PHASE II DRAINAGE REPORT
FOR
RIDGEGATE DEVELOPMENT

Prepared For:

Shea Homes
9380 Station Street, Suite 600
Lone Tree, CO 80124
(303) 791-8180
Contact: Ryan McDermed

Prepared By:

JR Engineering, LLC

7200 South Alton Way Suite C400
Centennial, CO 80112
(303) 267-6220
Contact: Aaron Clutter

July 13, 2020

Engineer's Certification

I affirm that this report and plan for the Phase II drainage design of Ridgegate Development was prepared by me (or under my direct supervision) in accordance with the provisions of Douglas County Drainage Design and Technical Criteria for the owners thereof. I understand that Douglas County does not and will not assume liability for drainage facilities designed by others.

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Aaron Clutter, P.E. Date

State of Colorado No. 36742

For and on Behalf of JR Engineering

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APPENDICES

I. GENERAL LOCATION AND DESCRIPTION

A. Site Location

The subject portion of the proposed Ridgegate development is located in Sections 23 and 24, Township 6 South, Range 69 West and Section 18, Township 6 South, Range 67 West of the 6th Principal Meridian. The site is located to the south of Ridgegate Parkway, east of Interstate Highway 25 (I-25), and north of the public service right-of-way. The site is bisected by reaches of Happy Canyon Creek and Badger Gulch run adjacent to the site on the west and east. The site is shown in the figure below.

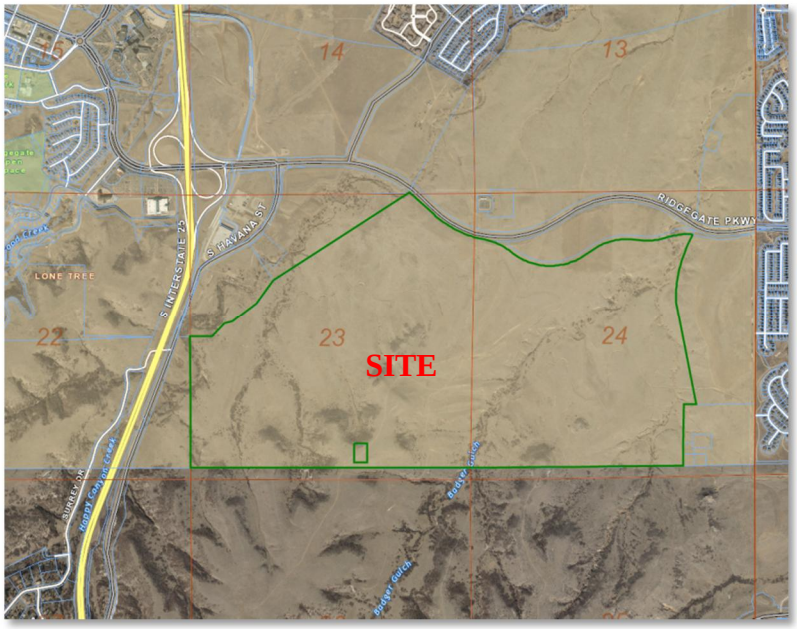


Figure 1: Vicinity Map

B. Description of Property

The site of the proposed Ridgegate Development consists of approximately 716 acres of undeveloped land. The proposed development will consist of a school site, parks, a recreation center, commercial lots, district roadways, and approximately 1590 residential lots with a mixture of single and multi-family. The site is currently unoccupied and undeveloped and is vegetated with native grasses and shrubs. The majority of soil in the proposed development is classified by the Natural Resource Conservation Service (NRCS) as Hydrologic Group C and D with small portions of the site consisting of Hydrologic Group B. Hydrologic Group B soils are described as "soils that have a moderate infiltration rate when thoroughly wetted and consists primarily of moderately deep to deep, moderately well to well drained soils with moderately fine to moderately coarse textures." Hydrologic Group C soils are described as "soils that have low infiltration rates when thoroughly wetted and consist chiefly of soils with a layer that impedes downward movement of water and soils with moderately fine to fine structure." Hydrologic Group D soils are described as "soils that have very low infiltration rates when thoroughly

wetted and consist chiefly of clay soils with high swelling potential, soils with a permanent high water table, soils with a claypan or clay layer at or near the surface and shallow soils over nearly impervious material."

The site slopes average 0-25% with some areas up to and over 33%. The terrain is mountainous and relatively steep throughout. The historic drainage patterns for the site are split in two directions. The western half of the site drains north and west to Happy Canyon Creek, while the eastern half of the site drains to the north and east to Badger Gulch.

The site is shown on the Federal Emergency Management Agency (FEMA), Flood Insurance Rate Map (FIRM) Community Panels No. 08035C0063G and 08035C0064G, February 17, 2017 and March 16, 2016 respectively. The majority of the site lies within Zone X which is the flood insurance rate zone that corresponds to areas outside the one percent annual chance floodplain. See the FIRM Map located in **Appendix A**. Portions of the site, consisting of approximately 50 acres, are located within the 100 year floodplains of Happy Canyon Creek and Badger Gulch. These 100 year floodplains are further discussed in the "Happy Canyon Creek Flood Hazard Area Delineation", by Muller Engineering Company, dated July 2014. There will be no proposed development of these areas.

There are two major drainage ways located adjacent to the site: Happy Canyon Creek and Badger Gulch. Happy Canyon Creek is located on the western edge of the site while Badger Gulch is located on the eastern edge of the site and is tributary to Happy Canyon Creek. Happy Canyon Creek and Badger Gulch each lie within a 100-year floodplain identified as Zone A in the FEMA FIRM Panels No. 08035C0063G and 08035C0064G.

There is one irrigation canal located on site: Arapahoe Canal. This is an abandoned irrigation canal that crosses the proposed development.

There are no active ditch facilities located within the site. There are no significant geologic features within the area to be developed, and areas of higher topography within the site will remain undeveloped under a conservation easement.

II. DRAINAGE BASINS AND SUB-BASINS

A. Major Drainage Basins

The Ridgegate Development lies within the Happy Canyon Creek and Badger Gulch drainage basins, which are left bank tributaries of Cherry Creek. The Badger Gulch drainageway is tributary to Happy Canyon Creek. This report has been prepared in conformance with the "Master Drainage Plan for Ridgegate – Happy Canyon Creek and Badger Gulch Drainage Basins", by Merrick & Company, revised May 2017.

In the existing condition, storm runoff from the undeveloped site on the western half of the site drains into Happy Canyon Creek via overland sheet flow and natural drainage channels. Storm runoff on the eastern half of the site drains into Badger Gulch via overland sheet flow and natural channels.

Development of the project site will result in increased runoff volume to Happy Canyon Creek and Badger Gulch. Onsite WQ/EURV ponds will be provided. Some incidental detention is provided due to the filling of the pond and the routing of the flows through the outlet structure. The proposed Ridgegate EURV ponds are proposed to discharge at a 100-year peak rate not less than 85% of the un-detained 100-year peak flows. This has been established in coordination with Merrick & Company in order to minimize the adverse effects of the peak discharge from the Ridgegate Development coinciding with the peaks in the respective receiving drainageways. Online detention is proposed in Happy Canyon Creek and Badger Gulch (by others). The inflows into Happy Canyon Creek and Badger Gulch will be analyzed in a separate drainage report by Merrick & Company. Per the "Master Drainage Plan for Ridgegate – Happy Canyon Creek and Badger Gulch Drainage Basins", by Merrick & Company, revised May 2017, creek stabilization improvements are proposed (by others) within the channels to stabilize the drainageways and protect against the effects of urbanization in the watersheds.

Offsite basins OS1-OS9 will generally sheet flow north where runoff will be captured by storm sewer and routed to the EURV ponds and then outfall to either Happy Canyon Creek or Badger Gulch. Sub-basin OS1-OS8 will outfall into Happy Canyon Creek, while sub-basin OS9 will outfall into Badger Gulch.

B. Minor Drainage Basins

There are eight developed condition basins denoted within this report. Each basin is representative of a particular storm sewer system and outfall location. The majority of the basins are routed to the EURV ponds A, B, C, D, E, F, R, and the existing WQ pond E. The existing WQ pond was constructed as part of the Ridgegate Parkway Improvement project. Excerpts are included in **Appendix D**.

The EURV Pond A Basin consists of 29 proposed sub-basins A0-A15 with three offsite sub-basins OS7a, OS7b and OS8 combining for a total of 165.5 acres. This basin represents the northwestern portion of the proposed development. These sub-basins are primarily a school site,

roadways, parks, commercial lots, and residential lots. Stormwater runoff is conveyed via curb & gutter and swales. Runoff is captured via a series of proposed on-grade and sump inlets as well as area inlets in the open space swales. Runoff is then piped north to the proposed EURV Pond A. The treated/detained pond releases are discharged to Happy Canyon Creek. Pond A has been design to capture primarily Phase 1 and a portion of Phase 2 of the Ridgegate development.

The EURV Pond B Basin consists of 19 proposed sub-basins B0-B7 with 10 offsite sub-basins OS2b-OS6b combining for a total of 256.0 acres. This basin represents the western portion of the proposed development. These sub-basins are primarily residential lots, roadways, and open space. Stormwater runoff is conveyed via curb & gutter and swales. Runoff is captured via a series of proposed on-grade and sump inlets as well as area inlets in the open space minor drainageways. Runoff is then piped north to the EURV Pond B. The treated/detained pond releases are discharged to Happy Canyon Creek. Pond B has been design to capture primarily Phase 2 and a portion of Phase 3 of the Ridgegate development.

The EURV Pond C Basin consists of three proposed sub-basins C0-C1b with two offsite sub-basins OS1 and OS2a combining for a total of 59.8 acres. This basin represents the southwestern portion of the proposed development. These sub-basins are primarily residential lots, roadways and open space. Stormwater runoff is conveyed via curb & gutter and swales. Runoff is captured via a series of proposed sump inlets as well as area inlets in the open space minor drainageways. Runoff is then piped north to the proposed EURV Pond C. The treated/detained pond releases are discharged to Happy Canyon Creek. Pond C has been design to capture a portion of Phase 3 of the Ridgegate development.

The EURV Pond D Basin consists of three proposed sub-basins D0-D2 combining for a total of 22.8 acres. This basin represents the western portion of the proposed development. These sub-basins are primarily parks. Stormwater runoff is conveyed northwest to the EURV Pond D. The treated/detained pond releases are discharged to Happy Canyon Creek. Pond D has been design to capture a portion of Phase 1 of the Ridgegate development.

The EURV Pond E Basin consists of 11 proposed sub-basins E0-E8 combining for a total of 38.0 acres. This basin represents the northeastern portion of the proposed development. These sub-basins are primarily residential lots, roadways, and parks. A portion of the stormwater runoff is conveyed via curb & gutter. Runoff is captured via proposed sump inlets. Runoff is then piped west to the proposed EURV Pond E. The treated/detained pond releases are discharged to Badger Gulch. Pond E has been design to capture a portion of Phase 4 of the Ridgegate development.

The EURV Pond F Basin consists of 9 proposed sub-basins F0-F8 with one offsite sub-basin OS9 combining for a total of 85.9 acres. This basin represents the southeastern portion of the proposed development. These sub-basins are primarily residential lots, roadways, and minor open spaces. Stormwater runoff is conveyed via curb & gutter and swales. Runoff is captured via a series of proposed on-grade and sump inlets as well as area inlets in the minor drainageways. Runoff is then piped east to the proposed EURV Pond F. The treated/detained pond releases are

discharged to Badger Gulch. Pond F has been design to capture a primarily Phase 5 of the Ridgegate development.

The EURV Pond R Basin consists of 25 sub-basins R0-R3, RB1-RB8b, RC1-RC6f combining for a total of 70.0 acres. These basins are primarily residential lots, commercial lots, roadways, and include a portion of Ridgegate Parkway. The stormwater runoff is conveyed via curb & gutter and swales. Runoff is captured via a series of existing and proposed on-grade and sump inlets. Runoff is then routed via existing pipe west within Ridgegate Parkway to the proposed EURV Pond R. The treated water is then released to an outfall, which discharges into Happy Canyon Creek. EURV Pond R will replace the existing WQ Pond B located on the north side of Ridgegate Parkway. This existing water quality pond was installed with the Ridgegate Parkway expansion and was planned to be temporary, so it will be removed and all stormwater runoff will be rerouted to EURV Pond R. Pond R has been design to capture a portion of Phase 1, 3 and 4 of the Ridgegate development.

