58**
D-19.1	DP 89	6,631 sf	0.15ac	C	100%		0%	0%	0%		0%	0%	46%		0%	0%	37%	0.15ac	100%	37%	**37.0%**	**0.34**	**0.58**
D-20	DP 92a	32,732 sf	0.75ac	C	100%	0.34ac	45%	45%	0%	0.37ac	49%	0%	46%		0%	0%	37%	0.04ac	6%	2%	**47.3%**	**0.38**	**0.60**
D-21	DP 90	175,102 sf	4.02ac	B	100%		0%	0%	0%		0%	0%	46%		0%	0%	37%	4.02ac	100%	37%	**37.0%**	**0.28**	**0.49**
D-22	DP 91	50,194 sf	1.15ac	B	100%		0%	0%	0%		0%	0%	46%		0%	0%	37%	1.15ac	100%	37%	**37.0%**	**0.28**	**0.49**
D-23		22,536 sf	0.52ac	C	100%	0.47ac	91%	91%	0%	0.05ac	9%	0%	46%		0%	0%	37%		0%	0%	**90.8%**	**0.76**	**0.84**
D-24		426,287 sf	9.79ac	C	100%		0%	0%	0%	7.39ac	75%	0%	46%		0%	0%	37%	2.40ac	25%	9%	**9.1%**	**0.21**	**0.53**
			57.48ac	C			0%								0%								
	DP 69	D1, D2	3.99ac	B	100%		0%	0%	0%		0%	0%	46%		0%	0%	37%	3.99ac	100%	37%	**37.0%**	**0.28**	**0.49**
	DP 71	D3, D4	3.69ac	B	100%		0%	0%	0%		0%	0%	46%		0%	0%	37%	3.69ac	100%	37%	**37.0%**	**0.28**	**0.49**
	DP 74	D3, D4, D6	4.10ac	C	100%		0%	0%	0%		0%	0%	46%		0%	0%	37%	4.10ac	100%	37%	**37.0%**	**0.34**	**0.58**
	DP 75	D1-D4, D6, D7	11.21ac	C	100%		0%	0%	0%		0%	0%	46%		0%	0%	37%	11.21ac	100%	37%	**37.0%**	**0.34**	**0.58**
	DP 76	D1-D4, D6-D8	12.97ac	C	100%		0%	0%	0%		0%	0%	46%		0%	0%	37%	12.97ac	100%	37%	**37.0%**	**0.34**	**0.58**
	DP 78	D1-D4, D6-D9	15.13ac	C	100%		0%	0%	0%		0%	0%	46%		0%	0%	37%	15.13ac	100%	37%	**37.0%**	**0.34**	**0.58**
	DP 79	D1-D4, D6-D10	17.13ac	C	100%		0%	0%	0%		0%	0%	46%		0%	0%	37%	17.13ac	100%	37%	**37.0%**	**0.34**	**0.58**
	DP 81	D11, D12	5.34ac	C	100%		0%	0%	0%		0%	0%	46%		0%	0%	37%	5.34ac	100%	37%	**37.0%**	**0.34**	**0.58**
	DP 82	D5, D13	4.48ac	C	100%		0%	0%	0%		0%	0%	46%		0%	0%	37%	4.48ac	100%	37%	**37.0%**	**0.34**	**0.58**
	DP 83	D5, D13, D14	7.79ac	C	100%		0%	0%	0%		0%	0%	46%		0%	0%	37%	7.79ac	100%	37%	**37.0%**	**0.34**	**0.58**
	DP 84.1	D15,D16	4.94ac	C	100%		0%	0%	0%		0%	0%	46%		0%	0%	37%	4.94ac	100%	37%	**37.0%**	**0.34**	**0.58**
	DP 85	D15,D16, D16.1	6.63ac	C	100%		0%	0%	0%		0%	0%	46%		0%	0%	37%	6.63ac	100%	37%	**37.0%**	**0.34**	**0.58**
	DP 86	D15 - D17	8.92ac	C	100%		0%	0%	0%		0%	0%	46%		0%	0%	37%	8.92ac	100%	37%	**37.0%**	**0.34**	**0.58**
	DP 87	D15 - D18	10.69ac	C	100%		0%	0%	0%		0%	0%	46%		0%	0%	37%	10.69ac	100%	37%	**37.0%**	**0.34**	**0.58**
	DP 88	D15 - D19	12.92ac	C	100%		0%	0%	0%	0.48ac	4%	0%	46%		0%	0%	37%	12.44ac	96%	36%	**35.6%**	**0.33**	**0.58**
	DP 92a	D20	0.75ac	C	100%		0%	0%	0%		0%	0%	46%		0%	0%	37%	0.75ac	100%	37%	**37.0%**	**0.34**	**0.58**
	DP 92b	D21,D22,D23	5.69ac	C	100%		0%	0%	0%		0%	0%	46%		0%	0%	37%	5.69ac	100%	37%	**37.0%**	**0.34**	**0.58**
	DP 93a	D1 -D19	26.95ac	C	100%		0%	0%	0%		0%	0%	46%		0%	0%	37%	43.17ac	160%	59%	**59.3%**	**0.45**	**0.63**
	DP 93b	D20-D24	16.23ac	C	100%	0.34ac	2%	2%	0%	0.37ac	2%	0%	46%		0%	0%	37%	7.61ac	47%	17%	**19.5%**	**0.26**	**0.55**
	DP 94	D1 - D24	59.55ac	C	100%	0.81ac	1%	1%	0%	7.80ac	13%	0%	46%		0%	0%	37%	50.94ac	86%	32%	**33.0%**	**0.32**	**0.57**

Basin Runoff Coefficient is based on UDFCD % Imperviousness Calculation

Runoff Coefficients and Percents Impervious									
Hydrologic Soil Type:	**C**	**Runoff Coef Calc Method**							**%Imp**
Land Use	Abb	%	C_2	C_5	C_{10}	C_{25}	C_{50}	C_{100}	Weighted %Imp
Commercial Area	CO	95%	0.80	0.82	0.84	0.87	0.89	0.89	A
Drives and Walks	DR	90%	0.73	0.75	0.77	0.80	0.83	0.83	B
Streets - Gravel (Packed)	GR	40%	0.28	0.35	0.42	0.50	0.55	0.58	C
Historic Flow Analysis	HI	2%	0.06	0.16	0.26	0.38	0.45	0.51	D
Lawns	LA	0%	0.04	0.15	0.25	0.37	0.44	0.50	
Off-site flow-Undeveloped	OF	45%	0.31	0.37	0.44	0.51	0.56	0.59	
Park	PA	7%	0.09	0.19	0.29	0.40	0.47	0.52	
Playground	PL	13%	0.13	0.23	0.32	0.42	0.49	0.54	
Streets - Paved	PV	100%	0.89	0.90	0.92	0.94	0.96	0.96	
Roofs	RO	90%	0.73	0.75	0.77	0.80	0.83	0.83	
Residential: 3.7 Lots/Acre	RS1	37%	0.26	0.34	0.41	0.49	0.54	0.58	
Residential: 1/5 Acre	RS2	46%	0.31	0.38	0.44	0.51	0.56	0.59	

Equations (% Impervious Calculation):

$C_A = K_A + (1.31\ i^3 - 1.44\ i^2 + 1.135\ i - 0.12)$ [Eqn RO-6]

$C_{CD} = K_{CD} + (0.858\ i^3 - 0.786\ i^2 + 0.774\ i + 0.04)$ [Eqn RO-7]

$C_B = (C_A + C_{CD}) / 2$

I = % imperviousness/100 as a decimal (See Table RO-3)

C_A = Runoff coefficient for NRCS Type A Soils

C_B = Runoff coefficient for NRCS Type B Soils

C_{CD} = Runoff coefficient for NRCS Type C and D Soils

Correction Factors - Table RO-4

K_A = For Type A Soils

K_A (2-yr)= 0

K_A (5-yr)= -0.08i + 0.09

K_A (10-yr)= -0.14i + 0.17

K_A (25-yr)= -0.19i + 0.24

K_A (50-yr)= -0.22i + 0.28

K_A (100-yr)= -0.25i + 0.32

K_{CD}=For Type C & D Soils

K_{CD} (2-yr)= 0

K_{CD} (5-yr)= -0.10i + 0.11

K_{CD} (10-yr)= -0.18i + 0.21

K_{CD} (25-yr)= -0.28i + 0.33

K_{CD} (50-yr)= -0.33i + 0.40

K_{CD} (100-yr)= -0.39i + 0.46

The Glen at Widefield
Developed Condition
Time of Concentration Calculation

Sub-Basin Data					Time of Concentration Estimate												
					Initial/Overland Time (t_i)			Travel Time (t_t)						Comp.	Min. Tc in Urban Tc Check (urban)		Final t_c
Basin	Design Point	Contributing Basins	Area	C_5	Length	Slope	t_i	Length	Slope	Land Type	Cv	Velocity	t_t	t_c	Total Length	t_c Check	
D-1	DP 68		2.53ac	0.28	100lf	2.4%	11.2 min.	600lf	3.5%	PV	20	3.7 ft/sec	2.7 min.	13.9 min.	700lf	13.9 min.	**13.9 min.**
D-2			1.46ac	0.28	85lf	1.5%	12.1 min.	655lf	0.9%	PV	20	1.9 ft/sec	5.8 min.	17.8 min.	740lf	14.1 min.	**14.1 min.**
D-3	DP 70		1.62ac	0.28	100lf	2.4%	11.2 min.	600lf	3.5%	PV	20	3.7 ft/sec	2.7 min.	13.9 min.	700lf	13.9 min.	**13.9 min.**
D-4			2.07ac	0.34	50lf	1.0%	9.9 min.	610lf	0.9%	PV	20	1.9 ft/sec	5.4 min.	15.3 min.	660lf	13.7 min.	**13.7 min.**
D-5	DP 72		2.41ac	0.34	60lf	2.0%	8.6 min.	790lf	0.5%	PV	20	1.4 ft/sec	9.3 min.	17.9 min.	850lf	14.7 min.	**14.7 min.**
D-6	DP 73		0.41ac	0.34	90lf	1.0%	13.3 min.	140lf	0.8%	PV	20	1.8 ft/sec	1.3 min.	14.6 min.	230lf	11.3 min.	**11.3 min.**
D-7			3.12ac	0.34	100lf	1.5%	12.2 min.	430lf	1.3%	PV	20	2.3 ft/sec	3.1 min.	15.4 min.	530lf	12.9 min.	**12.9 min.**
D-8			1.76ac	0.34	100lf	1.0%	14.0 min.	330lf	1.5%	PV	20	2.4 ft/sec	2.2 min.	16.2 min.	430lf	12.4 min.	**12.4 min.**
D-9	DP 77		2.16ac	0.28	100lf	2.0%	11.9 min.	300lf	1.3%	PV	20	2.3 ft/sec	2.2 min.	14.1 min.	400lf	12.2 min.	**12.2 min.**
D-10			2.00ac	0.34	100lf	1.5%	12.2 min.	660lf	1.1%	PV	20	2.1 ft/sec	5.2 min.	17.5 min.	760lf	14.2 min.	**14.2 min.**
D-11	DP 80		3.96ac	0.34	70lf	1.5%	10.2 min.	1095lf	1.2%	PV	20	2.2 ft/sec	8.3 min.	18.6 min.	1165lf	16.5 min.	**16.5 min.**
D-12			1.39ac	0.34	100lf	1.3%	12.8 min.	450lf	1.2%	PV	20	2.2 ft/sec	3.4 min.	16.3 min.	550lf	13.1 min.	**13.1 min.**
D-13			2.07ac	0.34	55lf	1.0%	10.4 min.	660lf	0.6%	PV	20	1.5 ft/sec	7.1 min.	17.5 min.	715lf	14.0 min.	**14.0 min.**
D-14			3.30ac	0.34	100lf	1.8%	11.5 min.	980lf	1.6%	PV	20	2.5 ft/sec	6.5 min.	18.0 min.	1080lf	16.0 min.	**16.0 min.**
D-15	DP 84		2.80ac	0.28	100lf	2.0%	11.9 min.	185lf	2.0%	PV	20	2.8 ft/sec	1.1 min.	13.0 min.	285lf	11.6 min.	**11.6 min.**
D-16			2.14ac	0.34	100lf	2.0%	11.1 min.	660lf	0.8%	PV	20	1.8 ft/sec	6.1 min.	17.3 min.	760lf	14.2 min.	**14.2 min.**
D-16.1			1.69ac	0.34	100lf	1.4%	12.5 min.	360lf	0.8%	PV	20	1.8 ft/sec	3.4 min.	15.9 min.	460lf	12.6 min.	**12.6 min.**
D-17			2.29ac	0.34	60lf	1.5%	9.5 min.	410lf	1.5%	PV	20	2.4 ft/sec	2.8 min.	12.3 min.	470lf	12.6 min.	**12.3 min.**
D-18			1.76ac	0.34	60lf	1.5%	9.5 min.	510lf	2.2%	PV	20	3.0 ft/sec	2.9 min.	12.3 min.	570lf	13.2 min.	**12.3 min.**
D-19			2.23ac	0.34	100lf	2.6%	10.2 min.	510lf	1.1%	PV	20	2.1 ft/sec	4.1 min.	14.2 min.	610lf	13.4 min.	**13.4 min.**
D-19.1			0.15ac	0.34	45lf	2.0%	7.5 min.	36lf	1.1%	PV	20	2.1 ft/sec	0.3 min.	7.7 min.	81lf	10.5 min.	**7.7 min.**
D-20	DP 92a		0.75ac	0.38	100lf	3.3%	8.8 min.	1300lf	0.8%	PV	20	1.8 ft/sec	12.1 min.	20.9 min.	1400lf	17.8 min.	**17.8 min.**
D-21	DP 90		4.02ac	0.28	50lf	2.0%	8.4 min.	610lf	2.1%	PV	20	2.9 ft/sec	3.5 min.	11.9 min.	660lf	13.7 min.	**11.9 min.**
D-22	DP 91		1.15ac	0.28	50lf	2.0%	8.4 min.	610lf	2.1%	PV	20	2.9 ft/sec	3.5 min.	11.9 min.	660lf	13.7 min.	**11.9 min.**
D-23			0.52ac	0.76	100lf	2.5%	4.6 min.	660lf	1.0%	PV	20	2.0 ft/sec	5.5 min.	10.1 min.	760lf	14.2 min.	**10.1 min.**
D-24			9.79ac	0.21	100lf	4.9%	9.6 min.	800lf	0.5%	GW	15	1.1 ft/sec	12.6 min.	22.2 min.	900lf	15.0 min.	**15.0 min.**
	DP 69	D1, D2	3.99ac	0.28	100lf	2.4%	11.2 min.	1385lf	2.0%	PV	20	2.8 ft/sec	8.2 min.	19.3 min.	1485lf	18.3 min.	**18.3 min.**
	DP 71	D3, D4	3.69ac	0.28	100lf	2.4%	11.2 min.	1370lf	2.0%	PV	20	2.8 ft/sec	8.1 min.	19.3 min.	1470lf	18.2 min.	**18.2 min.**
	DP 74	D3, D4, D6	4.10ac	0.34	100lf	2.4%	10.5 min.	1370lf	2.0%	PV	20	2.8 ft/sec	8.1 min.	18.5 min.	1470lf	18.2 min.	**18.2 min.**
	DP 75	D1-D4, D6, D7	11.21ac	0.34	100lf	2.4%	10.5 min.	1970lf	1.8%	PV	20	2.7 ft/sec	12.2 min.	22.7 min.	2070lf	21.5 min.	**21.5 min.**
	DP 76	D1-D4, D6-D8	12.97ac	0.34	100lf	2.4%	10.5 min.	2110lf	1.8%	PV	20	2.7 ft/sec	13.1 min.	23.6 min.	2210lf	22.3 min.	**22.3 min.**
	DP 78	D1-D4, D6-D9	15.13ac	0.34	100lf	2.4%	10.5 min.	2110lf	1.8%	PV	20	2.7 ft/sec	13.1 min.	23.6 min.	2210lf	22.3 min.	**22.3 min.**
	DP 79	D1-D4, D6-D10	17.13ac	0.34	100lf	2.4%	10.5 min.	2770lf	1.6%	PV	20	2.5 ft/sec	18.2 min.	28.7 min.	2870lf	25.9 min.	**25.9 min.**
	DP 81	D11, D12	5.34ac	0.34	70lf	1.5%	10.2 min.	1545lf	1.2%	PV	20	2.2 ft/sec	11.8 min.	22.0 min.	1615lf	19.0 min.	**19.0 min.**
	DP 82	D5, D13	4.48ac	0.34	60lf	2.0%	8.6 min.	1590lf	0.6%	PV	20	1.5 ft/sec	17.7 min.	26.3 min.	1650lf	19.2 min.	**19.2 min.**
	DP 83	D5, D13, D14	7.79ac	0.34	60lf	2.0%	8.6 min.	2640lf	0.9%	PV	20	1.9 ft/sec	23.2 min.	31.8 min.	2700lf	25.0 min.	**25.0 min.**
	DP 84.1	D15,D16	4.94ac	0.34	100lf	2.0%	11.1 min.	847lf	0.6%	PV	20	1.5 ft/sec	9.3 min.	20.5 min.	947lf	15.3 min.	**15.3 min.**
	DP 85	D15,D16, D16.1	6.63ac	0.34	100lf	2.0%	11.1 min.	1035lf	0.8%	PV	20	1.8 ft/sec	9.6 min.	20.8 min.	1135lf	16.3 min.	**16.3 min.**
	DP 86	D15 - D17	8.92ac	0.34	100lf	2.0%	11.1 min.	1320lf	0.7%	PV	20	1.7 ft/sec	13.1 min.	24.3 min.	1420lf	17.9 min.	**17.9 min.**
	DP 87	D18	1.76ac	0.34	100lf	2.0%	11.1 min.	2080lf	1.0%	PV	20	2.0 ft/sec	17.3 min.	28.4 min.	2180lf	22.1 min.	**22.1 min.**
	DP 88	D15 - D19	12.92ac	0.33	100lf	2.0%	11.2 min.	2580lf	1.0%	PV	20	2.0 ft/sec	21.5 min.	32.7 min.	2680lf	24.9 min.	**24.9 min.**
	DP 92a	D20	0.75ac	0.34	20lf	10.0%	2.9 min.	680lf	1.0%	PV	20	2.0 ft/sec	5.7 min.	8.6 min.	700lf	13.9 min.	**8.6 min.**
	DP 92b	D21,D22,D23	5.69ac	0.34	124lf	2.5%	11.5 min.	825lf	1.0%	PV	20	2.0 ft/sec	6.9 min.	18.4 min.	949lf	15.3 min.	**15.3 min.**
	DP 93a	D1 -D19	26.95ac	0.45	168lf	2.5%	11.3 min.	2820lf	1.0%	PV	20	2.0 ft/sec	23.5 min.	34.8 min.	2988lf	26.6 min.	**26.6 min.**
	DP 93b	D20-D24	16.23ac	0.26	124lf	2.5%	12.7 min.	825lf	1.0%	PV	20	2.0 ft/sec	6.9 min.	19.5 min.	949lf	15.3 min.	**15.3 min.**
	DP 94	D1 - D24	59.55ac	0.32	168lf	2.5%	13.7 min.	2820lf	1.0%	PV	20	2.0 ft/sec	23.5 min.	37.2 min.	2988lf	26.6 min.	**26.6 min.**

Equations:

t_i (Overland) = $0.395(1.1-C_5)L^{0.5} S^{-0.333}$

C_5 = Runoff coefficient for 5-year

L = Length of overland flow (ft)

S = Slope of flow path (ft/ft)

tc Check = (L/180)+10 (Developed Cond. Only)

L = Overall Length

Velocity (Travel Time) = $CvS^{0.5}$

Cv = Conveyance Coef (see Table RO-2)

S = Watercourse slope (ft/ft)

Land Surface Type	Type	Cv
Grassed Waterway	GW	15
Heavy Meadow	HM	2.5
Nearly Bare Ground	NBG	10
Paved Area	PV	20
Riprap (Not Buried)	RR	6.5
Short Pasture/Lawns	SP	7
Tillage/Fields	TF	5

