PHASE II DRAINAGE REPORT
FOR
HILLSIDE AT CASTLE ROCK PHASE 3&4
SDP25-0012

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June 3, 2026

Engineer's Certification

I affirm that this report and plan for the Phase II drainage design of Hillside at Castle Rock Phase 3&4 was prepared by me (or under my direct supervision) in accordance with the provisions of the Town of Castle Rock Drainage Design and Technical Criteria for the owners thereof. I understand that the Town of Castle Rock does not and will not assume liability for drainage facilities designed by others.

_____

Kurtis W. Williams, P.E. Date
State of Colorado No. 34270
For and on Behalf of JR Engineering

OWNER/DEVELOPER'S STATEMENT

As Owner/Developer of Land(s) identified within this report, I agree to proceed, implement, and comply with all recommendations and requirements outlined herein.

_____

Name of Developer

_____

Authorized Signature

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I. GENERAL LOCATION AND DESCRIPTION

A. Site Location

Hillside at Castle Rock Phase 3&4 (Site) is located within the SE 1/4 of the SW 1/4 of Section 3, Township 8 South, Range 67 West, of the 6th Principal Meridian, Town of Castle Rock, County of Douglas, State of Colorado. The Site is bounded by W Wolfersberger Rd to the southeast, Hillside at Castle Rock Phase 1 & 2 to the west, and a 16.5 acre residential property in unincorporated Douglas County zoned A1 (AG) to the north. A Vicinity Map is included in **Appendix A**.

B. Description of Property

The 48.3± acre Site is the third and fourth phase of the Hillside at Castle Rock subdivision, in total there are to be 5 phases. The previous two phases (Phases 1&2) are to be constructed prior to the beginning of Hillside at Castle Rock Phase 3 & 4 construction. Phases 3 & 4 include the extension of Grayside Cir (from west to east bisecting the Site) to the intersection with W Wolfensberger Rd, associated utilities including storm sewer that captures runoff from the Site, a retaining wall along the north property boundary allowing the Site grade to be lowered and flattened, and a water quality and detention pond (Pond B) that treats and detains flows from the Site.

The Site contains several old dwelling structures with a dirt driveway and is largely undeveloped with a vegetative cover of approximately 90% native grasses and approximately 5% trees.

The soils on-site are described as Bresser-Truckton sandy loams, Newlin gravelly sandy loam, and Stony Rough land by the NRCS soil survey. These soils are classified as Hydrologic Soil Group (HSG) B, B, and D, respectively. A Hydrologic Soil Group Map is included in **Appendix A**.

The existing Site slopes to the southeast at approximately 10% to the location of the receiving pond on the south side of Grayside Cir at the intersection with W Wolfensberger Rd.

There are no major drainageways located within the Site. The entire Site is located within and adjacent to Zone X (non-shaded area), as determined by the FIRM panel 08035C0169G (Panel 169 of 495), revised March 16, 2016. The non-shaded areas of the Zone X indicate these areas are outside the 0.2% annual chance floodplain. The overall Site is designated Zone X. The FIRM map is included in **Appendix A**.

II. DRAINAGE BASINS AND SUB BASINS

A. Major Drainage Basins

The Site is located within the Omni Tributary Major Drainage Basin. The Omni Tributary is approximately 1500 feet east of the Site and drains north to East Plum Creek, and

ultimately the South Platte River. The pond serving the Site will be constructed with Phases 3 & 4. The pond will release storm water into the existing storm water system that connects to an existing 12-foot by 8-foot concrete box culvert. The culvert crosses under W Wolfensberger road and discharges into the Omni Tributary.

No channel improvements are anticipated with this project.

Under fully developed conditions, developed flows from the Site will be captured and detained prior to releasing into the receiving channel. Since these flows will discharge within the box culvert, no adverse impacts to the receiving channel are anticipated.

Drainage Maps are included in **Appendix F**.

B. Minor Drainage Basins

The drainage design for the Site follows historic drainage patterns. Very little off-site flows enter the Site. Off-site flows from the west, are directed to Grayside Cir and are captured by the existing storm sewer system within the roadway. Off-site flows from the north are prevented from entering the Site by the channel associated with the existing retaining wall along the north property boundary. Flows from the Site are prevented from running off-site to the southeast by an existing swale directing flows to the existing detention and water quality pond. The flows produced by the development of Phases 3 & 4 are to be conveyed via the proposed roadway to a series of on grade No. 16 combo inlets. Flows from the future phase 5 improvements will run towards Grayside circle where a temporary swale will carry flows towards a type c area inlet. Flows coming off of W Wolfensberger road will be routed via both existing and proposed roadside ditches towards the propose Detention Pond B.

There are no irrigation canals or ditch facilities located within the Site.

The project proposes 46 paired homes, 19 single family homes, and associated alley access, sidewalks and utility infrastructure is proposed.

Hydrologic Computations are included in **Appendix B**.

III. DRAINAGE DESIGN CRITERIA

A. Regulations

Storm drainage analysis and design criteria for this project were taken from the Storm Drainage Design and Technical Criteria Manual (SDDTCM) by the Town of Castle Rock, dated February 2025 and the Mile High Flood District's (MHFD) Urban Storm Drainage Criteria Manual (USDCM) Volumes 1,2, & 3, latest online version.

B. Drainage Studies, Master Plans, Site Constraints

The *Site Development Plan 2nd Amendment Hillside – Arbors Site Development Plan*, prepared by Entitlement and Engineering Solutions, Inc (EES), dated 8/23/2023, provides a planning level design of the entire Hillside – Arbors subdivision.

The *Overall Phase III Drainage Report Hillside at Castle Rock*, prepared by Paragon Engineering Consultants, Inc., dated October 11, 2016, provides an overall detailed drainage analysis and design of the entire Hillside – Arbors subdivision.

The **Final Approved Phase III Drainage Report for Hillside at Castle Rock Phase 1 & 2 (Paragon Engineering Consultants, 2019)**, provides detailed drainage analysis and design of the first and second phase of the Hillside at Castle Rock project. The improvements (generally located at the west end of the subdivision) constructed with these plans include the west entrance off of W Wolfensberger Rd, the first 1/3 of Grayside Cir, a mix of single-family, duplex, and fourplex dwelling units, detention and water quality Pond A, and associated storm sewer system. All the above improvements (not including the pond outfall pipe that connects to the existing box culvert at the receiving channel) are upstream of the Site.

The ***Phase III Drainage Report Hillside at Castle Rock Phase 3 & 4***, prepared by **Entitlement and Engineering Solutions, Inc (EES), dated 8/25/2023**, provides a detailed drainage analysis and design of the third and fourth phase of the Hillside at Castle Rock project. The improvements (generally located in the center of the subdivision) associated with this report include the remaining 2/3 of Grayside Cir, detention and water quality Pond B (serves the Site), a grass-lined swale along the south property boundary of the Site (directing flows to Pond B), a concrete u-channel along the entire north property boundary of Hillside at Castle Rock, a retaining wall along the north property boundary of the Site (allowing for lowering and flattening of the Site) and associated storm sewer. The Site will drain to the infrastructure constructed during Phase 3 & 4. This report was used as the basis of design for the Proposed Hillside at Castle Rock Phases 3 & 4. Excerpts from this report are included in Appendix E.

The ***Public Improvement Construction Plans for Hillside at Castle Rock Phases 3 - 4***, **prepared by Entitlement and Engineering Solutions, Inc (EES), dated 8/23/2023**, provides the design for construction of the third and fourth phase of the Hillside at Castle Rock project. The improvements (generally located in the center of the subdivision) constructed with these plans include the east entrance off of W Wolfensberger Rd, the remaining 2/3 of Grayside Cir, a mix of duplex and single-family dwelling units, detention and water quality Pond B (serves the Site), a grass-lined swale along the south property boundary of the Site (directing flows to Pond B), a concrete u-channel along the entire north property boundary of Hillside at Castle Rock, a retaining wall along the north property boundary of the Site (allowing for lowering and flattening of the Site) and associated utilities. The Site will drain to the infrastructure constructed during Phase 3 & 4. Excerpts from these plans are included in Appendix E.

The drainage design of the Site is in conformance with the Town Master Plan for the area.

C. Hydrology

The Rational method was utilized to determine the hydrology of the Site. The 5-year storm (P1=1.43 inches) was analyzed as the minor event and the 100-year storm (P1=2.60 inches) was analyzed as the major event. Equation 5-1 from the USDCM was utilized to calculate the rainfall intensities. The percent impervious values were determined from the USCDM Tables 6-2 and 6-3. Runoff C values were determined from the USCDM Tables 6-5. These tables and the entire Runoff chapter (Chapter 6) of the USDCM Volume 1 was updated in March 2024. The above mention equation and tables are included in **Appendix B**.

Existing Sub-Basins:

Basin EX OS1 - Consists of landscape area. Runoff sheet flows down the hillside until hitting the Phase 1 & 2 rockfall mitigation channel at DP 1.

Basin EX-SB - Consists of an existing sediment basin and landscape area. Runoff sheet flows down the slope into the existing drainage rundown just east of the Phase 1 & 2 Rockfall mitigation channel construction limits, and ultimately into the existing sediment basin at DP 2.

Basin EX-A - Consists of rocky hillsides and landscape area. Runoff sheet flows down the existing hillside until channelizing and following its existing pattern south and east across the site to the Omni tributary channel.

Basin EX-B1 - Consists of roadway section, single-family housing, and landscape area. Runoff is directed into the roadway and is captured by No. 16 combo inlets at DP 11 to the east. Flows are conveyed north and east via storm sewer and discharge into Pond A.

Basin EX-B2 - Consists of roadway section and single-family housing. Runoff is conveyed into the roadway and is captured by No. 16 combo inlets at DP 13 to the east. Flows are conveyed north and east via storm sewer and discharge into Pond A.

Basin EX-B3 - Consists of landscape area, walls, and a concrete pan. Runoff is channelizing into the concrete pan and is then conveyed north and east and ultimately into Pond A at DP 6.

Basin EX-B4 - Consists of landscape area, maintenance trails, and Detention Pond A. Runoff sheet flows down the slope into the existing Detention Pond A at DP 15.

Basin EX-B5 - Consists of landscape area and single-family housing. Runoff sheet flows south and east to the concrete pan. Flows are then captured by an existing type c inlet at

DP 9. Flows are then conveyed north and east via storm sewer and discharge into Pond A.

Basin EX-C1 - Consists of existing roadway and landscape area. Runoff sheet flows across into the existing roadside ditch on the north side of W Wolfensberger road at DP 18, from this point it continues along the existing ditch until entering the Omni Tributary.

Basin EX-C2 - Consists of landscape area with some existing dwellings. Runoff sheet flows north and east until leaving the site at DP 23.

Basin EX-C3 - Consists of existing roadway and landscape area. Runoff sheet flows across into the existing roadside ditch on the north side of W Wolfensberger road at DP 22, from this point it continues along the existing ditch until entering the Omni Tributary.

Basin EX-D1 - Consists of landscape area and some lot area. Runoff is captured by a grass-lined swale along the south property boundary and directed to a 42"x29" CMP culvert at DP 20. Flows are conveyed underneath W Wolfensberger road to the Omni tributary. These EX–D1 flows are not a part of this site's proposed improvements; therefore, flows are not required to be treated for water quality.

Basin EX-D2 - Consists of landscape area and some lot area. Runoff is captured by a grass-lined swale along the south property boundary and directed to a 24" CMP culvert at DP 21. Flows are conveyed underneath W Wolfensberger road to the Omni tributary. These EX–D2 flows are not a part of this site's proposed improvements; therefore, flows are not required to be treated for water quality.

Basin EX-D3 – Consists of landscape area and some roadway area. Runoff is captured by a grass-lined swale along the south property boundary and directed to an area inlet at DP 8. Flows are conveyed north through the existing storm sewer to Detention Pond A.

Basin EX-D5 – Consists of landscape area and some roadway area. Runoff is captured by a grass-lined swale along the south property boundary at DP 17 where flows are transferred under the Proposed Pond B maintenance access road to EX-C1.

Basin EX-D6 – Consists of roadway section, concrete walks, and landscape area. Runoff is directed into the roadside swale and is captured by a proposed area inlet at Design Point 18 to the east. Flows are then discharged into the existing S Wolfensberger Road Storm System.

Proposed Sub-Basins:

OS2 - Consists of landscape area. Runoff sheet flows down the hillside until hitting the Phase 1 & 2 rockfall mitigation channel at DP RC1.

OS2.1 - Consists of landscape area. Runoff sheet flows down the hillside until hitting the Phase 1 & 2 rockfall mitigation channel at DP 3.

OS3 - Consists of landscape area. Runoff sheet flows down the hillside until hitting the Phase 1 & 2 rockfall mitigation channel at DP 5.

Basin A1 - Consists of roadway section, roofs, concrete walks and drives, and landscape area. Runoff is directed into the roadway and is captured by existing curb inlets at Design Point A1 along the southern flowline of Sub-Basin A1. Flows are conveyed east along the proposed storm sewer until outfalling to existing detention Pond A.

Basin A2 - Consists of roadway section, roofs, concrete walks and drives, and landscape area. Runoff is directed into the roadway and is captured by existing curb inlets at Design Point A2 along the northern flowline of Sub-Basin A2. Flows are conveyed east along the proposed storm sewer until outfalling to existing detention Pond A.

Basin A3 – Consists of roadway section, roofs, concrete walks and drives, and landscape area. Runoff is directed into the roadway and is captured by existing curb inlets at Design Point A3 along the southern flowline of Sub-Basin A3. Flows are conveyed east along the proposed storm sewer until outfalling to existing detention Pond A.

Basin A4 – Consists of roadway section, roofs, concrete walks and drives, and landscape area. Runoff is directed into the roadway and is captured by existing curb inlets at Design Point A4 along the northern flowline of Sub-Basin A4. Flows are conveyed east along the proposed storm sewer until outfalling to existing detention Pond A.

Basin A5 – Consists of roadway section, roofs, concrete walks and drives, and landscape area. Runoff is directed into the roadway and is captured by existing curb inlets at Design Point A5 along the northern flowline of Sub-Basin A5. Flows are conveyed east along the proposed storm sewer until outfalling to existing detention Pond A.

Basin A6 – Consists of roadway section, roofs, concrete walks and drives, and landscape area. Runoff is directed into the roadway and is captured by existing curb inlets at Design Point A6 along the northern flowline of Sub-Basin A6. Flows are conveyed east along the proposed storm sewer until outfalling to existing detention Pond A.

Basin A7 – Consists of roadway section, roofs, concrete walks and drives, and landscape area. Runoff is directed into the roadway and is captured by existing curb inlets at Design Point A7 along the southern flowline of Sub-Basin A7. Flows are conveyed southwest along the proposed storm sewer until outfalling to existing detention Pond A.

Basin A8 – Consists of roadway section, roofs, concrete walks and drives, and landscape area. Runoff is directed into the roadway and is captured by existing curb inlets at Design Point A8 along the northern flowline of Sub-Basin A8. Flows are conveyed east along the proposed storm sewer until outfalling to existing detention Pond A.

Basin A9 - Consists of roadway section, roofs, concrete walks and drives, and landscape area. Runoff is directed into the roadway and is captured by existing curb inlets at Design Point A9 along the southern flowline of Sub-Basin A9. Flows are conveyed east along the proposed storm sewer until outfalling to existing detention Pond A.

Basin A10 - Consists of roadway section, roofs, concrete walks and drives, and landscape area. Runoff is directed into the roadway and is captured by existing curb inlets at Design Point A9 along the northern flowline of Sub-Basin A10. Flows are conveyed east along the proposed storm sewer until outfalling to existing detention Pond A.

Basin A11 - Consists of roadway section, roofs, concrete walks and drives, and landscape area. Runoff is directed into the roadway and is captured by existing curb inlets at Design Point A9 along the northern flowline of Sub-Basin A11. Flows are conveyed east along the proposed storm sewer until outfalling to existing detention Pond A.

Basin A12 - Consists of roadway section, roofs, concrete walks and drives, and landscape area. Runoff is directed into the roadway and is captured by existing curb inlets at Design Point A12 along the southern flowline of Sub-Basin A12. Flows are conveyed east along the proposed storm sewer until outfalling to existing detention Pond A.

Basin A13 - Consists of concrete walks, concrete rockfall channel, and landscape area. Runoff is directed into the rockfall mitigation point at Design Point A13. Flows are conveyed southwest along the proposed storm sewer until outfalling to existing detention Pond A.

Basin A14 - Consists of roadway section, concrete walks and drives, and landscape area. Runoff is directed into the roadway and is captured by existing curb inlets at Design Point A14 along the northern flowline of Sub-Basin A14. Flows are conveyed east along the proposed storm sewer until outfalling to existing detention Pond A.

Basin EX-B3 - Consists of lot area, and landscape area. Runoff is directed into the rear lot concrete pan and is captured by existing 36" RCP FES at DP 30 to the east. Flows are conveyed south via existing storm sewer and discharge into existing Pond A. This sub-basin is referenced from the "**Phase III Drainage Report Hillside at Castle Rock Phase 3 & 4, Entitlement and Engineering Solutions, Inc, August 25, 2023**." Excerpts can be found in **Appendix E.** This sub-basin has been altered slightly from the **EES** report, this is due to minor overlot grading changes taking place in between phases 1-2 & 3-4.

Basin C1 - Consists of roadway section, concrete walks, and landscape area. Runoff is directed into the roadway and is captured by proposed curb inlets at Design Point 34 to the east. Flows are conveyed south via existing storm sewer and discharge into proposed Pond B.

Basin C2 - Consists of roadway section, concrete walks, and landscape area. Runoff is directed into the roadway and is captured by proposed curb inlets at Design Point 35 to

the east. Flows are conveyed south via proposed storm sewer and discharge into proposed Pond B.

Basin C3 - Consists of landscape area. Runoff is directed into the temporary grass lined swale and is captured by a proposed area inlet at Design Point 33 to the east. Flows are conveyed south via proposed storm sewer and discharge into proposed Pond B.

Basin C4 - Consists of landscape area. Runoff is directed into the grass lined swale to the southeast and eventually runs into proposed Pond B at DP 38.

Basin C5 - Consists of roadway section, concrete walks, and landscape area. Runoff is directed into the S. Wolfensberger Road ROW. Here flows continue along their historic drainage pattern to the NE along S. Wolfensberger Road until reaching the Omni Tributary.

Basin C6 - Consists of landscape area. Runoff is directed away from the site; these flows follow their existing drainage pattern and leave the site undetained at DP 52.

D. Hydraulics

The UDFCD spreadsheet UD Inlet v5.03 was utilized to determine if the proposed street section of Grayside Cir and proposed inlets within Grayside Cir have capacity to capture 100% of the developed flows from the Site. Grayside Cir is classified as local (Type A) per Table 7-2 of the Town of Castle Rock, Storm Drainage Design and Technical Criteria Manual. At this stage in design, a typical cross section proving major flow depth is contained within ROW is provided on Proposed Drainage Map located in **Appendix F.** In Final Design, cross sections for each relevant inlet location will be provided in the Overlot Grading plans within the Construction Documents.

The proposed inlets, Inlets A1-A14, as well as downstream proposed inlets capturing runoff from proposed Sub-Basins C1 and C2 are calculated in this report using flows from the hydrology JR Engineering delineated as a part of this report, results can be found in **Appendix B**.

Inlet calculations are included in **Appendix C**.

E. Storage and Water Quality Enhancement

Pond B is an extended detention basin (EDB) designed for full spectrum detention that will be constructed with Phases 3 & 4. The pond is designed to treat and detain developed flows from the Site per MHFD requirements. An impervious area analysis has been performed showing that the Site conforms to the Phase 3 & 4 drainage report and Pond B has adequate capacity for the developed Site flows. The Pond Capacity Analysis is included in Appendix D.

Pond A is an extended detention basin (EDB) designed for full spectrum detention that was be constructed with Phases 1 & 2 by EES. The pond is designed to treat and detain

developed flows from the Site per MHFD requirements. JR Engineering is proposing zero changes to the design approved along with the Phase 1 & 2 drainage Report by Paragon. Some of the assumptions made in the previous report about which sub-basins' flows were to be treated by existing Pond A vs the Proposed Pond B were incorrect, resulting in approximately a 1-acre difference between tributary area for Ex Pond A between the previous report by Paragon and this report.

The subsequent Phase III Drainage Report for Phase 3 & 4 by EES (8/25/2023) shows sub-basin delineations and flow routing that matches more closely to the calculations JR Engineering has performed as a part of this report.

See **Appendix E** for the Phase 1 & 2 Drainage Plan by Paragon, and the Phase III Drainage Report for Phase 3 & 4 by EES, which shows where the area difference occurs.

See below for a table comparing the Watershed information and required volume for the Paragon, EES and the JR calculated conditions. This table shows that the previous design for Ex Pond A will be insufficient for the updated watershed information. An updated UD-detention Spreadsheet for Ex Pond A has been provided in **Appendix D** which proposes increasing the diameter of the Water Quality holes from 1-5/8 inches, to 1-11/16 inches for an area of 2.28 square inches per hole. The holes **do not** need to be spaced differently from the approved Paragon report.

EX POND A CAPACITY ANALYSIS												
Approved Paragon Watershed Information			EES Watershed Information			JR Watershed Information			DELTA (JR-EES)		DELTA (JR-Paragon)	
AREA	45.63	AC	AREA	51.26	AC	AREA	50.20	AC	-1.06	AC	4.57	AC
% IMPERVIOUS	26.00	%	% IMPERVIOUS	26.00	%	% IMPERVIOUS	27.60	%	1.60	%	1.60	%
CALCULATED WQCV	0.526	AC-FT	CALCULATED WQCV	0.591	AC-FT	CALCULATED WQCV	0.601	AC-FT	0.010	AC-FT	0.08	AC-FT
CALCULATED EURV	0.604	AC-FT	CALCULATED EURV	0.679	AC-FT	CALCULATED EURV	0.735	AC-FT	0.056	AC-FT	0.13	AC-FT
CALCULATED 100YR	2.243	AC-FT	CALCULATED 100YR	2.225	AC-FT	CALCULATED 100YR	1.911	AC-FT	-0.314	AC-FT	-0.33	AC-FT
TOTAL VOLUME	3.373	AC-FT	TOTAL VOLUME	3.494	AC-FT	TOTAL VOLUME	3.247	AC-FT	-0.247	AC-FT	-0.13	AC-FT
5/1/2019 (Approved)			12/15/2023									

MHFD UD-Detention Results for both Ex Pond A and proposed Pond B are included in **Appendix D** along with this table.

There are several basins that are unable to be treated for water quality due to the topography of the site. The Sub-Basins are EX-D1, EX-D2, EX-D5, EX-D6, C5 and C6. In total there is 0.81 AC of impervious area leaving the Hillside site untreated for water quality.

IV. STORMWATER MANAGEMENT FACILITY DESIGN

A. Stormwater Conveyance Facilities

The existing storm sewer system constructed with prior phases of the subdivision is designed to capture and convey all developed flows from the Site to existing Pond B.

See **Appendix E** for excerpts from the Hillside at Castle Rock Phase 3 & 4 Construction Plans and Phase III Drainage Report.

B. Stormwater Storage Facilities

Pond B, to be constructed with Phases 3 & 4, is an extended detention basin located on the south side of Grayside Cir at the intersection with W Wolfensberger Rd. It is designed (by others) to treat and detain all developed flows from the Site (see **Appendix C** for capacity analysis). Pond B releases into existing storm sewer, constructed with previous phases of the Hillside at Castle Rock project, that runs along the north side of W Wolfensberger Rd. The existing sewer connects to an existing 12-foot by 8-foot concrete box culvert crossing under the road (approximately 600 feet east of the Site) and discharges into the Omni Tributary.

Under fully developed conditions, developed flows from the Site will be captured and detained prior to releasing into the receiving channel. Since these flows will discharge within the box culvert, no adverse impacts to the receiving channel are anticipated.

See **Appendix E** excerpts from the Hillside at Castle Rock Phase 3 & 4 Construction Plans and Phase III Drainage Report.

C. Water Quality Enhancement Control Measures

Pond B, discussed above, is designed by others as a full spectrum EDB that will provide water quality treatment for the Site.

D. Floodplain Modification

There are no defined floodplains within the Site.

E. Geotechnical Investigation and Sub-surface Collection System Design

A *Supplemental Preliminary Geotechnical Investigation Hillside at Castle Rock Phase 5*, CTL\Thompson, April 19, 2024 is submitted to the Town.

This study showed groundwater at depths of 13.5-18.5 feet below proposed grades, this is described to have little effect on construction apart from deep utilities or drilled peers. Sub-excavation is recommended to a depth of 8’ below non-basement foundations, and 3’ below basement foundations to reduce heave or settlement hazards. It is recommended that this sub-excavation extend at least 5’ laterally outside foundation extents. CTL also recommends foundation drains around basement or crawl space areas. See **Appendix E** for Geotechnical investigation excerpts.

In accordance with the Town’s Storm Drainage Criteria, Sub-surface collection systems are implemented along the receiving Right-of-Way lines where multi-lot drainage configurations discharge to the Right-of-Way, and where residential lots are placed in a cut slope configuration at the base of a hill.

F. Operation and Maintenance

See the Phase 3 & 4 Drainage Report (by EES) for operation and maintenance discussion.

G. Additional Permitting Requirements

There are no identified wetlands at this time. There are currently no endangered species located on the Site. There are no other permitting requirements placed on the Site.

H. General

Copies of the FIRM and soils map utilized in the design are included in Appendix A. All analysis calculations have been included in the Appendices as well.

V. CONCLUSIONS

A. Compliance with Standards

This report is in compliance with the standards set forth in the *Storm Drainage Design and Technical Criteria Manual* by the Town of Castle Rock as well as the *Urban Storm Drainage Criteria Manual* by Mile High Flood District. The Site is in accordance with the design of the previous phases of the Hillside – Arbors subdivision.

B. Variances

Variance requests will be submitted along with this SDP on the Water Quality Exclusions associated with this development.

C. Drainage Concept

Developed runoff is captured by storm sewer infrastructure and discharged into a water quality and detention pond. The pond releases at or below both approved release rates (Pond A) or pre-developed rates (Pond B) via storm sewer safely into the receiving channel without chance of causing scour or erosion. Therefore, no adverse impacts to upstream or downstream properties and facilities are anticipated.

VI. REFERENCES

1. *Storm Drainage Design and Technical Criteria Manual*, Town of Castle Rock, June 2019.

2. *Urban Storm Drainage Criteria Manual*, Mile High Flood District, Latest Revision.

3. *Site Development Plan 2nd Amendment Hillside – Arbors Site Development Plan*, Entitlement and Engineering Solutions, Inc., August 23, 2023.

4. *Overall Phase III Drainage Report Hillside at Castle Rock*, Paragon Engineering Consultants, Inc., Revised October 11 2016.

5. *Phase III Drainage Report Hillside at Castle Rock Phase 1 & 2*, Paragon Engineering Consultants, Inc., Revised July 2023.

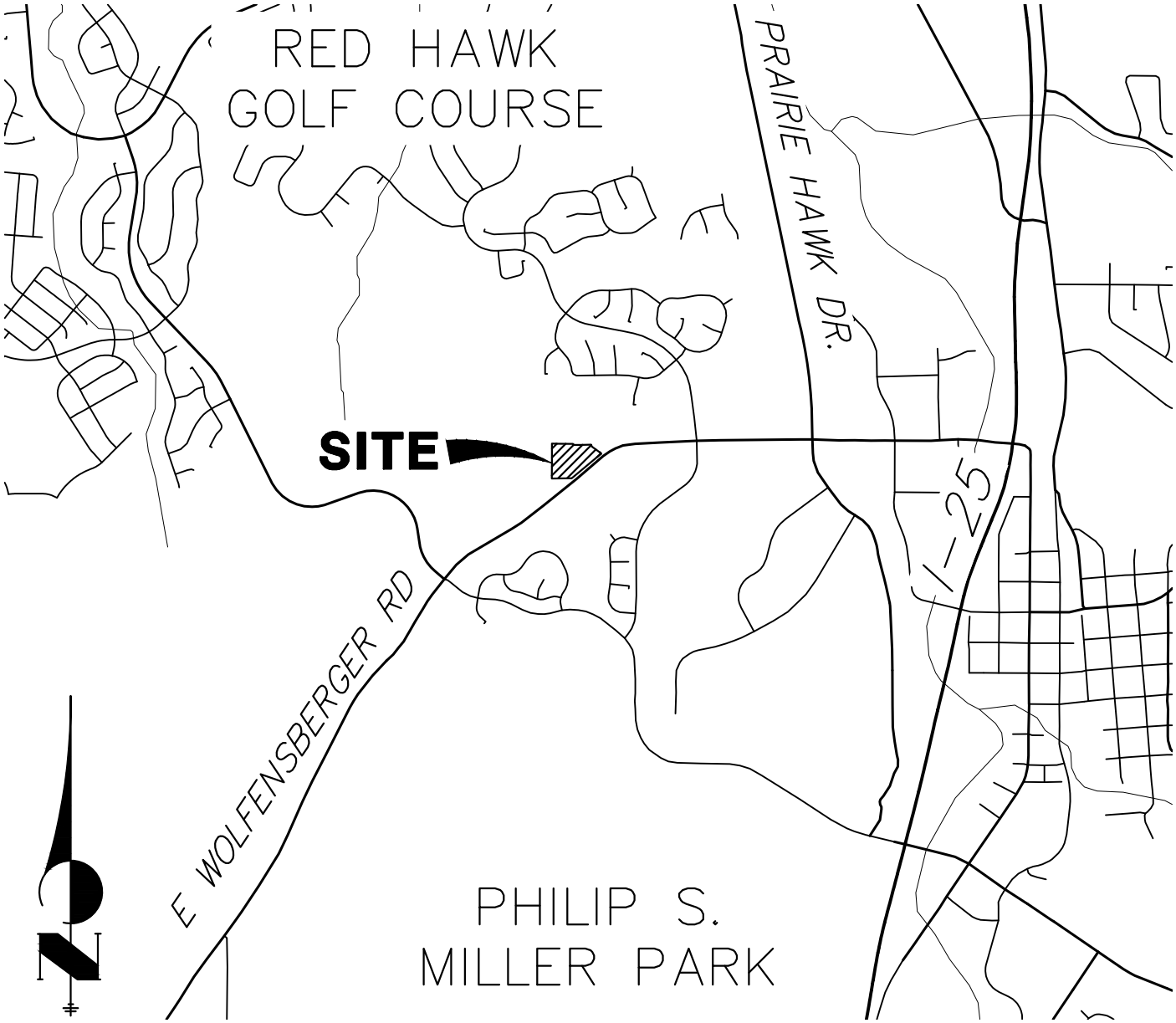
6. *Phase III Drainage Report Hillside at Castle Rock Phase 3 & 4*, Entitlement and Engineering Solutions, Inc, August 25, 2023.

7. *Public Improvement Construction Plans for Hillside at Castle Rock Phases 3 - 4*, Entitlement and Engineering Solutions, Inc, August 23, 2023.

8. *Supplemental Preliminary Geotechnical Investigation Hillside at Castle Rock Phase 5, CTL Thompson, April 19, 2024.*

APPENDIX A

FIGURES



VICINITY MAP

1"=2000'

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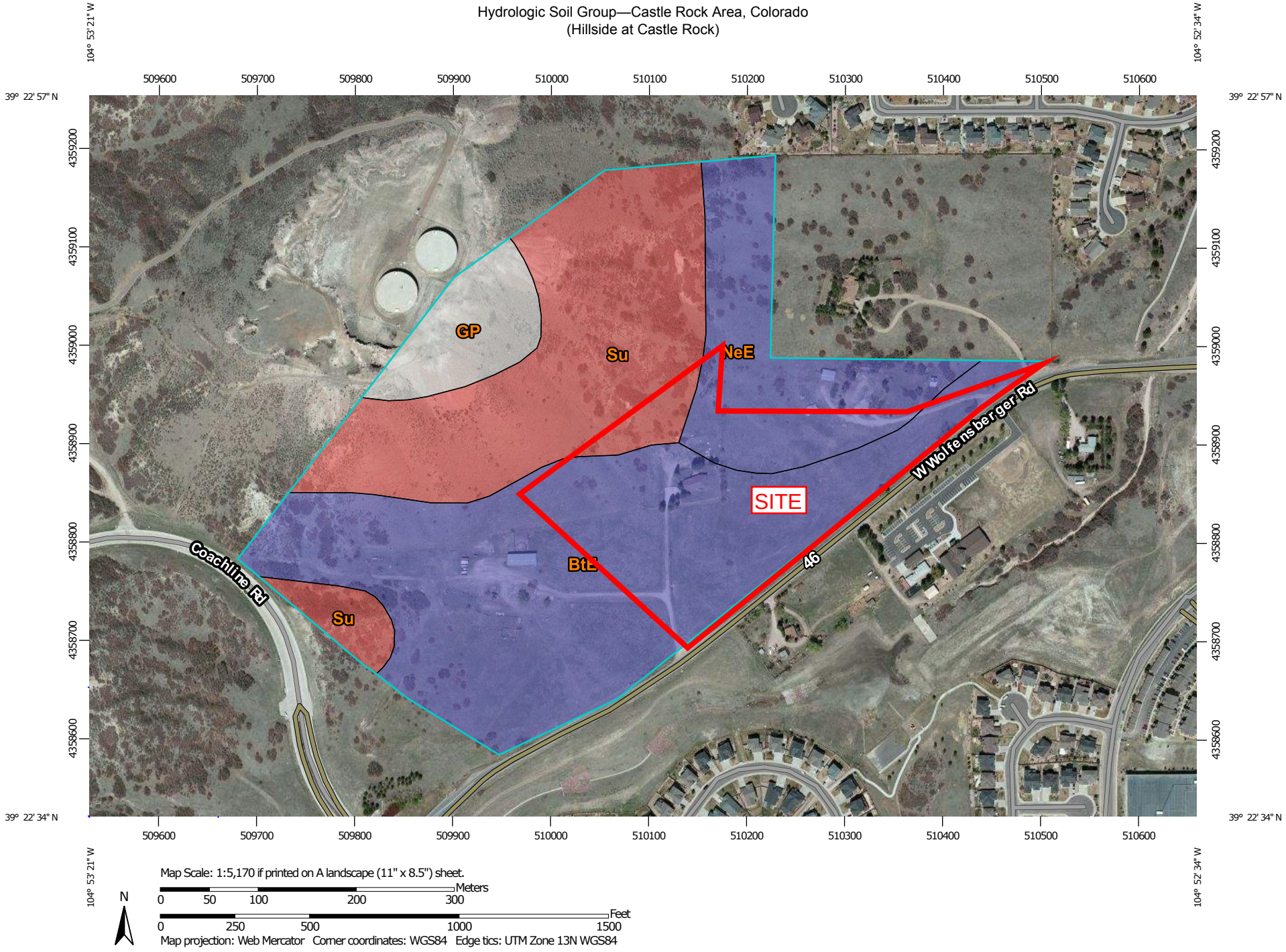
Hydrologic Soil Group—Castle Rock Area, Colorado
(Hillside at Castle Rock)



MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

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

Soil Rating Lines

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

Soil Rating Points

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

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

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

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

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

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

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

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

Soil Survey Area: Castle Rock Area, Colorado
Survey Area Data: Version 8, Sep 23, 2014

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

Date(s) aerial images were photographed: Mar 16, 2012—Apr 13, 2012

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

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Castle Rock Area, Colorado (CO622)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
BtE	Bresser-Truckton sandy loams, 5 to 25 percent slopes	B	28.1	46.3%
GP	Pits, gravel		3.9	6.4%
NeE	Newlin gravelly sandy loam, 8 to 30 percent slopes	B	9.6	15.8%
Su	Stony rough land	D	19.1	31.4%
Totals for Area of Interest			**60.8**	**100.0%**

Description

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

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

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

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

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

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

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

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables shown on this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Floodway Data table shown on this FIRM.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 13. The **horizontal datum** was NAD 83, GRS 1980 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 713- 3242**, or visit its website at http://www.ngs.noaa.gov.

Base map information shown on this FIRM was provided by the Douglas County GIS Department and the Town of Castle Rock GIS Department. Additional input was provided by the City of Lone Tree and Town of Parker. These data are current as of 2010.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

The **profile baselines** depicted on this map represent the hydraulic modeling baselines that match the flood profiles in the FIS report. As a result of improved topographic data, the **profile baseline**, in some cases, may deviate significantly from the channel centerline or appear outside the SFHA.

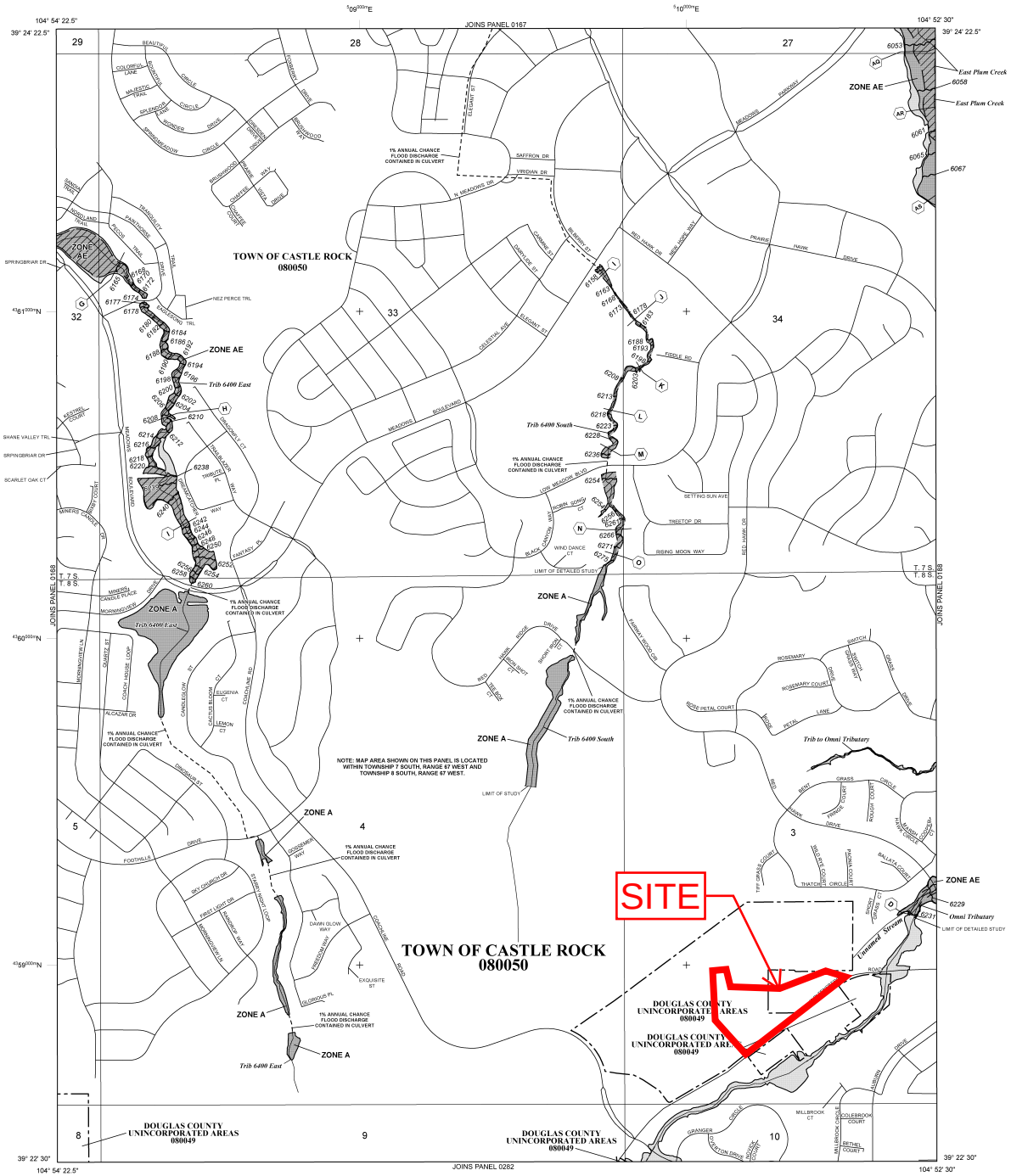
Based on updated topographic information, this map reflects more detailed and up-to-date **stream channel configurations and floodplain delineations** than those shown on the previous FIRM for this jurisdiction. As a result, the Flood Profiles and Floodway Data tables for multiple streams in the Flood Insurance Study Report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on the map. Also, the road to floodplain relationships for unrevised streams may differ from what is shown on previous maps.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

For information on available products associated with this FIRM visit the **Map Service Center (MSC)** website at http://msc.fema.gov. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the MSC website.

If you have **questions about this map,** how to order products, or the National Flood Insurance Program in general, please call the **FEMA Map Information eXchange (FMIX)** at **1-877-FEMA-MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/business/nfip.



LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Areas formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X	Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X	Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D	Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

1% Annual Chance Floodplain Boundary

0.2% Annual Chance Floodplain Boundary

Floodway boundary

Zone D boundary

CBRS and OPA boundary

Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths, or flood velocities.

513 Base Flood Elevation line and value; elevation in feet*

(EL 987) Base Flood Elevation value where uniform within zone; elevation in feet*

*Referenced to the North American Vertical Datum of 1988

A–A Cross section line

23–23 Transect line

45° 02' 08", 93° 02' 12" Geographic coordinates referenced to the North American Datum of 1983 (NAD 83) Western Hemisphere

$^{4}89^{000}$mN 1000-meter Universal Transverse Mercator grid values, zone 13

DX5510 × Bench mark (see explanation in Notes to Users section of this FIRM panel)

M1.5 River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP

SEPTEMBER 30, 2005

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

MARCH 16, 2016: to update corporate limits, to change base flood elevations, to add base flood elevations, to add special flood hazard areas, to update map format, to add roads and road names, to reflect updated topographic information, to incorporate previously issued letters of map revision.

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 500'

250 0 500 1000 FEET

150 0 150 300 METERS

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0169G

FIRM

FLOOD INSURANCE RATE MAP

DOUGLAS COUNTY, COLORADO AND INCORPORATED AREAS

PANEL 169 OF 495

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
CASTLE ROCK, TOWN OF	080050	0169	G
DOUGLAS COUNTY	080049	0169	G

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
08035C0169G
MAP REVISED
MARCH 16, 2016

Federal Emergency Management Agency

APPENDIX B

HYDROLOGY

Subdivision:	Ex Hillside Castle Rock Phase 3&4	**Project No.:**	16190.20
Location:	Castle Rock	**Date:**	7/23/25

SUB-BASIN SUMMARY TABLE

Tributary Sub-basin	Area (acres)	Percent Impervious	C_5	C_{100}	t_c (min)	Q_5 (cfs)	Q_{100} (cfs)
EX-A	17.88	5.9%	0.04	0.45	19.1	2.0	42.5
EX-B1	6.25	63.7%	0.53	0.73	12.5	11.8	29.3
EX-B2	3.26	62.5%	0.52	0.72	10.5	6.4	16.2
EX-B3	1.00	8.3%	0.06	0.47	10.2	0.2	3.3
EX-B4	3.28	13.6%	0.10	0.49	14.1	1.1	9.8
EX-B5	1.10	40.5%	0.32	0.62	6.8	1.6	5.5
EX-C1	10.58	7.4%	0.04	0.45	22.5	1.0	23.0
EX-C2	0.40	5.0%	0.03	0.45	11.4	0.0	1.2
EX-C3	1.06	8.4%	0.06	0.47	15.5	0.2	2.9
EX-D1	1.61	27.3%	0.21	0.55	14.7	1.1	5.3
EX-D2	1.34	23.8%	0.04	0.45	11.8	0.2	4.0
EX-D3	0.34	41.4%	0.33	0.62	10.2	0.4	1.5
EX-D5	5.46	16.0%	0.04	0.45	16.8	0.6	13.8
EX OS1	6.25	5.6%	0.07	0.49	12.9	1.5	19.5
EX-SB	1.91	10.5%	0.11	0.52	12.5	0.7	6.3
Existing Pond A Tributary	**41.27**	**40.0%**	---	---	---	---	---
Total	**61.72**	**18.2%**	---	---	---	**28.93**	**183.94**

DESIGN POINT TABLE

Design Point	Q_5 (cfs)	Q_{100} (cfs)
1	1.5	2.8
2	0.7	1.3
3.1	2.3	4.1
4	0.2	0.4
5.1	2.5	4.5
6	2.0	42.5
7.1	4.1	46.3
8	0.4	9.8
9	1.6	5.5
10.1	1.8	13.9
11	11.8	29.3
12.1	13.4	41.7
13	6.4	16.2
14.1	19.3	56.0
15	1.1	9.8
16.1	19.4	65.8
17	0.6	13.8
18	1.0	22.9
19.1	1.6	34.8
20	1.1	5.3
21	0.2	4.0
22	0.0	1.2
23	0.2	2.8

COMPOSITE % IMPERVIOUSNESS CALCULATIONS

Subdivision: Ex Hillside Castle Rock Phase 3&4
Location: Castle Rock

Project Name: Hillside
Project No.: 16190.20
Calculated By: BMP
Checked By: JP
Date: 7/23/25

Basin ID	Total Area (ac)	SFH-HIGH			Extended Detention Basin			Asphalt\Walk/Roofs			Maintenance Path			Receiving Pervious Area			Undisturbed Native Grasses			Basins Total Weighted % Imp.
		% Imp.	Area (ac)	Weighted % Imp.	% Imp.	Area (ac)	Weighted % Imp.	% Imp.	Area (ac)	Weighted % Imp.	% Imp.	Area (ac)	Weighted % Imp.	% Imp.	Area (ac)	Weighted % Imp.	% Imp.	Area (ac)	Weighted % Imp.	
EX-A	17.88	65%	0.00	0.0%	25%	0.00	0.0%	95%	0.05	0.3%	60%	0.20	0.7%	20%	0.00	0.0%	5%	17.63	4.9%	5.9%
EX-B1	6.25	65%	3.70	38.5%	25%	0.00	0.0%	95%	1.00	15.2%	60%	0.99	9.5%	20%	0.04	0.1%	5%	0.52	0.4%	63.7%
EX-B2	3.26	65%	1.99	39.7%	25%	0.00	0.0%	95%	0.75	21.9%	60%	0.00	0.0%	20%	0.04	0.2%	5%	0.48	0.7%	62.5%
EX-B3	1.00	65%	0.00	0.0%	25%	0.00	0.0%	95%	0.04	3.5%	60%	0.00	0.0%	20%	0.00	0.0%	5%	0.95	4.8%	8.3%
EX-B4	3.28	65%	0.00	0.0%	25%	0.96	7.3%	95%	0.00	0.0%	60%	0.17	3.0%	20%	0.00	0.0%	5%	2.15	3.3%	13.6%
EX-B5	1.10	65%	0.63	37.2%	25%	0.00	0.0%	95%	0.01	1.2%	60%	0.00	0.0%	20%	0.00	0.0%	5%	0.46	2.1%	40.5%
EX-C1	10.58	65%	0.00	0.0%	25%	0.00	0.0%	95%	0.21	1.9%	60%	0.12	0.7%	20%	0.02	0.0%	5%	10.23	4.8%	7.4%
EX-C2	0.40	65%	0.00	0.0%	25%	0.00	0.0%	95%	0.00	0.0%	60%	0.00	0.0%	20%	0.00	0.0%	5%	0.40	5.0%	5.0%
EX-C3	1.06	65%	0.00	0.0%	25%	0.00	0.0%	95%	0.02	1.6%	60%	0.04	2.0%	20%	0.00	0.0%	5%	1.01	4.8%	8.4%
EX-D1	1.61	65%	0.43	17.4%	25%	0.00	0.0%	95%	0.11	6.3%	60%	0.00	0.0%	20%	0.04	0.5%	5%	1.04	3.2%	27.3%
EX-D2	1.34	65%	0.00	0.0%	25%	0.00	0.0%	95%	0.27	19.0%	60%	0.00	0.0%	20%	0.07	1.0%	5%	1.01	3.8%	23.8%
EX-D3	0.34	65%	0.00	0.0%	25%	0.00	0.0%	95%	0.13	37.2%	60%	0.00	0.0%	20%	0.03	1.6%	5%	0.18	2.6%	41.4%
EX-D5	5.46	65%	0.00	0.0%	25%	0.00	0.0%	95%	0.65	11.3%	60%	0.00	0.0%	20%	0.10	0.4%	5%	4.71	4.3%	16.0%
EX OS1	6.25	65%	0.00	0.0%	25%	0.00	0.0%	95%	0.03	0.5%	60%	0.02	0.2%	20%	0.00	0.0%	5%	6.20	5.0%	5.6%
EX-SB	1.91	65%	0.00	0.0%	25%	0.53	6.9%	95%	0.00	0.0%	60%	0.00	0.0%	20%	0.00	0.0%	5%	1.38	3.6%	10.5%
Existing Pond A Tributary	**41.27**																			**40.00%**
Total	**61.72**																			**18.25%**

COMPOSITE RUNOFF COEFFICIENT CALCULATIONS

Subdivision: Ex Hillside Castle Rock Phase 3&4
Location: Castle Rock

Project Name: Hillside
Project No.: 16190.20
Calculated By: BMP
Checked By: JP
Date: 7/23/25

Basin ID	Total Area (ac)	Basins Total Weighted % Imp.	Hydrologic Soil Group			Hydrologic Soil Group			Minor Coefficients			Major Coefficients			Basins Total Weighted C_5	Basins Total Weighted C_{100}
			Area A (ac)	Area B (ac)	Area C/D (ac)	% A (ac)	% B (ac)	% C/D (ac)	$C_{5,A}$	$C_{5,B}$	$C_{5,C/D}$	$C_{100,A}$	$C_{100,B}$	$C_{100,C/D}$		
EX-A	17.88	5.9%	0.00	17.88	0.00	0%	100%	0%	0.02	0.04	0.08	0.16	0.45	0.51	0.04	0.45
EX-B1	6.25	63.7%	0.00	4.69	1.56	0%	75%	25%	0.48	0.53	0.56	0.61	0.73	0.75	0.53	0.73
EX-B2	3.26	62.5%	0.00	3.26	0.00	0%	100%	0%	0.47	0.52	0.55	0.60	0.72	0.74	0.52	0.72
EX-B3	1.00	8.3%	0.00	1.00	0.00	0%	100%	0%	0.04	0.06	0.10	0.17	0.47	0.52	0.06	0.47
EX-B4	3.28	13.6%	0.00	3.28	0.00	0%	100%	0%	0.07	0.10	0.15	0.22	0.49	0.54	0.10	0.49
EX-B5	1.10	40.5%	0.00	1.10	0.00	0%	100%	0%	0.27	0.32	0.37	0.43	0.62	0.65	0.32	0.62
EX-C1	10.58	5.6%	0.00	10.58	0.00	0%	100%	0%	0.02	0.04	0.08	0.15	0.45	0.51	0.04	0.45
EX-C2	0.40	5.0%	0.00	0.40	0.00	0%	100%	0%	0.02	0.03	0.08	0.15	0.45	0.50	0.03	0.45
EX-C3	1.06	8.4%	0.00	1.06	0.00	0%	100%	0%	0.04	0.06	0.10	0.18	0.47	0.52	0.06	0.47
EX-D1	1.61	27.3%	0.00	1.61	0.00	0%	100%	0%	0.16	0.21	0.26	0.32	0.55	0.60	0.21	0.55
EX-D2	1.34	5.6%	0.00	1.34	0.00	0%	100%	0%	0.02	0.04	0.08	0.15	0.45	0.51	0.04	0.45
EX-D3	0.34	41.4%	0.00	0.34	0.00	0%	100%	0%	0.28	0.33	0.37	0.43	0.62	0.65	0.33	0.62
EX-D5	5.46	5.6%	0.00	5.46	0.00	0%	100%	0%	0.02	0.04	0.08	0.15	0.45	0.51	0.04	0.45
EX OS1	6.25	5.6%	0.00	1.57	4.68	0%	25%	75%	0.02	0.04	0.08	0.15	0.45	0.51	0.07	0.49
EX-SB	1.91	10.5%	0.00	0.40	1.51	0%	21%	79%	0.05	0.07	0.12	0.19	0.47	0.53	0.11	0.52

STANDARD FORM SF-2
TIME OF CONCENTRATION

Subdivision: Ex Hillside Castle Rock Phase 3&4
Location: Castle Rock

Project Name: Hillside
Project No.: 16190.20
Calculated By: BMP
Checked By: JP
Date: 7/23/25

SUB-BASIN DATA						INITIAL/OVERLAND (T_i)			TRAVEL TIME (T_t)					*tc* CHECK (URBANIZED BASINS)			FINAL
BASIN ID	D.A. (ac)	Hydrologic Soils Group	Impervious (%)	C_5	C_{100}	L (ft)	S_o (%)	t_i (min)	L_t (ft)	S_t (%)	K	VEL. (ft/s)	t_t (min)	COMP. t_c (min)	TOTAL LENGTH (ft)	Urbanized t_c (min)	t_c (min)
EX-A	17.88	B	5.9%	0.04	0.45	500	50.00%	11.8	1244	16.30%	7	2.8	7.3	19.1	1744.0	30.2	19.12
EX-B1	6.25	B	63.7%	0.53	0.73	300	20.00%	6.6	1500	4.50%	20	4.2	5.9	12.5	1800.0	21.7	12.47
EX-B2	3.26	B	62.5%	0.52	0.72	51	1.50%	6.6	1294	7.43%	20	5.5	4.0	10.5	1345.0	19.8	10.54
EX-B3	1.00	B	8.3%	0.06	0.47	58	6.80%	7.6	829	7.40%	20	5.4	2.5	10.2	887.0	29.6	10.16
EX-B4	3.28	B	13.6%	0.10	0.49	300	16.80%	12.4	373	12.70%	10	3.6	1.7	14.1	673.0	25.3	14.09
EX-B5	1.10	B	40.5%	0.32	0.62	60	12.00%	4.8	561	5.63%	20	4.7	2.0	6.8	621.0	21.8	6.76
EX-C1	10.58	B	5.6%	0.04	0.45	500	35.00%	13.3	1500	14.90%	7	2.7	9.3	22.5	2000.0	31.7	22.53
EX-C2	0.40	B	5.0%	0.03	0.45	148	9.30%	11.2	29	9.28%	10	3.0	0.2	11.4	177.0	25.3	11.39
EX-C3	1.06	B	8.4%	0.06	0.47	300	12.00%	14.4	155	5.00%	10	2.2	1.2	15.5	455.0	25.7	15.51
EX-D1	1.61	B	27.3%	0.21	0.55	300	10.38%	12.9	501	8.73%	15	4.4	1.9	14.7	801.0	23.6	14.74
EX-D2	1.34	B	23.8%	0.04	0.45	150	15.00%	9.6	360	3.40%	15	2.8	2.2	11.8	510.0	24.6	11.79
EX-D3	0.34	B	5.6%	0.33	0.62	150	6.70%	9.1	147	2.31%	15	2.3	1.1	10.2	297.0	26.7	10.18
EX-D5	5.46	B	16.0%	0.04	0.45	470	50.00%	11.4	1200	14.00%	10	3.7	5.3	16.8	1670.0	28.0	16.79
EX OS1	6.25	B	5.6%	0.07	0.49	500	50.00%	11.4	491	8.00%	20	5.7	1.4	12.9	991.0	28.0	12.88
EX-SB	1.91	B	10.5%	0.11	0.52	500	50.00%	11.0	500	30.00%	10	5.5	1.5	12.5	1000.0	25.7	12.50

STANDARD FORM SF-3

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

Subdivision: Ex Hillside Castle Rock Phase 3&4
Location: Castle Rock
Design Storm: 5-Year P1 = 1.43 in/hr

Project Name: Hillside
Project No.: 16190.20
Calculated By: BMP
Checked By: JP
Date: 7/23/25

		DIRECT RUNOFF							TOTAL RUNOFF				STREET			PIPE				TRAVEL TIME			
STREET	Design Point	Basin ID	Area (Ac)	Runoff Coeff.	t_c (min)	C*A (Ac)	I (in/hr)	Q (cfs)	tc (min)	C*A (ac)	I (in/hr)	Q (cfs)	Q_{allow} (cfs)	C*A (ac)	Slope (%)	Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_t (min)	REMARKS
																							TOTAL RUNOFF FROM BASIN EX OS-1
	1	EX OS1	6.25	0.07	12.9	0.4	3.5	1.5															FLOWS DOWN HILL TO ROCKFALL MITIGATION CHANNEL. ENTERS CHANNEL AT DP 1. REACHES END OF PH1-2 IMPROVEMENTS, FLOWS TO EX POND A
																							TOTAL RUNOFF FROM BASIN EX-SB
	2	EX-SB	1.91	0.11	12.5	0.2	3.5	0.7															FLOWS TO SEDIMENT BASIN AT DP 3.1
																							SUM OF FLOWS FROM DP 1 & 2
	3.1								12.9	0.65	3.48	2.3											FLOWS TO DP 5.1
																							TOTAL RUNOFF FROM BASIN EX-B3, ENTERS CONCRETE CHANNEL
	4	EX-B3	1.00	0.06	10.2	0.1	3.8	0.2															FLOWS TO DP 7.1
																							SUM OF FLOWS FROM DP 3.1 & 4
	5.1								12.9	0.71	3.48	2.5											FLOWS TO DP 7.1
																							TOTAL RUNOFF FROM BASIN EX-A
	6	EX-A	17.88	0.04	19.1	0.7	2.9	2.0															FLOWS TO DP 7.1
																							SUM OF FLOWS FROM DP 5.1 & 6
	7.1								19.1	1.41	2.88	4.1											FLOWS TO EX POND A AT DP 16.1
																							TOTAL RUNOFF FROM BASIN EX-D3
	8	EX-D3	0.34	0.33	10.2	0.1	3.8	0.4															ENTERS EX TYPE C AT DP 8
																							TOTAL RUNOFF FROM BASIN EX-B5
	9	EX-B5	1.10	0.32	6.8	0.4	4.4	1.6															ENTERS EX TYPE C AT DP 9
																							SUM OF FLOWS FROM DP 8 & 9
	10.1								10.2	0.46	3.84	1.8											FLOWS TO DP 12.1
																							TOTAL RUNOFF FROM BASIN EX-B1
	11	EX-B1	6.25	0.53	12.5	3.3	3.5	11.8															ENTERS EX NUMBER 16 INLET AT DP 11
																							SUM OF FLOWS FROM DP 10.1 & 11
	12.1								12.5	3.80	3.53	13.4											FLOWS TO DP 14.1
																							TOTAL RUNOFF FROM BASIN EX-B2
	13	EX-B2	3.26	0.52	10.5	1.7	3.8	6.4															ENTERS EX NUMBER 16 INLET AT DP 11
																							SUM OF FLOWS FROM DP 12.1 & 13
	14.1								12.5	5.48	3.53	19.3											FLOWS TO DP 16.1
																							TOTAL RUNOFF FROM BASIN EX-B4
	15	EX-B4	3.28	0.10	14.1	0.3	3.3	1.1															FLOWS TO EX POND A AT DP 16.1
																							TOTAL FLOWS ENTERING EX POND A
	16.1								14.1	5.80	3.34	19.4											OUTFALLS THROUGH OUTLET STRUCTURE, FLOWS ROUTED VIA CITY STORM TO OMNI TRIBUTARY
																							TOTAL RUNOFF FROM BASIN EX-D5
	17	EX-D5	5.46	0.04	16.8	0.2	3.1	0.6															FLOWS TO EX SWALE AT DP 17
																							TOTAL RUNOFF FROM BASIN EX-C1
	18	EX-C1	10.58	0.04	22.5	0.4	2.6	1.0															FLOWS TO EX SWALE AT DP 18
																							SUM OF FLOWS FROM DP 17 & 18
	19.1								22.5	0.59	2.64	1.6											CONTINUES ALONG EX SWALE UNTIL ENTERING OMNI TRIBUTARY
																							TOTAL RUNOFF FROM BASIN EX-D1
	20	EX-D1	1.61	0.21	14.7	0.3	3.3	1.1															FLOWS TO EX SWALE AT DP 20, OUTFALLS VIA EX STORM SEWER TO EX OMNI TRIBUTARY
																							TOTAL RUNOFF FROM BASIN EX-D2
	21	EX-D2	1.34	0.04	11.8	0.1	3.6	0.2															FLOWS TO EX SWALE AT DP 21, OUTFALLS VIA EX STORM SEWER TO EX OMNI TRIBUTARY
																							TOTAL RUNOFF FROM BASIN EX-C2
	22	EX-C2	0.40	0.03	11.4	0.0	3.7	0.0															LEAVE SITE UNDETAINED AND UNTREATED AT DP 22
																							TOTAL RUNOFF FROM BASIN EX-C3
	23	EX-C3	1.06	0.06	15.5	0.1	3.2	0.2															LEAVE SITE UNDETAINED AND UNTREATED AT DP 23

STANDARD FORM SF-3

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

Subdivision: Ex Hillside Castle Rock Phase 3&4
Location: Castle Rock
Design Storm: 100-Year P1 = 2.6 in/hr

Project Name: Hillside
Project No.: 16190.20
Calculated By: BMP
Checked By: JP
Date: 7/23/25

		DIRECT RUNOFF							TOTAL RUNOFF				STREET			PIPE				TRAVEL TIME			
STREET	Design Point	Basin ID	Area (Ac)	Runoff Coeff.	t_c (min)	C*A (Ac)	I (in/hr)	Q (cfs)	tc (min)	C*A (ac)	I (in/hr)	Q (cfs)	Q_{street} (cfs)	C*A (ac)	Slope (%)	Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_c (min)	REMARKS
																							TOTAL RUNOFF FROM BASIN EX OS-1
	1	EX OS1	6.25	0.49	12.9	3.1	6.3	19.5															FLOWS DOWN HILL TO ROCKFALL MITIGATION CHANNEL. ENTERS CHANNEL AT DP 1. REACHES END OF PH1-2 IMPROVEMENTS, FLOWS TO EX POND A
																							TOTAL RUNOFF FROM BASIN EX-SB
	2	EX-SB	1.91	0.52	12.5	1.0	6.4	6.3															FLOWS TO SEDIMENT BASIN AT DP 3.1
																							SUM OF FLOWS FROM DP 1 & 2
	3.1								12.9	4.07	6.33	25.8											FLOWS TO DP 5.1
																							TOTAL RUNOFF FROM BASIN EX-B3, ENTERS CONCRETE CHANNEL
	4	EX-B3	1.00	0.47	10.2	0.5	7.0	3.3															FLOWS TO DP 7.1
																							SUM OF FLOWS FROM DP 3.1 & 4
	5.1								12.9	4.54	6.33	28.7											FLOWS TO DP 7.1
																							TOTAL RUNOFF FROM BASIN EX-A
	6	EX-A	17.88	0.45	19.1	8.1	5.2	42.5															FLOWS TO DP 7.1
																							SUM OF FLOWS FROM DP 5.1 & 6
	7.1								19.1	12.66	5.24	66.3											FLOWS TO EX POND A AT DP 16.1
																							TOTAL RUNOFF FROM BASIN EX-D3
	8	EX-B4	3.28	0.49	14.1	1.6	6.1	9.8															ENTERS EX TYPE C AT DP 8
																							TOTAL RUNOFF FROM BASIN EX-B5
	9	EX-B5	1.10	0.62	6.8	0.7	8.1	5.5															ENTERS EX TYPE C AT DP 9
																							SUM OF FLOWS FROM DP 8 & 9
	10.1								14.1	2.29	6.08	13.9											FLOWS TO DP 12.1
																							TOTAL RUNOFF FROM BASIN EX-B1
	11	EX-B1	6.25	0.73	12.5	4.6	6.4	29.3															ENTERS EX NUMBER 16 INLET AT DP 11
																							SUM OF FLOWS FROM DP 10.1 & 11
	12.1								14.1	6.86	6.08	41.7											FLOWS TO DP 14.1
																							TOTAL RUNOFF FROM BASIN EX-B2
	13	EX-B2	3.26	0.72	10.5	2.4	6.9	16.2															ENTERS EX NUMBER 16 INLET AT DP 11
																							SUM OF FLOWS FROM DP 12.1 & 13
	14.1								14.1	9.21	6.08	56.0											FLOWS TO DP 16.1
																							TOTAL RUNOFF FROM BASIN EX-B4
	15	EX-B4	3.28	0.49	14.1	1.6	6.1	9.8															FLOWS TO EX POND A AT DP 16.1
																							TOTAL FLOWS ENTERING EX POND A
	16.1								14.1	10.82	6.08	65.8											OUTFALLS THROUGH OUTLET STRUCTURE, FLOWS ROUTED VIA CITY STORM TO OMNI TRIBUTARY
																							TOTAL RUNOFF FROM BASIN EX-D5
	17	EX-D5	5.46	0.45	16.8	2.5	5.6	13.8															FLOWS TO EX SWALE AT DP 17
																							TOTAL RUNOFF FROM BASIN EX-C1
	18	EX-C1	10.58	0.45	22.5	4.8	4.8	22.9															FLOWS TO EX SWALE AT DP 18
																							SUM OF FLOWS FROM DP 17 & 18
	19.1								22.5	7.25	4.80	34.8											CONTINUES ALONG EX SWALE UNTIL ENTERING OMNI TRIBUTARY
																							TOTAL RUNOFF FROM BASIN EX-D1
	20	EX-D1	1.61	0.55	14.7	0.9	6.0	5.3															FLOWS TO EX SWALE AT DP 20, OUTFALLS VIA EX STORM SEWER TO EX OMNI TRIBUTARY
																							TOTAL RUNOFF FROM BASIN EX-D2
	21	EX-D2	1.34	0.45	11.8	0.6	6.6	4.0															FLOWS TO EX SWALE AT DP 21, OUTFALLS VIA EX STORM SEWER TO EX OMNI TRIBUTARY
																							TOTAL RUNOFF FROM BASIN EX-C2
	22	EX-C2	0.40	0.45	11.4	0.2	6.7	1.2															LEAVE SITE UNDETAINED AND UNTREATED AT DP 22
																							TOTAL RUNOFF FROM BASIN EX-C3
	23	EX-C3	1.06	0.47	15.5	0.5	5.8	2.8															LEAVE SITE UNDETAINED AND UNTREATED AT DP 23