The existing Water Quality Pond E consists of six sub-basins RE1-RE5 combining for a total of 20.4 acres. These basins are primarily residential lots, roadways, and minor open spaces. The stormwater runoff is conveyed via curb & gutter and swales. Runoff is captured via a series of existing and proposed on-grade and sump inlets. Runoff is then routed via existing pipe east within Ridgegate Parkway to the existing WQ Pond E. The treated water is then released to an outfall, which discharges into Badger Gulch. Existing WQ Pond E has been design to capture a portion of Phase 4 of the Ridgegate development.

Proposed eight sub-basins OF1 - OF8 are not proposed to be routed to the EURV ponds based on the locations. Sub-basin OF1 and OF2 are located in close proximity to the Happy Canyon and Badger Gulch drainageways and include only proposed roadways. The low point of the road is located near the channel crossings and it is proposed to discharge directly into the channel. Sub-basins OF3 – OF8 include the back half of proposed residential single family lots. The sub-basins back up to Happy Canyon or Badger Gulch and are not proposed to be routed to a EURV pond. A grass buffer is proposed on the back side of the lot to provide water quality.

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 Douglas County and the "Urban Storm Drainage Criteria Manual" (USDCM) by Mile High Flood Control District (MHFD).

B. Drainage Studies

The site has previously been studied by multiple reports. The "Master Drainage Plan for Ridgegate-Happy Canyon Creek and Badger Gulch Drainage Basins", by Merrick & Company, revised May 2017, has been utilized for the overall master planning of the site.

The "Phase III Drainage Report for Ridgegate Parkway Expansion – Phase I", by Merrick & Company, dated October 2018, and the "Phase III Drainage Report for Ridgegate Parkway Expansion – Phase II", by Merrick & Company, dated October 2018, have been utilized to confirm that this drainage report is in conformance with the allowable inflows into the existing storm sewer system located in Ridgegate Parkway. The allowable versus the proposed inflows into the existing storm sewer systems is presented in **Table 2**.

The "Happy Canyon Creek Flood Hazard Area Delineation", by Muller Engineering Company, dated July 2014, has been utilized for 100 year floodplain mapping.

C. Hydrology

The Rational method was utilized to determine the hydrology of the site. Rational method calculations were prepared for the sub-basins that directly impact the sizing of minor drainageways and pipe sizing. The 5-year storm was analyzed as the minor storm and the 100-year storm was analyzed as the major storm for aspects of design. The site is located in Douglas County Rainfall Zone 1. One-hour point rainfall values were taken from the SDDTCM and used in equation 5-1 from the USDCM to calculate intensities. 1-hour point rainfall values of 1.43 inches and 2.60 inches were used for a 5-year and 100-year storm events respectively.

Standard Forms SF-2 and SF-3 were used to determine the runoff from the minor and major storms on this site. Runoff coefficients were determined based on data presented in Table 6-5 from the USDCM. Basin percent impervious values were calculated based on proposed future land use and from data on Table 6-3 from the USDCM. Times of concentration were developed using equations from the USDCM. All runoff calculations and applicable charts and graphs are included in Appendix B of this report.

The hydrology calculations are presented in **Appendix B.**

D. Hydraulics

The sizing for the minor drainageways, emergency overflow spillways, and the EURV pond trickle channels will be provided with the Phase III Drainage reports for the site. All curb and

area inlet sizing and street capacity calculations will be provided with the Phase III Drainage reports for the site.

For this Phase II report, all storm sewer sizes shown on the drainage maps and in the calculations are preliminary. The pipes have been sized using only Manning's equation and are included in the SF-3 Rational Method calculations. At this time, profiles have not been completed for the storm sewer; therefore all slopes are reasonable assumptions to obtain a preliminary size. Hydraulic grade calculations and final storm sewer sizing will be prepared with the Phase III Drainage reports prepared for this project.

E. Pond Calculations and Water Quality Enhancement

The Ridgegate Development will be serviced by seven EURV ponds and one existing WQ pond. Outlet structures for these ponds will feature perforated plates for the WQCV and EURV discharge. These ponds were sized and designed per Mile High Flood Control District (MHFD) methods and criteria using the MHFD-Detention_v4.03 workbook as the primary design tool. The MHFD-Detention workbook was used to calculate detention volume requirements and to size the outlet structure. The UD-BMP_v3.07 workbook (MHFD) was used to design the grass buffers. The grass buffers are designed to provide water quality to the basins not routed to the EURV ponds

The MHFD-Detention and BMP calculations are presented in **Appendix C**.

All runoff from the proposed site will be captured and piped to seven proposed EURV ponds located offline from the receiving drainageways. Prior to being released into Happy Canyon Creek or Badger Gulch, the stormwater runoff will receive water quality in the proposed offline EURV Ponds, which will mitigate adverse impacts to stormwater quality. Detention will be provided in Happy Canyon Creek and Badger Gulch per the "Master Drainage Plan for Ridgegate – Happy Canyon Creek and Badger Gulch Drainage Basins", by Merrick & Company, revised May 2017. As a result, detention is not required in the on-site ponds within the Ridgegate development and will be required to only provide the WQCV and EURV volumes.

The ponds have been designed to release at a minimum 85% of the 100-year developed inflow. The pond outfalls to the receiving drainageways will include energy dissipation for the 100-year outfall and are planned to include low tail-water basins. The outfalls will be riprapped into Happy Canyon Creek or Badger Gulch to either the thalwag of the channel or the 100-year floodplain.

IV. STORMWATER MANAGEMENT FACILITY DESIGN

A. Stormwater Conveyance Facilities

The conveyance system within Ridgegate Development is that of a typical subdivision with curb and gutter capturing and conveying flows to on-grade and sump storm sewer inlets. Concentrated off-site flows are proposed to be channelized via minor drainageways and routed into the proposed storm sewer system and to the ponds.

For this submittal, all critical design points have been evaluated for preliminary pipe sizing. On-grade inlets have been preliminarily located to determine storm sewer sizing. Street capacity calculations, inlet calculations and storm pipe HGL's will be evaluated in the Phase III Drainage reports for this site.

All storm sewer pipes, inlets, and streets will be public improvements. The EURV ponds will reside on property owned by the City of Lone Tree but will be maintained by the Rampart Range Metro District. Easements and tracts will be established to allow for maintenance access to drainage facilities. Offsite drainageways will be located in easements.

B. Stormwater Storage Facilities

There are seven proposed EURV ponds within this project: five of which will outfall into Happy Canyon Creek, two will outfall into Badger Gulch. In-line detention is planned to be provided within Happy Canyon and Badger Gulch per the *Ridgegate Master Drainage Report* and will not be provided in the on-site ponds.

The proposed EURV ponds will utilize forebays at each outfall point into the pond in order to dissipate the energy from the storm runoff and collect sediment. Trickle channels will then convey the runoff to the outlet structure. The outlet structure will include micropools and contain the respective initial surcharge volumes. The outlet structure will utilize orifice plates for both the water quality capture volume (WQCV) and EURV. The outlets structure orifice plate will be sized to release the WQCV event over a period of 40 hours. For the developed 100-year inflows, an overflow grate on the top of the outlet structure will be used with minimal to no detention provided. All flows up to the 100-year discharging from the pond will then enter the channel via pipe. The ponds will also have emergency spillways to discharge emergency flows that are greater than the 100 year. Trash racks will be used to prevent any trash from escaping the development and for easy cleaning. A maintenance access trail will be constructed for easy access to the outlet structure and forebays for maintenance and repairs.

All pond outfalls will be riprapped into Happy Canyon Creek or Badger Gulch. The flows from the ponds are proposed to discharge into Happy Canyon Creek or Badger Gulch upstream of the 100-year floodplain and include a low-tailwater basin. In the situation that grading is done within the 100 year floodplain, a no-rise certification and a floodplain permit will be required. The preliminary pond volumes and water surface elevations for the WQCV, EURV, and 100 year storm events for each pond are shown in the table below.

A. Water Quality Enhancement Best Management Practices

Water quality is generally being provided for the site in the seven water quality and EURV ponds prior to entering Happy Canyon Creek and Badger Gulch. The ponds will be designed as Full-Spectrum Detention/EURV Ponds and will utilize forebays and an outlet structure to treat storm water runoff from the proposed development. The forebays will be used to dissipate the energy of the runoff and allow any remaining sediment to settle out of the water before it departs the pond. The outlet structure has been design with an orifice plate and designed to release the WQCV event over a period of 40 hours.

Table 1: EURV Pond Parameters

POND	Area (ac)	% Imp.	WQCV (ac-ft)	WQCV WSEL	EURV (ac-ft)	EURV WSEL	100 yr (ac-ft)	100 yr WSEL
EURV POND A	165.5	50%	2.85	5,976.07	7.87	5,980.31	29.67	5,981.74
EURV POND B	256.0	22%	2.67	5,963.01	5.15	5,965.96	38.98	5,967.52
EURV POND C	59.8	13%	0.42	6,098.44	0.66	6,099.54	8.63	6,102.98
EURV POND D	22.8	27%	0.27	6,009.86	0.58	6,011.99	3.40	6,013.17
EURV POND E	37.9	56%	0.71	6,011.70	2.20	6,015.32	6.70	6,015.98
EURV POND F	74.6	38%	1.09	6,064.19	2.80	6,068.05	12.12	6,069.32
EURV POND R	70.0	57%	1.33	6,076.04	3.88	6,081.99	12.80	6,081.99

Proposed sub-basins OF3 – OF8 include the back half of proposed residential single family lots. The sub-basins back up to Happy Canyon or Badger Gulch and are not proposed to be routed to a EURV pond. A four foot side grass buffer is proposed on the back side of the lot to provide water quality. Each lot is expected to have an inflow of no more than 0.2 cfs in the two-year storm and spans a minimum of approximately 45 feet along the channel. Per MHFD criteria, a 4 foot wide grass buffer is required to provide water quality. The maximum slope is expected to be no more than 6%.

Sub-basin OF1 and OF2 are located in close proximity to the Happy Canyon and Badger Gulch drainageways and include only proposed roadways. The low point of the road is located near the channel crossings and it is proposed to discharge directly into the channel. Sub-basin OF1 and OF2 are not proposed to be routed to a EURV pond. Refer to **Appendix C** for the water quality grass buffer calculations.

Table 3: Proposed Sub-basins Routed Off-site

	Sub-basin	Area (ac)	% Imp.	C_2	C_5	C_{100}	t_c (min)	Q_2 (cfs)	Q_5 (cfs)	Q_{100} (cfs)
OFFSITE - DRAINAGEWAYS	OF1	2.28	90%	0.74	0.77	0.85	10.5	6.4	6.7	13.4
	OF3	1.38	29%	0.21	0.28	0.60	5.5	1.4	1.8	7.2
	OF4	0.57	45%	0.34	0.40	0.67	5.0	0.9	1.1	3.4
	OF5	0.87	36%	0.26	0.32	0.62	5.2	1.1	1.3	4.7
	OF6	0.33	45%	0.34	0.40	0.67	5.0	0.5	0.6	1.9
	HC Total	2.82	35%	0.25	0.31	0.62	---	3.4	4.2	15.3
	OF2	0.65	90%	0.77	0.85	5.0	2.4	4.9	3.1	33.2
	OF7	1.40	45%	0.33	0.36	0.64	5.0	2.2	2.5	7.9
	OF8	1.33	45%	0.33	0.36	0.64	5.0	2.1	2.3	7.5
	BG Total	2.73	45%	0.33	0.36	0.64	---	4.4	4.8	15.3

B. Existing Ridgegate Parkway Storm Sewer

There is an existing storm sewer system located in Ridgegate Parkway that will be used to pipe flows to the EURV Pond R and the existing WQ Pond E. The proposed design flows that enter the existing storm sewer system located in Ridgegate Parkway are all within the allowable limit. The flows at design points RC4, RC3, RC1, RB5, and RE4 have design flows that are greater than the allowable inflows that were specified in the following reports: "Phase III Drainage Report for Ridgegate Parkway Expansion – Phase I", by Merrick & Company, dated October 2018, and the "Phase III Drainage Report for Ridgegate Parkway Expansion – Phase II", by Merrick & Company, dated October 2018. While the flows may be greater than originally designed for, they are not expected to cause adverse impacts to the existing storm sewer system as shown in the calculations for Pond R and Ex. WQ Pond E in the SF-3 Minor and Major calculations located in **Appendix B**. The allowable and proposed inflows for the 5-year and 100-year storm events entering the existing storm sewer system are shown in the table below.