The Glen at Widefield
Developed Condition
Runoff Calculation

Basin	Design Point	Contributing Basins	Drainage Area	C_5	C_{100}	Time of Concentration	Rainfall Intensity i_5	Rainfall Intensity i_{100}	Runoff Q_5	Runoff Q_{100}	Basin / DP
D-1	DP 68		2.53 ac	0.28	0.49	13.9 min.	3.6 in/hr	6.1 in/hr	**2.6 cfs**	**7.5 cfs**	D-1
D-2			1.46 ac	0.28	0.49	14.1 min.	3.6 in/hr	6.1 in/hr	**1.5 cfs**	**4.3 cfs**	D-2
D-3	DP 70		1.62 ac	0.28	0.49	13.9 min.	3.6 in/hr	6.1 in/hr	**1.7 cfs**	**4.8 cfs**	D-3
D-4			2.07 ac	0.34	0.58	13.7 min.	3.7 in/hr	6.1 in/hr	**2.5 cfs**	**7.4 cfs**	D-4
D-5	DP 72		2.41 ac	0.34	0.58	14.7 min.	3.5 in/hr	6.0 in/hr	**2.9 cfs**	**8.3 cfs**	D-5
D-6	DP 73		0.41 ac	0.34	0.58	11.3 min.	3.9 in/hr	6.6 in/hr	**0.5 cfs**	**1.6 cfs**	D-6
D-7			3.12 ac	0.34	0.58	12.9 min.	3.7 in/hr	6.3 in/hr	**3.9 cfs**	**11.3 cfs**	D-7
D-8			1.76 ac	0.34	0.58	12.4 min.	3.8 in/hr	6.4 in/hr	**2.2 cfs**	**6.5 cfs**	D-8
D-9	DP 77		2.16 ac	0.28	0.49	12.2 min.	3.8 in/hr	6.4 in/hr	**2.3 cfs**	**6.8 cfs**	D-9
D-10			2.00 ac	0.34	0.58	14.2 min.	3.6 in/hr	6.0 in/hr	**2.4 cfs**	**7.0 cfs**	D-10
D-11	DP 80		3.96 ac	0.34	0.58	16.5 min.	3.4 in/hr	5.7 in/hr	**4.5 cfs**	**13.0 cfs**	D-11
D-12			1.39 ac	0.34	0.58	13.1 min.	3.7 in/hr	6.3 in/hr	**1.7 cfs**	**5.0 cfs**	D-12
D-13			2.07 ac	0.34	0.58	14.0 min.	3.6 in/hr	6.1 in/hr	**2.5 cfs**	**7.3 cfs**	D-13
D-14			3.30 ac	0.34	0.58	16.0 min.	3.4 in/hr	5.7 in/hr	**3.8 cfs**	**11.0 cfs**	D-14
D-15	DP 84		2.80 ac	0.28	0.49	11.6 min.	3.9 in/hr	6.6 in/hr	**3.1 cfs**	**9.0 cfs**	D-15
D-16			2.14 ac	0.34	0.58	14.2 min.	3.6 in/hr	6.0 in/hr	**2.6 cfs**	**7.5 cfs**	D-16
D-16.1			1.69 ac	0.34	0.58	12.6 min.	3.8 in/hr	6.4 in/hr	**2.1 cfs**	**6.2 cfs**	D-16.1
D-17			2.29 ac	0.34	0.58	12.3 min.	3.8 in/hr	6.4 in/hr	**2.9 cfs**	**8.5 cfs**	D-17
D-18			1.76 ac	0.34	0.58	12.3 min.	3.8 in/hr	6.4 in/hr	**2.3 cfs**	**6.5 cfs**	D-18
D-19			2.23 ac	0.34	0.58	13.4 min.	3.7 in/hr	6.2 in/hr	**2.8 cfs**	**8.0 cfs**	D-19
D-19.1	DP 89		0.15 ac	0.34	0.58	7.7 min.	4.5 in/hr	7.6 in/hr	**0.2 cfs**	**0.7 cfs**	D-19.1
D-20	DP 92a		0.75 ac	0.38	0.60	17.8 min.	3.3 in/hr	5.5 in/hr	**0.9 cfs**	**2.5 cfs**	D-20
D-21	DP 90		4.02 ac	0.28	0.49	11.9 min.	3.9 in/hr	6.5 in/hr	**4.4 cfs**	**12.7 cfs**	D-21
D-22	DP 91		1.15 ac	0.28	0.49	11.9 min.	3.9 in/hr	6.5 in/hr	**1.3 cfs**	**3.6 cfs**	D-22
D-23			0.52 ac	0.76	0.84	10.1 min.	4.1 in/hr	6.9 in/hr	**1.6 cfs**	**3.0 cfs**	D-23
D-24			9.79 ac	0.21	0.53	15.0 min.	3.5 in/hr	5.9 in/hr	**7.1 cfs**	**30.6 cfs**	D-24
								Direct Summation:	**66.4 cfs**	**200.5 cfs**	
	DP 69	D1, D2	3.99 ac	0.28	0.49	18.3 min.	3.2 in/hr	5.4 in/hr	**3.6 cfs**	**10.5 cfs**	DP 69
	DP 71	D3, D4	3.69 ac	0.28	0.49	18.2 min.	3.2 in/hr	5.4 in/hr	**3.4 cfs**	**9.8 cfs**	DP 71
	DP 74	D3, D4, D6	4.10 ac	0.34	0.58	18.2 min.	3.2 in/hr	5.4 in/hr	**4.4 cfs**	**12.9 cfs**	DP 74
	DP 75	D1-D4, D6, D7	11.21 ac	0.34	0.58	21.5 min.	3.0 in/hr	5.0 in/hr	**11.2 cfs**	**32.4 cfs**	DP 75
	DP 76	D1-D4, D6-D8	12.97 ac	0.34	0.58	22.3 min.	2.9 in/hr	4.9 in/hr	**12.7 cfs**	**36.8 cfs**	DP 76
	DP 78	D1-D4, D6-D9	15.13 ac	0.34	0.58	22.3 min.	2.9 in/hr	4.9 in/hr	**14.8 cfs**	**43.0 cfs**	DP 78
	DP 79	D1-D4, D6-D10	17.13 ac	0.34	0.58	25.9 min.	2.7 in/hr	4.5 in/hr	**15.5 cfs**	**44.8 cfs**	DP 79
	DP 81	D11, D12	5.34 ac	0.34	0.58	19.0 min.	3.2 in/hr	5.3 in/hr	**5.7 cfs**	**16.4 cfs**	DP 81
	DP 82	D5, D13	4.48 ac	0.34	0.58	19.2 min.	3.2 in/hr	5.3 in/hr	**4.7 cfs**	**13.7 cfs**	DP 82
	DP 83	D5, D13, D14	7.79 ac	0.34	0.58	25.0 min.	2.8 in/hr	4.6 in/hr	**7.2 cfs**	**20.8 cfs**	DP 83
	DP 84.1	D15,D16	4.94 ac	0.34	0.58	15.3 min.	3.5 in/hr	5.9 in/hr	**5.8 cfs**	**16.8 cfs**	DP 84.1
	DP 85	D15,D16, D16.1	6.63 ac	0.34	0.58	16.3 min.	3.4 in/hr	5.7 in/hr	**7.5 cfs**	**21.8 cfs**	DP 85
	DP 86	D15 - D17	8.92 ac	0.34	0.58	17.9 min.	3.3 in/hr	5.5 in/hr	**9.7 cfs**	**28.2 cfs**	DP 86
	DP 87	D15 - D18	1.76 ac	0.34	0.58	22.1 min.	2.9 in/hr	4.9 in/hr	**1.7 cfs**	**5.0 cfs**	DP 87
	DP 88	D15 - D19	12.92 ac	0.33	0.58	24.9 min.	2.8 in/hr	4.6 in/hr	**11.7 cfs**	**34.5 cfs**	DP 88
	DP 92a	D20	0.75 ac	0.34	0.58	8.6 min.	4.4 in/hr	7.3 in/hr	**1.1 cfs**	**3.2 cfs**	DP 92a
	DP 92b	D21,D22,D23	5.69 ac	0.34	0.58	15.3 min.	3.5 in/hr	5.9 in/hr	**6.7 cfs**	**19.3 cfs**	DP 92b
	DP 93a	D1 -D19	26.95 ac	0.45	0.63	26.6 min.	2.7 in/hr	4.5 in/hr	**32.4 cfs**	**75.9 cfs**	DP 93a
	DP 93b	D20-D24	16.23 ac	0.26	0.55	15.3 min.	3.5 in/hr	5.9 in/hr	**14.6 cfs**	**52.5 cfs**	DP 93b
	DP 94	D1 - D24	59.55 ac	0.32	0.57	26.6 min.	2.7 in/hr	4.5 in/hr	**50.4 cfs**	**152.2 cfs**	DP 94

Equations (taken from Fig 6-5, City of Colorado Springs DCM):

i_2=-1.19 ln(T_c) + 6.035
i_5=-1.50 ln(T_c) + 7.583
i_{10}=-1.75 ln(T_c) + 8.847
i_{25}=-2.00 ln(T_c) + 10.111
i_{50}=-2.25 ln(T_c) + 11.375
i_{100}=-2.52 ln(T_c) + 12.735

Q = CiA
Q = Peak Runoff Rate (cubic feet/second)
C = Runoff coef representing a ration of peak runoff rate to ave rainfall intensity for a duration equal to the runoff time of concentration.
i = average rainfall intensity in inches per hour
A = Drainage area in acres

P1	Inches
WQCV	0.60 in
2 yr	1.19 in
5 yr	1.50 in
10 yr	1.75 in
25 yr	2.00 in
50 yr	2.25 in
100 yr	2.52 in

The Glen at Widefield
Inlet Summary and Calculations

Inlet ID	Design Flow (Basin or DP)	Flow to Inlet			Upstream Inlet(s)	Carry Over Flow		Flow to Inlet including Carry Over		Street Flow Depth		Street Section Capacity		Inlet Type	Inlet Condition	Inlet Capacity		Flow Not Captured by Inlet		
		2yr	5yr	100yr		5yr	100yr	5yr	100yr	5yr	100yr	5yr	100yr			5yr	100yr	5yr	100yr	
B-1	D-15,16		5.7cfs	16.4cfs	A-1	0.0cfs	0.0cfs	5.7cfs	16.4cfs	6.0in	7.8in	8.2cfs	23.7cfs	12' Type D-10-R	On Grade	5.7 cfs	11.2 cfs	0.0cfs	5.2cfs	to C-1
C-1	DP 85		2.1cfs	6.2cfs	A-1, B-1	0.0cfs	5.2cfs	2.2cfs	11.4cfs	6.0in	7.8in	8.2cfs	23.7cfs	12' Type D-10-R	On Grade	2.1 cfs	9.2 cfs	0.1cfs	2.2cfs	to D-1
D-1	DP 86		2.9cfs	8.5cfs	A-1, B-1, C-1	0.0cfs	2.2cfs	2.9cfs	10.7cfs	6.0in	7.8in	8.2cfs	23.7cfs	12' Type D-10-R	On Grade	2.9 cfs	9.0 cfs	0.0cfs	1.7cfs	to G-2
D-4	DP 82		4.7cfs	13.7cfs	A-1, B-1, C-1	0.0cfs	1.7cfs	4.7cfs	15.5cfs	6.0in	7.8in	8.2cfs	23.7cfs	16' Type D-10-R	On Grade	4.7 cfs	13.2 cfs	0.0cfs	2.3cfs	to G-3
G-1	DP 89		0.2cfs	0.7cfs	None	0.0cfs	5.7cfs	0.2cfs	6.3cfs	6.0in	7.8in	8.2cfs	23.7cfs	12' Type D-10-R	In Sump	9.7 cfs	35.9 cfs	0.0cfs	0.0cfs	Inflow
G-2	DP 88		5.0cfs	14.5cfs	A-1 thru D-1	0.0cfs	2.3cfs	5.1cfs	16.8cfs	6.0in	7.8in	8.2cfs	23.7cfs	12' Type D-10-R	On Grade	5.0 cfs	11.1 cfs	0.1cfs	5.7cfs	to G-1
G-3	DP 83		3.8cfs	13.2cfs	D-4	7.2cfs	20.8cfs	7.2cfs	20.8cfs	6.0in	7.8in	8.2cfs	23.7cfs	12' Type D-10-R	On Grade	4.8 cfs	10.0 cfs	2.4cfs	10.8cfs	to H-1
G-4	DP 81		5.7cfs	16.4cfs	None	5.7cfs	16.4cfs	5.7cfs	16.4cfs	6.0in	7.8in	8.2cfs	23.7cfs	16' Type D-10-R	In Sump	13.1 cfs	13.1 cfs	0.0cfs	3.3cfs	to H-1
E-1	DP 74		2.6cfs	7.0cfs	None	2.6cfs	7.0cfs	2.6cfs	7.0cfs	6.0in	7.8in	8.2cfs	23.7cfs	12' Type D-10-R	On Grade	2.6 cfs	6.7 cfs	0.0cfs	0.3cfs	to E-6
E-2	DP 69		3.6cfs	10.5cfs	E-1	3.6cfs	10.5cfs	3.6cfs	10.5cfs	6.0in	7.8in	8.2cfs	23.7cfs	12' Type D-10-R	On Grade	3.6 cfs	8.8 cfs	0.0cfs	1.7cfs	to E-6
E-6	DP 75		3.9cfs	13.3cfs	E-1, E-2	3.9cfs	13.3cfs	3.9cfs	13.3cfs	6.0in	7.8in	8.2cfs	23.7cfs	12' Type D-10-R	On Grade	11.6 cfs	33.7 cfs	0.0cfs	0.0cfs	to H-1
F-1	DP 77		2.3cfs	6.8cfs	None	0.0cfs	2.0cfs	2.3cfs	8.8cfs	6.0in	7.8in	8.2cfs	23.7cfs	8' Type D-10-R	In Sump	8.3 cfs	8.3 cfs	0.0cfs	0.5cfs	to H-1
H-1	DP 79		2.4cfs	7.0cfs	A thru H	2.2cfs	13.0cfs	4.7cfs	20.0cfs	6.0in	7.8in	8.2cfs	23.7cfs	16' Type D-10-R	In Sump	16.0 cfs	31.2 cfs	0.0cfs	0.0cfs	Inflow
J-1	DP 92a		0.9cfs	2.5cfs	DP 20 Only + Overtopping	0.0cfs	0.0cfs	0.9cfs	2.5cfs	6.0in	7.8in	8.2cfs	23.7cfs	12' Type D-10-R	In Sump	10.8 cfs	10.8 cfs	0.0cfs	0.0cfs	Inflow
J-2	DP 92b		1.3cfs	3.3cfs	DP 23 Only + Overtopping	0.0cfs	0.0cfs	1.3cfs	3.3cfs	6.0in	7.8in	8.2cfs	23.7cfs	12' Type D-10-R	In Sump	10.8 cfs	10.8 cfs	0.0cfs	0.0cfs	Inflow

The Glen at Widefield
Pipe Diameter Calculations

Pipe #	5yr Flow	100yr Flow	Design Flow	Contributing Flows	Manning 'n'	Pipe Slope	Calculated Pipe Diameter	**Pipe Diameter**	Minimum Slope of Pipe	Full Pipe Flow Velocity	**Mannings Pipe Capacity**	Capacity Check	Notes		Length
Golden Buffs Drive Trunkline Top to Bottom															
A4-B2	3.1 cfs	9.0 cfs	9.0 cfs	Detention Basin 'D'	0.013	**0.75%**	18-inch	**18-inch**	0.73%	5.2 ft/sec	**9.1 cfs**	OK	DP84	Future	(125.8)
B2-B3	5.8 cfs	16.8 cfs	16.8 cfs	Detention Basin 'D'	0.013	**0.57%**	24-inch	**24-inch**	0.55%	5.5 ft/sec	**17.1 cfs**	OK			153.6
B3-B4	5.8 cfs	16.8 cfs	16.8 cfs	Detention Basin 'D'	0.013	**0.57%**	24-inch	**24-inch**	0.55%	5.5 ft/sec	**17.1 cfs**	OK			168.2
B4-C2	5.8 cfs	16.8 cfs	16.8 cfs	Detention Basin 'D'	0.013	**0.57%**	24-inch	**24-inch**	0.55%	5.5 ft/sec	**17.1 cfs**	OK			80.6
C2-C3	7.5 cfs	21.8 cfs	21.8 cfs	Detention Basin 'D'	0.013	**0.57%**	26-inch	**30-inch**	0.28%	6.3 ft/sec	**31.1 cfs**	OK	DP85		78
C3-D2	7.5 cfs	21.8 cfs	21.8 cfs	Detention Basin 'D'	0.013	**0.50%**	27-inch	**30-inch**	0.28%	5.9 ft/sec	**29.1 cfs**	OK			92.1
D2-D4	9.7 cfs	28.2 cfs	28.2 cfs	Detention Basin 'D'	0.013	**0.50%**	30-inch	**30-inch**	0.47%	5.9 ft/sec	**29.1 cfs**	OK			177.8
D4-D5	14.5 cfs	41.9 cfs	41.9 cfs	Detention Basin 'D'	0.013	**1.05%**	30-inch	**30-inch**	1.04%	8.6 ft/sec	**42.1 cfs**	OK	DP86		211.9
D5-D6	14.5 cfs	41.9 cfs	41.9 cfs	Detention Basin 'D'	0.013	**1.05%**	30-inch	**30-inch**	1.04%	8.6 ft/sec	**42.1 cfs**	OK			161.5
D6-D7	14.5 cfs	41.9 cfs	41.9 cfs	Detention Basin 'D'	0.013	**1.05%**	30-inch	**30-inch**	1.04%	8.6 ft/sec	**42.1 cfs**	OK			216.5
D7-D8	14.5 cfs	41.9 cfs	41.9 cfs	Detention Basin 'D'	0.013	**0.50%**	34-inch	**36-inch**	0.39%	6.7 ft/sec	**47.3 cfs**	OK			85.3
D7-D8	14.5 cfs	41.9 cfs	41.9 cfs	Detention Basin 'D'	0.013	**0.50%**	34-inch	**36-inch**	0.39%	6.7 ft/sec	**47.3 cfs**	OK			78.7
D8-D9	16.2 cfs	46.9 cfs	46.9 cfs	Detention Basin 'D'	0.013	**0.50%**	36-inch	**36-inch**	0.50%	6.7 ft/sec	**47.3 cfs**	OK	DP87		83.2
D9-D10	16.2 cfs	46.9 cfs	46.9 cfs	Detention Basin 'D'	0.013	**0.50%**	36-inch	**36-inch**	0.50%	6.7 ft/sec	**47.3 cfs**	OK			80.5
D10-D11	16.2 cfs	46.9 cfs	46.9 cfs	Detention Basin 'D'	0.013	**0.50%**	36-inch	**36-inch**	0.50%	6.7 ft/sec	**47.3 cfs**	OK			78.1
D11-D12	16.2 cfs	46.9 cfs	46.9 cfs	Detention Basin 'D'	0.013	**0.50%**	36-inch	**36-inch**	0.50%	6.7 ft/sec	**47.3 cfs**	OK			155.4
D12-H1	16.2 cfs	46.9 cfs	46.9 cfs	Detention Basin 'D'	0.013	**0.50%**	36-inch	**36-inch**	0.50%	6.7 ft/sec	**47.3 cfs**	OK			94.1
H1-H2	30.1 cfs	74.1 cfs	74.1 cfs	Detention Basin 'D'	0.013	**0.50%**	43-inch	**36-inch**	1.23%	6.7 ft/sec	**47.3 cfs**	Exceed			55.9
															625.9
PennyCress Drive Trunkline Top to Bottom															
E1-E2	3.4 cfs	9.8 cfs	9.8 cfs	Detention Basin 'D'	0.013	**2.00%**	15-inch	**18-inch**	0.86%	8.4 ft/sec	**14.9 cfs**	OK			37.4
E2-E3	7.0 cfs	20.3 cfs	20.3 cfs	Detention Basin 'D'	0.013	**1.00%**	23-inch	**24-inch**	0.80%	7.2 ft/sec	**22.7 cfs**	OK			29.6
E3-E4	7.0 cfs	20.3 cfs	20.3 cfs	Detention Basin 'D'	0.013	**1.00%**	23-inch	**24-inch**	0.80%	7.2 ft/sec	**22.7 cfs**	OK			189.4
E4-E5	7.0 cfs	20.3 cfs	20.3 cfs	Detention Basin 'D'	0.013	**1.00%**	23-inch	**24-inch**	0.80%	7.2 ft/sec	**22.7 cfs**	OK			189.2
E5-E6	7.0 cfs	20.3 cfs	20.3 cfs	Detention Basin 'D'	0.013	**1.10%**	23-inch	**24-inch**	0.80%	7.6 ft/sec	**23.8 cfs**	OK			154.2
E6-E7	11.2 cfs	32.4 cfs	32.4 cfs	Detention Basin 'D'	0.013	**0.67%**	30-inch	**30-inch**	0.63%	6.9 ft/sec	**33.7 cfs**	OK	DP75		110.1
E7-F3	11.2 cfs	32.4 cfs	32.4 cfs	Detention Basin 'D'	0.013	**0.67%**	30-inch	**30-inch**	0.63%	6.9 ft/sec	**33.7 cfs**	OK			64.3
F3-F4	14.8 cfs	43.0 cfs	43.0 cfs	Detention Basin 'D'	0.013	**0.67%**	33-inch	**36-inch**	0.42%	7.7 ft/sec	**54.7 cfs**	OK	78		63.5
F4-F5	15.5 cfs	43.0 cfs	43.0 cfs	Detention Basin 'D'	0.013	**0.50%**	35-inch	**36-inch**	0.42%	6.7 ft/sec	**47.3 cfs**	OK			250.1
F5-F6	15.5 cfs	43.0 cfs	43.0 cfs	Detention Basin 'D'	0.013	**0.50%**	35-inch	**36-inch**	0.42%	6.7 ft/sec	**47.3 cfs**	OK			189.2
F6-F7	15.5 cfs	43.0 cfs	43.0 cfs	Detention Basin 'D'	0.013	**0.50%**	35-inch	**36-inch**	0.42%	6.7 ft/sec	**47.3 cfs**	OK			75
F7-H2	15.5 cfs	44.8 cfs	44.8 cfs	Detention Basin 'D'	0.013	**0.50%**	35-inch	**36-inch**	0.45%	6.7 ft/sec	**47.3 cfs**	OK	DP 79		112.1
															689.9
H2-END	32.4 cfs	75.9 cfs	75.9 cfs	Detention Basin 'D'	0.013	**0.50%**	43-inch	**42-inch**	0.57%	7.4 ft/sec	**71.3 cfs**	Exceed			
													Detention Basin 'D' Outlet Pipe to Marksheffel Road		
Inlet Pair at Inflow 'J'															
J1-J2	0.9 cfs	2.5 cfs	2.5 cfs	Detention Basin 'D'	0.013	**0.40%**	12-inch	**24-inch**	0.01%	4.6 ft/sec	**14.3 cfs**	OK			36.6
J2-End	1.3 cfs	3.3 cfs	3.3 cfs	Detention Basin 'D'	0.013	**0.40%**	14-inch	**24-inch**	0.02%	4.6 ft/sec	**14.3 cfs**	OK			59.7