Subdivision:	Hillside Castle Rock Phase 3&4	**Project No.**	16190.20
Location:	Castle Rock	**Date:**	12/1/25

SUB-BASIN SUMMARY TABLE

Tributary Sub-basin	Area (acres)	Percent Impervious	C_5	C_{100}	t_c (min)	Q_5 (cfs)	Q_{100} (cfs)
A1	1.40	53.2%	0.43	0.68	5.9	2.8	8.0
A2	0.85	68.9%	0.57	0.75	7.3	2.1	5.0
A3	0.77	44.4%	0.35	0.63	9.5	1.1	3.5
A4	0.17	66.8%	0.55	0.74	12.0	0.3	0.8
A5	0.37	53.4%	0.47	0.70	13.6	0.6	1.6
A6	0.35	69.7%	0.58	0.75	11.5	0.7	1.8
A7	0.83	53.4%	0.44	0.68	6.8	1.6	4.5
A8	0.64	69.7%	0.58	0.75	10.4	1.4	3.3
A9	1.81	95.0%	0.46	0.69	6.7	3.7	10.1
A10	0.88	79.3%	0.58	0.75	11.2	1.9	4.5
A11	0.21	56.2%	0.59	0.76	12.1	0.4	1.0
A12	0.14	56.2%	0.48	0.70	7.2	0.3	0.8
A13	0.39	34.6%	0.16	0.52	12.3	0.2	1.3
A14	0.05	79.3%	0.33	0.62	5.0	0.1	0.3
C1	0.31	95.0%	0.81	0.87	5.0	1.2	2.4
C2	0.40	79.3%	0.67	0.80	5.0	1.3	2.8
C3	2.32	56.2%	0.46	0.69	8.6	4.4	11.9
C4	2.02	34.6%	0.27	0.59	12.9	1.9	7.5
C5	0.22	58.2%	0.48	0.70	5.0	0.5	1.4
C6	0.41	31.3%	0.24	0.57	5.6	0.5	2.0
OS2	6.88	6.7%	0.09	0.51	13.7	2.0	21.5
OS2.1	8.86	5.1%	0.09	0.51	15.0	2.5	26.6
OS3	4.90	5.1%	0.07	0.50	14.6	1.2	14.6
EX-B1	6.18	63.4%	0.52	0.72	10.6	12.3	30.8
EX-B2	3.19	62.4%	0.51	0.72	10.6	6.2	15.8
EX-B3	2.01	11.4%	0.08	0.48	10.0	0.6	6.8
EX-B4	2.34	17.1%	0.13	0.51	9.6	1.2	8.5
EX-B5	1.10	27.3%	0.32	0.62	6.8	1.6	5.5
EX-D1	1.61	27.3%	0.21	0.55	14.7	1.1	5.3
EX-D2	1.34	23.8%	0.18	0.54	10.5	0.9	5.0
EX-D3	0.34	41.4%	0.33	0.62	10.2	0.4	1.5
EX-D5	2.28	36.7%	0.29	0.60	20.2	1.8	6.9
EX-D6	0.57	5.7%	0.32	0.62	8.0	0.8	2.7
EX-OS1	5.54	5.7%	0.07	0.49	12.6	1.4	17.4
Total	**61.68**	**30.0%**	---	---	---	**61.15**	**243.45**
EX POND A TOTAL	**50.20**	**27.6%**	---	---	---	---	---
PROPOSED POND B TOTAL	**5.05**	**51.8%**	---	---	---	---	---
EX UD TOTAL	**5.80**	**31.5%**	---	---	---	---	---
PROP UD TOTAL	**0.63**	**40.7%**	---	---	---	---	---
PROP UNTREATED IMPERVIOUS AREA	**0.26**	**AC**					

DESIGN POINT TABLE

Design Point	Q_5 (cfs)	Q_{100} (cfs)
1	1.4	17.4
RC1	2.0	21.5
RC2.1	3.3	38.3
3	2.5	26.6
4.1	5.8	63.3
5	1.2	14.6
6.1	6.9	77.7
A13	0.2	1.3
9.1	7.1	78.9
A1	2.8	8.0
A2	2.1	5.0
A2.1	4.8	12.5
A4	0.3	0.9
A4.1	4.3	11.2
A5	0.6	1.6
A5.1	4.7	12.2
A3	1.1	3.5
A6	0.7	1.7
A6.1	6.3	16.9
A7	1.6	4.5
A8	1.4	3.3
A8.1	8.7	23.3
A10	1.9	4.4
A10.1	10.5	27.4
A9	3.7	10.2
A11	0.4	1.0
A11.1	10.9	28.4
A12	0.3	0.8
A12.1	11.1	29.0
A13.1	9.8	86.3
A14	0.1	0.3
A14.1	9.8	86.4
23	0.4	1.5
24	1.6	5.5
25.1	11.4	15.8
26	12.3	30.8
27.1	23.6	46.5
28	6.2	15.8
29.1	29.8	62.2
30	0.6	6.8
31	1.1	8.4
32.1	38.3	153.8
33	4.3	11.9
34	1.2	2.4
35	1.3	2.8
36.1	2.5	5.2
37.1	16.1	25.9
38	1.9	7.5
39.1	7.4	21.4
40	1.8	6.9
41	0.8	2.7
42.1	2.4	8.7
43.1	8.3	25.9
44	0.5	1.3
50	1.1	5.3
51	0.9	5.0
52	0.5	2.0

COMPOSITE % IMPERVIOUS CALCULATIONS

Subdivision: Hillside Castle Rock Phase 3&4
Location: Castle Rock

Project Name: Hillside
Project No.: 16190.20
Calculated By: BMP
Checked By: JP
Date: 12/1/25

Basin ID	Total Area (ac)	SFH-HIGH			Extended Detention Basin			Asphalt\Walk/Roofs			Maintenance Path			Receiving Pervious Area			Undisturbed Native Grasses			Basins Total Weighted % Imp.
		% Imp.	Area (ac)	Weighted % Imp.	% Imp.	Area (ac)	Weighted % Imp.	% Imp.	Area (ac)	Weighted % Imp.	% Imp.	Area (ac)	Weighted % Imp.	% Imp.	Area (ac)	Weighted % Imp.	% Imp.	Area (ac)	Weighted % Imp.	
A1	1.40	65%	0.84	39.0%	25%	0.00	0.0%	95%	0.19	12.9%	60%	0.00	0.0%	20%	0.00	0.0%	5%	0.37	1.3%	53.2%
A2	0.85	65%	0.62	47.4%	25%	0.00	0.0%	95%	0.19	21.2%	60%	0.00	0.0%	20%	0.00	0.0%	5%	0.04	0.2%	68.9%
A3	0.77	65%	0.37	31.2%	25%	0.00	0.0%	95%	0.09	11.1%	60%	0.00	0.0%	20%	0.00	0.0%	5%	0.31	2.0%	44.4%
A4	0.17	65%	0.16	61.2%	25%	0.00	0.0%	95%	0.01	5.6%	60%	0.00	0.0%	20%	0.00	0.0%	5%	0.00	0.0%	66.8%
A5	0.37	65%	0.25	43.9%	25%	0.00	0.0%	95%	0.05	12.8%	60%	0.00	0.0%	20%	0.00	0.0%	5%	0.07	0.9%	57.7%
A6	0.35	65%	0.29	53.9%	25%	0.00	0.0%	95%	0.06	15.7%	60%	0.00	0.0%	20%	0.00	0.0%	5%	0.00	0.0%	69.5%
A7	0.83	65%	0.49	38.4%	25%	0.00	0.0%	95%	0.12	13.7%	60%	0.00	0.0%	20%	0.00	0.0%	5%	0.22	1.3%	53.4%
A8	0.64	65%	0.54	54.8%	25%	0.00	0.0%	95%	0.10	14.8%	60%	0.00	0.0%	20%	0.00	0.0%	5%	0.00	0.0%	69.7%
A9	1.81	65%	1.12	40.2%	25%	0.00	0.0%	95%	0.28	14.7%	60%	0.00	0.0%	20%	0.00	0.0%	5%	0.41	1.1%	56.0%
A10	0.88	65%	0.74	54.7%	25%	0.00	0.0%	95%	0.14	15.1%	60%	0.00	0.0%	20%	0.00	0.0%	5%	0.00	0.0%	69.8%
A11	0.21	65%	0.17	52.6%	25%	0.00	0.0%	95%	0.04	18.1%	60%	0.00	0.0%	20%	0.00	0.0%	5%	0.00	0.0%	70.7%
A12	0.14	65%	0.05	23.2%	25%	0.00	0.0%	95%	0.05	33.9%	60%	0.00	0.0%	20%	0.00	0.0%	5%	0.04	1.4%	58.6%
A13	0.39	65%	0.00	0.0%	25%	0.00	0.0%	95%	0.02	4.9%	60%	0.08	12.3%	20%	0.00	0.0%	5%	0.29	3.7%	20.9%
A14	0.05	65%	0.00	0.0%	25%	0.00	0.0%	95%	0.02	38.0%	60%	0.00	0.0%	20%	0.00	0.0%	5%	0.03	3.0%	41.0%
C1	0.31	65%	0.00	0.0%	25%	0.00	0.0%	95%	0.31	95.0%	60%	0.00	0.0%	20%	0.00	0.0%	5%	0.00	0.0%	95.0%
C2	0.40	65%	0.00	0.0%	25%	0.00	0.0%	95%	0.33	78.4%	60%	0.00	0.0%	20%	0.00	0.0%	5%	0.07	0.9%	79.3%
C3	2.32	65%	1.98	55.5%	25%	0.00	0.0%	95%	0.00	0.0%	60%	0.00	0.0%	20%	0.00	0.0%	5%	0.34	0.7%	56.2%
C4	2.02	65%	0.97	31.2%	25%	0.00	0.0%	95%	0.00	0.0%	60%	0.00	0.0%	20%	0.11	1.1%	5%	0.94	2.3%	34.6%
C5	0.22	65%	0.00	0.0%	25%	0.00	0.0%	95%	0.13	56.1%	60%	0.00	0.0%	20%	0.00	0.0%	5%	0.09	2.0%	58.2%
C6	0.41	65%	0.00	0.0%	25%	0.00	0.0%	95%	0.12	27.8%	60%	0.00	0.0%	20%	0.00	0.0%	5%	0.29	3.5%	31.3%
OS2	6.88	65%	0.00	0.0%	25%	0.00	0.0%	95%	0.05	0.7%	60%	0.13	1.1%	20%	0.00	0.0%	5%	6.70	4.9%	6.7%
OS2.1	8.86	65%	0.00	0.0%	25%	0.00	0.0%	95%	0.06	0.6%	60%	0.17	1.2%	20%	0.00	0.0%	5%	8.63	4.9%	6.7%
OS3	4.90	65%	0.00	0.0%	25%	0.00	0.0%	95%	0.01	0.2%	60%	0.00	0.0%	20%	0.00	0.0%	5%	4.89	5.0%	5.1%
EX-B1	6.18	65%	3.70	38.9%	25%	0.00	0.0%	95%	0.93	14.3%	60%	0.99	9.6%	20%	0.04	0.1%	5%	0.52	0.4%	63.4%
EX-B2	3.19	65%	1.92	39.1%	25%	0.00	0.0%	95%	0.75	22.3%	60%	0.00	0.0%	20%	0.04	0.2%	5%	0.48	0.8%	62.4%
EX-B3	2.01	65%	0.15	4.9%	25%	0.00	0.0%	95%	0.04	1.7%	60%	0.00	0.0%	20%	0.04	0.4%	5%	1.78	4.4%	11.4%
EX-B4	2.34	65%	0.00	0.0%	25%	0.96	10.3%	95%	0.00	0.0%	60%	0.17	4.2%	20%	0.00	0.0%	5%	1.21	2.6%	17.1%
EX-B5	1.10	65%	0.63	37.2%	25%	0.00	0.0%	95%	0.01	1.2%	60%	0.00	0.0%	20%	0.00	0.0%	5%	0.46	2.1%	40.5%
EX-D1	1.61	65%	0.43	17.4%	25%	0.00	0.0%	95%	0.11	6.3%	60%	0.00	0.0%	20%	0.04	0.5%	5%	1.04	3.2%	27.3%
EX-D2	1.34	65%	0.00	0.0%	25%	0.00	0.0%	95%	0.27	19.0%	60%	0.00	0.0%	20%	0.07	1.0%	5%	1.01	3.8%	23.8%
EX-D3	0.34	65%	0.00	0.0%	25%	0.00	0.0%	95%	0.13	37.2%	60%	0.00	0.0%	20%	0.03	1.6%	5%	0.18	2.6%	41.4%
EX-D5	2.28	65%	0.00	0.0%	25%	0.00	0.0%	95%	0.72	29.9%	60%	0.10	2.6%	20%	0.14	1.2%	5%	1.32	2.9%	36.7%
EX-D6	0.57	65%	0.00	0.0%	25%	0.00	0.0%	95%	0.22	36.7%	60%	0.00	0.0%	20%	0.04	1.4%	5%	0.31	2.7%	40.8%
EX-OS1	5.54	65%	0.00	0.0%	25%	0.00	0.0%	95%	0.03	0.5%	60%	0.02	0.2%	20%	0.00	0.0%	5%	5.49	5.0%	5.7%
TOTAL	**61.68**																			**30.05%**
EX POND A TOTAL	**50.20**																			**27.56%**
PROPOSED POND B TOTAL	**5.05**																			**51.78%**
EX UD TOTAL	**5.80**																			**31.49%**
PROP UD TOTAL	**0.63**																			**40.71%**

MS4 EXCLUSION CALCULATIONS

Basin ID	Total Area (ac)	SFH-HIGH			Extended Detention Basin			EXCLUDED EXISTING ROADWAY AREAS			TRAILS/MAINTENANCE PATH			Receiving Pervious Area			UNDEVELOPED LAND TO REMAIN			Basins Total Weighted % Imp.
		% Imp.	Area (ac)	Weighted % Imp.	% Imp.	Area (ac)	Weighted % Imp.	% Imp.	Area (ac)	Weighted % Imp.	% Imp.	Area (ac)	Weighted % Imp.	% Imp.	Area (ac)	Weighted % Imp.	% Imp.	Area (ac)	Weighted % Imp.	
EX-D1	1.61	65%	0.43	17.4%	25%	0.00	0.0%	95%	0.11	6.3%	60%	0.00	0.0%	20%	0.04	0.5%	5%	1.04	3.2%	27.3%
EX-D2	1.34	65%	0.00	0.0%	25%	0.00	0.0%	95%	0.27	19.0%	60%	0.00	0.0%	20%	0.07	1.0%	5%	1.01	3.8%	23.8%
EX-D5	2.28	65%	0.00	0.0%	25%	0.00	0.0%	95%	0.72	29.9%	60%	0.10	2.6%	20%	0.14	1.2%	5%	1.32	2.9%	36.7%
EX-D6	0.57	65%	0.00	0.0%	25%	0.00	0.0%	95%	0.22	36.7%	60%	0.00	0.0%	20%	0.04	1.4%	5%	0.31	2.7%	40.8%
C5	0.22	65%	0.00	0.0%	25%	0.00	0.0%	95%	0.13	35.6%	60%	0.00	0.0%	20%	0.00	0.0%	5%	0.09	3.1%	38.8%
C6	0.41	65%	0.00	0.0%	25%	0.00	0.0%	95%	0.12	16.6%	60%	0.00	0.0%	20%	0.00	0.0%	5%	0.29	4.1%	20.8%
UD TOTAL	**6.43**		**0.43**			**0.00**			**1.56**			**0.10**			**0.28**			**4.06**		**31.15%**
TOTAL EXCLUDED	**5.47**		**0.00**			**0.00**			**1.31**			**0.10**			**0.00**			**4.06**		
TOTAL UNTREATED MINUS EXCLUSIONS	**0.96**	**AC UNTREATED**																		

XX AREA NOT BEING SUMMED FOR EXCLUSION
XX AREAS BEING SUMMED
XX SUM OF EXCLUDED AREA

COMPOSITE RUNOFF COEFFICIENT CALCULATIONS

Subdivision: Hillside Castle Rock Phase 3&4
Location: Castle Rock

Project Name: Hillside
Project No.: 16190.20
Calculated By: BMP
Checked By: JP
Date: 12/1/25

Basin ID	Total Area (ac)	Basins Total Weighted % Imp.	Hydrologic Soil Group			Hydrologic Soil Group			Minor Coefficients			Major Coefficients			Basins Total Weighted C_5	Basins Total Weighted C_{100}
			Area A (ac)	Area B (ac)	Area C/D (ac)	% A (ac)	% B (ac)	% C/D (ac)	$C_{5,A}$	$C_{5,B}$	$C_{5,C/D}$	$C_{100,A}$	$C_{100,B}$	$C_{100,C/D}$		
A1	1.40	53.2%	0.00	1.40	0.00	0%	100%	0%	0.38	0.43	0.47	0.52	0.68	0.70	0.43	0.68
A2	0.85	68.9%	0.00	0.85	0.00	0%	100%	0%	0.53	0.57	0.60	0.65	0.75	0.77	0.57	0.75
A3	0.77	44.4%	0.00	0.77	0.00	0%	100%	0%	0.31	0.35	0.40	0.46	0.63	0.67	0.35	0.63
A4	0.17	66.8%	0.00	0.17	0.00	0%	100%	0%	0.51	0.55	0.58	0.63	0.74	0.76	0.55	0.74
A5	0.37	57.7%	0.00	0.37	0.00	0%	100%	0%	0.43	0.47	0.51	0.56	0.70	0.72	0.47	0.70
A6	0.35	69.5%	0.00	0.35	0.00	0%	100%	0%	0.54	0.58	0.61	0.65	0.75	0.77	0.58	0.75
A7	0.83	53.4%	0.00	0.83	0.00	0%	100%	0%	0.39	0.44	0.47	0.53	0.68	0.70	0.44	0.68
A8	0.64	69.7%	0.00	0.64	0.00	0%	100%	0%	0.54	0.58	0.61	0.65	0.75	0.77	0.58	0.75
A9	1.81	56.0%	0.00	1.81	0.00	0%	100%	0%	0.41	0.46	0.50	0.55	0.69	0.71	0.46	0.69
A10	0.88	69.8%	0.00	0.88	0.00	0%	100%	0%	0.54	0.58	0.61	0.65	0.75	0.77	0.58	0.75
A11	0.21	70.7%	0.00	0.21	0.00	0%	100%	0%	0.55	0.59	0.62	0.66	0.76	0.77	0.59	0.76
A12	0.14	58.6%	0.00	0.14	0.00	0%	100%	0%	0.44	0.48	0.51	0.57	0.70	0.72	0.48	0.70
A13	0.39	20.9%	0.00	0.39	0.00	0%	100%	0%	0.12	0.16	0.21	0.27	0.52	0.57	0.16	0.52
A14	0.05	41.0%	0.00	0.05	0.00	0%	100%	0%	0.28	0.33	0.37	0.43	0.62	0.65	0.33	0.62
C1	0.31	95.0%	0.00	0.31	0.00	0%	100%	0%	0.81	0.81	0.81	0.85	0.87	0.87	0.81	0.87
C2	0.40	79.3%	0.00	0.40	0.00	0%	100%	0%	0.64	0.67	0.69	0.73	0.80	0.81	0.67	0.80
C3	2.32	56.2%	0.00	2.32	0.00	0%	100%	0%	0.41	0.46	0.50	0.55	0.69	0.71	0.46	0.69
C4	2.02	34.6%	0.00	2.02	0.00	0%	100%	0%	0.22	0.27	0.32	0.38	0.59	0.63	0.27	0.59
C5	0.22	58.2%	0.00	0.22	0.00	0%	100%	0%	0.43	0.48	0.51	0.56	0.70	0.72	0.48	0.70
C6	0.41	31.3%	0.00	0.41	0.00	0%	100%	0%	0.20	0.24	0.29	0.35	0.57	0.61	0.24	0.57
OS2	6.88	6.7%	0.00	0.39	6.49	0%	6%	94%	0.03	0.05	0.09	0.16	0.46	0.51	0.09	0.51
OS2.1	8.86	6.7%	0.00	0.30	8.56	0%	3%	97%	0.03	0.05	0.09	0.16	0.46	0.51	0.09	0.51
OS3	4.90	5.1%	0.00	0.56	4.34	0%	11%	89%	0.02	0.03	0.08	0.15	0.45	0.50	0.07	0.50
EX-B1	6.18	63.4%	0.00	6.18	0.00	0%	100%	0%	0.48	0.52	0.56	0.60	0.72	0.74	0.52	0.72
EX-B2	3.19	62.4%	0.00	3.19	0.00	0%	100%	0%	0.47	0.51	0.55	0.60	0.72	0.74	0.51	0.72
EX-B3	2.01	11.4%	0.00	2.01	0.00	0%	100%	0%	0.05	0.08	0.13	0.20	0.48	0.53	0.08	0.48
EX-B4	2.34	17.1%	0.00	2.34	0.00	0%	100%	0%	0.09	0.13	0.17	0.24	0.51	0.55	0.13	0.51
EX-B5	1.10	40.5%	0.00	1.10	0.00	0%	100%	0%	0.27	0.32	0.37	0.43	0.62	0.65	0.32	0.62
EX-D1	1.61	27.3%	0.00	1.61	0.00	0%	100%	0%	0.16	0.21	0.26	0.32	0.55	0.60	0.21	0.55
EX-D2	1.34	23.8%	0.00	1.34	0.00	0%	100%	0%	0.14	0.18	0.23	0.29	0.54	0.58	0.18	0.54
EX-D3	0.34	41.4%	0.00	0.34	0.00	0%	100%	0%	0.28	0.33	0.37	0.43	0.62	0.65	0.33	0.62
EX-D5	2.28	36.7%	0.00	2.28	0.00	0%	100%	0%	0.24	0.29	0.34	0.40	0.60	0.63	0.29	0.60
EX-D6	0.57	40.8%	0.00	0.57	0.00	0%	100%	0%	0.27	0.32	0.37	0.43	0.62	0.65	0.32	0.62
EX-OS1	5.54	5.7%	0.00	1.38	4.16	0%	25%	75%	0.02	0.04	0.08	0.15	0.45	0.51	0.07	0.49

STANDARD FORM SF-2
TIME OF CONCENTRATION

Subdivision: Hillside Castle Rock Phase 3&4
Location: Castle Rock

Project Name: Hillside
Project No.: 16190.20
Calculated By: BMP
Checked By: JP
Date: 12/1/25

SUB-BASIN DATA						INITIAL/OVERLAND (T_i)			TRAVEL TIME (T_t)					*tc* CHECK (URBANIZED BASINS)			FINAL
BASIN ID	D.A. (ac)	Hydrologic Soils Group	Impervious (%)	C_5	C_{100}	L (ft)	S_o (%)	t_i (min)	L_t (ft)	S_t (%)	K	VEL. (ft/s)	t_t (min)	COMP. t_c (min)	TOTAL LENGTH (ft)	Urbanized t_c (min)	t_c (min)
A1	1.40	B	53.2%	0.43	0.68	116	25.00%	4.5	382	5.30%	20	4.6	1.4	5.9	498.0	18.6	5.87
A2	0.85	B	68.9%	0.57	0.75	44	1.14%	6.0	360	5.30%	20	4.6	1.3	7.3	404.0	15.7	7.35
A3	0.77	B	44.4%	0.35	0.63	240	13.00%	8.9	182	6.30%	20	5.0	0.6	9.5	422.0	19.3	9.54
A4	0.17	B	66.8%	0.55	0.74	121	0.78%	11.8	51	5.58%	20	4.7	0.2	12.0	172.0	14.8	11.95
A5	0.37	B	57.7%	0.47	0.70	122	0.81%	13.4	43	5.53%	20	4.7	0.2	13.6	165.0	16.4	13.56
A6	0.35	B	69.5%	0.58	0.75	121	0.80%	11.1	94	6.20%	20	5.0	0.3	11.5	215.0	14.5	11.45
A7	0.83	B	53.4%	0.44	0.68	150	14.70%	6.1	212	6.00%	20	4.9	0.7	6.8	362.0	17.8	6.78
A8	0.64	B	69.7%	0.58	0.75	123	1.20%	9.8	183	6.00%	20	4.9	0.6	10.4	306.0	14.8	10.41
A9	1.81	B	41.0%	0.46	0.69	148	22.00%	5.1	517	7.45%	20	5.5	1.6	6.7	665.0	21.2	6.66
A10	0.88	B	53.2%	0.58	0.75	122	1.00%	10.4	254	6.00%	20	4.9	0.9	11.2	376.0	18.0	11.21
A11	0.21	B	53.2%	0.59	0.76	121	0.62%	11.9	82	6.50%	20	5.1	0.3	12.1	203.0	17.3	12.13
A12	0.14	B	53.2%	0.48	0.70	105	4.50%	7.0	67	7.26%	20	5.4	0.2	7.2	172.0	17.2	7.18
A13	0.39	B	53.2%	0.16	0.52	30	0.50%	11.7	300	17.00%	20	8.2	0.6	12.3	330.0	17.7	12.33
A14	0.05	B	53.2%	0.33	0.62	34	21.00%	3.0	31	8.50%	20	5.8	0.1	3.1	65.0	17.1	5.00

STANDARD FORM SF-2
TIME OF CONCENTRATION

Subdivision: Hillside Castle Rock Phase 3&4
Location: Castle Rock

Project Name: Hillside
Project No.: 16190.20
Calculated By: BMP
Checked By: JP
Date: 12/1/25

SUB-BASIN DATA						INITIAL/OVERLAND (T_i)			TRAVEL TIME (T_t)					*tc* CHECK (URBANIZED BASINS)			FINAL
BASIN ID	D.A. (ac)	Hydrologic Soils Group	Impervious (%)	C_5	C_{100}	L (ft)	S_o (%)	t_i (min)	L_t (ft)	S_t (%)	K	VEL. (ft/s)	t_t (min)	COMP. t_c (min)	TOTAL LENGTH (ft)	Urbanized t_c (min)	t_c (min)
C1	0.31	B	95.0%	0.81	0.87	105	4.46%	3.2	67	7.26%	20	5.4	0.2	3.4	172.0	10.0	5.00
C2	0.40	B	79.3%	0.67	0.80	33.5	20.50%	1.7	31	8.52%	20	5.8	0.1	1.8	64.5	12.6	5.00
C3	2.32	B	56.2%	0.46	0.69	30	0.50%	8.0	300	17.00%	20	8.2	0.6	8.6	330.0	17.2	8.57
C1	0.31	B	95.0%	0.81	0.87	64	6.78%	2.2	562	6.50%	20	5.1	1.8	4.0	626.0	11.5	5.00
C2	0.40	B	79.3%	0.67	0.80	49	6.31%	3.0	557	6.33%	20	5.0	1.8	4.8	606.0	14.4	5.00
C3	2.32	B	56.2%	0.46	0.69	238	9.81%	8.4	408	6.70%	15	3.9	1.8	10.2	646.0	18.0	10.16
C4	2.02	B	34.6%	0.27	0.59	207	8.37%	10.7	574	8.55%	15	4.4	2.2	12.9	781.0	22.5	12.86
C5	0.22	B	58.2%	0.48	0.70	23	8.00%	2.7	135	5.00%	20	4.5	0.5	3.2	158.0	16.7	5.00
C6	0.41	B	31.3%	0.24	0.57	12	2.00%	4.3	231	3.55%	15	2.8	1.4	5.6	243.0	22.2	5.63
OS2	6.88	C/D	5.7%	0.09	0.51	500	50.00%	11.2	706	5.59%	20	4.7	2.5	13.7	1206.0	30.1	13.73
OS2.1	8.86	C/D	5.7%	0.09	0.51	500	50.00%	11.2	1067	5.59%	20	4.7	3.8	15.0	1567.0	32.7	14.99
OS3	4.90	C/D	5.7%	0.07	0.50	500	50.00%	11.4	900	5.59%	20	4.7	3.2	14.6	1400.0	31.5	14.58
EX-B1	6.18	B	31.3%	0.52	0.72	300	11.00%	8.2	1277	19.80%	20	8.9	2.4	10.6	1577.0	24.2	10.56
EX-B2	3.19	B	31.3%	0.51	0.72	51	1.50%	6.6	1294	7.43%	20	5.5	4.0	10.6	1345.0	26.6	10.55
EX-B3	2.01	B	11.4%	0.08	0.48	58	6.80%	7.4	829	7.40%	20	5.4	2.5	10.0	887.0	28.9	9.98
EX-B4	2.34	B	17.1%	0.13	0.51	181	17.00%	9.3	60	14.00%	10	3.7	0.3	9.6	241.0	23.3	9.56
EX-B5	1.10	B	40.5%	0.32	0.62	60	12.00%	4.8	561	5.63%	20	4.7	2.0	6.8	621.0	21.8	6.76
EX-D1	1.61	B	27.3%	0.21	0.55	300	10.38%	12.9	501	8.73%	15	4.4	1.9	14.7	801.0	23.6	14.74
EX-D2	1.34	B	23.8%	0.18	0.54	150	15.00%	8.3	360	3.40%	15	2.8	2.2	10.5	510.0	24.6	10.49
EX-D3	0.34	B	41.4%	0.33	0.62	150	6.70%	9.1	147	2.31%	15	2.3	1.1	10.2	297.0	20.1	10.18
EX-D5	2.28	B	36.7%	0.29	0.60	200	2.00%	16.5	697	4.43%	15	3.2	3.7	20.2	897.0	23.7	20.15
EX-D6	0.57	B	40.8%	0.32	0.62	137	12.00%	7.2	143	4.50%	15	3.2	0.7	8.0	280.0	19.8	7.97
EX-OS1	5.54	C/D	5.7%	0.07	0.49	500	50.00%	11.4	367	6.50%	20	5.1	1.2	12.6	867.0	27.5	12.62

STANDARD FORM SF-3

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

Subdivision: Hillside Castle Rock Phase 3&4
Location: Castle Rock
Design Storm: 5-Year P1 =1.43 in/hr

Project Name: Hillside
Project No.: 16190.20
Calculated By: BMP
Checked By: JP
Date: 12/1/25

		DIRECT RUNOFF							TOTAL RUNOFF				STREET			PIPE				TRAVEL TIME			
STREET	Design Point	Basin ID	Area (Ac)	Runoff Coeff.	tc (min)	C*A (Ac)	I (in/hr)	Q (cfs)	tc (min)	C*A (ac)	I (in/hr)	Q (cfs)	Qstreet (cfs)	C*A (ac)	Slope (%)	Qpipe (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	tt (min)	REMARKS
																							TOTAL UNDEVELOPED RUNOFF FROM BASIN EX OS-1
	1	EX-OS1	5.54	0.07	12.6	0.4	3.5	1.4															FLOWS DOWN SLOPE TO ROCKFALL MITIGATION CHANNEL AT DP 1
																							TOTAL UNDEVELOPED RUNOFF FROM BASIN OS-2
	RC1	OS2	6.88	0.09	13.7	0.6	3.4	2.0															FLOWS DOWN SLOPE TO ROCKFALL MITIGATION CHANNEL AT DP RC1
																							SUM OF FLOWS FROM DP 1 & RC1
	RC2.1								13.7	0.99	3.38	3.3											CONTINUES ALONG ROCKFALL MITIGATION CHANNEL TO DP 4.1
																							TOTAL UNDEVELOPED RUNOFF FROM BASIN OS-2.1
	3	OS2.1	8.86	0.09	15.0	0.8	3.3	2.5															FLOWS DOWN SLOPE TO ROCKFALL MITIGATION CHANNEL AT DP 3
																							SUM OF FLOWS FROM DP RC2.1 & 3
	4.1								15.0	1.77	3.25	5.8											CONTINUES ALONG ROCKFALL MITIGATION CHANNEL TO DP 6.1
																							TOTAL UNDEVELOPED RUNOFF FROM BASIN OS-3
	5	OS3	4.90	0.07	14.6	0.4	3.3	1.2															FLOWS DOWN SLOPE TO ROCKFALL MITIGATION CHANNEL AT DP 5
																							SUM OF FLOWS FROM DP 4.1 & 5
	6.1								15.0	2.12	3.25	6.9											CONTINUES ALONG ROCKFALL MITIGATION CHANNEL TO DP 9.1
																							TOTAL DEVELOPED FLOWS FROM BASIN A-14
	A13	A13	0.39	0.16	12.3	0.1	3.6	0.2															FLOWS DOWN SLOPE TO ROCKFALL MITIGATION CHANNEL AT DP 14
																							SUM OF FLOWS FROM DP 6.1 & A13
	9.1								15.0	2.18	3.25	7.1											PIPED TO DP A13.1
																							TOTAL DEVELOPED FLOWS FROM BASIN A-1
	A1	A1	1.40	0.43	5.9	0.6	4.6	2.8															CAPTURED BY ON GRADE TYPE 16 INLETS AT DP A1, PIPED TO DP A2.1
																							TOTAL DEVELOPED FLOWS FROM BASIN A-2
	A2	A2	0.85	0.57	7.3	0.5	4.3	2.1															CAPTURED BY ON GRADE TYPE 16 INLETS AT DP A2, PIPED TO DP A2.1
																							SUM OF FLOWS FROM DP A1 & A2
	A2.1								7.3	1.10	4.33	4.8											PIPED TO DP A4.1
																							TOTAL DEVELOPED FLOWS FROM BASIN A-4
	A4	A4	0.17	0.55	12.0	0.09	3.6	0.3															CAPTURED BY ON GRADE TYPE 16 INLETS AT DP A4, PIPED TO DP A4.1
																							SUM OF FLOWS FROM DP A2.1 & A4
	A4.1								12.0	1.19	3.60	4.3											PIPED TO DP A5.1
																							TOTAL DEVELOPED FLOWS FROM BASIN A-5
	A5	A5	0.37	0.47	13.6	0.18	3.4	0.6															CAPTURED BY ON GRADE TYPE 16 INLETS AT DP A5, PIPED TO DP A5.1
																							SUM OF FLOWS FROM DP A4.1, & A5
	A5.1								13.6	1.37	3.40	4.7											PIPED TO DP A6.1
																							TOTAL DEVELOPED FLOWS FROM BASIN A-3
	A3	A3	0.77	0.35	9.5	0.3	3.9	1.1															CAPTURED BY ON GRADE TYPE 16 INLETS AT DP A3, PIPED TO DP A6.1
																							TOTAL DEVELOPED FLOWS FROM BASIN A-6
	A6	A6	0.35	0.58	11.5	0.2	3.7	0.7															CAPTURED BY ON GRADE TYPE 16 INLETS AT DP A6, PIPED TO DP A6.1
																							SUM OF FLOWS FROM DP A5.1, A3, & A6
	A6.1								13.6	1.84	3.40	6.3											PIPED TO DP A8.1
																							TOTAL DEVELOPED FLOWS FROM BASIN A-7
	A7	A7	0.83	0.44	6.8	0.4	4.4	1.6															CAPTURED BY ON GRADE TYPE 16 INLETS AT DP A7, PIPED TO DP A8.1
																							TOTAL DEVELOPED FLOWS FROM BASIN A-8
	A8	A8	0.64	0.58	10.4	0.4	3.8	1.4															CAPTURED BY ON GRADE TYPE 16 INLETS AT DP A8, PIPED TO DP A8.1
																							SUM OF FLOWS FROM DP A6.1, A7, & A8
	A8.1								13.6	2.57	3.40	8.7											PIPED TO DP 10.1
																							TOTAL DEVELOPED FLOWS FROM BASIN A-10
	A10	A10	0.88	0.58	11.2	0.5	3.7	1.9															CAPTURED BY ON GRADE TYPE 16 INLETS AT DP A10, PIPED TO DP A10.1
																							SUM OF FLOWS FROM DP A8.1 & A10
	A10.1								13.6	3.08	3.40	10.5											PIPED TO DP 11.1
																							TOTAL DEVELOPED FLOWS FROM BASIN A-11
	A11	A11	0.21	0.59	12.1	0.1	3.6	0.4															CAPTURED BY ON GRADE TYPE 16 INLETS AT DP A11, PIPED TO DP A11.1
																							SUM OF FLOWS FROM DP A10.1 & A11
	A11.1								13.6	3.20	3.40	10.9											PIPED TO DP 12.1
																							TOTAL DEVELOPED FLOWS FROM BASIN A-12
	A12	A12	0.14	0.48	7.2	0.1	4.4	0.3															CAPTURED BY ON GRADE TYPE 16 INLETS AT DP A12, PIPED TO DP A12.1
																							SUM OF FLOWS FROM DP A11.1 & A12
	A12.1								13.6	3.27	3.40	11.1											PIPED TO DP A13.1
																							TOTAL DEVELOPED FLOWS FROM BASIN A-9
	A9	A9	1.81	0.46	6.7	0.83	4.5	3.7															CAPTURED BY ON GRADE TYPE 16 INLETS AT DP A9, PIPED TO DP A13.1
																							SUM OF FLOWS FROM DP 9.1 & A13
	A13.1								15.0	3.01	3.25	9.8											PIPED TO DP A14.1
																							TOTAL DEVELOPED FLOWS FROM BASIN A-14
	A14	A14	0.05	0.33	5.0	0.0	4.9	0.1															CAPTURED BY ON GRADE TYPE 16 INLETS AT DP A14, PIPED TO DP A14.1
																							SUM OF FLOWS FROM DP A13.1 & A14
	A14.1								15.0	3.03	3.25	9.8											FLOWS INTO POND EX POND A TO DP 32.1
																							TOTAL DEVELOPED FLOWS FROM BASIN EX-D3
	23	EX-D3	0.34	0.33	10.2	0.1	3.8	0.4															CAPTURED BY ON GRADE TYPE 16 INLETS AT DP 23, PIPED TO DP 24

STREET	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET			PIPE				TRAVEL TIME			REMARKS
		Basin ID	Area (Ac)	Runoff Coeff.	tc (min)	C*A (Ac)	I (in/hr)	Q (cfs)	tc (min)	C*A (ac)	I (in/hr)	Q (cfs)	Qstreet (cfs)	C*A (ac)	Slope (%)	Qpipe (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	tt (min)	
																							TOTAL DEVELOPED FLOWS FROM BASIN EX-B5
	24	EX-B5	1.10	0.32	6.8	0.4	4.4	1.6															SUM OF FLOWS FROM DP 23 & EX-B5, PIPED TO DP 25.1
																							TOTAL DEVELOPED FLOWS FROM BASIN 25.1
	25.1								10.2	0.46	3.84	11.4											SUM OF FLOWS FROM DP 24 & BASIN 25.1, PIPED TO DP 26
																							TOTAL DEVELOPED FLOWS FROM BASIN EX-B1
	26	EX-B1	6.18	0.52	10.6	3.2	3.8	12.3															SUM OF FLOWS FROM DP 25.1 & BASIN EX-B1, PIPED TO DP 27.1
																							TOTAL DEVELOPED FLOWS FROM BASIN 27.1
	27.1								10.6	3.70	3.79	23.6											SUM OF FLOWS FROM DP 26 & BASIN 27.1, PIPED TO DP 28
																							TOTAL DEVELOPED FLOWS FROM BASIN EX-B2
	28	EX-B2	3.19	0.51	10.6	1.6	3.8	6.2															SUM OF FLOWS FROM DP 27.1 & BASIN EX-B2, PIPED TO DP 29.1
																							SUM OF FLOWS FROM DP 27.1 & 28
	29.1								10.6	5.34	3.79	29.8											PIPED INTO EX POND A AT DP 29.1
																							TOTAL DEVELOPED FLOWS FROM BASIN EX-B3
	30	EX-B3	2.01	0.08	10.0	0.2	3.9	0.6															CONVEYED VIA GRASS SWALE AND THEN CONCRETE PAN INTO EX POND A TO DP 30
																							TOTAL DEVELOPED FLOWS FROM BASIN EX-B4
	31	EX-B4	2.34	0.13	9.6	0.3	3.9	1.1															FLOWS RUN DOWN SLOPES INTO EX POND A AT DP 31
																							SUM OF FLOWS ENTERING PROPOSED POND A
	32.1								15.0	8.82	3.25	38.3											RELEASE RATE RESTRICTED TO 8.5 CFS
																							TOTAL DEVELOPED FLOWS FROM BASIN C3
	33	C3	2.32	0.46	8.6	1.1	4.1	4.3															ROUTED VIA TEMPORARY DITCH TO AREA INLET AT DP 33
																							TOTAL DEVELOPED FLOWS FROM BASIN C-1
	34	C1	0.31	0.81	5.0	0.3	4.9	1.2															CAPTURED BY ON GRADE TYPE R INLETS AT DP 34
																							TOTAL DEVELOPED FLOWS FROM BASIN C-2
	35	C2	0.40	0.67	5.0	0.3	4.9	1.3															CAPTURED BY ON GRADE TYPE R INLETS AT DP 35
																							SUM OF FLOWS FROM DP 34 & 35
	36.1								5.0	0.52	4.85	2.5											PIPED TO DP 37.1
																							SUM OF FLOWS FROM DP 33 & 36.1
	37.1								8.6	1.58	4.10	16.1											PIPED TO PROPOSED POND B AT DP 37.1
																							TOTAL DEVELOPED FLOWS FROM BASIN C-4
	38	C4	2.02	0.27	12.9	0.6	3.5	1.9															CONVEYED VIA GRASS SWALE TO PROPOSED POND B AT DP 38
																							SUM OF FLOWS ENTERING PROPOSED POND B
	39.1								12.9	2.13	3.48	7.4											RELEASE RATE RESTRICTED TO 0.4 CFS
																							TOTAL DEVELOPED FLOWS FROM BASIN EX D-5 SHEET FLOW TO GRASS SWALE
	40	EX-D5	2.28	0.29	20.2	0.7	2.8	1.8															PIPED TO GRASS SWALE IN BASIN C-5 AT DP 40
																							TOTAL DEVELOPED FLOWS FROM BASIN C-5
	41	EX-D6	0.57	0.32	8.0	0.2	4.2	0.8															CAPTURED BY AREA INLET AT DP 41, ENTERS EXISTING OUTFALL SYSTEM AT DP 42.1
																							SUM OF FLOWS FROM DP 40 & 41
	42.1								20.2	0.84	2.80	2.4											ENTERS EXISTING OUTFALL SYSTEM AT DP 42.1 AND CONTINUES TO OMNI TRIBUTARY
																							SUM OF FLOWS ENTERING EXISTING OUTFALL SYSTEM
	43.1								20.2	2.97	2.80	8.3											CONTINUES TO OMNI TRIBUTARY
																							TOTAL DEVELOPED FLOWS FROM BASIN C-5
	44	C5	0.22	0.48	5.0	0.1	4.9	0.5															FLOWS CONVEYED TO S WOLFENSBERGER ROAD AT DP 44 AND ULTIMATELY INTO EXISTING ROADSIDE CHANNEL
																							TOTAL DEVELOPED FLOWS FROM BASIN EX-D1
	50	EX-D1	1.61	0.21	14.7	0.3	3.3	1.1															CONVEYED VIA EX GRASS SWALE TO EX FES, OUTFALLS TO OMNI TRIBUTARY AT DP 50
																							TOTAL DEVELOPED FLOWS FROM BASIN EX-D2
	51	EX-D2	1.34	0.18	10.5	0.2	3.8	0.9															CONVEYED VIA EX GRASS SWALE TO EX FES, OUTFALLS TO OMNI TRIBUTARY AT DP 51
																							TOTAL DEVELOPED FLOWS FROM BASIN C6
	52	C6	0.41	0.24	5.6	0.1	4.7	0.5															SHEET FLOWS AWAY FROM SITE, LEAVES SITE UNDETAINED AT DP 52

STANDARD FORM SF-3

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

Subdivision: Hillside Castle Rock Phase 3&4
Location: Castle Rock
Design Storm: 100-Year P1 =2.60 in/hr

Project Name: Hillside
Project No.: 16190.20
Calculated By: BMP
Checked By: JP
Date: 12/1/25

		DIRECT RUNOFF							TOTAL RUNOFF				STREET			PIPE				TRAVEL TIME			
STREET	Design Point	Basin ID	Area (Ac)	Runoff Coeff.	tc (min)	C*A (Ac)	I (in/hr)	Q (cfs)	tc (min)	C*A (ac)	I (in/hr)	Q (cfs)	Qstreet (cfs)	C*A (ac)	Slope (%)	Qpipe (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	tt (min)	REMARKS
																							TOTAL UNDEVELOPED RUNOFF FROM BASIN EX OS-1
	1	EX-OS1	5.54	0.49	12.6	2.7	6.4	17.4															FLOWS DOWN SLOPE TO ROCKFALL MITIGATION CHANNEL AT DP 1
																							TOTAL UNDEVELOPED RUNOFF FROM BASIN OS-2
	RC1	OS2	6.88	0.51	13.7	3.5	6.2	21.5															FLOWS DOWN SLOPE TO ROCKFALL MITIGATION CHANNEL AT DP RC1
																							SUM OF FLOWS FROM DP 1 & RC1
	RC2.1								13.7	6.22	6.15	38.3											CONTINUES ALONG ROCKFALL MITIGATION CHANNEL TO DP 4.1
																							TOTAL UNDEVELOPED RUNOFF FROM BASIN OS-2.1
	3	OS2.1	8.86	0.51	15.0	4.5	5.9	26.6															FLOWS DOWN SLOPE TO ROCKFALL MITIGATION CHANNEL AT DP 3
																							SUM OF FLOWS FROM DP RC2.1 & 3
	4.1								15.0	10.73	5.90	63.3											CONTINUES ALONG ROCKFALL MITIGATION CHANNEL TO DP 6.1
																							TOTAL UNDEVELOPED RUNOFF FROM BASIN OS-3
	5	OS3	4.90	0.50	14.6	2.4	6.0	14.6															FLOWS DOWN SLOPE TO ROCKFALL MITIGATION CHANNEL AT DP 5
																							SUM OF FLOWS FROM DP 4.1 & 5
	6.1								15.0	13.17	5.90	77.7											CONTINUES ALONG ROCKFALL MITIGATION CHANNEL TO DP 9.1
																							TOTAL DEVELOPED FLOWS FROM BASIN A-14
	A13	A13	0.39	0.52	12.3	0.2	6.5	1.3															FLOWS DOWN SLOPE TO ROCKFALL MITIGATION CHANNEL AT DP 14
																							SUM OF FLOWS FROM DP 6.1 & A13
	9.1								15.0	13.37	5.90	78.9											PIPED TO DP A13.1
																							TOTAL DEVELOPED FLOWS FROM BASIN A-1
	A1	A1	1.40	0.68	5.9	1.0	8.4	8.0															CAPTURED BY ON GRADE TYPE 16 INLETS AT DP A1, PIPED TO DP A2.1
																							TOTAL DEVELOPED FLOWS FROM BASIN A-2
	A2	A2	0.85	0.75	7.3	0.6	7.9	5.0															CAPTURED BY ON GRADE TYPE 16 INLETS AT DP A2, PIPED TO DP A2.1
																							SUM OF FLOWS FROM DP A1 & A2
	A2.1								7.3	1.59	7.87	12.5											PIPED TO DP A4.1
																							TOTAL DEVELOPED FLOWS FROM BASIN A-4
	A4	A4	0.17	0.74	12.0	0.13	6.5	0.9															CAPTURED BY ON GRADE TYPE 16 INLETS AT DP A4, PIPED TO DP A4.1
																							SUM OF FLOWS FROM DP A2.1 & A4
	A4.1								12.0	1.72	6.54	11.2											PIPED TO DP A5.1
																							TOTAL DEVELOPED FLOWS FROM BASIN A-5
	A5	A5	0.37	0.70	13.6	0.26	6.2	1.6															CAPTURED BY ON GRADE TYPE 16 INLETS AT DP A5, PIPED TO DP A5.1
																							SUM OF FLOWS FROM DP A4.1, & A5
	A5.1								13.6	1.98	6.18	12.2											PIPED TO DP A6.1
																							TOTAL DEVELOPED FLOWS FROM BASIN A-3
	A3	A3	0.77	0.63	9.5	0.5	7.2	3.5															CAPTURED BY ON GRADE TYPE 16 INLETS AT DP A3, PIPED TO DP A6.1
																							TOTAL DEVELOPED FLOWS FROM BASIN A-6
	A6	A6	0.35	0.75	11.5	0.3	6.7	1.7															CAPTURED BY ON GRADE TYPE 16 INLETS AT DP A6, PIPED TO DP A6.1
																							SUM OF FLOWS FROM DP A5.1, A3, & A6
	A6.1								13.6	2.73	6.18	16.9											PIPED TO DP A8.1
																							TOTAL DEVELOPED FLOWS FROM BASIN A-7
	A7	A7	0.83	0.68	6.8	0.6	8.1	4.5															CAPTURED BY ON GRADE TYPE 16 INLETS AT DP A7, PIPED TO DP A8.1
																							TOTAL DEVELOPED FLOWS FROM BASIN A-8
	A8	A8	0.64	0.75	10.4	0.5	6.9	3.3															CAPTURED BY ON GRADE TYPE 16 INLETS AT DP A8, PIPED TO DP A8.1
																							SUM OF FLOWS FROM DP A6.1, A7, & A8
	A8.1								13.6	3.77	6.18	23.3											PIPED TO DP 10.1
																							TOTAL DEVELOPED FLOWS FROM BASIN A-10
	A10	A10	0.88	0.75	11.2	0.7	6.7	4.4															CAPTURED BY ON GRADE TYPE 16 INLETS AT DP A10, PIPED TO DP A10.1
																							SUM OF FLOWS FROM DP A8.1 & A10
	A10.1								13.6	4.43	6.18	27.4											PIPED TO DP 11.1
																							TOTAL DEVELOPED FLOWS FROM BASIN A-11
	A11	A11	0.21	0.76	12.1	0.2	6.5	1.0															CAPTURED BY ON GRADE TYPE 16 INLETS AT DP A11, PIPED TO DP A11.1
																							SUM OF FLOWS FROM DP A10.1 & A11
	A11.1								13.6	4.59	6.18	28.4											PIPED TO DP 12.1
																							TOTAL DEVELOPED FLOWS FROM BASIN A-12
	A12	A12	0.14	0.70	7.2	0.1	7.9	0.8															CAPTURED BY ON GRADE TYPE 16 INLETS AT DP A12, PIPED TO DP A12.1
																							SUM OF FLOWS FROM DP A11.1 & A12
	A12.1								13.6	4.69	6.18	29.0											PIPED TO DP A13.1
																							TOTAL DEVELOPED FLOWS FROM BASIN A-9
	A9	A9	1.81	0.69	6.7	1.25	8.1	10.2															CAPTURED BY ON GRADE TYPE 16 INLETS AT DP A9, PIPED TO DP A13.1
																							SUM OF FLOWS FROM DP 9.1 & A13
	A13.1								15.0	14.62	5.90	86.3											PIPED TO DP A14.1
																							TOTAL DEVELOPED FLOWS FROM BASIN A-14
	A14	A14	0.05	0.62	5.0	0.0	8.8	0.3															CAPTURED BY ON GRADE TYPE 16 INLETS AT DP A14, PIPED TO DP A14.1
																							SUM OF FLOWS FROM DP A13.1 & A14
	A14.1								15.0	14.65	5.90	86.4											FLOWS INTO POND EX POND A TO DP 32.1
																							TOTAL DEVELOPED FLOWS FROM BASIN EX-D3
	23	EX-D3	0.34	0.62	10.2	0.2	7.0	1.5															CAPTURED BY ON GRADE TYPE 16 INLETS AT DP 23, PIPED TO DP 24

STREET	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET			PIPE				TRAVEL TIME			REMARKS
		Basin ID	Area (Ac)	Runoff Coeff.	tc (min)	C*A (Ac)	I (in/hr)	Q (cfs)	tc (min)	C*A (ac)	I (in/hr)	Q (cfs)	Qstreet (cfs)	C*A (ac)	Slope (%)	Qpipe (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	tt (min)	
																							TOTAL DEVELOPED FLOWS FROM BASIN EX-B5
	24	EX-B5	1.10	0.62	6.8	0.7	8.1	5.5															SUM OF FLOWS FROM DP 23 & EX-B5, PIPED TO DP 25.1
																							TOTAL DEVELOPED FLOWS FROM BASIN 25.1
	25.1								10.2	0.89	6.99	15.8											SUM OF FLOWS FROM DP 24 & BASIN 25.1, PIPED TO DP 26
																							TOTAL DEVELOPED FLOWS FROM BASIN EX-B1
	26	EX-B1	6.18	0.72	10.6	4.5	6.9	30.8															SUM OF FLOWS FROM DP 25.1 & BASIN EX-B1, PIPED TO DP 27.1
																							TOTAL DEVELOPED FLOWS FROM BASIN 27.1
	27.1								10.6	5.36	6.88	46.5											SUM OF FLOWS FROM DP 26 & BASIN 27.1, PIPED TO DP 28
																							TOTAL DEVELOPED FLOWS FROM BASIN EX-B2
	28	EX-B2	3.19	0.72	10.6	2.3	6.9	15.8															SUM OF FLOWS FROM DP 27.1 & BASIN EX-B2, PIPED TO DP 29.1
																							SUM OF FLOWS FROM DP 27.1 & 28
	29.1								10.6	7.65	6.88	62.2											PIPED INTO EX POND A AT DP 29.1
																							TOTAL DEVELOPED FLOWS FROM BASIN EX-B3
	30	EX-B3	2.01	0.48	10.0	1.0	7.0	6.8															CONVEYED VIA GRASS SWALE AND THEN CONCRETE PAN INTO EX POND A TO DP 30
																							TOTAL DEVELOPED FLOWS FROM BASIN EX-B4
	31	EX-B4	2.34	0.51	9.6	1.2	7.2	8.4															FLOWS RUN DOWN SLOPES INTO EX POND A AT DP 31
																							SUM OF FLOWS ENTERING PROPOSED POND A
	32.1								15.0	24.44	5.90	153.8											RELEASE RATE RESTRICTED TO 56.3 CFS
																							TOTAL DEVELOPED FLOWS FROM BASIN C3
	33	C3	2.32	0.69	8.6	1.6	7.5	11.9															ROUTED VIA TEMPORARY DITCH TO AREA INLET AT DP 33
																							TOTAL DEVELOPED FLOWS FROM BASIN C-1
	34	C1	0.31	0.87	5.0	0.3	8.8	2.4															CAPTURED BY ON GRADE TYPE R INLETS AT DP 34
																							TOTAL DEVELOPED FLOWS FROM BASIN C-2
	35	C2	0.40	0.80	5.0	0.3	8.8	2.8															CAPTURED BY ON GRADE TYPE R INLETS AT DP 35
																							SUM OF FLOWS FROM DP 34 & 35
	36.1								5.0	0.59	8.82	5.2											PIPED TO DP 37.1
																							SUM OF FLOWS FROM DP 33 & 36.1
	37.1								8.6	2.19	7.46	25.9											PIPED TO PROPOSED POND B AT DP 37.1
																							TOTAL DEVELOPED FLOWS FROM BASIN C-4
	38	C4	2.02	0.59	12.9	1.2	6.3	7.5															CONVEYED VIA GRASS SWALE TO PROPOSED POND B AT DP 38
																							SUM OF FLOWS ENTERING PROPOSED POND B
	39.1								12.9	3.38	6.33	21.4											RELEASE RATE RESTRICTED TO 6.3 CFS
																							TOTAL DEVELOPED FLOWS FROM BASIN EX D-5 SHEET FLOW TO GRASS SWALE
	40	EX-D5	2.28	0.60	20.2	1.4	5.1	6.9															PIPED TO GRASS SWALE IN BASIN C-5 AT DP 40
																							TOTAL DEVELOPED FLOWS FROM BASIN C-5
	41	EX-D6	0.57	0.62	8.0	0.4	7.7	2.7															CAPTURED BY AREA INLET AT DP 41, ENTERS EXISTING OUTFALL SYSTEM AT DP 42.1
																							SUM OF FLOWS FROM DP 40 & 41
	42.1								20.2	1.71	5.09	8.7											ENTERS EXISTING OUTFALL SYSTEM AT DP 42.1 AND CONTINUES TO OMNI TRIBUTARY
																							SUM OF FLOWS ENTERING EXISTING OUTFALL SYSTEM
	43.1								20.2	5.09	5.09	25.9											CONTINUES TO OMNI TRIBUTARY
																							TOTAL DEVELOPED FLOWS FROM BASIN C-5
	44	C5	0.22	0.70	5.0	0.2	8.8	1.3															FLOWS CONVEYED TO S WOLFENSBERGER ROAD AT DP 44 AND ULTIMATELY INTO EXISTING ROADSIDE CHANNEL
																							TOTAL DEVELOPED FLOWS FROM BASIN EX-D1
	50	EX-D1	1.61	0.55	14.7	0.9	6.0	5.3															CONVEYED VIA EX GRASS SWALE TO EX FES, OUTFALLS TO OMNI TRIBUTARY AT DP 50
																							TOTAL DEVELOPED FLOWS FROM BASIN EX-D2
	51	EX-D2	1.34	0.54	10.5	0.7	6.9	5.0															CONVEYED VIA EX GRASS SWALE TO EX FES, OUTFALLS TO OMNI TRIBUTARY AT DP 51
																							TOTAL DEVELOPED FLOWS FROM BASIN C6
	52	C6	0.41	0.57	5.6	0.2	8.5	2.0															SHEET FLOWS AWAY FROM SITE, LEAVES SITE UNDETAINED AT DP 52

APPENDIX C
HYDRAULICS

MHFD-Inlet, Version 5.03 (August 2023)

INLET MANAGEMENT

Worksheet Protected

INLET NAME	A1	A2	A4
Site Type (Urban or Rural)	URBAN	URBAN	URBAN
Inlet Application (Street or Area)	STREET	STREET	STREET
Hydraulic Condition	On Grade	On Grade	On Grade
Inlet Type	Denver No. 16 Combination	Denver No. 16 Combination	Denver No. 16 Combination

USER-DEFINED INPUT

User-Defined Design Flows

Minor Q_{Known} (cfs)	2.8	2.1	0.3
Major Q_{Known} (cfs)	8.0	5.0	0.9

Bypass (Carry-Over) Flow from Upstream Inlets must be organized from upstream (left) to downstream (right) in order for bypass flows to be linked.