Table 2: Allowable vs. Proposed Inflows into Existing Ridgegate Storm Sewer System

RIDGEGATE PARKWAY STORM SEWER ALLOWABLE INFLOWS						
Design Point	5-yr Minor Storm			100 yr- Major Storm		
	Allowable Inflow (cfs)	Proposed Inflow (cfs)	Δ Inflow (cfs)	Allowable Inflow (cfs)	Proposed Inflow (cfs)	Δ Inflow (cfs)
EURV POND R						
RC4	29.7	31.9	2.2	86.3	72.3	-14.0
RC3	30.5	33.6	3.1	89.1	76.9	-12.2
RC2	36.2	27.1	-9.1	80.4	67.8	-12.6
RC1	59.6	62.0	2.4	160	152.0	-8.0
RB1	38.1	22.5	-15.6	79.1	59.0	-20.1
RB2	87.1	84.1	-3.0	219.2	210.7	-8.5
RB3	2.3	0.7	-1.6	5.9	1.6	-4.3
RB4	89.2	86.0	-3.2	225.9	216.0	-9.9
RB5	3.4	4.0	0.6	10.3	9.0	-1.3
RB6	91.7	89.1	-2.6	234.3	222.9	-11.4
EX WQ POND E						
RE1	20.0	19.4	-0.6	45.2	44.4	-0.8
RE2	18.3	2.8	-15.5	40.6	7.3	-33.3
RE3	10.6	10.4	-0.2	23.6	23.1	-0.5
RE4	29.3	29.4	0.1	67.3	67.5	0.2
RE5	21.4	9.9	-11.5	47.3	22.3	-25.0
Ex. Pond E Outfall	44.7	36.8	-7.9	102.9	84.3	-18.6

C. Floodplain Modification

There are no modifications proposed to any floodplain. The project site is outside the one percent annual chance floodplain, and there are no CLOMR, LOMR, or floodplain permitting requirements. In the situation that grading is done within the 100 year floodplain, a no-rise certification and a floodplain permit will be required.

D. Additional Permitting Requirements

An Approved Jurisdictional Determination, provided by the U.S. Army Corps of Engineers, Corps File No. MWO-2019-01406-DEN, has determined that there are no water resources of the U.S. on this site; therefore, a Department of the Army permit will not be required for this site. There are currently no endangered species located on the site. There are no other permitting requirements placed on the site.

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 Douglas County as well as the "Urban Storm Drainage Criteria Manual" by the Mile High Flood Control District (MHFD).

B. Variances

No variances are requested at this time.

C. Drainage Concept

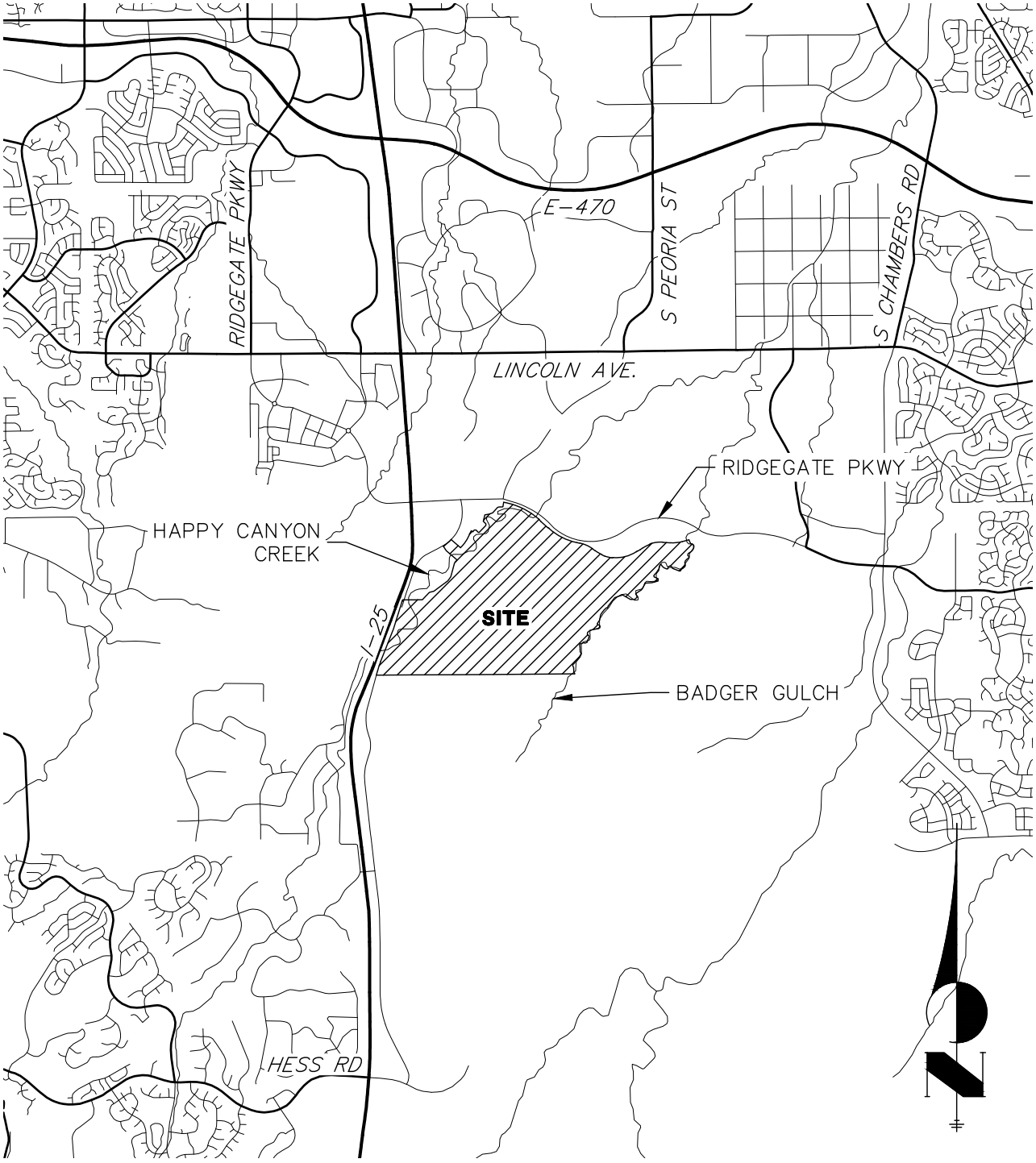
All proposed runoff will be safely conveyed through the site and release at allowable rates at the existing outfall points from the site. Water quality is currently or will be provided at the outfall locations in exclusion of at the roadway crossings over the drainageways. Minimal to no adverse effects to the Happy Canyon Creek or Badger Gulch and downstream infrastructure are expected as a result of the proposed Ridgegate Development improvements. Minimal to no impacts are expected with respect to stormwater quality, quantity, or timing.

REFERENCES

1. Happy Canyon Creek Flood Hazard Area Delineation, by Muller Engineering Company, dated July 2014.
2. Master Drainage Plan for Ridgegate-Happy Canyon Creek and Badger Gulch Drainage Basins, Merrick & Company, Revised May 2017.
3. Phase III Drainage Report for Ridgegate Parkway Expansion – Phase I, by Merrick & Company, dated October 2018.
4. Phase III Drainage Report for Ridgegate Parkway Expansion – Phase II, by Merrick & Company, dated October 2018.
5. Storm Drainage Design and Technical Criteria Manual, Douglas County, July 2008.
6. Urban Storm Drainage Criteria Manual, Mile High Flood Control District, Latest Revision.

APPENDIX A

FIGURES, EXHIBITS, AND EXCERPTS



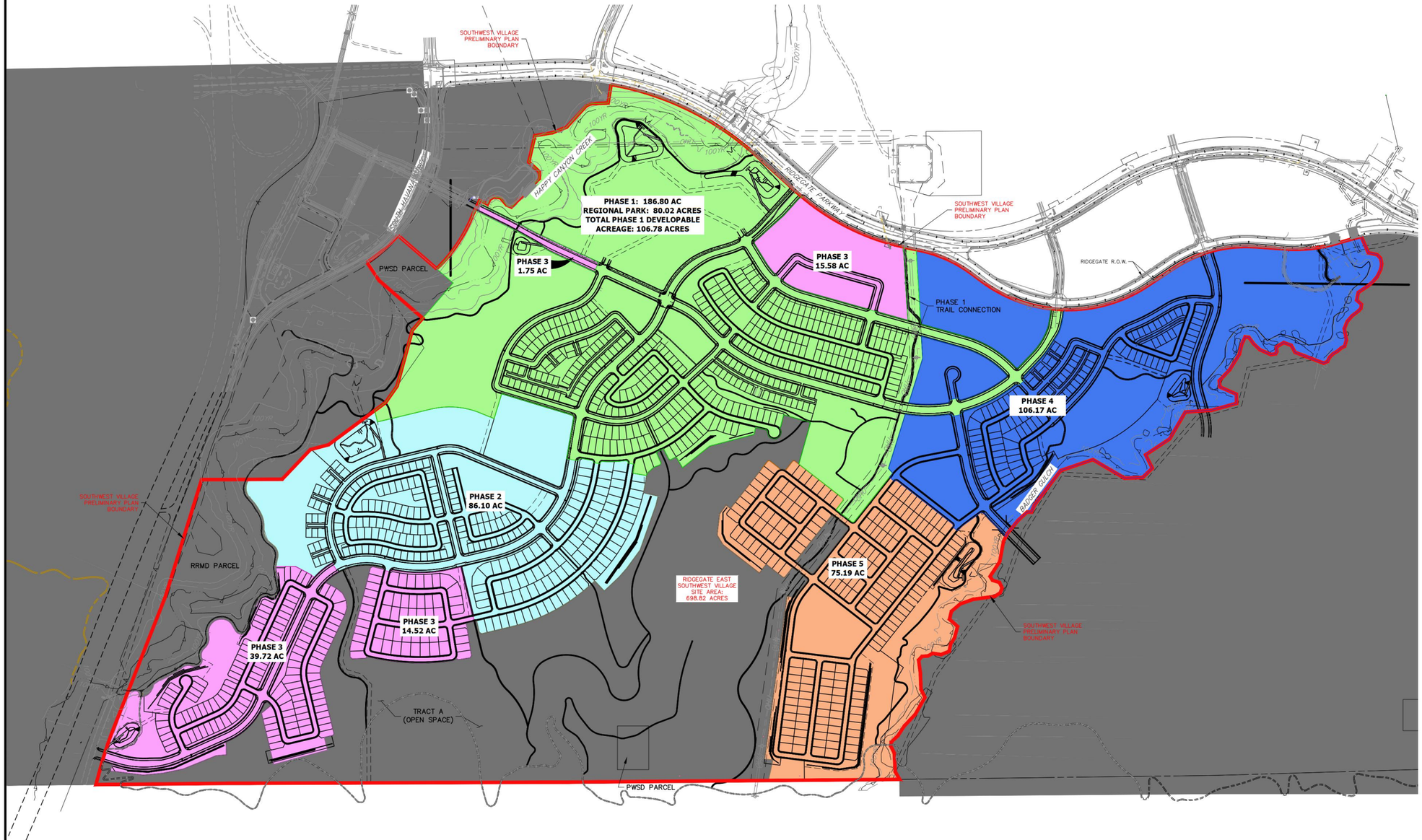
VICINITY MAP

SCALE 1'=5000'

15950.00
4/15/2020
SHEET 1 OF 1

J·R ENGINEERING
A Westrian Company

Centennial 303-740-9393 • Colorado Springs 719-593-2593
Fort Collins 970-491-9888 • www.jrengineering.com



PRELIMINARY PLAN BOUNDARY

	RIDGEGATE EAST - SOUTHWEST VILLAGE PRELIMINARY PLAN	698.82 ACRES

PHASING LEGEND

SHEA HOMES IMPROVEMENTS	ACREAGE
FILING 1 BOUNDARY	186.80 ACRES
FILING 2 BOUNDARY	86.10 ACRES
FILING 3 BOUNDARY	71.57 ACRES
FILING 4 BOUNDARY	106.17 ACRES
FILING 5 BOUNDARY	75.19 ACRES