Equations:

Pipe Dia=$((2.16Qn)/(S^{0.5}))^{0.375}$
- Q = Discharge in cubic feet per second
- n = Manning's roughness coefficient
  - RCP=0.013, CMP=0.024, HDPE (smooth)=0.012
- S = Slope of the pipe
- R_h = Hydraulic Radius

Flow Velocity = $(1.49/n)R_h^{2/3} S^{1/2}$

Pipe Capacity = $(1.49/n)AR_h^{2/3} S^{1/2}$
- A = Cross-sectional area of pipe
- A=p ($D^2/4$)
- D = Inside Diameter of Pipe

$R_h = A_w/W_p$
- $A_w = p(d^2/4)$
- A_w = Water Cross Sectional Area
- d = Flow Depth Within Pipe
- W_p = pd (For Capacity Calculation)
  - W_p=Wetted Perimeter of Pipe

APPENDIX A.1

Supporting Hydrologic Tables and Figures

Table 6-6. Runoff Coefficients for Rational Method
(Source: UDFCD 2001)

Land Use or Surface Characteristics	Percent Impervious	Runoff Coefficients											
		2-year		5-year		10-year		25-year		50-year		100-year	
		HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D
Business													
Commercial Areas	95	0.79	0.80	0.81	0.82	0.83	0.84	0.85	0.87	0.87	0.88	0.88	0.89
Neighborhood Areas	70	0.45	0.49	0.49	0.53	0.53	0.57	0.58	0.62	0.60	0.65	0.62	0.68
Residential													
1/8 Acre or less	65	0.41	0.45	0.45	0.49	0.49	0.54	0.54	0.59	0.57	0.62	0.59	0.65
1/4 Acre	40	0.23	0.28	0.30	0.35	0.36	0.42	0.42	0.50	0.46	0.54	0.50	0.58
1/3 Acre	30	0.18	0.22	0.25	0.30	0.32	0.38	0.39	0.47	0.43	0.52	0.47	0.57
1/2 Acre	25	0.15	0.20	0.22	0.28	0.30	0.36	0.37	0.46	0.41	0.51	0.46	0.56
1 Acre	20	0.12	0.17	0.20	0.26	0.27	0.34	0.35	0.44	0.40	0.50	0.44	0.55
Industrial													
Light Areas	80	0.57	0.60	0.59	0.63	0.63	0.66	0.66	0.70	0.68	0.72	0.70	0.74
Heavy Areas	90	0.71	0.73	0.73	0.75	0.75	0.77	0.78	0.80	0.80	0.82	0.81	0.83
Parks and Cemeteries	7	0.05	0.09	0.12	0.19	0.20	0.29	0.30	0.40	0.34	0.46	0.39	0.52
Playgrounds	13	0.07	0.13	0.16	0.23	0.24	0.31	0.32	0.42	0.37	0.48	0.41	0.54
Railroad Yard Areas	40	0.23	0.28	0.30	0.35	0.36	0.42	0.42	0.50	0.46	0.54	0.50	0.58
Undeveloped Areas													
Historic Flow Analysis--Greenbelts, Agriculture	2	0.03	0.05	0.09	0.16	0.17	0.26	0.26	0.38	0.31	0.45	0.36	0.51
Pasture/Meadow	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50
Forest	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50
Exposed Rock	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Offsite Flow Analysis (when landuse is undefined)	45	0.26	0.31	0.32	0.37	0.38	0.44	0.44	0.51	0.48	0.55	0.51	0.59
Streets													
Paved	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Gravel	80	0.57	0.60	0.59	0.63	0.63	0.66	0.66	0.70	0.68	0.72	0.70	0.74
Drive and Walks	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Roofs	90	0.71	0.73	0.73	0.75	0.75	0.77	0.78	0.80	0.80	0.82	0.81	0.83
Lawns	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50

3.2 Time of Concentration

One of the basic assumptions underlying the Rational Method is that runoff is a function of the average rainfall rate during the time required for water to flow from the hydraulically most remote part of the drainage area under consideration to the design point. However, in practice, the time of concentration can be an empirical value that results in reasonable and acceptable peak flow calculations.

For urban areas, the time of concentration (t_c) consists of an initial time or overland flow time (t_i) plus the travel time (t_t) in the storm sewer, paved gutter, roadside drainage ditch, or drainage channel. For non-urban areas, the time of concentration consists of an overland flow time (t_i) plus the time of travel in a concentrated form, such as a swale or drainageway. The travel portion (t_t) of the time of concentration can be estimated from the hydraulic properties of the storm sewer, gutter, swale, ditch, or drainageway. Initial time, on the other hand, will vary with surface slope, depression storage, surface cover, antecedent rainfall, and infiltration capacity of the soil, as well as distance of surface flow. The time of concentration is represented by Equation 6-7 for both urban and non-urban areas.

Table 6-7. Conveyance Coefficient, C_v

Type of Land Surface	C_v
Heavy meadow	2.5
Tillage/field	5
Riprap (not buried)*	6.5
Short pasture and lawns	7
Nearly bare ground	10
Grassed waterway	15
Paved areas and shallow paved swales	20

* For buried riprap, select C_v value based on type of vegetative cover.

The travel time is calculated by dividing the flow distance (in feet) by the velocity calculated using Equation 6-9 and converting units to minutes.

The time of concentration (t_c) is then the sum of the overland flow time (t_i) and the travel time (t_t) per Equation 6-7.

3.2.3 First Design Point Time of Concentration in Urban Catchments

Using this procedure, the time of concentration at the first design point (typically the first inlet in the system) in an urbanized catchment should not exceed the time of concentration calculated using Equation 6-10. The first design point is defined as the point where runoff first enters the storm sewer system.

$$t_c = \frac{L}{180} + 10 \qquad \text{(Eq. 6-10)}$$

Where:

t_c = maximum time of concentration at the first design point in an urban watershed (min)

L = waterway length (ft)

Equation 6-10 was developed using the rainfall-runoff data collected in the Denver region and, in essence, represents regional "calibration" of the Rational Method. Normally, Equation 6-10 will result in a lesser time of concentration at the first design point and will govern in an urbanized watershed. For subsequent design points, the time of concentration is calculated by accumulating the travel times in downstream drainageway reaches.

3.2.4 Minimum Time of Concentration

If the calculations result in a t_c of less than 10 minutes for undeveloped conditions, it is recommended that a minimum value of 10 minutes be used. The minimum t_c for urbanized areas is 5 minutes.

3.2.5 Post-Development Time of Concentration

As Equation 6-8 indicates, the time of concentration is a function of the 5-year runoff coefficient for a drainage basin. Typically, higher levels of imperviousness (higher 5-year runoff coefficients) correspond to shorter times of concentration, and lower levels of imperviousness correspond to longer times of

For Colorado Springs and much of the Fountain Creek watershed, the 1-hour depths are fairly uniform and are summarized in Table 6-2. Depending on the location of the project, rainfall depths may be calculated using the described method and the NOAA Atlas maps shown in Figures 6-6 through 6-17.

Table 6-2. Rainfall Depths for Colorado Springs

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

Where Z= 6,840 ft/100

These depths can be applied to the design storms or converted to intensities (inches/hour) for the Rational Method as described below. However, as the basin area increases, it is unlikely that the reported point rainfalls will occur uniformly over the entire basin. To account for this characteristic of rain storms an adjustment factor, the Depth Area Reduction Factor (DARF) is applied. This adjustment to rainfall depth and its effect on design storms is also described below. The UDFCD UD-Rain spreadsheet, available on UDFCD's website, also provides tools to calculate point rainfall depths and Intensity-Duration-Frequency curves[2] and should produce similar depth calculation results.

2.2 Design Storms

Design storms are used as input into rainfall/runoff models and provide a representation of the typical temporal distribution of rainfall events when the creation or routing of runoff hydrographs is required. It has long been observed that rainstorms in the Front Range of Colorado tend to occur as either short-duration, high-intensity, localized, convective thunderstorms (cloud bursts) or longer-duration, lower-intensity, broader, frontal (general) storms. The significance of these two types of events is primarily determined by the size of the drainage basin being studied. Thunderstorms can create high rates of runoff within a relatively small area, quickly, but their influence may not be significant very far downstream. Frontal storms may not create high rates of runoff within smaller drainage basins due to their lower intensity, but tend to produce larger flood flows that can be hazardous over a broader area and extend further downstream.

- **Thunderstorms**: Based on the extensive evaluation of rain storms completed in the Carlton study (Carlton 2011), it was determined that typical thunderstorms have a duration of about 2 hours. The study evaluated over 300,000 storm cells using gage-adjusted NEXRAD data, collected over a 14-year period (1994 to 2008). Storms lasting longer than 3 hours were rarely found. Therefore, the results of the Carlton study have been used to define the shorter duration design storms.

  To determine the temporal distribution of thunderstorms, 22 gage-adjusted NEXRAD storm cells were studied in detail. Through a process described in a technical memorandum prepared by the City of Colorado Springs (City of Colorado Springs 2012), the results of this analysis were interpreted and normalized to the 1-hour rainfall depth to create the distribution shown in Table 6-3 with a 5 minute time interval for drainage basins up to 1 square mile in size. This distribution represents the rainfall

APPENDIX B

Detention Basin Calculations

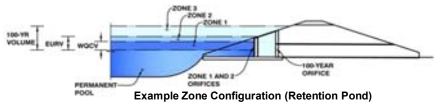
Full Spectrum Detention Basin/Extended Detention Basin
Detention Volume and Emergency Spillway
Outlet Structure Calculations
Trickle Channel Capacity and Outlet Structure Sizing
Trash Rack and Safety Grate Sizing
Forebay Sizing Calculations

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: The Glen at Widefield Filing No. 10

Basin ID: Detention Basin "D"



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	**EDB**			
Watershed Area =	62.07	acres		
Watershed Length =	1,660	ft		
Watershed Slope =	0.017	ft/ft		
Watershed Imperviousness =	32.80%	percent		
Percentage Hydrologic Soil Group A =	0.0%	percent		
Percentage Hydrologic Soil Group B =	0.0%	percent		
Percentage Hydrologic Soil Groups C/D =	100.0%	percent		
Desired WQCV Drain Time =	40.0	hours		
Location for 1-hr Rainfall Depths =	User Input			
Water Quality Capture Volume (WQCV) =	0.827	acre-feet	Optional User Override	
Excess Urban Runoff Volume (EURV) =	1.862	acre-feet	1-hr Precipitation	
2-yr Runoff Volume (P1 = 1.19 in.) =	1.715	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	2.783	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	3.904	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	6.004	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	7.506	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	9.404	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.2 in.) =	13.341	acre-feet	3.20	inches
Approximate 2-yr Detention Volume =	1.607	acre-feet		
Approximate 5-yr Detention Volume =	2.628	acre-feet		
Approximate 10-yr Detention Volume =	3.033	acre-feet		
Approximate 25-yr Detention Volume =	3.385	acre-feet		
Approximate 50-yr Detention Volume =	3.536	acre-feet		
Approximate 100-yr Detention Volume =	4.277	acre-feet		

Stage-Storage Calculation

Zone 1 Volume (WQCV) =	0.827	acre-feet
Zone 2 Volume (EURV - Zone 1) =	1.035	acre-feet
Zone 3 (100yr + 1 / 2 WQCV - Zones 1 & 2) =	2.828	acre-feet
Total Detention Basin Volume =	4.690	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	**user**	acre-feet

Depth Increment = ____ ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	26	0.001		
	--	0.65	--	--	--	26	0.001	17	0.000
	--	1.00	--	--	--	4,698	0.108	797	0.018
	--	2.00	--	--	--	24,450	0.561	15,174	0.348
	--	3.00	--	--	--	46,873	1.076	51,079	1.173
	--	4.00	--	--	--	58,751	1.349	103,891	2.385
	--	5.00	--	--	--	66,008	1.515	166,270	3.817
	--	6.00	--	--	--	73,878	1.696	236,213	5.423
	--	7.00	--	--	--	82,194	1.887	314,249	7.214
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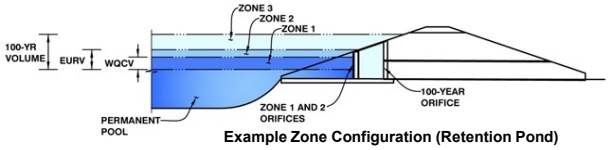
Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: The Glen at Widefield Filing 10,11 & Designeated Future Area

Basin ID: D'



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.65	0.827	Orifice Plate
Zone 2 (EURV)	3.60	1.035	Orifice Plate
(100+1/2WQCV)	5.56	2.828	Weir&Pipe (Rect.)
		4.690	Total

0

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

Underdrain Orifice Invert Depth =	N/A	ft (distance below the filtration media surface)	Underdrain Orifice Area =	N/A	ft^2
Underdrain Orifice Diameter =	N/A	inches	Underdrain Orifice Centroid =	N/A	feet

Calculated Parameters for Underdrain

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

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	1.042E-02	ft^2
Depth at top of Zone using Orifice Plate =	3.86	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	N/A	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	1.50	sq. inches (diameter = 1-3/8 inches)	Elliptical Slot Area =	N/A	ft^2

Calculated Parameters for Plate

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	0.50	1.00	1.50	2.00	2.50		
Orifice Area (sq. inches)	1.50	1.50	1.50	1.50	1.50	1.50		

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

User Input: Vertical Orifice (Circular or Rectangular)

	Not Selected	Not Selected			Not Selected	Not Selected	
Invert of Vertical Orifice =	2.72	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	0.35	N/A	ft^2
Depth at top of Zone using Vertical Orifice =	3.85	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	0.33	N/A	feet
Vertical Orifice Diameter =	8.00	N/A	inches				

Calculated Parameters for Vertical Orifice

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

	Zone 3 Weir	Not Selected			Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	3.86	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	5.11	N/A	feet
Overflow Weir Front Edge Length =	6.25	N/A	feet	Over Flow Weir Slope Length =	5.15	N/A	feet
Overflow Weir Slope =	4.00	N/A	H:V (enter zero for flat grate)	Grate Open Area / 100-yr Orifice Area =	13.53	N/A	should be ≥ 4
Horiz. Length of Weir Sides =	5.00	N/A	feet	Overflow Grate Open Area w/o Debris =	22.55	N/A	ft^2
Overflow Grate Open Area % =	70%	N/A	%, grate open area/total area	Overflow Grate Open Area w/ Debris =	11.27	N/A	ft^2
Debris Clogging % =	50%	N/A	%				

Calculated Parameters for Overflow Weir

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

	Zone 3 Rectangular	Not Selected			Zone 3 Rectangular	Not Selected	
Depth to Invert of Outlet Pipe =	0.33	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	1.67	N/A	ft^2
Rectangular Orifice Width =	24.00	N/A	inches	Outlet Orifice Centroid =	0.42	N/A	feet
Rectangular Orifice Height =	10.00		inches	Half-Central Angle of Restrictor Plate on Pipe =	N/A	N/A	radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	6.00	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	1.49	feet
Spillway Crest Length =	24.00	feet	Stage at Top of Freeboard =	8.49	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	1.89	acres
Freeboard above Max Water Surface =	1.00	feet			