Receive Bypass Flow from:	No Bypass Flow Received	No Bypass Flow Received	A2
Minor Bypass Flow Received, Q_b (cfs)	0.0	0.0	0.4
Major Bypass Flow Received, Q_b (cfs)	0.0	0.0	1.8

Watershed Characteristics

Subcatchment Area (acres)			
Percent Impervious			
NRCS Soil Type			

Watershed Profile

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

Minor Storm Rainfall Input

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

Major Storm Rainfall Input

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

CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	**2.8**	**2.1**	**0.7**
Major Total Design Peak Flow, Q (cfs)	**8.0**	**5.0**	**2.7**
Minor Flow Bypassed Downstream, Q_b (cfs)	0.0	0.4	0.2
Major Flow Bypassed Downstream, Q_b (cfs)	0.4	1.8	1.3

MHFD-Inlet, Version 5.03 (August 2023)

INLET MANAGEMENT

Worksheet Protected

INLET NAME	A5	A3	A6
Site Type (Urban or Rural)	URBAN	URBAN	URBAN
Inlet Application (Street or Area)	STREET	STREET	STREET
Hydraulic Condition	On Grade	On Grade	On Grade
Inlet Type	Denver No. 16 Combination	Denver No. 16 Combination	Denver No. 16 Combination

USER-DEFINED INPUT

User-Defined Design Flows

Minor Q_{Known} (cfs)	0.6	1.1	0.7
Major Q_{Known} (cfs)	1.6	3.5	1.7

Bypass (Carry-Over) Flow from Upstream

Receive Bypass Flow from:	A4	A1	A5
Minor Bypass Flow Received, Q_b (cfs)	0.2	0.0	0.0
Major Bypass Flow Received, Q_b (cfs)	1.3	0.4	0.0

Watershed Characteristics

Subcatchment Area (acres)			
Percent Impervious			
NRCS Soil Type			

Watershed Profile

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

Minor Storm Rainfall Input

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

Major Storm Rainfall Input

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

CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	**0.8**	**1.1**	**0.7**
Major Total Design Peak Flow, Q (cfs)	**2.9**	**3.9**	**1.7**
Minor Flow Bypassed Downstream, Q_b (cfs)	0.0	0.2	0.0
Major Flow Bypassed Downstream, Q_b (cfs)	0.0	1.2	0.3

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INLET MANAGEMENT

Worksheet Protected

INLET NAME	A7	A8	A10
Site Type (Urban or Rural)	URBAN	URBAN	URBAN
Inlet Application (Street or Area)	STREET	STREET	STREET
Hydraulic Condition	On Grade	On Grade	On Grade
Inlet Type	Denver No. 16 Combination	Denver No. 16 Combination	Denver No. 16 Combination

USER-DEFINED INPUT

User-Defined Design Flows

Minor Q_{Known} (cfs)	1.6	1.4	1.9
Major Q_{Known} (cfs)	4.5	3.3	4.4

Bypass (Carry-Over) Flow from Upstream

Receive Bypass Flow from:	A3	A6	A8
Minor Bypass Flow Received, Q_b (cfs)	0.2	0.0	0.5
Major Bypass Flow Received, Q_b (cfs)	1.2	0.3	1.9

Watershed Characteristics

Subcatchment Area (acres)			
Percent Impervious			
NRCS Soil Type			

Watershed Profile

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

Minor Storm Rainfall Input

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

Major Storm Rainfall Input

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

CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	**1.8**	**1.4**	**2.4**
Major Total Design Peak Flow, Q (cfs)	**5.7**	**3.6**	**6.3**
Minor Flow Bypassed Downstream, Q_b (cfs)	0.1	0.5	1.0
Major Flow Bypassed Downstream, Q_b (cfs)	1.5	1.9	4.1

MHFD-Inlet, Version 5.03 (August 2023)

INLET MANAGEMENT

Worksheet Protected

INLET NAME	A11	A12	A9
Site Type (Urban or Rural)	URBAN	URBAN	URBAN
Inlet Application (Street or Area)	STREET	STREET	STREET
Hydraulic Condition	On Grade	On Grade	On Grade
Inlet Type	Denver No. 16 Combination	Denver No. 16 Combination	Denver No. 16 Combination

USER-DEFINED INPUT

User-Defined Design Flows

Minor Q_{Known} (cfs)	0.4	0.3	3.7
Major Q_{Known} (cfs)	1.0	0.8	10.2

Bypass (Carry-Over) Flow from Upstream

Receive Bypass Flow from:	A10	A11	A7
Minor Bypass Flow Received, Q_b (cfs)	1.0	0.5	0.1
Major Bypass Flow Received, Q_b (cfs)	4.1	3.1	1.5

Watershed Characteristics

Subcatchment Area (acres)			
Percent Impervious			
NRCS Soil Type			

Watershed Profile

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

Minor Storm Rainfall Input

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

Major Storm Rainfall Input

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

CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	**1.4**	**0.8**	**3.8**
Major Total Design Peak Flow, Q (cfs)	**5.1**	**3.9**	**11.7**
Minor Flow Bypassed Downstream, Q_b (cfs)	0.5	0.1	0.0
Major Flow Bypassed Downstream, Q_b (cfs)	3.1	1.7	2.3

MHFD-Inlet, Version 5.03 (August 2023)

INLET MANAGEMENT

Worksheet Protected

C1 & C2 FLOWS BASED ON FUTURE PHASE-FINAL CONDITON RUNOFF CALCULATIONS

INLET NAME	A14	C1	C2
Site Type (Urban or Rural)	URBAN	URBAN	URBAN
Inlet Application (Street or Area)	STREET	STREET	STREET
Hydraulic Condition	On Grade	On Grade	On Grade
Inlet Type	Denver No. 16 Combination	CDOT Type R Curb Opening	CDOT Type R Curb Opening

USER-DEFINED INPUT

User-Defined Design Flows

Minor Q_{Known} (cfs)	0.1	2.8	2.3
Major Q_{Known} (cfs)	0.3	6.8	6.7

Bypass (Carry-Over) Flow from Upstream

Receive Bypass Flow from:	A12	A9	A14
Minor Bypass Flow Received, Q_b (cfs)	0.1	0.0	0.0
Major Bypass Flow Received, Q_b (cfs)	1.7	2.3	0.5

Watershed Characteristics

Subcatchment Area (acres)			
Percent Impervious			
NRCS Soil Type			

Watershed Profile

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

Minor Storm Rainfall Input

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

Major Storm Rainfall Input

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

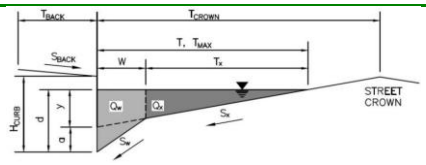
CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	**0.2**	**2.8**	**2.3**
Major Total Design Peak Flow, Q (cfs)	**2.0**	**9.1**	**7.2**
Minor Flow Bypassed Downstream, Q_b (cfs)	0.0	0.0	0.0
Major Flow Bypassed Downstream, Q_b (cfs)	0.5	0.0	0.0

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

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

Project:
Inlet ID: **A1**



Gutter Geometry:			
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	5.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.016	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.9	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.028	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 =	0.058	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} =	16.9	16.9	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.0	5.2	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☑	☑	

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (T * S_x * 12)	y =	5.68	5.68	inches
Vertical Depth between Gutter Lip and Gutter Flowline (W * S_w * 12)	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.32	1.32	inches
Water Depth at Gutter Flowline (y + a)	d =	7.00	7.00	inches
Allowable Spread for Discharge outside the Gutter Section (T - W)	T_X =	14.9	14.9	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.327	0.327	
Discharge outside the Gutter Section, carried in Section T_X	Q_X =	29.3	29.3	cfs
Discharge within the Gutter Section (Q_T - Q_X - Q_{BACK})	Q_W =	14.2	14.2	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	7.8	7.8	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**51.3**	**51.3**	**cfs**
Flow Velocity within the Gutter Section	V =	14.2	14.2	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	8.3	8.3	

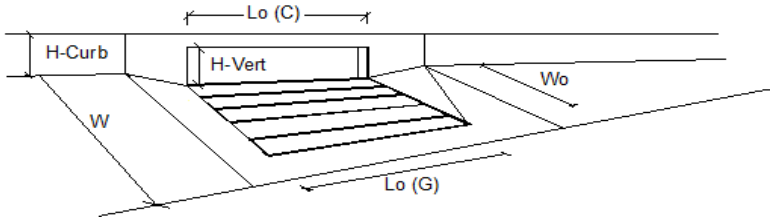
Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	8.0	11.5	ft
Theoretical Spread for Discharge outside the Gutter Section (T - W)	$T_{X\,TH}$ =	6.0	9.5	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.641	0.470	
Theoretical Discharge outside the Gutter Section, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	2.6	8.9	cfs
Actual Discharge outside the Gutter Section, (limited by distance T_{CROWN})	Q_X =	2.6	8.9	cfs
Discharge within the Gutter Section (Q_d - Q_X)	Q_W =	4.6	7.9	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.9	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	7.1	17.7	cfs
Average Flow Velocity Within the Gutter Section	V =	9.1	11.3	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	3.0	4.9	
Slope-Based Safety Factor for Minor/Major Storm depth reduction, d ≥ 6"	R =	1.00	0.60	
Max Flow based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**7.1**	**10.7**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.00	4.51	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.00	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**7.1**	**10.7**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 2.80 cfs on sheet 'Inlet Management'
Major storm max. allowable capacity GOOD - greater than the design peak flow of 8.00 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.03 (August 2023)

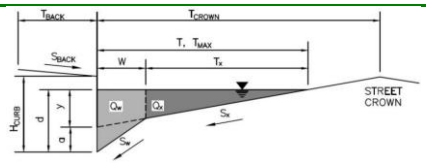


Design Information (Input)		MINOR	MAJOR	
Type of Inlet (Denver No. 16 Combination)	Type =	Denver No. 16 Combination		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	2.0	2.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	6	6	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	3.00	3.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	1.73	1.73	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f (G) =	0.50	0.50	
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	
Design Discharge for Half of Street (from *Inlet Management*)	Q_o =	2.8	8.0	cfs
Water Spread Width	T =	5.0	8.4	ft
Water Depth at Flowline (outside of local depression)	d =	3.0	4.1	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.0	inches
Ratio of Gutter Flow to Design Flow	E_o =	0.852	0.614	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	0.4	3.1	cfs
Discharge within the Gutter Section W	Q_w =	2.4	4.9	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.34	0.52	sq ft
Velocity within the Gutter Section W	V_W =	7.1	9.4	fps
Water Depth for Design Condition	d_{LOCAL} =	5.0	6.1	inches
Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	18.00	18.00	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	0.803	0.566	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	6.30	6.30	fps
Interception Rate of Frontal Flow	R_f =	1.00	0.91	
Interception Rate of Side Flow	R_x =	0.85	0.80	
Interception Capacity	Q_i =	2.7	6.9	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoeff =	1.97	1.97	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	0.16	0.16	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	15.05	15.05	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	5.71	5.71	fps
Interception Rate of Frontal Flow	R_f =	0.97	0.86	
Interception Rate of Side Flow	R_x =	0.79	0.73	
Actual Interception Capacity	**Q_a =**	**2.6**	**6.4**	**cfs**
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**0.2**	**1.6**	**cfs**
Curb Opening or Slotted Inlet Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e	S_e =	0.146	0.113	ft/ft
Required Length L_T to Have 100% Interception	L_T =	2.24	7.45	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	2.24	7.45	ft
Interception Capacity	Q_i =	0.2	1.2	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoeff =	1.31	1.31	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.04	0.04	
Effective (Unclogged) Length	L_e =	2.24	7.45	ft
Actual Interception Capacity	**Q_a =**	**0.2**	**1.2**	**cfs**
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**0.0**	**0.4**	**cfs**
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**2.8**	**7.6**	**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**	**%**

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

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

Project:
Inlet ID: **A2**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	5.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.016	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.9	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 =	0.058	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} =	16.9	16.9	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.0	5.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☑	☑	

Maximum Capacity for 1/2 Street based On Allowable Spread

		Minor Storm	Major Storm	
Water Depth without Gutter Depression (T * S_x * 12)	y =	4.06	4.06	inches
Vertical Depth between Gutter Lip and Gutter Flowline (W * S_w * 12)	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline (y + a)	d =	5.57	5.57	inches
Allowable Spread for Discharge outside the Gutter Section (T - W)	T_X =	14.9	14.9	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.352	0.352	
Discharge outside the Gutter Section, carried in Section T_X	Q_X =	16.7	16.7	cfs
Discharge within the Gutter Section (Q_T - Q_X - Q_{BACK})	Q_W =	9.1	9.1	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	1.8	1.8	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**27.6**	**27.6**	**cfs**
Flow Velocity within the Gutter Section	V =	11.9	11.9	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	5.5	5.5	

Maximum Capacity for 1/2 Street based on Allowable Depth

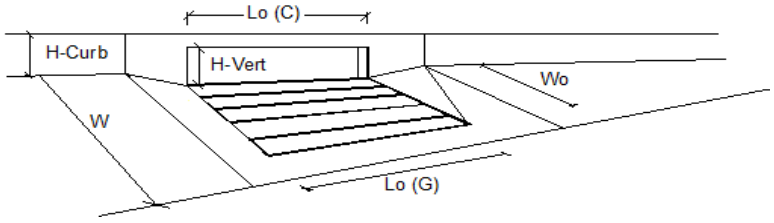
		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	10.4	14.5	ft
Theoretical Spread for Discharge outside the Gutter Section (T - W)	$T_{X\,TH}$ =	8.4	12.5	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.560	0.409	
Theoretical Discharge outside the Gutter Section, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	3.6	10.5	cfs
Actual Discharge outside the Gutter Section, (limited by distance T_{CROWN})	Q_X =	3.6	10.5	cfs
Discharge within the Gutter Section (Q_d - Q_X)	Q_W =	4.6	7.3	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.6	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	8.1	18.4	cfs
Average Flow Velocity Within the Gutter Section	V =	9.1	10.9	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	3.0	4.6	
Slope-Based Safety Factor for Minor/Major Storm depth reduction, d ≥ 6"	R =	1.00	0.70	
Max Flow based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**8.1**	**12.9**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.00	4.55	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.00	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**8.1**	**12.9**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 2.10 cfs on sheet 'Inlet Management'
Major storm max. allowable capacity GOOD - greater than the design peak flow of 5.00 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.03 (August 2023)

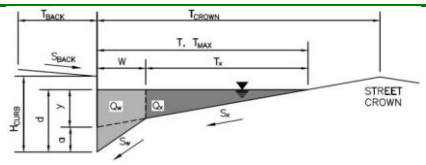


Design Information (Input)		MINOR	MAJOR	
Type of Inlet (Denver No. 16 Combination)	Type =	Denver No. 16 Combination		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	2.0	2.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	3	3	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	3.00	3.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	1.73	1.73	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f (G) =	0.50	0.50	
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	
Design Discharge for Half of Street (from *Inlet Management*)	Q_o =	2.1	5.0	cfs
Water Spread Width	T =	5.0	8.2	ft
Water Depth at Flowline (outside of local depression)	d =	2.7	3.5	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.0	inches
Ratio of Gutter Flow to Design Flow	E_o =	0.889	0.674	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	0.2	1.6	cfs
Discharge within the Gutter Section W	Q_w =	1.9	3.4	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.29	0.42	sq ft
Velocity within the Gutter Section W	V_W =	6.5	8.1	fps
Water Depth for Design Condition	d_{LOCAL} =	4.7	5.5	inches
Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	9.00	9.00	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	0.846	0.628	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	3.53	3.53	fps
Interception Rate of Frontal Flow	R_f =	0.81	0.76	
Interception Rate of Side Flow	R_x =	0.49	0.44	
Interception Capacity	Q_i =	1.6	3.2	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoeff =	1.75	1.75	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	0.29	0.29	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	6.38	6.38	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	2.97	2.97	fps
Interception Rate of Frontal Flow	R_f =	0.76	0.71	
Interception Rate of Side Flow	R_x =	0.30	0.26	
Actual Interception Capacity	**Q_a =**	**1.5**	**2.7**	**cfs**
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**0.6**	**2.3**	**cfs**
Curb Opening or Slotted Inlet Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e	S_e =	0.150	0.119	ft/ft
Required Length L_T to Have 100% Interception	L_T =	4.13	8.80	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	4.13	8.80	ft
Interception Capacity	Q_i =	0.3	0.6	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoeff =	1.00	1.00	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.06	0.06	
Effective (Unclogged) Length	L_e =	4.13	8.50	ft
Actual Interception Capacity	**Q_a =**	**0.3**	**0.5**	**cfs**
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**0.4**	**1.8**	**cfs**
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**1.7**	**3.2**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.4**	**1.8**	**cfs**
Capture Percentage = Q_a/Q_o	**C% =**	**82**	**64**	**%**

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

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

Project:
Inlet ID: **A4**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	5.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.016	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.9	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 =	0.058	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} =	16.9	16.9	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.0	5.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☑	☑	

Maximum Capacity for 1/2 Street based On Allowable Spread

		Minor Storm	Major Storm	
Water Depth without Gutter Depression (T * S_x * 12)	y =	4.06	4.06	inches
Vertical Depth between Gutter Lip and Gutter Flowline (W * S_w * 12)	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline (y + a)	d =	5.57	5.57	inches
Allowable Spread for Discharge outside the Gutter Section (T - W)	T_X =	14.9	14.9	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.352	0.352	
Discharge outside the Gutter Section, carried in Section T_X	Q_X =	16.7	16.7	cfs
Discharge within the Gutter Section (Q_T - Q_X - Q_{BACK})	Q_W =	9.1	9.1	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	1.8	1.8	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**27.6**	**27.6**	**cfs**
Flow Velocity within the Gutter Section	V =	11.9	11.9	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	5.5	5.5	

Maximum Capacity for 1/2 Street based on Allowable Depth

		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	10.4	14.5	ft
Theoretical Spread for Discharge outside the Gutter Section (T - W)	$T_{X\,TH}$ =	8.4	12.5	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.560	0.409	
Theoretical Discharge outside the Gutter Section, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	3.6	10.5	cfs
Actual Discharge outside the Gutter Section, (limited by distance T_{CROWN})	Q_X =	3.6	10.5	cfs
Discharge within the Gutter Section (Q_d - Q_X)	Q_W =	4.6	7.3	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.6	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	8.1	18.4	cfs
Average Flow Velocity Within the Gutter Section	V =	9.1	10.9	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	3.0	4.6	
Slope-Based Safety Factor for Minor/Major Storm depth reduction, d ≥ 6"	R =	1.00	0.70	
Max Flow based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**8.1**	**12.9**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.00	4.55	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.00	inches

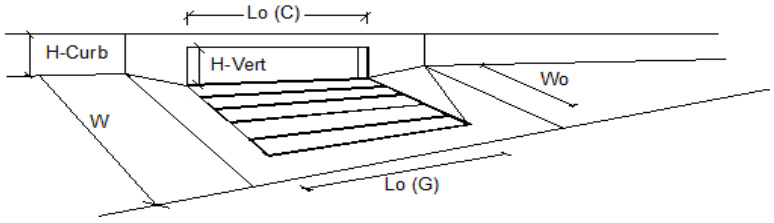
MINOR STORM Allowable Capacity is based on Depth Criterion
MAJOR STORM Allowable Capacity is based on Depth Criterion

	Minor Storm	Major Storm	
Q_{allow} =	**8.1**	**12.9**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 0.68 cfs on sheet 'Inlet Management'
Major storm max. allowable capacity GOOD - greater than the design peak flow of 2.71 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.03 (August 2023)

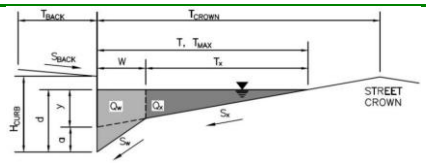


Design Information (Input)		MINOR	MAJOR	
Type of Inlet (Denver No. 16 Combination)	Type =	Denver No. 16 Combination		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	2.0	2.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	3.00	3.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	1.73	1.73	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f (G) =	0.50	0.50	
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	
Design Discharge for Half of Street (from *Inlet Management*)	Q_o =	0.7	2.7	cfs
Water Spread Width	T =	1.9	5.9	ft
Water Depth at Flowline (outside of local depression)	d =	2.0	2.9	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.0	inches
Ratio of Gutter Flow to Design Flow	E_o =	1.000	0.827	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	0.0	0.5	cfs
Discharge within the Gutter Section W	Q_w =	0.7	2.2	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.00	0.32	sq ft
Velocity within the Gutter Section W	V_W =	0.0	7.0	fps
Water Depth for Design Condition	d_{LOCAL} =	4.0	4.9	inches
Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	3.00	3.00	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	0.984	0.782	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	1.86	1.86	fps
Interception Rate of Frontal Flow	R_f =	0.73	0.65	
Interception Rate of Side Flow	R_x =	0.09	0.07	
Interception Capacity	Q_i =	0.5	1.4	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoeff =	1.00	1.00	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	0.50	0.50	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	1.50	1.50	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	1.07	1.07	fps
Interception Rate of Frontal Flow	R_f =	0.66	0.58	
Interception Rate of Side Flow	R_x =	0.02	0.01	
Actual Interception Capacity	**Q_a =**	**0.4**	**1.2**	**cfs**
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**0.2**	**1.5**	**cfs**
Curb Opening or Slotted Inlet Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e	S_e =	0.166	0.141	ft/ft
Required Length L_T to Have 100% Interception	L_T =	2.38	6.48	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	2.38	3.00	ft
Interception Capacity	Q_i =	0.1	0.3	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoeff =	1.00	1.00	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.17	0.17	
Effective (Unclogged) Length	L_e =	2.38	2.50	ft
Actual Interception Capacity	**Q_a =**	**0.1**	**0.2**	**cfs**
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**0.2**	**1.3**	**cfs**
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**0.5**	**1.5**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.2**	**1.3**	**cfs**
Capture Percentage = Q_a/Q_o	**C% =**	**77**	**54**	**%**

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

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

Project:
Inlet ID: **A5**



Gutter Geometry:			
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	5.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.016	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.9	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 =	0.058	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} =	16.9	16.9	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.0	5.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☑	☑	

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (T * S_x * 12)	y =	4.06	4.06	inches
Vertical Depth between Gutter Lip and Gutter Flowline (W * S_w * 12)	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline (y + a)	d =	5.57	5.57	inches
Allowable Spread for Discharge outside the Gutter Section (T - W)	T_X =	14.9	14.9	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.352	0.352	
Discharge outside the Gutter Section, carried in Section T_X	Q_X =	16.7	16.7	cfs
Discharge within the Gutter Section (Q_T - Q_X - Q_{BACK})	Q_W =	9.1	9.1	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	1.8	1.8	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**27.6**	**27.6**	**cfs**
Flow Velocity within the Gutter Section	V =	11.9	11.9	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	5.5	5.5	

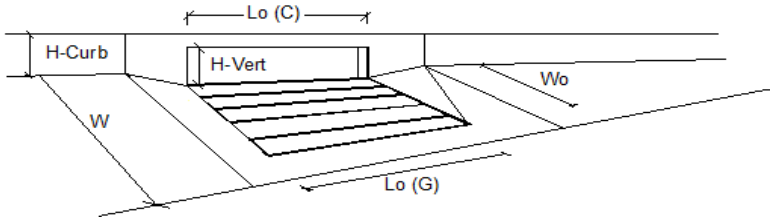
Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	10.4	14.5	ft
Theoretical Spread for Discharge outside the Gutter Section (T - W)	$T_{X\,TH}$ =	8.4	12.5	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.560	0.409	
Theoretical Discharge outside the Gutter Section, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	3.6	10.5	cfs
Actual Discharge outside the Gutter Section, (limited by distance T_{CROWN})	Q_X =	3.6	10.5	cfs
Discharge within the Gutter Section (Q_d - Q_X)	Q_W =	4.6	7.3	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.6	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	8.1	18.4	cfs
Average Flow Velocity Within the Gutter Section	V =	9.1	10.9	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	3.0	4.6	
Slope-Based Safety Factor for Minor/Major Storm depth reduction, d ≥ 6"	R =	1.00	0.70	
Max Flow based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**8.1**	**12.9**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.00	4.55	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.00	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**8.1**	**12.9**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 0.76 cfs on sheet 'Inlet Management'
Major storm max. allowable capacity GOOD - greater than the design peak flow of 2.85 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.03 (August 2023)

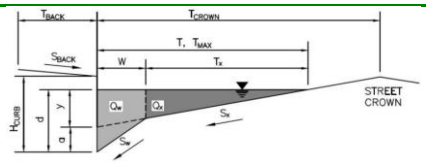


Design Information (Input)		MINOR	MAJOR	
Type of Inlet (Denver No. 16 Combination)	Type =	Denver No. 16 Combination		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	2.0	2.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	6	6	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	3.00	3.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	1.73	1.73	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f (G) =	0.50	0.50	
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	
Design Discharge for Half of Street (from *Inlet Management*)	Q_o =	0.8	2.9	cfs
Water Spread Width	T =	1.9	6.1	ft
Water Depth at Flowline (outside of local depression)	d =	2.0	3.0	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.0	inches
Ratio of Gutter Flow to Design Flow	E_o =	1.000	0.815	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	0.0	0.5	cfs
Discharge within the Gutter Section W	Q_w =	0.8	2.3	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.00	0.33	sq ft
Velocity within the Gutter Section W	V_W =	0.0	7.1	fps
Water Depth for Design Condition	d_{LOCAL} =	4.0	5.0	inches
Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	18.00	18.00	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	0.983	0.769	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	6.30	6.30	fps
Interception Rate of Frontal Flow	R_f =	1.00	1.00	
Interception Rate of Side Flow	R_x =	0.85	0.81	
Interception Capacity	Q_i =	0.8	2.7	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoeff =	1.97	1.97	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	0.16	0.16	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	15.05	15.05	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	5.71	5.71	fps
Interception Rate of Frontal Flow	R_f =	1.00	1.00	
Interception Rate of Side Flow	R_x =	0.79	0.74	
Actual Interception Capacity	**Q_a =**	**0.8**	**2.7**	**cfs**
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**0.0**	**0.2**	**cfs**
Curb Opening or Slotted Inlet Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e	S_e =	0.166	0.139	ft/ft
Required Length L_T to Have 100% Interception	L_T =	0.24	2.22	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	0.24	2.22	ft
Interception Capacity	Q_i =	0.0	0.2	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoeff =	1.31	1.31	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.04	0.04	
Effective (Unclogged) Length	L_e =	0.24	2.22	ft
Actual Interception Capacity	**Q_a =**	**0.0**	**0.2**	**cfs**
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**0.0**	**0.0**	**cfs**
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**0.8**	**2.9**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.00**	**0.0**	**cfs**
Capture Percentage = Q_a/Q_o	**C% =**	**100**	**100**	**%**

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

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

Project:
Inlet ID: **A3**



Gutter Geometry:			
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	5.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.016	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.9	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 =	0.058	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} =	16.9	16.9	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.0	5.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☑	☑	

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (T * S_x * 12)	y =	4.06	4.06	inches
Vertical Depth between Gutter Lip and Gutter Flowline (W * S_w * 12)	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline (y + a)	d =	5.57	5.57	inches
Allowable Spread for Discharge outside the Gutter Section (T - W)	T_X =	14.9	14.9	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.352	0.352	
Discharge outside the Gutter Section, carried in Section T_X	Q_X =	16.7	16.7	cfs
Discharge within the Gutter Section (Q_T - Q_X - Q_{BACK})	Q_W =	9.1	9.1	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	1.8	1.8	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**27.6**	**27.6**	**cfs**
Flow Velocity within the Gutter Section	V =	11.9	11.9	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	5.5	5.5	

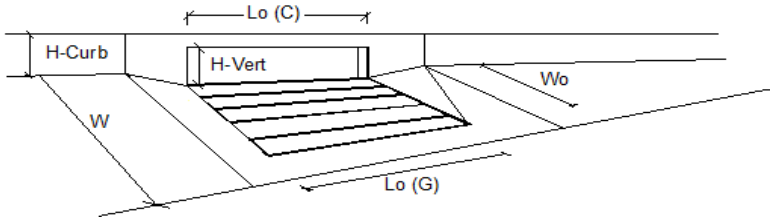
Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	10.4	14.5	ft
Theoretical Spread for Discharge outside the Gutter Section (T - W)	$T_{X\,TH}$ =	8.4	12.5	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.560	0.409	
Theoretical Discharge outside the Gutter Section, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	3.6	10.5	cfs
Actual Discharge outside the Gutter Section, (limited by distance T_{CROWN})	Q_X =	3.6	10.5	cfs
Discharge within the Gutter Section (Q_d - Q_X)	Q_W =	4.6	7.3	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.6	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	8.1	18.4	cfs
Average Flow Velocity Within the Gutter Section	V =	9.1	10.9	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	3.0	4.6	
Slope-Based Safety Factor for Minor/Major Storm depth reduction, d ≥ 6"	R =	1.00	0.70	
Max Flow based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**8.1**	**12.9**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.00	4.55	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.00	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**8.1**	**12.9**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 1.10 cfs on sheet 'Inlet Management'
Major storm max. allowable capacity GOOD - greater than the design peak flow of 3.94 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.03 (August 2023)

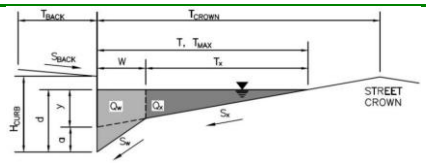


Design Information (Input)		MINOR	MAJOR	
Type of Inlet (Denver No. 16 Combination)	Type =	Denver No. 16 Combination		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	2.0	2.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	3	3	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	3.00	3.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	1.73	1.73	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f (G) =	0.50	0.50	
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	
Design Discharge for Half of Street (from *Inlet Management*)	Q_o =	1.1	3.9	cfs
Water Spread Width	T =	2.2	7.3	ft
Water Depth at Flowline (outside of local depression)	d =	2.0	3.3	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.0	inches
Ratio of Gutter Flow to Design Flow	E_o =	1.000	0.733	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	0.0	1.0	cfs
Discharge within the Gutter Section W	Q_w =	1.1	2.9	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.17	0.38	sq ft
Velocity within the Gutter Section W	V_W =	6.3	7.7	fps
Water Depth for Design Condition	d_{LOCAL} =	4.0	5.3	inches
Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	9.00	9.00	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	0.979	0.687	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	3.53	3.53	fps
Interception Rate of Frontal Flow	R_f =	0.75	0.78	
Interception Rate of Side Flow	R_x =	0.43	0.45	
Interception Capacity	Q_i =	0.8	2.7	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoeff =	1.75	1.75	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	0.29	0.29	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	6.38	6.38	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	2.97	2.97	fps
Interception Rate of Frontal Flow	R_f =	0.70	0.73	
Interception Rate of Side Flow	R_x =	0.26	0.27	
Actual Interception Capacity	**Q_a =**	**0.8**	**2.3**	**cfs**
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**0.3**	**1.6**	**cfs**
Curb Opening or Slotted Inlet Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e	S_e =	0.166	0.127	ft/ft
Required Length L_T to Have 100% Interception	L_T =	2.85	7.16	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	2.85	7.16	ft
Interception Capacity	Q_i =	0.1	0.5	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoeff =	1.00	1.00	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.06	0.06	
Effective (Unclogged) Length	L_e =	2.85	7.16	ft
Actual Interception Capacity	**Q_a =**	**0.1**	**0.4**	**cfs**
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**0.2**	**1.2**	**cfs**
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**0.9**	**2.7**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.2**	**1.2**	**cfs**
Capture Percentage = Q_a/Q_o	**C% =**	**81**	**69**	**%**

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

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

Project:
Inlet ID: **A6**



Gutter Geometry:			
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	5.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.016	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.9	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 =	0.058	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} =	16.9	16.9	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.0	5.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☑	☑	

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (T * S_x * 12)	y =	4.06	4.06	inches
Vertical Depth between Gutter Lip and Gutter Flowline (W * S_w * 12)	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline (y + a)	d =	5.57	5.57	inches
Allowable Spread for Discharge outside the Gutter Section (T - W)	T_X =	14.9	14.9	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.352	0.352	
Discharge outside the Gutter Section, carried in Section T_X	Q_X =	16.7	16.7	cfs
Discharge within the Gutter Section (Q_T - Q_X - Q_{BACK})	Q_W =	9.1	9.1	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	1.8	1.8	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**27.6**	**27.6**	**cfs**
Flow Velocity within the Gutter Section	V =	11.9	11.9	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	5.5	5.5	

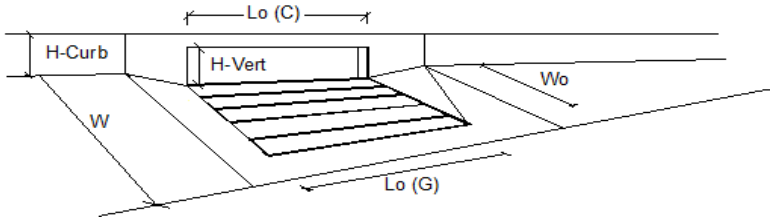
Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	10.4	14.5	ft
Theoretical Spread for Discharge outside the Gutter Section (T - W)	$T_{X\,TH}$ =	8.4	12.5	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.560	0.409	
Theoretical Discharge outside the Gutter Section, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	3.6	10.5	cfs
Actual Discharge outside the Gutter Section, (limited by distance T_{CROWN})	Q_X =	3.6	10.5	cfs
Discharge within the Gutter Section (Q_d - Q_X)	Q_W =	4.6	7.3	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.6	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	8.1	18.4	cfs
Average Flow Velocity Within the Gutter Section	V =	9.1	10.9	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	3.0	4.6	
Slope-Based Safety Factor for Minor/Major Storm depth reduction, d ≥ 6"	R =	1.00	0.70	
Max Flow based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**8.1**	**12.9**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.00	4.55	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.00	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**8.1**	**12.9**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 0.70 cfs on sheet 'Inlet Management'
Major storm max. allowable capacity GOOD - greater than the design peak flow of 1.70 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.03 (August 2023)

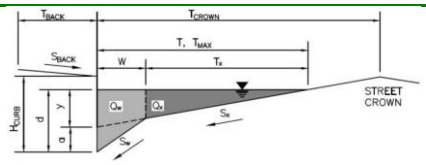


Design Information (Input)		MINOR	MAJOR	
Type of Inlet (Denver No. 16 Combination)	Type =	Denver No. 16 Combination		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	2.0	2.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	3	3	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	3.00	3.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	1.73	1.73	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f (G) =	0.50	0.50	
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	
Design Discharge for Half of Street (from *Inlet Management*)	Q_o =	0.7	1.7	cfs
Water Spread Width	T =	1.9	4.3	ft
Water Depth at Flowline (outside of local depression)	d =	2.0	2.5	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.0	inches
Ratio of Gutter Flow to Design Flow	E_o =	1.000	0.933	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	0.0	0.1	cfs
Discharge within the Gutter Section W	Q_w =	0.7	1.6	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.00	0.26	sq ft
Velocity within the Gutter Section W	V_W =	0.0	6.2	fps
Water Depth for Design Condition	d_{LOCAL} =	4.0	4.5	inches
Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	9.00	9.00	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	0.984	0.893	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	3.53	3.53	fps
Interception Rate of Frontal Flow	R_f =	0.88	0.82	
Interception Rate of Side Flow	R_x =	0.55	0.49	
Interception Capacity	Q_i =	0.6	1.3	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoeff =	1.75	1.75	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	0.29	0.29	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	6.38	6.38	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	2.97	2.97	fps
Interception Rate of Frontal Flow	R_f =	0.83	0.77	
Interception Rate of Side Flow	R_x =	0.35	0.31	
Actual Interception Capacity	**Q_a =**	**0.6**	**1.2**	**cfs**
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**0.1**	**0.5**	**cfs**
Curb Opening or Slotted Inlet Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e	S_e =	0.166	0.157	ft/ft
Required Length L_T to Have 100% Interception	L_T =	1.71	3.46	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	1.71	3.46	ft
Interception Capacity	Q_i =	0.1	0.2	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoeff =	1.00	1.00	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.06	0.06	
Effective (Unclogged) Length	L_e =	1.71	3.46	ft
Actual Interception Capacity	**Q_a =**	**0.1**	**0.2**	**cfs**
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**0.0**	**0.3**	**cfs**
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**0.7**	**1.4**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.02**	**0.3**	**cfs**
Capture Percentage = Q_a/Q_o	**C% =**	**97**	**85**	**%**

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

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

Project:
Inlet ID: **A7**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	5.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.016	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.9	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 =	0.058	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} =	16.9	16.9	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.0	5.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☑	☑	

Maximum Capacity for 1/2 Street based On Allowable Spread

		Minor Storm	Major Storm	
Water Depth without Gutter Depression (T * S_x * 12)	y =	4.06	4.06	inches
Vertical Depth between Gutter Lip and Gutter Flowline (W * S_w * 12)	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline (y + a)	d =	5.57	5.57	inches
Allowable Spread for Discharge outside the Gutter Section (T - W)	T_X =	14.9	14.9	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.352	0.352	
Discharge outside the Gutter Section, carried in Section T_X	Q_X =	16.7	16.7	cfs
Discharge within the Gutter Section (Q_T - Q_X - Q_{BACK})	Q_W =	9.1	9.1	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	1.8	1.8	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**27.6**	**27.6**	**cfs**
Flow Velocity within the Gutter Section	V =	11.9	11.9	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	5.5	5.5	

Maximum Capacity for 1/2 Street based on Allowable Depth

		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	10.4	14.5	ft
Theoretical Spread for Discharge outside the Gutter Section (T - W)	$T_{X\,TH}$ =	8.4	12.5	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.560	0.409	
Theoretical Discharge outside the Gutter Section, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	3.6	10.5	cfs
Actual Discharge outside the Gutter Section, (limited by distance T_{CROWN})	Q_X =	3.6	10.5	cfs
Discharge within the Gutter Section (Q_d - Q_X)	Q_W =	4.6	7.3	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.6	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	8.1	18.4	cfs
Average Flow Velocity Within the Gutter Section	V =	9.1	10.9	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	3.0	4.6	
Slope-Based Safety Factor for Minor/Major Storm depth reduction, d ≥ 6"	R =	1.00	0.70	
Max Flow based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**8.1**	**12.9**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.00	4.55	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.00	inches

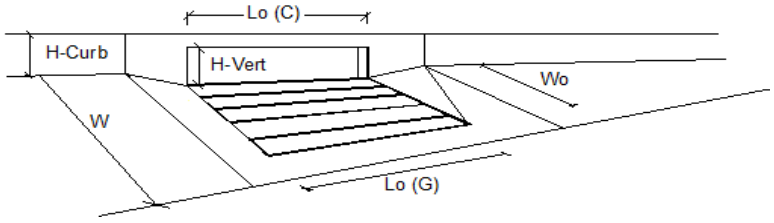
MINOR STORM Allowable Capacity is based on Depth Criterion
MAJOR STORM Allowable Capacity is based on Depth Criterion

	Minor Storm	Major Storm	
Q_{allow} =	**8.1**	**12.9**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 1.80 cfs on sheet 'Inlet Management'
Major storm max. allowable capacity GOOD - greater than the design peak flow of 5.72 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.03 (August 2023)

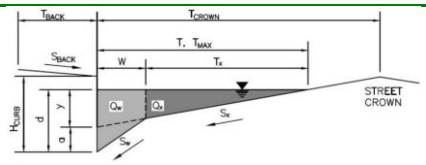


Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	Denver No. 16 Combination		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	2.0	2.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	4	4	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	3.00	3.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	1.73	1.73	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f (G) =	0.50	0.50	
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	
Design Discharge for Half of Street (from *Inlet Management*)	Q_o =	1.8	5.7	cfs
Water Spread Width	T =	4.5	8.8	ft
Water Depth at Flowline (outside of local depression)	d =	2.6	3.6	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.0	inches
Ratio of Gutter Flow to Design Flow	E_o =	0.922	0.640	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	0.1	2.1	cfs
Discharge within the Gutter Section W	Q_w =	1.7	3.7	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.27	0.44	sq ft
Velocity within the Gutter Section W	V_W =	6.3	8.4	fps
Water Depth for Design Condition	d_{LOCAL} =	4.6	5.6	inches
Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	12.00	12.00	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	0.880	0.594	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	4.31	4.31	fps
Interception Rate of Frontal Flow	R_f =	0.89	0.81	
Interception Rate of Side Flow	R_x =	0.65	0.59	
Interception Capacity	Q_i =	1.6	4.1	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoeff =	1.88	1.88	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	0.24	0.24	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	9.18	9.18	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	3.57	3.57	fps
Interception Rate of Frontal Flow	R_f =	0.82	0.75	
Interception Rate of Side Flow	R_x =	0.50	0.44	
Actual Interception Capacity	**Q_a =**	**1.4**	**3.6**	**cfs**
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**0.4**	**2.2**	**cfs**
Curb Opening or Slotted Inlet Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e	S_e =	0.155	0.114	ft/ft
Required Length L_T to Have 100% Interception	L_T =	3.14	8.70	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	3.14	8.70	ft
Interception Capacity	Q_i =	0.3	0.7	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoeff =	1.25	1.25	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.05	0.05	
Effective (Unclogged) Length	L_e =	3.14	8.70	ft
Actual Interception Capacity	**Q_a =**	**0.3**	**0.6**	**cfs**
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**0.1**	**1.5**	**cfs**
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**1.7**	**4.2**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.1**	**1.5**	**cfs**
Capture Percentage = Q_a/Q_o	**C% =**	**93**	**73**	**%**

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

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

Project:
Inlet ID: **A8**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	5.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.016	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.9	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 =	0.060	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} =	16.9	16.9	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.0	5.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☑	☑	

Maximum Capacity for 1/2 Street based On Allowable Spread

		Minor Storm	Major Storm	
Water Depth without Gutter Depression (T * S_x * 12)	y =	4.06	4.06	inches
Vertical Depth between Gutter Lip and Gutter Flowline (W * S_w * 12)	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline (y + a)	d =	5.57	5.57	inches
Allowable Spread for Discharge outside the Gutter Section (T - W)	T_X =	14.9	14.9	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.352	0.352	
Discharge outside the Gutter Section, carried in Section T_X	Q_X =	17.0	17.0	cfs
Discharge within the Gutter Section (Q_T - Q_X - Q_{BACK})	Q_W =	9.2	9.2	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	1.8	1.8	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**28.1**	**28.1**	**cfs**
Flow Velocity within the Gutter Section	V =	12.1	12.1	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	5.6	5.6	

Maximum Capacity for 1/2 Street based on Allowable Depth

		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	10.4	14.5	ft
Theoretical Spread for Discharge outside the Gutter Section (T - W)	$T_{X\,TH}$ =	8.4	12.5	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.560	0.409	
Theoretical Discharge outside the Gutter Section, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	3.6	10.7	cfs
Actual Discharge outside the Gutter Section, (limited by distance T_{CROWN})	Q_X =	3.6	10.7	cfs
Discharge within the Gutter Section (Q_d - Q_X)	Q_W =	4.6	7.4	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.6	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	8.3	18.7	cfs
Average Flow Velocity Within the Gutter Section	V =	9.3	11.1	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	3.1	4.6	
Slope-Based Safety Factor for Minor/Major Storm depth reduction, d ≥ 6"	R =	1.00	0.68	
Max Flow based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**8.3**	**12.8**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.00	4.52	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.00	inches

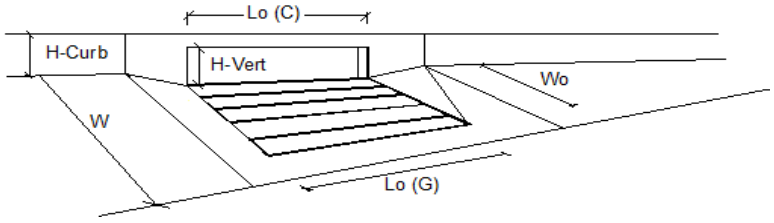
MINOR STORM Allowable Capacity is based on Depth Criterion
MAJOR STORM Allowable Capacity is based on Depth Criterion

	Minor Storm	Major Storm	
Q_{allow} =	**8.3**	**12.8**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 1.42 cfs on sheet 'Inlet Management'
Major storm max. allowable capacity GOOD - greater than the design peak flow of 3.55 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.03 (August 2023)

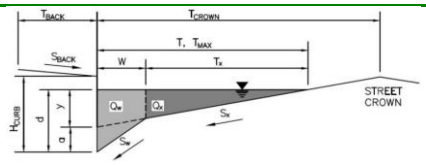


Design Information (Input)		MINOR	MAJOR	
Type of Inlet (Denver No. 16 Combination)	Type =	Denver No. 16 Combination		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	2.0	2.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	3.00	3.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	1.73	1.73	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f (G) =	0.50	0.50	
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	
Design Discharge for Half of Street (from *Inlet Management*)	Q_o =	1.4	3.6	cfs
Water Spread Width	T =	3.6	6.8	ft
Water Depth at Flowline (outside of local depression)	d =	2.4	3.2	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.0	inches
Ratio of Gutter Flow to Design Flow	E_o =	0.967	0.763	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	0.0	0.8	cfs
Discharge within the Gutter Section W	Q_w =	1.4	2.7	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.23	0.36	sq ft
Velocity within the Gutter Section W	V_W =	5.9	7.5	fps
Water Depth for Design Condition	d_{LOCAL} =	4.4	5.2	inches
Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	3.00	3.00	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	0.931	0.716	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	1.86	1.86	fps
Interception Rate of Frontal Flow	R_f =	0.67	0.63	
Interception Rate of Side Flow	R_x =	0.07	0.06	
Interception Capacity	Q_i =	0.9	1.7	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoeff =	1.00	1.00	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	0.50	0.50	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	1.50	1.50	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	1.07	1.07	fps
Interception Rate of Frontal Flow	R_f =	0.60	0.56	
Interception Rate of Side Flow	R_x =	0.02	0.01	
Actual Interception Capacity	**Q_a =**	**0.8**	**1.4**	**cfs**
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**0.6**	**2.1**	**cfs**
Curb Opening or Slotted Inlet Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e	S_e =	0.162	0.132	ft/ft
Required Length L_T to Have 100% Interception	L_T =	3.94	8.08	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	3.00	3.00	ft
Interception Capacity	Q_i =	0.2	0.3	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoeff =	1.00	1.00	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.17	0.17	
Effective (Unclogged) Length	L_e =	2.50	2.50	ft
Actual Interception Capacity	**Q_a =**	**0.1**	**0.3**	**cfs**
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**0.5**	**1.9**	**cfs**
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**0.9**	**1.7**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.5**	**1.9**	**cfs**
Capture Percentage = Q_a/Q_o	**C% =**	**66**	**47**	**%**

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

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

Project:
Inlet ID: **A10**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	5.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.016	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.9	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 =	0.060	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} =	16.9	16.9	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.0	5.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☑	☑	

Maximum Capacity for 1/2 Street based On Allowable Spread

		Minor Storm	Major Storm	
Water Depth without Gutter Depression (T * S_x * 12)	y =	4.06	4.06	inches
Vertical Depth between Gutter Lip and Gutter Flowline (W * S_w * 12)	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline (y + a)	d =	5.57	5.57	inches
Allowable Spread for Discharge outside the Gutter Section (T - W)	T_X =	14.9	14.9	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.352	0.352	
Discharge outside the Gutter Section, carried in Section T_X	Q_X =	17.0	17.0	cfs
Discharge within the Gutter Section (Q_T - Q_X - Q_{BACK})	Q_W =	9.2	9.2	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	1.8	1.8	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**28.1**	**28.1**	**cfs**
Flow Velocity within the Gutter Section	V =	12.1	12.1	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	5.6	5.6	

Maximum Capacity for 1/2 Street based on Allowable Depth

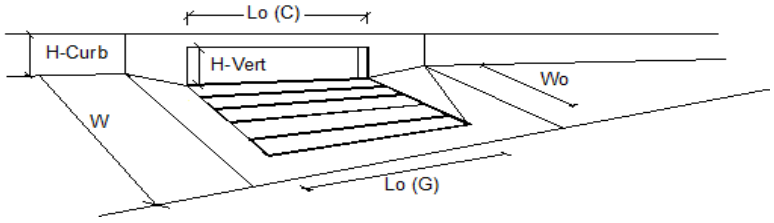
		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	10.4	14.5	ft
Theoretical Spread for Discharge outside the Gutter Section (T - W)	$T_{X\,TH}$ =	8.4	12.5	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.560	0.409	
Theoretical Discharge outside the Gutter Section, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	3.6	10.7	cfs
Actual Discharge outside the Gutter Section, (limited by distance T_{CROWN})	Q_X =	3.6	10.7	cfs
Discharge within the Gutter Section (Q_d - Q_X)	Q_W =	4.6	7.4	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.6	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	8.3	18.7	cfs
Average Flow Velocity Within the Gutter Section	V =	9.3	11.1	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	3.1	4.6	
Slope-Based Safety Factor for Minor/Major Storm depth reduction, d ≥ 6"	R =	1.00	0.68	
Max Flow based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**8.3**	**12.8**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.00	4.52	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.00	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**8.3**	**12.8**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 2.38 cfs on sheet 'Inlet Management'
Major storm max. allowable capacity GOOD - greater than the design peak flow of 6.27 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.03 (August 2023)

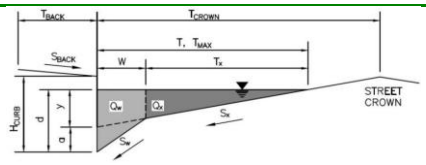


Design Information (Input)		MINOR	MAJOR	
Type of Inlet (Denver No. 16 Combination)	Type =	Denver No. 16 Combination		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	2.0	2.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	3.00	3.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	1.73	1.73	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f (G) =	0.50	0.50	
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	
Design Discharge for Half of Street (from *Inlet Management*)	Q_o =	2.4	6.3	cfs
Water Spread Width	T =	5.4	9.1	ft
Water Depth at Flowline (outside of local depression)	d =	2.8	3.7	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.0	inches
Ratio of Gutter Flow to Design Flow	E_o =	0.864	0.622	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	0.3	2.4	cfs
Discharge within the Gutter Section W	Q_w =	2.1	3.9	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.30	0.45	sq ft
Velocity within the Gutter Section W	V_W =	6.8	8.6	fps
Water Depth for Design Condition	d_{LOCAL} =	4.8	5.7	inches
Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	3.00	3.00	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	0.819	0.577	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	1.86	1.86	fps
Interception Rate of Frontal Flow	R_f =	0.65	0.58	
Interception Rate of Side Flow	R_x =	0.07	0.05	
Interception Capacity	Q_i =	1.3	2.2	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoeff =	1.00	1.00	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	0.50	0.50	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	1.50	1.50	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	1.07	1.07	fps
Interception Rate of Frontal Flow	R_f =	0.58	0.51	
Interception Rate of Side Flow	R_x =	0.01	0.01	
Actual Interception Capacity	**Q_a =**	**1.1**	**1.9**	**cfs**
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**1.2**	**4.4**	**cfs**
Curb Opening or Slotted Inlet Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e	S_e =	0.146	0.111	ft/ft
Required Length L_T to Have 100% Interception	L_T =	5.86	12.67	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	3.00	3.00	ft
Interception Capacity	Q_i =	0.2	0.4	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoeff =	1.00	1.00	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.17	0.17	
Effective (Unclogged) Length	L_e =	2.50	2.50	ft
Actual Interception Capacity	**Q_a =**	**0.2**	**0.3**	**cfs**
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**1.0**	**4.1**	**cfs**
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**1.3**	**2.2**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**1.0**	**4.1**	**cfs**
Capture Percentage = Q_a/Q_o	**C% =**	**56**	**35**	**%**

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

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

Project:
Inlet ID: **A11**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	5.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.016	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.9	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 =	0.060	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} =	16.9	16.9	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.0	5.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☑	☑	

Maximum Capacity for 1/2 Street based On Allowable Spread

		Minor Storm	Major Storm	
Water Depth without Gutter Depression (T * S_x * 12)	y =	4.06	4.06	inches
Vertical Depth between Gutter Lip and Gutter Flowline (W * S_w * 12)	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline (y + a)	d =	5.57	5.57	inches
Allowable Spread for Discharge outside the Gutter Section (T - W)	T_X =	14.9	14.9	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.352	0.352	
Discharge outside the Gutter Section, carried in Section T_X	Q_X =	17.0	17.0	cfs
Discharge within the Gutter Section (Q_T - Q_X - Q_{BACK})	Q_W =	9.2	9.2	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	1.8	1.8	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**28.1**	**28.1**	**cfs**
Flow Velocity within the Gutter Section	V =	12.1	12.1	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	5.6	5.6	

Maximum Capacity for 1/2 Street based on Allowable Depth

		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	10.4	14.5	ft
Theoretical Spread for Discharge outside the Gutter Section (T - W)	$T_{X\,TH}$ =	8.4	12.5	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.560	0.409	
Theoretical Discharge outside the Gutter Section, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	3.6	10.7	cfs
Actual Discharge outside the Gutter Section, (limited by distance T_{CROWN})	Q_X =	3.6	10.7	cfs
Discharge within the Gutter Section (Q_d - Q_X)	Q_W =	4.6	7.4	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.6	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	8.3	18.7	cfs
Average Flow Velocity Within the Gutter Section	V =	9.3	11.1	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	3.1	4.6	
Slope-Based Safety Factor for Minor/Major Storm depth reduction, d ≥ 6"	R =	1.00	0.68	
Max Flow based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**8.3**	**12.8**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.00	4.52	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.00	inches

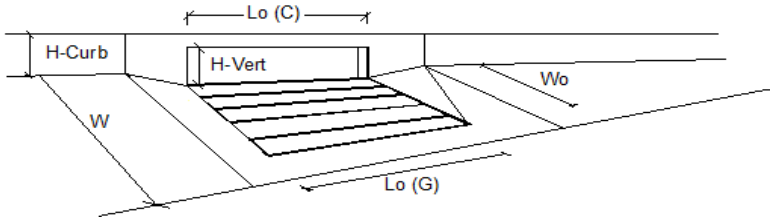
MINOR STORM Allowable Capacity is based on Depth Criterion
MAJOR STORM Allowable Capacity is based on Depth Criterion

	Minor Storm	Major Storm	
Q_{allow} =	**8.3**	**12.8**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 1.44 cfs on sheet 'Inlet Management'
Major storm max. allowable capacity GOOD - greater than the design peak flow of 5.08 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.03 (August 2023)

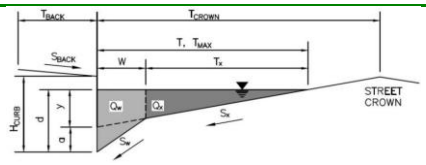


Design Information (Input)		MINOR	MAJOR	
Type of Inlet (Denver No. 16 Combination)	Type =	Denver No. 16 Combination		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	2.0	2.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	3.00	3.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	1.73	1.73	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f (G) =	0.50	0.50	
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	
Design Discharge for Half of Street (from *Inlet Management*)	Q_o =	1.4	5.1	cfs
Water Spread Width	T =	3.7	8.2	ft
Water Depth at Flowline (outside of local depression)	d =	2.4	3.5	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.0	inches
Ratio of Gutter Flow to Design Flow	E_o =	0.965	0.673	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	0.1	1.7	cfs
Discharge within the Gutter Section W	Q_w =	1.4	3.4	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.23	0.42	sq ft
Velocity within the Gutter Section W	V_W =	6.0	8.2	fps
Water Depth for Design Condition	d_{LOCAL} =	4.4	5.5	inches
Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	3.00	3.00	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	0.929	0.627	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	1.86	1.86	fps
Interception Rate of Frontal Flow	R_f =	0.67	0.60	
Interception Rate of Side Flow	R_x =	0.07	0.06	
Interception Capacity	Q_i =	0.9	2.0	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoeff =	1.00	1.00	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	0.50	0.50	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	1.50	1.50	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	1.07	1.07	fps
Interception Rate of Frontal Flow	R_f =	0.60	0.53	
Interception Rate of Side Flow	R_x =	0.02	0.01	
Actual Interception Capacity	**Q_a =**	**0.8**	**1.7**	**cfs**
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**0.6**	**3.4**	**cfs**
Curb Opening or Slotted Inlet Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e	S_e =	0.161	0.118	ft/ft
Required Length L_T to Have 100% Interception	L_T =	3.98	10.74	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	3.00	3.00	ft
Interception Capacity	Q_i =	0.2	0.4	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoeff =	1.00	1.00	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.17	0.17	
Effective (Unclogged) Length	L_e =	2.50	2.50	ft
Actual Interception Capacity	**Q_a =**	**0.1**	**0.3**	**cfs**
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**0.5**	**3.1**	**cfs**
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**0.9**	**2.0**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.5**	**3.1**	**cfs**
Capture Percentage = Q_a/Q_o	**C% =**	**66**	**39**	**%**

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

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

Project:
Inlet ID: **A12**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	5.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.016	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.9	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 =	0.060	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} =	16.9	16.9	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.0	5.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☑	☑	

Maximum Capacity for 1/2 Street based On Allowable Spread

		Minor Storm	Major Storm	
Water Depth without Gutter Depression (T * S_x * 12)	y =	4.06	4.06	inches
Vertical Depth between Gutter Lip and Gutter Flowline (W * S_w * 12)	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline (y + a)	d =	5.57	5.57	inches
Allowable Spread for Discharge outside the Gutter Section (T - W)	T_X =	14.9	14.9	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.352	0.352	
Discharge outside the Gutter Section, carried in Section T_X	Q_X =	17.0	17.0	cfs
Discharge within the Gutter Section (Q_T - Q_X - Q_{BACK})	Q_W =	9.2	9.2	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	1.8	1.8	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**28.1**	**28.1**	**cfs**
Flow Velocity within the Gutter Section	V =	12.1	12.1	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	5.6	5.6	

Maximum Capacity for 1/2 Street based on Allowable Depth

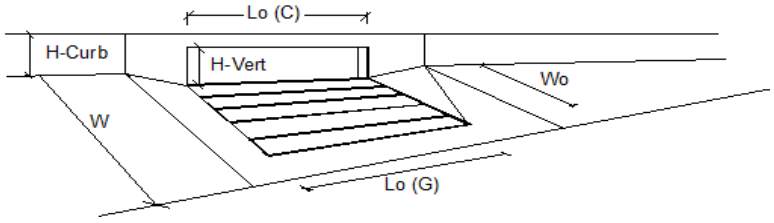
		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	10.4	14.5	ft
Theoretical Spread for Discharge outside the Gutter Section (T - W)	$T_{X\,TH}$ =	8.4	12.5	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.560	0.409	
Theoretical Discharge outside the Gutter Section, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	3.6	10.7	cfs
Actual Discharge outside the Gutter Section, (limited by distance T_{CROWN})	Q_X =	3.6	10.7	cfs
Discharge within the Gutter Section (Q_d - Q_X)	Q_W =	4.6	7.4	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.6	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	8.3	18.7	cfs
Average Flow Velocity Within the Gutter Section	V =	9.3	11.1	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	3.1	4.6	
Slope-Based Safety Factor for Minor/Major Storm depth reduction, d ≥ 6"	R =	1.00	0.68	
Max Flow based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**8.3**	**12.8**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.00	4.52	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.00	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**8.3**	**12.8**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 0.79 cfs on sheet 'Inlet Management'
Major storm max. allowable capacity GOOD - greater than the design peak flow of 3.87 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.03 (August 2023)

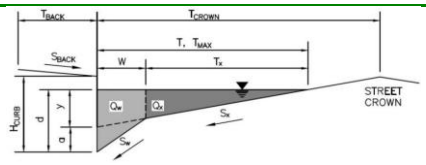


Design Information (Input)		MINOR	MAJOR	
Type of Inlet (Denver No. 16 Combination)	Type =	Denver No. 16 Combination		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	2.0	2.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	2	2	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	3.00	3.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	1.73	1.73	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f (G) =	0.50	0.50	
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	
Design Discharge for Half of Street (from *Inlet Management*)	Q_o =	0.8	3.9	cfs
Water Spread Width	T =	2.0	7.2	ft
Water Depth at Flowline (outside of local depression)	d =	2.0	3.2	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.0	inches
Ratio of Gutter Flow to Design Flow	E_o =	1.000	0.741	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	0.0	1.0	cfs
Discharge within the Gutter Section W	Q_w =	0.8	2.9	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.00	0.37	sq ft
Velocity within the Gutter Section W	V_W =	0.0	7.7	fps
Water Depth for Design Condition	d_{LOCAL} =	4.0	5.2	inches
Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	6.00	6.00	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	0.982	0.694	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	2.87	2.87	fps
Interception Rate of Frontal Flow	R_f =	0.80	0.71	
Interception Rate of Side Flow	R_x =	0.30	0.24	
Interception Capacity	Q_i =	0.6	2.2	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoeff =	1.50	1.50	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	0.38	0.38	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	3.75	3.75	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	2.17	2.17	fps
Interception Rate of Frontal Flow	R_f =	0.74	0.65	
Interception Rate of Side Flow	R_x =	0.13	0.10	
Actual Interception Capacity	**Q_a =**	**0.6**	**1.9**	**cfs**
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**0.2**	**2.0**	**cfs**
Curb Opening or Slotted Inlet Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e	S_e =	0.166	0.128	ft/ft
Required Length L_T to Have 100% Interception	L_T =	2.26	7.95	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	2.26	6.00	ft
Interception Capacity	Q_i =	0.1	0.4	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoeff =	1.00	1.00	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.08	0.08	
Effective (Unclogged) Length	L_e =	2.26	5.50	ft
Actual Interception Capacity	**Q_a =**	**0.1**	**0.3**	**cfs**
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**0.1**	**1.7**	**cfs**
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**0.7**	**2.2**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.1**	**1.7**	**cfs**
Capture Percentage = Q_a/Q_o	**C% =**	**86**	**57**	**%**

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

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

Project:
Inlet ID: **A9**



Gutter Geometry:			
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	5.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.016	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.9	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 =	0.080	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} =	16.9	16.9	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.0	5.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☑	☑	

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (T * S_x * 12)	y =	4.06	4.06	inches
Vertical Depth between Gutter Lip and Gutter Flowline (W * S_w * 12)	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline (y + a)	d =	5.57	5.57	inches
Allowable Spread for Discharge outside the Gutter Section (T - W)	T_X =	14.9	14.9	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.352	0.352	
Discharge outside the Gutter Section, carried in Section T_X	Q_X =	19.6	19.6	cfs
Discharge within the Gutter Section (Q_T - Q_X - Q_{BACK})	Q_W =	10.7	10.7	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	2.1	2.1	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**32.4**	**32.4**	**cfs**
Flow Velocity within the Gutter Section	V =	14.0	14.0	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	6.5	6.5	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	10.4	14.5	ft
Theoretical Spread for Discharge outside the Gutter Section (T - W)	$T_{X\,TH}$ =	8.4	12.5	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.560	0.409	
Theoretical Discharge outside the Gutter Section, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	4.2	12.4	cfs
Actual Discharge outside the Gutter Section, (limited by distance T_{CROWN})	Q_X =	4.2	12.4	cfs
Discharge within the Gutter Section (Q_d - Q_X)	Q_W =	5.4	8.6	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.7	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	9.6	21.6	cfs
Average Flow Velocity Within the Gutter Section	V =	10.7	12.8	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	3.6	5.4	
Slope-Based Safety Factor for Minor/Major Storm depth reduction, d ≥ 6"	R =	1.00	0.54	
Max Flow based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**9.6**	**11.7**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.00	4.24	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.00	inches

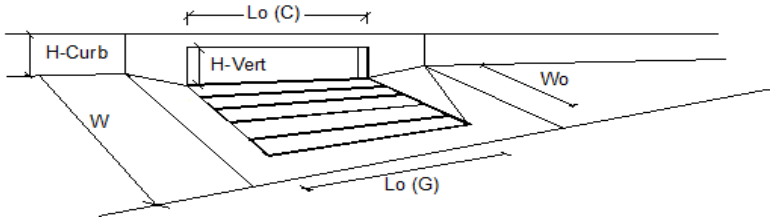
MINOR STORM Allowable Capacity is based on Depth Criterion
MAJOR STORM Allowable Capacity is based on Depth Criterion

	Minor Storm	Major Storm	
Q_{allow} =	**9.6**	**11.7**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 3.83 cfs on sheet 'Inlet Management'
Major storm max. allowable capacity GOOD - greater than the design peak flow of 11.72 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.03 (August 2023)

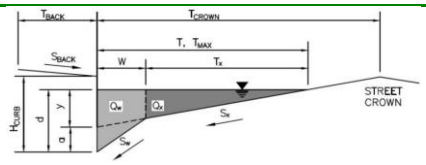


Design Information (Input)		MINOR	MAJOR	
Type of Inlet (Denver No. 16 Combination)	Type =	Denver No. 16 Combination		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	2.0	2.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	6	6	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	3.00	3.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	1.73	1.73	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f (G) =	0.50	0.50	
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	
Design Discharge for Half of Street (from *Inlet Management*)	Q_o =	3.8	11.7	cfs
Water Spread Width	T =	6.6	11.3	ft
Water Depth at Flowline (outside of local depression)	d =	3.1	4.2	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.0	inches
Ratio of Gutter Flow to Design Flow	E_o =	0.781	0.516	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	0.8	5.7	cfs
Discharge within the Gutter Section W	Q_w =	3.0	6.0	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.35	0.54	sq ft
Velocity within the Gutter Section W	V_W =	8.6	11.2	fps
Water Depth for Design Condition	d_{LOCAL} =	5.1	6.2	inches
Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	18.00	18.00	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	0.734	0.475	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	6.30	6.30	fps
Interception Rate of Frontal Flow	R_f =	0.95	0.82	
Interception Rate of Side Flow	R_x =	0.76	0.70	
Interception Capacity	Q_i =	3.4	8.8	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoeff =	1.97	1.97	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	0.16	0.16	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	15.05	15.05	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	5.71	5.71	fps
Interception Rate of Frontal Flow	R_f =	0.89	0.77	
Interception Rate of Side Flow	R_x =	0.68	0.60	
Actual Interception Capacity	**Q_a =**	**3.2**	**8.0**	**cfs**
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**0.6**	**3.7**	**cfs**
Curb Opening or Slotted Inlet Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e	S_e =	0.134	0.096	ft/ft
Required Length L_T to Have 100% Interception	L_T =	4.35	12.70	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	4.35	12.70	ft
Interception Capacity	Q_i =	0.6	1.6	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoeff =	1.31	1.31	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.04	0.04	
Effective (Unclogged) Length	L_e =	4.35	12.70	ft
Actual Interception Capacity	**Q_a =**	**0.6**	**1.4**	**cfs**
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**0.0**	**2.3**	**cfs**
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**3.8**	**9.4**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.04**	**2.3**	**cfs**
Capture Percentage = Q_a/Q_o	**C% =**	**99**	**80**	**%**

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

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

Project:
Inlet ID: **A14**



Gutter Geometry:			
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	5.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.016	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.9	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 =	0.080	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} =	16.9	16.9	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.0	5.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☑	☑	

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (T * S_x * 12)	y =	4.06	4.06	inches
Vertical Depth between Gutter Lip and Gutter Flowline (W * S_w * 12)	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline (y + a)	d =	5.57	5.57	inches
Allowable Spread for Discharge outside the Gutter Section (T - W)	T_X =	14.9	14.9	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.352	0.352	
Discharge outside the Gutter Section, carried in Section T_X	Q_X =	19.6	19.6	cfs
Discharge within the Gutter Section (Q_T - Q_X - Q_{BACK})	Q_W =	10.7	10.7	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	2.1	2.1	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**32.4**	**32.4**	**cfs**
Flow Velocity within the Gutter Section	V =	14.0	14.0	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	6.5	6.5	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	10.4	14.5	ft
Theoretical Spread for Discharge outside the Gutter Section (T - W)	$T_{X\,TH}$ =	8.4	12.5	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.560	0.409	
Theoretical Discharge outside the Gutter Section, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	4.2	12.4	cfs
Actual Discharge outside the Gutter Section, (limited by distance T_{CROWN})	Q_X =	4.2	12.4	cfs
Discharge within the Gutter Section (Q_d - Q_X)	Q_W =	5.4	8.6	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.7	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	9.6	21.6	cfs
Average Flow Velocity Within the Gutter Section	V =	10.7	12.8	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	3.6	5.4	
Slope-Based Safety Factor for Minor/Major Storm depth reduction, d ≥ 6"	R =	1.00	0.54	
Max Flow based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**9.6**	**11.7**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.00	4.24	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.00	inches

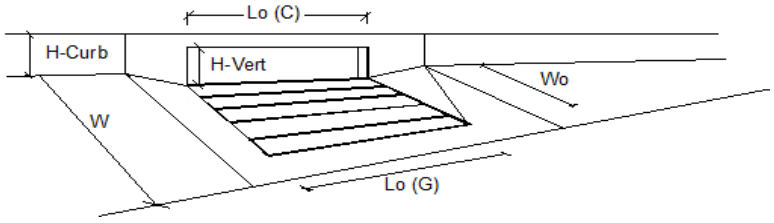
MINOR STORM Allowable Capacity is based on Depth Criterion
MAJOR STORM Allowable Capacity is based on Depth Criterion

	Minor Storm	Major Storm	
Q_{allow} =	**9.6**	**11.7**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 0.21 cfs on sheet 'Inlet Management'
Major storm max. allowable capacity GOOD - greater than the design peak flow of 1.98 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.03 (August 2023)

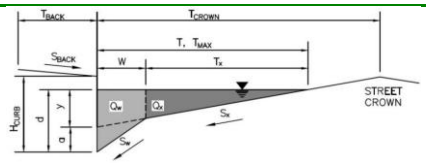


Design Information (Input)		MINOR	MAJOR	
Type of Inlet (Denver No. 16 Combination)	Type =	Denver No. 16 Combination		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	2.0	2.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	3	3	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	3.00	3.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	1.73	1.73	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f (G) =	0.50	0.50	
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	
Design Discharge for Half of Street (from *Inlet Management*)	Q_o =	0.2	2.0	cfs
Water Spread Width	T =	1.1	4.3	ft
Water Depth at Flowline (outside of local depression)	d =	1.8	2.5	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.0	inches
Ratio of Gutter Flow to Design Flow	E_o =	1.000	0.935	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	0.0	0.1	cfs
Discharge within the Gutter Section W	Q_w =	0.2	1.9	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.00	0.26	sq ft
Velocity within the Gutter Section W	V_W =	0.0	7.2	fps
Water Depth for Design Condition	d_{LOCAL} =	3.8	4.5	inches
Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	9.00	9.00	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	0.995	0.895	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	3.53	3.53	fps
Interception Rate of Frontal Flow	R_f =	0.95	0.74	
Interception Rate of Side Flow	R_x =	0.62	0.42	
Interception Capacity	Q_i =	0.2	1.4	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoeff =	1.75	1.75	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	0.29	0.29	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	6.38	6.38	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	2.97	2.97	fps
Interception Rate of Frontal Flow	R_f =	0.90	0.69	
Interception Rate of Side Flow	R_x =	0.43	0.25	
Actual Interception Capacity	**Q_a =**	**0.2**	**1.3**	**cfs**
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**0.0**	**0.7**	**cfs**
Curb Opening or Slotted Inlet Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e	S_e =	0.166	0.157	ft/ft
Required Length L_T to Have 100% Interception	L_T =	0.72	4.34	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	0.72	4.34	ft
Interception Capacity	Q_i =	0.0	0.3	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoeff =	1.00	1.00	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.06	0.06	
Effective (Unclogged) Length	L_e =	0.72	4.34	ft
Actual Interception Capacity	**Q_a =**	**0.0**	**0.2**	**cfs**
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**0.0**	**0.5**	**cfs**
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**0.2**	**1.5**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**0.48**	**cfs**
Capture Percentage = Q_a/Q_o	**C% =**	**100**	**76**	**%**

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

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

Project:
Inlet ID: **C1**



Gutter Geometry:			
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	5.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =		ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.016	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.9	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 =	0.060	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} =	11.9	11.9	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☐	

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (T * S_x * 12)	y =	2.86	2.86	inches
Vertical Depth between Gutter Lip and Gutter Flowline (W * S_w * 12)	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline (y + a)	d =	4.37	4.37	inches
Allowable Spread for Discharge outside the Gutter Section (T - W)	T_X =	9.9	9.9	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.495	0.495	
Discharge outside the Gutter Section, carried in Section T_X	Q_X =	5.7	5.7	cfs
Discharge within the Gutter Section (Q_T - Q_X - Q_{BACK})	Q_W =	5.6	5.6	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**11.3**	**11.3**	**cfs**
Flow Velocity within the Gutter Section	V =	10.0	10.0	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	3.6	3.6	

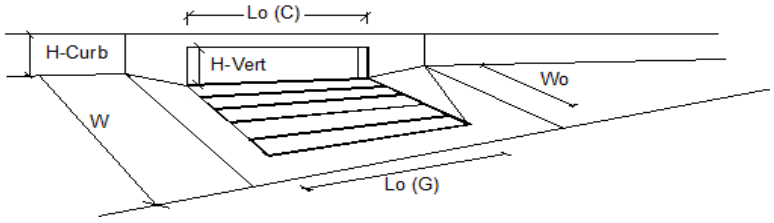
Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	18.7	18.7	ft
Theoretical Spread for Discharge outside the Gutter Section (T - W)	$T_{X\,TH}$ =	16.7	16.7	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.318	0.318	
Theoretical Discharge outside the Gutter Section, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	23.0	23.0	cfs
Actual Discharge outside the Gutter Section, (limited by distance T_{CROWN})	Q_X =	23.0	23.0	cfs
Discharge within the Gutter Section (Q_d - Q_X)	Q_W =	10.7	10.7	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	33.7	33.7	cfs
Average Flow Velocity Within the Gutter Section	V =	12.9	12.9	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	6.4	6.4	
Slope-Based Safety Factor for Minor/Major Storm depth reduction, d ≥ 6"	R =	0.43	0.43	
Max Flow based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**14.4**	**14.4**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.68	4.68	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.00	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**11.3**	**11.3**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 2.84 cfs on sheet 'Inlet Management'
Major storm max. allowable capacity GOOD - greater than the design peak flow of 9.12 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.03 (August 2023)

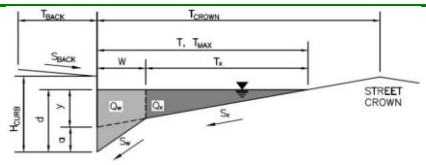


Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	2	2	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	10.00	10.00	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	
Design Discharge for Half of Street (from *Inlet Management*)	Q_o =	2.8	9.1	cfs
Water Spread Width	T =	6.0	10.8	ft
Water Depth at Flowline (outside of local depression)	d =	3.0	4.1	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.0	inches
Ratio of Gutter Flow to Design Flow	E_o =	0.820	0.539	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	0.5	4.2	cfs
Discharge within the Gutter Section W	Q_w =	2.3	4.9	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.33	0.52	sq ft
Velocity within the Gutter Section W	V_W =	7.1	9.5	fps
Water Depth for Design Condition	d_{LOCAL} =	6.0	7.1	inches
Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	N/A	N/A	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	N/A	N/A	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Interception Capacity	Q_i =	N/A	N/A	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoeff =	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Actual Interception Capacity	**Q_a =**	**N/A**	**N/A**	**cfs**
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**N/A**	**N/A**	**cfs**
Curb Opening or Slotted Inlet Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e	S_e =	0.174	0.121	ft/ft
Required Length L_T to Have 100% Interception	L_T =	8.24	17.63	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	8.24	17.63	ft
Interception Capacity	Q_i =	2.8	9.1	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoeff =	1.33	1.33	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.03	0.03	
Effective (Unclogged) Length	L_e =	8.24	17.63	ft
Actual Interception Capacity	**Q_a =**	**2.8**	**9.1**	**cfs**
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**0.0**	**0.0**	**cfs**
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**2.8**	**9.1**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**0.0**	**cfs**
Capture Percentage = Q_a/Q_o	**C% =**	**100**	**100**	**%**

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

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

Project:
Inlet ID: **C2**



Gutter Geometry:			
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	5.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =		ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.016	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	19.9	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 =	0.066	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} =	11.9	11.9	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☐	

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (T * S_x * 12)	y =	2.86	2.86	inches
Vertical Depth between Gutter Lip and Gutter Flowline (W * S_w * 12)	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline (y + a)	d =	4.37	4.37	inches
Allowable Spread for Discharge outside the Gutter Section (T - W)	T_X =	9.9	9.9	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.495	0.495	
Discharge outside the Gutter Section, carried in Section T_X	Q_X =	6.0	6.0	cfs
Discharge within the Gutter Section (Q_T - Q_X - Q_{BACK})	Q_W =	5.9	5.9	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**11.9**	**11.9**	**cfs**
Flow Velocity within the Gutter Section	V =	10.5	10.5	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	3.8	3.8	

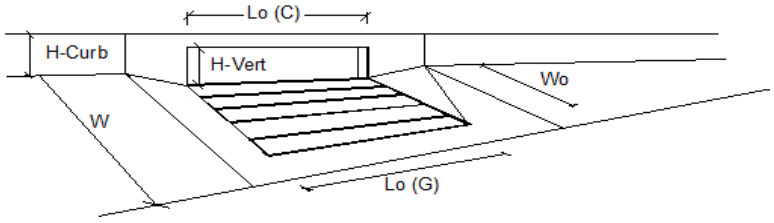
Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	18.7	18.7	ft
Theoretical Spread for Discharge outside the Gutter Section (T - W)	$T_{X\,TH}$ =	16.7	16.7	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.318	0.318	
Theoretical Discharge outside the Gutter Section, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	24.1	24.1	cfs
Actual Discharge outside the Gutter Section, (limited by distance T_{CROWN})	Q_X =	24.1	24.1	cfs
Discharge within the Gutter Section (Q_d - Q_X)	Q_W =	11.2	11.2	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	35.4	35.4	cfs
Average Flow Velocity Within the Gutter Section	V =	13.5	13.5	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	6.7	6.7	
Slope-Based Safety Factor for Minor/Major Storm depth reduction, d ≥ 6"	R =	0.40	0.40	
Max Flow based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**14.0**	**14.0**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.58	4.58	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.00	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**11.9**	**11.9**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 2.30 cfs on sheet 'Inlet Management'
Major storm max. allowable capacity GOOD - greater than the design peak flow of 7.18 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.03 (August 2023)



Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	15.00	15.00	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	
Design Discharge for Half of Street (from *Inlet Management*)	Q_o =	2.3	7.2	cfs
Water Spread Width	T =	5.1	9.5	ft
Water Depth at Flowline (outside of local depression)	d =	2.7	3.8	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.0	inches
Ratio of Gutter Flow to Design Flow	E_o =	0.883	0.603	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	0.3	2.9	cfs
Discharge within the Gutter Section W	Q_w =	2.0	4.3	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.29	0.47	sq ft
Velocity within the Gutter Section W	V_W =	7.0	9.3	fps
Water Depth for Design Condition	d_{LOCAL} =	5.7	6.8	inches
Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	N/A	N/A	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	N/A	N/A	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Interception Capacity	Q_i =	N/A	N/A	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoeff =	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Actual Interception Capacity	**Q_a =**	**N/A**	**N/A**	**cfs**
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**N/A**	**N/A**	**cfs**
Curb Opening or Slotted Inlet Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e	S_e =	0.186	0.133	ft/ft
Required Length L_T to Have 100% Interception	L_T =	7.21	15.02	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	7.21	15.00	ft
Interception Capacity	Q_i =	2.3	7.2	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoeff =	1.31	1.31	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.04	0.04	
Effective (Unclogged) Length	L_e =	7.21	14.35	ft
Actual Interception Capacity	**Q_a =**	**2.3**	**7.2**	**cfs**
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**0.0**	**0.0**	**cfs**
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**2.3**	**7.2**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**0.0**	**cfs**
Capture Percentage = Q_a/Q_o	**C% =**	**100**	**100**	**%**

APPENDIX D

WATER QUALITY ENHANCMENT CONTROL MEASURES

EX POND A CAPACITY ANALYSIS

Approved Paragon Watershed Information			EES Watershed Information			JR Watershed Information			DELTA (JR-EES)		DELTA (JR-Paragon)	
AREA	45.63	AC	AREA	51.26	AC	AREA	50.20	AC	-1.06	AC	4.57	AC
% IMPERVIOUS	26.00	%	% IMPERVIOUS	26.00	%	% IMPERVIOUS	27.60	%	1.60	%	1.60	%
CALCULATED WQCV	0.526	AC-FT	CALCULATED WQCV	0.591	AC-FT	CALCULATED WQCV	0.601	AC-FT	0.010	AC-FT	0.08	AC-FT
CALCULATED EURV	0.604	AC-FT	CALCULATED EURV	0.679	AC-FT	CALCULATED EURV	0.735	AC-FT	0.056	AC-FT	0.13	AC-FT
CALCULATED 100YR	2.243	AC-FT	CALCULATED 100YR	2.225	AC-FT	CALCULATED 100YR	1.911	AC-FT	-0.314	AC-FT	-0.33	AC-FT
TOTAL VOLUME	3.373	AC-FT	TOTAL VOLUME	3.494	AC-FT	TOTAL VOLUME	3.247	AC-FT	-0.247	AC-FT	-0.13	AC-FT
5/1/2019 (Approved)			12/15/2023									

JR WATERSHED INFORMATION

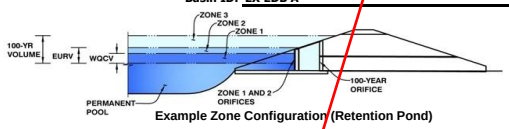
JR POND A CALCS, USING PARAGON DESIGN INFORMATION

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: HILLSIDE POND A

Basin ID: EX EDB A



Example Zone Configuration (Retention Pond)

WATERSHED AREA AND IMPERVIOUSNESS FROM JR RATIONAL CALCULATIONS

Watershed Information

Selected BMP Type =	EDB	
Watershed Area =	50.20	acres
Watershed Length =	2,477	ft
Watershed Length to Centroid =	1,675	ft
Watershed Slope =	0.060	ft/ft
Watershed Imperviousness =	27.60%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	53.0%	percent
Percentage Hydrologic Soil Groups C/D =	47.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

After providing required inputs above including 1-hour rainfall depths, click 'Run CUHP' to generate runoff hydrographs using the embedded Colorado Urban Hydrograph Procedure.