N

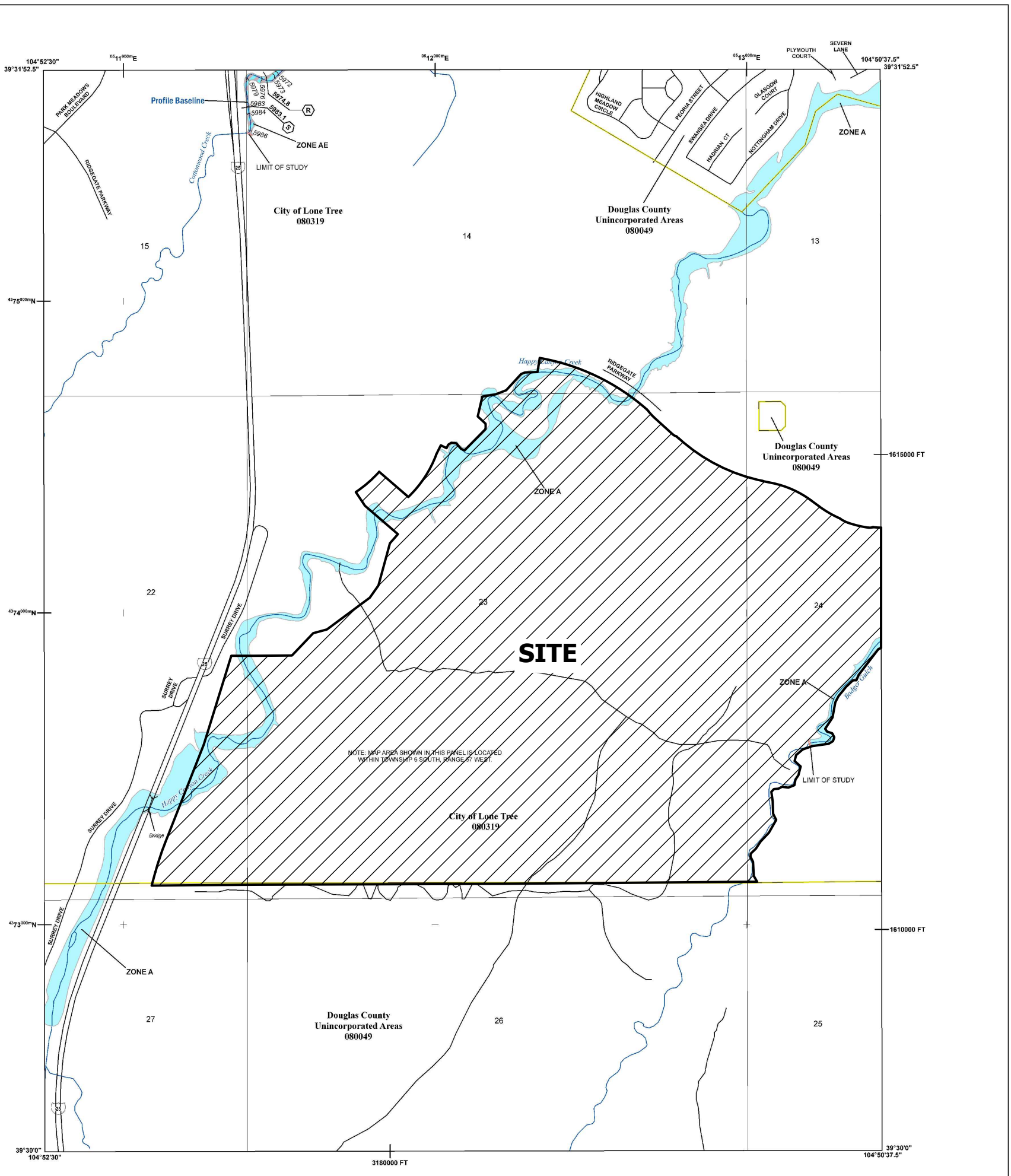
400 200 0 400 800

ORIGINAL SCALE: 1" = 400'

PLAT BOUNDARY EXHIBIT
RIDGEGATE SOUTHWEST VILLAGE
JOB NO. 15950.00
7/6/2020
SHEET 1 OF 1

J·R ENGINEERING
A Westrian Company

Centennial 303-740-9393 • Colorado Springs 719-593-2593
Fort Collins 970-491-9888 • www.jrengineering.com



FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR ZONE DESCRIPTIONS AND INDEX MAP
THE INFORMATION DEPICTED ON THIS MAP AND SUPPORTING DOCUMENTATION ARE ALSO AVAILABLE IN DIGITAL FORMAT AT
HTTP://MSC.FEMA.GOV

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

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

OTHER AREAS
- NO SCREEN Areas of Minimal Flood Hazard *Zone X*
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Accredited or Provisionally Accredited Levee, Dike, or Floodwall
- Non-accredited Levee, Dike, or Floodwall
- E 18.2 / 17.5 Cross Sections with 1% Annual Chance Water Surface Elevation (BFE)
- 8 Coastal Transect
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature
- 513 Base Flood Elevation Line (BFE)

OTHER FEATURES
- Limit of Study
- Jurisdiction Boundary

NOTES TO USERS

For information and questions about this map, available products associated with this FIRM including historic versions of this FIRM, how to order products or the National Flood Insurance Program in general, please call the FEMA Map Information eXchange at 1-877-FEMA-MAP (1-877-336-2627) or visit the FEMA Map Service Center 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 website. Users may determine the current map date for each FIRM panel by visiting the FEMA Map Service Center website or by calling the FEMA Map Information eXchange.

Communities annexing land on adjacent FIRM panels must obtain a current copy of the adjacent panel as well as the current FIRM Index. These may be ordered directly from the Map Service Center at the number listed above.

For community and countywide map dates refer to the Flood Insurance Study report for this jurisdiction. To determine if flood insurance is available in the community, contact your Insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

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 2003.

SCALE

Map Projection:
NAD83 UTM Zone 13N
Western Hemisphere; Vertical Datum: NAVD88

1 inch = 500 feet 1:6,000

0 1,000 2,000 Feet

0 250 500 Meters

PANEL LOCATOR

* PANEL NOT PRINTED

FEMA
National Flood Insurance Program

NATIONAL FLOOD INSURANCE PROGRAM
FLOOD INSURANCE RATE MAP

DOUGLAS COUNTY, COLORADO
And Incorporated Areas

PANEL 63 OF 495

FEMA

Panel Contains:

COMMUNITY	NUMBER	PANEL	SUFFIX
DOUGLAS COUNTY	080049	0063	G
LONE TREE, CITY OF	080319	0063	G

VERSION NUMBER
2.3.3.2

MAP NUMBER
08035C0063G

MAP REVISED
FEBRUARY 17, 2017

X:\1590000.all\1595000\Drawings\Sheet Dwgs\Drainage\Preliminary\FIRM Map.dwg, FIRM 1, 3/10/2020 10:56:50 AM, MiskellC

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.

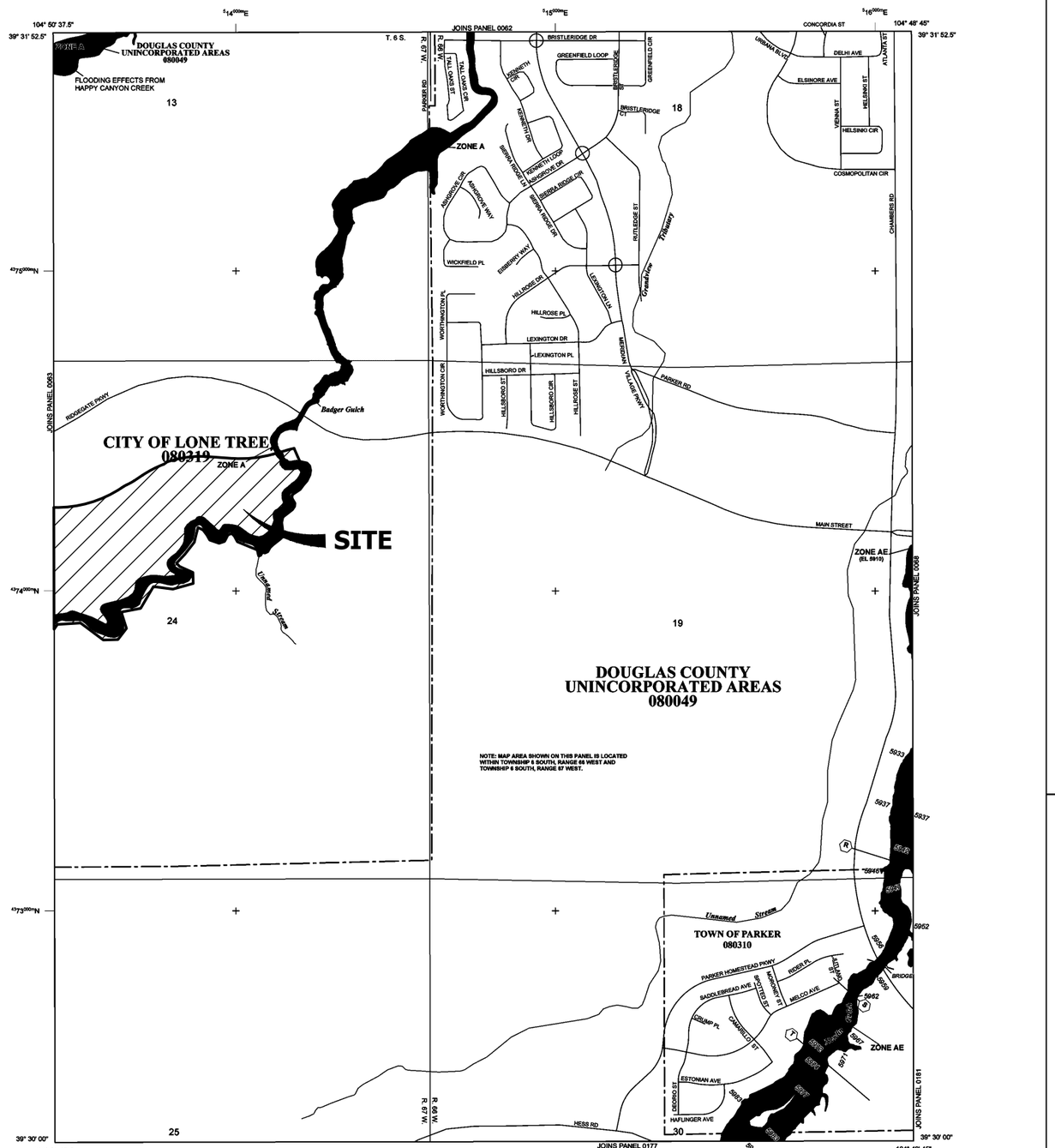
Based on updated topographic information, this map reflects more detailed and up-to-date **stream channel configurations** and **floodplain delineations** than those shown on the previous FIRM for this jurisdiction. As a result, the Flood Profiles and Floodway Data tables for multiple streams in the 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/businessnfip.