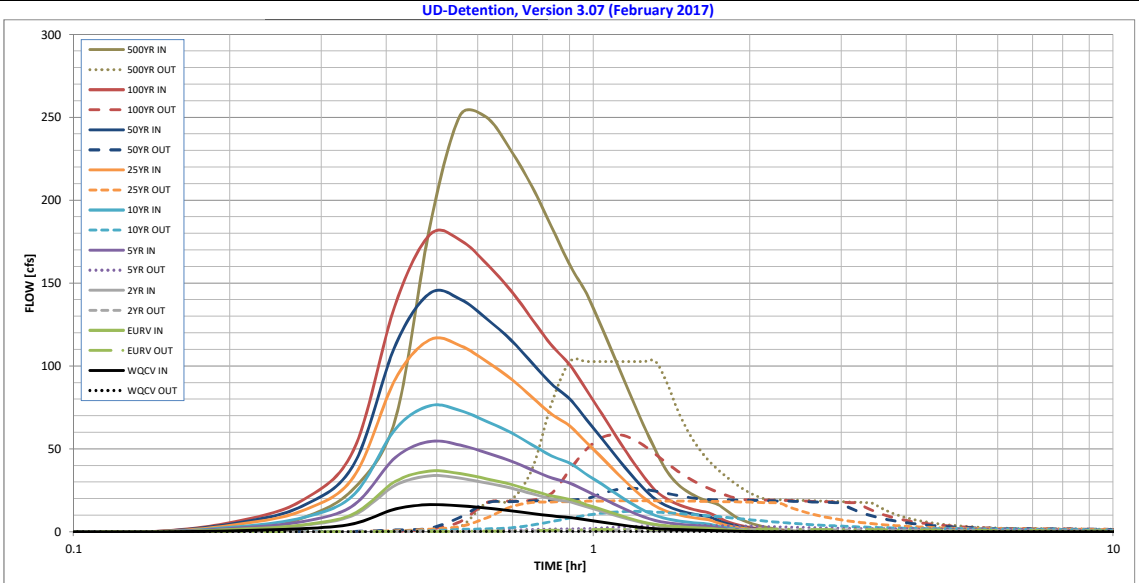
Calculated Parameters for Spillway

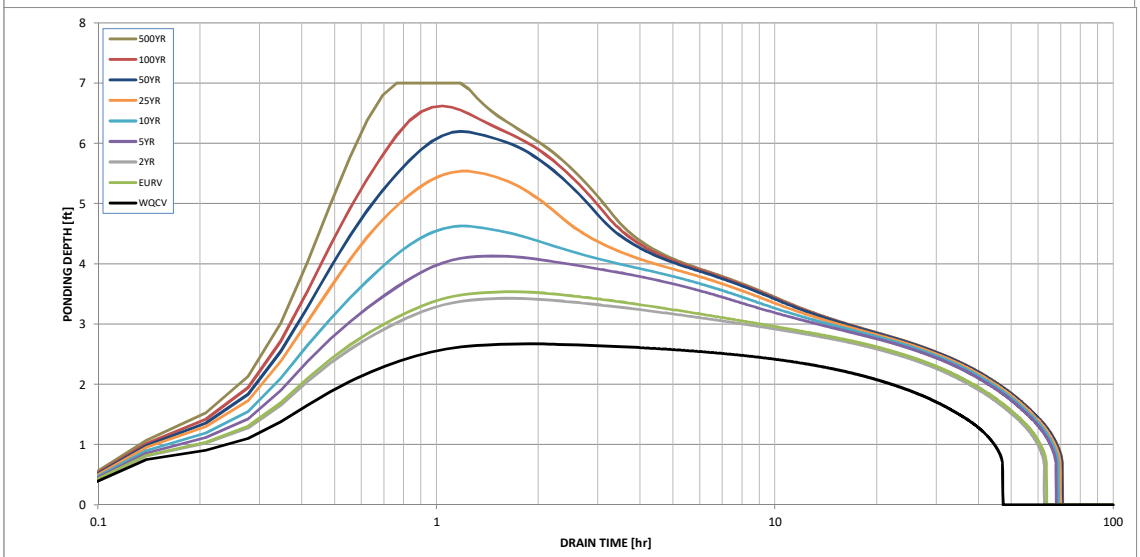
Routed Hydrograph Results

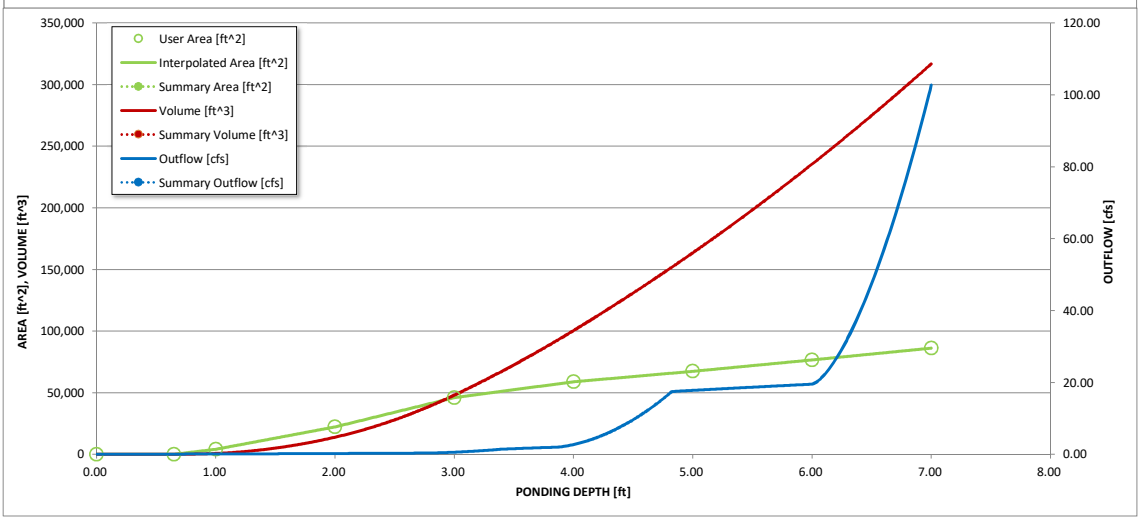
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	3.20
Calculated Runoff Volume (acre-ft) =	0.827	1.862	1.715	2.783	3.904	6.004	7.506	9.404	13.341
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.827	1.862	1.714	2.783	3.904	6.002	7.501	9.404	13.337
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.02	0.16	0.43	0.98	1.29	1.67	2.45
Predevelopment Peak Q (cfs) =	0.0	0.0	1.2	9.9	26.7	60.7	80.1	103.5	152.3
Peak Inflow Q (cfs) =	16.5	36.7	33.8	54.6	76.1	115.9	144.1	179.4	251.4
Peak Outflow Q (cfs) =	0.3	1.5	1.4	3.5	11.7	18.7	26.4	59.6	102.7
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.4	0.4	0.3	0.3	0.6	0.7
Structure Controlling Flow =	Plate	Vertical Orifice 1	Vertical Orifice 1	Overflow Grate 1	Overflow Grate 1	Outlet Plate 1	Spillway	Spillway	N/A
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	0.1	0.4	0.7	0.7	0.7	0.8
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) =	45	61	60	63	61	57	55	51	45
Time to Drain 99% of Inflow Volume (hours) =	**48**	65	64	68	68	67	66	65	61
Maximum Ponding Depth (ft) =	2.60	3.48	3.37	4.09	4.60	5.52	6.20	6.63	7.00
Area at Maximum Ponding Depth (acres) =	0.87	1.20	1.18	1.36	1.45	1.61	1.73	1.82	1.89
Maximum Volume Stored (acre-ft) =	0.783	1.708	1.589	2.493	3.210	4.629	5.748	6.529	7.214

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			

Outflow Hy

Storm Inflow Hydrographs UD-Dete

The user can override the calculated inflow hyc

Time Interval	SOURCE	WORKBOOK	WORKBOOK
	TIME	WQCV [cfs]	EURV [cfs]
4.16 min	0:00:00	0.00	0.00
	0:04:10	0.00	0.00
Hydrograph	0:08:19	0.00	0.00
Constant	0:12:29	0.73	1.58
1.202	0:16:38	1.96	4.32
	0:20:48	5.03	11.08
	0:24:58	13.82	30.42
	0:29:07	16.46	36.71
	0:33:17	15.72	35.14
	0:37:26	14.31	31.99
	0:41:36	12.80	28.71
	0:45:46	11.07	24.95
	0:49:55	9.64	21.67
	0:54:05	8.73	19.65
	0:58:14	7.22	16.38
	1:02:24	5.91	13.50
	1:06:34	4.57	10.57
	1:10:43	3.42	8.05
	1:14:53	2.47	5.91
	1:19:02	1.91	4.49
	1:23:12	1.57	3.66
	1:27:22	1.33	3.09
	1:31:31	1.17	2.70
	1:35:41	1.05	2.42
	1:39:50	0.97	2.22
	1:44:00	0.71	1.64
	1:48:10	0.52	1.20
	1:52:19	0.38	0.88
	1:56:29	0.28	0.65
	2:00:38	0.20	0.47
	2:04:48	0.14	0.34
	2:08:58	0.10	0.24
	2:13:07	0.07	0.17
	2:17:17	0.04	0.10
	2:21:26	0.02	0.06
	2:25:36	0.01	0.02
	2:29:46	0.00	0.00
	2:33:55	0.00	0.00
	2:38:05	0.00	0.00
	2:42:14	0.00	0.00
	2:46:24	0.00	0.00
	2:50:34	0.00	0.00
	2:54:43	0.00	0.00
	2:58:53	0.00	0.00
	3:03:02	0.00	0.00
	3:07:12	0.00	0.00
	3:11:22	0.00	0.00
	3:15:31	0.00	0.00
	3:19:41	0.00	0.00
	3:23:50	0.00	0.00
	3:28:00	0.00	0.00
	3:32:10	0.00	0.00
	3:36:19	0.00	0.00
	3:40:29	0.00	0.00
	3:44:38	0.00	0.00
	3:48:48	0.00	0.00
	3:52:58	0.00	0.00
	3:57:07	0.00	0.00
	4:01:17	0.00	0.00
	4:05:26	0.00	0.00
	4:09:36	0.00	0.00
	4:13:46	0.00	0.00
	4:17:55	0.00	0.00
	4:22:05	0.00	0.00
	4:26:14	0.00	0.00
	4:30:24	0.00	0.00
	4:34:34	0.00	0.00
	4:38:43	0.00	0.00
	4:42:53	0.00	0.00
	4:47:02	0.00	0.00
	4:51:12	0.00	0.00
	4:55:22	0.00	0.00
	4:59:31	0.00	0.00

Detention Basin Outlet Structure Design

Outflow Hydrograph Workbook Filename:

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

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

Time Interval	SOURCE	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK
	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
4.16 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:04:10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hydrograph	0:08:19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Constant	0:12:29	0.73	1.58	1.46	2.32	3.18	4.63	5.57	6.67	8.68
1.202	0:16:38	1.96	4.32	3.98	6.37	8.80	13.10	16.01	19.55	26.39
	0:20:48	5.03	11.08	10.23	16.35	22.60	33.64	41.12	50.21	67.85
	0:24:58	13.82	30.42	28.08	44.87	61.97	92.15	112.53	137.27	185.10
	0:29:07	16.46	36.71	33.83	54.55	76.12	115.94	144.06	179.41	251.40
	0:33:17	15.72	35.14	32.38	52.31	73.18	112.32	140.35	176.01	249.89
	0:37:26	14.31	31.99	29.47	47.61	66.62	102.61	128.49	161.53	230.36
	0:41:36	12.80	28.71	26.44	42.82	60.01	92.50	115.88	145.75	208.01
	0:45:46	11.07	24.95	22.96	37.33	52.47	81.14	101.82	128.29	183.59
	0:49:55	9.64	21.67	19.95	32.51	45.79	70.94	89.10	112.33	160.88
	0:54:05	8.73	19.65	18.09	29.42	41.36	63.86	80.04	100.70	143.70
	0:58:14	7.22	16.38	15.07	24.58	34.64	53.76	67.61	85.38	122.62
	1:02:24	5.91	13.50	12.41	20.32	28.69	44.63	56.19	71.02	102.14
	1:06:34	4.57	10.57	9.71	16.01	22.71	35.57	44.93	57.00	82.44
	1:10:43	3.42	8.05	7.38	12.28	17.53	27.61	34.98	44.48	64.58
	1:14:53	2.47	5.91	5.41	9.10	13.08	20.76	26.38	33.67	49.15
	1:19:02	1.91	4.49	4.12	6.87	9.82	15.47	19.59	24.91	36.30
	1:23:12	1.57	3.66	3.36	5.56	7.90	12.37	15.61	19.77	28.60
	1:27:22	1.33	3.09	2.84	4.69	6.65	10.39	13.10	16.56	23.88
	1:31:31	1.17	2.70	2.48	4.09	5.79	9.02	11.35	14.33	20.60
	1:35:41	1.05	2.42	2.23	3.66	5.18	8.05	10.12	12.77	18.31
	1:39:50	0.97	2.22	2.04	3.36	4.74	7.36	9.25	11.65	16.68
	1:44:00	0.71	1.64	1.51	2.49	3.53	5.55	7.02	8.93	13.00
	1:48:10	0.52	1.20	1.10	1.81	2.56	4.01	5.07	6.44	9.36
	1:52:19	0.38	0.88	0.81	1.33	1.89	2.97	3.76	4.78	6.95
	1:56:29	0.28	0.65	0.60	0.99	1.41	2.21	2.79	3.55	5.15
	2:00:38	0.20	0.47	0.43	0.72	1.03	1.62	2.06	2.62	3.82
	2:04:48	0.14	0.34	0.31	0.52	0.74	1.17	1.49	1.90	2.77
	2:08:58	0.10	0.24	0.22	0.37	0.54	0.85	1.08	1.37	2.00
	2:13:07	0.07	0.17	0.15	0.26	0.37	0.60	0.76	0.98	1.43
	2:17:17	0.04	0.10	0.09	0.16	0.24	0.39	0.50	0.65	0.96
	2:21:26	0.02	0.06	0.05	0.09	0.14	0.23	0.29	0.38	0.58
	2:25:36	0.01	0.02	0.02	0.04	0.06	0.11	0.14	0.19	0.29
	2:29:46	0.00	0.00	0.00	0.01	0.02	0.03	0.04	0.06	0.10
	2:33:55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:38:05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:42:14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:46:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:50:34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:54:43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:58:53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:03:02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:07:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:11:22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:19:41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:23:50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:28:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:32:10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:36:19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:44:38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:48:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:52:58	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:57:07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:01:17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:09:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:13:46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:17:55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:22:05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:26:14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:34:34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:38:43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:42:53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:47:02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:51:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:59:31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Design Procedure Form: Extended Detention Basin (EDB)

UD-BMP (Version 3.07, March 2018)

Designer: M Kahnke
Company: Kiowa Engineering
Date: November 27, 2019
Project: The Glen at Widefield - Filing No 11
Location: Widefield, CO

1. Basin Storage Volume

A) Effective Imperviousness of Tributary Area, I_a — I_a = 32.8 %

B) Tributary Area's Imperviousness Ratio ($i = I_a / 100$) — i = 0.328

C) Contributing Watershed Area — Area = 62.070 ac

D) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm — d_6 = 0.42 in

E) Design Concept (Select EURV when also designing for flood control)

Choose One
- ○ Water Quality Capture Volume (WQCV)
- ◉ Excess Urban Runoff Volume (EURV)

F) Design Volume (WQCV) Based on 40-hour Drain Time
($V_{DESIGN} = (1.0 * (0.91 * i^3 - 1.19 * i^2 + 0.78 * i) / 12 * Area$)
V_{DESIGN} = ac-ft

G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume
($V_{WQCV\ OTHER} = (d_6 * (V_{DESIGN}/0.43))$)
$V_{DESIGN\ OTHER}$ = ac-ft

H) User Input of Water Quality Capture Volume (WQCV) Design Volume (Only if a different WQCV Design Volume is desired)
$V_{DESIGN\ USER}$ = 0.830 ac-ft

I) NRCS Hydrologic Soil Groups of Tributary Watershed
i) Percentage of Watershed consisting of Type A Soils — HSG_A = 0 %
ii) Percentage of Watershed consisting of Type B Soils — HSG_B = 0 %
iii) Percentage of Watershed consisting of Type C/D Soils — $HSG_{C/D}$ = 100 %

J) Excess Urban Runoff Volume (EURV) Design Volume
For HSG A: $EURV_A = 1.68 * i^{1.28}$
For HSG B: $EURV_B = 1.36 * i^{1.08}$
For HSG C/D: $EURV_{C/D} = 1.20 * i^{1.08}$
$EURV_{DESIGN}$ = 1.862 ac-f t

K) User Input of Excess Urban Runoff Volume (EURV) Design Volume (Only if a different EURV Design Volume is desired)
$EURV_{DESIGN\ USER}$ = ac-f t

2. Basin Shape: Length to Width Ratio
(A basin length to width ratio of at least 2:1 will improve TSS reduction.)
L : W = 2.0 : 1

3. Basin Side Slopes

A) Basin Maximum Side Slopes
(Horizontal distance per unit vertical, 4:1 or flatter preferred)
Z = 6.00 ft / ft

4. Inlet

A) Describe means of providing energy dissipation at concentrated inflow locations:
2 Presedimentation Forebays ('Inflow H' and 'Inflow J')

5. Forebay

A) Minimum Forebay Volume
(V_{FMIN} = 3% of the WQCV)
V_{FMIN} = 0.025 ac-ft

B) Actual Forebay Volume
V_F = 0.025 ac-ft

C) Forebay Depth
(D_F = 30 inch maximum)
D_F = 30.0 in

D) Forebay Discharge

i) Undetained 100-year Peak Discharge
Q_{100} = 75.90 cfs

ii) Forebay Discharge Design Flow
($Q_F = 0.02 * Q_{100}$)
Q_F = 1.52 cfs

E) Forebay Discharge Design

Choose One
- ○ Berm With Pipe
- ◉ Wall with Rect. Notch
- ○ Wall with V-Notch Weir

F) Discharge Pipe Size (minimum 8-inches)
Calculated D_P = in

G) Rectangular Notch Width
Calculated W_N = 7.4 in

Design Procedure Form: Extended Detention Basin (EDB)

Designer: M Kahnke
Company: Kiowa Engineering
Date: November 27, 2019
Project: The Glen at Widefield - Filing No 11
Location: Widefield, CO

6. Trickle Channel

A) Type of Trickle Channel — Choose One: (●) Concrete ( ) Soft Bottom

FOR A CONCRETE TRICKLE CHANNEL, SLOPE SHOULD BE BETWEEN 0.004 AND 0.010 FT/FT.

F) Slope of Trickle Channel — S = 0.0003 ft / ft

7. Micropool and Outlet Structure

A) Depth of Micropool (2.5-feet minimum) — D_M = 2.5 ft

B) Surface Area of Micropool (10 ft^2 minimum) — A_M = 17 sq ft

C) Outlet Type — Choose One: (●) Orifice Plate ( ) Other (Describe):

D) Smallest Dimension of Orifice Opening Based on Hydrograph Routing (Use UD-Detention) — $D_{orifice}$ = 10.00 inches

E) Total Outlet Area — A_{ot} = 240.00 square inches

8. Initial Surcharge Volume

A) Depth of Initial Surcharge Volume (Minimum recommended depth is 4 inches) — D_{IS} = 4 in

B) Minimum Initial Surcharge Volume (Minimum volume of 0.3% of the WQCV) — V_{IS} = 108 cu ft

C) Initial Surcharge Provided Above Micropool — V_s = 5.7 cu ft

9. Trash Rack

A) Water Quality Screen Open Area: $A_t = A_{ot} * 38.5*(e^{-0.095D})$ — A_t = 3,573 square inches

B) Type of Screen (If specifying an alternative to the materials recommended in the USDCM, indicate "other" and enter the ratio of the total open are to the total screen are for the material specified.) — *Aluminum Amico-Klemp SR Series with Cross Rods 4" O.C.*

Other (Y/N): N

C) Ratio of Total Open Area to Total Area (only for type 'Other') — User Ratio =

D) Total Water Quality Screen Area (based on screen type) — A_{total} = 4641 sq. in.

E) Depth of Design Volume (EURV or WQCV) (Based on design concept chosen under 1E) — H= 3.66 feet

F) Height of Water Quality Screen (H_{TR}) — H_{TR}= 71.92 inches

G) Width of Water Quality Screen Opening ($W_{opening}$) (Minimum of 12 inches is recommended) — $W_{opening}$ = 64.5 inches

Design Procedure Form: Extended Detention Basin (EDB)

Designer: M Kahnke
Company: Kiowa Engineering
Date: November 27, 2019
Project: The Glen at Widefield - Filing No 11
Location: Widefield, CO

10. Overflow Embankment

A) Describe embankment protection for 100-year and greater overtopping:

10' Width Earthen Berm where elevated above grade with buried riprap spillway, per criteria.

B) Slope of Overflow Embankment
(Horizontal distance per unit vertical, 4:1 or flatter preferred)

Ze = 4.00 ft / ft

11. Vegetation

Choose One
- (•) Irrigated
- ( ) Not Irrigated

AVOID PLACING IRRIGATION HEADS IN THE BOTTOM OF THE BASIN

12. Access

A) Describe Sediment Removal Procedures

Sedimentation forebays will capture light sediment. Detention basin planned with access road. Perimeter maintenance road is drivable. Concrete trickle channel throughout low-flow section. Outlet structure has trash rack, per criteria. O & M Manual provided, per criteria.