			Optional User Overrides
Water Quality Capture Volume (WQCV) =	0.601	acre-feet	acre-feet
Excess Urban Runoff Volume (EURV) =	1.336	acre-feet	acre-feet
2-yr Runoff Volume (P1 = 0.83 in.) =	0.728	acre-feet	inches
5-yr Runoff Volume (P1 = 1.43 in.) =	2.349	acre-feet	1.43 inches
10-yr Runoff Volume (P1 = 1.33 in.) =	1.924	acre-feet	inches
25-yr Runoff Volume (P1 = 1.69 in.) =	3.631	acre-feet	inches
50-yr Runoff Volume (P1 = 1.99 in.) =	4.845	acre-feet	inches
100-yr Runoff Volume (P1 = 2.6 in.) =	7.632	acre-feet	2.60 inches
500-yr Runoff Volume (P1 = 3.14 in.) =	9.973	acre-feet	inches
Approximate 2-yr Detention Volume =	0.716	acre-feet	
Approximate 5-yr Detention Volume =	1.547	acre-feet	
Approximate 10-yr Detention Volume =	1.625	acre-feet	
Approximate 25-yr Detention Volume =	2.086	acre-feet	
Approximate 50-yr Detention Volume =	2.294	acre-feet	
Approximate 100-yr Detention Volume =	3.247	acre-feet	

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.601	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.735	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	1.911	acre-feet
Total Detention Basin Volume =	3.247	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 = 1.00 ft

CONTOUR DATA FROM APPROVED PHASE 1&2 REPORT BY PARAGON

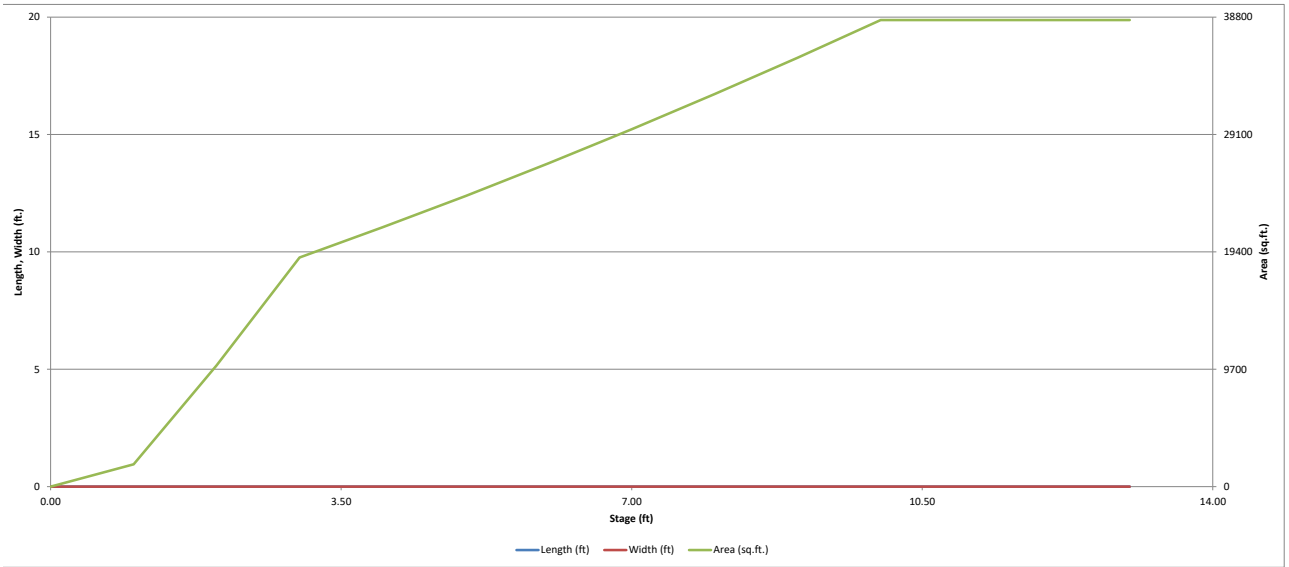
Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
6298.5									
Top of Micropool	--	0.00	--	--	--	0	0.000		
6299.5	--	1.00	--	--	--	1,846	0.042	923	0.021
6300.5	--	2.00	--	--	--	10,022	0.230	6,857	0.157
6301.5	--	3.00	--	--	--	18,940	0.435	21,338	0.490
6302.5	--	4.00	--	--	--	21,439	0.492	41,527	0.953
6303.5	--	5.00	--	--	--	24,016	0.551	64,255	1.475
6304.5	--	6.00	--	--	--	26,723	0.613	89,624	2.057
6305.5	--	7.00	--	--	--	29,538	0.678	117,755	2.703
6306.5	--	8.00	--	--	--	32,449	0.745	148,748	3.415
6307.5	--	9.00	--	--	--	35,454	0.814	182,700	4.194
6308.5	--	10.00	--	--	--	38,561	0.885	219,707	5.044
6309.5 SPILLWAY	--	11.00	--	--	--	38,561	0.885	258,268	5.929
6310.5	--	12.00	--	--	--	38,561	0.885	296,829	6.814
6311.5	--	13.00	--	--	--	38,561	0.885	335,390	7.700

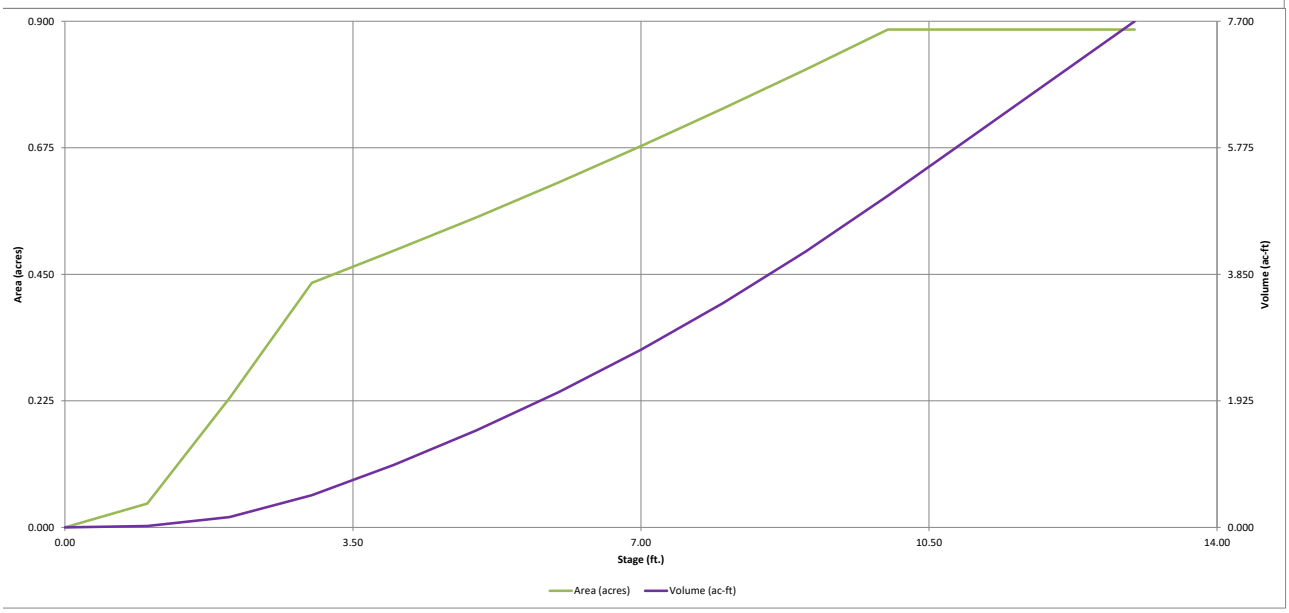
OVERDETENTION FOR UNIMPROVED OS BASINS' RUNOFF

CUHP REQUIRED VOLUME

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)



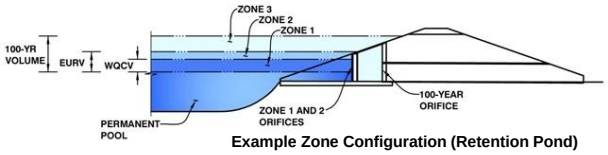


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: HILLSIDE POND A

Basin ID: EX EDB A



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.26	0.601	Orifice Plate
Zone 2 (EURV)	4.75	0.735	Orifice Plate
Zone 3 (100-year)	7.78	1.911	Weir&Pipe (Restrict)
Total (all zones)		3.247	

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

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

Centroid of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	1.583E-02	ft^2
Depth at top of Zone using Orifice Plate =	4.75	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 =	2.28	sq. inches (diameter = 1-11/16 inches)	Elliptical Slot Area =	N/A	ft^2

Calculated Parameters for Plate

INCREASED DIAMETER FOR WQ HOLES

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	1.36	2.72					
Orifice Area (sq. inches)	2.28	2.28	2.28					

	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 =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	N/A	N/A	ft^2
Depth at top of Zone using Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	N/A	N/A	feet
Vertical Orifice Diameter =	N/A	N/A	inches				

Calculated Parameters for Vertical Orifice

User Input: Overflow Weir (Dropbox with Flat or Sloped Grate and Outlet Pipe OR Rectangular/Trapezoidal Weir and No Outlet Pipe)

	Zone 3 Weir	Not Selected			Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	4.10	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	7.35	N/A	feet
Overflow Weir Front Edge Length =	4.00	N/A	feet	Overflow Weir Slope Length =	13.40	N/A	feet
Overflow Weir Grate Slope =	4.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	9.67	N/A	
Horiz. Length of Weir Sides =	13.00	N/A	feet	Overflow Grate Open Area w/o Debris =	37.31	N/A	ft^2
Overflow Grate Type =	Type C Grate	N/A		Overflow Grate Open Area w/ Debris =	18.65	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 Restrictor	Not Selected			Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	2.83	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	3.86	N/A	ft^2
Outlet Pipe Diameter =	30.00	N/A	inches	Outlet Orifice Centroid =	1.02	N/A	feet
Restrictor Plate Height Above Pipe Invert =	22.00		inches	Half-Central Angle of Restrictor Plate on Pipe =	2.06	N/A	radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	8.00	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	1.55	feet
Spillway Crest Length =	10.00	feet	Stage at Top of Freeboard =	10.55	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	0.89	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	5.53	acre-ft

Calculated Parameters for Spillway

Routed Hydrograph Results

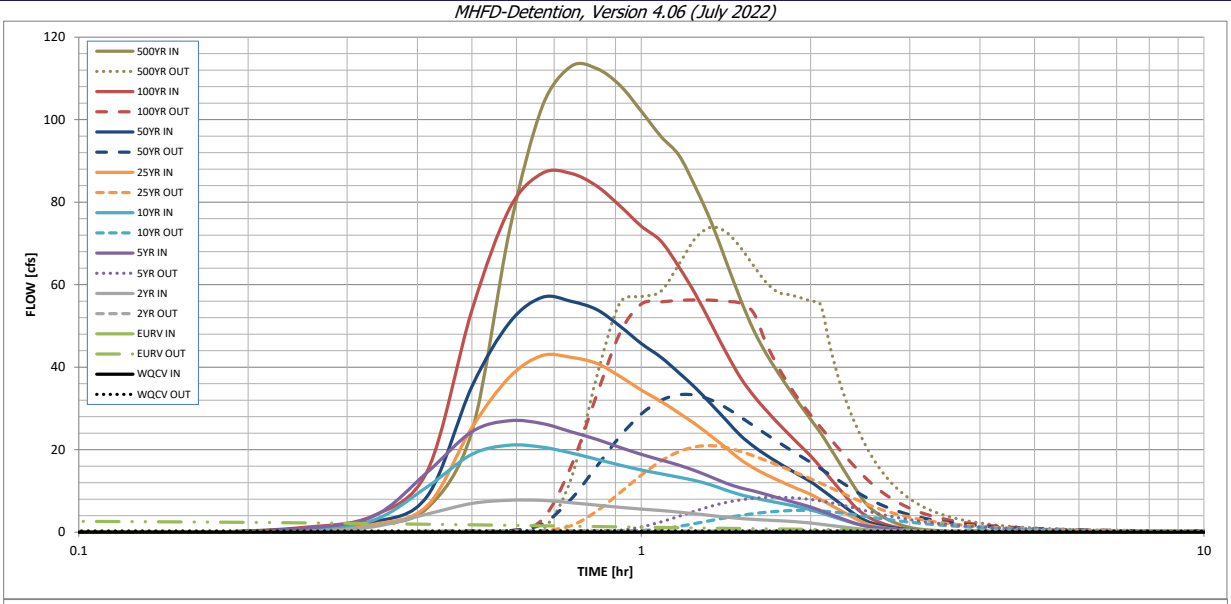
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

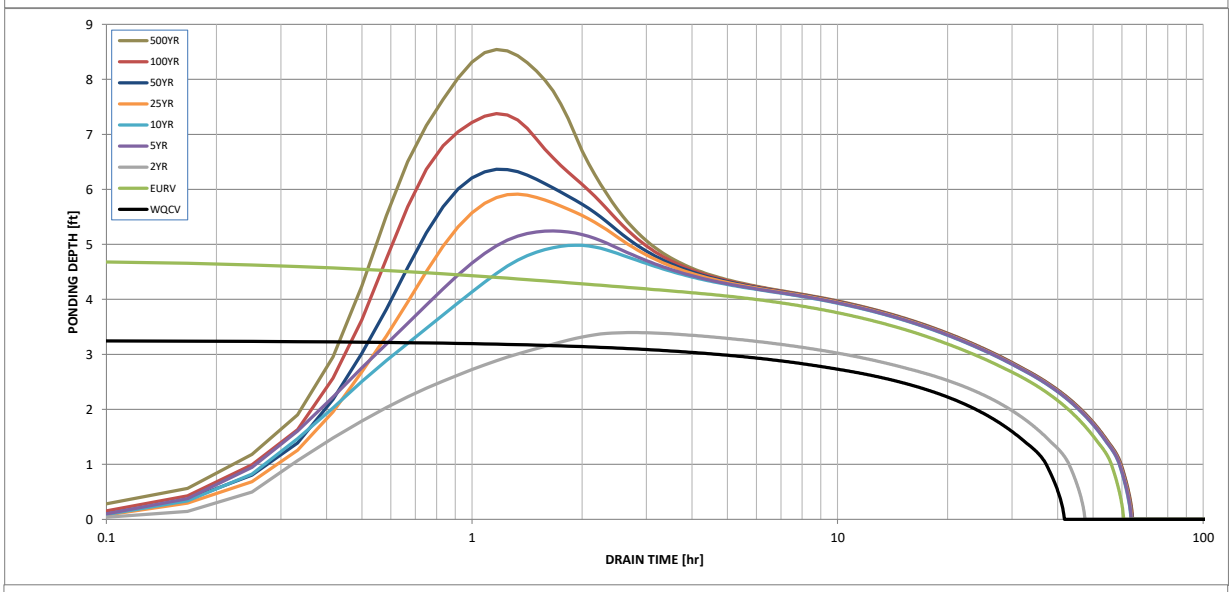
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	0.83	1.43	1.33	1.69	1.99	2.60	3.14
CUHP Runoff Volume (acre-ft) =	0.601	1.336	0.728	2.349	1.924	3.631	4.845	7.632	9.973
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.728	2.349	1.924	3.631	4.845	7.632	9.973
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.4	14.4	9.3	29.2	41.3	68.3	90.8
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.01	0.29	0.19	0.58	0.82	1.36	1.81
Peak Inflow Q (cfs) =	N/A	N/A	7.7	27.0	21.1	42.8	56.9	87.0	112.9
Peak Outflow Q (cfs) =	0.3	3.0	0.3	8.5	5.3	21.0	33.3	56.3	73.9
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.6	0.6	0.7	0.8	0.8	0.8
Structure Controlling Flow =	Plate	Overflow Weir 1	Plate	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	0.07	N/A	0.2	0.1	0.5	0.9	1.5	1.6
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	38	53	43	53	54	50	47	41	37
Time to Drain 99% of Inflow Volume (hours) =	**40**	58	46	59	59	57	56	53	51
Maximum Ponding Depth (ft) =	3.26	4.75	3.40	5.24	4.98	5.91	6.36	7.38	8.54
Area at Maximum Ponding Depth (acres) =	0.45	0.54	0.46	0.57	0.55	0.61	0.64	0.70	0.78
Maximum Volume Stored (acre-ft) =	0.605	1.339	0.664	1.609	1.464	2.003	2.283	2.959	3.827

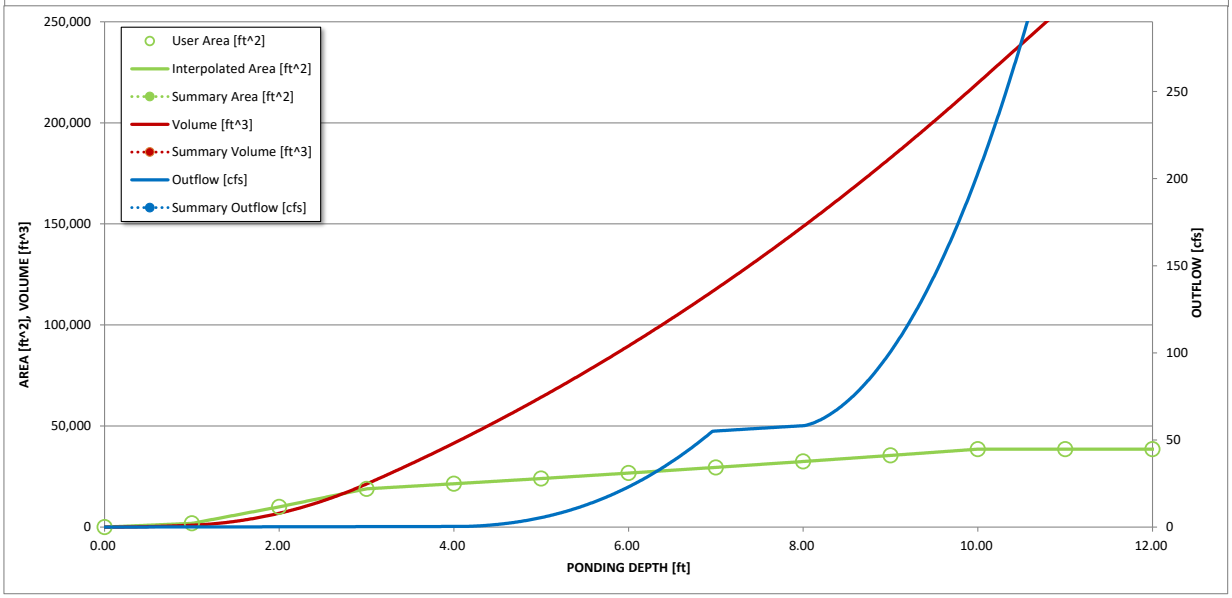
REDUCED 5 AND 100 YEAR OUTFLOWS FROM EES DESIGN

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)







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

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename:

Inflow Hydrographs

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

	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.24
	0:15:00	0.00	0.00	0.16	0.93	0.74	0.58	0.85	1.13	1.60
	0:20:00	0.00	0.00	1.31	3.81	2.86	1.88	2.42	3.95	5.87
	0:25:00	0.00	0.00	4.41	14.56	11.03	6.46	8.79	14.89	24.46
	0:30:00	0.00	0.00	6.97	24.38	18.89	25.39	35.35	53.85	73.22
	0:35:00	0.00	0.00	7.74	27.02	21.09	37.63	50.83	78.50	103.17
	0:40:00	0.00	0.00	7.71	26.33	20.60	42.82	56.93	87.00	112.92
	0:45:00	0.00	0.00	7.15	24.34	19.21	42.38	55.97	86.97	112.38
	0:50:00	0.00	0.00	6.56	22.50	17.67	40.92	53.96	83.90	108.29
	0:55:00	0.00	0.00	6.03	20.54	16.26	37.76	49.93	79.07	102.05
	1:00:00	0.00	0.00	5.60	18.87	15.08	34.44	45.72	74.17	95.95
	1:05:00	0.00	0.00	5.26	17.50	14.16	31.74	42.42	70.58	91.36
	1:10:00	0.00	0.00	4.86	16.24	13.32	28.88	38.63	64.29	83.45
	1:15:00	0.00	0.00	4.44	14.84	12.47	26.11	34.89	57.54	74.95
	1:20:00	0.00	0.00	4.03	13.32	11.41	23.20	30.92	50.28	65.45
	1:25:00	0.00	0.00	3.64	11.86	10.16	20.39	27.10	43.43	56.52
	1:30:00	0.00	0.00	3.32	10.75	9.10	17.62	23.46	37.51	49.01
	1:35:00	0.00	0.00	3.11	9.99	8.32	15.58	20.82	33.10	43.33
	1:40:00	0.00	0.00	2.94	9.15	7.70	13.96	18.70	29.57	38.69
	1:45:00	0.00	0.00	2.79	8.33	7.13	12.60	16.88	26.44	34.57
	1:50:00	0.00	0.00	2.65	7.55	6.61	11.36	15.22	23.61	30.83
	1:55:00	0.00	0.00	2.44	6.82	6.05	10.24	13.70	20.98	27.34
	2:00:00	0.00	0.00	2.22	6.09	5.45	9.17	12.24	18.50	24.06
	2:05:00	0.00	0.00	1.93	5.22	4.70	7.90	10.51	15.76	20.40
	2:10:00	0.00	0.00	1.64	4.35	3.95	6.64	8.78	13.07	16.81
	2:15:00	0.00	0.00	1.37	3.51	3.24	5.41	7.09	10.46	13.32
	2:20:00	0.00	0.00	1.11	2.73	2.58	4.23	5.50	7.97	10.03
	2:25:00	0.00	0.00	0.87	2.02	1.99	3.12	4.01	5.71	7.17
	2:30:00	0.00	0.00	0.67	1.53	1.53	2.18	2.86	4.13	5.30
	2:35:00	0.00	0.00	0.54	1.22	1.23	1.59	2.13	3.06	3.99
	2:40:00	0.00	0.00	0.44	1.00	1.01	1.19	1.62	2.28	2.98
	2:45:00	0.00	0.00	0.37	0.82	0.83	0.91	1.24	1.68	2.21
	2:50:00	0.00	0.00	0.30	0.67	0.68	0.69	0.95	1.22	1.61
	2:55:00	0.00	0.00	0.25	0.54	0.55	0.53	0.73	0.87	1.16
	3:00:00	0.00	0.00	0.21	0.43	0.44	0.41	0.56	0.64	0.85
	3:05:00	0.00	0.00	0.17	0.34	0.35	0.32	0.44	0.50	0.67
	3:10:00	0.00	0.00	0.14	0.27	0.28	0.25	0.35	0.39	0.53
	3:15:00	0.00	0.00	0.12	0.21	0.22	0.20	0.27	0.31	0.42
	3:20:00	0.00	0.00	0.09	0.16	0.17	0.15	0.21	0.25	0.33
	3:25:00	0.00	0.00	0.07	0.12	0.13	0.12	0.16	0.19	0.25
	3:30:00	0.00	0.00	0.05	0.08	0.10	0.09	0.12	0.13	0.18
	3:35:00	0.00	0.00	0.04	0.06	0.07	0.06	0.08	0.09	0.12
	3:40:00	0.00	0.00	0.03	0.04	0.05	0.04	0.05	0.06	0.07
	3:45:00	0.00	0.00	0.02	0.02	0.03	0.02	0.03	0.03	0.04
	3:50:00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	3:55:00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Summary Stage-Area-Volume-Discharge Relationships

The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.
The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

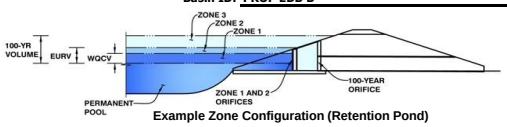
Stage - Storage Description	Stage [ft]	Area [ft^2]	Area [acres]	Volume [ft^3]	Volume [ac-ft]	Total Outflow [cfs]

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: HILLSIDE POND B

Basin ID: PROP EDB B



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB	
Watershed Area =	5.05	acres
Watershed Length =	739	ft
Watershed Length to Centroid =	431	ft
Watershed Slope =	0.060	ft/ft
Watershed Imperviousness =	51.80%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	100.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

After providing required inputs above including 1-hour rainfall depths, click 'Run CUHP' to generate runoff hydrographs using the embedded Colorado Urban Hydrograph Procedure.

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.089	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.280	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 0.83 in.) =	0.152	acre-feet		inches
5-yr Runoff Volume (P1 = 1.43 in.) =	0.334	acre-feet	1.43	inches
10-yr Runoff Volume (P1 = 1.33 in.) =	0.295	acre-feet		inches
25-yr Runoff Volume (P1 = 1.69 in.) =	0.454	acre-feet		inches
50-yr Runoff Volume (P1 = 1.99 in.) =	0.573	acre-feet		inches
100-yr Runoff Volume (P1 = 2.6 in.) =	0.838	acre-feet	2.60	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	1.064	acre-feet		inches
Approximate 2-yr Detention Volume =	0.147	acre-feet		
Approximate 5-yr Detention Volume =	0.277	acre-feet		
Approximate 10-yr Detention Volume =	0.291	acre-feet		
Approximate 25-yr Detention Volume =	0.353	acre-feet		
Approximate 50-yr Detention Volume =	0.386	acre-feet		
Approximate 100-yr Detention Volume =	0.500	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.089	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.192	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.220	acre-feet
Total Detention Basin Volume =	0.500	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	

Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	**user**	acre-feet

Depth Increment = 0.50 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)
6274.9 **Top of Micropool**	--	0.00	--	--	--	43	0.001		
6275	--	0.10	--	--	--	43	0.001	4	0.000
6275.5	--	0.60	--	--	--	461	0.011	130	0.003
6276	--	1.10	--	--	--	3,023	0.069	1,002	0.023
6276.5	--	1.60	--	--	--	4,379	0.101	2,852	0.065
6277	--	2.10	--	--	--	5,140	0.118	5,232	0.120
6277.5	--	2.60	--	--	--	5,958	0.137	8,006	0.184
6278	--	3.10	--	--	--	6,817	0.156	11,200	0.257
6278.5	--	3.60	--	--	--	7,673	0.176	14,822	0.340
6279	--	4.10	--	--	--	8,554	0.196	18,879	0.433
6279.5 - SPILLWAY	--	4.60	--	--	--	9,458	0.217	23,382	0.537
6280	--	5.10	--	--	--	10,392	0.239	28,344	0.651
6280.5	--	5.60	--	--	--	11,359	0.261	33,782	0.776
6281	--	6.10	--	--	--	12,360	0.284	39,712	0.912

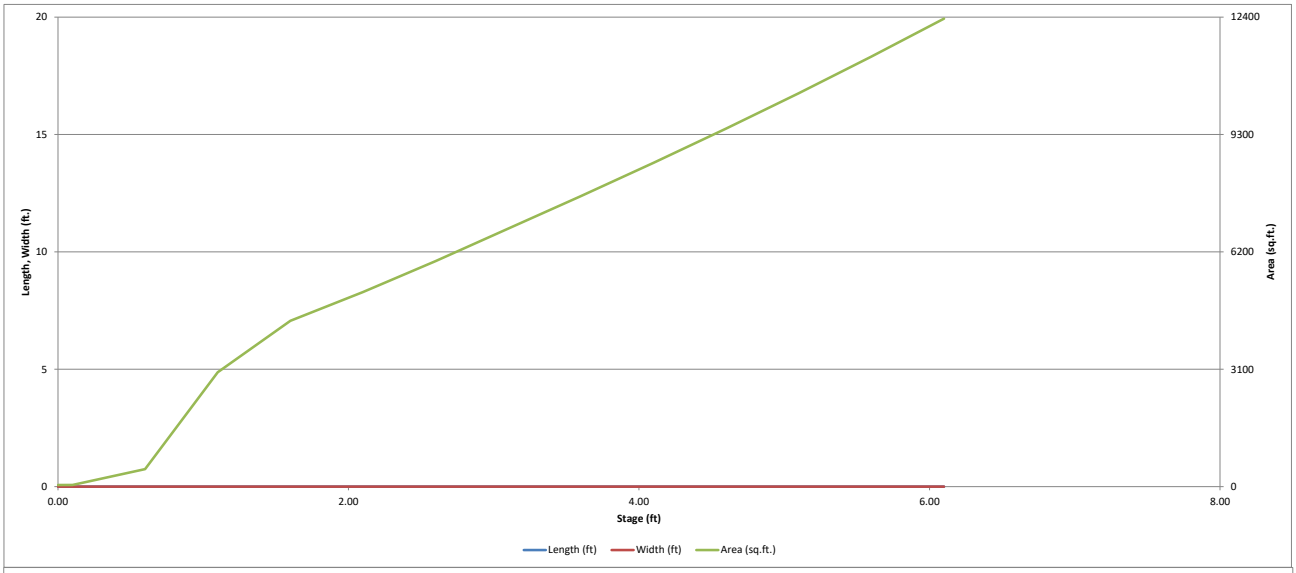
100 YEAR REQUIRED VOLUME ACHEIVED JUST BELOW SPILLWAY

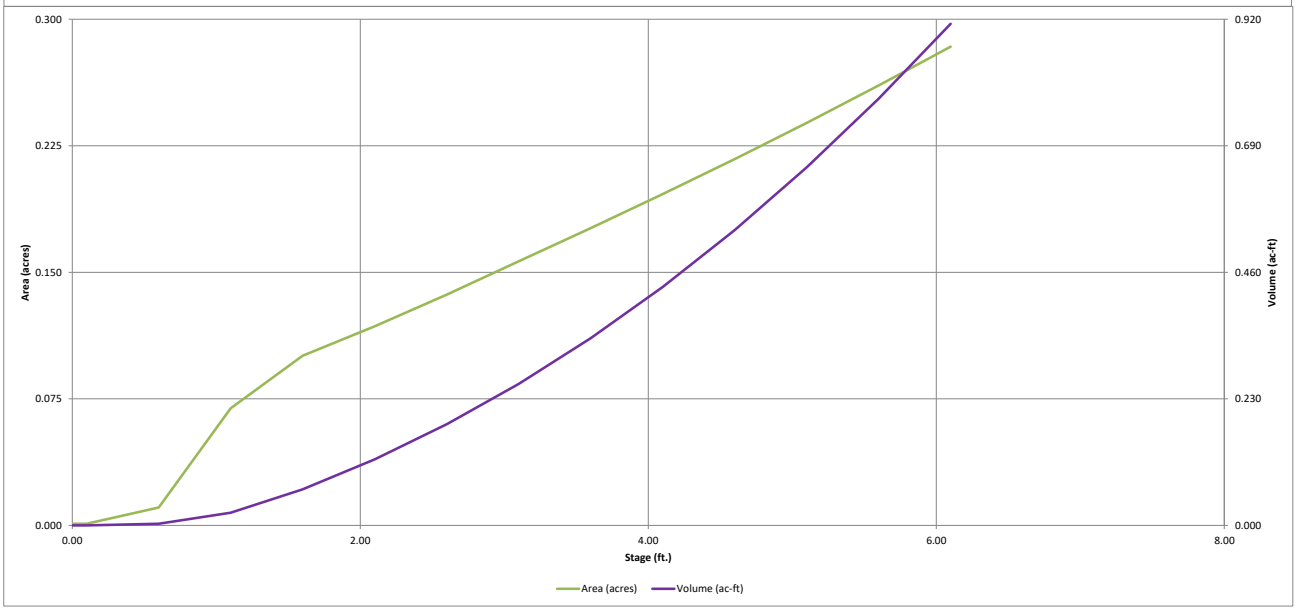
1.0 FOOT OF FREEBOARD

CUHP REQUIRED VOLUME

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)



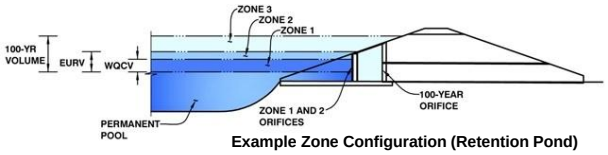


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: HILLSIDE POND B

Basin ID: PROP EDB B



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	1.83	0.089	Orifice Plate
Zone 2 (EURV)	3.25	0.192	Rectangular Orifice
Zone 3 (100-year)	4.43	0.220	Weir&Pipe (Restrict)
Total (all zones)		0.500	

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)

Centroid of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	2.708E-03	ft^2
Depth at top of Zone using Orifice Plate =	1.87	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	4.70	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	0.39	sq. inches (diameter = 11/16 inch)	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	0.62	1.25					
Orifice Area (sq. inches)	0.39	0.39	0.39					

	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)

	Zone 2 Rectangular	Not Selected			Zone 2 Rectangular	Not Selected	
Invert of Vertical Orifice =	1.83	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	0.04	N/A	ft^2
Depth at top of Zone using Vertical Orifice =	3.25	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	0.08	N/A	feet
Vertical Orifice Height =	2.00	N/A	inches				
Vertical Orifice Width =	2.99		inches				

Calculated Parameters for Vertical Orifice

User Input: Overflow Weir (Dropbox with Flat or Sloped Grate and Outlet Pipe OR Rectangular/Trapezoidal Weir and No Outlet Pipe)

	Zone 3 Weir	Not Selected			Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	3.24	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	5.18	N/A	feet
Overflow Weir Front Edge Length =	5.00	N/A	feet	Overflow Weir Slope Length =	7.99	N/A	feet
Overflow Weir Grate Slope =	4.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	43.74	N/A	
Horiz. Length of Weir Sides =	7.75	N/A	feet	Overflow Grate Open Area w/o Debris =	27.80	N/A	ft^2
Overflow Grate Type =	Type C Grate	N/A		Overflow Grate Open Area w/ Debris =	13.90	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 Restrictor	Not Selected			Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.25	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	0.64	N/A	ft^2
Outlet Pipe Diameter =	18.00	N/A	inches	Outlet Orifice Centroid =	0.34	N/A	feet
Restrictor Plate Height Above Pipe Invert =	7.00		inches	Half-Central Angle of Restrictor Plate on Pipe =	1.35	N/A	radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	4.60	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.39	feet
Spillway Crest Length =	20.00	feet	Stage at Top of Freeboard =	5.99	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	0.28	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	0.88	acre-ft

Calculated Parameters for Spillway

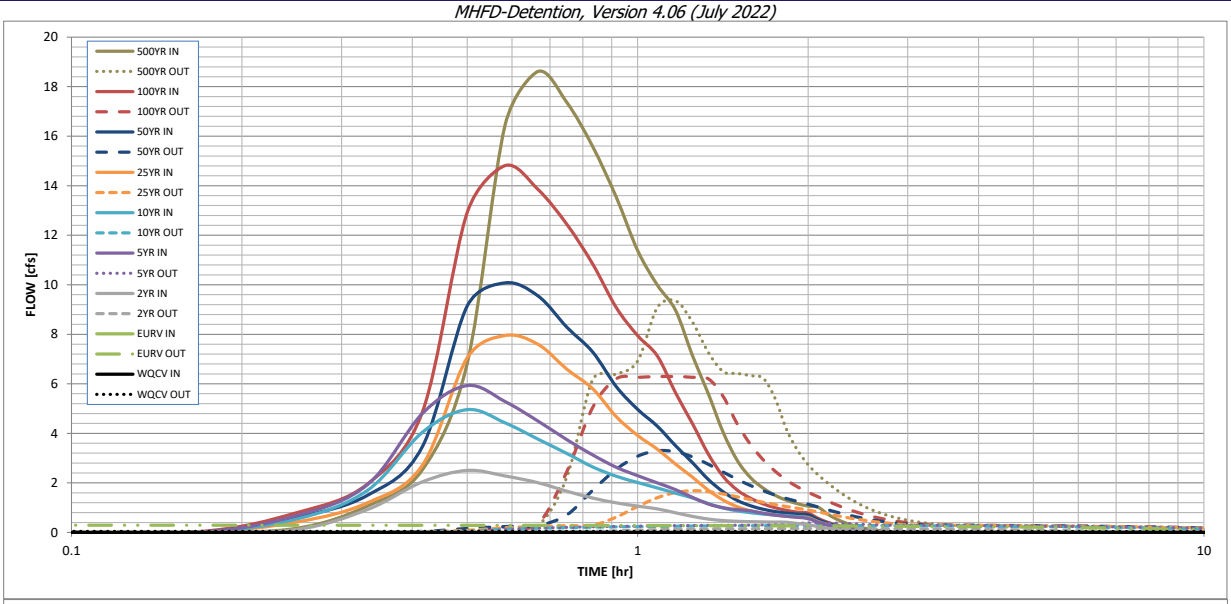
Routed Hydrograph Results

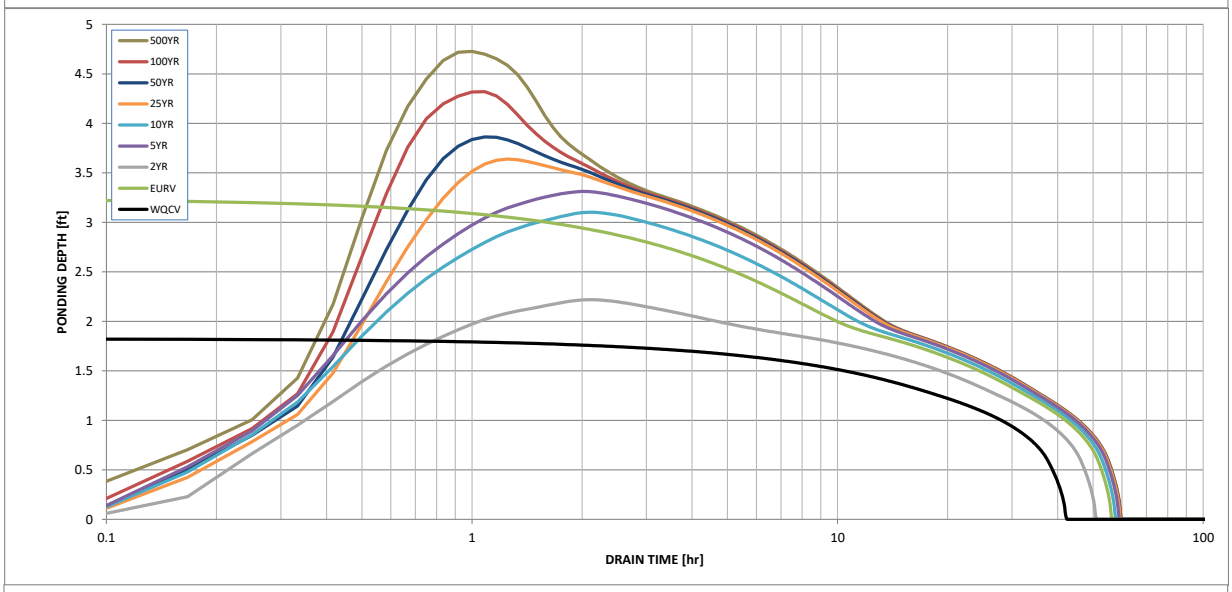
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

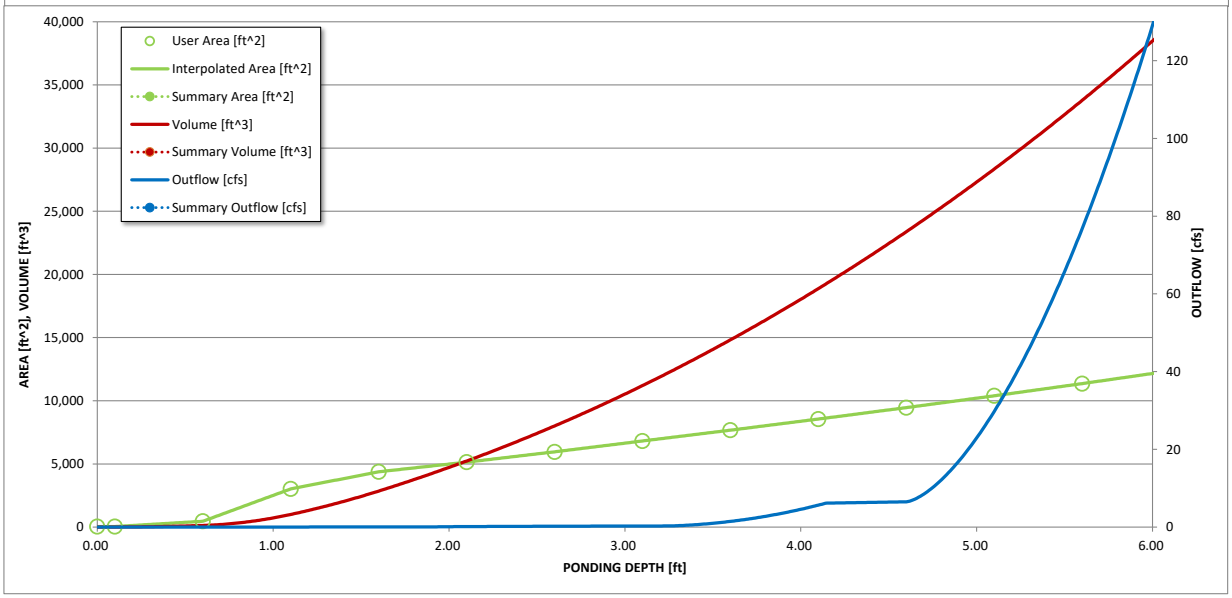
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	0.83	1.43	1.33	1.69	1.99	2.60	3.14
CUHP Runoff Volume (acre-ft) =	0.089	0.280	0.152	0.334	0.295	0.454	0.573	0.838	1.064
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.152	0.334	0.295	0.454	0.573	0.838	1.064
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.0	1.4	0.9	3.1	4.5	7.4	9.9
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.01	0.28	0.17	0.61	0.88	1.47	1.95
Peak Inflow Q (cfs) =	N/A	N/A	2.5	5.9	5.0	8.0	10.1	14.8	18.6
Peak Outflow Q (cfs) =	0.0	0.3	0.2	0.4	0.3	1.7	3.3	6.3	9.4
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.3	0.3	0.5	0.7	0.8	0.9
Structure Controlling Flow =	Plate	Overflow Weir 1	Vertical Orifice 1	Overflow Weir 1	Vertical Orifice 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	0.00	N/A	0.0	N/A	0.0	0.1	0.2	0.2
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	38	47	45	49	48	47	45	41	38
Time to Drain 99% of Inflow Volume (hours) =	**40**	52	48	54	53	53	52	51	49
Maximum Ponding Depth (ft) =	1.83	3.25	2.22	3.31	3.10	3.64	3.86	4.32	4.73
Area at Maximum Ponding Depth (acres) =	0.11	0.16	0.12	0.16	0.16	0.18	0.19	0.21	0.22
Maximum Volume Stored (acre-ft) =	0.090	0.281	0.133	0.291	0.257	0.346	0.387	0.476	0.563

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)







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

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename:

Inflow Hydrographs

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

	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.17
	0:15:00	0.00	0.00	0.12	0.68	0.54	0.42	0.61	0.80	1.07
	0:20:00	0.00	0.00	0.93	1.93	1.70	1.20	1.50	1.96	2.53
	0:25:00	0.00	0.00	2.04	4.80	4.04	2.71	3.46	4.86	6.83
	0:30:00	0.00	0.00	2.50	5.93	4.96	7.05	9.14	12.92	16.45
	0:35:00	0.00	0.00	2.28	5.28	4.42	7.95	10.08	14.81	18.61
	0:40:00	0.00	0.00	2.01	4.50	3.77	7.60	9.55	13.85	17.36
	0:45:00	0.00	0.00	1.66	3.74	3.19	6.59	8.28	12.44	15.57
	0:50:00	0.00	0.00	1.39	3.13	2.64	5.80	7.28	10.83	13.54
	0:55:00	0.00	0.00	1.19	2.63	2.27	4.67	5.89	9.08	11.38
	1:00:00	0.00	0.00	1.06	2.29	2.02	3.92	4.97	7.95	9.99
	1:05:00	0.00	0.00	0.95	2.00	1.80	3.36	4.29	7.13	8.97
	1:10:00	0.00	0.00	0.79	1.73	1.58	2.76	3.50	5.64	7.13
	1:15:00	0.00	0.00	0.65	1.41	1.39	2.23	2.81	4.39	5.59
	1:20:00	0.00	0.00	0.54	1.14	1.17	1.70	2.13	3.16	4.03
	1:25:00	0.00	0.00	0.48	1.00	0.98	1.30	1.64	2.25	2.90
	1:30:00	0.00	0.00	0.45	0.92	0.87	1.03	1.29	1.71	2.21
	1:35:00	0.00	0.00	0.43	0.87	0.80	0.87	1.08	1.38	1.79
	1:40:00	0.00	0.00	0.42	0.77	0.74	0.76	0.93	1.15	1.49
	1:45:00	0.00	0.00	0.42	0.70	0.70	0.70	0.84	1.00	1.30
	1:50:00	0.00	0.00	0.41	0.65	0.68	0.65	0.78	0.89	1.16
	1:55:00	0.00	0.00	0.36	0.61	0.64	0.62	0.74	0.82	1.06
	2:00:00	0.00	0.00	0.31	0.56	0.57	0.60	0.71	0.78	1.02
	2:05:00	0.00	0.00	0.23	0.41	0.42	0.44	0.52	0.57	0.74
	2:10:00	0.00	0.00	0.17	0.29	0.30	0.31	0.37	0.41	0.53
	2:15:00	0.00	0.00	0.12	0.21	0.21	0.22	0.26	0.29	0.38
	2:20:00	0.00	0.00	0.08	0.14	0.15	0.16	0.18	0.20	0.26
	2:25:00	0.00	0.00	0.06	0.10	0.10	0.11	0.13	0.14	0.18
	2:30:00	0.00	0.00	0.04	0.06	0.07	0.07	0.09	0.10	0.12
	2:35:00	0.00	0.00	0.02	0.04	0.04	0.05	0.06	0.06	0.08
	2:40:00	0.00	0.00	0.01	0.02	0.02	0.03	0.03	0.04	0.05
	2:45:00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.02	0.02
	2:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
	2:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Summary Stage-Area-Volume-Discharge Relationships

The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.
The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

Stage - Storage Description	Stage [ft]	Area [ft^2]	Area [acres]	Volume [ft^3]	Volume [ac-ft]	Total Outflow [cfs]

APPENDIX E
REFERENCED MATERIAL

PARAGON ENGINEERING CONSULTANTS, INC.

PHASE III DRAINAGE REPORT
Hillside at Castle Rock Phase 1 & 2

Castle Rock, Colorado

CD 16-0019

January 23, 2019
Revised February 26, 2019
Revised March 5, 2019
Revised April 3, 2019

PREPARED FOR:

Wolfensberger Property Group, LLC.
9116 W. Bowles Avenue, Suite 15
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(303) 979-9858

PREPARED BY:

PARAGON ENGINEERING CONSULTANTS, INC.
7852 South Elati Street, Suite 101
Littleton, CO, CO. 80120
(303) 794-8604

Paragon Project No. 15-005

of Wolfensberger Road. These basins will be discussed in details below to meet the TOCR SDD&TCM criteria on undetained and bypass the onsite stormwater quality.

B. Construction Phasing and Interim Runoff Conveyance

The Overall Phase II Drainage Report defines the proposed drainage patterns and drainage improvements at full buildout. The site will be developed in phases, including phased grading, utilities and streets. This report covers Phase 1 & 2 construction and also includes updated Rational and Detention Pond Calculations for Detention Pond A and its tributary basins.

C. Basin Details-Phase 1 and Phase 2

Basin ID	Design Point	C_5	C_{100}	Q_5 (cfs)	Q_{100} (cfs)
OS-1	5	0.05	0.49	1.00	17.79

Basin OS-1 consists of approximately 6.25 acres in the northwest portion of the site. The upper portion of this basin includes land owned by Castle Rock Land Company, LLC. Runoff originating from this basin will be intercepted by a 3-foot wide concrete rock mitigation and drainage channel and conveyed to D.P. 5. A temporary slope drain will convey runoff from the channel to a sedimentation basin located downstream in Basin OS-2. The sedimentation releases runoff via a perforated stand pipe or overflow spillway, depending on the magnitude of runoff, to a diversion channel which conveys runoff the Design Point 3. Runoff is then conveyed by another temporary slope drain to the north forebay of Detention Pond A. If construction of Phase 2 improvements does not begin within 2-years of construction plan approval, the temporary sedimentation basin will have to be replace with a permanent structure.

Basin ID	Design Point	C_5	C_{100}	Q_5 (cfs)	Q_{100} (cfs)
OS-2	3	0.05	0.49	2.04	36.33

Basin OS-2 consists of approximately 19.77 acres of undeveloped land in the north central portion of the site. The upper portion of this basin includes land owned by Castle Rock Land Company, LLC. This basin sheet flows in a southerly direction to Design Point 3 and will remain undeveloped in Phase 1 & 2 except for the improvements required to convey runoff from Basin OS-1 to Detention Pond A as mentioned in the Basin OS-1 description above.

Basin ID	Design Point	C_5	C_{100}	Q_5 (cfs)	Q_{100} (cfs)
OS-3	19	0.05	0.49	2.28	40.54

Basin OS-3 consists of approximately 16.05 acres in the northeastern portion of the site. The upper portion of this basin includes land owned by Castle Rock Land Company, LLC. This basin sheet flows in a southerly direction to Design Point 19 and will remain undeveloped in Phase 1 & 2.

Basin ID	Design Point	C_5	C_{100}	Q_5 (cfs)	Q_{100} (cfs)
B1	8	0.35	0.63	6.94	22.79

STATES RUNOFF WILL BYPASS POND, MAP SHOWS CONTOURS DRAINING INTO IT. APPROX 1/3.

DOESN'T MATCH MAP

Basin B1 is 6.24 acres located in the western portion of the site. Basin improvements include residential lots, the future recreation center, open space and streets. Developed runoff will be conveyed via street curb and gutter and to D.P. 8. The 5-yr and 100-yr flow rates are below street capacity. Runoff will be captured by four Triple Type 16 Combination inlets. Runoff will be then discharged to Detention Pond A through 30" RCP storm pipes. Refer to Appendix C for inlet hydraulic calculations. The four Triple Type 16 Combination inlets are on a continuous grade and are designed to capture 100% of the 5-yr storm runoff and 97% of the 100-yr storm runoff. In case of these inlets become clogged, runoff will travel to the roadside ditch along Wolfensberger Road. We will apply for a variance for the bypassed 100-yr flows.

Basin ID	Design Point	C_5	C_{100}	Q_5 (cfs)	Q_{100} (cfs)
B2	7	0.49	0.71	6.79	17.88

DOESN'T MATCH MAP

Basin B2 consists of approximately 3.42 acres of residential lots, roadway and open space. It is located in the western portion of the site and includes the lots on the north side of Grayside Circle. Developed runoff will be conveyed via street curb and gutter to D.P. 7. The 5-yr and 100-yr flow rates are below street capacity. Runoff will be captured by four Triple Type 16 Combination inlets at D.P. 7. Runoff will then be conveyed through 30" RCP storm pipes to Detention Pond A. Refer to Appendix C for inlet's hydraulic calculations. The four Triple Type 16 Combination inlets are on a continuous grade and are designed to capture 100% of the 5-yr storm runoff and 97% of the 100-yr storm runoff. In case of these inlets become clogged, runoff will travel to the roadside ditch along Wolfensberger Road. We will apply for a variance for the bypassed 100-yr flows.

Basin ID	Design Point	C_5	C_{100}	Q_5 (cfs)	Q_{100} (cfs)
B3	9	0.49	0.71	2.16	5.68

DOESN'T MATCH MAP

Basin B3 is approximately 3.33 acres consisting of open space, the backyards of future Duplex and 4-Plex Units. Developed runoff will sheet flow from the duplexes and 4-Plexs to a 1' wide concrete channel. The concrete channel protects the downstream retaining walls and conveys the runoff to Design Point 10 where it is captured by a manhole fitted with a circular domed inlet grate. The manhole is part of Storm Sewer A and conveys the runoff to Forebay A.

Basin ID	Design Point	C5	C100	Q5 (cfs)	Q100 (cfs)
B4	10	0.15	0.52	0.34	2.12

DOESN'T MATCH MAP

Basin B4 is approximately 0.46 acres consisting of open space, the backyards of future Duplex and 4-Plex Units. Developed runoff will sheet flow from the duplexes and 4-Plexs to a 1' wide concrete channel. The concrete channel protects the downstream retaining walls and conveys the runoff to Design Point 10 where it is captured by a manhole fitted with a circular domed inlet grate. The manhole is part of Storm Sewer A and conveys the runoff to Forebay A.

.

Basin ID	Design Point	C_5	C_{100}	Q_5 (cfs)	Q_{100} (cfs)
B5	20	0.32	0.62	1.38	4.82

Basin B5 consists of approximately 1.08 acres of Walkout Duplex Units, open space and landscape areas. Developed runoff will be conveyed via 1-foot wide concrete trickle channel running along the back of Walkout Duplex Units to D.P. 20 where a Type C area inlet intercepts flows and conveys them to Detention Pond A through Storm Sewer System B. Refer to Appendix C for concrete trickle channel and inlet hydraulic calculations.

Basin ID	Design Point	C_5	C_{100}	Q_5 (cfs)	Q_{100} (cfs)
B6	11	0.01	0.44	0.09	7.19

DOESN'T MATCH MAP

Basin B6 consists of approximately 2.56 acres of open space and landscape areas and includes the West Detention Pond A. Developed runoff will sheet flow to the pond bottom where it will be picked up by the low flow channel and conveyed to the detention pond outlet structure at Design Point 11.

Basin ID	Design Point	C_5	C_{100}	Q_5 (cfs)	Q_{100} (cfs)
D1	14	0.21	0.55	1.40	6.77

Basin D1 consists of approximately 1.61 acres of open space and Walkout Fourplex Units for the onsite and 0.11 acres of paved area for the offsite. Developed runoff will sheet flow to the improved roadside ditch along Wolfensberger Road. The onsite runoff will be released undetained due to grading constraints. Onsite flows will then continue in the roadside ditch and intercepted by an existing 42"x29" CMP roadway culvert at D.P. 14 along with approximately 58 cfs of existing offsite runoff (See excerpts from Castle Highlands Filing No. 2 Phase III Drainage Study, by JR Engineering, 8/2001 in Appendix D). The culvert conveys stormwater south across Wolfensberger Road and ultimately to the existing Omni channel located approximately 1000 feet to the south. The undetained runoff is not allowed to be released undetained, therefore, we will apply for a variance for the bypassed 100-yr flows.

Basin ID	Design Point	C_5	C_{100}	Q_5 (cfs)	Q_{100} (cfs)
D2	15	0.17	0.53	0.87	4.85

Basin D2 consists of approximately 1.34 acres of open spaces for the onsite and paved area for the offsite. Developed runoff sheet flows to the improved roadside ditch along Wolfensberger Road. The onsite runoff will be release undetained due to grading constraints. This runoff will be intercepted by a 24" FES (D.P. 15) that connected to an existing 24" CMP storm pipe and ultimately to the existing Omni Tributary located approximately 1000 feet to the south. The undetained runoff is not allowed to be released undetained, therefore, we will apply for a variance

for the bypassed 100-yr flows.

Basin ID	Design Point	C_5	C_{100}	Q_5 (cfs)	Q_{100} (cfs)
D3	16	0.35	0.62	0.55	1.75

Basin D3 consists of approximately 0.34 acres of open space and paved areas. This is an offsite basin. Developed runoff will be captured by a Type C inlet (D.P. 16) and conveyed to Detention Pond A for water quality and detention through the proposed storm sewer system.

Basin ID	Design Point	C_5	C_{100}	Q_5 (cfs)	Q_{100} (cfs)
D4	17	0.86	0.89	0.50	0.94

Basin D4 consists of approximately 0.12 acres of paved area, at the entrance of Grayside Circle. Due to grading constraints, developed runoff will be released undetained from the site to the proposed roadside ditch along the north side of Wolfensberger Road for water quality treatment. The undetained runoff is not allowed to be released undetained, therefore, we will apply for a variance for the bypassed 100-yr flows.

Basin ID	Design Point	C_5	C_{100}	Q_5 (cfs)	Q_{100} (cfs)
D5	18	0.23	0.56	0.82	3.56

Basin D5 consists of approximately 1.0 acres of road pavement, concrete public trail and roadside ditch east of the entrance of Grayside Circle. This basin is located in the Wolfensberger right-of-way, developed runoff will be released undetained to the proposed roadside ditch along the north side of Wolfensberger Road for water quality treatment.

In addition, the table below summaries basins that are discharged:

Treated & Untreated Basin Analysis Data Table

Basin ID	Total Untreated Area (ac)	Total Area (ac)
D1	1.61	
D2	1.34	
D4	0.12	
TOTAL	3.07	50.17

SEE JR RATIONAL CALCS FOR EXISTING POND A TRIBUTARY AREA

The total percent of untreated area 6.1%. The allowable undetained release per the TOCR and the Stormwater Discharges Associated with Municipal Separate Storm Sewer Systems (MS4s) is zero cfs, therefore, we will apply for a variance for the undetained runoff.