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 equalled 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
- 4939000 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

NFIP NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0064G

FIRM

FLOOD INSURANCE RATE MAP

DOUGLAS COUNTY, COLORADO AND INCORPORATED AREAS

PANEL 64 OF 495
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

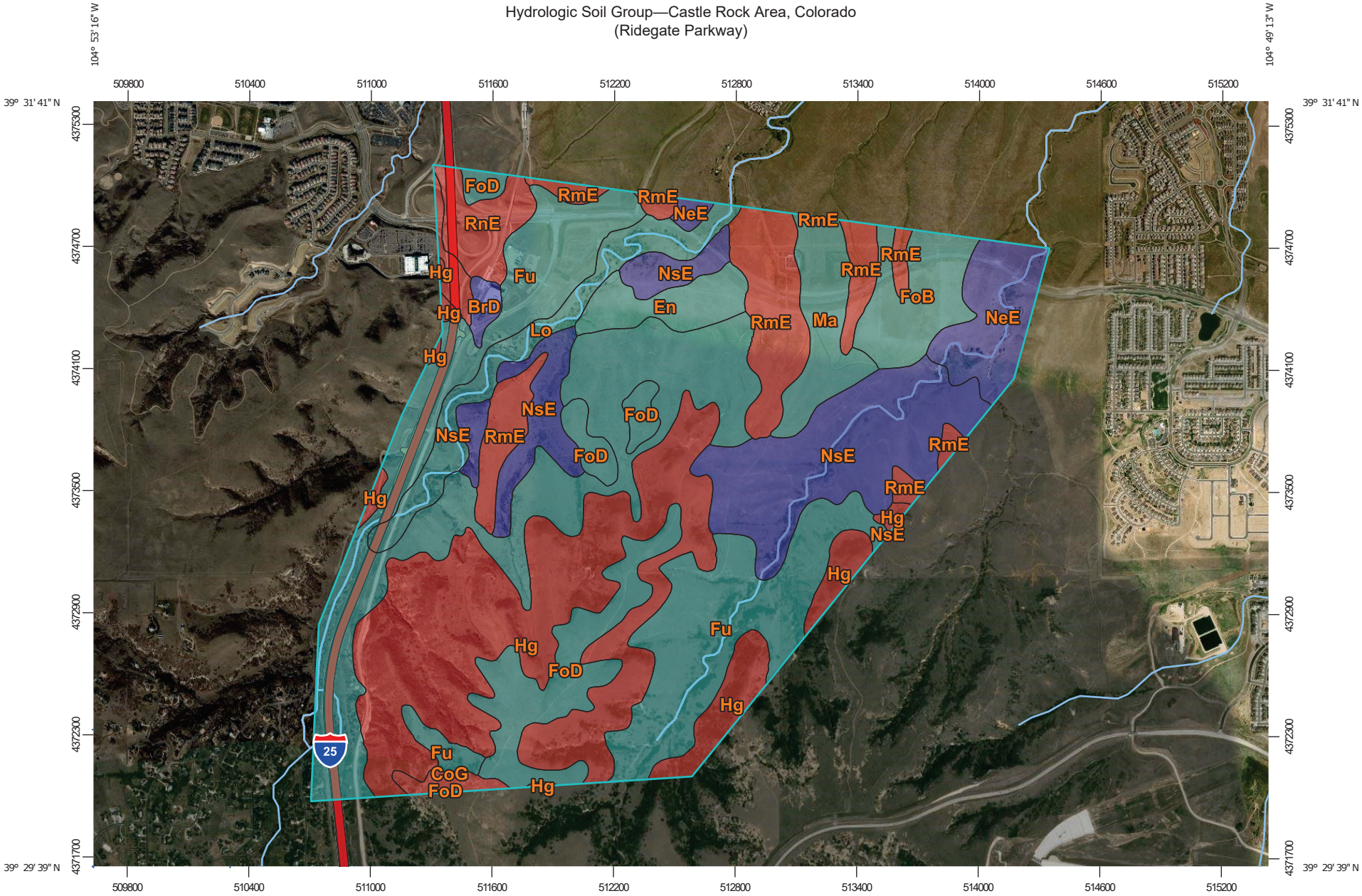
COMMUNITY	NUMBER	PANEL	SUFFIX
DOUGLAS COUNTY	080049	0064	G
LONE TREE, CITY OF	080319	0064	G
PARKER, TOWN OF	080310	0064	G

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
08035C0064G
MAP REVISED
MARCH 16, 2016

Federal Emergency Management Agency

Hydrologic Soil Group—Castle Rock Area, Colorado
(Ridegate Parkway)



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.

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

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

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

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

Soil Survey Area: Castle Rock Area, Colorado
Survey Area Data: Version 11, Sep 10, 2018

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—Nov 19, 2018

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

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
BrD	Bresser sandy loam, cool, 5 to 9 percent slopes	B	9.0	0.5%
CoG	Coni rocky loam, 3 to 100 percent slopes	D	11.1	0.6%
En	Englewood clay loam	C	42.5	2.3%
FoB	Fondis clay loam, 1 to 3 percent slopes	C	65.5	3.5%
FoD	Fondis clay loam, 3 to 9 percent slopes	C	122.1	6.6%
Fu	Fondis-Kutch association	C	541.8	29.2%
Hg	Hilly gravelly land	D	417.4	22.5%
Lo	Loamy alluvial land	C	78.0	4.2%
Ma	Manzanola clay loam	C	61.5	3.3%
NeE	Newlin gravelly sandy loam, 8 to 30 percent slopes	B	71.9	3.9%
NsE	Newlin-Satanta complex, 5 to 20 percent slopes	B	242.0	13.0%
RmE	Renohill-Buick complex, 5 to 25 percent slopes	D	154.8	8.3%
RnE	Renohill-Manzanola clay loams, 3 to 20 percent slopes	D	40.1	2.2%
Totals for Area of Interest			**1,857.6**	**100.0%**

Description

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

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

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

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

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

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

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

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

APPENDIX B

HYDROLOGIC CALCULATIONS

Subdivision: Ridgegate Project Name: Phase II Drainage Report

Location: Lone Tree Project No.: 15950.00 Date: 7/13/20

BASIN SUMMARY TABLE								
	Sub-basin	Area (ac)	% Imp.	C_5	C_{100}	t_c (min)	Q_5 (cfs)	Q_{100} (cfs)
EURV POND A	A0	3.10	68%	0.58	0.76	7.0	7.9	18.8
	A1	6.58	25%	0.20	0.55	27.6	3.1	15.6
	A2a	1.40	44%	0.39	0.66	8.1	2.3	7.1
	A2b	2.68	63%	0.55	0.74	8.8	6.0	14.7
	A3a	2.04	75%	0.65	0.79	7.9	5.6	12.4
	A3b	8.57	54%	0.48	0.71	17.3	12.5	33.3
	A3c	1.23	75%	0.65	0.79	7.7	3.4	7.5
	A4	6.96	78%	0.68	0.81	9.7	18.5	39.9
	A5	8.14	75%	0.65	0.79	7.6	22.6	50.1
	A6a	5.03	74%	0.64	0.79	14.9	10.5	23.5
	A6b	2.82	85%	0.73	0.83	5.0	10.0	20.7
	A6c	2.24	55%	0.49	0.71	13.8	3.7	9.7
	A6d	10.83	55%	0.49	0.71	15.4	16.9	44.8
	A7	5.38	55%	0.49	0.71	11.4	9.6	25.4
	A8	12.71	41%	0.37	0.65	11.9	17.0	54.4
	A9a	4.31	82%	0.71	0.82	9.3	12.1	25.5
	A9b	6.79	41%	0.37	0.65	13.8	8.4	27.1
	A10	14.64	56%	0.50	0.71	17.7	21.8	57.0
	A11a	2.14	90%	0.77	0.85	6.4	7.5	15.0
	A11b	5.46	66%	0.57	0.75	13.3	10.8	25.7
	A11c	5.76	55%	0.49	0.71	9.4	11.1	29.5
	A12a	0.63	90%	0.77	0.85	5.0	2.4	4.7
	A12b	1.16	90%	0.77	0.85	5.0	4.3	8.7
	A12c	2.83	55%	0.49	0.71	12.4	4.9	12.9
	A12d	4.77	54%	0.48	0.70	15.0	7.4	19.9
	A13a	0.86	90%	0.77	0.85	5.0	3.2	6.5
	A13b	0.85	90%	0.77	0.85	5.0	3.2	6.4
	A14	13.90	20%	0.20	0.56	15.8	8.7	45.2
	A15	2.74	67%	0.58	0.76	9.0	6.4	15.3
	OS7a	6.75	5%	0.08	0.50	14.0	1.7	20.7
	OS7b	6.56	5%	0.08	0.50	22.7	1.3	15.8
	OS8	5.68	6%	0.09	0.51	21.3	1.3	14.3
	Basin A Total	165.54	50%	0.44	0.69		155.5	464.5
EURV POND B	B0	264%	68%	0.59	0.76	6.1	7.2	16.8
	B1a	562%	57%	0.50	0.71	15.3	9.0	23.4
	B1b	7.61	58%	0.48	0.70	13.8	12.4	32.9
	B1c	2.71	84%	0.73	0.83	9.3	7.8	16.2
	B1d	2.85	56%	0.50	0.71	6.3	6.4	16.9
	B1e	6.28	55%	0.46	0.69	14.5	9.5	26.0
	B1f	1.76	75%	0.65	0.79	8.1	4.8	10.6
	B1g	3.31	55%	0.48	0.71	11.9	5.8	15.3
	B2	8.15	55%	0.48	0.71	8.8	16.0	42.7
	B3a	7.64	60%	0.51	0.72	14.7	12.9	32.9
	B3b	1.68	55%	0.48	0.70	13.7	2.7	7.3
	B4	4.08	52%	0.47	0.70	12.6	6.7	18.2
	B5a	5.60	48%	0.42	0.68	18.1	7.0	20.4
	B5b	5.20	72%	0.63	0.78	13.0	11.3	25.6
	B5c	3.83	54%	0.45	0.69	14.5	5.7	15.8
	B5d	3.76	55%	0.49	0.71	8.0	7.7	20.4
	B6a	3.65	55%	0.49	0.71	13.1	6.1	16.3
	B6b	2.38	55%	0.49	0.71	14.3	3.8	10.2
	B7	4.23	55%	0.49	0.71	6.7	9.2	24.4

Subdivision: Ridgegate Project Name: Phase II Drainage Report

Location: Lone Tree Project No.: 15950.00 Date: 7/13/20

BASIN SUMMARY TABLE

	Sub-basin	Area (ac)	% Imp.	C_5	C_{100}	t_c (min)	Q_5 (cfs)	Q_{100} (cfs)
EURV POND B	OS3	72.31	5%	0.07	0.50	52.4	8.5	104.5
	OS2b	1.81	5%	0.08	0.50	11.8	0.5	6.0
	OS4a	3.10	7%	0.05	0.46	20.8	0.4	7.2
	OS4b	3.04	5%	0.08	0.50	13.6	0.8	9.5
	OS5a	1.90	5%	0.08	0.50	13.8	0.5	5.9
	OS5b	59.27	5%	0.08	0.50	39.4	8.6	103.1
	OS5c	2.48	5%	0.08	0.50	16.6	0.6	7.0
	OS5d	1.11	5%	0.08	0.50	13.5	0.3	3.5
	OS6a	4.84	5%	0.08	0.50	13.3	1.3	15.2
	OS6b	23.13	5%	0.08	0.50	23.1	4.6	55.1
	Basin B Total	255.97	22%	0.21	0.57		78.8	374.3
EURV POND C	C0	1.74	46%	0.41	0.67	10.3	2.7	8.2
	C1a	2.43	82%	0.70	0.82	7.4	7.4	15.6
	C1b	5.39	46%	0.41	0.67	13.6	7.6	22.4
	OS1	10.85	5%	0.08	0.50	13.3	2.8	34.2
	OS2a	39.42	5%	0.08	0.50	40.6	5.6	67.4
	Basin C Total	59.83	13%	0.14	0.54		11.1	93.8
EURV POND D	D0	1.21	68%	0.59	0.76	5.0	3.5	8.1
	D1	8.23	25%	0.24	0.58	17.7	5.8	26.1
	D2	13.34	25%	0.21	0.56	23.3	7.3	35.3
	Basin D Total	22.78	27%	0.24	0.58		13.6	60.4
EURV POND R	R0	2.95	68%	0.57	0.75	5.9	7.8	18.7
	R1	4.45	77%	0.67	0.80	8.9	12.0	26.2
	RB1	0.87	68%	0.57	0.75	7.6	2.1	5.1
	RB2	0.63	81%	0.69	0.81	6.4	2.0	4.2
	RB3	0.28	59%	0.52	0.73	6.7	0.6	1.7
	RB4	1.00	51%	0.45	0.69	7.0	2.0	5.5
	RB5	1.96	44%	0.40	0.67	7.4	3.4	10.3
	RB6	1.34	53%	0.47	0.70	6.0	2.9	7.9
	RB8a	7.82	75%	0.65	0.79	5.0	24.7	54.6
	RB8b	2.62	10%	0.12	0.52	11.5	1.1	9.1
	RC1	2.33	30%	0.28	0.61	9.1	2.6	10.3
	RC2	3.27	31%	0.29	0.61	14.0	3.2	12.2
	RC3	1.10	53%	0.47	0.70	12.2	1.8	5.0
	RC4	0.28	61%	0.53	0.73	8.2	0.6	1.6
	RC7	9.32	85%	0.73	0.83	6.7	30.4	63.0
	RC6a	0.75	90%	0.77	0.85	5.1	2.8	5.6
	RC6b	2.29	75%	0.65	0.79	6.8	6.6	14.6
	RC6c	1.45	90%	0.77	0.85	6.5	5.0	10.1
	RC6d	0.66	75%	0.65	0.79	6.2	2.0	4.3
	RC6e	0.36	75%	0.65	0.79	6.2	1.1	2.4
	RC6f	3.47	61%	0.54	0.74	8.4	7.7	19.2
	R2a	1.87	71%	0.61	0.77	5.0	5.5	12.7
	R2b	1.18	75%	0.65	0.79	6.0	3.5	7.8
	R2c	3.13	75%	0.65	0.79	10.8	7.6	16.9
	R3	14.66	24%	0.22	0.57	20.9	8.7	41.7
	Basin R Total	70.04	57%	0.40	0.53		96.9	257.0
On-site HC Pond Total		1148.32	34%	0.30	0.60	---	355.9	1250.0