Notes:

The Glen at Widefield
Detention Volume Calculations

Detention Basin 'D' Earthwork (November 27, 2019)

Elevation	Area (A)	Avg. Area	Volume	Depth	Cumulative Volume		Elev.
5670.35	26sf						
5671	26sf	26sf	17cf	0.6 ft	**17cf**	**0.00ac-ft**	5671
5672	4,698sf	2,362sf	2,362cf	1.6 ft	**2,379cf**	**0.05ac-ft**	5672
5673	24,450sf	14,574sf	14,574cf	2.6 ft	**16,953cf**	**0.39ac-ft**	5673
5674	46,873sf	35,662sf	35,662cf	3.6 ft	**52,614cf**	**1.21ac-ft**	5674
5675	58,751sf	52,812sf	52,812cf	4.6 ft	**105,426cf**	**2.42ac-ft**	5675
5676	66,008sf	62,380sf	62,380cf	5.6 ft	**167,806cf**	**3.85ac-ft**	5676
5677	73,878sf	69,943sf	69,943cf	6.6 ft	**237,749cf**	**5.46ac-ft**	5677
5678	82,194sf	78,036sf	78,036cf	7.6 ft	**315,785cf**	**7.25ac-ft**	5678

Average End Area Formula: V = (A1+A2)/2 x Elev Difference

WQCV =	34,800 cf	0.99 ac-ft	5685.73 ft
100yr Volume =	158,123 cf	3.63 ac-ft	5676.00 ft
100yr Volume + 1/2 WQCV =	178,160 cf	4.09 ac-ft	5676.38 ft
	Detention Freeboard Depth =		1.62 ft
Spillway Crest =	211,050 cf	4.85 ac-ft	5677.00 ft

OrigInal Detention Basin 'D' Earthwork (Preliminary)

Elevation	Area (A)	Avg. Area	Volume	Depth	Cumulative Volume		Elev.
5665.7	0sf						
5667	39,170sf	19,585sf	25,461cf	-3.4 ft	**25,461cf**	**0.58ac-ft**	5667
5668	42,246sf	40,708sf	40,708cf	-2.4 ft	**66,169cf**	**1.52ac-ft**	5668
5669	45,423sf	43,835sf	43,835cf	-1.4 ft	**110,004cf**	**2.53ac-ft**	5669
5670	48,700sf	47,062sf	47,062cf	-0.4 ft	**157,065cf**	**3.61ac-ft**	5670
5671	52,078sf	50,389sf	50,389cf	0.6 ft	**207,454cf**	**4.76ac-ft**	5671
5672	55,556sf	53,817sf	53,817cf	1.6 ft	**261,271cf**	**6.00ac-ft**	5672
5673	59,134sf	57,345sf	57,345cf	2.6 ft	**318,616cf**	**7.31ac-ft**	5673

Average End Area Formula: V = (A1+A2)/2 x Elev Difference

WQCV =	34,800 cf	0.99 ac-ft	5667.23 ft
100yr Volume =	158,123 cf	3.63 ac-ft	5670.02 ft
100yr Volume + 1/2 WQCV =	178,160 cf	4.09 ac-ft	5670.42 ft
	Detention Freeboard Depth =		2.58 ft
Spillway Crest =	308,232 cf	7.08 ac-ft	5673.00 ft

APPENDIX B.1

Supporting Detention Basin Tables and Figures

beneficial if a project is being phased or when adequate land is not available to combine all of the elements in one facility.

4.1.1 Flood Control Volume

UDFCD has developed empirical equations for estimating the total required storage volume that can be applied to on-site, multi-level ponds or to on-site or sub-regional FSD ponds. The empirical equations include:

$$V_i = K_i A \quad \text{Equation 13-1}$$

For NRCS soil types B, C and D.

$$K_{100} = (1.78 \cdot I - 0.002 I^2 - 3.56) / 900 \quad \text{Equation 13-2}$$

$$K_5 = (0.77 \cdot I - 2.65) / 1{,}000 \quad \text{Equation 13-3}$$

For NRCS soil Type A:

$$K_{100A} = (-0.00005501 \cdot I^2 + 0.030148 \cdot I - 0.12) / 12 \quad \text{Equation 13-4}$$

Where:

V_i = required volume, with i= year storm, acre-feet

K_i = empirical volume coefficient, with i= year storm

i = return period for storm event, years

I = fully developed tributary basin imperviousness, %

A = tributary drainage basin area, acres

These equations can be applied to calculate the total detention storage for drainage basins up to about 130 acres. When more than one soil type or land use is present in the drainage basin, the storage volume must be weighted by the proportionate areas of each soil type and/or land use. For FSDs, the EURV need not be added to this volume. See UDFCD Manual Volume 2, Storage Chapter for a full description of this method.

4.1.2 EURV

UDFCD has developed empirical equations for estimating the EURV portion of the storage volume that can be applied to on-site, sub-regional or regional FSD ponds.

The empirical equations are as follows:

For NRCS Soil Group A:

$$EURV_A = 1.1\ (2.0491(I/100) - 0.1113) \quad \text{Equation 13-5}$$

For NRCS Soil Group B:

$$EURV_B = 1.1\ (1.2846(I/100) - 0.0461) \quad \text{Equation 13-6}$$

For NRCS Soil Group C/D:

$$EURV_{CD} = 1.1\ (1.1381(I/100) - 0.0339) \qquad \text{Equation 13-7}$$

Where:

$EURV_K$ = Excess Urban Runoff Volume in watershed inches, K=A, B or C/D soil group

I = drainage basin imperviousness, %

These equations apply to all FSDs and the EURV need not be added to the flood control volume or to the WQCV. When more than one soil type or land use is present in the drainage basin, the EURV must be weighted by the proportionate areas of each soil type and/or land use. If hydrologic routing is used to size the flood control volume, the EURV remains the same as calculated by these equations and is included in the pond's stage/storage configuration for modeling.

4.1.3 Initial Surcharge Volume

The initial surcharge volume is at least 0.3 percent of the WQCV and should be 4- to 12-inches deep. The initial surcharge volume is included in the WQCV and does not increase the required total storage volume.

4.1.4 Design Worksheets

The Full Spectrum Worksheet in the UD-Detention Spreadsheet performs all of these calculations for the standard designs. For multi-level ponds, the flood control volumes are calculated for the two design storm frequencies: the major storm and the minor storm.

4.2 Allowable Release Rates

Allowable release rates from detention facilities vary with the type of facility and with the storage volume type, as follows:

- **Flood Storage Volume**: The flood storage release rates are determined by the allowable release rates that are intended to approximate storm event runoff rates from the undeveloped upstream drainage basin.
- **EURV**: The EURV release rate is determined based on a72-hour drain time. The purpose of this slow release rate is to mitigate the impacts of increased runoff volumes due to development by reducing the potential for downstream erosion.
- **WQCV**: The WQCV release rate is determined based on a 40-hour drain time for extended detention basins. The purpose of this slow release rate is to provide time for pollutants to settle, The WQCV is incorporated into the EURV and works with it to release less erosive flows. The method for determining this design rate is described in Chapter 3 of Volume 2 of this Manual.

4.2.1 Flood Storage Release Rates

Allowable releases rates from the flood storage element of detention may be based on generalized average unit runoff rates or estimates of pre-development runoff rates. Allowable unit release rates (cfs/ac) may be used for any type of detention, however, when a hydrograph routing method is applied (for regional or

Safety Grates

Safety grates are intended to keep people and animals from inadvertently entering a storm drain. They are sometimes required even when debris entering a storm drain is not a concern. The grate on top of the outlet drop box is considered a safety grate and should be designed accordingly. The danger associated with outlet structures is the potential associated with pinning a person or animal to unexposed outlet pipe or grate. See the *Culverts and Bridges* chapter of Volume 2 of this manual for design criteria related to safety grates.

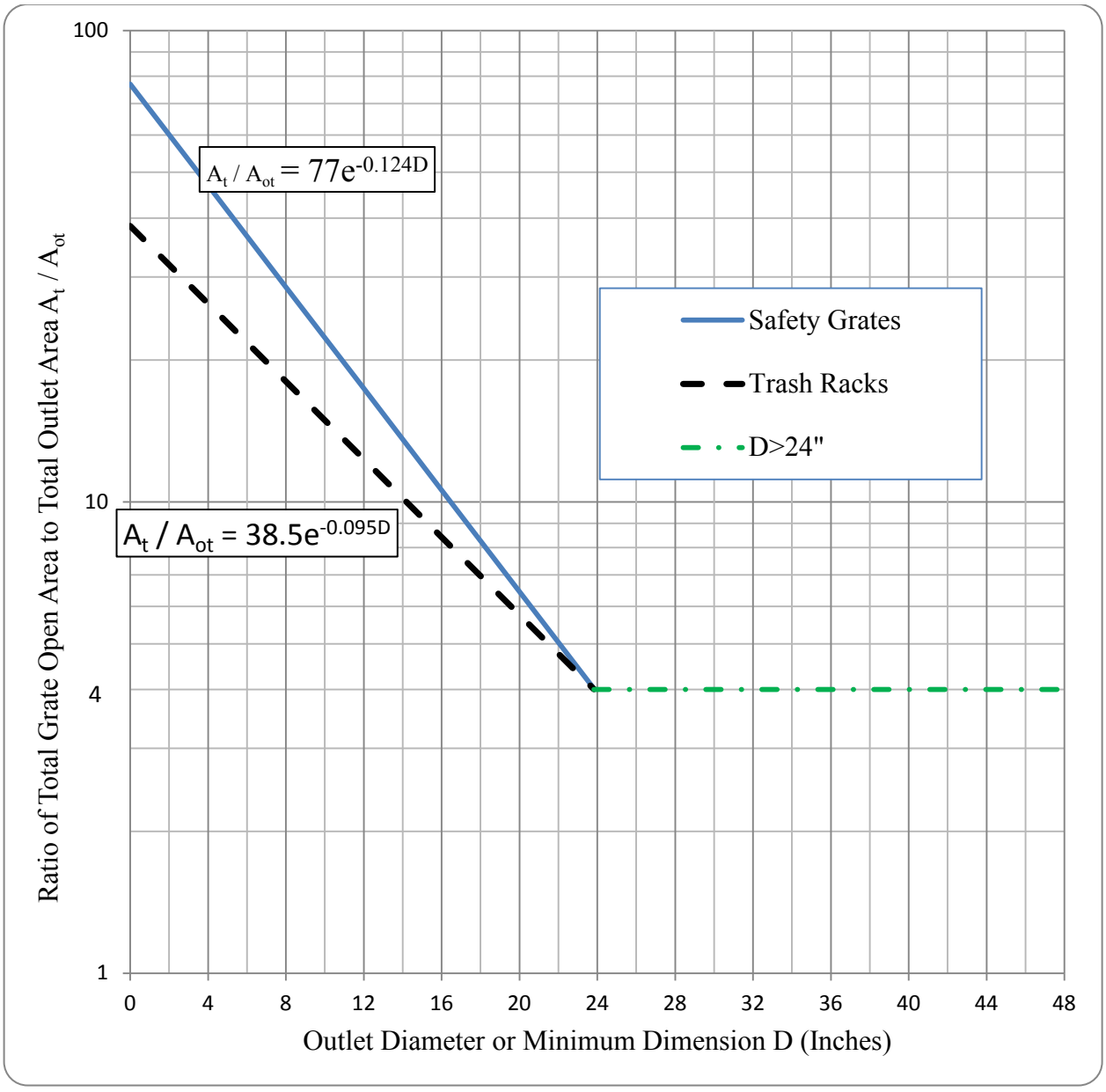
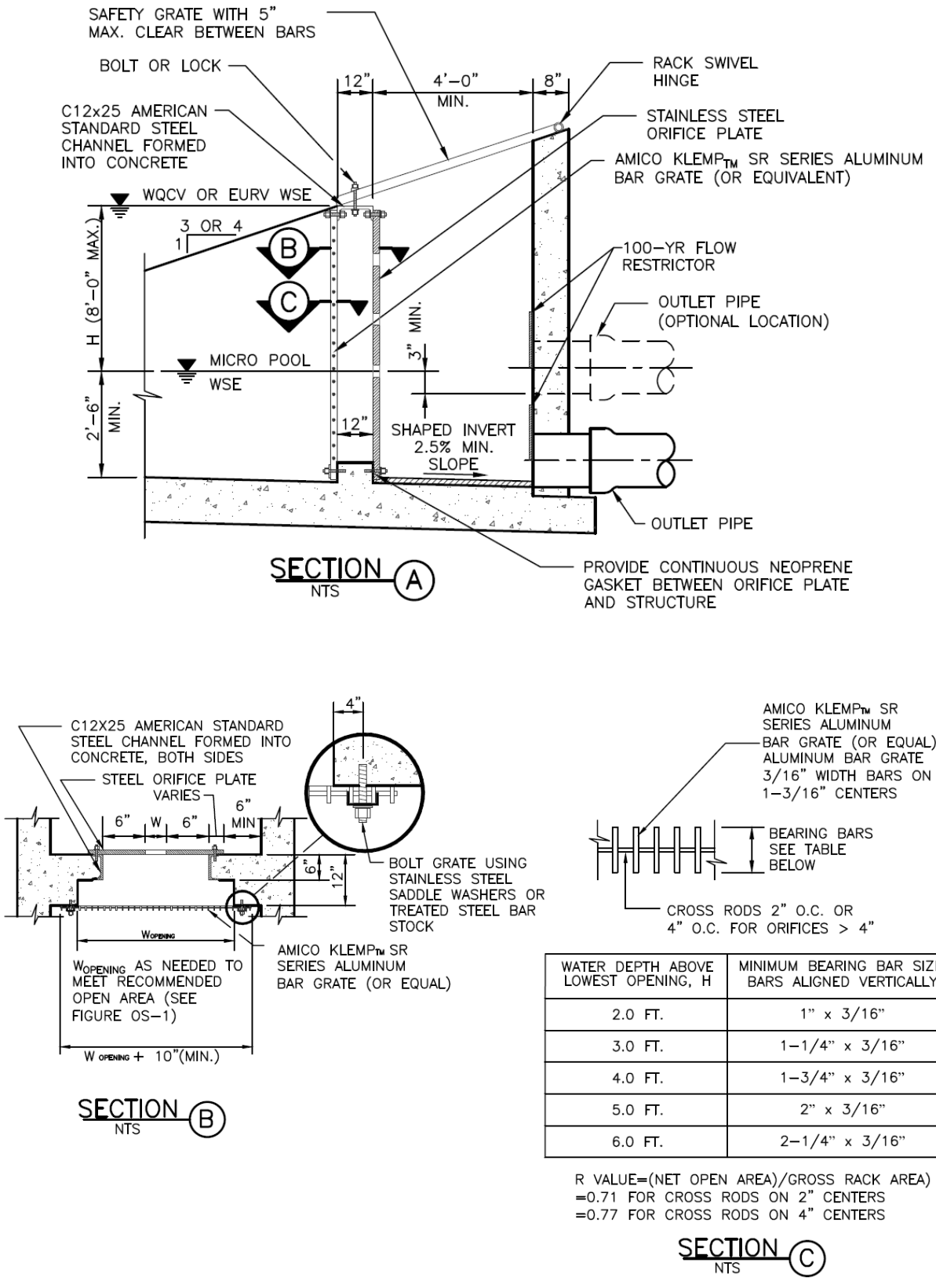


Figure OS-1. Trash Rack Sizing

Table OS-2. Thickness of steel water quality plate

Steel plate thickness (in inches) based on design depth and span of plate											
		Head (feet)									
		3	4	5	6	7	8	9	10	11	12
Span (feet)	1	0.1875	0.1875	0.1875	0.1875	0.1875	0.1875	0.1875	0.1875	0.1875	0.1875
	2	0.1875	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500
	3	0.2500	0.2500	0.3750	0.3750	0.3750	0.3750	0.3750	0.3750	0.3750	0.5000
	4	0.2500	0.3750	0.3750	0.3750	0.3750	0.5000	0.5000	0.5000	0.5000	0.5000



WATER DEPTH ABOVE LOWEST OPENING, H	MINIMUM BEARING BAR SIZE, BARS ALIGNED VERTICALLY
2.0 FT.	1" x 3/16"
3.0 FT.	1–1/4" x 3/16"
4.0 FT.	1–3/4" x 3/16"
5.0 FT.	2" x 3/16"
6.0 FT.	2–1/4" x 3/16"

Figure OS-6. Typical outlet structure with bar grate trash rack

Figure 13-9. Concept for Integral Forebay at Pipe Outfall

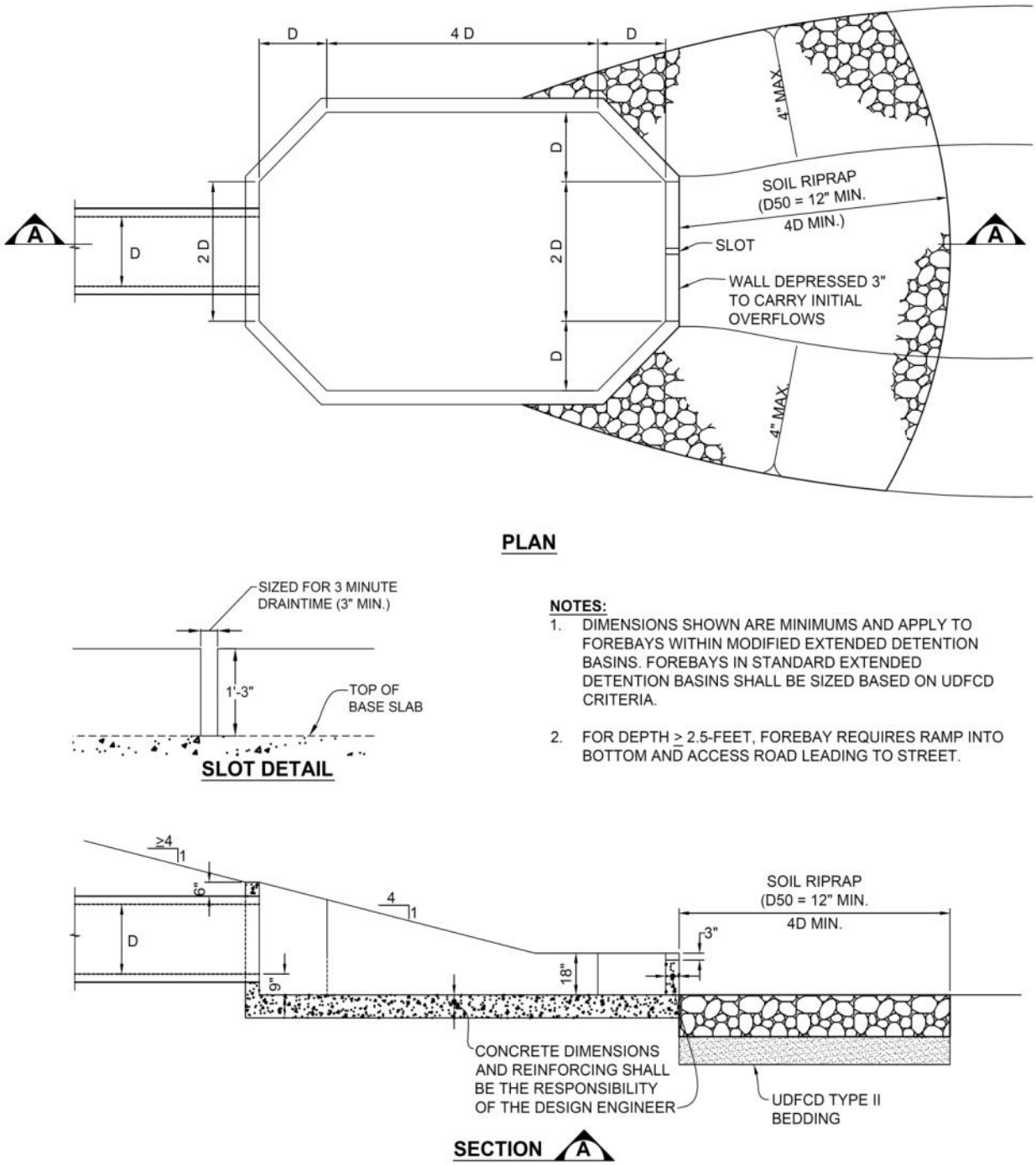


Figure 13-11. Concept for Outlet Structure with Flared Wingwalls and Handrail
(Integral Micropool Shown)