D. Stormwater Storage Facilities

The proposed Phase 1 & 2 improvements will utilize one of the proposed two extended detention

ponds. Detention Pond A has been redesigned based on current UDFCD and Town of Castle Rock design manuals.

Pond A is located east of the westerly entrance ant t d at full buildout, will process flows from Major Basin A, B, D3, OS-1 and OS-2. Please note that Basin A, is outside the limits of the Phase 1 & 2 Construction Plans. Detention Pond A is not being phased but designed and constructed for full buildout. In order to not disturb the pond during future phase construction, a Forebay and the last run of Storm Sewer A, which will be plugged, are being built with Phase 1 & 2 construction. This means that the plugged Storm Sewer A and Forebay will not be functional. It also means that Detention Pond A is over sized for Phase 1 & 2 improvements. Detention and water quality Pond A improvements consist of a two concrete forebays, 2-foot wide concrete low flow channel, 117 sf, 2.5-feet deep integrated micro-pool, two 12-foot wide gravel maintenance roads with working benches, EURV and 100-yr outlet structure, and 12-foot wide access road on top of the embankment.

At full buildout, total routed flows from the above basins contribute to this pond is 99.9 cfs for 100-year storm event. The WQCV is 0.501 as-ft; EURV capture volume is 0.487 ac-ft and 100-yr plus water quality control volume is 3.271 ac-ft. The EURV release time is 59 hours and the 100-year release rate is 66.1 cfs which is 88% of the allowable release rate. An outfall pipe, 30" RCP storm sewer, conveys runoff to existing roadside ditch located east of the site and ultimately to existing Omni open channel. A 20-foot wide emergency overflow spillway is also designed to convey runoff to the roadside ditch on Wolfensberger Road. As mentioned above, this roadside ditch is designed and improved to have enough capacity to convey flows from emergency spillway of Pond A in case the outlet structure becomes clogged. Refer to Appendix C for hydraulic calculations.

DOESNT MATCH UD-DETENTION IN THIS SAME PARAGON REPORT

According to the Colorado Revised Statute 37-92-602(8) pertaining Stormwater Detention and Infiltration Facilities, the Detention Pond A is designed to continuously release or infiltrate at least 97% of all of the runoff from a rainfall event that is less than or equal to a 5-year storm within 72 hours after the end of the event; and continuous release or infiltrate as quickly as practical, but in all cases, releases or infiltrates at least 99% of the runoff within 120 hours after the end of events greater than a 5-year storm.

E. Water Quality Enhancement Best Management Practices

Non-structural practices are those practices which when implemented will minimize erosion and sediment transport. These practices include interim and permanent practices and include, but are not limited to: maintaining existing permanent vegetation, mulching, surface roughening, and vegetative buffer strips. Existing and proposed roadside ditches offsite will be improved for better stormwater quality when Wolfensberger Road is improved.

F. Floodplain Modifications

There are no major and minor drainage ways, existing irrigation canals or ditches within the limits of the site and it does not lie within a designated floodplain as shown on FEMA FIRM Map 08035C0169G revised March 16, 2016, included in Appendix A. There are no proposed floodplain modifications.

MHFD IMPERVIOUS VALUES UPDATED MARCH 2024.

JR PERFORMED RATIONAL CALCS FOR PARAGON SUB-BASIN DELINEATIONS DUE TO THIS CHANGE IN CRITERIA

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RUNOFF COEFFICIENTS - DEVELOPED

PHASE III DRAINAGE REPORT FOR HILLSIDE PHASE 1 AND 2 CONSTRUCTION

PROJECT NAME: Hillside at Castle Rock - Phase 1 & 2
PROJECT NUMBER: 15-005
CALCULATED BY: TWD
CHECKED BY: TWD

DATE: April 2, 2019

	Type D Soils	Type B Soils			Type B Soil	Type D Soil
	Historic / Open Space	M.F. Detached	Tract / Open Space	M.F. Attached	Streets	Streets
Land Use	Area	Area	Area	Area	Area	Area
2-Yr Coeff.	0.01	0.46	0.01	0.60	0.84	0.83
5-YEAR Coeff.	0.05	0.49	0.01	0.63	0.86	0.85
100-YEAR Coeff.	0.49	0.71	0.44	0.78	0.89	0.89
Impervious	2%	60%	2%	75%	100%	100%

Note: Runoff coefficients shown were obtained from UDFCD Table 6-3 and 6-5

Design Basin	Design Point	Historic / Open Space Area (AC)	M.F. Detached Area (AC)	Tract / Open Space Area (AC)	M.F. Attached Area (AC)	Streets Area (AC)	Streets Area (AC)	Area (AC)	CC_2	CC_5	CC_{100}	% Imp.
B1	8		4.42	1.83				**6.25**	0.33	0.35	0.63	43%
B2	7		3.42					**3.42**	0.46	0.49	0.71	60%
B3	9		0.33					**0.33**	0.46	0.49	0.71	60%
B4	10		0.10	0.33				**0.43**	0.11	0.15	0.52	15%
B5	20		0.70	0.38				**1.08**	0.30	0.32	0.62	40%
B6	11			2.58				**2.58**	0.01	0.01	0.44	2%
SUBTOTAL FOR BASIN B		**0.00**	**8.97**	**5.12**	**0.00**	**0.00**	**0.00**	**14.09**	0.30	0.32	0.61	39%
		0.0%	**63.6%**	**36.4%**	**0.0%**	**0.0%**	**0.0%**	**100%**				
D1	14		0.45	1.04		0.11		**1.61**	0.20	0.21	0.55	25%
D2	15			1.09		0.25		**1.34**	0.17	0.17	0.53	21%
D3	16			0.20		0.14		**0.34**	0.35	0.35	0.62	42%
D4	17					0.12		**0.12**	0.84	0.86	0.89	100%
D5	18			0.74		0.26		**1.00**	0.23	0.23	0.56	28%
SUBTOTAL FOR BASIN D		**0.00**	**0.45**	**3.07**	**0.00**	**0.89**	**0.00**	**4.41**	0.22	0.23	0.56	28%
		0.0%	**10.3%**	**69.5%**	**0.0%**	**20.2%**	**0.0%**	**100%**				
OS-1	5	6.25						**6.25**	0.01	0.05	0.49	2%
OS-1 WQ		6.12						**6.14**	0.01	0.05	0.49	1.99%
OS-2	3	19.77						**19.77**	0.01	0.05	0.49	2%
OS-3	19	16.05						**16.05**	0.01	0.05	0.49	2%
SUBTOTAL FOR BASIN OS		**16.05**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**48.21**	0.00	0.02	0.16	1%
		33.3%	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**33%**				
TOTAL STUDY AREA		**16.05**	**9.42**	**8.19**	**0.00**	**0.89**	**0.00**	**66.71**	**0.08**	**0.09**	**0.28**	**10.5%**
		24.1%	**14.1%**	**12.3%**	**0.0%**	**1.3%**	**0.0%**	**51.8%**				

SUBTRACT OS-1 WQ FROM TOTAL AND ITS APPROX EQUAL TO OUR TOTAL STUDY AREA. NO OTHER MENTION OF OS-1 WQ ANYWHERE TO BE ABLE TO REASON WHAT THAT AREA IS DOING, FEELS LIKE DOUBLE COUNTED AREA

60.59 (THIS TABLE) VS 60.70 (JR CALCULATIONS)

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STANDARD FORM SF-3 - DEVELOPED
STORM DRAINAGE DESIGN - RATIONAL METHOD 5-YEAR EVENT

PHASE III DRAINAGE REPORT FOR HILLSIDE PHASE 1 AND 2 CONSTRUCTION

PROJECT NAME: Hillside at Castle Rock - Phase 1 & 2
PROJECT NUMBER: 15-005
CALCULATED BY: TWD
CHECKED BY: TWD

DATE: April 2, 2019

P_1 (1-Hour Rainfall) = 1.43

STORM LINE	DESIGN POINT	DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			REMARKS
		DESIGN BASIN	AREA (AC)	RUNOFF COEFF C_5	tc (min)	C*A(ac)	I (in/hr)	Q (cfs)	tc(min)	∑(C*A) (ac)	I (in/hr)	Q (cfs)	SLOPE (%)	STREET FLOW(cfs)	DESIGN FLOW(cfs)	SLOPE (%)	PIPE SIZE (in)	LENGTH (ft)	VELOCITY (fps)	tt (min)	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
	1	OS-2	19.77	0.05	34.5	0.99	2.06	2.04	34.5	1.30	2.06	2.7									
	5	OS-1	6.25	0.05	15.5	0.31	3.19	1.00													
Inlet B1	7	B1	6.25	0.35	15.7	2.18	3.18	6.94													
B1+B5+D3	7	B1	6.25	0.35	15.7	2.18	3.18	6.94	15.7	2.65	3.18	8.4									
B1+B2+B5+D3	8	B2	3.42	0.49	8.9	1.68	4.05	6.79	15.7	4.32	3.18	13.7									
	9	B3	0.33	0.49	7.6	0.16	4.27	0.69													
		B4	0.43	0.15	5.0	0.06	4.85	0.31	7.6	0.23	4.27	1.0									
D3+B5	20	B5	1.08	0.32	9.2	0.35	3.99	1.38	9.2	0.47	3.99	1.9									
		B6	2.58	0.01	12.6	0.03	3.51	0.09													West Pond
	19	OS-3	16.05	0.05	19.7	0.80	2.84	2.28													
	14	D1	1.61	0.21	7.9	0.33	4.22	1.40													
	15	D2	1.34	0.17	10.5	0.23	3.79	0.87													
	16	D3	0.34	0.35	6.3	0.12	4.55	0.55													Discharge offsite
	17	D4	0.12	0.86	5.0	0.10	4.85	0.50													Discharge offsite
	18	D5	1.00	0.23	12.7	0.23	3.50	0.82													To inlet then to Pond A
																					Dischrage offsite

RUNOFF CALCULATED BY OTHERS FROM EXISTING SUB-BASIN B1

SUM FROM DP INTO POND A

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STANDARD FORM SF-3 - DEVELOPED
STORM DRAINAGE DESIGN - RATIONAL METHOD 100-YEAR EVENT

PHASE III DRAINAGE REPORT FOR HILLSIDE PHASE 1 AND 2 CONSTRUCTION

PROJECT NAME: Hillside at Castle Rock - Phase 1 & 2
PROJECT NUMBER: 15-005
CALCULATED BY: TWD
CHECKED BY: TWD

DATE: April 2, 2019

P_1 (1-Hour Rainfall) = 2.60

STORM LINE	DESIGN POINT	DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			REMARKS
		DESIGN BASIN	AREA (AC)	RUNOFF COEFF C_{100}	tc (min)	C*A(ac)	I (in/hr)	Q (cfs)	tc(min)	∑(C*A) (ac)	I (in/hr)	Q (cfs)	SLOPE (%)	STREET FLOW(cfs)	DESIGN FLOW(cfs)	SLOPE (%)	PIPE SIZE (in)	LENGTH (ft)	VELOCITY (fps)	tt (min)	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
	1	OS-2	19.77	0.49	34.5	9.69	3.75	36.33	34.5	12.75	3.75	47.8									
	5	OS-1	6.25	0.49	15.5	3.06	5.81	17.79													
Inlet B1	8	B1	6.25	0.63	15.7	3.94	5.78	22.79													
Pipe B1+B5+D3	8	B1	6.25	0.63	15.7	3.94	5.78	22.79	15.7	4.82	5.78	27.8									
Pipe B1+B2+B5+D3	7	B2	3.42	0.71	8.9	2.43	7.36	17.88	15.7	7.25	5.78	41.9									
	9	B3	0.33	0.71	7.6	0.23	7.77	1.82													
B3+B4		B4	0.43	0.52	5.0	0.22	8.82	1.97	7.6	0.46	7.77	3.6									
Pipe D3+B5	20	B5	1.08	0.62	9.2	0.66	7.25	4.82	9.2	0.88	7.25	6.3									
		B6	2.58	0.44	12.6	1.14	6.38	7.25													
	19	OS-3	16.05	0.49	19.7	7.86	5.16	40.54													
	14	D1	1.61	0.55	7.9	0.88	7.67	6.77													
	15	D2	1.34	0.53	10.5	0.70	6.89	4.85													
	16	D3	0.34	0.62	6.3	0.21	8.27	1.75													Discharge offsite
	17	D4	0.12	0.89	5.0	0.11	8.82	0.94													Discharge offsite
	18	D5	1.00	0.56	12.7	0.56	6.37	3.56													To inlet then to Pond A
																					Dischrage offsite

RUNOFF CALCULATED BY OTHERS FROM EXISTING SUB-BASIN B1

SUM FROM DP INTO POND A

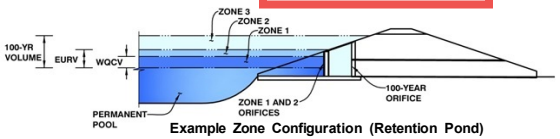
PARAGON POND A DESIGN SHEETS FOR REFERENCE

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: Hillside at Castle Rock

Basin ID West Detention Pond A - Full Buildout



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	EDB	
Watershed Area =	45.63	acres
Watershed Length =	1,949	ft
Watershed Slope =	0.080	ft/ft
Watershed Imperviousness =	26.00%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	47.0%	percent
Percentage Hydrologic Soil Groups C/D =	53.0%	percent
Desired WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	
Water Quality Capture Volume (WQCV) =	0.526	acre-feet
Excess Urban Runoff Volume (EURV) =	1.130	acre-feet
2-yr Runoff Volume (P1 = 1.06 in.) =	0.838	acre-feet
5-yr Runoff Volume (P1 = 1.43 in.) =	1.428	acre-feet
10-yr Runoff Volume (P1 = 1.66 in.) =	2.171	acre-feet
25-yr Runoff Volume (P1 = 2.07 in.) =	4.023	acre-feet
50-yr Runoff Volume (P1 = 2.26 in.) =	4.990	acre-feet
100-yr Runoff Volume (P1 = 2.6 in.) =	6.562	acre-feet
500-yr Runoff Volume (P1 = 3.71 in.) =	10.719	acre-feet
Approximate 2-yr Detention Volume =	0.784	acre-feet
Approximate 5-yr Detention Volume =	1.346	acre-feet
Approximate 10-yr Detention Volume =	1.754	acre-feet
Approximate 25-yr Detention Volume =	2.220	acre-feet
Approximate 50-yr Detention Volume =	2.264	acre-feet
Approximate 100-yr Detention Volume =	2.847	acre-feet

Optional User Override 1-hr Precipitation	
1.06	inches
1.43	inches
1.66	inches
2.07	inches
2.26	inches
2.60	inches
3.71	inches

Stage-Storage Calculation

Zone 1 Volume (WQCV) =	0.526	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.604	acre-feet
Zone 3 Volume (User Defined - Zones 1 & 2) =	2.243	acre-feet
Total Detention Basin Volume =	3.373	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	

Depth Increment = 1 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	--	--	--	0	0.000		
	--	1.00	--	--	--	1,846	0.042	905	0.021
	--	2.00	--	--	--	10,022	0.230	6,757	0.155
	--	3.00	--	--	--	18,940	0.435	21,338	0.490
	--	4.00	--	--	--	21,439	0.492	41,527	0.953
	--	5.00	--	--	--	24,016	0.551	64,255	1.475
	--	6.00	--	--	--	26,723	0.613	89,624	2.057
	--	7.00	--	--	--	29,538	0.678	117,755	2.703
	--	8.00	--	--	--	32,449	0.745	148,748	3.415
	--	9.00	--	--	--	35,454	0.814	182,700	4.194
	--	10.00	--	--	--	38,651	0.887	219,752	5.045
	--	11.00	--	--	--	38,651	0.887	258,403	5.932
	--	12.00	--	--	--	38,651	0.887	297,054	6.819
	--	13.00	--	--	--	38,651	0.887	335,705	7.707
	--		--	--	--				
	--		--	--	--				
	--		--	--	--			

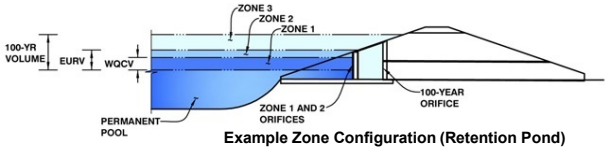
PARAGON POND A DESIGN SHEETS FOR REFERENCE

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: Hillside

Basin ID: West Detention Pond A



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.09	0.526	Orifice Plate
Zone 2 (EURV)	4.36	0.604	Orifice Plate
Zone 3 (User)	7.95	2.243	Weir&Pipe (Restrict)
		3.373	Total

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

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

Calculated Parameters for Underdrain

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

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

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	4.08	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	16.30	inches
Orifice Plate: Orifice Area per Row =	2.08	sq. inches (diameter = 1-5/8 inches)

Calculated Parameters for Plate

WQ Orifice Area per Row =	1.444E-02	ft^2
Elliptical Half-Width =	N/A	feet
Elliptical Slot Centroid =	N/A	feet
Elliptical Slot Area =	N/A	ft^2

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	1.36	2.72					
Orifice Area (sq. inches)	2.08	2.08	2.08					

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

User Input: Vertical Orifice (Circular or Rectangular)

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

Calculated Parameters for Vertical Orifice

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

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

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	4.10	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	4.00	N/A	feet
Overflow Weir Slope =	4.00	N/A	H:V (enter zero for flat grate)
Horiz. Length of Weir Sides =	13.00	N/A	feet
Overflow Grate Open Area % =	70%	N/A	%, grate open area/total area
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	7.35	N/A	feet
Over Flow Weir Slope Length =	13.40	N/A	feet
Grate Open Area / 100-yr Orifice Area =	9.73	N/A	should be ≥ 4
Overflow Grate Open Area w/o Debris =	37.52	N/A	ft^2
Overflow Grate Open Area w/ Debris =	18.76	N/A	ft^2

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

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	2.83	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	30.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	22.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	3.86	N/A	ft^2
Outlet Orifice Centroid =	1.02	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	2.06	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	8.00	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	10.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

Spillway Design Flow Depth=	1.87	feet
Stage at Top of Freeboard =	10.87	feet
Basin Area at Top of Freeboard =	0.89	acres

Routed Hydrograph Results

Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.06	1.43	1.66	2.07	2.26	2.60	3.71
Calculated Runoff Volume (acre-ft) =	0.526	1.130	0.838	1.428	2.171	4.023	4.990	6.562	10.719
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.526	1.130	0.838	1.429	2.173	4.026	4.995	6.567	10.723
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.01	0.08	0.30	0.87	1.13	1.53	2.55
Predevelopment Peak Q (cfs) =	0.0	0.0	0.6	3.8	13.8	39.5	51.6	69.7	116.4
Peak Inflow Q (cfs) =	10.3	21.9	16.3	27.6	41.7	76.6	94.6	123.6	199.0
Peak Outflow Q (cfs) =	0.2	0.7	0.3	3.3	13.4	42.7	53.1	56.8	125.6
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.9	1.0	1.1	1.0	0.8	1.1
Structure Controlling Flow =	Plate	Overflow Grate 1	Plate	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Outlet Plate 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	0.01	N/A	0.1	0.3	1.1	1.4	1.5	1.6
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) =	39	58	51	58	56	51	48	45	36
Time to Drain 99% of Inflow Volume (hours) =	**41**	62	54	63	62	59	58	56	52
Maximum Ponding Depth (ft) =	3.01	4.23	3.68	4.57	5.14	5.97	6.36	7.55	9.31
Area at Maximum Ponding Depth (acres) =	0.44	0.51	0.47	0.53	0.56	0.61	0.64	0.71	0.84
Maximum Volume Stored (acre-ft) =	0.494	1.068	0.794	1.238	1.553	2.033	2.283	3.079	4.442

APPROVED RELEASE RATE USED, MISMATCH TO NARRATIVE

Version 4.05 Released March 2017

INLET MANAGEMENT

Worksheet Protected

DP-8

INLET NAME	INLET B1A	INLET B1B	INLET B1C	INLET B1D
Site Type (Urban or Rural)	URBAN	URBAN	URBAN	URBAN
Inlet Application (Street or Area)	STREET	STREET	STREET	STREET
Hydraulic Condition	On Grade	On Grade	On Grade	On Grade
Inlet Type	Denver No. 16 Combination	Denver No. 16 Combination	Denver No. 16 Combination	Denver No. 16 Combination

USER-DEFINED INPUT

User-Defined Design Flows

Minor Q_{Known} (cfs)	6.9	0.0	0.0	0.0
Major Q_{Known} (cfs)	22.8	0.0	0.0	0.0

Bypass (Carry-Over) Flow from Upstream

Receive Bypass Flow from:	No Bypass Flow Received	INLET B1A	INLET B1B	INLET B1C
Minor Bypass Flow Received, Q_b (cfs)	0.0	2.6	0.4	0.1
Major Bypass Flow Received, Q_b (cfs)	0.0	13.8	7.1	4.6

Watershed Characteristics

Subcatchment Area (acres)				
Percent Impervious				
NRCS Soil Type				

Watershed Profile

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

Minor Storm Rainfall Input

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

Major Storm Rainfall Input

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

CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	**6.9**	**2.6**	**0.4**	**0.1**
Major Total Design Peak Flow, Q (cfs)	**22.8**	**13.8**	**7.1**	**4.6**
Minor Flow Bypassed Downstream, Q_b (cfs)	2.6	0.4	0.1	0.0
Major Flow Bypassed Downstream, Q_b (cfs)	13.8	7.1	4.6	1.3

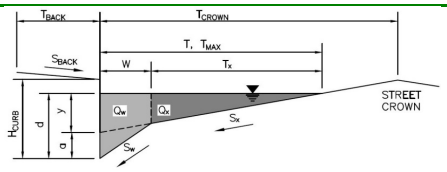
Version 4.05 Released March 2017

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

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

Project: Hillside at Castle Rock

Inlet ID: INLET B1A



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	0.0	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} =	20.8	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} =	20.8	20.8	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	8.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

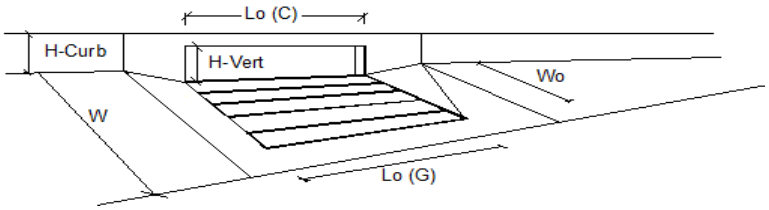
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**16.3**	**33.2**	**cfs**

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

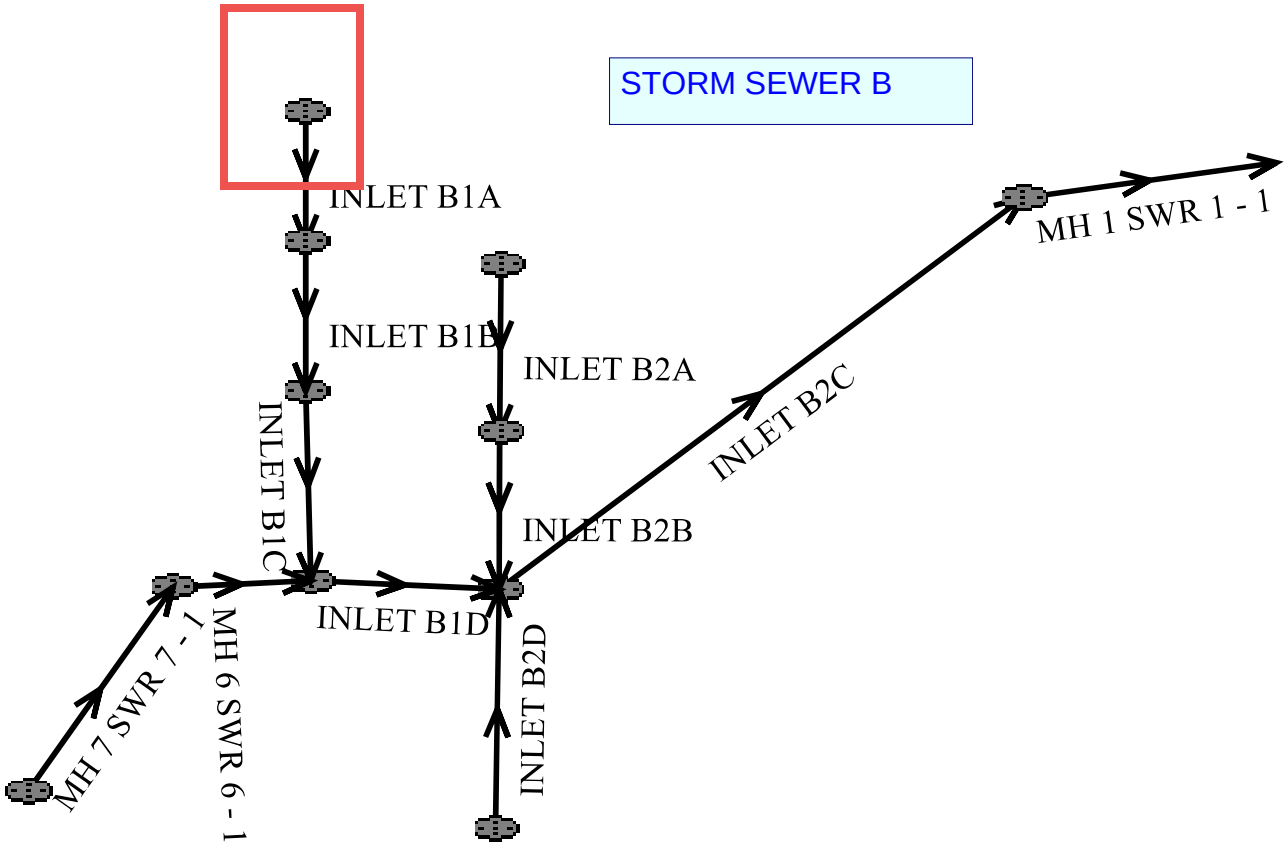
Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

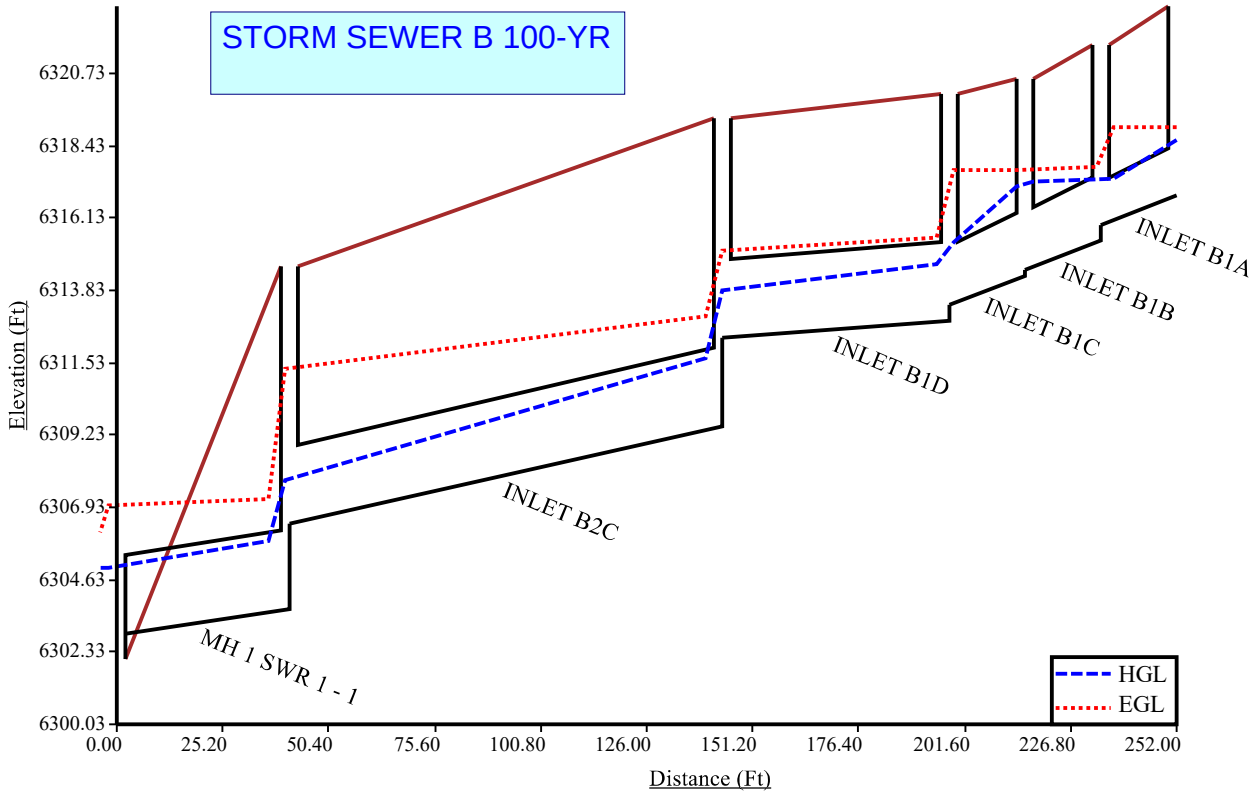
INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	Denver No. 16 Combination		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	2.0	2.0	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 =	3.00	3.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	1.73	1.73	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	0.50	0.50	
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	
Design Discharge for Half of Street (from Sheet *Inlet Management*)	**Q_o =**	**6.9**	**22.8**	cfs
Water Spread Width	T =	10.5	17.4	ft
Water Depth at Flowline (outside of local depression)	d =	4.0	5.7	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.0	inches
Ratio of Gutter Flow to Design Flow	E_o =	0.555	0.344	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	3.1	15.0	cfs
Discharge within the Gutter Section W	Q_w =	3.8	7.8	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.51	0.78	sq ft
Velocity within the Gutter Section W	V_W =	7.6	10.1	fps
Water Depth for Design Condition	d_{LOCAL} =	6.0	7.7	inches
Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	9.00	9.00	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	0.512	0.311	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	3.53	3.53	fps
Interception Rate of Frontal Flow	R_f =	0.81	0.66	
Interception Rate of Side Flow	R_x =	0.48	0.37	
Interception Capacity	Q_i =	4.5	10.5	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoef =	1.75	1.75	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	0.29	0.29	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	6.38	6.38	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	2.97	2.97	fps
Interception Rate of Frontal Flow	R_f =	0.76	0.61	
Interception Rate of Side Flow	R_x =	0.29	0.21	
Actual Interception Capacity	**Q_a =**	**3.7**	**7.6**	cfs
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**3.3**	**15.2**	cfs
Curb or Slotted Inlet Opening Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e (based on grate carry-over)	S_e =	0.101	0.070	ft/ft
Required Length L_T to Have 100% Interception	L_T =	11.06	28.68	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	9.00	9.00	ft
Interception Capacity	Q_i =	0.8	1.9	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoef =	1.00	1.00	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.06	0.06	
Effective (Unclogged) Length	L_e =	8.70	8.70	ft
Actual Interception Capacity	**Q_a =**	**0.7**	**1.4**	cfs
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**2.6**	**13.8**	cfs
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**4.4**	**9.0**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**2.6**	**13.8**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**63**	**39**	**%**


STORM SEWER B
INLET B1A
INLET B1B
INLET B1C
INLET B1D
INLET B2A
INLET B2B
INLET B2C
INLET B2D
MH 1 SWR 1 - 1
MH 6 SWR 6 - 1
MH 7 SWR 7 - 1


STORM SEWER B 100-YR
6320.73
6318.43
6316.13
6313.83
6311.53
6309.23
6306.93
6304.63
6302.33
6300.03
Elevation (Ft)
0.00
25.20
50.40
75.60
100.80
126.00
151.20
176.40
201.60
226.80
252.00
Distance (Ft)
MH 1 SWR 1 - 1
INLET B2C
INLET B1D
INLET B1C
INLET B1B
INLET B1A
HGL
EGL

Program:
UDSEWER Math Model Interface 2.1.1.4
Run Date:
3/4/2019 4:05:01 PM

UDSewer Results Summary

Project Title: 15-005 Hillside
Project Description: 100-yr Storm Sewer B

System Input Summary

Rainfall Parameters

Rainfall Return Period: 100
Rainfall Calculation Method: Formula

One Hour Depth (in): 2.60
Rainfall Constant "A": 28.5
Rainfall Constant "B": 10
Rainfall Constant "C": 0.786

Rational Method Constraints

Minimum Urban Runoff Coeff.: 0.20
Maximum Rural Overland Len. (ft): 500
Maximum Urban Overland Len. (ft): 300
Used UDFCD Tc. Maximum: No

Sizer Constraints

Minimum Sewer Size (in): 18.00
Maximum Depth to Rise Ratio: 0.90
Maximum Flow Velocity (fps): 18.0
Minimum Flow Velocity (fps): 2.0

Backwater Calculations:

Tailwater Elevation (ft): 6305.00

Manhole Input Summary:

		Given Flow		Sub Basin Information						
Element Name	Ground Elevation (ft)	Total Known Flow (cfs)	Local Contribution (cfs)	Drainage Area (Ac.)	Runoff Coefficient	5yr Coefficient	Overland Length (ft)	Overland Slope (%)	Gutter Length (ft)	Gutter Velocity (fps)
OUTFALL 1	6302.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MH 1 SWR 1 - 1	6314.59	41.90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
INLET B2C	6319.29	41.90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
INLET B1D	6320.07	27.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MH 6 SWR 6 - 1	6317.31	6.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MH 7 SWR 7 - 1	6319.58	1.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
INLET B1C	6320.55	18.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
INLET B1B	6321.62	15.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
INLET B1A	6322.85	9.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

INLET B1D	41.13	8.38	21.57	7.36	18.07	9.00	1.41	Supercritical	27.80	0.00	
MH 6 SWR 6 - 1	22.68	7.22	10.66	4.67	8.65	6.18	1.49	Supercritical Jump	6.30	9.64	
MH 7 SWR 7 - 1	10.53	5.96	5.97	3.42	4.96	4.41	1.43	Supercritical	1.75	0.00	
INLET B1C	51.23	16.31	18.44	7.03	9.88	14.92	3.34	Supercritical	18.20	0.00	
INLET B1B	51.73	16.46	17.14	6.54	9.07	14.44	3.40	Supercritical Jump	15.70	17.06	
INLET B1A	24.02	13.59	13.93	6.13	7.63	12.62	3.20	Supercritical	9.00	0.00	
INLET B2B	43.04	13.70	15.81	6.10	9.20	12.10	2.82	Supercritical	13.40	0.00	
INLET B2A	19.98	11.31	12.98	5.72	7.81	10.61	2.66	Supercritical	7.80	0.00	
INLET B2D	38.63	12.30	4.72	2.97	3.02	5.69	2.42	Supercritical	1.30	0.00	

- A Froude number of 0 indicates that pressured flow occurs (adverse slope or undersized pipe).
- If the sewer is not pressurized, full flow represents the maximum gravity flow in the sewer.
- If the sewer is pressurized, full flow represents the pressurized flow conditions.

Sewer Sizing Summary:

			Existing		Calculated		Used			
Element Name	**Peak Flow (cfs)**	**Cross Section**	**Rise**	**Span**	**Rise**	**Span**	**Rise**	**Span**	**Area (ft^2)**	**Comment**
MH 1 SWR 1 - 1	41.90	CIRCULAR	30.00 in	30.00 in	27.00 in	27.00 in	30.00 in	30.00 in	4.91	
INLET B2C	41.90	CIRCULAR	30.00 in	30.00 in	27.00 in	27.00 in	30.00 in	30.00 in	4.91	
INLET B1D	27.80	CIRCULAR	30.00 in	30.00 in	27.00 in	27.00 in	30.00 in	30.00 in	4.91	
MH 6 SWR 6 - 1	6.30	CIRCULAR	24.00 in	24.00 in	18.00 in	18.00 in	24.00 in	24.00 in	3.14	
MH 7 SWR 7 - 1	1.75	CIRCULAR	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	1.77	
INLET B1C	18.20	CIRCULAR	24.00 in	24.00 in	18.00 in	18.00 in	24.00 in	24.00 in	3.14	
INLET B1B	15.70	CIRCULAR	24.00 in	24.00 in	18.00 in	18.00 in	24.00 in	24.00 in	3.14	
INLET B1A	9.00	CIRCULAR	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	1.77	
INLET B2B	13.40	CIRCULAR	24.00 in	24.00 in	18.00 in	18.00 in	24.00 in	24.00 in	3.14	
INLET B2A	7.80	CIRCULAR	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	1.77	
INLET B2D	1.30	CIRCULAR	24.00 in	24.00 in	18.00 in	18.00 in	24.00 in	24.00 in	3.14	

- Calculated diameter was determined by sewer hydraulic capacity rounded up to the nearest commercially available size.
- Sewer sizes should not decrease downstream.
- All hydraulics where calculated using the 'Used' parameters.

Grade Line Summary:

Tailwater Elevation (ft): 6305.00

	Invert Elev.		Downstream Manhole Losses		HGL		EGL		
Element Name	**Downstream (ft)**	**Upstream (ft)**	**Bend Loss (ft)**	**Lateral Loss (ft)**	**Downstream (ft)**	**Upstream (ft)**	**Downstream (ft)**	**Friction Loss (ft)**	**Upstream (ft)**
MH 1 SWR 1 - 1	6302.91	6303.69	0.00	0.00	6305.00	6305.86	6306.99	0.20	6307.19
INLET B2C	6306.41	6309.50	0.50	0.00	6307.79	6311.67	6311.33	1.67	6313.00
INLET B1D	6312.32	6312.86	0.32	0.00	6313.83	6314.66	6315.08	0.42	6315.50
MH 6 SWR 6 - 1	6313.36	6313.60	0.01	0.00	6315.44	6315.45	6315.51	0.01	6315.51
MH 7 SWR 7 - 1	6314.35	6315.00	0.01	0.00	6315.50	6315.50	6315.52	0.15	6315.68
INLET B1C	6313.36	6314.28	0.69	0.00	6315.35	6317.12	6317.64	0.00	6317.64
INLET B1B	6314.47	6315.41	0.02	0.00	6317.28	6317.35	6317.66	0.08	6317.75

INLET B1A	6315.90	6316.84	0.02	0.00	6317.37	6318.61	6319.01	0.00	6319.01
INLET B2B	6312.84	6313.49	0.01	0.00	6313.76	6314.81	6315.14	0.24	6315.39
INLET B2A	6314.00	6314.65	0.02	0.00	6314.82	6316.08	6316.40	0.00	6316.40
INLET B2D	6313.35	6313.87	0.00	0.00	6313.60	6314.26	6314.10	0.30	6314.40

- Bend and Lateral losses only apply when there is an outgoing sewer. The system outfall, sewer #0, is not considered a sewer.
- Bend loss = Bend K * V_fi ^ 2/(2*g)
- Lateral loss = V_fo ^ 2/(2*g)- Junction Loss K * V_fi ^ 2/(2*g).
- Friction loss is always Upstream EGL - Downstream EGL.

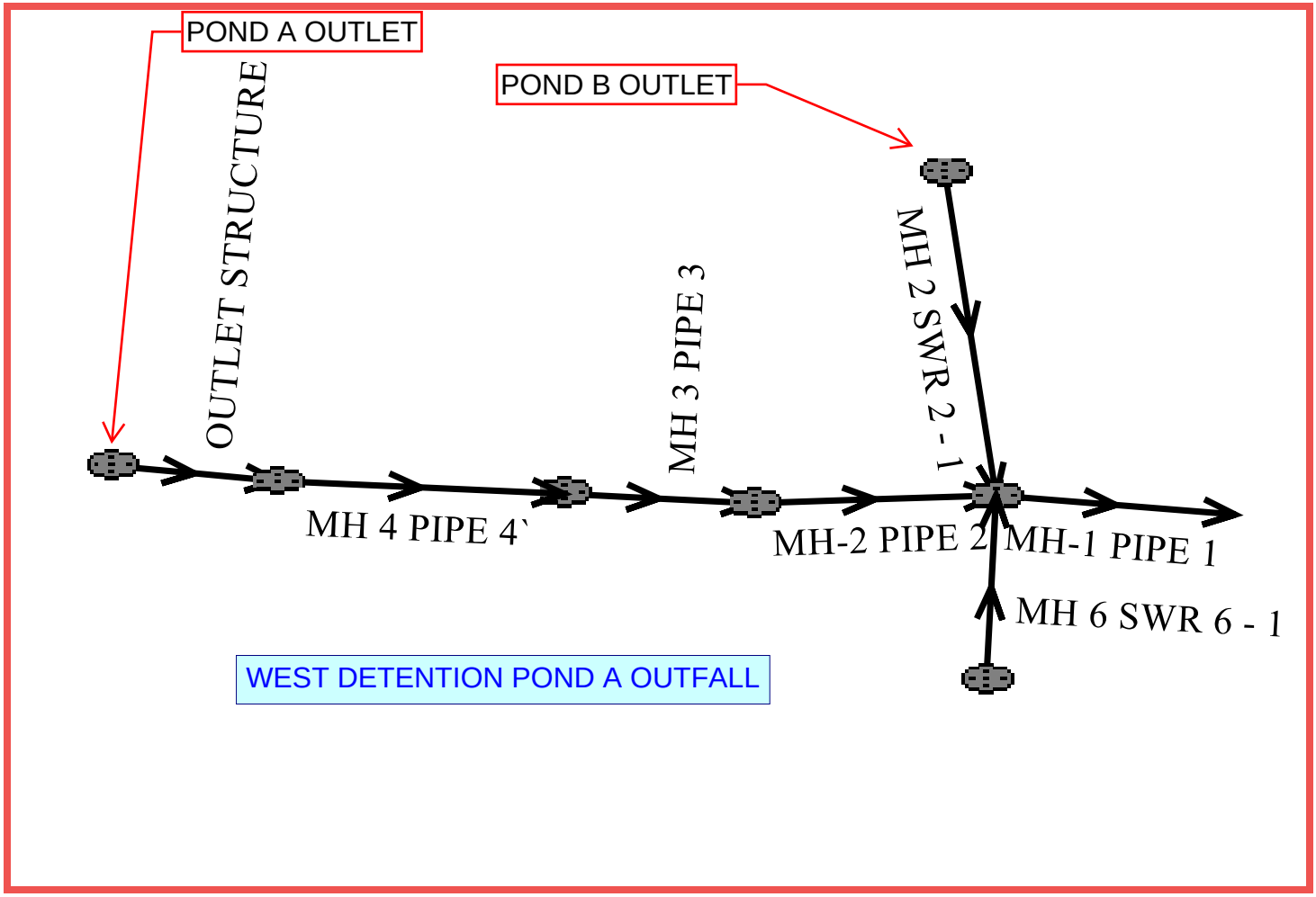
Excavation Estimate:

The trench side slope is 1.0 ft/ft
The minimum trench width is 2.00 ft

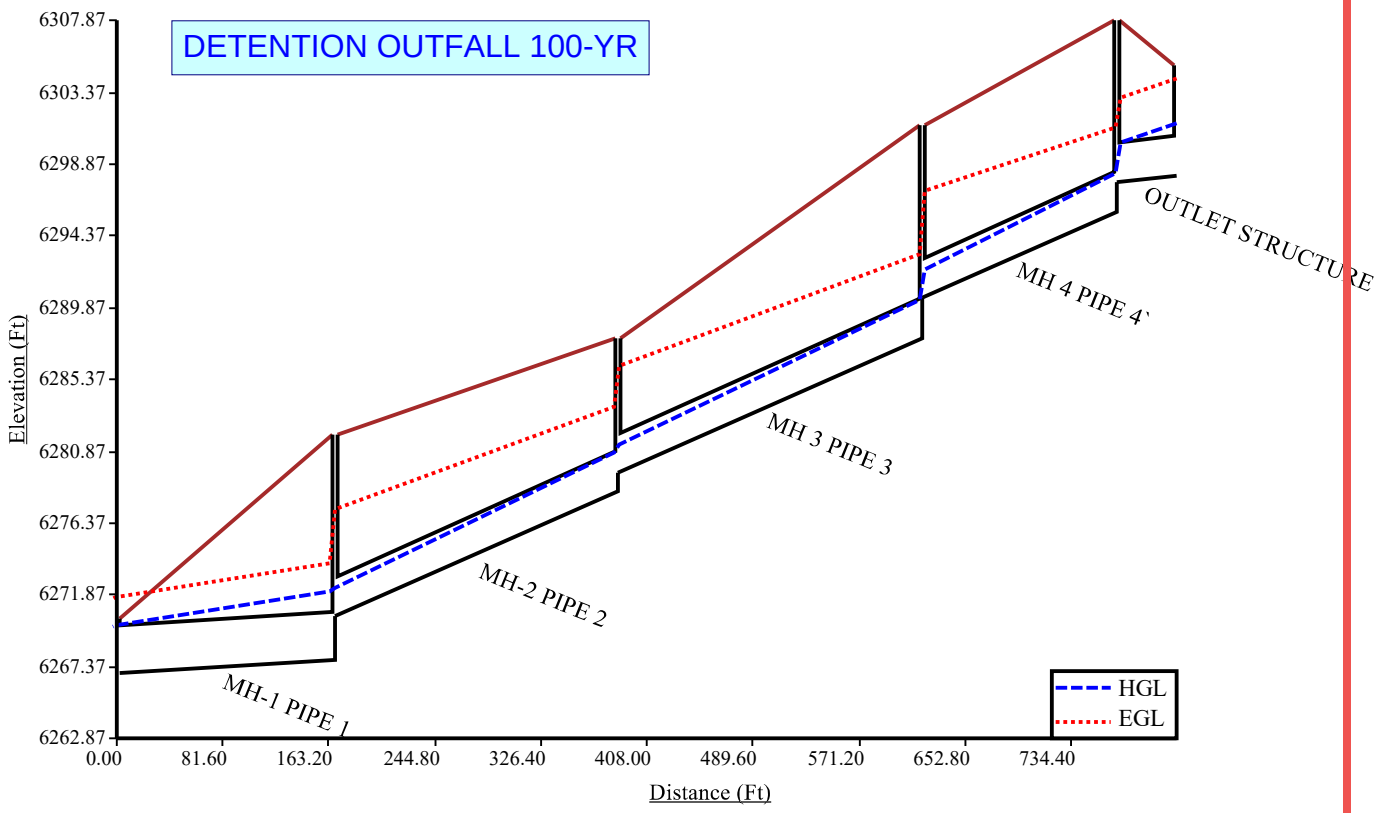
					Downstream			Upstream				
Element Name	**Length (ft)**	**Wall (in)**	**Bedding (in)**	**Bottom Width (ft)**	**Top Width (ft)**	**Trench Depth (ft)**	**Cover (ft)**	**Top Width (ft)**	**Trench Depth (ft)**	**Cover (ft)**	**Volume (cu. yd)**	**Comment**
MH 1 SWR 1 - 1	41.02	3.50	6.00	6.08	0.00	0.00	0.00	20.30	11.69	8.11	92.41	Sewer Too Shallow
INLET B2C	102.94	3.50	6.00	6.08	14.86	8.97	5.39	18.08	10.58	7.00	332.00	
INLET B1D	53.99	3.50	6.00	6.08	12.44	7.76	4.18	12.92	8.00	4.42	117.66	
MH 6 SWR 6 - 1	24.50	3.00	4.00	5.50	12.43	7.30	4.47	6.42	4.29	1.46	34.47	Sewer Too Shallow
MH 7 SWR 7 - 1	64.99	2.50	4.00	4.92	5.42	3.50	1.25	8.66	5.12	2.87	55.32	Sewer Too Shallow
INLET B1C	17.96	3.00	4.00	5.50	12.41	7.29	4.46	11.54	6.85	4.02	32.88	
INLET B1B	18.06	3.00	4.00	5.50	11.16	6.66	3.83	11.42	6.79	3.96	30.36	
INLET B1A	18.06	2.50	4.00	4.92	10.94	6.26	4.01	11.52	6.55	4.30	27.75	
INLET B2B	18.08	3.00	4.00	5.50	11.90	7.03	4.20	11.24	6.70	3.87	31.49	
INLET B2A	18.14	2.50	4.00	4.92	10.73	6.15	3.90	10.74	6.16	3.91	26.02	
INLET B2D	18.05	3.00	4.00	5.50	10.89	6.53	3.69	7.88	5.02	2.19	24.13	

Total earth volume for sewer trenches = 804 cubic yards.

- The trench was estimated to have a bottom width equal to the outer pipe diameter plus 36 inches.
- If the calculated width of the trench bottom is less than the minimum acceptable width, the minimum acceptable width was used.
- The sewer wall thickness is equal to: (equivalent diameter in inches/12)+1 inches
- The sewer bedding thickness is equal to:
  - Four inches for pipes less than 33 inches.
  - Six inches for pipes less than 60 inches.
  - Eight inches for all larger sizes.


POND A OUTLET
POND B OUTLET
OUTLET STRUCTURE
MH 3 PIPE 3
MH 2 SWR 2 - 1
MH 4 PIPE 4`
MH-2 PIPE 2
MH-1 PIPE 1
MH 6 SWR 6 - 1
WEST DETENTION POND A OUTFALL

1


DETENTION OUTFALL 100-YR
6307.87
6303.37
6298.87
6294.37
6289.87
6285.37
6280.87
6276.37
6271.87
6267.37
6262.87
Elevation (Ft)
0.00
81.60
163.20
244.80
326.40
408.00
489.60
571.20
652.80
734.40
Distance (Ft)
MH-1 PIPE 1
MH-2 PIPE 2
MH 3 PIPE 3
MH 4 PIPE 4
OUTLET STRUCTURE
HGL
EGL

Program:
UDSEWER Math Model Interface 2.1.1.4
Run Date:
3/4/2019 4:30:09 PM

UDSewer Results Summary

Project Title: 15-005 Hillside
Project Description: DETENTION OUTFALL STORM PIPE - 100-YR STORM

System Input Summary

Rainfall Parameters

Rainfall Return Period: 100
Rainfall Calculation Method: Formula

One Hour Depth (in): 2.60
Rainfall Constant "A": 28.5
Rainfall Constant "B": 10
Rainfall Constant "C": 0.786

Rational Method Constraints

Minimum Urban Runoff Coeff.: 0.20
Maximum Rural Overland Len. (ft): 500
Maximum Urban Overland Len. (ft): 300
Used UDFCD Tc. Maximum: No

Sizer Constraints

Minimum Sewer Size (in): 18.00
Maximum Depth to Rise Ratio: 0.90
Maximum Flow Velocity (fps): 18.0
Minimum Flow Velocity (fps): 2.0

Backwater Calculations:

Tailwater Elevation (ft): 6269.88

Manhole Input Summary:

		Given Flow		Sub Basin Information						
Element Name	Ground Elevation (ft)	Total Known Flow (cfs)	Local Contribution (cfs)	Drainage Area (Ac.)	Runoff Coefficient	5yr Coefficient	Overland Length (ft)	Overland Slope (%)	Gutter Length (ft)	Gutter Velocity (fps)
OUTFALL 4	6270.38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MH-1 PIPE 1	6281.92	75.32	0.00	1.00	0.10	0.10	1.00	1.00	1.00	2.00
MH-2 PIPE 2	6287.97	66.10	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MH 3 PIPE 3	6301.34	66.10	0.00	1.00	1.00	1.00	1.00	1.00	1.00	2.00
MH 4 PIPE 4`	6307.91	66.10	0.00	1.00	1.00	1.00	1.00	1.00	1.00	2.00
OUTLET STRUCTURE	6305.08	66.10	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MH 6 SWR 6 - 1	6273.50	5.78	0.00	1.00	1.00	1.00	1.00	1.00	1.00	2.00
MH 2 SWR 2 - 1	6278.00	9.22	0.00	1.00	1.00	1.00	1.00	1.00	1.00	2.00

TOTAL OUT DOES NOT CORRECTLY SUM TO ALL OF THESE FLOWS. CORRECT SUM IS 81.1 CFS

POND A RELEASE FROM NARRATIVE, MISMATCH TO UD-DETENTION

DP 42.1 FLOWS

MAX POND B RELEASE MAX RELEASE, SEE CALCS IN THIS APPENDIX FROM SDP OVERALL REPORT BY PARAGON

Manhole Output Summary:

DETENTION VOLUME BY THE FULL SPECTRUM METHOD

Project: Hillside at Castle Rock
Basin ID: East Pond

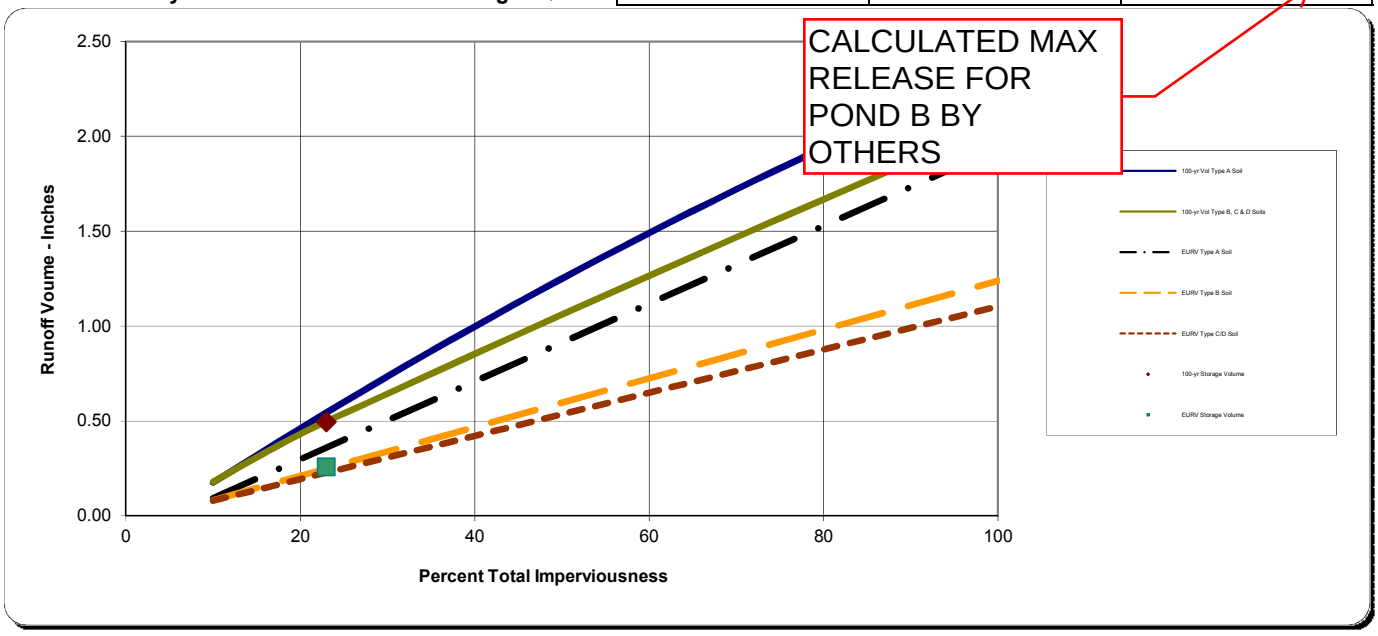
* User input data shown in blue.

Area of Watershed (acres)	10.03	
Subwatershed Imperviousness	23.0%	
Level of Minimizing Directly Connected Impervious Area (MDCIA)	0	0
Effective Imperviousness[1]	23.0%	

Hydrologic Soil Type	Percentage of Area	Area (acres)
Type A		0.0
Type B	30.0%	3.0
Type C or D	70.0%	7.0

Recommended Horton's Equation Parameters for CUHP		
Infiltration (inches per hour)		Decay Coefficient--α
Initial--f_i	Final--fo	
3.45	0.5	0.0018

	Detention Volumes [2,5]		
	(watershed inches)	(acre-feet)	Maximum Allowable Release Rate, cfs[3]
Excess Urban Runoff Volume[4]	0.26	0.22	Design Oulet to Empty EURV in 72 Hours
100-year Detention Volume Including WQCV [5]	0.50	0.41	9.58



Notes:

1) Effective imperviousness is based on Figure ND-1 of the Urban Storm Drainage Criteria Manual (USDCM).

2) Results shown reflect runoff reduction from Level 1 or 2 MDCIA and are plotted at the watershed's total imperviousness value; the impact of MDCIA is reflected by the results being below the curves.

3) Maximum allowable release rates for 100-year event are based on Table SO-1. Outlet for the Excess Urban Runoff Volume (EURV) to be designed to empty out the EURV in 72 hours. Outlet design is similar to one for the WQCV outlet of an extended detention basin (i.e., perforated plate with a micro-pool) and extends to top of EURV water surface elevation.

4) EURV approximates the difference between developed and pre-developed runoff volume.

5) 100-yr detention volume includes EURV. No need to add more volume for WQCV or EURV

NOTES:

1. THIS DRAINAGE PLAN IS TO PROVIDE PHASE III DRAINAGE STUDY INFORMATION FOR HILLSIDE PHASE 1 & 2 STORM CONVEYANCE AND STORAGE FACILITIES ONLY. SEE THE HILLSIDE PHASE II DRAINAGE STUDY FOR OVERALL SITE DRAINAGE IMPROVEMENTS.

2. SEE THE HILLSIDE PHASE 1 AND 2 CONSTRUCTION PLANS FOR DRAINAGE CHANNEL AND ROCK MITIGATION CHANNEL DETAILS AS WELL AS DETENTION CONVEYANCE AND STORAGE FACILITY DETAILS.

3. SEE THE HILLSIDE PHASE 1 AND 2 CONSTRUCTION PLANS FOR FOR SPECIFIC LOT DRAINAGE DETAILS.

4. PROPOSED GRADING CONTOURS SHOWN ARE OVERLOT GRADING WITH FINISHED GRADE STREETS FOR PHASE 1. FOR FINAL LOT GRADING, REFER TO LOT TYPE CONFIGURATION IN THE HILLSIDE PHASE 1 AND 2 CONSTRUCTION PLANS.

5. PHASE LINES ARE FOR INFORMATION ONLY.

DRAINAGE LEGEND

BASIN — BASIN NAME
AREA — 5 yr — 5 yr C VALUE; 100 yr — 100 yr C VALUE
BASIN ACREAGE

1 — DESIGN POINT
BASIN BOUNDARY LINE
6280 — EX. MAJOR CONTOUR
EX. MINOR CONTOUR
6280 — PR. MAJOR CONTOUR
PR. MINOR CONTOUR
SURFACE FLOW DIRECTION

WATER QUALITY AND DETENTION

	Volume Required		Volume Provided *		Elevation	Release
	Cubic Ft	Acre-Ft	Cubic Ft	Acre-Ft	(FT)	Rate (cfs)
Forebay						
Micropool						
Water Quality		0.526		0.526	6304.09	
10 year		2.171		2.171		13.4
10 year + WQ		2.697		2.697	6308.00	
100 year		2.847		2.847		56.8
100 year + WQ		3.373		3.373	6308.95	

OS-1 6.25 | .05 | .49
OS-2 19.77 | .05 | .49
OS-3 6.05 | .05 | .49
B1 6.24 | .35 | .63
B2 3.44 | .49 | .71
B3 0.33 | .49 | .71
B4 0.43 | .15 | .52
B5 1.08 | .32 | .62
B6 2.58 | .01 | .44
D1 1.61 | .21 | .55
D2 1.34 | .17 | .53
D3 0.34 | .35 | .62
D4 0.12 | .86 | .89
D5 1.00 | .23 | .56

CASTLE ROCK LAND COMPANY LLC RECEPTION NO. 9757009 AND 9754291
CASTLE ROCK LAND COMPANY LLC RECEPTION NO. 9757009 AND 9754291
CASTLE ROCK LAND COMPANY LLC 250504000049 RECEPTION NO. 9754291
DEBORA L ANDERSON BEAVER ROC A BEAVER RECEPTION NO. 9415368 UNICORPORATED DOUGLAS COUNTY - A1
UNICORPORATED DOUGLAS COUNTY - A1
PROPERTY LINE
ROCKFALL MITIGATION CHANNEL AND TRAIL/MAINTENANCE ROAD
30' DRAINAGE AND ACCESS EASEMENT
R.O.W.
20.00' IREA ESMT
20.00' UTILITY AND ACCESS ESMT
COACHLINE ROAD
TEMPORARY SLOPE DRAIN
RETAINING WALLS
CONSTRUCTION PHASE LIMIT
HIGH POINT
FUTURE PHASE
PHASE 2
PHASE 1
TEMPORARY SEDIMENTATION BASIN TO BE CONVERTED INTO A PERMANENT FACILITY IF PHASE 2 CONSTRUCTION DOES NOT BEGIN WITHIN 2-YEARS OF CONSTRUCTION DRAWING APPROVAL. SEE TOWN OF CASTLE ROCK GESC PLAN STANDARD NOTES AND DETAILS SHEET 2 OF 3 FOR CONSTRUCTION DETAILS.
INSTALL 5' WIDE PLASTIC LINER IN TEMPORARY SEDIMENT BASIN OUTFALL CHANNEL PER TOWN OF CASTLE ROCK DIVERSION DITCH DETAIL C.
20' DRAINAGE EASEMENT
BEGIN RETAINING WALL DRAINAGE CHANNEL
TIERED RETAINING WALLS
GRAYSIDE CIRCLE
BEGIN DRAINAGE CHANNEL
LANDSCAPE WALLS
RETAINING WALL DRAINAGE CHANNEL
DETENTION POND
STORM LINE 'B'
NW COR. SE 1/4, SW 1/4 SEC. 3
SW COR SEC 3
PROJECT BOUNDARY
FUTURE ROW FOR EAST ROAD
12' WIDE TOP EMBANKMENT ACCESS ROAD
DRAINAGE AND ACCESS EASEMENT
TRACT BOUNDARY
36" RCP STORM
30.00' DRAINAGE EASEMENT
36" FES STORM OUTFALL w/ RIPRAP
EX. OPEN CHANNEL (OMNI TRIBUTARY)
EX. ROADSIDE DITCH
EX. DUAL 48" CMP
WOLFENSBERGER ROAD
30" RCP STORM SEWER 'POND A OUTFALL'
END OF IMPROVEMENT AND MATCH INTO EX. ROADSIDE DITCH FOR PHASE 1&2 CONSTRUCTION. FUTURE DEVELOPMENT WILL PROVIDE ADDITIONAL IMPROVEMENT FOR EXISTING ROADSIDE DITCH
20' EMERGENCY SPILLWAY
2' WIDE w/ 6" DEPTH LOW FLOW CHANNEL
12' WIDE @ 10% MAINTENANCE ACCESS ROAD w/ WORKING BENCH
MICRO-POOL & OUTLET STRUCTURE
CONC. FOREBAY
EX. ROADSIDE DITCH TO BE IMPROVED FOR STORMWATER QUALITY
EX. STORM SEWER MH
TYPE C AREA INLET (PUBLIC)
TRIPLE TYPE 16 INLETS
EXTEND 24" CMP w/ 24" FES
EX. 24" CMP
100-YR WATER SURFACE
EX. 42"x29" CMP
BEGIN IMPROVEMENT FOR EX. ROADSIDE DITCH
EX. ROADSIDE DITCH TO BE IMPROVED FOR STORMWATER QUALITY
UNICORPORATED DOUGLAS COUNTY - A1

0 100 200 Feet

Know what's below. Call before you dig.

REVISIONS		
1	SUBMIT TO TOCR	09-15-16
2	SUBMIT TO TOCR	10/19/16
3	SUBMIT TO TOCR	10/27/17
4	SUBMIT TO TOCR	01/23/19
5	SUBMIT TO TOCR	03/03/19
6	SUBMIT TO TOCR	04/03/19

PARAGON ENGINEERING CONSULTANTS, INC.
7852 SOUTH ELATI STREET, SUITE 106
LITTLETON, CO 80120 303-794-8604

COLORADO REGISTERED PROFESSIONAL ENGINEER 34200 5/1/2019

HILLSIDE AT CASTLE ROCK

PHASE 1 & 2 DRAINAGE PLAN

DESIGN:	HQT	DATE:	4/3/2019	SCALE:	1" = 100'
DRAWN:	HQT	PROJECT NO:	15-005		

SHEET D1.0

REVIEWER NOTES:

1. THIS OVERALL DRAINAGE MAP IS TO PROVIDE GENERAL LOCATIONS AND INFORMATION FOR STORM CONVEYANCE AND STORAGE FACILITIES, RETAINING WALLS, AS WELL AS CONSTRUCTION PHASING ONLY. FOR MORE DETAILS REFER TO PROPOSED DRAINAGE PLAN 1 & 2 AND CONSTRUCTION PLANS.
2. ALL TRICKLE AND DRAINAGE/ROCK MITIGATION CHANNELS' DETAILS ARE DESIGNED AND SHOWN IN CONSTRUCTION PLANS.
3. FOR LOT TYPE CONFIGURATIONS REFER TO CONSTRUCTION PLANS FOR LOT DRAINAGE DETAILS.
4. PROPOSED GRADING CONTOURS SHOWN ARE OVERLOT GRADING WITH FINISHED STREET GRADING. FOR FINAL AREA GRADING FOR LOT, REFER TO LOT TYPE CONFIGURATION IN CONSTRUCTION PLANS.
5. PHASE LINES ARE FOR INFORMATION ONLY.
6. ALL STORM CONVEYANCE AND STORAGE FACILITIES WITHIN THE PROJECT BOUNDARY ARE PRIVATE UNLESS OTHERWISE NOTED.