Subdivision: Ridgegate Project Name: Phase II Drainage Report
Location: Lone Tree Project No.: 15950.00 Date: 7/13/20

BASIN SUMMARY TABLE

	Sub-basin	Area (ac)	% Imp.	C_5	C_{100}	t_c (min)	Q_5 (cfs)	Q_{100} (cfs)
EURV POND E	E0	1.70	68%	0.56	0.75	5.8	4.5	10.7
	E1	6.91	26%	0.20	0.55	22.6	3.6	18.2
	E2a	2.80	90%	0.77	0.85	11.1	8.0	16.1
	E2b	6.80	55%	0.47	0.70	17.5	9.7	26.1
	E2c	1.36	90%	0.77	0.85	6.4	4.7	9.5
	E3	3.99	55%	0.48	0.70	8.7	7.7	20.8
	E4	4.77	55%	0.46	0.69	10.5	8.4	22.8
	E5	0.45	90%	0.77	0.85	5.0	1.7	3.4
	E6	3.68	57%	0.47	0.70	7.8	7.4	19.8
	E7	1.64	75%	0.63	0.78	5.0	5.0	11.3
	E8	3.84	55%	0.47	0.70	8.3	7.4	20.1
	Basin E Total	37.94	56%	0.47	0.70		46.8	126.5
EURV POND F	F0	2.53	85%	0.72	0.82	5.1	8.7	18.3
	F1	11.50	55%	0.46	0.69	14.7	17.4	47.5
	F2	7.82	55%	0.45	0.69	11.6	12.9	35.5
	F3	6.07	55%	0.49	0.71	8.9	11.9	31.7
	F4	3.02	32%	0.26	0.58	13.7	2.6	10.8
	F5	5.38	38%	0.32	0.62	7.8	7.2	25.5
	F6	6.69	54%	0.48	0.71	11.4	11.8	31.6
	F7	5.41	55%	0.45	0.68	7.0	10.7	29.5
	F8	1.20	90%	0.77	0.85	5.9	4.3	8.6
	OS9	25.01	5%	0.06	0.48	19.2	4.3	63.2
	Basin F Total	74.63	38%	0.32	0.62		57.9	208.5
EX WQ POND E	RE1	3.00	61%	0.53	0.73	18.2	4.7	11.8
	RE2a	5.16	75%	0.65	0.79	10.5	12.7	28.1
	RE2b	2.53	75%	0.65	0.79	5.6	7.7	17.1
	RE3	1.58	56%	0.48	0.71	11.7	2.8	7.4
	RE4	4.09	75%	0.64	0.79	9.4	10.4	23.1
	RE5	4.01	75%	0.63	0.78	9.6	9.9	22.4
	Ex. Basin E Total	20.37	71%	0.61	0.77		36.8	84.3
On-site BG Pond Total		265.88	48%	0.41	0.67	---	141.5	419.2

	Sub-basin	Area (ac)	% Imp.	C_2	C_5	C_{100}	t_c (min)	Q_2 (cfs)	Q_5 (cfs)	Q_{100} (cfs)
OFFSITE - DRAINAGEWAYS	OF1	2.28	90%	0.74	0.77	0.85	10.5	6.4	6.7	13.4
	OF3	1.38	29%	0.21	0.28	0.60	5.5	1.4	1.8	7.2
	OF4	0.57	45%	0.34	0.40	0.67	5.0	0.9	1.1	3.4
	OF5	0.87	36%	0.26	0.32	0.62	5.2	1.1	1.3	4.7
	OF6	0.33	45%	0.34	0.40	0.67	5.0	0.5	0.6	1.9
	HC Total	2.82	35%	0.25	0.31	0.62	---	3.4	4.2	15.3
	OF2	0.65	90%	0.77	0.85	5.0	2.4	4.9	3.1	33.2
	OF7	1.40	45%	0.33	0.36	0.64	5.0	2.2	2.5	7.9
	OF8	1.33	45%	0.33	0.36	0.64	5.0	2.1	2.3	7.5
	BG Total	2.73	45%	0.33	0.36	0.64	---	4.4	4.8	15.3

Subdivision: Ridgegate
Location: Lone Tree

Project Name: Phase II Drainage Report
Project No.: 15950.00
Date: 7/13/20

DESIGN POINT TABLE

	Design Point	Q_5 (cfs)	Q_{100} (cfs)
Happy Canyon (HC)			
EURV POND A	1A	16.2	40.2
	2A	21.8	57.1
	3A	36.5	93.6
	4A	59.0	147.7
	5A	17.9	65.6
	6A	14.2	67.4
	7A	27.7	118.5
	8A	40.2	152.2
	9A	9.6	25.4
	10A	18.6	41.9
	11A	55.4	187.8
	12A	32.0	93.4
	13A	34.3	98.6
	14A	18.5	39.9
	15A	45.2	123.2
	16A	59.5	161.1
	17A	105.1	324.9
	18A	108.9	335.5
	19A	3.1	15.6
	A3a	5.6	12.4
	A6c	3.7	9.7
	A6d	17.6	61.5
	A11b	10.8	25.7
	A11c	11.1	29.5
	A12c	4.9	12.9
	A12d	7.4	19.9
	OS7a	1.7	20.7
	OS7b	1.3	15.8
	OS8	1.3	14.3
	0A	155.5	464.5
	Outfall	66.9	413.3

DESIGN POINT TABLE

	Design Point	Q_5 (cfs)	Q_{100} (cfs)
Happy Canyon (HC)			
EURV POND B	1B	18.0	53.9
	2B	27.3	75.0
	3B	8.6	107.5
	4B	23.1	123.9
	5B	28.8	142.7
	6B	12.9	122.4
	7B	38.3	238.1
	8B	49.1	267.6
	9B	8.5	74.2
	10B	12.9	86.0
	11B	2.7	7.3
	12B	28.6	127.2
	13B	31.0	132.5
	14B	40.9	156.0
	13B	31.0	132.5
	14B	40.9	156.0
	15B	74.1	363.3
	16B	9.2	24.4
	B1g	5.8	15.3
	B2	12.6	40.2
	B4	6.7	18.2
	B5a	7.0	20.4
	B5c	5.7	15.8
	B5d	7.7	20.4
	OS2b	0.5	6.0
	OS3	8.5	104.5
	OS4a	0.4	7.2
	OS4b	0.8	9.4
	OS5a	0.5	5.9
	OS5b	8.6	103.1
	OS5c	0.6	7.0
	OS5d	0.3	3.5
	OS6a	1.3	15.3
	OS6b	4.6	55.2
	0B	78.8	374.3
	Outfall	78.3	371.4

DESIGN POINT TABLE

	Design Point	Q_5 (cfs)	Q_{100} (cfs)
Happy Canyon (HC)			
EURV POND C	1C	9.8	49.5
	2C	7.6	22.4
	OS1	2.8	34.2
	OS2a	5.6	67.4
	0C	11.1	93.8
	Outfall	11.1	83.2
EURV POND D	1D	7.3	35.3
	2D	5.8	26.1
	0D	13.6	60.4
	Outfall	10.0	59.9
EURV POND R	1R	12.0	26.2
	2R	8.7	41.7
	3R	2.8	5.6
	4R	14.1	31.4
	5R	16.1	35.4
	6R	11.1	23.8
	7R	24.5	53.6
	8R	25.6	55.9
	9R	26.1	57.2
	10R	32.0	72.1
	RB1	22.5	59.0
	RB2	84.1	210.7
	RB3	0.7	1.6
	RB4	86.0	216.0
	RB5	4.0	9.0
	RB6	89.1	222.9
	RC1	62.0	152.0
	RC2	27.1	67.8
	RC3	33.6	76.9
	RC4	31.9	72.3
	RC7	30.4	62.9
	R2c	7.6	16.8
	R6b	6.6	14.6
	R8a	24.6	54.6
	R8b	1.1	9.2
	0R	96.9	257.0
	Outfall	24.6	227.2
On-site Outfall into HC		190.8	1155.0

Subdivision: Ridgegate
Location: Lone Tree

Project Name: Phase II Drainage Report
Project No.: 15950.00
Date: 7/13/20

DESIGN POINT TABLE

	Design Point	Q_5 (cfs)	Q_{100} (cfs)
Badger Gulch (BG)			
EURV POND E	1E	13.1	32.7
	2E	14.2	34.8
	3E	26.6	70.4
	4E	32.5	87.1
	5E	17.3	40.6
	E1	3.7	18.2
	E2b	9.7	26.1
	E4	8.4	22.8
	E7	5.0	11.3
	E8	7.4	20.2
	0E	46.8	126.5
	Outfall	8.9	120.0
EURV POND F	1F	10.9	78.8
	2F	25.4	69.6
	3F	30.2	132.0
	4F	13.5	40.0
	5F	22.6	64.6
	6F	46.0	177.7
	7F	54.2	200.9
	F5	7.2	25.6
	F6	11.8	31.6
	F7	10.7	29.5
	F8	6.4	62.9
	OS9	4.3	63.2
	0F	57.9	208.5
	Outfall	25.6	199.4
EX WQ POND E	R6	7.7	17.1
	R7	18.9	41.9
	RE1	19.4	44.4
	RE2	2.8	7.3
	RE3	10.4	23.1
	RE4	29.4	67.5
	RE5	9.9	22.3
	0E	36.8	84.3
	Outfall	36.8	62.6
On-site Outfall into BG		71.3	382.0

COMPOSITE % IMPERVIOUS CALCULATIONS

Subdivision: Ridgegate
Location: Lone Tree

Project Name: Phase II Drainage Report
Project No.: 15950.00
Calculated By: KAU
Date: 7/13/20