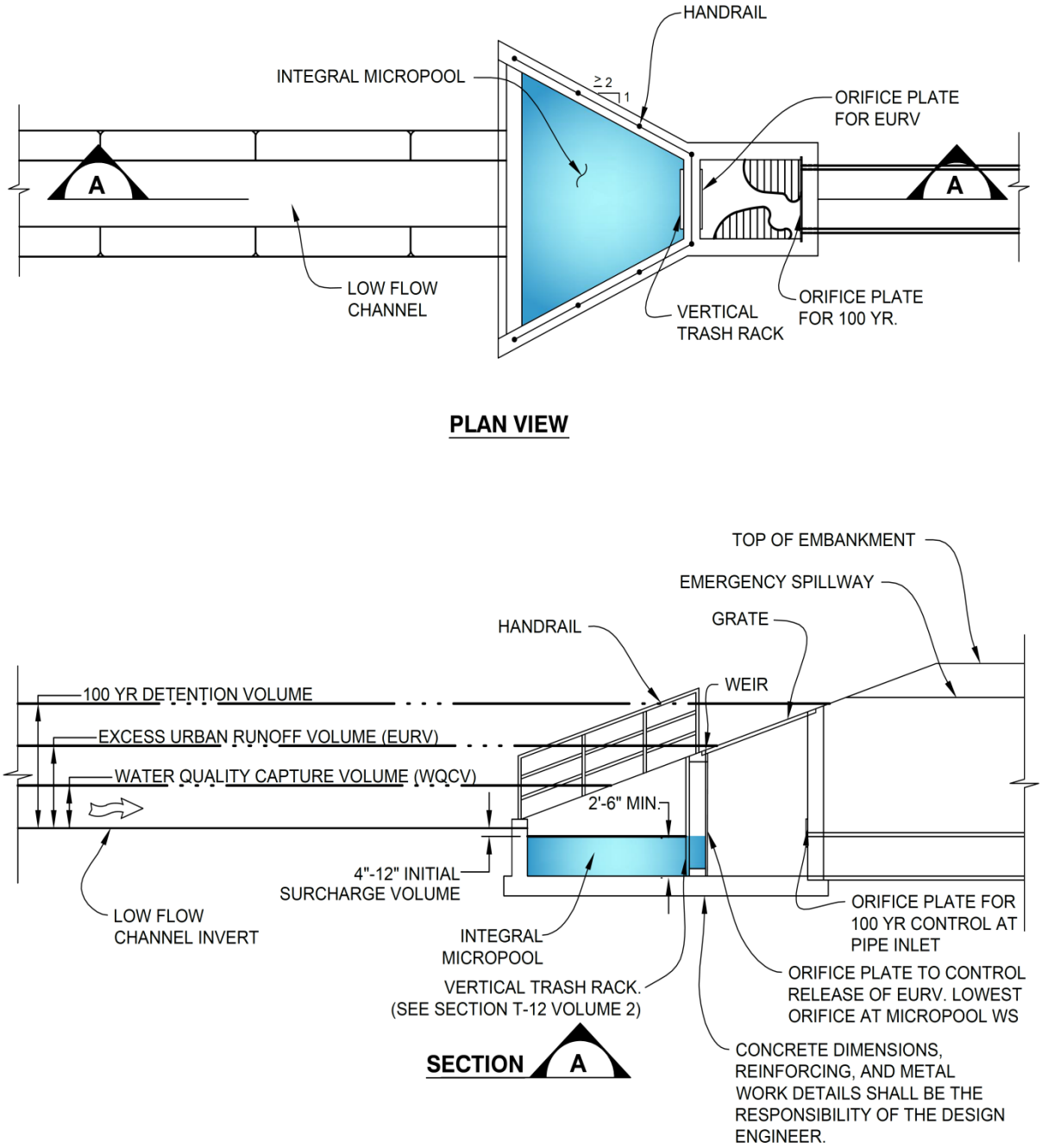


Figure 13-12c. Emergency Spillway Protection

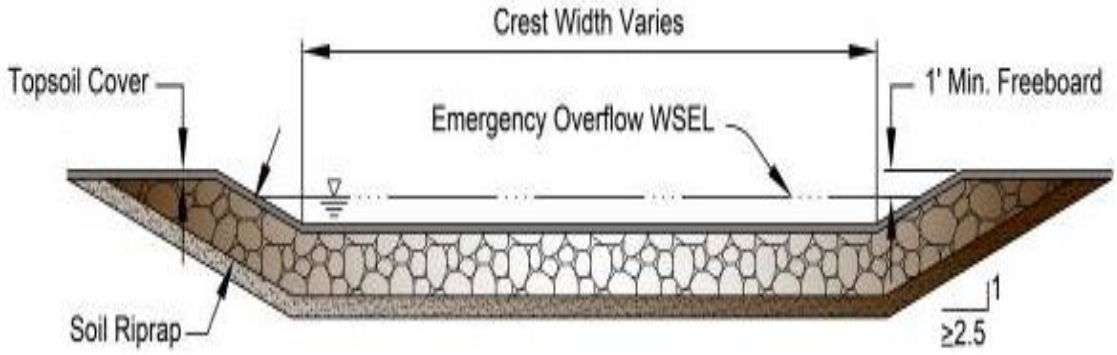
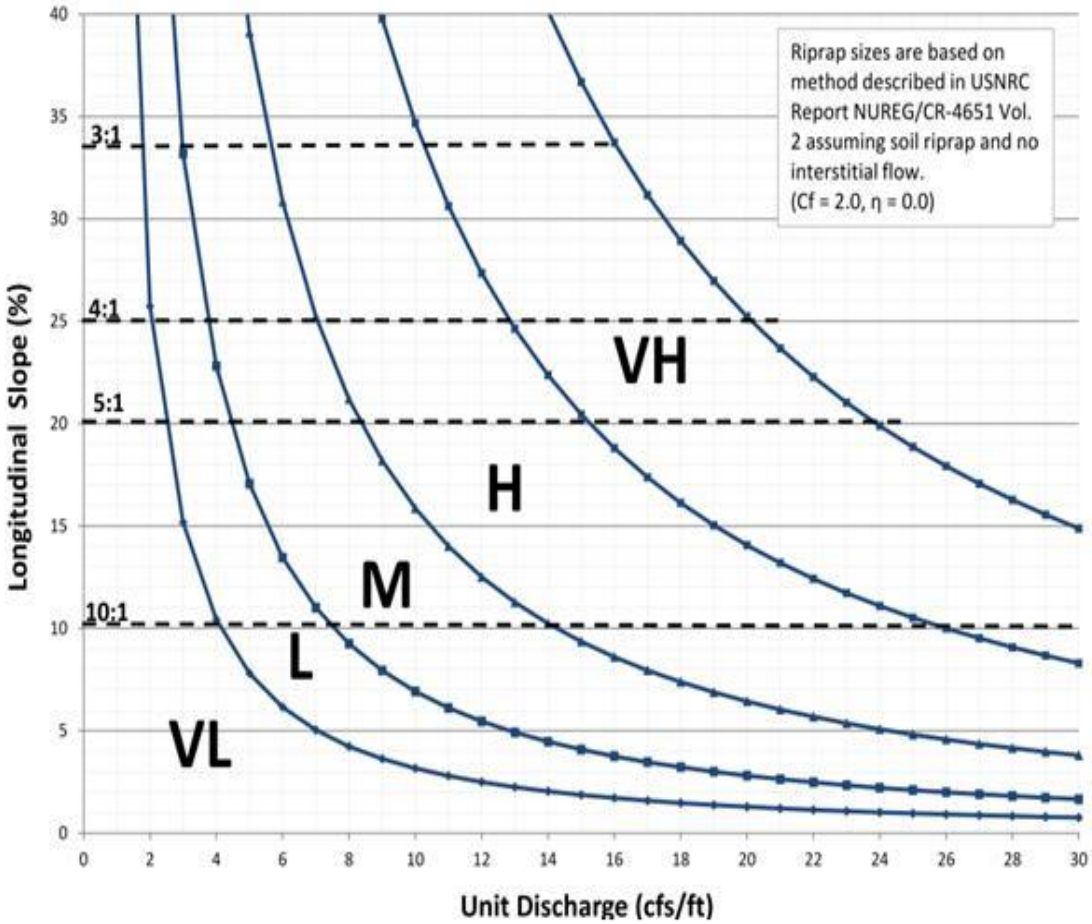


Figure 13-12d. Riprap Types for Emergency Spillway Protection



APPENDIX C

Hydraulic Calculations

Open Channel Calculations
Inlet Summary & Calculations

Version 4.05 Released March 2017

INLET MANAGEMENT

Worksheet Protected

INLET NAME	B-1	C-1	D-1	D-4	G-1
Site Type (Urban or Rural)	URBAN	URBAN	URBAN	URBAN	URBAN
Inlet Application (Street or Area)	STREET	STREET	STREET	STREET	STREET
Hydraulic Condition	On Grade	On Grade	On Grade	On Grade	In Sump
Inlet Type	Colorado Springs D-10-R	Colorado Springs D-10-R	Colorado Springs D-10-R	Colorado Springs D-10-R	CDOT Type R Curb Opening

USER-DEFINED INPUT

User-Defined Design Flows

Minor Q_{Known} (cfs)	5.7	2.1	2.9	4.7	0.2
Major Q_{Known} (cfs)	16.4	6.2	8.5	13.7	0.7

Bypass (Carry-Over) Flow from Upstream

Receive Bypass Flow from:	No Bypass Flow Received	User-Defined	User-Defined	User-Defined	User-Defined
Minor Bypass Flow Received, Q_b (cfs)	0.0	0.0	0.0	0.0	0.0
Major Bypass Flow Received, Q_b (cfs)	0.0	5.2	2.2	1.7	11.8

Watershed Characteristics

Subcatchment Area (acres)					
Percent Impervious					
NRCS Soil Type	C	C	C	C	C

Watershed Profile

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

Minor Storm Rainfall Input

Design Storm Return Period, T_r (years)					
One-Hour Precipitation, P_1 (inches)					
C_1					
C_2					
C_3					
User-defined C					
User-defined 5-yr C_5					
User-defined T_c					

Major Storm Rainfall Input

Design Storm Return Period, T_r (years)					
One-Hour Precipitation, P_1 (inches)					
C_1					
C_2					
C_3					
User-defined C					
User-defined 5-yr C_5					
User-defined T_c					

CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	**5.7**	**2.1**	**2.9**	**4.7**	**0.2**
Major Total Design Peak Flow, Q (cfs)	**16.4**	**11.4**	**10.7**	**15.4**	**12.5**
Minor Flow Bypassed Downstream, Q_b (cfs)	0.0	0.0	0.0	0.0	N/A
Major Flow Bypassed Downstream, Q_b (cfs)	5.2	2.2	1.7	2.2	N/A

Version 4.05 Released March 2017

INLET MANAGEMENT

Worksheet Protected

INLET NAME	G-2	G-3	G-4	E-1
Site Type (Urban or Rural)	URBAN	URBAN	URBAN	URBAN
Inlet Application (Street or Area)	STREET	STREET	STREET	STREET
Hydraulic Condition	On Grade	On Grade	In Sump	On Grade
Inlet Type	Colorado Springs D-10-R	Colorado Springs D-10-R	Colorado Springs D-10-R	Colorado Springs D-10-R

USER-DEFINED INPUT

User-Defined Design Flows

Minor Q_{Known} (cfs)	5.0	3.8	5.7	2.6
Major Q_{Known} (cfs)	14.5	10.9	16.4	7.0

Bypass (Carry-Over) Flow from Upstream

Receive Bypass Flow from:	User-Defined	User-Defined	User-Defined	User-Defined
Minor Bypass Flow Received, Q_b (cfs)	0.0	1.0	0.0	0.0
Major Bypass Flow Received, Q_b (cfs)	1.7	2.3	0.0	0.3

Watershed Characteristics

Subcatchment Area (acres)				
Percent Impervious				
NRCS Soil Type	C	C	C	C

Watershed Profile

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

Minor Storm Rainfall Input

Design Storm Return Period, T_r (years)				
One-Hour Precipitation, P_1 (inches)				
C_1				
C_2				
C_3				
User-defined C				
User-defined 5-yr C_5				
User-defined T_c				

Major Storm Rainfall Input

Design Storm Return Period, T_r (years)				
One-Hour Precipitation, P_1 (inches)				
C_1				
C_2				
C_3				
User-defined C				
User-defined 5-yr C_5				
User-defined T_c				

CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	**5.0**	**4.8**	**5.7**	**2.6**
Major Total Design Peak Flow, Q (cfs)	**16.2**	**13.2**	**16.4**	**7.3**
Minor Flow Bypassed Downstream, Q_b (cfs)	0.0	0.0	N/A	0.0
Major Flow Bypassed Downstream, Q_b (cfs)	5.1	3.2	N/A	0.4

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INLET MANAGEMENT

Worksheet Protected

INLET NAME	E-2	E-6	H-2	J-1
Site Type (Urban or Rural)	URBAN	URBAN	URBAN	URBAN
Inlet Application (Street or Area)	STREET	STREET	STREET	STREET
Hydraulic Condition	On Grade	On Grade	In Sump	In Sump
Inlet Type	Colorado Springs D-10-R	Colorado Springs D-10-R	Colorado Springs D-10-R	Colorado Springs D-10-R

USER-DEFINED INPUT

User-Defined Design Flows

Minor Q_{Known} (cfs)	3.6	3.9	2.4	0.9
Major Q_{Known} (cfs)	10.5	11.3	7.0	2.5

Bypass (Carry-Over) Flow from Upstream

Receive Bypass Flow from:	User-Defined	No Bypass Flow Received	User-Defined	No Bypass Flow Received
Minor Bypass Flow Received, Q_b (cfs)	0.0	0.0	2.3	0.0
Major Bypass Flow Received, Q_b (cfs)	1.7	2.0	12.4	0.0

Watershed Characteristics

Subcatchment Area (acres)				
Percent Impervious				
NRCS Soil Type	C	C	C	C

Watershed Profile

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

Minor Storm Rainfall Input

Design Storm Return Period, T_r (years)				
One-Hour Precipitation, P_1 (inches)				
C_1				
C_2				
C_3				
User-defined C				
User-defined 5-yr C_5				
User-defined T_c				

Major Storm Rainfall Input

Design Storm Return Period, T_r (years)				
One-Hour Precipitation, P_1 (inches)				
C_1				
C_2				
C_3				
User-defined C				
User-defined 5-yr C_5				
User-defined T_c				

CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	**3.6**	**3.9**	**4.7**	**0.9**
Major Total Design Peak Flow, Q (cfs)	**12.2**	**13.3**	**19.4**	**2.5**
Minor Flow Bypassed Downstream, Q_b (cfs)	0.0	0.0	N/A	N/A
Major Flow Bypassed Downstream, Q_b (cfs)	2.6	3.2	N/A	N/A

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INLET MANAGEMENT

Worksheet Protected

INLET NAME	J-2	F-1
Site Type (Urban or Rural)	URBAN	URBAN
Inlet Application (Street or Area)	STREET	STREET
Hydraulic Condition	In Sump	In Sump
Inlet Type	Colorado Springs D-10-R	Colorado Springs D-10-R

USER-DEFINED INPUT

User-Defined Design Flows

Minor Q_{Known} (cfs)	1.3	2.3
Major Q_{Known} (cfs)	3.3	6.8

Bypass (Carry-Over) Flow from Upstream

Receive Bypass Flow from:	No Bypass Flow Received	No Bypass Flow Received
Minor Bypass Flow Received, Q_b (cfs)	0.0	0.0
Major Bypass Flow Received, Q_b (cfs)	0.0	0.0

Watershed Characteristics

Subcatchment Area (acres)		
Percent Impervious		
NRCS Soil Type	C	C

Watershed Profile

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

Minor Storm Rainfall Input

Design Storm Return Period, T_r (years)		
One-Hour Precipitation, P_1 (inches)		
C_1		
C_2		
C_3		
User-defined C		
User-defined 5-yr C_5		
User-defined T_c		

Major Storm Rainfall Input

Design Storm Return Period, T_r (years)		
One-Hour Precipitation, P_1 (inches)		
C_1		
C_2		
C_3		
User-defined C		
User-defined 5-yr C_5		
User-defined T_c		

CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	**1.3**	**2.3**
Major Total Design Peak Flow, Q (cfs)	**3.3**	**6.8**
Minor Flow Bypassed Downstream, Q_b (cfs)	N/A	N/A
Major Flow Bypassed Downstream, Q_b (cfs)	N/A	N/A

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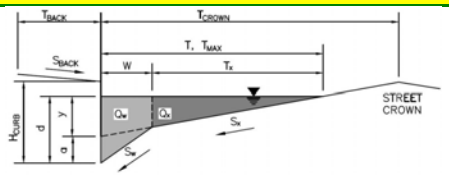
ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

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

Project: The Glen at Widefield Filing No 11

Inlet ID: B-1



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	**0.0057**	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	**17.0**	**17.0**	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	**6.0**	7.8	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☑	check = yes

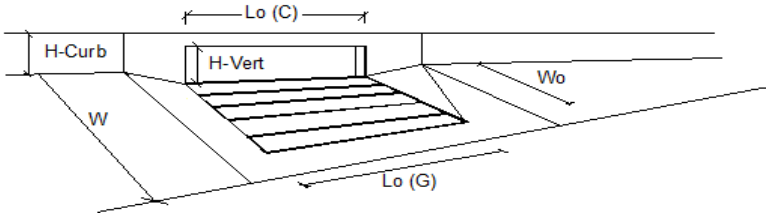
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**8.2**	**23.7**	**cfs**

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

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

INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	Colorado Springs D-10-R		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	4.0	4.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	3	3	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	4.00	4.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	

Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**5.7**	**11.2**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**5.2**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**99**	**68**	**%**

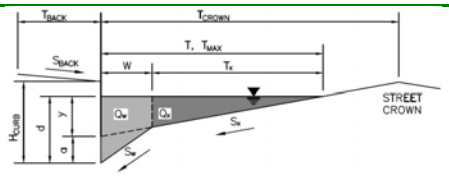
Version 4.05 Released March 2017

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

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

Project: The Glen at Widefield Filing No 11

Inlet ID: C-1



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.006	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	7.8	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☑	check = yes

MINOR STORM Allowable Capacity is based on Spread Criterion

MAJOR STORM Allowable Capacity is based on Depth Criterion

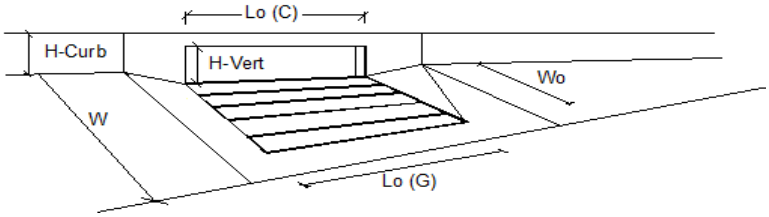
	Minor Storm	Major Storm	
Q_{allow} =	**8.2**	**23.7**	**cfs**

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

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

INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	Colorado Springs D-10-R		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	4.0	4.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	3	3	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	4.00	4.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	

Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**2.1**	**9.2**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**2.2**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**81**	**%**

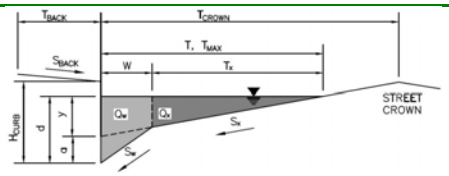
Version 4.05 Released March 2017

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

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

Project: The Glen at Widefield Filing No 11

Inlet ID: D-1



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.040	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	15.8	15.8	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.6	7.8	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

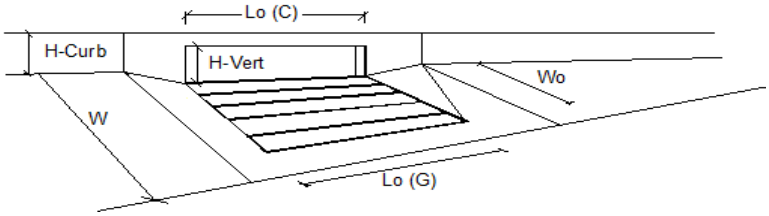
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**11.0**	**18.2**	**cfs**

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

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

INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	Colorado Springs D-10-R		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	4.0	4.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	3	3	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	4.00	4.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	

Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**2.9**	**9.0**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**1.7**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**85**	**%**

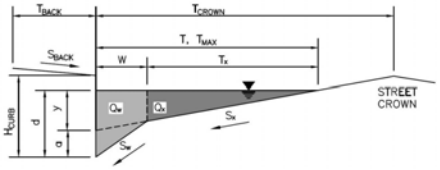
Version 4.05 Released March 2017

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

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

Project: The Glen at Widefield Filing No 11

Inlet ID: D-4



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	20.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.006	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	7.8	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☑	check = yes

MINOR STORM Allowable Capacity is based on Spread Criterion

MAJOR STORM Allowable Capacity is based on Depth Criterion

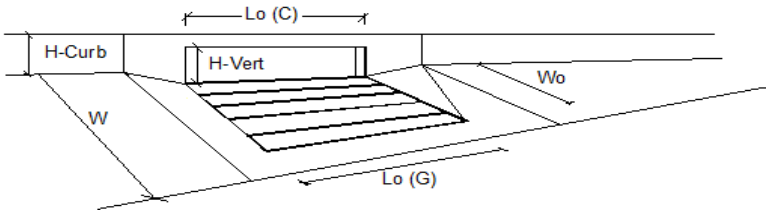
	Minor Storm	Major Storm	
Q_{allow} =	**8.2**	**23.8**	**cfs**

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

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

INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	Colorado Springs D-10-R		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	4.0	4.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	4	4	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	4.00	4.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	

Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**4.7**	**13.2**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**2.2**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**85**	**%**

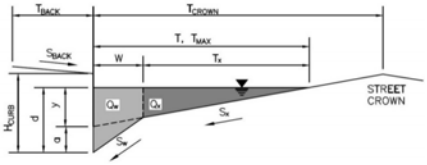
Version 4.05 Released March 2017

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

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

Project: The Glen at Widefield Filing No 11

Inlet ID: G-1



Gutter Geometry (Enter data in the blue cells)

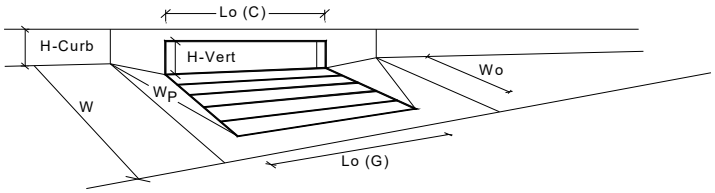
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	20.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	20.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	20.0	20.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	10.8	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

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

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	6.0	6.3	inches
Grate Information		MINOR	MAJOR	Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	15.00	15.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.33	0.36	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.57	0.60	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.79	0.81	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**9.7**	**11.2**	**cfs**
WARNING: Inlet Capacity less than Q Peak for Major Storm	$Q_{PEAK\ REQUIRED}$ =	0.2	12.5	cfs

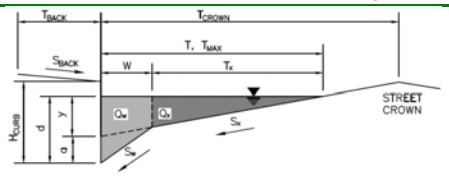
Version 4.05 Released March 2017

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

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

Project: The Glen at Widefield Filing No 11

Inlet ID: G-2



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	20.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.005	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	7.8	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☑	check = yes

MINOR STORM Allowable Capacity is based on Spread Criterion

MAJOR STORM Allowable Capacity is based on Depth Criterion

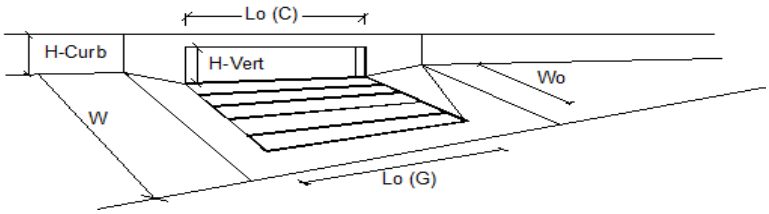
	Minor Storm	Major Storm	
Q_{allow} =	**7.7**	**22.3**	**cfs**

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

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

INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



Design Information (Input)	Colorado Springs D-10-R	MINOR	MAJOR	
Type of Inlet	Type =	Colorado Springs D-10-R		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	4.0	4.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	3	3	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	4.00	4.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	

Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**5.0**	**11.1**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**5.1**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**68**	**%**

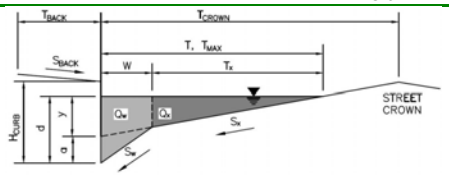
Version 4.05 Released March 2017

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

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

Project: The Glen at Widefield Filing No 11

Inlet ID: G-3



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	20.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.007	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	7.8	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

MINOR STORM Allowable Capacity is based on Spread Criterion

MAJOR STORM Allowable Capacity is based on Spread Criterion

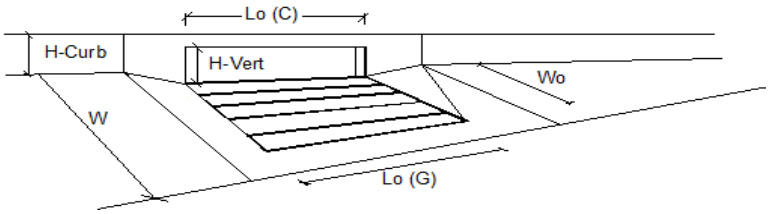
	Minor Storm	Major Storm	
Q_{allow} =	**8.8**	**8.8**	**cfs**

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

WARNING: MAJOR STORM max. allowable capacity is less than the design flow given on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



Design Information (Input)	Colorado Springs D-10-R	MINOR	MAJOR	
Type of Inlet	Type =	Colorado Springs D-10-R		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	4.0	4.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	3	3	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	4.00	4.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	

Street Hydraulics: WARNING: Q > ALLOWABLE Q FOR MAJOR STORM	MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**4.8**	**10.0**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**3.2**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**76**	**%**

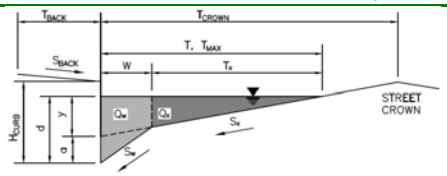
Version 4.05 Released March 2017

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

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

Project: The Glen at Widefield Filing No 11

Inlet ID: G-4



Gutter Geometry (Enter data in the blue cells)

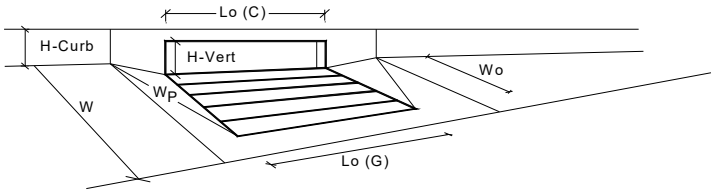
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	20.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	7.8	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

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

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



Design Information (Input)	Colorado Springs D-10-R			
		MINOR	MAJOR	
Type of Inlet	Type =	Colorado Springs D-10-R		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	4.00	4.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	4	4	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	5.6	5.6	inches
				☐ Override Depths
Grate Information		MINOR	MAJOR	
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	4.00	4.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	8.00	8.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	8.00	8.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	81.00	81.00	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.30	0.30	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.53	0.53	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.76	0.76	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**13.1**	**13.1**	**cfs**
WARNING: Inlet Capacity less than Q Peak for Major Storm	$Q_{PEAK\ REQUIRED}$ =	5.7	16.4	cfs

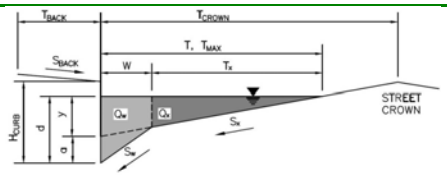
Version 4.05 Released March 2017

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

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

Project: The Glen at Widefield Filing No 11

Inlet ID: E-1



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	20.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.009	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	7.8	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☑	check = yes

MINOR STORM Allowable Capacity is based on Spread Criterion

MAJOR STORM Allowable Capacity is based on Depth Criterion

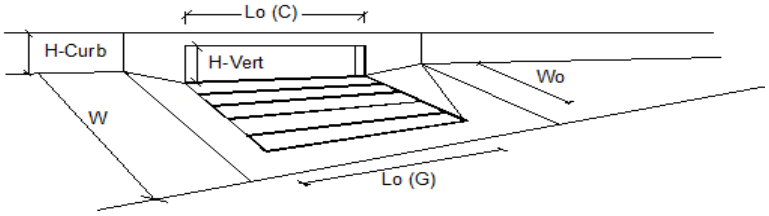
	Minor Storm	Major Storm	
Q_{allow} =	**10.2**	**29.7**	**cfs**

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

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

INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	Colorado Springs D-10-R		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	4.0	4.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	3	3	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	4.00	4.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	

Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**2.6**	**6.9**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**0.4**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**95**	**%**

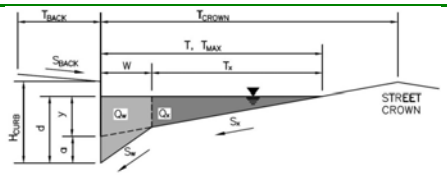
Version 4.05 Released March 2017

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

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

Project: The Glen at Widefield Filing No 11

Inlet ID: E-2



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	20.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.009	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	7.8	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☑	check = yes

MINOR STORM Allowable Capacity is based on Spread Criterion

MAJOR STORM Allowable Capacity is based on Depth Criterion

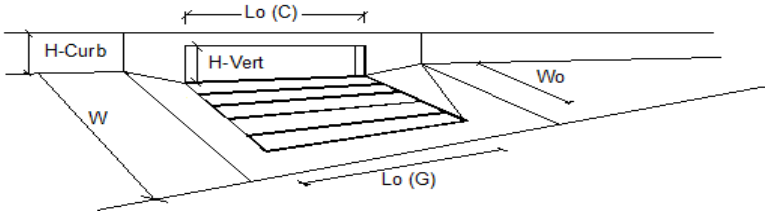
	Minor Storm	Major Storm	
Q_{allow} =	**10.2**	**29.7**	**cfs**

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

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

INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	Colorado Springs D-10-R		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	4.0	4.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	3	3	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	4.00	4.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	

Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**3.6**	**9.6**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**2.6**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**79**	**%**

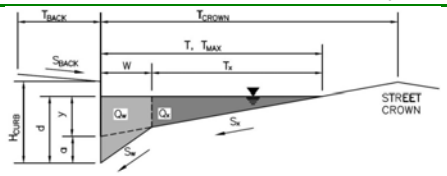
Version 4.05 Released March 2017

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

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

Project: The Glen at Widefield Filing No 11

Inlet ID: E-6



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	20.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.011	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	7.8	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☑	check = yes

MINOR STORM Allowable Capacity is based on Spread Criterion

MAJOR STORM Allowable Capacity is based on Depth Criterion

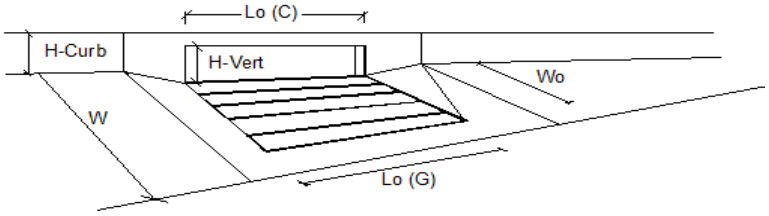
	Minor Storm	Major Storm	
Q_{allow} =	**11.6**	**33.7**	**cfs**

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

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

INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



Design Information (Input)	Colorado Springs D-10-R	MINOR	MAJOR	
Type of Inlet	Type =	Colorado Springs D-10-R		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	4.0	4.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	3	3	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	4.00	4.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	

Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**3.9**	**10.1**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**3.2**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**76**	**%**

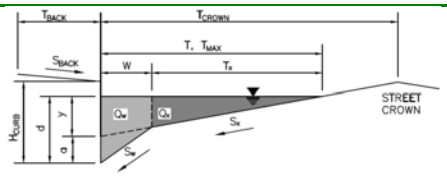
Version 4.05 Released March 2017

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

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

Project: The Glen at Widefield Filing No 11

Inlet ID: H-2



Gutter Geometry (Enter data in the blue cells)

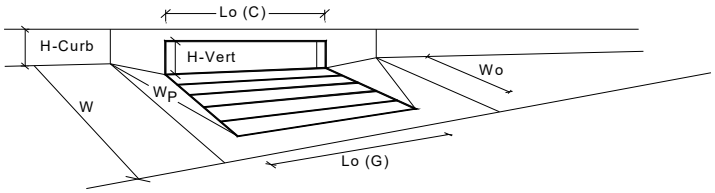
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	20.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	7.8	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

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

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	Colorado Springs D-10-R		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	4.00	4.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	4	4	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	6.0	7.8	inches
Grate Information		MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	4.00	4.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	8.00	8.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	8.00	8.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	81.00	81.00	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.33	0.48	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.57	0.74	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.79	0.88	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**16.0**	**31.2**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	4.7	19.4	cfs

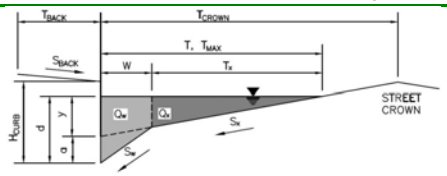
Version 4.05 Released March 2017

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

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

Project: The Glen at Widefield Filing No 11

Inlet ID: J-1



Gutter Geometry (Enter data in the blue cells)

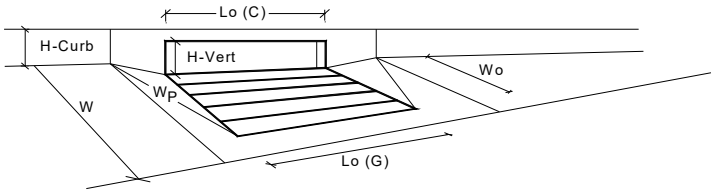
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	20.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	7.8	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

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

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	Colorado Springs D-10-R		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	4.00	4.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	3	3	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	5.6	5.6	inches
Grate Information		MINOR	MAJOR	Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	4.00	4.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	8.00	8.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	8.00	8.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	81.00	81.00	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.30	0.30	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.53	0.53	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.84	0.84	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**10.8**	**10.8**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	0.9	2.5	cfs

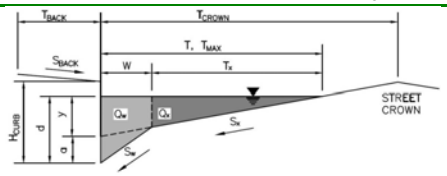
Version 4.05 Released March 2017

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

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

Project: The Glen at Widefield Filing No 11

Inlet ID: J-2



Gutter Geometry (Enter data in the blue cells)

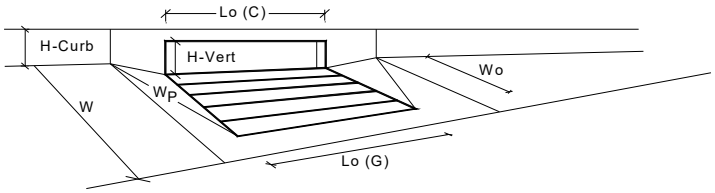
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	20.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	7.8	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

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

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	Colorado Springs D-10-R		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	4.00	4.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	3	3	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	5.6	5.6	inches
Grate Information		MINOR	MAJOR	Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	4.00	4.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	8.00	8.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	8.00	8.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	81.00	81.00	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.30	0.30	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.53	0.53	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.84	0.84	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**10.8**	**10.8**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	1.3	3.3	cfs

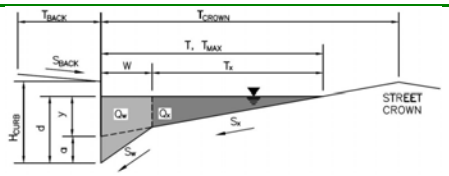
Version 4.05 Released March 2017

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

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

Project: The Glen at Widefield Filing No 11

Inlet ID: F-1



Gutter Geometry (Enter data in the blue cells)

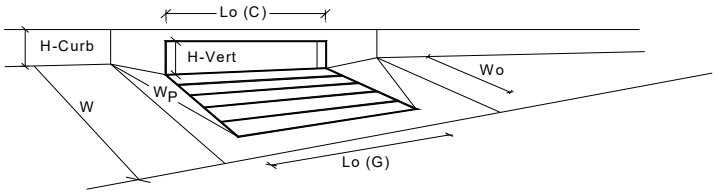
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	20.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	20.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	7.8	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

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

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017

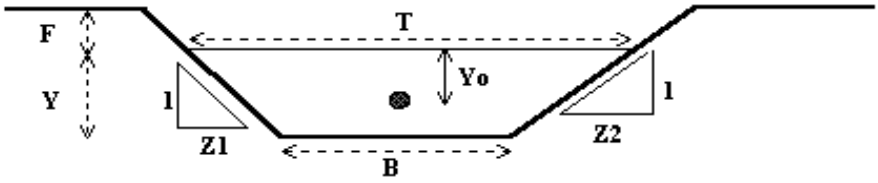


Design Information (Input)	Colorado Springs D-10-R	MINOR	MAJOR	
Type of Inlet	Type =	Colorado Springs D-10-R		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	4.00	4.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	2	2	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	5.6	5.6	inches
Grate Information		MINOR	MAJOR	☐ Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	4.00	4.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	8.00	8.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	8.00	8.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	81.00	81.00	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.30	0.30	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.56	0.56	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.99	0.99	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**8.3**	**8.3**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	2.3	6.8	cfs

Normal Flow Analysis - Trapezoidal Channel

Project: Glen at Widefield Filing No. 10

Channel ID: Detention Basin D Open Channel to Markscheffel Side Ditch



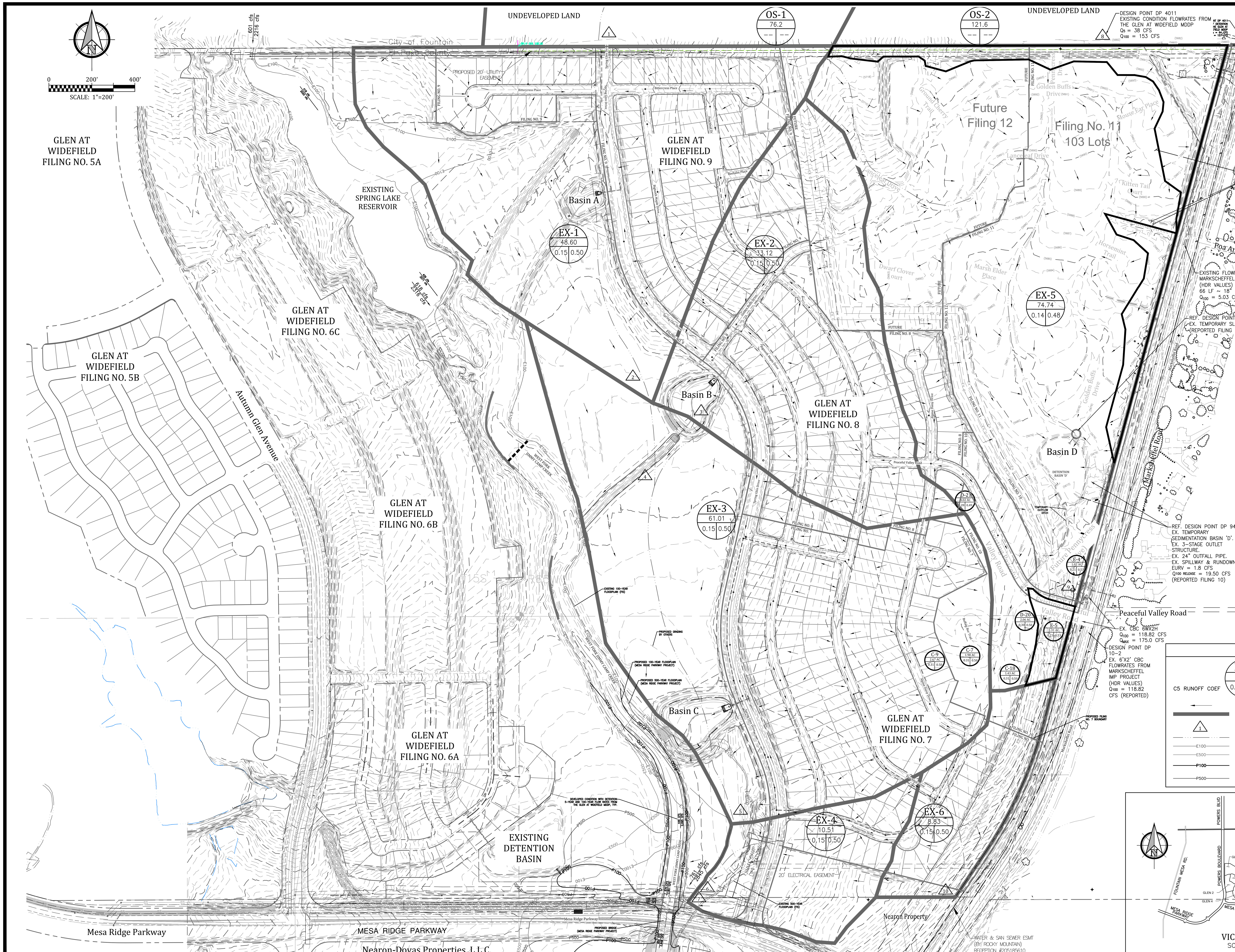
Design Information (Input)			
Channel Invert Slope	So =	0.0044	ft/ft
Manning's n	n =	0.024	
Bottom Width	B =	4.00	ft
Left Side Slope	Z1 =	3.00	ft/ft
Right Side Slope	Z2 =	3.00	ft/ft
Freeboard Height	F =	1.00	ft
Design Water Depth	Y =	**1.00**	ft