OVERALL DETAIL DRAINAGE PLAN 1 - SEE SHEET D1.2

OVER DETAIL DRAINAGE PLAN 2 - SEE SHEET D1.3

FOR REFERENCE ONLY

DRAINAGE LEGEND

- BASIN — BASIN NAME
- AREA — 5 yr — 5 yr C VALUE; 100 yr — 100 yr C VALUE
- BASIN ACREAGE
- 1 — DESIGN POINT
- BASIN BOUNDARY LINE
- 6280 — EX. MAJOR CONTOUR
- EX. MINOR CONTOUR
- 6280 — PR. MAJOR CONTOUR
- PR. MINOR CONTOUR
- SURFACE FLOW DIRECTION

CASTLE ROCK LAND COMPANY LLC RECEPTION NO. 9757009 AND 9754291

OS-1: 6.25 | .05 | .49

OS-2: 15.28 | .05 | .49

OS-3: 5.64 | .05 | .49

A1: 4.76 | .80 | .89

A2: 3.60 | .80 | .89

B1: 6.25 | .35 | .63

B2: 3.42 | .49 | .71

B3: 1.03 | .49 | .71

B4: 0.74 | .28 | .59

B5: 1.08 | .32 | .61

B6: 2.88 | .01 | .44

C1: 1.83 | .63 | .78

C2: 1.04 | .63 | .78

C3: 1.53 | .01 | .44

C4: 0.45 | .30 | .59

D1: 1.61 | .21 | .55

D2: 1.34 | .17 | .53

D3: 0.34 | .35 | .62

D4: 0.12 | .86 | .89

D5: 1.82 | .25 | .57

30' DRAINAGE EASEMENT

ROCKFALL MITIGATION CHANNEL & TRAIL

RETAINING WALLS

R.O.W.

PROPERTY LINE

COACHLINE ROAD

HIGH POINT

CONSTRUCTION PHASE LIMIT

PHASE 2

PHASE 1

FUTURE PHASES

EAST ROAD

WEST ROAD

WOLFENSBERGER ROAD

1' WIDE DRAINAGE CHANNEL

20' DRAINAGE EASEMENT

LANDSCAPE WALLS

CASTLE ROCK LAND COMPANY LLC 250504000049 RECEPTION NO. 9754291

DEBORA L ANDERSON BEAVER ROC A BEAVER RECEPTION NO. 9415368 UNICORPORATED DOUGLAS COUNTY – A1

UNICORPORATED DOUGLAS COUNTY – A1

30" FES CONNECTS TO CHANNEL

STORM LINE 'A'

STORM LINE 'B'

STORM LINE 'C'

12' WIDE TOP EMBANKMENT ACCESS ROAD

DETENTION POND 'A'

DETENTION POND 'B'

36" FES STORM OUTFALL w/ RIPRAP

EX. OPEN CHANNEL (OMNI TRIBUTARY)

20' EMERGENCY SPILLWAY

EX. ROADSIDE DITCH

EX. DUAL 48" CMP

TYPE C AREA INLET (PUBLIC)

10' WIDE TOP EMBANKMENT ACCESS ROAD

CONC. FOREBAY

30" RCP STORM SEWER 'POND A OUTFALL'

GRASS-LINED SWALES

184 SF w/ 2.5 FT DEPTH MICRO-POOL & OUTLET STRUCTURE

12' WIDE @ 10% MAINTENANCE ACCESS ROAD w/ WORKING BENCH

36 SF w/ 2.5 FT DEPTH MICRO-POOL & OUTLET STRUCTURE

2' WIDE w/ 6" DEPTH TRICKLE CHANNEL

EXTEND 24" CMP w/ 24" FES

EX. 24" CMP

EX. STORM SEWER MH

EX. 42"x29" CMP

EX. ROADSIDE DITCH TO BE IMPROVED FOR STORMWATER QUALITY

0 100 200 Feet

Know what's below. Call before you dig.

REVISIONS		
1	SDP TO TOCR	01/04/15
2	CD'S TO TOCR	03/11/16
3	SDP TO TOCR	07/19/16
4	SDP TO TOCR	8/4/16
5	SDP TO TOCR	10/11/16
6	SUBMIT TO TOCR	01/23/19

PARAGON ENGINEERING CONSULTANTS, INC.
7852 SOUTH ELATI STREET, SUITE 106
LITTLETON, CO 80120 303-794-8604

HILLSIDE AT CASTLE ROCK PHASE II

OVERALL DRAINAGE MAP

COLORADO REGISTERED 34200 5/1/2019 PROFESSIONAL ENGINEER

DESIGN: TD | DATE: 4/2/2019 | SCALE: 1" = 50'

DRAWN: WLB | PROJECT NO: 15-005

SHEET D1.1

Phase III Drainage Report

HILLSIDE AT CASTLE ROCK
Phase 3 & 4

Northeast Corner of Wolfsenberger Road and Stagecoach Road
Castle Rock, Douglas County
Colorado, 80109

Initial Submittal: August 25, 2023
1st Resubmittal: December 15th, 2023
3rd Resubmittal:
4th Resubmittal:
5th Resubmittal:
6th Resubmittal:

CD23-0036 & SDP23-0030

Prepared For:

BLVD Hillside, LLC
600 Grant Street, Suite 404
Denver, CO 80203
Contact: Aaron Foy
Phone: (303) 200-0742

Prepared By:

EES
ENTITLEMENT AND ENGINEERING SOLUTIONS, INC.

3801 E Florida Ave
Suite 425
Denver, CO 80210
303-572-7997
www.ees.us.com

Contact: Michael S. Goodhue
Email: Michael.Goodhue@ees.us.com

Utilize Stream Channel Stabilization Techniques (Step 3 of 4):
Proposed streets, inlets, storm sewer system and low flow channels are the major drainageway for the site as well as the offsite improved roadside ditch. Onsite drainage and low flow channels are concrete and do not require further stabilization. The Wolfensberger roadside ditch has 8:1 side slopes and a longitudinal slope of approximately 3%. The roadside ditch will be stabilized with reinforced rock berms, seeding and mulching (See.the approved Hillside at Castle Rock Phase 3 & 4 TESC Report TES 23-0041)

Undertake Source Control (Step 4 of 4):
During construction and overlot grading, sediment BMP's need to be employed to minimize sediment deposit in detention facilities. Detention facilities will be required to have daily inspection and during before and after storm, and repair as necessary (See the Hillside at Castle Rock Phase 3 & 4 TESC Report TES 23-0041).

IV. STORMWATER MANAGEMENT FACILITY DESIGN

A. Stormwater Conveyance Facilities

The site is being laid out to match the existing topography as much as possible and therefore will follow the existing drainage patterns. The anticipated flows within the site will be conveyed within the street curb & gutter sections to the greatest extent possible. When street capacities are met, storm sewer inlets will be designed to intercept flows and convey them to the proposed detention facilities. As mentioned above, the site is located within Sub-basin 21 of the Plum Creek Basin and tributaries to Omni drainageway that conveys stormwater to East Plum Creek.

After leaving the onsite water quality detention ponds, stormwater will be discharged into an existing Omni Tributary culvert underneath Wolfensberger Road and ultimately to East Plum Creek. Refer to maps in the Appendix D for offsite stormwater conveyance. Due to grading constraints, runoff from proposed drainage basin C-6 will be undetained and sheet flow to the existing roadside ditch along north side of Wolfensberger Road. These basins will be discussed in detail below to meet the TOCR SDD&TCM criteria on undetained flows that bypass the onsite stormwater quality.

Construction Phasing and Interim Runoff Conveyance

The site will be developed in phases, including phased grading, utilities and streets. This report covers Phase 3 & 4 construction and also includes updated Rational and Detention Pond Calculations for Detention Pond A and its tributary basins.

Basin Details-Phase 3 and Phase 4

Basin ID	Design Point	C_5	C_{100}	Q_5 (cfs)	Q_{100} (cfs)
OS-1	1	0.01	0.44	0.13	10.20

Basin OS-1 consists of approximately 5.38 acres in the northwest portion of the site. The upper portion of this basin includes land owned by Castle Rock Land Company, LLC. Runoff originating from this basin sheets flows onto the site and will be intercepted by a 3-foot wide concrete rock mitigation and drainage channel. Runoff is channeled downstream and is captured by a proposed headwall at D.P. 4. Runoff is then conveyed via storm pipe to the north forebay of Existing Detention Pond A.

Basin ID	Design Point	C_5	C_{100}	Q_5 (cfs)	Q_{100} (cfs)
OS-2	2	0.01	0.44	0.29	22.98

Basin OS-2 consists of approximately 15.28 acres in the north portion of the site. Runoff originating from this basin sheets flows onto the site and will be intercepted by a 3-foot wide concrete rock mitigation and drainage channel. Runoff is channeled downstream and is captured by a proposed headwall at D.P. 4. Runoff is then conveyed via storm pipe to the north forebay of Existing Detention Pond A.

Basin ID	Design Point	C_5	C_{100}	Q_5 (cfs)	Q_{100} (cfs)
OS-3	3	0.01	0.44	0.14	11.45

Basin OS-3 consists of approximately 4.89 acres in the northeast portion of the site. Runoff originating from this basin sheets flows onto the site and will be intercepted by a 3-foot wide concrete rock mitigation and drainage channel. Runoff is channeled downstream and is captured by a proposed headwall at D.P. 4. Runoff is then conveyed via storm pipe to the north forebay of Existing Detention Pond A.

Basin ID	Design Point	C_5	C_{100}	Q_5 (cfs)	Q_{100} (cfs)
A-1	5	0.44	0.70	8.06	23.09

Basin A-1 is 5.51 acres located in the western portion of the site. Basin improvements include residential lots, open space and streets. Developed runoff will be conveyed via street curb and gutter and to D.P. 5. The 5-yr and 100-yr flow rates are below street capacity. Runoff will be captured by four Triple Type 16 Combination inlets. Runoff will be then discharged to existing Detention Pond A through series of RCP storm pipes. Refer to Appendix C for inlet hydraulic calculations. The four Triple Type 16 Combination inlets are on a continuous grade and are designed to capture 100% of the 5-yr storm runoff and 100% of the 100-yr storm runoff. In case of these inlets become clogged, runoff will travel to Detention Pond B.

Basin ID	Design Point	C_5	C_{100}	Q_5 (cfs)	Q_{100} (cfs)
A-2	6	0.64	0.78	8.54	18.94

Basin A-2 is 3.59 acres located in the western portion of the site. Basin improvements include residential lots, open space and streets. Developed runoff will be conveyed via street curb and gutter and to D.P. 6. The 5-yr and 100-yr flow rates are below street capacity. Runoff will be captured by four Triple Type 16 Combination inlets. Runoff will be then discharged to existing Detention Pond A through a series of RCP storm pipes. Refer to Appendix C for inlet hydraulic calculations. The four Triple Type 16 Combination inlets are on a continuous grade and are designed to capture 100% of the 5-yr storm runoff and 100% of the 100-yr storm runoff. In case of these inlets become clogged, runoff will travel to Detention Pond B.

Basin ID	Design Point	C_5	C_{100}	Q_5 (cfs)	Q_{100} (cfs)
C-1	7	0.52	0.71	1.40	3.48

Basin C-1 is approximately 0.56 acres consisting of roadway paving, sidewalk, and landscaping. Developed runoff will be conveyed via street curb and gutter and to D.P. 7. The 5-yr and 100-yr flow rates are below street capacity. Runoff will be captured by two Triple Type 16 Combination inlets. Runoff will be then discharged to Detention Pond B through a series of RCP storm pipes. Refer to Appendix C for inlet hydraulic calculations. The two Triple Type 16 Combination inlets are on a continuous grade and are designed to capture 100% of the 5-yr storm runoff and 100% of the 100-yr storm runoff. In case of these inlets become clogged, runoff will be passed to the Wolfsenberger ROW.

Basin ID	Design Point	C5	C100	Q5 (cfs)	Q100 (cfs)
C-2	8	0.82	0.87	1.38	2.67

Basin C-2 is approximately 0.35 acres consisting of roadway paving, sidewalk, and landscaping. Developed runoff will be conveyed via street curb and gutter and to D.P. 8. The 5-yr and 100-yr flow rates are below street capacity. Runoff will be captured by two Triple Type 16 Combination inlets. Runoff will be then discharged to Detention Pond B through a series of RCP storm pipes. Refer to Appendix C for inlet hydraulic calculations. The two Triple Type 16 Combination inlets are on a continuous grade and are designed to capture 100% of the 5-yr storm runoff and 100% of the 100-yr storm runoff. In case of these inlets become clogged, runoff will be passed to the Wolfsenberger ROW.

Basin ID	Design Point	C_5	C_{100}	Q_5 (cfs)	Q_{100} (cfs)
C-3	9	0.53	0.73	4.20	10.43

Basin C-3 is approximately 2.15 acres consisting of future multi-family. Developed runoff will be conveyed via a soil riprap lined swale and to D.P. 9. The 5-yr and 100-yr flow rates are below street capacity. Runoff will be captured by a Type C inlet. Runoff will be then discharged to Detention Pond B through 18" RCP storm pipes. Refer to Appendix C for inlet hydraulic calculations. The Type C inlet is in sump and designed to capture 100% of the 5-yr storm runoff and 100% of the 100-yr storm runoff. In case of this inlet becoming clogged, runoff will be passed to the Wolfsenberger ROW.

Basin ID	Design Point	C_5	C_{100}	Q_5 (cfs)	Q_{100} (cfs)
C-4	10	0.37	0.64	2.06	6.48

Basin C-4 is approximately 1.65 acres consisting of future multi-family and Detention Pond B. Developed runoff will be conveyed via a soil riprap lined swale and to D.P. 10 within Detention Pond B.

Basin ID	Design Point	C_5	C_{100}	Q_5 (cfs)	Q_{100} (cfs)
C-5	11	0.01	0.44	0.02	1.55

Basin C-5 is approximately 0.40 acres consisting of future multi-family and landscaping. Developed

runoff will be conveyed via a soil riprap lined swale along Wolfsenberger Road to a proposed Type C inlet at D.P. 11.

Basin ID	Design Point	C_5	C_{100}	Q_5 (cfs)	Q_{100} (cfs)
C-6	12	0.34	0.61	0.92	3.04

Basin C-6 consists of approximately 0.56 acres of roadway paving, sidewalk and landscaping. Developed runoff is concentrated in curb and gutter and passed offsite to the Wolfsenberger ROW.

Untreated Basin Analysis Data Table

Basin ID	Total Untreated Area (ac)	Total Basin Area (ac)	Total Site Area (ac)
C-6	0.56	0.56	21.356

The total amount of untreated area for basin C-6 is 0.56 acres. The site is approximately 21.356 acres. Therefore, only 2.62% of the site is undetained and untreated. Per TOCR SDD&TCM & Stormwater Discharges Associated with Municipal Separate Storm Sewer Systems (MS4s), the allowable undetained release is zero cfs, therefore, a variance for the undetained runoff will be included with the submittal documents.

Stormwater Storage Facilities

The proposed Phase 3 & 4 improvements will utilize one existing Detention Pond A and Proposed Detention Pond B. Detention Pond B has been designed based on current UDFCD and Town of Castle Rock design manuals.

Pond B is located east of the easterly entrance and at full buildout, will process flows from Major Basin C. Detention and water quality Pond B improvements consist of a one concrete forebay, 2-foot wide concrete low flow channel, 2.5-feet deep integrated micro-pool, one 12-foot wide gravel maintenance roads with working benches, EURV and 100-yr outlet structure, and 12-foot wide access road on top of the embankment.

Total routed flows from the above basins contribute to this pond is 23.06 cfs for 100-year storm event. The WQCV is 0.116 ac-ft; EURV capture volume is 0.389 ac-ft and 100-yr plus ½ WQCV volume is 0.701 ac-ft. The EURV release time is 71 hours and the 100-year release rate is 8.2 cfs which is 90% of the allowable release rate. An outfall pipe, 18” RCP storm sewer, conveys runoff to existing 30” storm sewer in the Wolfsenberger Road. A 20-foot wide emergency overflow spillway is also designed to convey runoff to the roadside ditch on Wolfensberger Road. Refer to Appendix C for hydraulic calculations.

According to the Colorado Revised Statute 37-92-602(8) pertaining Stormwater Detention and Infiltration Facilities, the Detention Pond A is designed to continuously release or infiltrate at least 97% of all of the runoff from a rainfall event that is less than or equal to a 5-year storm within 72 hours after the end of the event; and continuous release or infiltrate as quickly as practical, but in all cases, releases or infiltrates at least 99% of the runoff within 120 hours after the end of events greater than a 5-year storm.

PROPOSED CONDITIONS

Runoff Coefficients

Project: Hillside at Castle Rock - Phase 3 & 4
Section:

Created by: GSR
Checked by: MSG

Date: 12/5/2023
Date:

Sub-Basin Data			Composite C					Sub Area (Apartments)						Sub Area (Paving)						Sub Area (Drives and Walks)						Sub Area (Landscape)					
Basin ID	Description	Total Area (ac)	C_2	C_5	C_{10}	C_{100}	I (%)	C_2	C_5	C_{10}	C_{100}	I (%)	Area (ac)	C_2	C_5	C_{10}	C_{100}	I (%)	Area (ac)	C_2	C_5	C_{10}	C_{100}	I (%)	Area (ac)	C_2	C_5	C_{10}	C_{100}	I (%)	Area (ac)
On/Off-Site Detained																															
A-1	Apartments, Paving, Drives/Walks & Landscaping	5.51	0.42	0.44	0.48	0.70	52.7	0.60	0.63	0.66	0.78	75	2.92	0.84	0.86	0.86	0.89	100	0.43	0.74	0.76	0.78	0.84	90	0.27	0.01	0.01	0.07	0.44	2	2.16
A-2	Apartments, Paving, Drives/Walks & Landscaping	3.59	0.62	0.64	0.67	0.78	87.9	0.60	0.63	0.66	0.78	90	2.76	0.84	0.86	0.86	0.89	100	0.43	0.74	0.76	0.78	0.84	90	0.26	0.01	0.01	0.07	0.44	2	0.14
C-1	Paving, Drives/Walks, & Landscaping	0.56	0.51	0.52	0.54	0.71	60.9	0.60	0.63	0.66	0.78	90	0.00	0.84	0.86	0.86	0.89	100	0.22	0.74	0.76	0.78	0.84	90	0.13	0.01	0.01	0.07	0.44	2	0.21
C-2	Paving, Drives/Walks, & Landscaping	0.35	0.80	0.82	0.83	0.87	96.3	0.60	0.63	0.66	0.78	90	0.00	0.84	0.86	0.86	0.89	100	0.22	0.74	0.76	0.78	0.84	90	0.13	0.01	0.01	0.07	0.44	2	0.00
C-3	Apartments & Landscaping	2.15	0.51	0.53	0.57	0.73	76.0	0.60	0.63	0.66	0.78	90	1.81	0.84	0.86	0.86	0.89	100	0.00	0.74	0.76	0.78	0.84	90	0.00	0.01	0.01	0.07	0.44	2	0.34
C-4	Apartments, Landscaping & Detention Pond	1.65	0.35	0.37	0.41	0.64	52.9	0.60	0.63	0.66	0.78	90	0.95	0.84	0.86	0.86	0.89	100	0.00	0.74	0.76	0.78	0.84	90	0.00	0.01	0.01	0.07	0.44	2	0.70
C-5	Landscaping	0.40	0.01	0.01	0.07	0.44	2.0	0.60	0.63	0.66	0.78	90	0.00	0.84	0.86	0.86	0.89	100	0.00	0.74	0.76	0.78	0.84	90	0.00	0.01	0.01	0.07	0.44	2	0.40
C-6	Paving, Drives/Walks, & Landscaping	0.56	0.33	0.34	0.38	0.61	40.1	0.60	0.63	0.66	0.78	90	0.00	0.84	0.86	0.86	0.89	100	0.14	0.74	0.76	0.78	0.84	90	0.08	0.01	0.01	0.07	0.44	2	0.33
OS-1	Landscaping	5.38	0.01	0.01	0.07	0.44	2.0	0.60	0.63	0.66	0.78	90	0.00	0.84	0.86	0.86	0.89	100	0.00	0.74	0.76	0.78	0.84	90	0.00	0.01	0.01	0.07	0.44	2	5.38
OS-2	Landscaping	15.28	0.01	0.01	0.07	0.44	2.0	0.60	0.63	0.66	0.78	90	0.00	0.84	0.86	0.86	0.89	100	0.00	0.74	0.76	0.78	0.84	90	0.00	0.01	0.01	0.07	0.44	2	15.28
OS-3	Landscaping	4.89	0.01	0.01	0.07	0.44	2.0	0.60	0.63	0.66	0.78	90	0.00	0.84	0.86	0.86	0.89	100	0.00	0.74	0.76	0.78	0.84	90	0.00	0.01	0.01	0.07	0.44	2	4.89
Total		**5.67**	0.43	0.44	0.48	0.68	60.2	0.60	0.63	0.66	0.78	90	**2.76**	0.84	0.86	0.86	0.89	100	**0.58**	0.74	0.76	0.78	0.84	90	**0.34**	0.01	0.01	0.07	0.44	2	**1.98**

MATCHES OUR POND B AREA

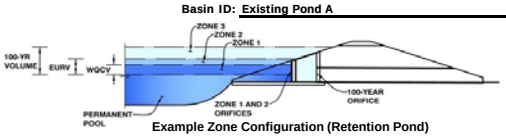
EES POND A DESIGN SHEETS FOR REFERENCE

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: Hillside at Castle Rock - Phase 3& 4

Basin ID: Existing Pond A



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB	
Watershed Area =	51.26	acres
Watershed Length =	1,949	ft
Watershed Length to Centroid =	1,000	ft
Watershed Slope =	0.080	ft/ft
Watershed Imperviousness =	26.00%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	47.0%	percent
Percentage Hydrologic Soil Groups C/D =	53.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	Denver - Capitol Building	

Steep Slope > 0.06 ft/ft

After providing required inputs above including 1-hour rainfall depths, click 'Run CUHP' to generate runoff hydrographs using the embedded Colorado Urban Hydrograph Procedure.

			Optional User Overrides
Water Quality Capture Volume (WQCV) =	0.591	acre-feet	acre-feet
Excess Urban Runoff Volume (EURV) =	1.270	acre-feet	acre-feet
2-yr Runoff Volume (P1 = 1.06 in.) =	1.125	acre-feet	1.06 inches
5-yr Runoff Volume (P1 = 1.43 in.) =	2.330	acre-feet	1.43 inches
10-yr Runoff Volume (P1 = 1.66 in.) =	3.201	acre-feet	1.66 inches
25-yr Runoff Volume (P1 = 2.07 in.) =	5.203	acre-feet	2.07 inches
50-yr Runoff Volume (P1 = 2.26 in.) =	5.996	acre-feet	2.26 inches
100-yr Runoff Volume (P1 = 2.6 in.) =	7.705	acre-feet	2.60 inches
500-yr Runoff Volume (P1 = 3.7 in.) =	12.547	acre-feet	3.70 inches
Approximate 2-yr Detention Volume =	0.880	acre-feet	
Approximate 5-yr Detention Volume =	1.512	acre-feet	
Approximate 10-yr Detention Volume =	1.970	acre-feet	
Approximate 25-yr Detention Volume =	2.493	acre-feet	
Approximate 50-yr Detention Volume =	2.543	acre-feet	
Approximate 100-yr Detention Volume =	3.199	acre-feet	

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.591	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.679	acre-feet
Zone 3 (100yr + 1 / 2 WQCV - Zones 1 & 2) =	2.225	acre-feet
Total Detention Basin Volume =	3.494	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	--	--	--	20	0.000		
	--	1.00	--	--	--	1,846	0.042	933	0.021
	--	2.00	--	--	--	10,022	0.230	6,867	0.158
	--	3.00	--	--	--	18,940	0.435	21,348	0.490
	--	4.00	--	--	--	21,439	0.492	41,537	0.954
	--	5.00	--	--	--	24,016	0.551	64,265	1.475
	--	6.00	--	--	--	26,723	0.613	89,634	2.058
	--	7.00	--	--	--	29,538	0.678	117,765	2.704
	--	8.00	--	--	--	32,449	0.745	148,758	3.415
	--	9.00	--	--	--	35,454	0.814	182,710	4.194
	--	10.00	--	--	--	38,651	0.887	219,762	5.045
	--	11.00	--	--	--	38,651	0.887	258,413	5.932
	--	12.00	--	--	--	38,651	0.887	297,064	6.820
	--	13.00	--	--	--	38,651	0.887	335,715	7.707
	--		--	--	--				

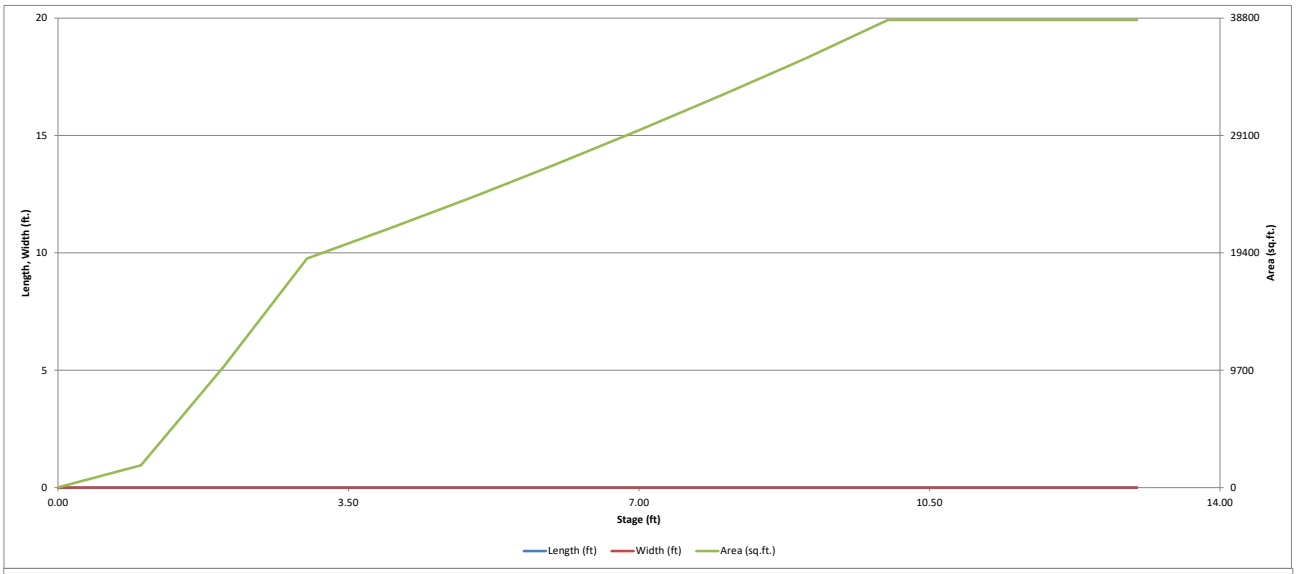
WATERSHED INFO MATCHES TO JR'S CALCULATED VALUES.

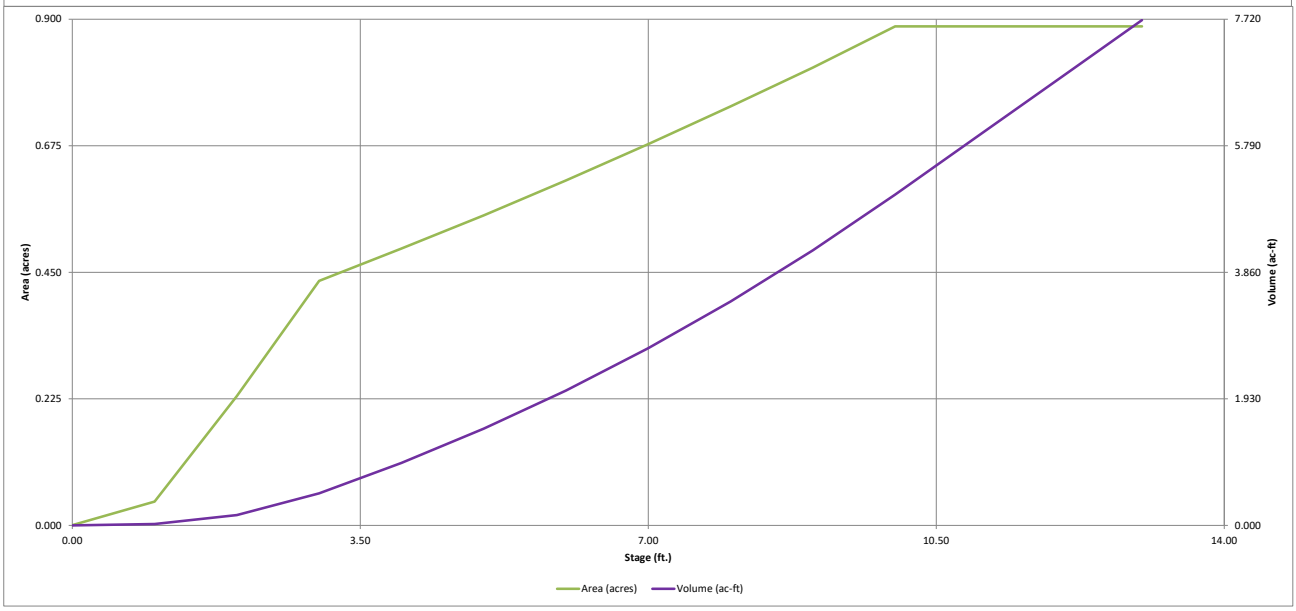
MUCH NEWER THAN PARAGON REPORT, ALSO CLOSER TO OUR MATH

EES POND A DESIGN SHEETS FOR REFERENCE

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)





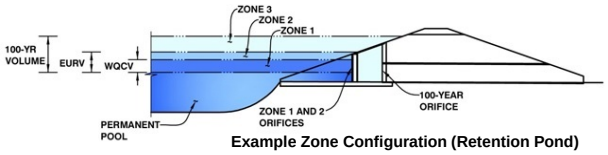
EES POND A DESIGN SHEETS FOR REFERENCE

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: Hillside at Castle Rock - Phase 3& 4

Basin ID: Existing Pond A



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.23	0.591	Orifice Plate
Zone 2 (EURV)	4.62	0.679	Orifice Plate
3 (100+1/2WQCV)	8.11	2.225	Weir&Pipe (Restrict)
Total (all zones)		3.494	

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)

Centroid of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	N/A	ft^2
Depth at top of Zone using Orifice Plate =	4.59	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 =	N/A	sq. 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	1.36	2.72					
Orifice Area (sq. inches)	2.08	2.08	2.08					

	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 =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	N/A	N/A	ft^2
Depth at top of Zone using Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	N/A	N/A	feet
Vertical Orifice Diameter =	N/A	N/A	inches				

Calculated Parameters for Vertical Orifice

User Input: Overflow Weir (Dropbox with Flat or Sloped Grate and Outlet Pipe OR Rectangular/Trapezoidal Weir and No Outlet Pipe)

	Zone 3 Weir	Not Selected			Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	4.10	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	7.35	N/A	feet
Overflow Weir Front Edge Length =	4.00	N/A	feet	Overflow Weir Slope Length =	13.40	N/A	feet
Overflow Weir Grate Slope =	4.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	9.04	N/A	
Horiz. Length of Weir Sides =	13.00	N/A	feet	Overflow Grate Open Area w/o Debris =	37.31	N/A	ft^2
Overflow Grate Type =	Type C Grate	N/A		Overflow Grate Open Area w/ Debris =	18.65	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 Restrictor	Not Selected			Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	2.83	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	4.13	N/A	ft^2
Outlet Pipe Diameter =	30.00	N/A	inches	Outlet Orifice Centroid =	1.07	N/A	feet
Restrictor Plate Height Above Pipe Invert =	23.50		inches	Half-Central Angle of Restrictor Plate on Pipe =	2.17	N/A	radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	8.00	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.94	feet
Spillway Crest Length =	38.00	feet	Stage at Top of Freeboard =	9.94	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	0.88	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	4.99	acre-ft

Calculated Parameters for Spillway

Routed Hydrograph Results

The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

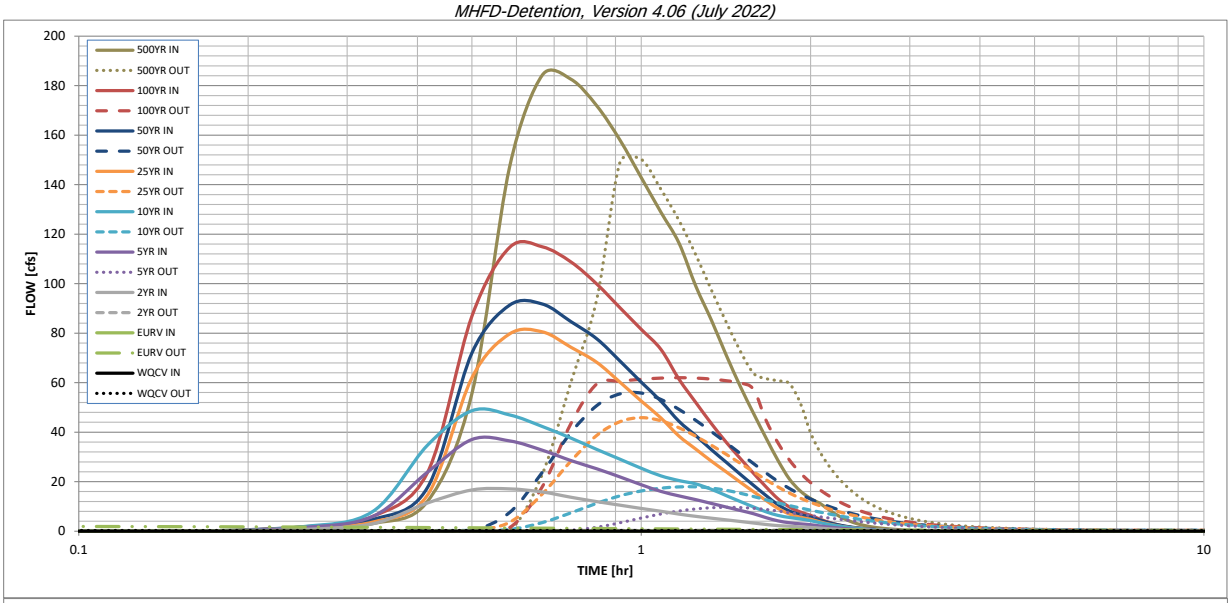
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.06	1.43	1.66	2.07	2.26	2.60	3.70
CUHP Runoff Volume (acre-ft) =	0.591	1.270	1.125	2.330	3.201	5.203	5.996	7.705	12.547
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	1.125	2.330	3.201	5.203	5.996	7.705	12.547
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	3.8	21.8	32.0	63.9	74.5	96.1	159.6
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.07	0.43	0.62	1.25	1.45	1.88	3.11
Peak Inflow Q (cfs) =	N/A	N/A	17.1	37.0	48.7	80.5	91.8	114.9	184.2
Peak Outflow Q (cfs) =	0.3	2.1	0.5	9.6	17.9	45.8	55.8	62.0	150.2
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.4	0.6	0.7	0.7	0.65	0.9
Structure Controlling Flow =	Plate	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	0.05	0.00	0.2	0.5	1.2	1.5	1.6	1.7
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	41	58	59	57	55	50	48	44	35
Time to Drain 99% of Inflow Volume (hours) =	**44**	63	63	64	63	60	59	57	53
Maximum Ponding Depth (ft) =	3.23	4.62	4.21	5.33	5.78	6.73	6.98	7.99	8.79
Area at Maximum Ponding Depth (acres) =	0.45	0.53	0.50	0.57	0.60	0.66	0.68	0.74	0.80
Maximum Volume Stored (acre-ft) =	0.592	1.270	1.058	1.655	1.924	2.523	2.690	3.400	4.025

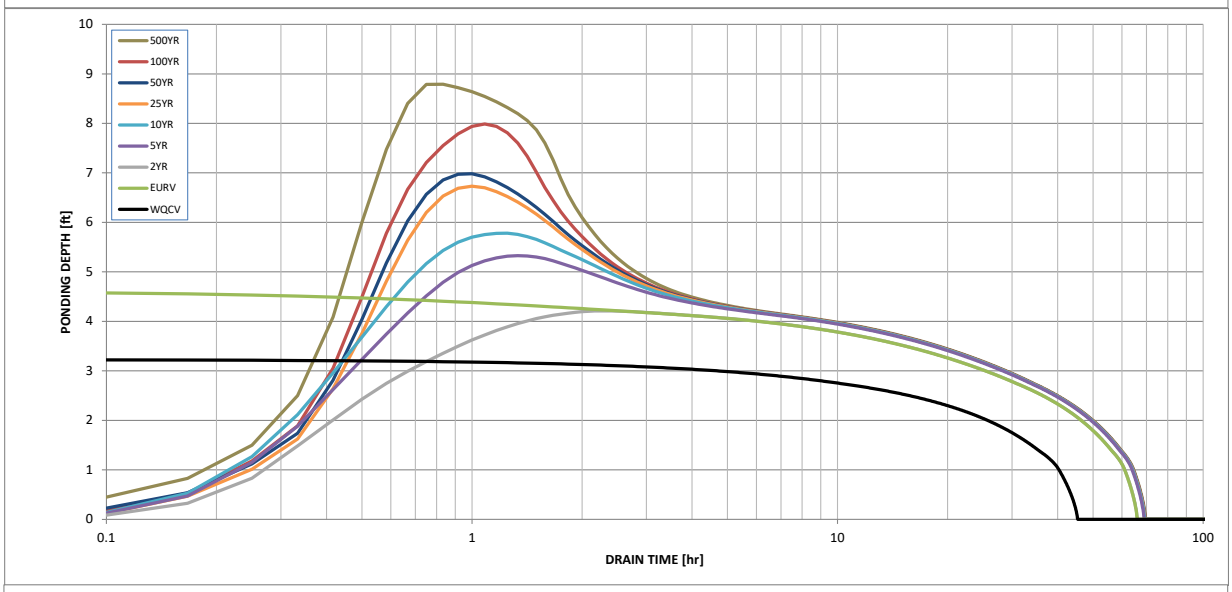
EXACT SAME AS APPROVED PARAGON DESIGN UNTIL THIS AREA

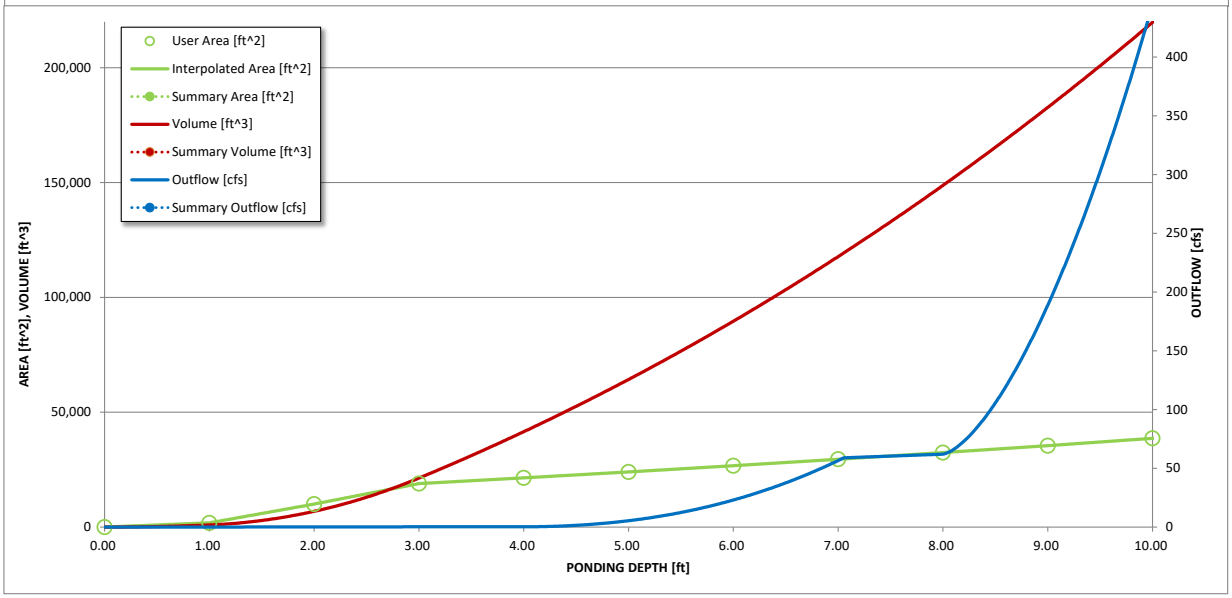
EES POND A DESIGN SHEETS FOR REFERENCE

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)







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

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename:

Inflow Hydrographs

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

	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.06	0.68
	0:15:00	0.00	0.00	0.72	1.46	1.81	1.43	1.69	1.73	3.06
	0:20:00	0.00	0.00	3.02	6.00	8.00	3.69	4.71	6.00	12.00
	0:25:00	0.00	0.00	11.38	23.82	34.71	14.55	17.60	23.63	55.67
	0:30:00	0.00	0.00	16.66	37.04	48.67	62.04	72.05	86.91	147.20
	0:35:00	0.00	0.00	17.08	36.47	46.96	79.70	91.32	114.64	184.23
	0:40:00	0.00	0.00	15.84	32.72	42.30	80.54	91.78	114.90	182.57
	0:45:00	0.00	0.00	13.70	28.51	37.59	74.29	84.63	108.75	171.87
	0:50:00	0.00	0.00	11.94	25.21	33.03	68.21	77.72	99.86	157.96
	0:55:00	0.00	0.00	10.50	21.91	29.06	60.16	68.72	90.24	142.82
	1:00:00	0.00	0.00	9.18	18.75	25.40	52.55	60.17	81.51	128.89
	1:05:00	0.00	0.00	8.04	16.08	22.35	45.76	52.55	73.47	116.42
	1:10:00	0.00	0.00	6.89	14.26	20.45	38.42	44.41	61.42	98.97
	1:15:00	0.00	0.00	5.99	12.74	19.09	33.14	38.58	51.97	85.09
	1:20:00	0.00	0.00	5.24	11.19	16.88	28.23	32.86	43.37	70.97
	1:25:00	0.00	0.00	4.57	9.74	14.33	23.92	27.79	35.85	58.43
	1:30:00	0.00	0.00	3.92	8.36	11.97	19.77	22.96	29.34	47.56
	1:35:00	0.00	0.00	3.29	7.04	9.78	15.95	18.51	23.36	37.61
	1:40:00	0.00	0.00	2.71	5.46	7.82	12.38	14.38	17.86	28.56
	1:45:00	0.00	0.00	2.25	4.17	6.37	9.17	10.68	13.06	21.08
	1:50:00	0.00	0.00	2.00	3.41	5.55	6.94	8.15	9.78	16.25
	1:55:00	0.00	0.00	1.73	2.96	4.93	5.63	6.66	7.76	13.19
	2:00:00	0.00	0.00	1.52	2.61	4.25	4.81	5.71	6.39	11.05
	2:05:00	0.00	0.00	1.22	2.07	3.37	3.68	4.38	4.75	8.29
	2:10:00	0.00	0.00	0.95	1.60	2.62	2.76	3.29	3.42	6.01
	2:15:00	0.00	0.00	0.74	1.24	2.02	2.07	2.47	2.43	4.30
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	2:25:00	0.00	0.00	0.44	0.73	1.14	1.15	1.36	1.26	2.24
	2:30:00	0.00	0.00	0.34	0.54	0.83	0.86	1.01	0.94	1.65
	2:35:00	0.00	0.00	0.26	0.40	0.62	0.64	0.75	0.71	1.24
	2:40:00	0.00	0.00	0.20	0.29	0.47	0.48	0.56	0.54	0.94
	2:45:00	0.00	0.00	0.15	0.21	0.35	0.36	0.42	0.41	0.71
	2:50:00	0.00	0.00	0.10	0.14	0.25	0.26	0.31	0.30	0.52
	2:55:00	0.00	0.00	0.07	0.09	0.16	0.18	0.21	0.21	0.35
	3:00:00	0.00	0.00	0.04	0.06	0.10	0.12	0.14	0.13	0.22
	3:05:00	0.00	0.00	0.02	0.03	0.05	0.06	0.07	0.07	0.11
	3:10:00	0.00	0.00	0.01	0.01	0.02	0.03	0.03	0.03	0.04
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

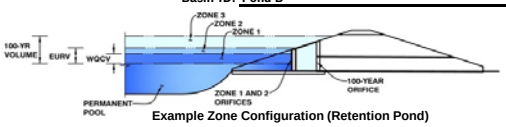
EES POND B DESIGN SHEETS FOR REFERENCE

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: Hillside at Castle Rock - Phase 3 & 4

Basin ID: Pond B



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB	
Watershed Area =	5.38	acres
Watershed Length =	579	ft
Watershed Length to Centroid =	376	ft
Watershed Slope =	0.060	ft/ft
Watershed Imperviousness =	66.30%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	99.2%	percent
Percentage Hydrologic Soil Groups C/D =	0.8%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	Highlands Ranch - Highlands Ranch Mansion	

After providing required inputs above including 1-hour rainfall depths, click 'Run CUHP' to generate runoff hydrographs using the embedded Colorado Urban Hydrograph Procedure.

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.116	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.390	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.06 in.) =	0.286	acre-feet	1.06	inches
5-yr Runoff Volume (P1 = 1.43 in.) =	0.428	acre-feet	1.43	inches
10-yr Runoff Volume (P1 = 1.66 in.) =	0.520	acre-feet	1.66	inches
25-yr Runoff Volume (P1 = 1.67 in.) =	0.542	acre-feet		inches
50-yr Runoff Volume (P1 = 2.26 in.) =	0.795	acre-feet	2.26	inches
100-yr Runoff Volume (P1 = 2.6 in.) =	0.956	acre-feet	2.60	inches
500-yr Runoff Volume (P1 = 3.01 in.) =	1.138	acre-feet		inches
Approximate 2-yr Detention Volume =	0.270	acre-feet		
Approximate 5-yr Detention Volume =	0.387	acre-feet		
Approximate 10-yr Detention Volume =	0.489	acre-feet		
Approximate 25-yr Detention Volume =	0.463	acre-feet		
Approximate 50-yr Detention Volume =	0.580	acre-feet		
Approximate 100-yr Detention Volume =	0.643	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.116	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.273	acre-feet
Zone 3 (100yr + 1 / 2 WQCV - Zones 1 & 2) =	0.311	acre-feet
Total Detention Basin Volume =	0.701	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

6275

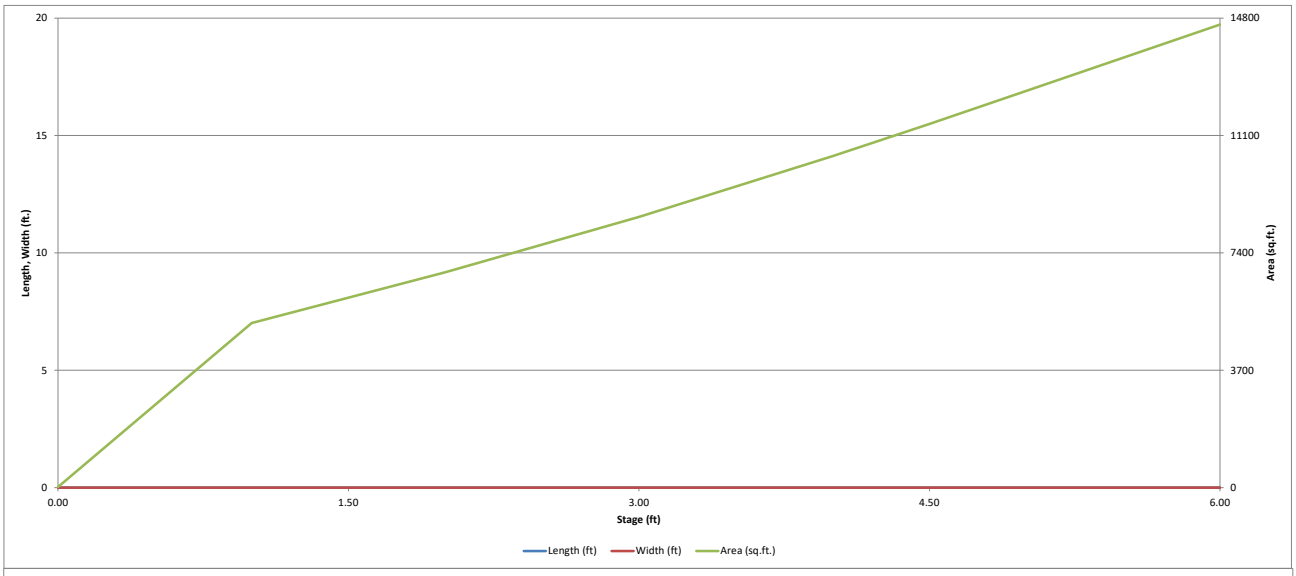
Depth Increment = ft

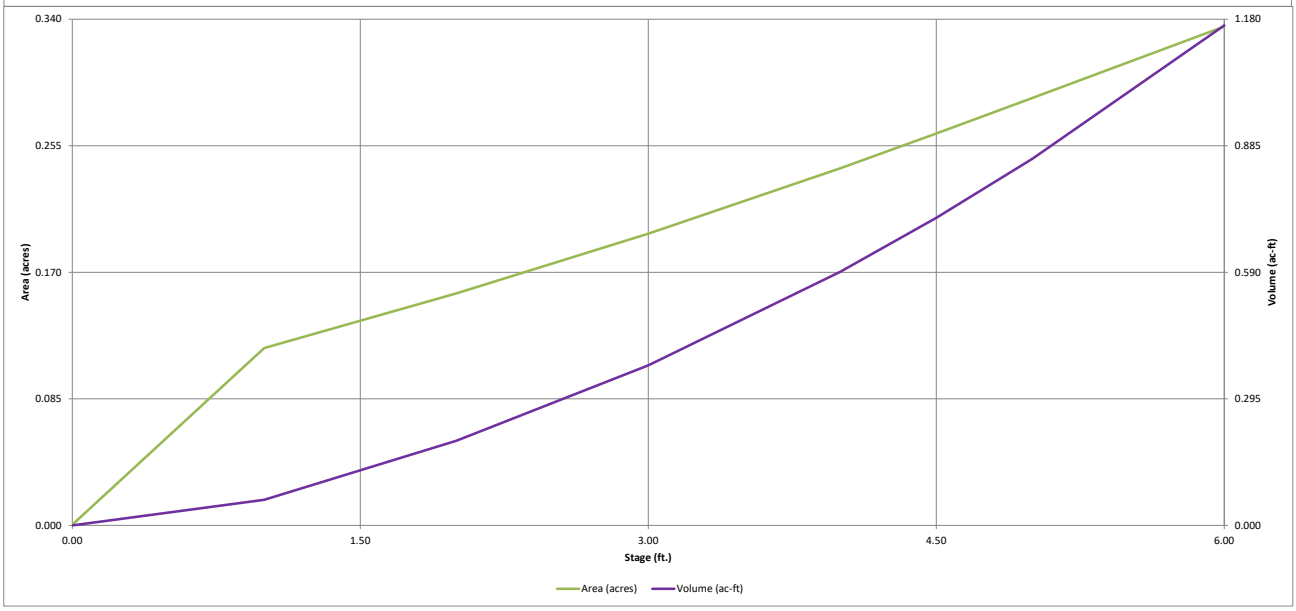
Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	20	0.000		
76	--	1.00	--	--	--	5,190	0.119	2,605	0.060
77	--	2.00	--	--	--	6,788	0.156	8,594	0.197
78	--	3.00	--	--	--	8,535	0.196	16,255	0.373
79	--	4.00	--	--	--	10,450	0.240	25,748	0.591
Spill Invert -79.5	--	4.50	--	--	--	11,465	0.263	31,227	0.717
80	--	5.00	--	--	--	12,507	0.287	37,220	0.854
81	--	6.00	--	--	--	14,597	0.335	50,772	1.166

EES POND B DESIGN SHEETS FOR REFERENCE

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)





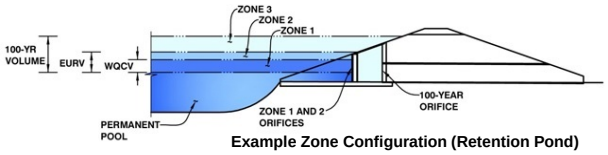
EES POND B DESIGN SHEETS FOR REFERENCE

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: Hillside at Castle Rock - Phase 3 & 4

Basin ID: Pond B



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	1.45	0.116	Orifice Plate
Zone 2 (EURV)	3.09	0.273	Orifice Plate
3 (100+1/2WQCV)	4.44	0.311	Weir&Pipe (Restrict)
Total (all zones)		0.701	

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	ft²
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)

Centroid of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	7.153E-03	ft²
Depth at top of Zone using Orifice Plate =	3.09	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	12.40	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	1.03	sq. inches (diameter = 1-1/8 inches)	Elliptical Slot Area =	N/A	ft²

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	1.03	2.06					
Orifice Area (sq. inches)	1.03	1.03	1.03					

	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 =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	N/A	N/A	ft²
Depth at top of Zone using Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	N/A	N/A	feet
Vertical Orifice Diameter =	N/A	N/A	inches				

Calculated Parameters for Vertical Orifice

User Input: Overflow Weir (Dropbox with Flat or Sloped Grate and Outlet Pipe OR Rectangular/Trapezoidal Weir and No Outlet Pipe)

	Zone 3 Weir	Not Selected			Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	3.09	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	3.09	N/A	feet
Overflow Weir Front Edge Length =	2.80	N/A	feet	Overflow Weir Slope Length =	3.40	N/A	feet
Overflow Weir Grate Slope =	0.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	10.71	N/A	
Horiz. Length of Weir Sides =	3.40	N/A	feet	Overflow Grate Open Area w/o Debris =	7.53	N/A	ft²
Overflow Grate Type =	Close Mesh Grate	N/A		Overflow Grate Open Area w/ Debris =	3.77	N/A	ft²
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 Restrictor	Not Selected			Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	2.50	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	0.70	N/A	ft²
Outlet Pipe Diameter =	18.00	N/A	inches	Outlet Orifice Centroid =	0.37	N/A	feet
Restrictor Plate Height Above Pipe Invert =	7.55		inches	Half-Central Angle of Restrictor Plate on Pipe =	1.41	N/A	radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	4.50	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.78	feet
Spillway Crest Length =	7.00	feet	Stage at Top of Freeboard =	6.28	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	0.34	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	1.17	acre-ft

Calculated Parameters for Spillway

Routed Hydrograph Results

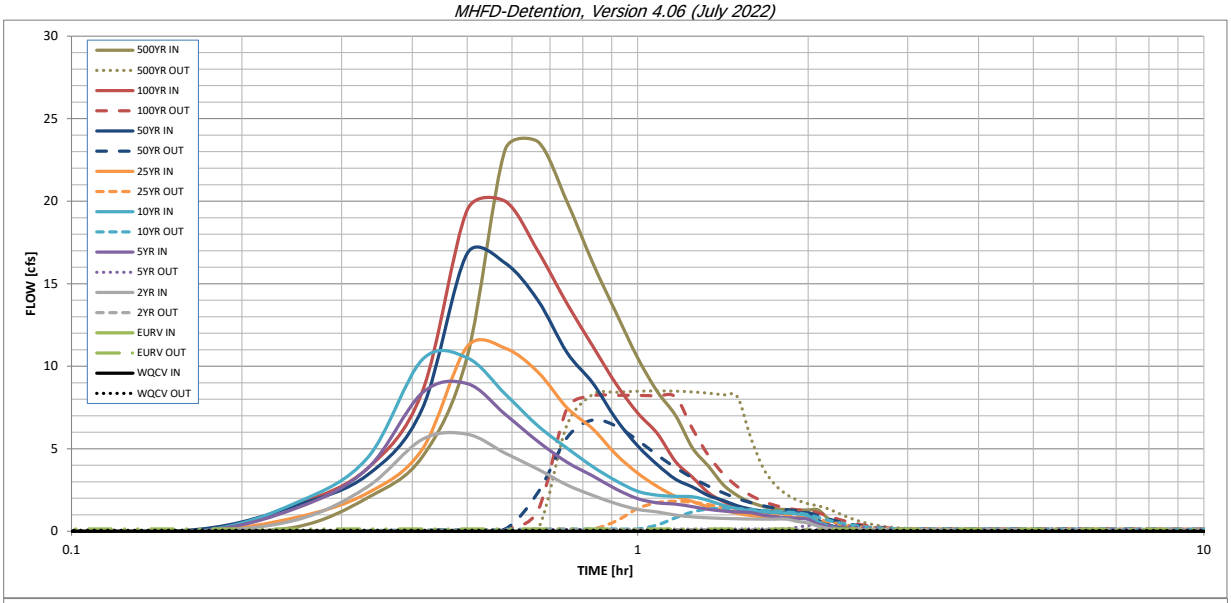
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

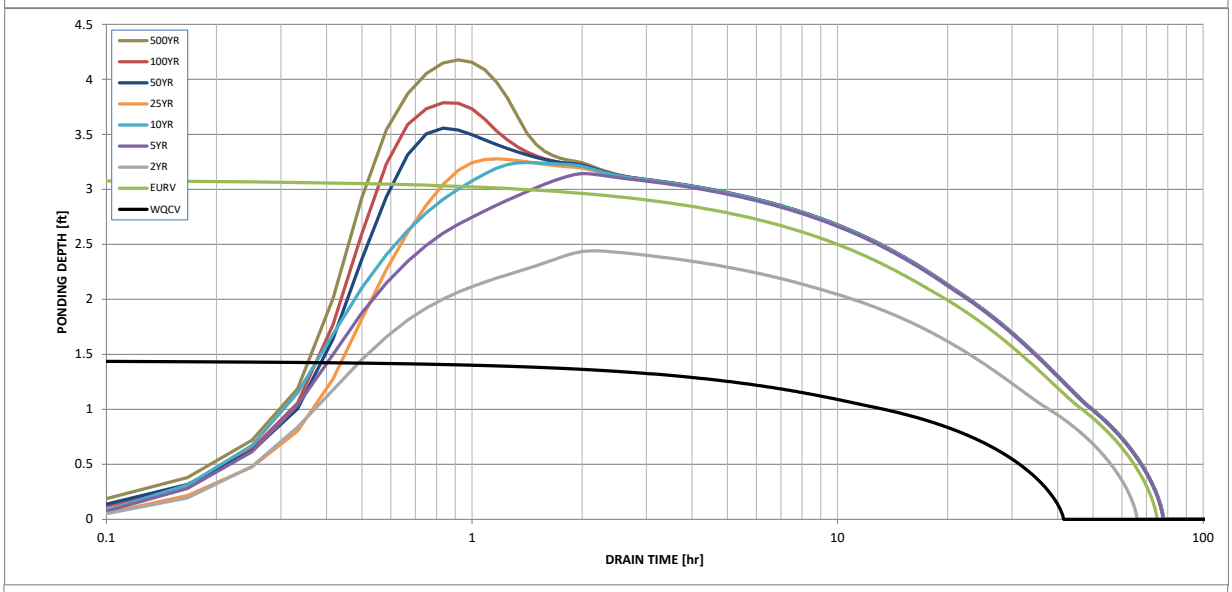
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.06	1.43	1.66	1.67	2.26	2.60	3.01
CUHP Runoff Volume (acre-ft) =	0.116	0.390	0.286	0.428	0.520	0.542	0.795	0.956	1.138
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.286	0.428	0.520	0.542	0.795	0.956	1.138
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.1	1.8	2.7	3.7	7.0	9.14	11.4
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.02	0.33	0.50	0.69	1.31	1.70	2.11
Peak Inflow Q (cfs) =	N/A	N/A	5.9	8.9	10.5	11.2	16.8	20.0	23.6
Peak Outflow Q (cfs) =	0.1	0.1	0.1	0.4	1.4	1.8	6.7	8.2	8.5
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.2	0.5	0.5	1.0	0.90	0.7
Structure Controlling Flow =	Plate	Overflow Weir 1	Plate	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Outlet Plate 1
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	0.0	0.2	0.2	0.9	1.1	1.1
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	38	67	59	69	68	67	64	62	60
Time to Drain 99% of Inflow Volume (hours) =	**40**	71	63	74	73	73	72	71	70
Maximum Ponding Depth (ft) =	1.45	3.09	2.44	3.14	3.24	3.28	3.56	3.79	4.18
Area at Maximum Ponding Depth (acres) =	0.14	0.20	0.17	0.20	0.21	0.21	0.22	0.23	0.25
Maximum Volume Stored (acre-ft) =	0.117	0.391	0.270	0.401	0.421	0.428	0.488	0.539	0.633

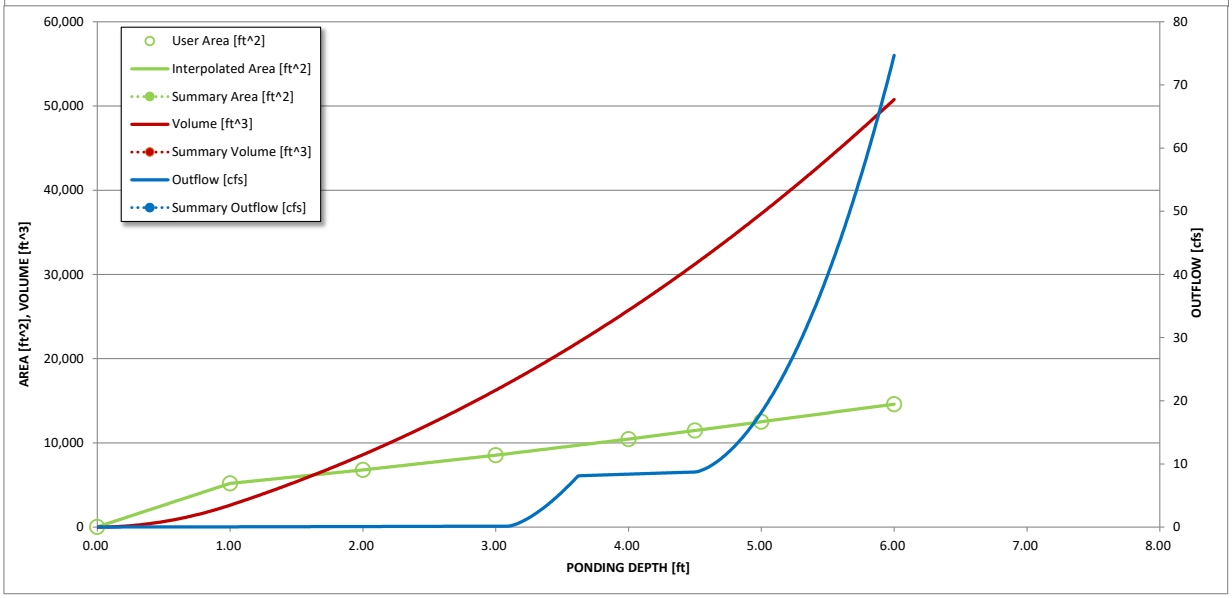
EES POND B DESIGN SHEETS FOR REFERENCE

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)







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

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename:

Inflow Hydrographs

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

	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.05	0.27
	0:15:00	0.00	0.00	0.70	1.41	1.75	0.85	1.59	1.64	2.03
	0:20:00	0.00	0.00	2.70	3.81	4.45	2.32	3.42	3.82	4.52
	0:25:00	0.00	0.00	5.57	8.39	10.41	4.98	7.44	8.48	10.58
	0:30:00	0.00	0.00	5.88	8.95	10.51	11.19	16.83	19.47	23.12
	0:35:00	0.00	0.00	4.74	7.09	8.32	11.10	16.25	20.00	23.60
	0:40:00	0.00	0.00	3.76	5.44	6.39	9.65	13.99	16.97	19.98
	0:45:00	0.00	0.00	2.81	4.19	5.04	7.49	10.84	13.81	16.25
	0:50:00	0.00	0.00	2.18	3.35	3.91	6.20	8.98	11.21	13.21
	0:55:00	0.00	0.00	1.68	2.55	3.05	4.64	6.78	8.91	10.51
	1:00:00	0.00	0.00	1.33	1.98	2.43	3.52	5.18	7.17	8.46
	1:05:00	0.00	0.00	1.17	1.73	2.19	2.72	4.04	5.92	7.02
	1:10:00	0.00	0.00	0.98	1.65	2.12	2.12	3.16	4.22	5.05
	1:15:00	0.00	0.00	0.88	1.49	2.09	1.81	2.68	3.27	3.95
	1:20:00	0.00	0.00	0.82	1.33	1.87	1.48	2.17	2.34	2.82
	1:25:00	0.00	0.00	0.78	1.23	1.57	1.28	1.87	1.80	2.17
	1:30:00	0.00	0.00	0.76	1.17	1.38	1.09	1.55	1.47	1.76
	1:35:00	0.00	0.00	0.75	1.14	1.26	0.96	1.35	1.26	1.51
	1:40:00	0.00	0.00	0.74	0.98	1.18	0.89	1.22	1.14	1.37
	1:45:00	0.00	0.00	0.74	0.88	1.13	0.85	1.16	1.10	1.32
	1:50:00	0.00	0.00	0.74	0.82	1.11	0.83	1.12	1.09	1.29
	1:55:00	0.00	0.00	0.60	0.79	1.05	0.82	1.11	1.09	1.29
	2:00:00	0.00	0.00	0.51	0.73	0.94	0.81	1.10	1.09	1.29
	2:05:00	0.00	0.00	0.31	0.44	0.57	0.50	0.68	0.67	0.79
	2:10:00	0.00	0.00	0.19	0.26	0.35	0.30	0.41	0.40	0.48
	2:15:00	0.00	0.00	0.10	0.15	0.20	0.18	0.24	0.23	0.28
	2:20:00	0.00	0.00	0.05	0.09	0.11	0.10	0.13	0.13	0.16
	2:25:00	0.00	0.00	0.02	0.04	0.05	0.05	0.07	0.06	0.08
	2:30:00	0.00	0.00	0.01	0.01	0.01	0.02	0.02	0.02	0.02
	2:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

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DETENTION POND SUMMARY									
POND NAME	TRIBUTARY AREA	REQUIRED VOLUME (WQCV)	WQCV WSEL	REQUIRED VOLUME (EURV)	EURV WSEL	100-YR + ½ WQCV DETENTION VOLUME	PROVIDED VOLUME	100-YEAR WATER SURFACE ELEVATION	100-YEAR RELEASE RATE
EXISTING POND A	51.26	0.591	6304.23	0.68 AC-FT	6305.62	3.494 AC-FT	7.71 AC-FT	6308.99	62.00 CFS
POND B	5.38	0.116	6276.45	0.273 AC-FT	6278.09	0.701 AC-FT	0.717 AC-FT	6278.79	8.20 CFS

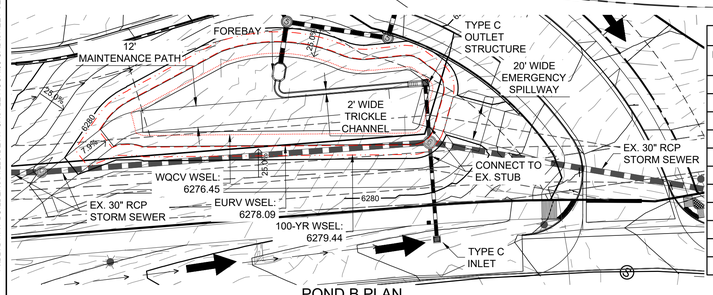
OS3 PROPERLY ROUTED TO POND A IN EES REPORT. ASSUMED TO REACH POND B IN APPROVED PARAGON REPORT

DRAINAGE LEGEND

- PROPOSED PROPERTY LINE
- 5280 2' EXISTING MINOR CONTOUR
- 5280 10' EXISTING MAJOR CONTOUR
- 5280 2' MINOR CONTOUR
- 5280 10' MAJOR CONTOUR
- PROPOSED BASIN DELINEATION
- PROPOSED STORM SEWER (BY OTHERS)
- PROPOSED STORM INLET AND MANHOLE
- EXISTING STORM INLET AND MANHOLE
- PROPOSED DRAINAGE FLOW ARROW
- # DESIGN POINT
- HP / LP HIGH POINT & LOW POINT
- WQCV WSEL
- EURV WSEL
- 100-YEAR WSEL
- A-X / A / A BASIN DESIGNATION, 5-YEAR RUNOFF COEFFICIENT, 100-YEAR RUNOFF COEFFICIENT, BASIN AREA IN ACRES

OS-1 5.38 0.01 0.44
OS-2 15.28 0.01 0.44
OS-3 4.89 0.01 0.44
B-1 4.58 46 66
B-2 4.98 46 66
B-3 3.29 08 35
B-4 2.18 08 35
B-5 1.08 29 47
D-1 1.61 25 45
D-2 1.34 23 42
D-3 0.34 41 60
D-4
D-5 1.82 31 52
A-1 5.51 0.44 70
A-2 3.59 64 78
C-1 0.56 52 71
C-2 0.35 82 87
C-3 2.15 53 73
C-4 1.65 37 64
C-5 0.56 34 61
C-6 0.56 34 61

ROCK MITIGATION CHANNEL
GRAYSIDE CIRCLE
GRAYSIDE CIRCLE
WOLFENSBERGER ROAD
INLET A-1 4 - TRIPLE NO. 16 COMBO INLETS
INLET A-2 4 - TRIPLE NO. 16 COMBO INLETS
INLET C-3 TYPE C INLET
SWALE C-3
SWALE C-3
INLET C-1 2 - DOUBLE NO. 16 COMBO INLETS
INLET C-2 2 - DOUBLE NO. 16 COMBO INLETS
SWALE C-4
EX. DETENTION POND A
DETENTION POND B
INLET D-5 TYPE C INLET
EX. 30" RCP STORM SEWER
EX. 30" RCP STORM SEWER
EX. 36" RCP STORM SEWER
EX. 12' X 8' CONCRETE BOX CULVERT



POND B PLAN
SCALE: 1"=20'

DIRECT RUNOFF BASIN SUMMARY TABLE						
DESIGN POINT	BASIN ID	TRIBUTARY AREA (ACRES)	C_5	C_{100}	5-YEAR RUNOFF (CFS)	100-YEAR RUNOFF (CFS)
1	OS-1	5.38	0.01	0.44	0.13	10.20
2	OS-2	15.28	0.01	0.44	0.29	22.98
3	OS-3	4.89	0.01	0.44	0.14	11.45
5	A-1	5.51	0.48	0.70	8.06	23.09
6	A-2	3.59	0.64	0.78	8.54	18.94
7	C-1	0.56	0.52	0.71	1.40	3.48
8	C-2	0.35	0.82	0.87	1.38	2.67
9	C-3	2.15	0.53	0.73	4.20	10.43
10	C-4	1.65	0.37	0.64	2.06	6.48
11	C-5	0.40	0.01	0.44	0.02	1.55
12	C-6	0.56	0.34	0.61	0.92	3.04

N

SCALE IN FEET 0 100 200

IF BAR DOES NOT MEASURE 1 INCH THEN DRAWING IS NOT TO SCALE

TOWN APPROVAL BLOCK

TOWN OF CASTLE ROCK APPROVAL
PLANS ARE HEREBY APPROVED FOR ONE YEAR FROM DATE OF DEVELOPMENT SERVICES APPROVAL

APPROVED BY:

DEVELOPMENT SERVICES DATE

No.	REVISION	BY	DATE

PRELIMINARY NOT FOR CONSTRUCTION

EES ENTITLEMENT AND ENGINEERING SOLUTIONS, INC.
3801 E. Florida Avenue, Suite 425
Denver, CO 80210
303-572-7997 www.ees.us.com

BLVD. BUILDERS

CONSTRUCTION DOCUMENTS

HILLSIDE AT CASTLE ROCK - PHASES 3-4

NEC WOLFSENBERGER ROAD AND COACHLINE ROAD

PROPOSED DRAINAGE MAP

PROJECT NO:	BLV001.02
DESIGNED BY:	MG
DRAWN BY:	MG
DATE:	2023/08/02

2
SHEET 2 OF 2

CD23-0036

P:\BLVD\HWY BUILDERS\HILLSIDE AT CASTLE ROCK\08 CAD\SHEET SET\5\DRAINAGE PLANS\PROPOSED DRAINAGE MAP.DWG 12/5/2023 1:18 PM Gregory Rivera

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TOWN OF CASTLE ROCK GENERAL NOTES:

1. ALL MATERIALS, WORKMANSHIP, AND CONSTRUCTION OF PUBLIC IMPROVEMENTS SHALL MEET OR EXCEED THE STANDARDS AND SPECIFICATIONS SET FORTH IN THE TOWN OF CASTLE ROCK (TCR) MUNICIPAL CODE, TCR TECHNICAL MANUALS, AND APPLICABLE STATE AND FEDERAL REGULATIONS. WHERE THERE IS CONFLICT BETWEEN THESE PLANS AND THE TECHNICAL MANUAL OR ANY APPLICABLE STANDARDS, THE MORE STRINGENT STANDARD SHALL APPLY. ALL WORK SHALL BE INSPECTED AND APPROVED BY THE TCR CONSTRUCTION INSPECTOR.