Designation				LD Single Family (55%) (w/ Internal Roads) LD Single Family (45%) (w/o Internal Roads)			Parks/Trails (10%) Playground/Back yard(25%)			Undeveloped/Lawn (2%) Undeveloped w/ Gravel Trail (5%)			HD Small Lot Residential (w/ Internal Roadways) / School			Roadways (within ROW) Pond Area			Commercial Recreation Center			Basins Total Weighted % Imp.
		Basin ID	Total Area (ac)	% 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.	
BASINS TREATED IN ON-SITE PONDS																						
HAPPY CANYON (HC) ON-SITE	EURV POND A	A0	3.10	55%	0.00	0.0%	10%	0.00	0.0%	2%	0.78	0.5%	75%	0.00	0.0%	90%	2.33	67.5%	85%	0.00	0.0%	68.0%
		A1	6.58	55%	0.00	0.0%	25%	6.58	25.0%	2%	0.00	0.0%	75%	0.00	0.0%	90%	0.00	0.0%	85%	0.00	0.0%	25.0%
		A2a	1.40	55%	0.00	0.0%	10%	0.00	0.0%	2%	0.74	1.1%	75%	0.00	0.0%	90%	0.66	42.4%	85%	0.00	0.0%	43.5%
		A2b	2.68	55%	0.00	0.0%	10%	0.00	0.0%	2%	0.83	0.6%	75%	0.00	0.0%	90%	1.85	62.1%	85%	0.00	0.0%	62.7%
		A3a	2.04	55%	0.00	0.0%	10%	0.00	0.0%	2%	0.00	0.0%	75%	2.04	75.0%	90%	0.00	0.0%	85%	0.00	0.0%	75.0%
		A3b	8.57	55%	0.00	0.0%	10%	0.00	0.0%	2%	3.33	0.8%	75%	0.78	6.8%	90%	4.46	46.8%	85%	0.00	0.0%	54.4%
		A3c	1.23	55%	0.00	0.0%	10%	0.00	0.0%	2%	0.00	0.0%	75%	1.23	75.0%	90%	0.00	0.0%	85%	0.00	0.0%	75.0%
		A4	6.96	55%	0.00	0.0%	10%	0.00	0.0%	2%	0.00	0.0%	75%	5.43	58.5%	90%	1.53	19.8%	85%	0.00	0.0%	78.3%
		A5	8.14	55%	0.00	0.0%	10%	0.00	0.0%	2%	0.00	0.0%	75%	8.14	75.0%	90%	0.00	0.0%	85%	0.00	0.0%	75.0%
		A6a	5.03	55%	1.87	20.4%	10%	0.00	0.0%	2%	0.16	0.1%	75%	0.00	0.0%	90%	3.00	53.7%	85%	0.00	0.0%	74.2%
		A6b	2.82	55%	0.00	0.0%	10%	0.00	0.0%	2%	0.00	0.0%	75%	0.00	0.0%	90%	0.00	0.0%	85%	2.82	85.0%	85.0%
		A6c	2.24	55%	2.24	55.0%	10%	0.00	0.0%	2%	0.00	0.0%	75%	0.00	0.0%	90%	0.00	0.0%	85%	0.00	0.0%	55.0%
		A6d	10.83	55%	10.83	55.0%	10%	0.00	0.0%	2%	0.00	0.0%	75%	0.00	0.0%	90%	0.00	0.0%	85%	0.00	0.0%	55.0%
		A7	5.38	55%	5.38	55.0%	10%	0.00	0.0%	2%	0.00	0.0%	75%	0.00	0.0%	90%	0.00	0.0%	85%	0.00	0.0%	55.0%
		A8	12.71	55%	9.35	40.5%	10%	0.00	0.0%	2%	3.36	0.5%	75%	0.00	0.0%	90%	0.00	0.0%	85%	0.00	0.0%	41.0%
		A9a	4.31	55%	1.01	12.9%	10%	0.00	0.0%	2%	0.00	0.0%	75%	0.00	0.0%	90%	3.30	68.9%	85%	0.00	0.0%	81.8%
		A9b	6.79	55%	4.63	37.5%	10%	2.16	3.2%	2%	0.00	0.0%	75%	0.00	0.0%	90%	0.00	0.0%	85%	0.00	0.0%	40.7%
		A10	14.64	55%	13.64	51.2%	10%	0.00	0.0%	2%	0.00	0.0%	75%	1.00	5.1%	90%	0.00	0.0%	85%	0.00	0.0%	56.4%
		A11a	2.14	55%	0.00	0.0%	10%	0.00	0.0%	2%	0.00	0.0%	75%	0.00	0.0%	90%	2.14	90.0%	85%	0.00	0.0%	90.0%
		A11b	5.46	55%	0.00	0.0%	10%	0.00	0.0%	2%	0.68	0.2%	75%	4.78	65.7%	90%	0.00	0.0%	85%	0.00	0.0%	65.9%
		A11c	5.76	55%	5.76	55.0%	10%	0.00	0.0%	2%	0.00	0.0%	75%	0.00	0.0%	90%	0.00	0.0%	85%	0.00	0.0%	55.0%
		A12a	0.63	55%	0.00	0.0%	10%	0.00	0.0%	2%	0.00	0.0%	75%	0.00	0.0%	90%	0.63	90.0%	85%	0.00	0.0%	90.0%
		A12b	1.16	55%	0.00	0.0%	10%	0.00	0.0%	2%	0.00	0.0%	75%	0.00	0.0%	90%	1.16	90.0%	85%	0.00	0.0%	90.0%
		A12c	2.83	55%	2.83	55.0%	10%	0.00	0.0%	2%	0.00	0.0%	75%	0.00	0.0%	90%	0.00	0.0%	85%	0.00	0.0%	55.0%
		A12d	4.77	55%	0.00	0.0%	10%	1.54	3.2%	2%	0.00	0.0%	75%	3.23	50.8%	90%	0.00	0.0%	85%	0.00	0.0%	54.0%
		A13a	0.86	55%	0.00	0.0%	25%	0.00	0.0%	2%	0.00	0.0%	75%	0.00	0.0%	90%	0.86	90.0%	85%	0.00	0.0%	90.0%
		A13b	0.85	55%	0.00	0.0%	25%	0.00	0.0%	2%	0.00	0.0%	75%	0.00	0.0%	90%	0.85	90.0%	85%	0.00	0.0%	90.0%
		A14	13.90	55%	0.96	3.8%	25%	8.53	15.3%	2%	4.41	0.6%	75%	0.00	0.0%	90%	0.00	0.0%	85%	0.00	0.0%	19.8%
		A15	2.74	55%	0.00	0.0%	25%	0.44	4.0%	2%	0.00	0.0%	75%	2.30	63.0%	90%	0.00	0.0%	85%	0.00	0.0%	67.0%
		OS7a	6.75	55%	0.00	0.0%	25%	0.00	0.0%	5%	6.75	5.0%	75%	0.00	0.0%	90%	0.00	0.0%	85%	0.00	0.0%	5.0%
		OS7b	6.56	55%	0.00	0.0%	25%	0.00	0.0%	5%	6.56	5.0%	75%	0.00	0.0%	90%	0.00	0.0%	85%	0.00	0.0%	5.0%
		OS8	5.68	55%	0.00	0.0%	25%	0.32	1.4%	5%	5.36	4.7%	75%	0.00	0.0%	90%	0.00	0.0%	85%	0.00	0.0%	6.1%
	EURV POND B	B0	2.64	55%	0.00	0.0%	10%	0.00	0.0%	2%	0.66	0.5%	75%	0.00	0.0%	90%	1.98	67.5%	85%	0.00	0.0%	68.0%
		B1a	5.62	55%	5.23	51.2%	10%	0.00	0.0%	2%	0.00	0.0%	75%	0.00	0.0%	90%	0.39	6.2%	85%	0.00	0.0%	57.4%
		B1b	7.61	55%	6.93	50.1%	10%	0.00	0.0%	2%	0.00	0.0%	75%	0.00	0.0%	90%	0.68	8.0%	85%	0.00	0.0%	58.1%
		B1c	2.71	55%	0.00	0.0%	10%	0.00	0.0%	2%	0.00	0.0%	75%	1.03	28.5%	90%	1.68	55.8%	85%	0.00	0.0%	84.3%
		B1d	2.85	55%	1.26	24.3%	10%	0.43	1.5%	2%	0.00	0.0%	75%	1.16	30.5%	90%	0.00	0.0%	85%	0.00	0.0%	56.4%
		B1e	6.28	55%	6.28	55.0%	10%	0.00	0.0%	2%	0.00	0.0%	75%	0.00	0.0%	90%	0.00	0.0%	85%	0.00	0.0%	55.0%
		B1f	1.76	55%	0.00	0.0%	10%	0.00	0.0%	2%	0.00	0.0%	75%	1.76	75.0%	90%	0.00	0.0%	85%	0.00	0.0%	75.0%
		B1g	3.31	55%	3.31	55.0%	10%	0.00	0.0%	2%	0.00	0.0%	75%	0.00	0.0%	90%	0.00	0.0%	85%	0.00	0.0%	55.0%
		B2	8.15	55%	8.15	55.0%	10%	0.00	0.0%	2%	0.00	0.0%	75%	0.00	0.0%	90%	0.00	0.0%	85%	0.00	0.0%	55.0%
		B3a	7.64	55%	3.60	25.9%	10%	1.31	1.7%	2%	0.00	0.0%	75%	0.00	0.0%	90%	2.73	32.2%	85%	0.00	0.0%	59.8%
		B3b	1.68	55%	1.68	55.0%	10%	0.00	0.0%	2%	0.00	0.0%	75%	0.00	0.0%	90%	0.00	0.0%	85%	0.00	0.0%	55.0%
		B4	4.08	55%	3.84	51.8%	10%	0.24	0.6%	2%	0.00	0.0%	75%	0.00	0.0%	90%	0.00	0.0%	85%	0.00	0.0%	52.4%
		B5a	5.60	55%	4.87	47.8%	10%	0.00	0.0%	2%	0.73	0.3%	75%	0.00	0.0%	90%	0.00	0.0%	85%	0.00	0.0%	48.1%
		B5b	5.20	55%	1.38	14.6%	10%	0.00	0.0%	2%	0.49	0.2%	75%	0.00	0.0%	90%	3.33	57.6%	85%	0.00	0.0%	72.4%
		B5c	3.83	55%	3.74	53.7%	10%	0.00	0.0%	2%	0.09	0.0%	75%	0.00	0.0%	90%	0.00	0.0%	85%	0.00	0.0%	53.8%
		B5d	3.76	55%	3.76	55.0%	10%	0.00	0.0%	2%	0.00	0.0%	75%	0.00	0.0%	90%	0.00	0.0%	85%	0.00	0.0%	55.0%
		B6a	3.65	55%	3.65	55.0%	10%	0.00	0.0%	2%	0.00	0.0%	75%	0.00	0.0%	90%	0.00	0.0%	85%	0.00	0.0%	55.0%
		B6b	2.38	55%	2.38	55.0%	10%	0.00	0.0%	2%	0.00	0.0%	75%	0.00	0.0%	90%	0.00	0.0%	85%	0.00	0.0%	55.0%
		B7	4.23	55%	0.00	0.0%	10%	0.00	0.0%	2%	1.14	0.5%	75%	3.09	54.8%	90%	0.00	0.0%	85%	0.00	0.0%	55.3%

COMPOSITE % IMPERVIOUS CALCULATIONS

Subdivision: Ridgegate
Location: Lone Tree

Project Name: Phase II Drainage Report
Project No.: 15950.00
Calculated By: KAU
Date: 7/13/20