Normal Flow Condtion (Calculated)			
Discharge	**Q =**	**22.25**	cfs
Froude Number	**Fr =**	**0.67**	
Flow Velocity	**V =**	**3.18**	fps
Flow Area	A =	7.00	sq ft
Top Width	T =	10.00	ft
Wetted Perimeter	P =	10.32	ft
Hydraulic Radius	R =	0.68	ft
Hydraulic Depth	D =	0.70	ft
Specific Energy	Es =	1.16	ft
Centroid of Flow Area	Yo =	0.43	ft
Specific Force	Fs =	0.32	kip

APPENDIX D

Existing and Proposed Drainage Plans

Sheet 1 – Historic Conditions (Overall)
Sheet 2 - Developed Conditions Onsite (South)
Sheet 3 – Developed Conditions Onsite (North)



DETENTION BASIN 'D' DATA

	REQUIRED VOLUME	RELEASE RATE
WQCV	0.83 AC-FT	0.3 CFS
EURV	1.28 AC-FT	1.6 CFS
5-YR		3.9 CFS
100-YR + ½ WQCV	2.83 AC-FT	58.8 CFS
TOP OF EMBANKMENT ELEVATION: 5678.0		

DESIGN POINT FLOWS

	5-YEAR	100-YEAR
1	48 cfs	163 cfs
2	42 cfs	232 cfs
3	13 cfs	74 cfs
4	48 cfs	268 cfs
5	58 cfs	323 cfs
6	4 cfs	25 cfs
7	55 cfs	310 cfs
8	38 cfs	153 cfs
9	35 cfs	196 cfs
10	3 cfs	18 cfs

Kiowa Engineering Corporation
1604 South 21st Street
Colorado Springs, Colorado 80904
(719) 630-7342

WIDEFIELD Investment Group

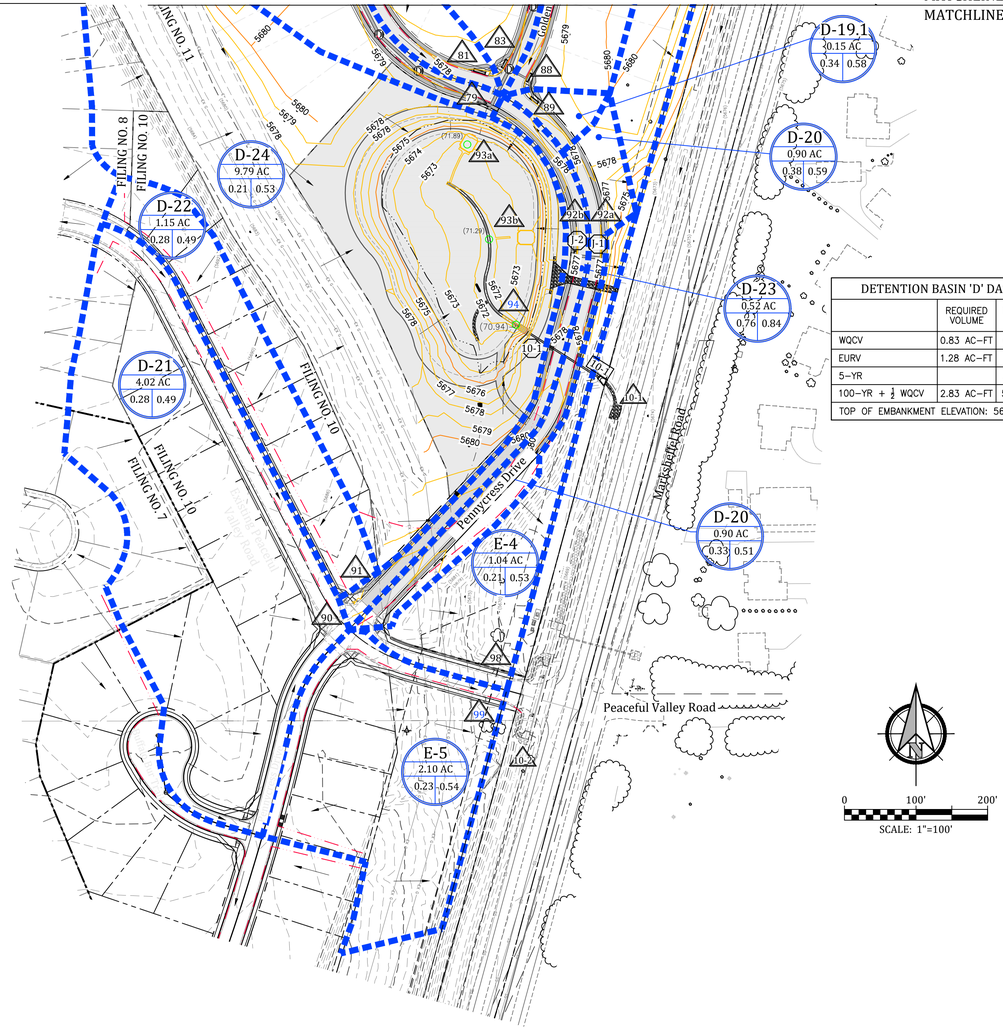
THE GLEN AT WIDEFIELD
FILING NO. 11
HISTORIC DRAINAGE BASINS (WITH CURRENT CONDITIONS)
El Paso, County, Colorado

Project No.:	19016
Date:	November 21, 2019
Design:	CJC
Drawn:	MJK
Check:	AMcC
Revisions:	

SHEET
H-1
1 of 3 Sheets

19016 Filing 11 – Historic Conditions.dwg/Nov 25, 2019

MATCHLINE SEE SHEET D-2
MATCHLINE SEE SHEET D-1



MATCHLINE SEE SHEET D-2
MATCHLINE SEE SHEET D-1

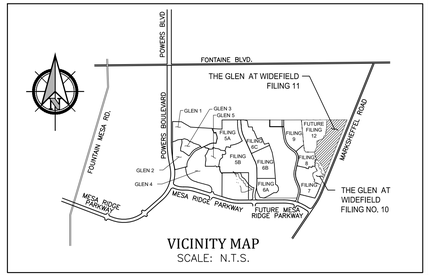
DETENTION BASIN 'D' DATA		
	REQUIRED VOLUME	RELEASE RATE
WQCV	0.83 AC-FT	0.3 CFS
EURV	1.28 AC-FT	1.6 CFS
5-YR		3.9 CFS
100-YR + ½ WQCV	2.83 AC-FT	58.8 CFS
TOP OF EMBANKMENT ELEVATION: 5678.0		

DESIGN POINT FLOWS	5-YEAR	100-YEAR
79	15.5 cfs	44.8 cfs
81	5.7 cfs	16.4 cfs
83	7.2 cfs	20.8 cfs
88	11.7 cfs	34.5 cfs
89	0.2 cfs	0.7 cfs
90	4.4 cfs	12.7 cfs
91	1.3 cfs	3.6 cfs
92a	1.1 cfs	3.2 cfs
92b	7.1 cfs	20.6 cfs
93a	32.4 cfs	75.9 cfs
93b	14.8 cfs	53.6 cfs
94	50.5 cfs	153.1 cfs
10-1		19.5 cfs
10-2		118.82 cfs*

*HDR FINAL DRAINAGE REPORT VALUE FOR MARKSCHEFFEL IMPS PROJECT

LEGEND	
D-n / 2.67 AC / 0.31 0.50	DRAINAGE BASIN DESIGNATION; DRAINAGE BASIN ACRES; C5 RUNOFF COEF; C100 RUNOFF COEFFICIENT
2.2 cfs / 4.3 cfs	5-YEAR RUNOFF; 100-YEAR RUNOFF
	DIRECTIONAL FLOW ARROW
	DRAINAGE BASIN BOUNDARY
1	DESIGN POINT
	TIME OF CONCENTRATION PATH
10	HYDRAULIC STRUCTURE IDENTIFIER
S10	STORM SEWER IDENTIFIER
	PROPOSED STORM SEWER PIPE
	PROPOSED STORM SEWER MANHOLE
	PROPOSED STORM DRAINAGE CURB INLET
(6020)	EXISTING CONTOURS
6020	PROPOSED CONTOURS

N
0 100' 200'
SCALE: 1"=100'



VICINITY MAP
SCALE: N.T.S.

Kiowa Engineering Corporation
1604 South 21st Street
Colorado Springs, Colorado 80904
(719) 630-7342

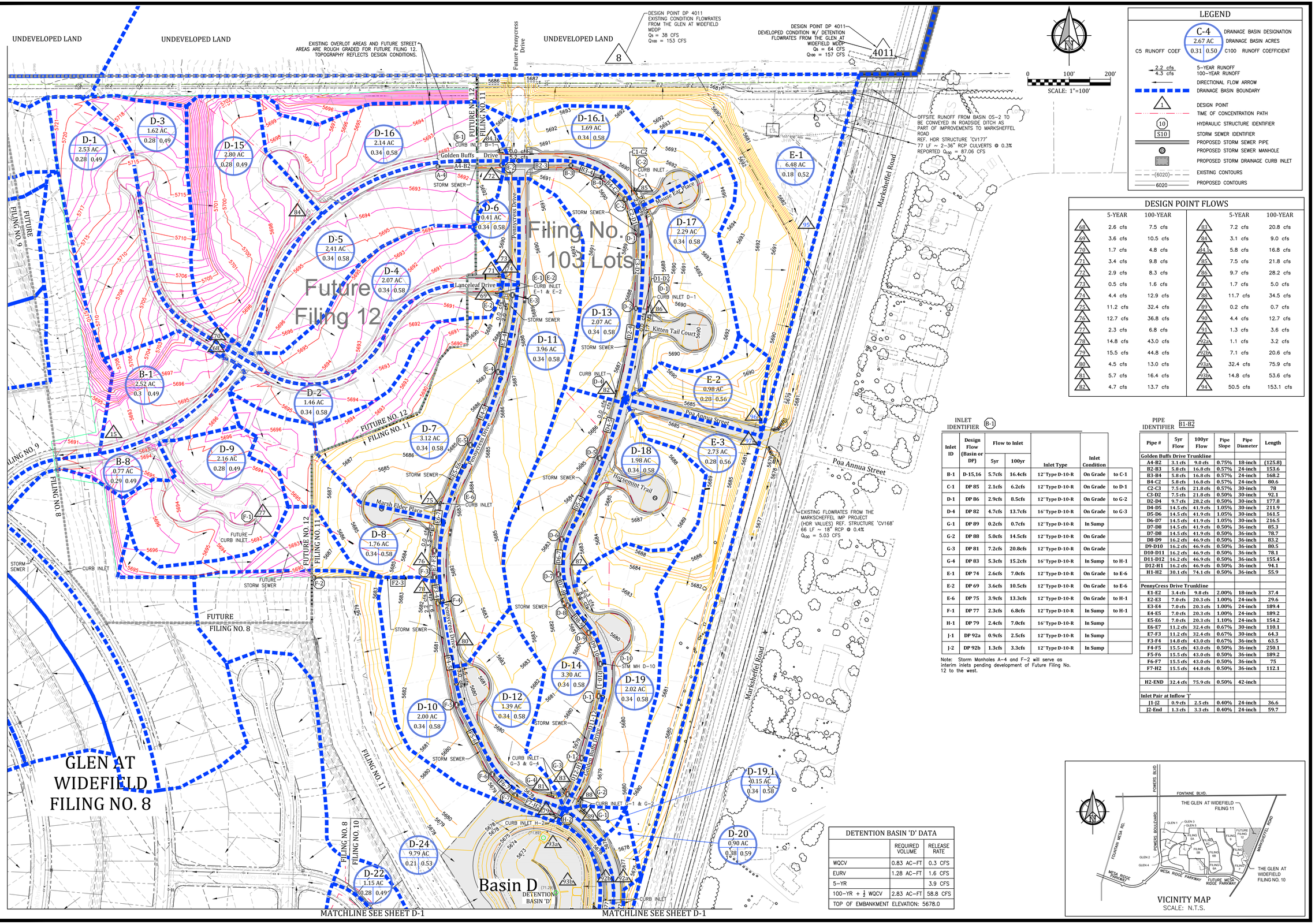
WIDEFIELD Investment Group

THE GLEN AT WIDEFIELD
FILING NO. 11
DEVELOPED DRAINAGE BASINS (ON-SITE)
El Paso, County, Colorado

Project No.:	19016
Date:	November 27, 2019
Design:	MJK
Drawn:	MJK
Check:	AMcC
Revisions:	

SHEET
D-1
2 of 3 Sheets

19016 Filing 11 – Developed Conditions.dwg/Nov 26, 2019



LEGEND

- C-4 / 2.67 AC / C5 0.31 / C100 0.50 — DRAINAGE BASIN DESIGNATION; DRAINAGE BASIN ACRES; C5 RUNOFF COEF; C100 RUNOFF COEFFICIENT
- 2.2 cfs / 4.3 cfs — 5-YEAR RUNOFF / 100-YEAR RUNOFF
- DIRECTIONAL FLOW ARROW
- DRAINAGE BASIN BOUNDARY
- 1 — DESIGN POINT
- TIME OF CONCENTRATION PATH
- 10 / S10 — HYDRAULIC STRUCTURE IDENTIFIER; STORM SEWER IDENTIFIER
- PROPOSED STORM SEWER PIPE
- PROPOSED STORM SEWER MANHOLE
- PROPOSED STORM DRAINAGE CURB INLET
- (6020) — EXISTING CONTOURS
- 6020 — PROPOSED CONTOURS

DESIGN POINT FLOWS

	5-YEAR	100-YEAR		5-YEAR	100-YEAR
68	2.6 cfs	7.5 cfs	83	7.2 cfs	20.8 cfs
69	3.6 cfs	10.5 cfs	84	3.1 cfs	9.0 cfs
70	1.7 cfs	4.8 cfs	84.1	5.8 cfs	16.8 cfs
71	3.4 cfs	9.8 cfs	85	7.5 cfs	21.8 cfs
72	2.9 cfs	8.3 cfs	86	9.7 cfs	28.2 cfs
73	0.5 cfs	1.6 cfs	87	1.7 cfs	5.0 cfs
74	4.4 cfs	12.9 cfs	88	11.7 cfs	34.5 cfs
75	11.2 cfs	32.4 cfs	89	0.2 cfs	0.7 cfs
76	12.7 cfs	36.8 cfs	90	4.4 cfs	12.7 cfs
77	2.3 cfs	6.8 cfs	91	1.3 cfs	3.6 cfs
78	14.8 cfs	43.0 cfs	92a	1.1 cfs	3.2 cfs
79	15.5 cfs	44.8 cfs	92b	7.1 cfs	20.6 cfs
80	4.5 cfs	13.0 cfs	93a	32.4 cfs	75.9 cfs
81	5.7 cfs	16.4 cfs	93b	14.8 cfs	53.6 cfs
82	4.7 cfs	13.7 cfs	94	50.5 cfs	153.1 cfs

INLET IDENTIFIER (B-1)

Inlet ID	Design Flow (Basin or DP)	Flow to Inlet 5yr	Flow to Inlet 100yr	Inlet Type	Inlet Condition	
B-1	D-15,16	5.7cfs	16.4cfs	12' Type D-10-R	On Grade	to C-1
C-1	DP 85	2.1cfs	6.2cfs	12' Type D-10-R	On Grade	to D-1
D-1	DP 86	2.9cfs	8.5cfs	12' Type D-10-R	On Grade	to G-2
D-4	DP 82	4.7cfs	13.7cfs	16' Type D-10-R	On Grade	to G-3
G-1	DP 89	0.2cfs	0.7cfs	12' Type D-10-R	In Sump	
G-2	DP 88	5.0cfs	14.5cfs	12' Type D-10-R	On Grade	
G-3	DP 81	7.2cfs	20.8cfs	12' Type D-10-R	On Grade	
G-4	DP 83	5.3cfs	15.2cfs	16' Type D-10-R	In Sump	to H-1
E-1	DP 74	2.6cfs	7.0cfs	12' Type D-10-R	On Grade	to E-6
E-2	DP 69	3.6cfs	10.5cfs	12' Type D-10-R	On Grade	to E-6
E-6	DP 75	3.9cfs	13.3cfs	12' Type D-10-R	On Grade	to H-1
F-1	DP 77	2.3cfs	6.8cfs	12' Type D-10-R	In Sump	to H-1
H-1	DP 79	2.4cfs	7.0cfs	16' Type D-10-R	In Sump	
J-1	DP 92a	0.9cfs	2.5cfs	12' Type D-10-R	In Sump	
J-2	DP 92b	1.3cfs	3.3cfs	12' Type D-10-R	In Sump	

Note: Storm Manholes A-4 and F-2 will serve as interim inlets pending development of Future Filing No. 12 to the west.

PIPE IDENTIFIER (B1-B2)

Pipe #	5yr Flow	100yr Flow	Pipe Slope	Pipe Diameter	Length
Golden Buffs Drive Trunkline					
A4-B2	3.1 cfs	9.0 cfs	0.75%	18-inch	(125.8)
B2-B3	5.8 cfs	16.8 cfs	0.57%	24-inch	153.6
B3-B4	5.8 cfs	16.8 cfs	0.57%	24-inch	168.2
B4-C2	5.8 cfs	16.8 cfs	0.57%	24-inch	80.6
C2-C3	7.5 cfs	21.8 cfs	0.57%	30-inch	78
C3-D2	7.5 cfs	21.8 cfs	0.50%	30-inch	92.1
D2-D4	9.7 cfs	28.2 cfs	0.50%	30-inch	177.8
D4-D5	14.5 cfs	41.9 cfs	1.05%	30-inch	211.9
D5-D6	14.5 cfs	41.9 cfs	1.05%	30-inch	161.5
D6-D7	14.5 cfs	41.9 cfs	1.05%	30-inch	216.5
D7-D8	14.5 cfs	41.9 cfs	0.50%	36-inch	85.3
D7-D8	14.5 cfs	41.9 cfs	0.50%	36-inch	78.7
D8-D9	16.2 cfs	46.9 cfs	0.50%	36-inch	83.2
D9-D10	16.2 cfs	46.9 cfs	0.50%	36-inch	80.5
D10-D11	16.2 cfs	46.9 cfs	0.50%	36-inch	78.1
D11-D12	16.2 cfs	46.9 cfs	0.50%	36-inch	155.4
D12-H1	16.2 cfs	46.9 cfs	0.50%	36-inch	94.1
H1-H2	30.1 cfs	74.1 cfs	0.50%	36-inch	55.9
PennyCress Drive Trunkline					
E1-E2	3.4 cfs	9.8 cfs	2.00%	18-inch	37.4
E2-E3	7.0 cfs	20.3 cfs	1.00%	24-inch	29.6
E3-E4	7.0 cfs	20.3 cfs	1.00%	24-inch	189.4
E4-E5	7.0 cfs	20.3 cfs	1.00%	24-inch	189.2
E5-E6	7.0 cfs	20.3 cfs	1.10%	24-inch	154.2
E6-E7	11.2 cfs	32.4 cfs	0.67%	30-inch	110.1
E7-F3	11.2 cfs	32.4 cfs	0.67%	30-inch	64.3
F3-F4	14.8 cfs	43.0 cfs	0.67%	36-inch	63.5
F4-F5	15.5 cfs	43.0 cfs	0.50%	36-inch	250.1
F5-F6	15.5 cfs	43.0 cfs	0.50%	36-inch	189.2
F6-F7	15.5 cfs	43.0 cfs	0.50%	36-inch	75
F7-H2	15.5 cfs	44.8 cfs	0.50%	36-inch	112.1
H2-END	32.4 cfs	75.9 cfs	0.50%	42-inch	
Inlet Pair at Inflow 'J'					
J1-J2	0.9 cfs	2.5 cfs	0.40%	24-inch	36.6
J2-End	1.3 cfs	3.3 cfs	0.40%	24-inch	59.7

DETENTION BASIN 'D' DATA

	REQUIRED VOLUME	RELEASE RATE
WQCV	0.83 AC-FT	0.3 CFS
EURV	1.28 AC-FT	1.6 CFS
5-YR		3.9 CFS
100-YR + ½ WQCV	2.83 AC-FT	58.8 CFS
TOP OF EMBANKMENT ELEVATION: 5678.0		

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