2. THE CONTRACTOR IS SPECIFICALLY CAUTIONED THAT THE LOCATION AND/OR ELEVATION OF EXISTING UTILITIES AS SHOWN ON THESE PLANS IS BASED ON RECORDS OF THE VARIOUS UTILITY COMPANIES AND, WHERE POSSIBLE, MEASUREMENTS TAKEN IN THE FIELD. THE INFORMATION IS NOT TO BE RELIED UPON AS BEING EXACT OR COMPLETE.

3. THE CONTRACTOR MUST CALL THE LOCAL UTILITY LOCATION CENTER AT LEAST 72 HOURS BEFORE ANY EXCAVATION TO REQUEST EXACT FIELD LOCATIONS OF THE UTILITIES. PRIOR TO CONSTRUCTION, THE CONTRACTOR SHALL VERIFY PERTINENT LOCATIONS AND ELEVATIONS, ESPECIALLY AT CONNECTION POINTS AND AT POTENTIAL UTILITY CONFLICTS. IT SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR TO RELOCATE ALL EXISTING UTILITIES THAT CONFLICT WITH THE PROPOSED IMPROVEMENTS SHOWN ON THESE PLANS.

4. THE CONTRACTOR SHALL COORDINATE AND COOPERATE WITH THE TOWN AND ALL UTILITY COMPANIES INVOLVED WITH REGARD TO RELOCATIONS OR ADJUSTMENTS OF EXISTING UTILITIES DURING CONSTRUCTION AND TO ASSURE THAT THE WORK IS ACCOMPLISHED IN A TIMELY FASHION AND WITH A MINIMUM DISRUPTION OF SERVICE. THE CONTRACTOR SHALL BE RESPONSIBLE FOR CONTACTING ALL PARTIES AFFECTED BY ANY DISRUPTION OF ANY UTILITY SERVICE.

5. CONTRACTOR SHALL PROVIDE A MINIMUM SEVENTY-TWO (72) HOURS NOTICE TO THE ON-SITE TCR CONSTRUCTION INSPECTOR, (720) 733-2200, PRIOR TO MAKING ANY CONNECTIONS/TIE-INS TO EXISTING WATER, SANITARY SEWER, AND/OR STORM SEWER SYSTEMS PROVIDED THAT THE UTILITY TIE-IN DOES NOT DISRUPT SERVICE TO EXISTING CR WATER CUSTOMERS. IF THE TIE-IN WILL DISRUPT UTILITY SERVICE, THEN CONTRACTOR SHALL PROVIDE A MINIMUM OF THREE (3) WEEKS NOTICE TO THE TCR CONSTRUCTION INSPECTOR TO ALLOW TIME FOR CR WATER TO PROVIDE WRITTEN NOTIFICATION TO EXISTING CUSTOMERS AFFECTED BY THE TIE-IN. ALL TOWN UTILITY TIE-INS MUST BE APPROVED BY CR WATER PRIOR TO COMMENCING WORK.

6. THE CONTRACTOR SHALL HAVE ONE (1) SIGNED COPY OF THE APPROVED PLANS, ONE (1) COPY OF THE APPROPRIATE CRITERIA AND SPECIFICATIONS, AND A COPY OF ANY PERMITS AND EXTENSION AGREEMENTS NEEDED FOR THE JOB ONSITE AT ALL TIMES.

7. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ALL ASPECTS OF SAFETY INCLUDING, BUT NOT LIMITED TO, EXCAVATION, TRENCHING, SHORING, TRAFFIC CONTROL, AND SECURITY.

8. IF DURING THE CONSTRUCTION PROCESS CONDITIONS ARE ENCOUNTERED WHICH COULD INDICATE A SITUATION THAT IS NOT IDENTIFIED IN THE PLANS OR SPECIFICATIONS, THE CONTRACTOR SHALL CONTACT THE TCR CONSTRUCTION INSPECTOR IMMEDIATELY.

9. ALL REFERENCES TO ANY PUBLISHED STANDARDS SHALL REFER TO THE LATEST REVISION OF SAID STANDARD UNLESS SPECIFICALLY STATED OTHERWISE.

10. THE CONTRACTOR SHALL SUBMIT A TRAFFIC CONTROL PLAN IN ACCORDANCE WITH MUTCD TO THE APPROPRIATE RIGHT-OF-WAY AUTHORITY (TOWN, COUNTY OR STATE) FOR APPROVAL PRIOR TO ANY CONSTRUCTION ACTIVITIES WITHIN OR AFFECTING THE RIGHT-OF-WAY. THE CONTRACTOR SHALL BE RESPONSIBLE FOR PROVIDING ANY AND ALL TRAFFIC CONTROL DEVICES AS MAY BE REQUIRED BY THE CONSTRUCTION ACTIVITIES.

11. THE CONTRACTOR IS RESPONSIBLE FOR PROVIDING ALL LABOR AND MATERIALS NECESSARY FOR THE COMPLETION OF THE INTENDED IMPROVEMENTS SHOWN ON THESE DRAWINGS OR AS DESIGNATED TO BE PROVIDED, INSTALLED, OR CONSTRUCTED UNLESS SPECIFICALLY NOTED OTHERWISE.

12. THE CONTRACTOR SHALL BE RESPONSIBLE FOR RECORDING AS-BUILT INFORMATION ON A SET OF RECORD DRAWINGS KEPT ON THE CONSTRUCTION SITE AND AVAILABLE TO THE TCR CONSTRUCTION INSPECTOR AT ALL TIMES.

13. DIMENSIONS FOR LAYOUT AND CONSTRUCTION ARE NOT TO BE SCALED FROM ANY DRAWING. IF PERTINENT DIMENSIONS ARE NOT SHOWN, CONTACT THE CONSULTANT ENGINEER FOR CLARIFICATION AND ANNOTATE THE DIMENSION ON THE AS-BUILT RECORD DRAWINGS.

14. ALL INITIAL SEDIMENT CONTROL MEASURES SHALL BE INSTALLED PER THE TEMPORARY EROSION & SEDIMENT CONTROL (TESC) PLAN PRIOR TO ANY EARTH-DISTURBING ACTIVITY. ALL EROSION AND SEDIMENT CONTROL PRACTICES MUST BE MAINTAINED IN EFFECTIVE OPERATING CONDITION AT ALL TIMES. REMOVAL OF CONTROL MEASURES SHALL NOT OCCUR WITHOUT THE APPROVAL OF THE STORMWATER INSPECTOR. THE CONTRACTOR SHALL BE RESPONSIBLE FOR KEEPING ROADWAYS FREE AND CLEAR OF ALL CONSTRUCTION DEBRIS AND DIRT TRACKED FROM THE SITE. THE CONTRACTOR SHALL ALSO COMPLY WITH ALL TERMS AND CONDITIONS OF THE COLORADO CONSTRUCTION GENERAL PERMIT FOR STORMWATER DISCHARGES.

15. THE CONTRACTOR SHALL PROVIDE AN ACTION PLAN IMMEDIATELY FOLLOWING THE PRE-CONSTRUCTION MEETING DETAILING SUFFICIENT MEANS TO MITIGATE DUST ON SITE DURING OVERLOT GRADING, ROCK CRUSHING OR OTHER EARTHWORK ACTIVITIES. IF THE CONTRACTOR FAILS TO CONTROL DUST, ALL EARTH DISTURBING ACTIVITIES SHALL BE STOPPED UNTIL SUFFICIENT MEASURES ARE TAKEN TO THE TOWN'S SATISFACTION. THE CONTRACTOR SHALL ALSO COMPLY WITH ALL TERMS AND CONDITIONS OF THE COLORADO AIR QUALITY REGULATIONS FOR LAND DEVELOPMENT, AS REQUIRED.

16. THE CONTRACTOR SHALL SEQUENCE INSTALLATION OF UTILITIES IN SUCH A MANNER AS TO MINIMIZE POTENTIAL UTILITY CONFLICTS. IN GENERAL, STORM SEWER AND SANITARY SEWER SHOULD BE CONSTRUCTED PRIOR TO INSTALLATION OF THE WATER LINES AND DRY UTILITIES.

17. THERE SHALL BE NO SITE CONSTRUCTION ACTIVITIES ON SATURDAYS UNLESS SPECIFICALLY APPROVED BY THE TCR CONSTRUCTION INSPECTOR AND NO SITE CONSTRUCTION ACTIVITIES ON SUNDAYS OR HOLIDAYS UNLESS THERE IS PRIOR WRITTEN APPROVAL BY THE PUBLIC WORKS DIRECTOR.

18. NO SOLID OBJECT (EXCLUDING FIRE HYDRANTS AND TRAFFIC CONTROL DEVICES AND TRAFFIC SIGNS) EXCEEDING THIRTY (30) INCHES IN HEIGHT ABOVE THE FLOWLINE ELEVATION OF THE ADJACENT STREET, INCLUDING BUT NOT LIMITED TO BUILDINGS, UTILITY CABINETS, WALLS, FENCES, LANDSCAPE PLANTINGS, CROPS, CUT SLOPES, AND BERMS, SHALL BE PLACED WITHIN SIGHT DISTANCE LINES AND SIGHT DISTANCE EASEMENTS.

19. THIS PROPERTY IS LOCATED WITHIN ZONE X AS PER FEMA FIRM PANEL NO. 0169G DATED MARCH 16, 2016.

20. BENCHMARK: NGS STATION "N 393". A BRASS DISK IN THE CENTER OF THE EAST END OF A 10 FT (3.0 M) BY 15 FT (4.6 M) EXPOSED AREA OF OUTCROPPING BEDROCK, 149.9 FT (45.7 M) EAST OF THE NEAR RAIL, 50.9 FT (15.5 M) WEST OF THE CENTERLINE OF COUNTY ROAD 25, 0.7 FT (0.2 M) WEST OF THE EAST EDGE OF THE OUTCROP, AND EAST OF THE EXTENDED CENTER OF INTERSTATE 25 EXIT 182, 10 FT (3.0 M) BELOW THE ROAD, AND 1 FT (0.3 M) NORTH OF A FIBERGLASS WITNESS POST. ELEVATION = 6222.12 (NAVD 88)

PROJECT BENCHMARK:
THE SOUTHWEST 1/16TH CORNER OF SECTION 3, TOWNSHIP 8 SOUTH, RANGE 67 WEST, BEING A 3" ALUMINUM CAP STAMPED "PLS 25629 1995".
ELEVATION = 6352.83 (NAVD 88).
ELEVATION BASED ON NGS STATION "N 393" AS DESCRIBED ABOVE.

21. BASIS OF BEARINGS:
BEARINGS ARE BASED ON THE SOUTH LINE OF THE SOUTHEAST 1/4 OF THE SOUTHEAST 1/4 OF SECTION 4, TOWNSHIP 8 SOUTH, RANGE 67 WEST OF THE 6TH PRINCIPAL MERIDIAN AND ASSUMED TO BEAR N89°26'32"W.

P:\BLVDWAY BUILDERS\HILLSIDE AT CASTLE ROCK\08 CAD\SHEET SETS\PH 3-4 CDS\01 COVER SHEET.DWG 8/23/2023 11:58 AM Jeff Cooper

PUBLIC IMPROVEMENT CONSTRUCTION PLANS FOR:

HILLSIDE AT CASTLE ROCK
PHASES 3 - 4

LOCATED IN THE SW 1/4 OF SECTION 3 AND THE SE 1/4 OF SECTION 4, TOWNSHIP 8 SOUTH, RANGE 67 WEST, 6th P.M., TOWN OF CASTLE ROCK, COUNTY OF DOUGLAS, STATE OF COLORADO

TOWN OF CASTLE ROCK PROJECT NO. CD 23-00___

CONTACTS:

OWNER/DEVELOPER:
BLVD HILLSIDE, LLC.
600 GRANT STREET, SUITE 404
DENVER, COLORADO 80203
PHONE: 303-200-0742
CONTACT: AARON FOY
AARON@BLVDBUILDERS.COM

ENGINEER / PLAN PREPARER:
ENTITLEMENT & ENGINEERING SOLUTIONS, INC.
3801 E. FLORIDA AVE., SUITE 425
GLENDALE, COLORADO 80210
PHONE: 303-572-7997
CONTACT: LUKE BREEDLOVE
LUKE.BREEDLOVE@EES.US.COM

LAND SURVEYOR:
FARNSWORTH GROUP
223 WILLOW STREET
FORT COLLINS, COLORADO 80524
PHONE: 970-484-7477
CONTACT: JOHN MCGEHEE
EMAIL: JMCGEHEE@F-W.COM

LANDSCAPE PLANNER:
PCS GROUP, INC.
1007 16TH STREET #3, B-180
DENVER, COLORADO 80265
PHONE: 303-531-4908
CONTACT: PAUL SHOUKAS
PAUL@PCSGROUPCO.COM

TOWN OF CASTLE ROCK PUBLIC WORKS DEPARTMENT:
4175 NORTH CASTLETON COURT
CASTLE ROCK, CO 80104
PHONE: (720) 733-2462
CONTACT: BOB GOEBEL, DIRECTOR

CASTLE ROCK WATER DEPARTMENT:
175 KELLOGG COURT
BUILDING 171
CASTLE ROCK, CO 80109
PHONE: (720) 733-6000
EMAIL: WATER@CRGOV.COM

DRY UTILITY COMPANIES:

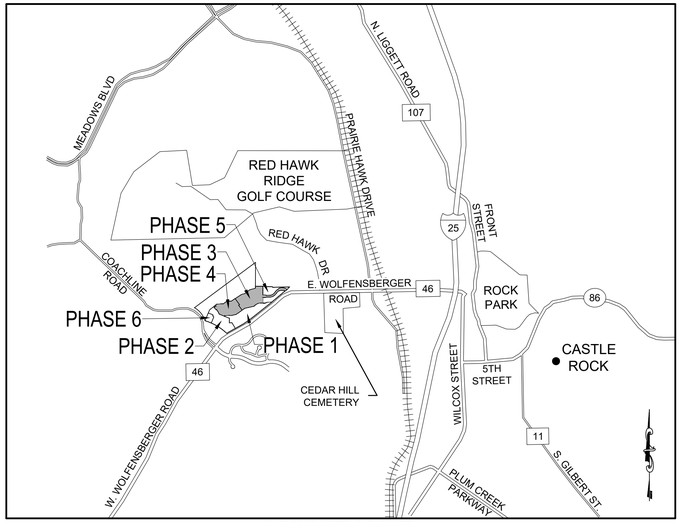
(ELECTRICAL)
CORE
5496 NORTH U.S. HWY. 85
SEDALIA, CO 80135
BROOKS KAUFMAN
(720) 733-5493

(GAS)
BLACK HILLS ENERGY
1769 PARK STREET
CASTLE ROCK, CO 80109
CONTACT: RON ZUROFF
(303) 217-7811

(COMMUNICATION)
CENTURY LINK
9750 E. COSTILLA AVE.
ENGLEWOOD, CO 80112
CONTACT : CHARLES PLACE
(720) 578-5132

(COMMUNICATION)
COMCAST CABLE
6850 S. TUCSON WAY
ENGLEWOOD, CO 80112
CONTACT: SCOTT MOORE
(303) 603-5665

FIELD CHANGE ORDER			
FCO No.	Submittal Date	Description	Approval Date
FCO23-00__			



VICINITY MAP
SCALE: 1" = 2,000'±

APPROVED VARIANCES:

1. VARIANCE NO. 15-0036 APPROVAL DATE: 7/1/15
DESCRIPTION: A 1% VARIANCE IN THE MAXIMUM STREET GRADE FOR AN APPROXIMATE 500 FT. SEGMENT OF LOCAL ROAD.

2. VARIANCE NO. 16-0047 APPROVAL DATE: 8/3/16
DESCRIPTION: CROSS PANS AT ENTRY STREETS.

3. VARIANCE NO. 16-0048 APPROVAL DATE: 8/10/16
DESCRIPTION: 10% OF SITE RUNOFF NOT REQUIRED TO RUN THROUGH A WATER QUALITY FEATURE.

4. VARIANCE NO. 19-0020 APPROVAL DATE: 5/2/19
DESCRIPTION: OFFSITE PERVIOUS AREAS AND 0.49 ACRES OF DEVELOPED IMPERVIOUS AREA ARE NOTE CAPTURED AND TREATED.

5. VARIANCE NO. 19-0021 APPROVAL DATE: 5/2/19
DESCRIPTION: ROCK FALL MITIGATION CHANNEL FREEBOARD.

6. VARIANCE NO. 19-0022 APPROVAL DATE: 5/2/19
DESCRIPTION: CONCRETE CHANNEL FREEBOARD

GENERAL LEGEND:

PROPERTY LINE
5530 EXIST. CONTOUR
X EXIST. FENCE
E EXIST. BURIED ELECTRIC LINE
G EXIST. GAS MAIN
CTV EXIST. CATV LINE
COM EXIST. COMMUNICATION LINE
S EXIST. SANITARY SEWER
EXIST. STORM SEWER
W EXIST. WATER MAIN
EXIST. SANITARY SEWER MH
EXIST. STORM MANHOLE
EXIST. FIRE HYDRANT
EXIST. WATER VALVE
EXIST. UTILITY RISER
EXIST. STREET SIGN
EXIST. VEGETATION
EXIST. ASPHALT PAVEMENT

x 5537.30 PROPOSED SPOT ELEVATION
2% PROPOSED SLOPE
PROPOSED PHASING LINE
5530 PROPOSED CONTOUR
S PROPOSED SANITARY SEWER
W PROPOSED WATER MAIN
PROPOSED C.L. SWALE
PROPOSED 100-YR EGL
PROPOSED 100-YR HGL
PROPOSED STORM SEWER
PROPOSED AREA INLET
PROPOSED WATER VALVE
PROPOSED FIRE HYDRANT
PROPOSED SIGN
PROPOSED STREET LIGHT
PROPOSED ROADWAY STRIPING
PROPOSED ASPHALT PAVEMENT
PROPOSED CONCRETE PAVEMENT
10 PROPOSED LOT NUMBER
2 PROPOSED BLOCK NUMBER
PROPOSED DRAINAGE FLOW ARROW
PROPOSED CLEANOUT
PROPOSED 12"X8" REDUCER

Sheet List Table		
Sheet Number		Sheet Title
1	C0.1	COVER SHEET
2	C0.2	STANDARD NOTES
3	C0.3	TYPICAL ROADWAY SECTIONS
4	C1.1	EXISTING CONDITIONS PLAN 1
5	C1.2	EXISTING CONDITIONS PLAN 2
6	C1.3	OVERALL UTILITY PHASING PLAN
7	C1.4	OVERALL ROADWAY PHASING PLAN
8	C2.1	OVERLOT GRADING TEMPLATES
9	C2.2	OVERLOT GRADING PLAN 1
10	C2.3	OVERLOT GRADING PLAN 2
11	C5.1	STORM SEWER A P&P
12	C5.2	STORM SEWER B, C & D P&P
13	C5.3	STORM SEWER DETAILS
14	C6.1	PHASE 3 WATER PLAN & PROFILE 1
15	C6.2	PHASE 3 WATER PLAN & PROFILE 2
16	C6.3	PHASE 3 WATER PLAN & PROFILE 3
17	C6.4	PHASE 3 WATER PLAN & PROFILE 4
18	C6.5	PHASE 3 WATER PLAN & PROFILE 5
19	C6.6	PHASE 4 WATER PLAN & PROFILE
20	C6.7	WATER DETAILS 1
21	C6.8	WATER DETAILS 2
22	C6.9	WATER DETAILS 3
23	C6.10	WATER DETAILS 3
24	C6.11	WATER DETAILS 4
25	C7.1	PHASE 3 SANITARY SEWER PLAN & PROFILE 1
26	C7.2	PHASE 3 SANITARY SEWER PLAN & PROFILE 2
27	C7.3	PHASE 3 SANITARY SEWER PLAN & PROFILE 3
28	C7.4	PHASE 3 SANITARY SEWER PLAN & PROFILE 4
29	C7.5	PHASE 4 SANITARY SEWER PLAN & PROFILE 1
30	C7.6	SANITARY SEWER DETAILS 1
31	C7.7	SANITARY SEWER DETAILS 2
32	C8.1	ROCK FALL MITIGATION CHANNEL PLAN & PROFILE STA. 10+00 - 15+50
33	C8.2	ROCK FALL MITIGATION CHANNEL PLAN & PROFILE STA. 15+50 - 22+00
34	C8.3	ROCK FALL MITIGATION CHANNEL PLAN & PROFILE STA. 22+00 - 26+30
35	C9.1	PHASE 3 GRAYSIDE CIRCLE SIGNAGE, STRIPING & LIGHTING PLAN 1
36	C9.2	PHASE 3 GRAYSIDE CIRCLE SIGNAGE, STRIPING & LIGHTING PLAN 2
37	C9.3	PHASE 4 GRAYSIDE CIRCLE SIGNAGE, STRIPING, & LIGHTING PLAN
38	C9.4	WOLFENSBERGER ROAD SIGNAGE, STRIPING & LIGHTING PLAN
39	C10.1	PHASE 3 GRAYSIDE CIRCLE PLAN & PROFILE 1
40	C10.2	PHASE 3 GRAYSIDE CIRCLE PLAN & PROFILE 2
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48	C11.1	DETENTION POND PLAN
49	C11.2	POND DETAILS
50	C11.3	POND DETAILS
51	LP0.1	MASTER PLANTING PLAN
52	LP0.2	NOTES, CHARTS AND PLANTING DETAILS
53	LP0.3	GESC PLAN, NOTES AND DETAILS
54-59	LP1.1-LP1.6	PLANTING PLANS
60	IR 0.1	IRRIGATION SCHEDULE AND NOTES
61-66	IR 1.1-IR1.6	IRRIGATION PLANS
67-69	IR 2.1-IR2.3	IRRIGATION DETAILS
70	IR 2.4	IRRIGATION DETAILS AND CHARTS

INDEMNIFICATION AND ADHERENCE TO STANDARDS STATEMENTS:

THESE PLANS HAVE BEEN REVIEWED BY THE TOWN OF CASTLE ROCK FOR CONCEPT ONLY. THE REVIEW DOES NOT IMPLY RESPONSIBILITY BY THE REVIEWING DEPARTMENT, THE TOWN ENGINEER, OR THE TOWN OF CASTLE ROCK FOR ACCURACY AND CORRECTNESS OF THE CALCULATIONS. FURTHERMORE, THE REVIEW DOES NOT IMPLY THAT QUANTITIES OF ITEMS ON THE PLANS ARE THE FINAL QUANTITIES REQUIRED. THE REVIEW SHALL NOT BE CONSTRUED FOR ANY REASON AS ACCEPTANCE OF FINANCIAL RESPONSIBILITY BY THE TOWN FOR ADDITIONAL QUANTITIES OF ITEMS SHOWN THAT MAY BE REQUIRED DURING THE CONSTRUCTION PHASE. ALL WORK SHALL BE CONSTRUCTED IN ACCORDANCE WITH THE TOWN OF CASTLE ROCK MUNICIPAL CODE, TECHNICAL MANUALS AND/OR OTHER TOWN-APPROVED APPLICABLE STANDARDS.

PROFESSIONAL ENGINEER CERTIFICATION:

I HEREBY AFFIRM THAT THESE FINAL CONSTRUCTION PLANS FOR HILLSIDE AT CASTLE ROCK PHASES 3-4 WERE PREPARED UNDER MY DIRECT SUPERVISION, IN ACCORDANCE WITH ALL APPLICABLE TOWN OF CASTLE ROCK AND STATE OF COLORADO STANDARDS AND STATUES, RESPECTIVELY; AND THAT I AM FULLY RESPONSIBLE FOR ALL DESIGN AND REVISIONS RELATIVE TO SAID PLANS.

MICHAEL S. GOODHUE
REGISTERED PROFESSIONAL
ENGINEER COLORADO NO. 48230

811 Know what's below. Call before you dig.

CALL UTILITY NOTIFICATION CENTER OF COLORADO
1-800-922-1987 or 811
CALL 3-BUSINESS DAYS (NOT INCLUDING INITIAL DAY OF CONTACT) IN ADVANCE BEFORE YOU DIG, GRADE, OR EXCAVATE FOR THE MARKING OF UNDERGROUND MEMBER UTILITIES.

TOWN APPROVAL BLOCK

TOWN OF CASTLE ROCK APPROVAL
PLANS ARE HEREBY APPROVED FOR ONE YEAR FROM DATE OF DEVELOPMENT SERVICES APPROVAL

APPROVED BY:

DEVELOPMENT SERVICES DATE

No.	REVISION	BY	DATE

PRELIMINARY NOT FOR CONSTRUCTION

EES ENTITLEMENT AND ENGINEERING SOLUTIONS, INC.
3801 E. Florida Avenue, Suite 425
Denver, CO 80210
303-572-7997 www.ees.us.com

BLVD. BUILDERS

CONSTRUCTION PLANS
HILLSIDE AT CASTLE ROCK - PHASES 3-4
CASTLE ROCK, COLORADO
COVER SHEET

PROJECT NO:	BLV001.02
DESIGNED BY:	WLB
DRAWN BY:	WLB
DATE:	8/23/2023

C0.1
SHEET 01 OF 70

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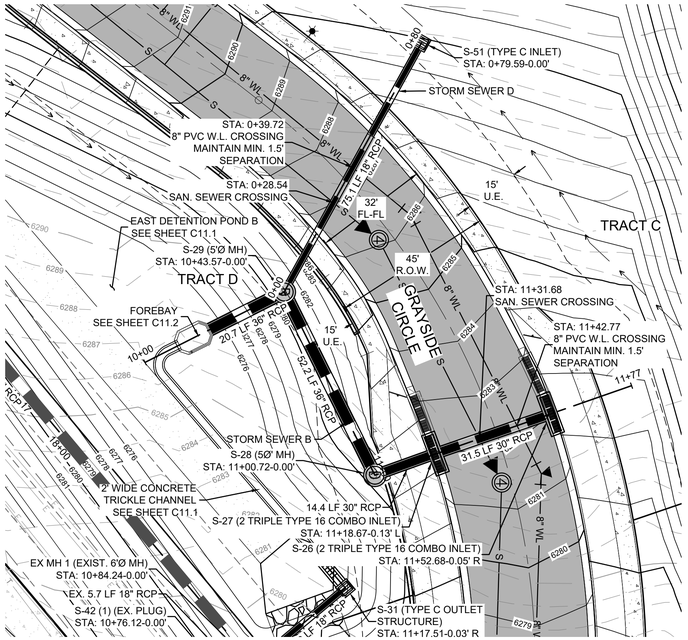

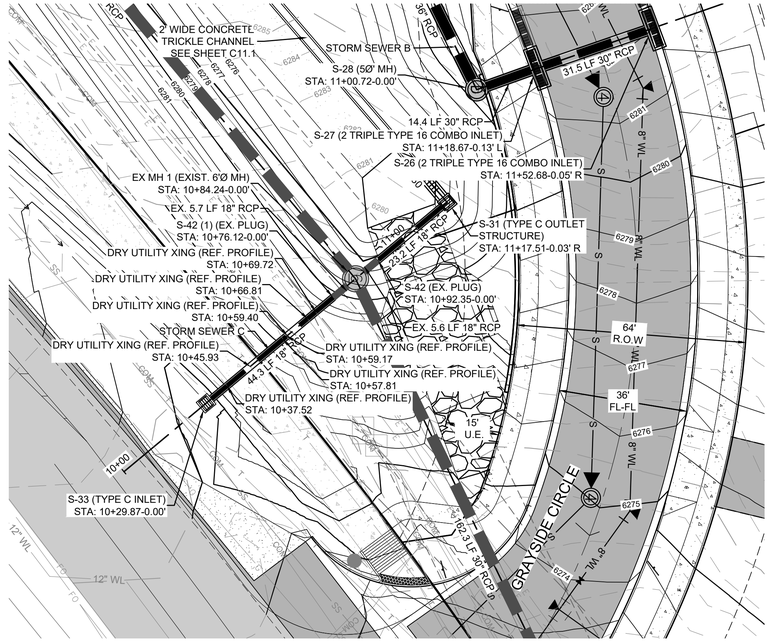

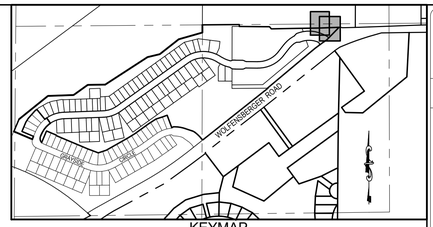

GENERAL LEGEND:

	PROPERTY LINE
5530	EXIST. CONTOUR
X	EXIST. FENCE
E	EXIST. BURIED ELECTRIC LINE
G	EXIST. GAS MAIN
CTV	EXIST. CATV LINE
COM	EXIST. COMMUNICATION LINE
S	EXIST. SANITARY SEWER
	EXIST. STORM SEWER
W	EXIST. WATER MAIN
Ⓢ	EXIST. SANITARY SEWER MH
Ⓓ	EXIST. STORM MANHOLE
	EXIST. FIRE HYDRANT
	EXIST. WATER VALVE
	EXIST. UTILITY RISER
	EXIST. STREET SIGN
	EXIST. VEGETATION
	EXIST. ASPHALT PAVEMENT
x 5537.30	PROPOSED SPOT ELEVATION
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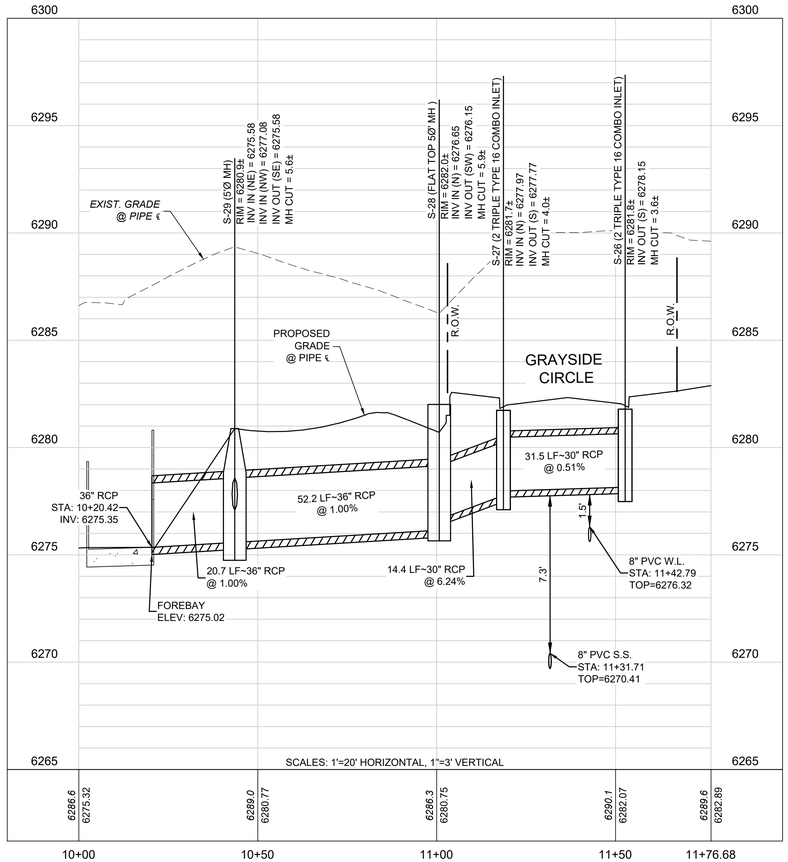
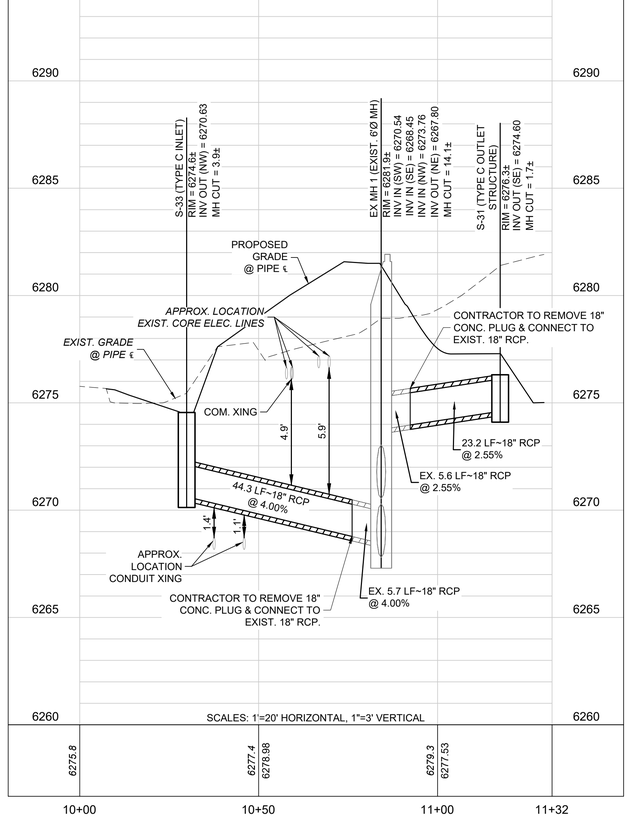
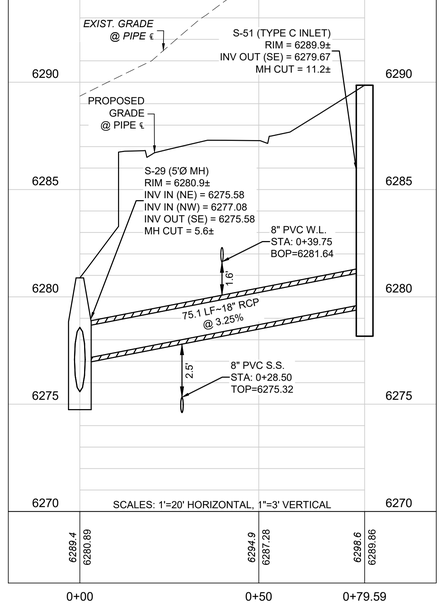


PROFILE PH 3-4 STORM B (STA: 10+00 TO 11+77)



PROFILE PH 3-4 STORM C (STA: 10+00 TO 11+32)



PROFILE PH 3-4 STORM D (STA: 0+00 TO 0+80)

PROJECT BENCHMARK:

TOP OF THE SW 1/16 CORNER OF SECTION 3, TOWNSHIP 8 SOUTH, RANGE 67 WEST, BEING A 3" ALUMINUM CAP STAMPED "PLS 25629 1995" WITH AN ELEVATION OF 6352.83 FEET NAVD 88. THIS ELEVATION IS BASED UPON NGS STATION "N 393" WITH A PUBLISHED ELEVATION OF 6222.12 FEET NAVD 88.

811 Know what's below. Call before you dig.

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1-800-922-1987 or 811
CALL 3-BUSINESS DAYS (NOT INCLUDING INITIAL DAY OF CONTACT) IN ADVANCE BEFORE YOU DIG, GRADE, OR EXCAVATE FOR THE MARKING OF UNDERGROUND MEMBER UTILITIES.

TOWN APPROVAL BLOCK

TOWN OF CASTLE ROCK APPROVAL
PLANS ARE HEREBY APPROVED FOR ONE YEAR FROM DATE OF DEVELOPMENT SERVICES APPROVAL

APPROVED BY:

DEVELOPMENT SERVICES DATE

No.	REVISION	BY	DATE

PRELIMINARY NOT FOR CONSTRUCTION

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Denver, CO 80210
303-572-7997 www.ees.us.com

BLVD. BUILDERS

CONSTRUCTION PLANS

HILLSIDE AT CASTLE ROCK - PHASES 3-4

CASTLE ROCK, COLORADO

STORM SEWER B, C & D P&P

PROJECT NO:	BLV001.02
DESIGNED BY:	WLB
DRAWN BY:	WLB
DATE:	8/23/2023

C5.2

SHEET 12 OF 70

P:\BLVDWAY BUILDERS\HILLSIDE AT CASTLE ROCK\08 CAD\SHEET SET\SPH 3-4 CDS\14 STORM SEWER PLAN AND PROFILE DWG 8/23/2023 12:03 PM Jeff Cooper

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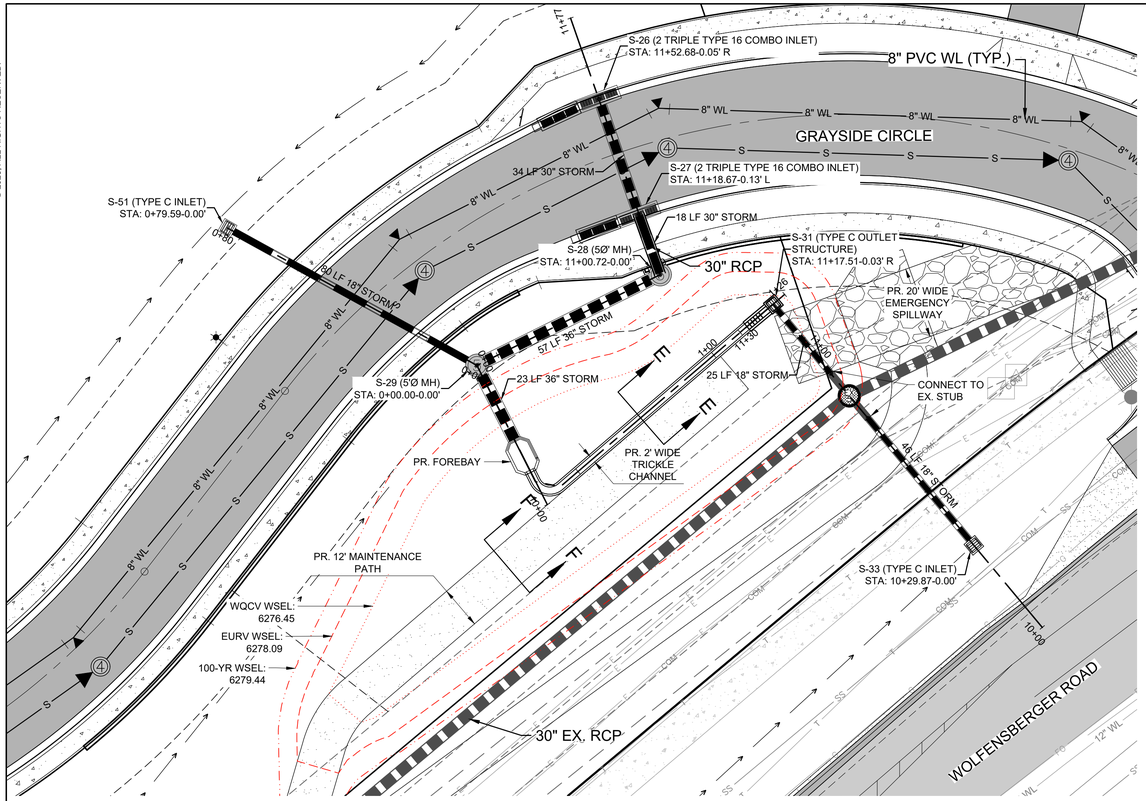
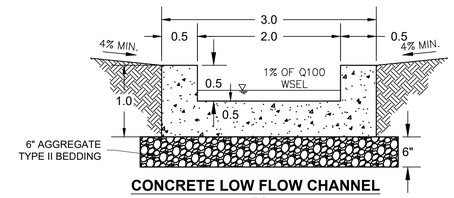
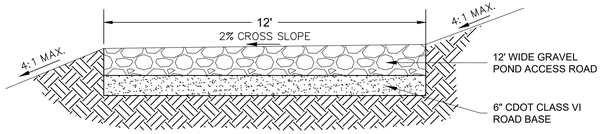
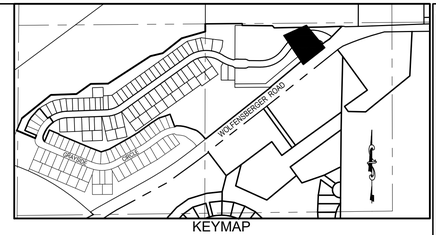




CONCRETE LOW FLOW CHANNEL
N.T.S.
SECTION E-E

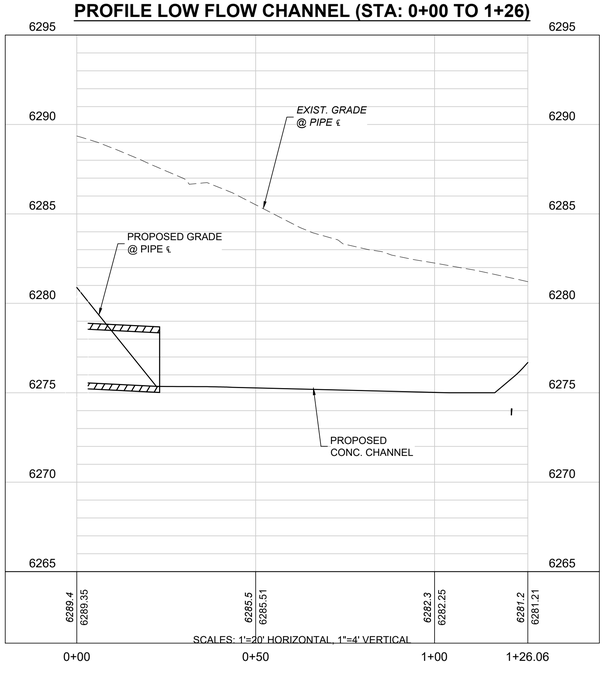


12' WIDE GRAVEL MAINTENANCE ACCESS ROAD
N.T.S.
SECTION F-F

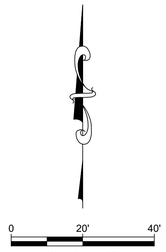


KEYMAP
SCALE: 1"=500'

PROFILE LOW FLOW CHANNEL (STA: 0+00 TO 1+26)



SCALES: 1"=20' HORIZONTAL, 1"=4' VERTICAL



SCALE: 1" = 20'

BENCHMARK:
NGS STATION "N 393". A BRASS DISK IN THE CENTER OF THE EAST END OF A 10 FT (3.0 M) BY 15 FT (4.6 M) EXPOSED AREA OF OUTCROPPING BEDROCK, 149.9 FT (45.7 M) EAST OF THE NEAR RAIL, 50.9 FT (15.5 M) WEST OF THE CENTERLINE OF COUNTY ROAD 25, 0.7 FT (0.2 M) WEST OF THE EAST EDGE OF THE OUTCROP, AND EAST OF THE EXTENDED CENTER OF INTERSTATE 25 EXIT 182, 10 FT (3.0 M) BELOW THE ROAD, AND 1 FT (0.3 M) NORTH OF A FIBERGLASS WITNESS POST. ELEVATION = 6222.12 (NAVD 88)

PROJECT BENCHMARK:
THE SOUTHWEST 1/16TH CORNER OF SECTION 3, TOWNSHIP 8 SOUTH, RANGE 67 WEST, BEING A 3" ALUMINUM CAP STAMPED "PLS 25629 1995".
ELEVATION = 6352.83 (NAVD 88).
ELEVATION BASED ON NGS STATION "N 393" AS DESCRIBED ABOVE.

TOWN APPROVAL BLOCK

TOWN OF CASTLE ROCK APPROVAL
PLANS ARE HEREBY APPROVED FOR ONE YEAR FROM DATE OF DEVELOPMENT SERVICES APPROVAL

APPROVED BY:

DEVELOPMENT SERVICES DATE

No.	REVISION	BY	DATE

PRELIMINARY
NOT FOR
CONSTRUCTION

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303-572-7997
www.ees.us.com

BLVD. BUILDERS

CONSTRUCTION PLANS

HILLSIDE AT CASTLE ROCK - PHASES 3-4

CASTLE ROCK, COLORADO

DETENTION POND PLAN

PROJECT NO: BLV001.02
DESIGNED BY: WLB
DRAWN BY: WLB
DATE: 8/24/2023

C11.1
SHEET 48 OF 70

P:\BLVD\WAY BUILDERS\HILLSIDE AT CASTLE ROCK\08 CAD\SHEET SET\SPH 3-4 CD\3\20 DETENTION POND PLAN.DWG 8/24/2023 8:12 AM Jeff Cooper

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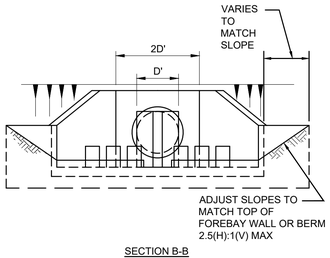
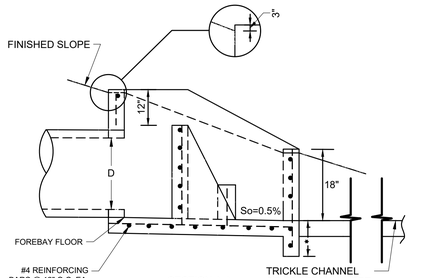
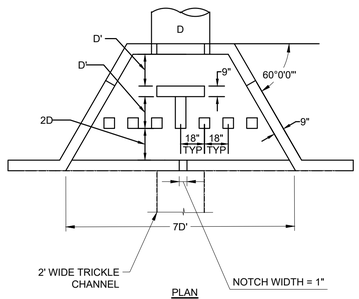


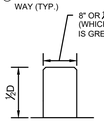
SECTION B-B



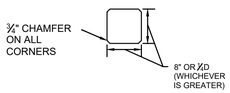
SECTION A-A



PLAN



ELEVATION
(LOOKING UPSTREAM)

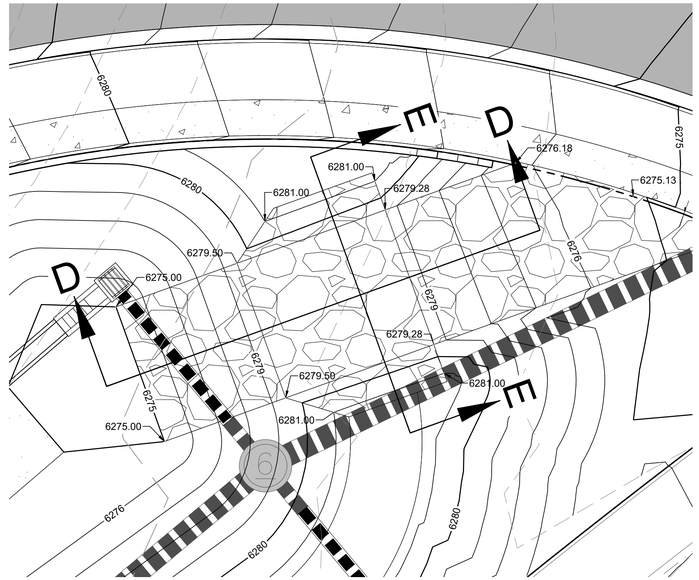


PLAN VIEW

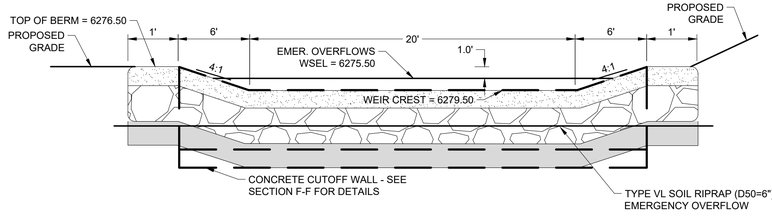
BAFFLE BLOCK GEOMETRY

MODIFIED IMPACT STILLING BASIN
FOR CONDUITS 18" TO 48" IN DIAMETER
(PART 1 OF 2)

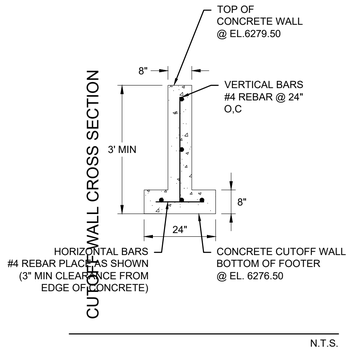
MODIFIED IMPACT STILLING BASIN
FOR CONDUITS 18" TO 48" IN DIAMETER
(PART 2 OF 2)



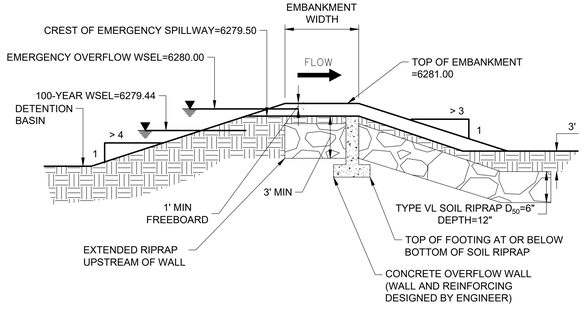
C POND A EMERGENCY OVERFLOW SPILLWAY
SCALE: 1" = 10'



E-E EMERGENCY OVERFLOW SPILLWAY PROFILE
SCALE: NTS



N.T.S.



D-D EMERGENCY OVERFLOW SPILLWAY SECTION
SCALE: NTS

TOWN APPROVAL BLOCK

TOWN OF CASTLE ROCK APPROVAL
PLANS ARE HEREBY APPROVED FOR ONE YEAR FROM DATE OF DEVELOPMENT SERVICES APPROVAL

APPROVED BY:

DEVELOPMENT SERVICES DATE

No.	REVISION	BY	DATE

PRELIMINARY
NOT FOR
CONSTRUCTION

EES
ENTITLEMENT AND ENGINEERING SOLUTIONS, INC.
3801 E. Florida Avenue, Suite 425
Denver, CO 80210
303-572-7997 www.ees.us.com

BLVD. BUILDERS

CONSTRUCTION PLANS

HILLSIDE AT CASTLE ROCK - PHASES 3-4

CASTLE ROCK, COLORADO

POND DETAILS

PROJECT NO:	BLV001.02
DESIGNED BY:	GSR
DRAWN BY:	RAK
DATE:	08/01/2023

C11.2
SHEET ---- OF 70

P:\BLVD\MAY BUILDERS\HILLSIDE AT CASTLE ROCK\06 CAD\SHEET SETS\PH 3-4 CDS\POND DETAILS.DWG 8/23/2023 12:53 PM Jeff Cooper

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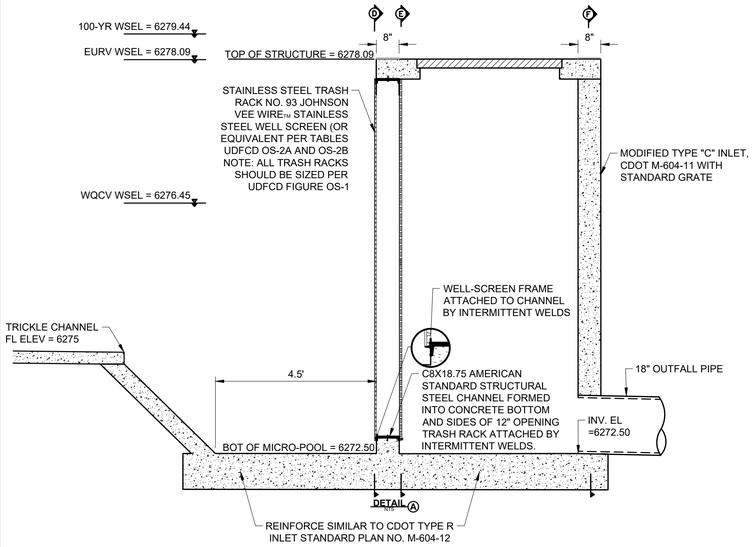
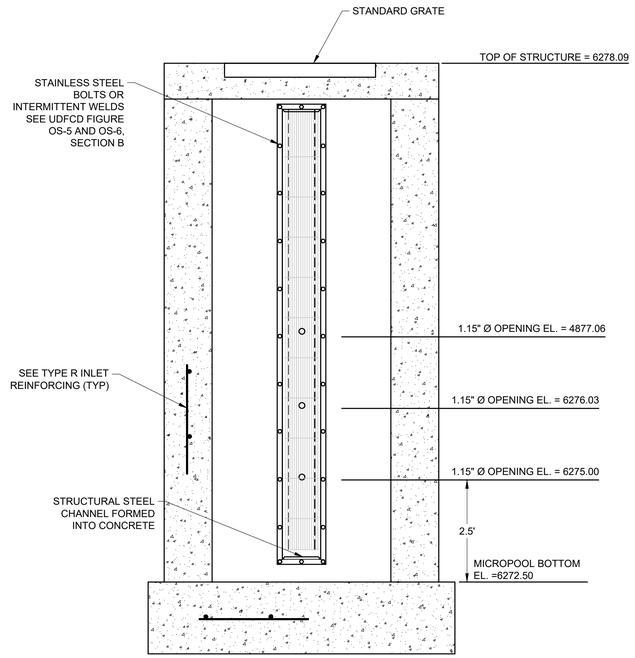
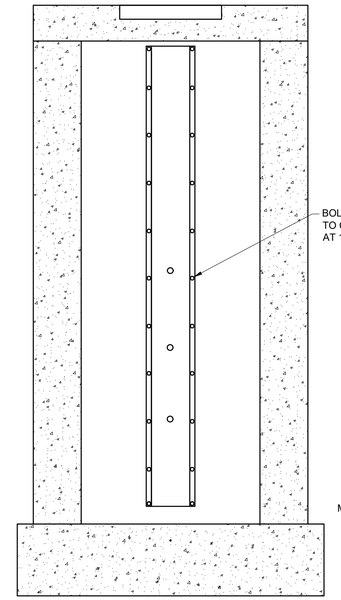
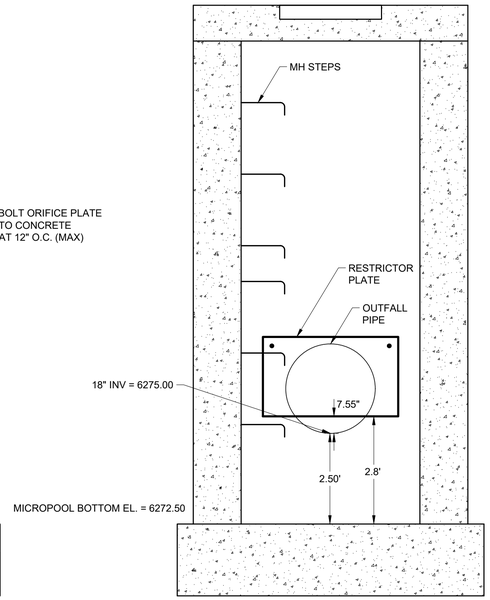




SECTION D
NTS



SECTION E
NTS



SECTION F
NTS

WARNING

KEEP SCREEN AND GRATE CLEAN. UNAUTHORIZED MODIFICATION OF THIS OUTLET IS A CODE VIOLATION

DETENTION WARNING 12" X 12"

POND SIGN
NTS

TOWN APPROVAL BLOCK

TOWN OF CASTLE ROCK APPROVAL
PLANS ARE HEREBY APPROVED FOR ONE YEAR FROM DATE OF DEVELOPMENT SERVICES APPROVAL

APPROVED BY:

DEVELOPMENT SERVICES DATE

No.	REVISION	BY	DATE

PRELIMINARY NOT FOR CONSTRUCTION

EES ENTITLEMENT AND ENGINEERING SOLUTIONS, INC.
3801 E. Florida Avenue, Suite 425
Denver, CO 80210
303-572-7997 www.ees.us.com

BLVD. BUILDERS

CONSTRUCTION PLANS

HILLSIDE AT CASTLE ROCK - PHASES 3-4

CASTLE ROCK, COLORADO

POND DETAILS

PROJECT NO:	BLV001.02
DESIGNED BY:	WLB
DRAWN BY:	WLB
DATE:	8/23/2023

C11.3
SHEET 49 OF 70

P:\BLVD\WAY BUILDERS\HILLSIDE AT CASTLE ROCK\08 CAD\SHEET SET\SPH 3-4 CD\SPOND DETAILS.DWG 8/23/2023 12:53 PM Jeff Cooper

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CTL|THOMPSON
Founded in 1971

SUPPLEMENTAL PRELIMINARY GEOTECHNICAL INVESTIGATION

HILLSIDE AT CASTLE ROCK, PHASE 5
55 TOWNHOME UNITS
WEST OF WOLFENSBERGER ROAD AND GRAYSIDE CIRCLE (EAST INTERSECTION)
CASTLE ROCK, COLORADO

Prepared for:

BLVDWAY COMMUNITIES
600 Grant Street, Suite 404
Denver, Colorado 80203

Attention:
Jonathan Adkins

Project No. DN51,445.000-115-R6

April 19, 2024

CTL|Thompson, Inc.
Denver, Fort Collins, Colorado Springs, Glenwood Springs, Pueblo, Summit County – Colorado
Cheyenne, Wyoming and Bozeman, Montana

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SCOPE

This report presents the results of our Supplemental Preliminary Geotechnical Investigation for the 55 townhome lots planned within the Hillside at Castle Rock, Phase 5 located west of the easternmost intersection of Wolfensberger Road and Grayside Circle in Castle Rock, Colorado (Figs. 1A and 1B). The purpose of our investigation was to provide a preliminary evaluation of the subsurface conditions to assist in budgeting and planning of site development and residential construction. The scope of services was described in our Contract Modification No. DN 22-0010-CM8 dated March 21, 2024. We have completed or are concurrently performing other tasks within Hillside at Castle Rock with results under separate covers, including preliminary and design-level geotechnical studies. Evaluation of the property for the presence of potentially hazardous materials (Phase I ESA) was not included within the scope of this investigation.

The report contains descriptions of the site geology and setting, subsurface conditions and groundwater levels encountered in widely spaced exploratory borings, identification of geologic hazards and geotechnical concerns, and mitigation concepts. Results were used to develop preliminary discussions of residential site development, including sub-excavation to reduce potential movements, foundation/floor system/pavement support discussions, and drainage considerations.

This report was prepared considering data developed during previous investigation, site reconnaissance, exploratory drilling and sampling, field and laboratory testing, engineering analysis, and our experience. It is based on the *Arbors Townhome Concept Plan* prepared by PCS Group dated January 17, 2024. Changes to the proposed construction may require revision of this report and the recommended design criteria. The preliminary discussions for foundations, floor systems and pavements are intended for budgeting and planning purposes only. Additional, site-specific investigations will be necessary to design structures, pavements and other improvements. A summary of our conclusions and recommendations follows, with more detailed discussion in the report.

SUMMARY

1. Strata found in our borings consisted of nil to about 7 feet of man-placed fill and 6 to 23 feet of native sand and clay, underlain sandstone and claystone bedrock of the Dawson Formation. The fill is believed to be related to existing/previous

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structures and ponds/ditches. Bedrock was encountered in 10 borings and was relatively shallower in the northwest portion of Phase 5 (Fig. 2). Testing indicates the soils and bedrock are erratically expansive, but predominantly low swelling. Relatively higher compressing or swelling materials were found in nearby phases.

2. Groundwater was measured in TH-5, TH-6 and TH-7 at depths of about 23, 19 and 18.5 feet below existing grades or approximate elevations 6294 to 6301.5 feet. All other test holes were dry to their maximum explored depths. We estimate groundwater to be about 13.5 to 18.5 feet below proposed grades in the west-central part of the site. Groundwater is not expected to affect construction other than potentially installation of deep utilities and drilled piers, if used. Groundwater may fluctuate seasonally and rise after construction in response to precipitation, landscaping irrigation, and changes in land use.

3. Geologic maps show the presence of alluvial fan and colluvium deposits. The presence of existing fill and expansive soils and bedrock constitutes a geologic hazard. Potentially collapsible soils may also be present in Phase 5. There is risk that slabs-on-grade and foundations will experience heave or settlement, and damage. We believe the recommendations presented in this report will help to reduce risk of damage; they will not eliminate that risk. Slabs-on-grade and, in some instances, foundations may be damaged by soil movements, particularly if excessive wetting is allowed to occur.

4. We estimate total potential ground heave of about 2 inches. We recommended performing sub-excavation to depths of 8 feet below non-basement foundations or 3 feet below basement foundations as a means to reduce the potential risk of heave or settlement and provide more uniform support conditions. Sub-excavation should extend at least 5 feet laterally outside foundation extents. Refer to Figs. 3-5.

5. Based on the Town of Castle Rock specifications for pavements, we recommend performing sub-excavation to a depth of at least 2 feet below finished subgrade elevation in areas underlain by clay or claystone; this may potentially be near TH-1, TH-2, TH-4 and TH-7. Areas with sand likely do not require sub-excavation. We estimate pavement sections may consist of 4 inches of asphalt over 6 or 8 inches of aggregate base course or chemically treated subgrade. A design-level pavement design study should be performed after site grading and sub-excavation, if performed.

6. Control of surface drainage will be critical to the performance of foundations. Overall surface drainage should be designed to provide rapid run-off of surface water away from the proposed structures and off pavements and flatwork. Water should not be allowed to pond near the crests of slopes, near structures, or on pavements and flatwork. We recommend perimeter foundation drains around basement areas, or crawl space areas where basements are not used. No perimeter drains are required if post-tensioned slab-on-grade foundations or slab-on-void construction are used unless the floor levels are below exterior grades.

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SITE CONDITIONS

Phase 5 contains about 4.9 acres located northwest of the easternmost intersection of Wolfensberger Road and Grayside Circle in Castle Rock, Colorado (Photo 1 and Figs. 1A and 1B). It is at the northeast corner of the Hillside at Castle Rock development, and is the final phase. The site is bordered by a single-family residence lot to the north, Wolfensberger Road to the southeast, Phase 1 to the southwest, and Phase 3 to the west. Phases 1-4 are under construction. The Wall Mountain Tuff butte is located about ¼-mile to the northwest. The butte has two water storage tanks and a former quarry. The butte quarry was likely a source of building blocks and gravel comprised of rhyolite. Spoils from the quarry are present near the top of the hillside. The site generally slopes to the east and south towards Wolfensberger Road with overall topographic relief of about 30-40 feet. Ground cover consists of grass, scattered shrubs and bushes, and existing structures in the north part. Several trees surround the structures. The main structure appears to be an abandoned single-family residence or farmstead, with two smaller structures to the west appearing to be a detached garage and shed. Wire fences and overheard utility lines traverse the site.

Based on review of historical aerial images dating back to 1937, the site appears to have been used for agricultural purposes, with many of the historical aerial photos showing shallow drainage ditches which parallel the face of the hillside. The existing structures on the north end of the site were built sometime between 1955 and 1993. A large, disturbed area is present at the southeast end of the site in the 1955 photo (Photo 2) and may be related to an old pond, which is believed to have been backfilled at some time. The largest, centrally located structure was demolished sometime between 2008 and 2011. The site appears to have remained largely unchanged since 2011.

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INVESTIGATION

We investigated subsurface conditions on March 29 and 30, 2024 by drilling and sampling 11 exploratory borings at the approximate locations shown on Figs. 1A and 1B. Boring locations were staked and surveyed by Aztec Consultants, Inc. prior to drilling, and the elevation data was provided to us. Prior to drilling, we contacted the Utility Notification Center of Colorado and local sewer and water districts to mark the locations of buried utilities.

The borings were drilled to depths of 25 or 30 feet using 4-inch diameter, continuous-flight, solid-stem auger powered by truck-mounted CME-45 drill rigs. We obtained samples at approximate 2 to 5-foot intervals using 2.5-inch diameter (O.D.) modified California barrel samplers driven by blows of an automatic 140-pound hammer falling 30 inches. Bulk samples of the upper 5 feet were obtained from auger cuttings at TH-4 and TH-10. Our field representatives observed drilling, logged the strata encountered, and obtained samples. Graphical summary logs of the borings, including results of field penetration resistance tests and a portion of laboratory test data, are presented in Appendix A.

Samples were returned to our laboratory where they were examined, classified and assigned testing. Laboratory tests included moisture content, dry density, particle-size analysis (gradation and percent passing the No. 200 sieve), Atterberg limits, swell-consolidation, and water-soluble sulfate concentration. Swell-consolidation tests were performed by wetting the samples under confining pressures that approximate the overburden pressure after the proposed grading (the pressure exerted by the overlying soils after site grading). Load-back analysis was performed on select samples to help estimate swelling pressures. Laboratory test results are presented in Appendix B and summarized in Table B-I.

SUBSURFACE CONDITIONS

Strata encountered in our exploratory borings consisted of nil to about 7 feet of man-placed fill and 6 to 23 feet of native sand and clay, underlain by sandstone, claystone, and interbedded claystone/sandstone bedrock. Bedrock was encountered in 10 borings and was shallower in the north and northwest portions of the site. Some pertinent engineering characteristics of the soil and bedrock are described in the following paragraphs.

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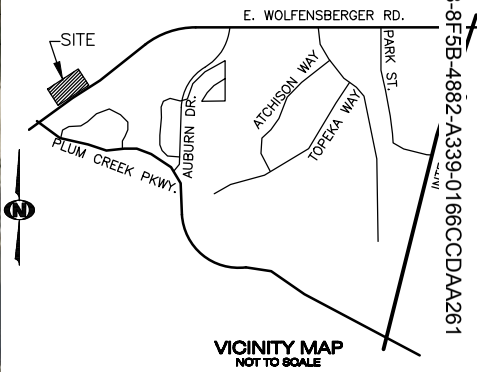

LEGEND:

TH-1 ● APPROXIMATE LOCATION OF EXPLORATORY BORING

PCH-1 ● APPROXIMATE LOCATION OF PCH EXPLORATORY BORING (2015)

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HILLSIDE AT CASTLE ROCK, PHASE 5
CTL|T Project No. DN51,445-115-R6

Locations of Exploratory Borings (Aerial Image) Fig. 1B

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LEGEND:

TH-1 ●	APPROXIMATE LOCATION OF EXPLORATORY BORING
PCH-1 ○	APPROXIMATE LOCATION OF PCH EXPLORATORY BORING (2015)
8	INDICATES ESTIMATED DEPTH TO BEDROCK BELOW EXISTING GRADE (FEET)
(13.5)	INDICATES ESTIMATED DEPTH TO BEDROCK BELOW PROPOSED OVERLOT GRADE (FEET)
[6299.5]	INDICATES ESTIMATED BEDROCK ELEVATION (FEET)

NOTE: THIS ESTIMATE WAS BASED UPON A SUBJECTIVE ANALYSIS OF DRILL HOLE DATA AND MAY NOT REFLECT LOCAL VARIATIONS.

BLVDWAY COMMUNITIES
HILLSIDE AT CASTLE ROCK, PHASE 5
CTL|T Project No. DN51,445-115-R6

Approximate Bedrock Depth and Elevation

Fig. 2

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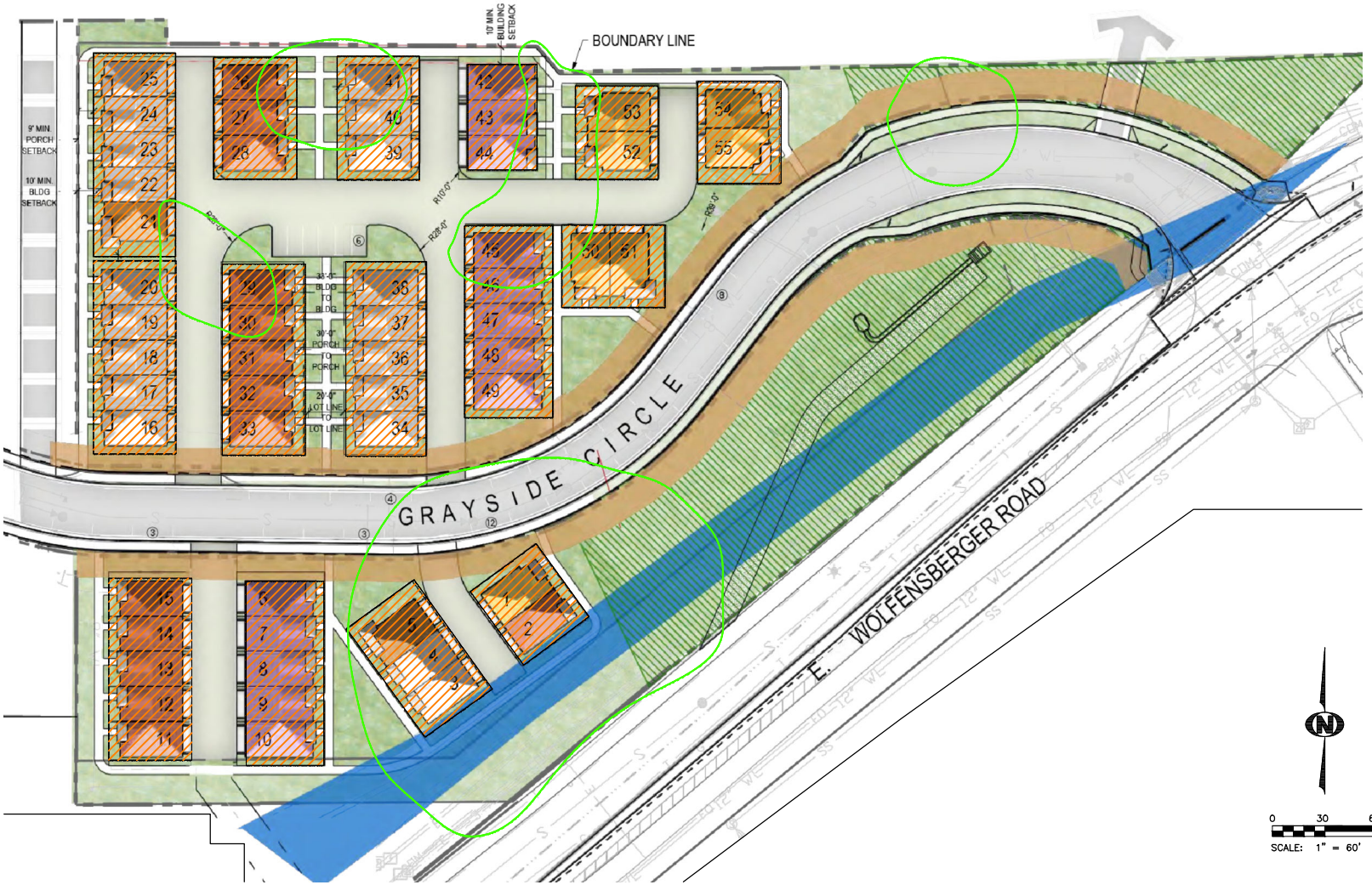

BLVDWAY COMMUNITIES
HILLSIDE AT CASTLE ROCK, PHASE 5
CTL|T Project No. DN51,445-115-R6

Sub-excavation Recommendations

Fig. 3

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APPENDIX A
SUMMARY LOGS OF EXPLORATORY BORINGS

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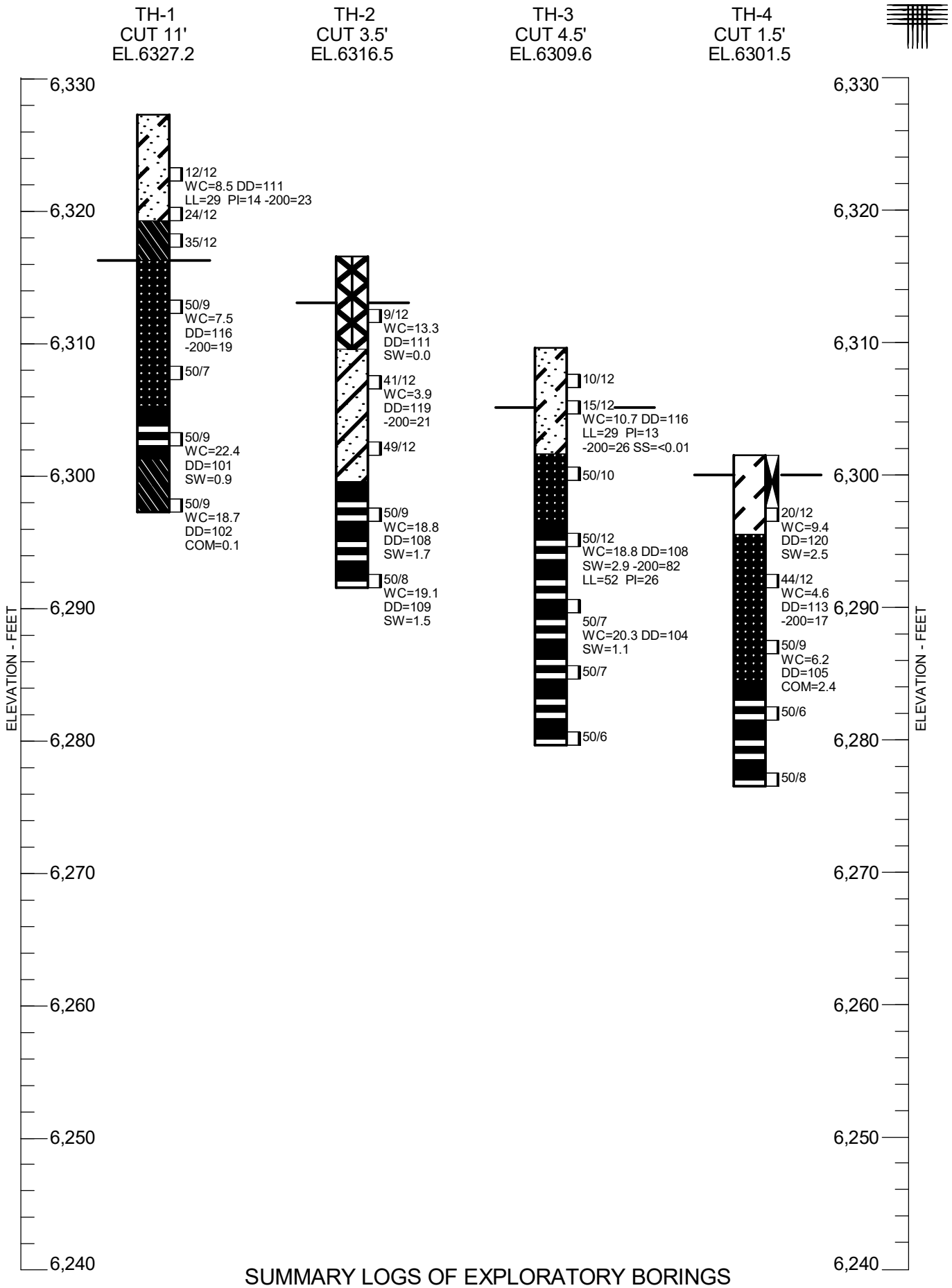

SUMMARY LOGS OF EXPLORATORY BORINGS

BLVDWAY COMMUNITIES
HILLSIDE AT CASTLEROCK, PHASE 5
CTL|T PROJECT NO. DN51,445-115-R6

FIG. A-1

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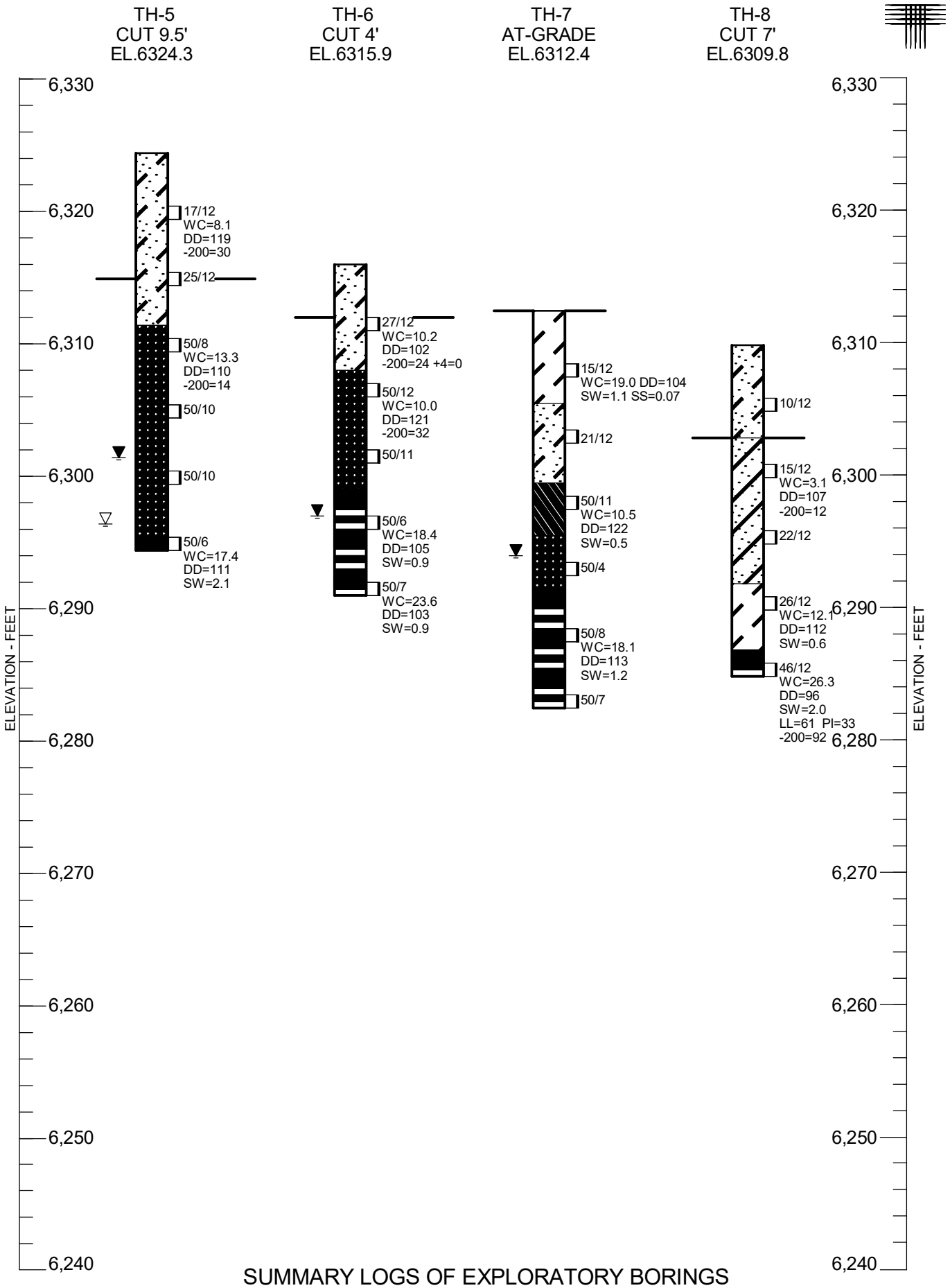
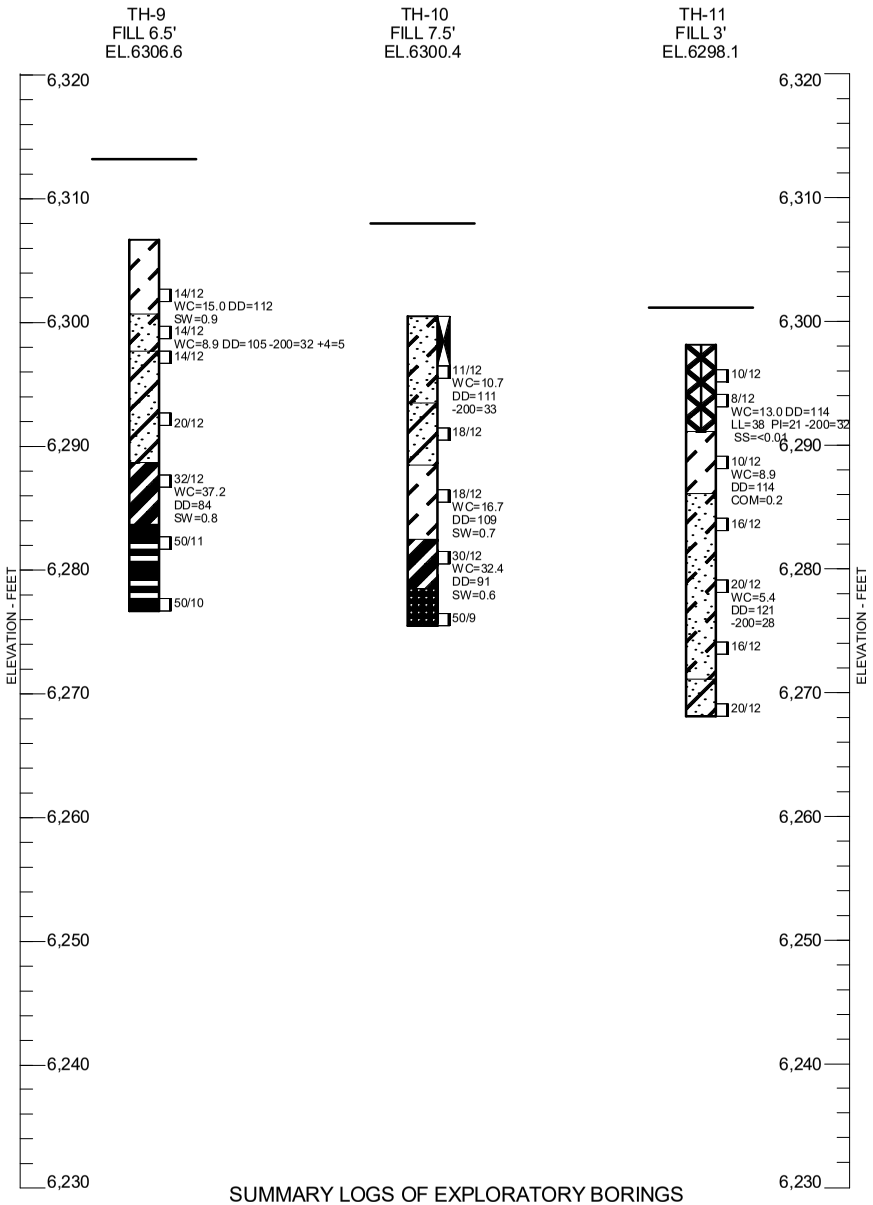


SUMMARY LOGS OF EXPLORATORY BORINGS

BLVDWAY COMMUNITIES
HILLSIDE AT CASTLEROCK, PHASE 5
CTL|T PROJECT NO. DN51,445-115-R6

FIG. A-2



SUMMARY LOGS OF EXPLORATORY BORINGS

BLVDWAY COMMUNITIES
HILLSIDE AT CASTLEROCK, PHASE 5
CTL|T PROJECT NO. DN51,445-115-R6

LEGEND:

- FILL, SAND, SILTY, CLAYEY, POSSIBLE ORGANICS IN TH-11, LOOSE TO MEDIUM DENSE, MOIST, DARK BROWN, BLACK, BROWN, RED, WHITE.
- CLAY, SANDY TO VERY SANDY, SILTY, SOME GRAVEL, STIFF TO VERY STIFF, SLIGHTLY MOIST TO MOIST, BROWN, LIGHT BROWN, TAN, WHITE (CL).
- SAND, SILTY, SLIGHTLY CLAYEY TO CLAYEY, SOME GRAVEL, MEDIUM DENSE, SLIGHTLY MOIST TO MOIST, BROWN, LIGHT BROWN, WHITE, TAN, GRAY (SC, SM-SC).
- SAND, SLIGHTLY SILTY TO SILTY, SOME GRAVEL, MEDIUM DENSE TO DENSE, SLIGHTLY MOIST, TAN, GRAY, BROWN, LIGHT BROWN, WHITE (SP-SM, SM).
- WEATHERED CLAYSTONE, SANDY, SILTY, MOIST, BROWN, GRAY, TAN.
- BEDROCK, CLAYSTONE, SILTY, SANDY AT TIMES, MEDIUM HARD TO VERY HARD, MOIST, GRAY, BROWN, BLUISH-GRAY, RUST.
- BEDROCK, SANDSTONE, SILTY TO CLAYEY, MEDIUM HARD TO VERY HARD, MOIST, TAN, GRAY, RUST, WHITE, BLUISH-GRAY.
- BEDROCK, INTERBEDDED CLAYSTONE/SANDSTONE, SILTY, MEDIUM HARD TO HARD, MOIST, GRAY, WHITE.
- DRIVE SAMPLE. THE SYMBOL 12/12 INDICATES 12 BLOWS OF A 140-POUND HAMMER FALLING 30 INCHES WERE REQUIRED TO DRIVE A 2.5-INCH O.D. SAMPLER 12 INCHES.
- INDICATES BULK SAMPLE COLLECTED FROM AUGER CUTTINGS.
- WATER LEVEL MEASURED AT TIME OF DRILLING.
- WATER LEVEL MEASURED AFTER DRILLING ON APRIL 1, 2024

NOTES:

1. THE BORINGS WERE DRILLED ON MARCH 29TH AND 30TH, 2024 USING A 4-INCH DIAMETER, CONTINUOUS-FLIGHT SOLID-STEM AUGER AND TRUCK-MOUNTED CME-45 DRILL RIGS.
2. BORING LOCATIONS AND ELEVATIONS WERE STAKED AND SURVEYED BY AZTEC CONSULTANTS, INC.
3. WC - INDICATES MOISTURE CONTENT (%).
   DD - INDICATES DRY DENSITY (PCF).
   SW - INDICATES SWELL WHEN WETTED UNDER APPROXIMATE OVERBURDEN PRESSURE (%).
   COM - INDICATES COMPRESSION WHEN WETTED UNDER APPROXIMATE OVERBURDEN PRESSURE (%).
   LL - INDICATES LIQUID LIMIT.
   PI - INDICATES PLASTICITY INDEX.
   -200 - INDICATES PASSING NO. 200 SIEVE (%).
   +4 - INDICATES RETAINED ON NO. 4 SIEVE (%).
   SS - INDICATES WATER-SOLUBLE SULFATE CONTENT (%).
4. THESE LOGS ARE SUBJECT TO THE EXPLANATIONS, LIMITATIONS, AND CONCLUSIONS AS CONTAINED IN THIS REPORT.

FIG. A-3

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TABLE 7-2
MINOR STORM ALLOWABLE FLOW DEPTH AND ROADWAY ENCROACHMENT FOR STREETS WITH CURB AND GUTTER

Drainage Classification	Allowable Flow Depth in Gutter Flowline[1]	Maximum Roadway Encroachment
Type A	No curb overtopping.	Flow may spread to crown of street.
Type B	No curb overtopping.	Flow spread must leave at least one 10-foot lane free of water (5-feet either side of the street crown).
Type C	No curb overtopping.	Flow spread must leave at least two 10-foot lanes free of water (10-feet each side of the street crown or median).

[1] If a 4-inch curb with an attached sidewalk is used (i.e., combination or rollover curb), the flow depth is limited to 4-inches.

7.4 Major (100-Year) Storm Allowable Street Flow

7.4.1 Allowable Flow Depth for a Street with Curb and Gutter. The Town allows the use of streets for drainage conveyance in the major storm with limitations on the depth of flow in the curb and gutter. Table 7-3 summarizes these limitations for each drainage classification. The maximum street capacity is based on the allowable depth at the gutter flowline.

TABLE 7-3
MAJOR STORM ALLOWABLE FLOW DEPTH FOR STREETS WITH CURB AND GUTTER

Drainage Classification	Allowable Flow Depth
Type A, B and C	The depth of water at the gutter flowline shall not exceed 12-inches.[1]

[1] See Section 7.5.3 for further information on allowable flow depth limits.

7.5 Hydraulic Evaluation of Street Capacity

Once the design discharge is calculated (see Chapter 6, Hydrology), hydraulic calculations are to be completed to determine the capacity of street gutters and the resulting encroachment onto the street section. All street capacity and encroachment calculations shall conform to the Streets/Inlets/Storm Sewers chapter in Volume 1 of the MHFD Manual unless otherwise noted herein. For more detailed information on the methodology used for the hydraulic evaluation of street capacity see Section 2.3 of Chapter 7 in Volume 1 of the MHFD Manual.

7.5.1 Minor (5-year) Storm Street Capacity Worksheet. The Streets/Inlets/Storm Sewers chapter in Volume 1 of the MHFD Manual provides an analysis tool used for determining the minor storm street capacity and flow encroachment. This tool

is the UD-Inlet spreadsheet which can be accessed via the internet at mhfd.org. This worksheet completes a hydraulic evaluation of the theoretical street capacity for the minor storm by calculating the theoretical minor event street gutter flow capacity based on both 1) the allowable spread, and 2) the allowable gutter depth. A reduction factor is then applied to the theoretical gutter flow based on allowable depth and the lesser of the allowable street capacities governs for the minor event.

7.5.2 Major (100-year) Storm Street Capacity Worksheet. Similar to the minor storm, the Streets/Inlets/Storm Sewers chapter in Volume 1 of the MHFD Manual provides an analysis tool used for determining the major storm street capacity. This tool is the the UD-Inlet spreadsheet which can be accessed via the internet at MHFD.org. This worksheet completes a hydraulic evaluation of the theoretical street capacity for the major storm and then applies the major storm reduction factor. The design engineer must use UD-Inlet to determine the allowable gutter capacity. The engineer must enter the data appropriate for the street section and the minor/major storm criteria for the drainage classification for the worksheet to calculate the allowable gutter capacity based on the data and criteria provided.

7.5.3 Major Storm Street Capacity Limitations.

Allowable flow depths greater than the minor storm may only be used if the following conditions apply:

1. The design must demonstrate that the major storm flow is fully contained, at the assumed depth, within the roadway and the area adjacent to the roadway such that no structures are impacted and no flow is released beyond the typical street section. A cross section of the street is required on the Overlot Grading Plan showing the minimum high points adjacent to the right-of-way.
2. A minimum of 1-foot above the assumed depth shall be provided as freeboard to the finished floor for structures that are proposed adjacent to the roadway.
3. All window well openings shall be set at or above the finish floor of the structure. Window wells behind a high point at or above the minimum freeboard elevation are exempt from this rule.
4. Conveyance of the major storm flow at the assumed depth will not result in diversions at driveways, intersections, or other locations.
5. For areas where the finished floor does not meet the minimum freeboard requirement, the overlot grading plan shall establish a high point at or above the freeboard elevation adjacent to the roadway to contain the major storm flow in the area adjacent to the roadway. Such areas shall be secured in a slope easement on the plat.
6. Full consideration to cross street flow implications is to be given in the routing of major storm flow and inlet sizing as per Section 7.6.3.

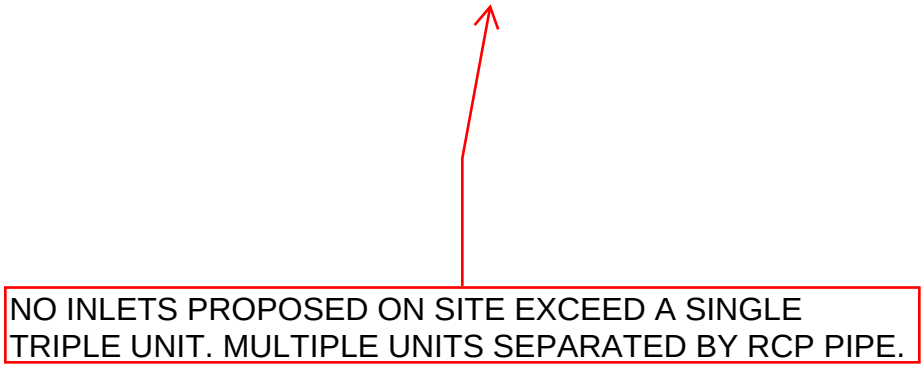
TYPICAL CROSS SECTION PROVIDED ON DRAINAGE MAP. DETAILED CROSS SECTIONS TO BE PROVIDED IN CONSTRUCTION DOCUMENTS.

8.7 Other Design Considerations

8.7.1 Curb Chase Drain (Sidewalk Chase). Curb chase drains shall NOT be used in place of a standard inlet to remove runoff from a street section. Curb chase drains have limited efficiency and have poor long-term performance.

8.7.2 Median Inlets. For all streets constructed with asphalt, the median shall be constructed with a "catch" curb and gutter. Inlets are required along the median to reduce ponding at curb and gutter low points and to eliminate concentrated flow crossing over the lanes of traffic at the nose of the median. Figure 8-1, Special Median Inlet Details, presents conceptual representations of options available for placing median nose inlets. The final design and construction drawings must address inlet sizing, dimensions, and required curb and gutter transitions. If a street is constructed with concrete, it is acceptable for the median curb and gutter to be constructed as a "spill" section.

8.7.3 Maximum Inlet Length. Inlets shall be designed to blend in with the streetscape, and not present a dramatic structural departure from the general surroundings. The use of extremely long inlets is discouraged, as they are generally not aesthetic, require increased maintenance, and are viewed as a hazard by the public. The maximum length of an inlet in a specific location shall not exceed the length of a triple unit (i.e., 15-feet. for a Type R inlet).



manhole is acceptable and required when proposed for the purposes of energy dissipation in small outfall systems.

9.7.7 Manhole Shaping. All manholes shall be constructed with fill concrete to the top of the highest crown of the highest top of pipe entering or exiting the manhole. The shaping shall match the pipe section below pipe springline and consist of vertical walls above pipe springline. This shaping significantly reduces manhole losses. The appropriate loss coefficient can be determined using Figure ST-8 and Table ST-9 in Volume 1 of the *UDFCD Manual* for full shaping. Douglas County Standard Detail SD-6, provides construction details for channelization in slab base and box base manholes.

9.7.8 Other Design Considerations. The following design criteria shall also be met:

- The elevation of the pipe crowns shall be matched when the downstream pipe is larger than the upstream pipe. This will minimize the backwater effects on the upstream pipe.
- The invert of a manhole shall be constructed with a slope between the upstream and downstream pipes. The slope shall be the average of the upstream and downstream pipe slopes or based on a fall of 0.1-foot through the manhole.
- It is critical that gutter pans, curb heads, and any other problematic locations be avoided when determining the horizontal placement of manholes.

9.8 Hydraulic Design

Once the layout of the storm sewer system is determined, the peak flows in the system must be calculated followed by a hydraulic analysis to determine pipe capacity and size. The pipe size shall not decrease moving downstream (even if the capacity is available due to increased slope, etc.) in order to reduce clogging potential.

9.8.1 Allowable Storm Sewer Velocity and Slope. The allowable storm sewer velocity is dependent on many factors, including the type of pipe, the acceptable water level during the pipe design life, proposed flow conditions (open channel versus pressure flows), and the type and quality of construction of joints, manholes, and junctions.

1. Maximum velocity. In consideration of the above factors, the maximum velocity in all storm sewers shall be limited to 18-fps.
2. Minimum velocity. The need to maintain a self-cleaning storm sewer system is recognized as a goal to minimize the costs for maintenance of storm sewer facilities. Sediment deposits, once established, are generally difficult to remove even with pressure cleaning equipment. A minimum velocity of 4-fps is required when the storm sewer conveys runoff from frequently occurring storm events. Assuming that the pipe has been designed to near full flow, a flow depth equal to 25-percent of the pipe diameter and the corresponding flow rate shall be used to check the minimum velocity. If the pipe is not designed to flow near full, a flow depth equal to 25-percent of the design flow

2. Step 2 Pipe Capacity. In the major storm event it is acceptable to have a surcharge in the system. Therefore Manning's equation is not applicable for those pipes which are under pressure flow conditions. There may be cases where the major storm event does not result in a surcharge of the system. In these pipes the capacity can be calculated using Manning's equation, as described in Section 9.8.2.

3. Step 3 Hydraulic and Energy Grade Lines. Hydraulic grade line calculations for the storm sewer system shall be provided for the major storm event. The major storm energy grade line must not rise past the elevation 1-foot below the final grade along the storm sewer system. When a storm sewer is flowing under a pressure flow condition, the energy and hydraulic grade lines shall be calculated using the pressure-momentum theory. The capacity calculations generally proceed from the storm sewer outlet upstream, accounting for all energy losses. These losses are added to the energy grade line and accumulate to the upstream end of the storm sewer. The hydraulic grade line is then determined by subtracting the velocity head from the energy grade line at each change in the energy grade line slope. Refer to Section 4.4 in the Streets/Inlets/Storm Sewers chapter of Volume 1 of the *UDFCD Manual* as a guideline for completing hydraulic grade line and energy grade line calculations. The procedure described in the *UDFCD Manual* is based on the FHWA HEC-22 publication. All of the losses through a storm sewer system (at bends, junctions, transitions, entrances, and exits) are based upon coefficients recommended in the *UDFCD Manual*.

9.8.4 Computer Programs. It is recommended that a computer program be used for the design or as a calculation "check" of a storm sewer system. NeoUDSewer is the software created to supplement the *UDFCD Manual* and is an approved computer program for storm sewer analysis in the County. NeoUDSewer is a powerful tool which can calculate rainfall and runoff using the Rational Method and then size a circular storm sewer based on Manning's equation. Example 6.13 in the Streets/Inlets/Storm Sewers chapter of the *UDFCD Manual* is an example of sample project input and the resulting output from NeoUDSewer.

If an alternate computer program (i.e., StormCAD) is used, a calibration model based on Example 6.13 in the *UDFCD Manual* must be completed and provided to the County. This calibration model is generated by completing an analysis of Example 6.13 with the alternate computer model. The results of this alternate model must be comparable to the results from the NeoUDSewer analysis. It is not necessary to calibrate the hydrologic analysis as shown in Example 6.13; rather, the design engineer may input the peak flow directly to obtain a comparison of the resulting hydraulic and energy grade lines through the example system. The goal of this model calibration is to verify that the loss coefficients and other system assumptions used in the alternate computer program are equivalent to the methodology applied by NeoUDSewer, which is accepted by the County.

Summary of Water Quality Conformance to MS4 Permit

The purpose of this worksheet is to document conformance with the Town of Castle Rock's MS4 permit with regard to permanent water quality on land disturbance projects.

Project Name Hillside at Castle Rock Phase 3&4 SDP

Project Owner BLVD Hillside LLC

Project Location Castle Rock, Colorado,

ToCR Project Number SDP25-0000

Total Site Area 5.68 **acres**

Total Size of Common Plan of Development 61.68 **acres**

Check all that apply:

- ☑ **Project within Plum Creek Basin**
- ☐ **Project within Cherry Creek Basin**

Estimated construction completion date JULY 2026

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1. The water quality control measure(s) for applicable development sites shall meet one of the following base design standards as per the SDDTCM Section 14.4. Please select all design standards that were applied to meet conformance with the MS4 on this site.

   - ☑ WQCV standard
   - ☐ Pollutant removal standard
   - ☐ Runoff reduction standard
   - ☐ Applicable site draining to regional WQVC control measure (accepts drainage prior to discharging to WOTS)
   - ☐ Applicable site draining to regional WQVC control facility (with receiving pervious area control measure upstream of WOTS)
   - ☐ Constrained redevelopment sites standard
     - Imperviousness of existing site _____/_____(Imp. Ac/Site Ac) =____%
     - Variance required TCV No. _____
   - ☐ Existing control measure with WQCV per previous criteria standards
     - Reference Construction Permit No. _____
   - ☐ Cherry Creek Basin only, choose one: ☐ Tier 1 ☐ Tier 2 ☐ Tier 3
   - ☐ No control measures provided (See Permanent WQ Worksheet for applicability)

Summary of Water Quality Conformance to MS4 Permit

2. Was an exclusion to water quality applied as per SDDTCM Section 13.1.5? ☐ Yes ☑ No

   i. If yes, please select all that apply, provide total excluded impervious area(s) and submit variance, as applicable: TCV No. _____

   - ☐ Pavement management site
     Excluded impervious area: _____ acres
   - ☐ Excluded roadway redevelopment
     Excluded impervious area: _____ acres
   - ☑ Excluded existing roadway areas
     Excluded impervious area: 1.31 acres
   - ☐ Above ground and below ground utilities
   - ☐ Large lot single family home
   - ☐ Non-residential and non-commercial infiltration
     Excluded impervious area: _____ acres
   - ☑ Land disturbance for land to remain undeveloped
     Excluded impervious area: 4.06 acres
   - ☐ Stream Stabilization Sites
     Excluded impervious area: _____ acres
   - ☑ Trails
     Excluded impervious area: 0.10 acres
   - ☐ Oil and Gas Exploration

3. For Development and Redevelopment sites, following any exclusions claimed above, was any portion of the site excluded up to 20% of the site and not to exceed one acre? ☐ Yes ☑ No

   If yes, complete the following:

   Excluded area: 0.96 acres

   Total Site area: 61.68 acres, 1.48 % site excluded

4. For Constrained sites, was any portion of the site excluded up to 50% of the site and not to exceed 50% of the impervious area? ☐ Yes ☑ No

   If yes, complete the following:

   Excluded area: _____ acres

   Excluded impervious area: _____ acres

   Total Site area: _____ acres, _____ % site excluded

   Total Impervious area: _____ acres, _____ % impervious excluded

Permanent Water Quality Determination Worksheet (Taken from 2019 SDDTCM Sections 13.1.4 and 13.1.5)

Project:		**Project#**		**Applicant:**
Section	**Questions**	**Response**	**Check those that apply**	**Instructions**
1	**Non-applicable Sites**			
1.1	Will the project result in a temporary disturbance of greater than one acre?	No	☐	Proceed to section 1.2.
		Yes	☐	Proceed to section 2.
1.2	Is the project part of a larger common plan of development or sale where multiple separate and distinct construction activities may be taking place at different times on different schedules, but remain related and are within 1/4 mile of each other? (A common plan of development will generally be documented on a site development plan, master plan, or equivalent, for the property/project)	No	☐	Proceed to section 1.3.
		Yes	☐	Proceed to section 2.
1.3	Is the project within the Cherry Creek Watershed?	Yes	☐	Permanent water quality control measures may be required. Refer to Water Qualtiy Control Regulation 72.7 for details and allowable exclusions.
		No	☐	Permanent water quality control measures are not required.
2	**Applicable Site Types and Exclusions by Variance**			
2.1	Does the project have more than 35% impervious area on the existing site?	No	☐	Project is an applicable Development Site. Proceed to section 3.
		Yes	☐	Proceed to 2.2.
2.2	Does the project have greater than 75% impervious area on the existing site?	No	☐	Project is an applicable Redevelopment Site. Proceed to section 3.
		Yes	☐	Project is an applicable Constrainted Redevelopment Site. Proceed to 2.3.
2.3	Will 100% of the runoff from the existing and proposed site be captured and treated using one or more of the allowable design standards for permanent water quality?	Yes	☐	No further action required.
		No	☐	Proceed to 2.4.
2.4	Do any other water quality exclusions apply to the site?	No	☐	Portions of the project are excluded. Proceed with design in accordance with Constrained Redevelopment standards and apply for **variance** for Constrained Redevelopment Sites.
		Yes	☐	Proceed to section 3. Following approval of other exclusions, design remaining site in accordance with Constrained Redevelopment standards and apply for **variance** for Constrained Redevelopment Sites.
3	**Applicable Sites with Other Exclusions by Variance**			
3.1	**Category 1: Roadways, bridges and trails only**			
3.1.1	Is the project a bike or pedestrian trail?	Yes	☐	Proceed to next line.
		No	☐	Proceed to 3.1.2.
	Is the trail for a roadway?	Yes	☐	Proceed to 3.1.2.
		No	☐	Project is excluded. Submit **variance** for Trails Excluded from Permanent Water Quality Requirements.
3.1.2	Is the project primarily used for parking or access to parking?	Yes	☐	This exclusion does not apply. Permanent water quality is required.
		No	☐	Proceed to 3.1.3.
3.1.3	Does the project add impervious area?	No	☐	Project is excluded. Submit **variance** for Pavement Management Sites Excluded from Permanent Water Quality Requirements.
		Yes	☐	Proceed to 3.1.4.

Section	Questions	Response	Check those that apply	Instructions
3.1.4	Does the project add more than 8.25 feet of paved width at any location to the existing roadway?	No	☐	Project is excluded. Submit **variance** for Roadway Redevelopment Sites Excluded from Permanent Water Quality Requirements.
		Yes	☐	Proceed to next line.
	Does the project add more than one acre of paved area per mile to an existing roadway?	No	☐	Project is excluded. Submit **variance** for Roadway Redevelopment Sites Excluded from Permanent Water Quality Requirements.
		Yes	☐	Proceed to next line.
	Does the project increase the width by two times or more, on average, of the original roadway area?	No	☐	Existing areas of site are excluded only. Submit **variance** for Existing Roadway Surfaces Only Excluded from Permanent Water Quality Requirements.
		Yes	☐	This exclusion does not apply. Permanent water quality is required.
3.2	**Category 2: Non-residential and non-commercial projects only**			
3.2.1	Is the project associated with oil and gas exploration, production, processing, or treatment operations or transmission facilities, including activities necessary to prepare a site for drilling and the movement and placement of drilling equipment?	Yes	☐	Project is excluded. Submit **variance** for Oil and Gas Exploration Sites Excluded from Permanent Water Quality Requirements.
		No	☐	Proceed to 3.2.2.
3.2.2	Is the project for stream stabilization?	Yes	☐	Project is excluded. Submit **variance** for Stream Stabilization Sites Excluded from Permanent Water Quality Requirements.
		No	☐	Proceed to 3.2.3.
3.2.3	Is the project for installation or maintenance of aboveground or underground utilities or infrastructure that does not permanently alter the terrain, ground cover, or drainage patterns from those present prior to the construction activity including activities to install, replace or maintain utilities under roadways or other paved areas that return the surface to the same condition?	Yes	☐	Project is excluded. Submit **variance** for Aboveground and Underground Utilities Excluded from Permanent Water Quality Requirements.
		No	☐	Proceed to 3.2.4.
3.2.4	Is the project on undeveloped land (land with no human-made structures such as buildings or pavement) that will remain undeveloped after the project?	Yes	☐	Project is excluded. Submit **variance** for Sites with Land Disturbances to Undeveloped Land that will Remain Undeveloped Excluded from Permanent Water Quality Requirements.
		No	☐	Proceed to 3.2.5.
3.2.5	Will the post-project condition result in surface water discharge during the 80th percentile storm runoff event?	No	☐	Project is excluded. Submit **study** along with **variance** for Non-residential and Non-commercial Infiltration Conditions Excluded from Permanent Water Quality Requirements.
		Yes	☐	This exclusion does not apply. Permanent water quality is required.
3.3	**Category 3: Residential, Agricultural and Commercial projects**			
3.3.1	Is the project a single-family residential lot, or agricultural zoned lands, greater than or equal to 2.5 acres in size per dwelling unit?	Yes	☐	Proceed to next line.
		No	☐	Proceed to 3.3.2.
	Is the project site greater than 10% impervious?	No	☐	Project is excluded. Submit **variance** for Large Lot Single Family Sites Excluded from Permanent Water Quality Requirements.
		Yes	☐	Proceed to next line.
	Is the project site greater than 20% impervious?	Yes	☐	This exclusion does not apply. Permanent water quality is required.
		No	☐	Proceed to next line.
	Will the post-project condition result in surface water discharge during the 80th percentile storm runoff event?	No	☐	Project is excluded. Submit **study** along with **variance** for Large Lot Single Family Sites Excluded from Permanent Water Quality Requirements.
		Yes	☐	This exclusion does not apply. Permanent water quality is required.

Section	Questions	Response	Check those that apply	Instructions
3.3.2	Will 100% of the runoff from the residential or commercial site be captured?	Yes	☐	This exclusion does not apply. Permanent water quality is required.
		No	☐	Proceed to next line.
	Is all or a portion of the site undeveloped or will it remain undeveloped after construction?	Yes	☐	This portion of the project is excluded. Submit **variance** for Sites with Land Disturbance to Undeveloped Land that will Remain Undeveloped Excluded from Permanent Water Quality Requirements. Proceed to next line.
		No	☐	Proceed to next line.
	Is the remaining untreated impervious area greater than 20% of the site?	Yes	☐	This exclusion does not apply. Permanent water quality is required.
		No	☐	Proceed to next line.
	Is the remaining untreated impervious area greater than one acre?	Yes	☐	This exclusion does not apply. Permanent water quality is required.
		No	☐	Proceed to next line.
	Is it practicable to capture runoff from portions of the site that will not drain to a control measure?	No	☐	Document justification demonstrating that it is not practicable to capture runoff from this portion of the site in the **drainage report**. No further action is needed.
		Yes	☐	This exclusion does not apply. Permanent water quality is required.

APPENDIX F
DRAINAGE MAPS

HILLSIDE AT CASTLE ROCK PHASE 3&4

SE 1/4 OF THE SW 1/4 OF SECTION 3, TOWNSHIP 8 SOUTH
RANGE 67 WEST OF THE 6TH PM
TOWN OF CASTLE ROCK, DOUGLAS COUNTY, COLORADO

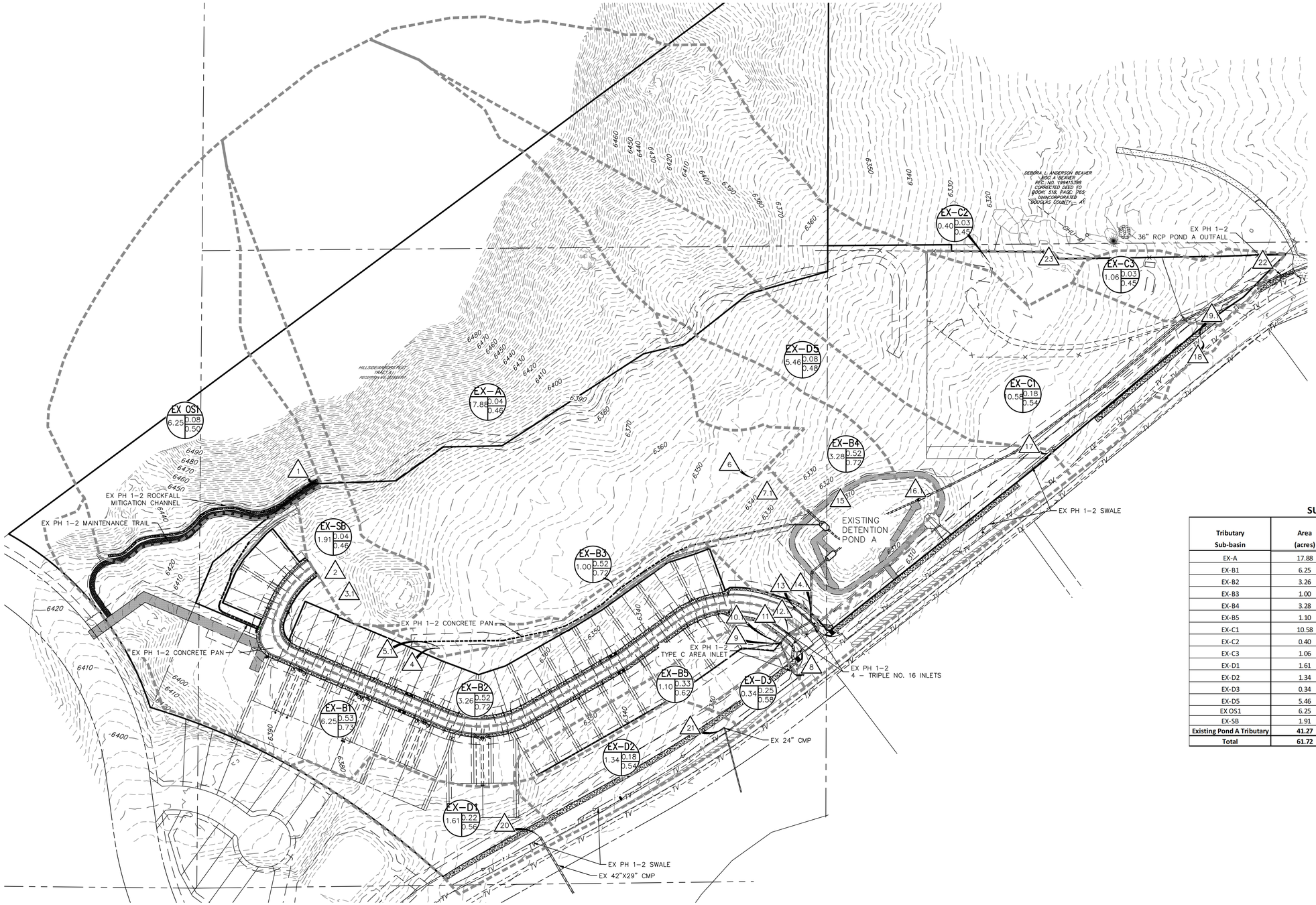
EXISTING DRAINAGE MAPS

LEGEND

EXISTING SUB–BASIN

DESIGN POINT (X)

SUB–BASIN DESIGNATION (NAME / AC / MIN / MAJ)



DESIGN POINT TABLE

Design Point	Q_5 (cfs)	Q_{100} (cfs)
1	1.5	19.5
2	0.7	6.3
3.1	2.3	25.8
4	0.2	3.3
5.1	2.5	28.7
6	2.0	42.5
7.1	4.1	66.3
8	0.4	9.8
9	1.6	5.5
10.1	1.8	13.9
11	11.8	29.3
12.1	13.4	41.7
13	6.4	16.2
14.1	19.3	56.0
15	1.1	9.8
16.1	19.4	65.8
17	0.6	13.8
18	1.0	22.9
19.1	1.6	34.8
20	1.1	5.3
21	0.2	4.0
22	0.0	1.2
23	0.2	2.8

100 50 0 100 200

ORIGINAL SCALE: 1" = 100'

SUB-BASIN SUMMARY TABLE

Tributary Sub-basin	Area (acres)	Percent Impervious	C_5	C_{100}	t_c (min)	Q_5 (cfs)	Q_{100} (cfs)
EX-A	17.88	5.9%	0.04	0.45	19.1	2.0	42.5
EX-B1	6.25	63.7%	0.53	0.73	12.5	11.8	29.3
EX-B2	3.26	62.5%	0.52	0.72	10.5	6.4	16.2
EX-B3	1.00	8.3%	0.06	0.47	10.2	0.2	3.3
EX-B4	3.28	13.6%	0.10	0.49	14.1	1.1	9.8
EX-B5	1.10	40.5%	0.32	0.62	6.8	1.6	5.5
EX-C1	10.58	7.4%	0.04	0.45	22.5	1.0	23.0
EX-C2	0.40	5.0%	0.03	0.45	11.4	0.0	1.2
EX-C3	1.06	8.4%	0.06	0.47	15.5	0.2	2.9
EX-D1	1.61	27.3%	0.21	0.55	14.7	1.1	5.3
EX-D2	1.34	23.8%	0.04	0.45	11.8	0.2	4.0
EX-D3	0.34	41.4%	0.33	0.62	10.2	0.4	1.5
EX-D5	5.46	16.0%	0.04	0.45	16.8	0.6	13.8
EX OS1	6.25	5.6%	0.07	0.49	12.9	1.5	19.5
EX-SB	1.91	10.5%	0.11	0.52	12.5	0.7	6.3
Existing Pond A Tributary	**41.27**	**40.0%**	---	---	---	---	---
Total	**61.72**	**18.2%**	---	---	---	**28.93**	**183.94**

EXISTING DRAINAGE MAPS
HILLSIDE AT CASTLE ROCK PHASE 3&4
JOB NO. 16190.20
2025–07–28
SHEET 1 OF 2

J·R ENGINEERING
A Westrian Company

Centennial 303–740–9393 • Colorado Springs 719–593–2593
Fort Collins 970–491–9888 • www.jrengineering.com

HILLSIDE AT CASTLE ROCK PHASE 3&4

SE 1/4 OF THE SW 1/4 OF SECTION 3, TOWNSHIP 8 SOUTH
RANGE 67 WEST OF THE 6TH PM
TOWN OF CASTLE ROCK, DOUGLAS COUNTY, COLORADO

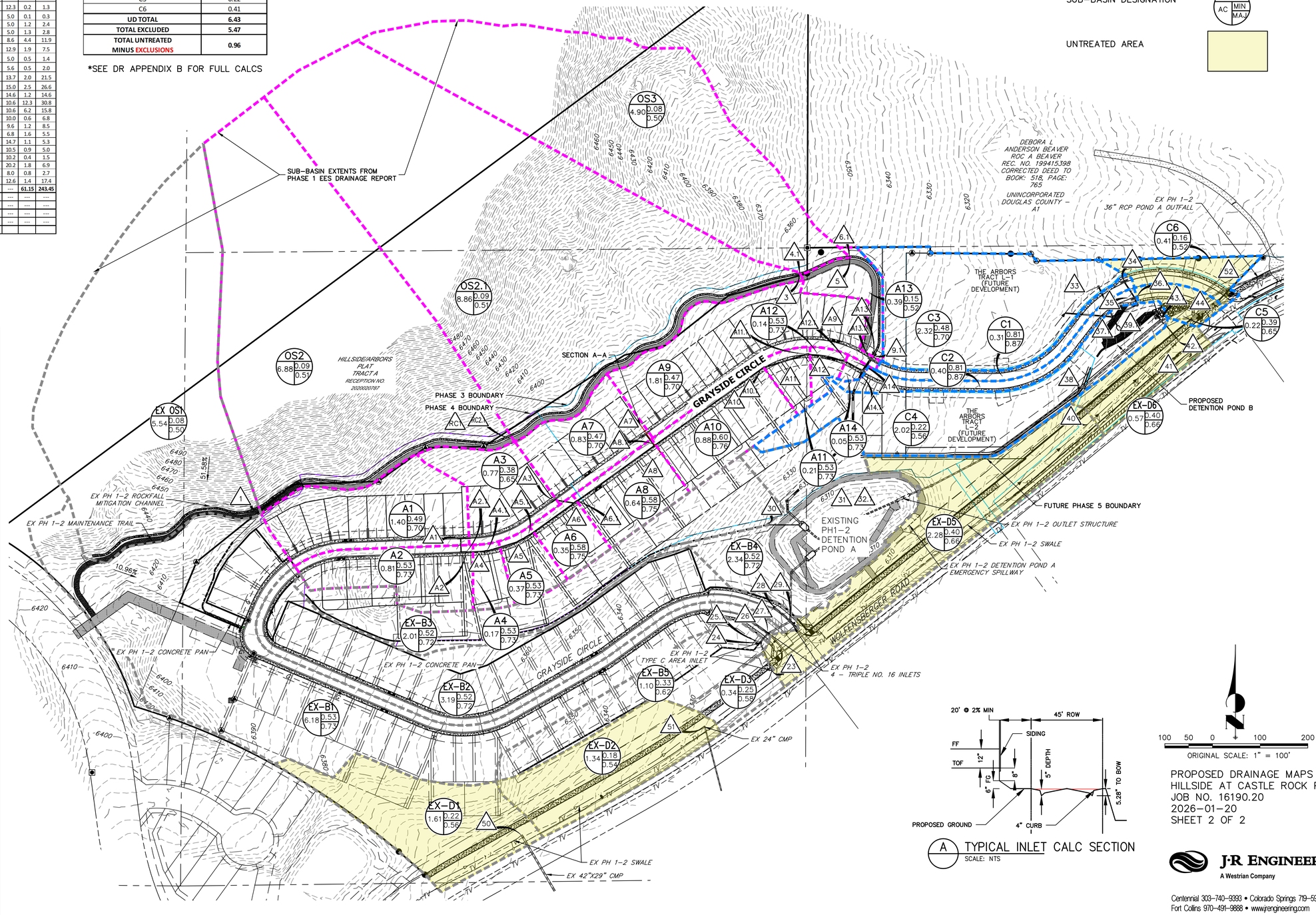
PROPOSED DRAINAGE MAPS

Tributary Sub-basin	Area (acres)	Percent Impervious	C_5	C_{100}	t_c (min)	Q_5 (cfs)	Q_{100} (cfs)
A1	1.40	53.2%	0.43	0.68	5.9	2.8	8.0
A2	0.85	68.9%	0.57	0.75	7.3	2.1	5.0
A3	0.77	44.4%	0.35	0.63	9.5	1.1	3.5
A4	0.17	66.8%	0.55	0.74	12.0	0.3	0.8
A5	0.37	53.4%	0.47	0.70	13.6	0.6	1.6
A6	0.35	69.7%	0.58	0.75	11.5	0.7	1.8
A7	0.83	53.4%	0.44	0.68	6.8	1.6	4.5
A8	0.64	69.7%	0.58	0.75	10.4	1.4	3.3
A9	1.81	95.0%	0.46	0.69	6.7	3.7	10.1
A10	0.88	79.3%	0.58	0.75	11.2	1.9	4.5
A11	0.21	56.2%	0.59	0.76	12.1	0.4	1.0
A12	0.14	56.2%	0.48	0.70	7.2	0.3	0.8
A13	0.39	34.6%	0.16	0.52	12.3	0.2	1.3
A14	0.05	79.3%	0.33	0.62	5.0	0.1	0.3
C1	0.31	95.0%	0.81	0.87	5.0	1.2	2.4
C2	0.40	79.3%	0.67	0.80	5.0	1.3	2.8
C3	2.32	56.2%	0.46	0.69	8.6	4.4	11.9
C4	2.02	34.6%	0.27	0.59	12.9	1.9	7.5
C5	0.22	58.2%	0.48	0.70	5.0	0.5	1.4
C6	0.41	31.3%	0.24	0.57	5.6	0.5	2.0
OS2	6.88	6.7%	0.09	0.51	13.7	2.0	21.5
OS2.1	8.86	5.1%	0.09	0.51	15.0	2.5	26.6
OS3	4.90	5.1%	0.07	0.50	14.6	1.2	14.6
EX-B1	6.18	63.4%	0.52	0.72	10.6	12.3	30.8
EX-B2	3.19	62.4%	0.51	0.72	10.6	6.2	15.8
EX-B3	2.01	11.4%	0.08	0.48	10.0	0.6	6.8
EX-B4	2.34	17.1%	0.13	0.51	9.6	1.2	8.5
EX-B5	1.10	27.3%	0.32	0.62	6.8	1.6	5.5
EX-D1	1.61	27.3%	0.21	0.55	14.7	1.1	5.3
EX-D2	1.34	23.8%	0.18	0.54	10.5	0.9	5.0
EX-D3	0.34	41.4%	0.33	0.62	10.2	0.4	1.5
EX-D5	2.28	36.7%	0.29	0.60	20.2	1.8	6.9
EX-D6	0.57	5.7%	0.32	0.62	8.0	0.8	2.7
EX-OS1	5.54	5.7%	0.07	0.49	12.6	1.4	17.4
Total	**61.68**	**30.0%**	---	---	---	**61.15**	**243.45**
EX POND A TOTAL	**50.20**	**27.6%**	---	---	---	---	---
PROPOSED POND B TOTAL	**5.05**	**51.8%**	---	---	---	---	---
EX UD TOTAL	**5.80**	**31.5%**	---	---	---	---	---
PROP UD TOTAL	**0.63**	**40.7%**	---	---	---	---	---
PROP UNTREATED IMPERVIOUS AREA	**0.26**	**AC**					

Basin ID	Total Area (ac)
EX-D1	1.61
EX-D2	1.34
EX-D5	2.28
EX-D6	0.57
C5	0.22
C6	0.41
UD TOTAL	**6.43**
TOTAL EXCLUDED	**5.47**
TOTAL UNTREATED MINUS EXCLUSIONS	**0.96**

*SEE DR APPENDIX B FOR FULL CALCS

Design Point	Q_5 (cfs)	Q_{100} (cfs)
1	1.4	17.4
RC1	2.0	21.5
RC2.1	3.3	38.3
3	2.5	26.6
4.1	5.8	63.3
5	1.2	14.6
6.1	6.9	77.7
A13	0.2	1.3
9.1	7.1	78.9
A1	2.8	8.0
A2	2.1	5.0
A2.1	4.8	12.5
A4	0.3	0.9
A4.1	4.3	11.2
A5	0.6	1.6
A5.1	4.7	12.2
A3	1.1	3.5
A6	0.7	1.7
A6.1	6.3	16.9
A7	1.6	4.5
A8	1.4	3.3
A8.1	8.7	23.3
A10	1.9	4.4
A10.1	10.5	27.4
A9	3.7	10.2
A11	0.4	1.0
A11.1	10.9	28.4
A12	0.3	0.8
A12.1	11.1	29.0
A13.1	9.8	86.3
A14	0.1	0.3
A14.1	9.8	86.4
23	0.4	1.5
24	1.6	5.5
25.1	11.4	15.8
26	12.3	30.8
27.1	23.6	46.5
28	6.2	15.8
29.1	29.8	62.2
30	0.6	6.8
31	1.1	8.4
32.1	38.3	153.8
33	4.3	11.9
34	1.2	2.4
35	1.3	2.8
36.1	2.5	5.2
37.1	16.1	25.9
38	1.9	7.5
39.1	7.4	21.4
40	1.8	6.9
41	0.8	2.7
42.1	2.4	8.7
43.1	8.3	25.9
44	0.5	1.3
50	1.1	5.3
51	0.9	5.0
52	0.5	2.0



LEGEND

- PROPOSED SUB-BASIN
- FUTURE DRAINAGE BASIN
- EXISTING DRAINAGE BASIN
- DESIGN POINT (X)
- SUB-BASIN DESIGNATION (NAME / AC / MIN / MAJ)
- UNTREATED AREA

A TYPICAL INLET CALC SECTION
SCALE: NTS

PROPOSED DRAINAGE MAPS
HILLSIDE AT CASTLE ROCK PHASE 3&4
JOB NO. 16190.20
2026-01-20
SHEET 2 OF 2

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