Designation				LD Single Family (55%) (w/ Internal Roads) LD Single Family (45%) (w/o Internal Roads)			Parks/Trails (10%) Playground/Back yard(25%)			Undeveloped/Lawn (2%) Undeveloped w/ Gravel Trail (5%)			HD Small Lot Residential (w/ Internal Roadways) / School			Roadways (within ROW) Pond Area			Commercial Recreation Center			Basins Total Weighted % Imp.
		Basin ID	Total Area (ac)	% 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.	
BASINS TREATED IN ON-SITE PONDS																						
HAPPY CANYON (HC) ON-SITE	EURV POND B	OS3	72.31	55%	0.00	0.0%	10%	1.62	0.2%	5%	70.69	4.9%	75%	0.00	0.0%	90%	0.00	0.0%	85%	0.00	0.0%	5.1%
		OS2b	1.81	55%	0.00	0.0%	10%	0.00	0.0%	5%	1.81	5.0%	75%	0.00	0.0%	90%	0.00	0.0%	85%	0.00	0.0%	5.0%
		OS4a	3.10	55%	0.00	0.0%	10%	1.33	4.3%	5%	1.77	2.9%	75%	0.00	0.0%	90%	0.00	0.0%	85%	0.00	0.0%	7.1%
		OS4b	3.04	55%	0.00	0.0%	10%	0.00	0.0%	5%	3.04	5.0%	75%	0.00	0.0%	90%	0.00	0.0%	85%	0.00	0.0%	5.0%
		OS5a	1.90	55%	0.00	0.0%	10%	0.00	0.0%	5%	1.90	5.0%	75%	0.00	0.0%	90%	0.00	0.0%	85%	0.00	0.0%	5.0%
		OS5b	59.27	55%	0.00	0.0%	10%	0.00	0.0%	5%	59.27	5.0%	75%	0.00	0.0%	90%	0.00	0.0%	85%	0.00	0.0%	5.0%
		OS5c	2.48	55%	0.00	0.0%	10%	0.00	0.0%	5%	2.48	5.0%	75%	0.00	0.0%	90%	0.00	0.0%	85%	0.00	0.0%	5.0%
		OS5d	1.11	55%	0.00	0.0%	10%	0.00	0.0%	5%	1.11	5.0%	75%	0.00	0.0%	90%	0.00	0.0%	85%	0.00	0.0%	5.0%
		OS6a	4.84	55%	0.00	0.0%	10%	0.00	0.0%	5%	4.84	5.0%	75%	0.00	0.0%	90%	0.00	0.0%	85%	0.00	0.0%	5.0%
		OS6b	23.13	55%	0.00	0.0%	10%	0.00	0.0%	5%	23.13	5.0%	75%	0.00	0.0%	90%	0.00	0.0%	85%	0.00	0.0%	5.0%
	EURV POND C	C0	1.74	55%	0.00	0.0%	10%	0.00	0.0%	2%	0.87	1.0%	75%	0.00	0.0%	90%	0.87	45.0%	85%	0.00	0.0%	46.0%
		C1a	2.43	55%	0.00	0.0%	10%	0.00	0.0%	2%	0.23	0.2%	75%	0.00	0.0%	90%	2.20	81.5%	85%	0.00	0.0%	81.7%
		C1b	5.39	55%	4.49	45.8%	10%	0.00	0.0%	2%	0.90	0.3%	75%	0.00	0.0%	90%	0.00	0.0%	85%	0.00	0.0%	46.2%
		OS1	10.85	55%	0.00	0.0%	10%	0.00	0.0%	5%	10.85	5.0%	75%	0.00	0.0%	90%	0.00	0.0%	85%	0.00	0.0%	5.0%
		OS2a	39.42	55%	0.00	0.0%	10%	0.00	0.0%	5%	39.42	5.0%	75%	0.00	0.0%	90%	0.00	0.0%	85%	0.00	0.0%	5.0%
HAPPY CANYON (HC) ON-SITE	EURV POND R	R0	2.95	55%	0.00	0.0%	10%	0.00	0.0%	2%	0.74	0.5%	75%	0.00	0.0%	90%	2.21	67.5%	85%	0.00	0.0%	68.0%
		R1	4.45	55%	0.00	0.0%	10%	0.00	0.0%	2%	0.65	0.3%	75%	0.00	0.0%	90%	3.80	76.9%	85%	0.00	0.0%	77.1%
		RB1	0.87	55%	0.00	0.0%	10%	0.00	0.0%	2%	0.22	0.5%	75%	0.00	0.0%	90%	0.65	67.0%	85%	0.00	0.0%	67.5%
		RB2	0.63	55%	0.00	0.0%	10%	0.00	0.0%	2%	0.07	0.2%	75%	0.00	0.0%	90%	0.56	80.6%	85%	0.00	0.0%	80.8%
		RB3	0.28	55%	0.00	0.0%	10%	0.00	0.0%	2%	0.10	0.7%	75%	0.00	0.0%	90%	0.18	58.5%	85%	0.00	0.0%	59.2%
		RB4	1.00	55%	0.00	0.0%	10%	0.00	0.0%	2%	0.44	0.9%	75%	0.00	0.0%	90%	0.56	50.2%	85%	0.00	0.0%	51.1%
		RB5	1.96	55%	0.00	0.0%	10%	0.00	0.0%	2%	1.02	1.0%	75%	0.00	0.0%	90%	0.94	43.3%	85%	0.00	0.0%	44.4%
		RB6	1.34	55%	0.00	0.0%	10%	0.00	0.0%	2%	0.56	0.8%	75%	0.00	0.0%	90%	0.78	52.3%	85%	0.00	0.0%	53.2%
		RB8a	7.82	55%	0.00	0.0%	10%	0.00	0.0%	2%	0.00	0.0%	75%	7.82	75.0%	90%	0.00	0.0%	85%	0.00	0.0%	75.0%
		RB8b	2.62	55%	0.00	0.0%	10%	2.62	10.0%	2%	0.00	0.0%	75%	0.00	0.0%	90%	0.00	0.0%	85%	0.00	0.0%	10.0%
		RC1	2.33	55%	0.00	0.0%	10%	0.00	0.0%	2%	1.58	1.4%	75%	0.00	0.0%	90%	0.75	28.9%	85%	0.00	0.0%	30.3%
		RC2	3.27	55%	0.00	0.0%	10%	0.00	0.0%	2%	2.19	1.3%	75%	0.00	0.0%	90%	1.08	29.8%	85%	0.00	0.0%	31.2%
		RC3	1.10	55%	0.00	0.0%	10%	0.00	0.0%	2%	0.46	0.8%	75%	0.00	0.0%	90%	0.64	52.0%	85%	0.00	0.0%	52.9%
		RC4	0.28	55%	0.00	0.0%	10%	0.00	0.0%	2%	0.09	0.7%	75%	0.00	0.0%	90%	0.19	60.2%	85%	0.00	0.0%	60.9%
		RC7	9.32	55%	0.00	0.0%	10%	0.00	0.0%	2%	0.00	0.0%	75%	0.00	0.0%	90%	0.00	0.0%	85%	9.32	85.0%	85.0%
		RC6a	0.75	55%	0.00	0.0%	10%	0.00	0.0%	2%	0.00	0.0%	75%	0.00	0.0%	90%	0.75	90.0%	85%	0.00	0.0%	90.0%
		RC6b	2.29	55%	0.00	0.0%	10%	0.00	0.0%	2%	0.00	0.0%	75%	2.29	75.0%	90%	0.00	0.0%	85%	0.00	0.0%	75.0%
		RC6c	1.45	55%	0.00	0.0%	10%	0.00	0.0%	2%	0.00	0.0%	75%	0.00	0.0%	90%	1.45	90.0%	85%	0.00	0.0%	90.0%
		RC6d	0.66	55%	0.00	0.0%	10%	0.00	0.0%	2%	0.00	0.0%	75%	0.66	75.0%	90%	0.00	0.0%	85%	0.00	0.0%	75.0%
		RC6e	0.36	55%	0.00	0.0%	10%	0.00	0.0%	2%	0.00	0.0%	75%	0.36	75.0%	90%	0.00	0.0%	85%	0.00	0.0%	75.0%
		RC6f	3.47	55%	1.00	15.9%	10%	0.00	0.0%	2%	0.73	0.4%	75%	0.00	0.0%	90%	1.74	45.1%	85%	0.00	0.0%	61.4%
		R2a	1.87	55%	0.57	16.8%	10%	0.00	0.0%	2%	0.18	0.2%	75%	0.00	0.0%	90%	1.12	53.9%	85%	0.00	0.0%	70.9%
		R2b	1.18	55%	0.00	0.0%	10%	0.00	0.0%	2%	0.00	0.0%	75%	1.18	75.0%	90%	0.00	0.0%	85%	0.00	0.0%	75.0%
		R2c	3.13	55%	0.00	0.0%	10%	0.00	0.0%	2%	0.00	0.0%	75%	3.13	75.0%	90%	0.00	0.0%	85%	0.00	0.0%	75.0%
		R3	14.66	55%	0.00	0.0%	25%	13.75	23.4%	2%	0.91	0.1%	75%	0.00	0.0%	90%	0.00	0.0%	85%	0.00	0.0%	23.6%

COMPOSITE % IMPERVIOUS CALCULATIONS

Subdivision: Ridgegate
Location: Lone Tree

Project Name: Phase II Drainage Report
Project No.: 15950.00
Calculated By: KAU
Date: 7/13/20

Designation				LD Single Family (55%) (w/ Internal Roads) LD Single Family (45%) (w/o Internal Roads)			Parks/Trails (10%) Playground/Back yard(25%)			Undeveloped/Lawn (2%) Undeveloped w/ Gravel Trail (5%)			HD Small Lot Residential (w/ Internal Roadways) / School			Roadways (within ROW) Pond Area			Commercial Recreation Center			Basins Total Weighted % Imp.
		Basin ID	Total Area (ac)	% 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.	
BASINS TREATED IN ON-SITE PONDS																						
HAPPY CANYON (HC) ON-SITE	EURV POND D	D0	1.21	55%	0.00	0.0%	25%	0.00	0.0%	2%	0.30	0.5%	75%	0.00	0.0%	90%	0.91	67.5%	85%	0.00	0.0%	68.0%
		D1	8.23	55%	0.00	0.0%	25%	8.23	25.0%	2%	0.00	0.0%	75%	0.00	0.0%	90%	0.00	0.0%	85%	0.00	0.0%	25.0%
		D2	13.34	55%	0.00	0.0%	25%	13.34	25.0%	2%	0.00	0.0%	75%	0.00	0.0%	90%	0.00	0.0%	85%	0.00	0.0%	25.0%
	OFFSITE	OF1	2.28	55%	0.00	0.0%	25%	0.00	0.0%	2%	0.00	0.0%	75%	0.00	0.0%	90%	2.28	90.0%	85%	0.00	0.0%	90.0%
		OF3	1.38	45%	0.84	27.4%	10%	0.00	0.0%	5%	0.54	2.0%	75%	0.00	0.0%	90%	0.00	0.0%	85%	0.00	0.0%	29.3%
		OF4	0.57	45%	0.57	45.0%	10%	0.00	0.0%	5%	0.00	0.0%	75%	0.00	0.0%	90%	0.00	0.0%	85%	0.00	0.0%	45.0%
		OF5	0.87	45%	0.68	35.2%	10%	0.00	0.0%	5%	0.19	1.1%	75%	0.00	0.0%	90%	0.00	0.0%	85%	0.00	0.0%	36.3%
		OF6	0.33	45%	0.33	45.0%	10%	0.00	0.0%	5%	0.00	0.0%	75%	0.00	0.0%	90%	0.00	0.0%	85%	0.00	0.0%	45.0%
	EURV POND A		165.54																			49.7%
	EURV POND B		255.97																			22.3%
	EURV POND C		59.83																			13.0%
	EURV POND R		70.04																			57.0%
	EURV POND D		22.78																			27.3%
	OFFSITE		5.43																			58.5%
TOTAL HAPPY CANYON			579.59																			33.9%
BADGER GULCH (BG) ON-SITE	EURV POND E	E2a	2.80	55%	0.00	0.0%	25%	0.00	0.0%	2%	0.00	0.0%	75%	0.00	0.0%	90%	2.80	90.0%	85%	0.00	0.0%	90.0%
		E2b	6.80	55%	6.80	55.0%	25%	0.00	0.0%	2%	0.00	0.0%	75%	0.00	0.0%	90%	0.00	0.0%	85%	0.00	0.0%	55.0%
		E2c	1.36	55%	0.00	0.0%	25%	0.00	0.0%	2%	0.00	0.0%	75%	0.00	0.0%	90%	1.36	90.0%	85%	0.00	0.0%	90.0%
		E3	3.99	55%	3.99	55.0%	10%	0.00	0.0%	2%	0.00	0.0%	75%	0.00	0.0%	90%	0.00	0.0%	85%	0.00	0.0%	55.0%
		E4	4.77	55%	4.77	55.0%	10%	0.00	0.0%	2%	0.00	0.0%	75%	0.00	0.0%	90%	0.00	0.0%	85%	0.00	0.0%	55.0%
		E5	0.45	55%	0.00	0.0%	10%	0.00	0.0%	2%	0.00	0.0%	75%	0.00	0.0%	90%	0.45	90.0%	85%	0.00	0.0%	90.0%
		E6	3.68	55%	3.20	47.8%	10%	0.00	0.0%	2%	0.09	0.0%	75%	0.00	0.0%	90%	0.39	9.5%	85%	0.00	0.0%	57.4%
		E7	1.64	55%	0.00	0.0%	10%	0.00	0.0%	2%	0.00	0.0%	75%	1.64	75.0%	90%	0.00	0.0%	85%	0.00	0.0%	75.0%
		E8	3.84	55%	3.84	55.0%	10%	0.00	0.0%	2%	0.00	0.0%	75%	0.00	0.0%	90%	0.00	0.0%	85%	0.00	0.0%	55.0%
	EURV POND F	F0	2.53	55%	0.82	17.8%	10%	-0.19	-0.7%	2%	0.00	0.0%	75%	0.00	0.0%	90%	1.90	67.5%	85%	0.00	0.0%	84.6%
		F1	11.50	55%	11.50	55.0%	10%	0.00	0.0%	2%	0.00	0.0%	75%	0.00	0.0%	90%	0.00	0.0%	85%	0.00	0.0%	55.0%
		F2	7.82	55%	7.82	55.0%	10%	0.00	0.0%	2%	0.00	0.0%	75%	0.00	0.0%	90%	0.00	0.0%	85%	0.00	0.0%	55.0%
		F3	6.07	55%	6.07	55.0%	10%	0.00	0.0%	2%	0.00	0.0%	75%	0.00	0.0%	90%	0.00	0.0%	85%	0.00	0.0%	55.0%
		F4	3.02	55%	0.70	12.7%	10%	1.88	6.2%	2%	0.00	0.0%	75%	0.00	0.0%	90%	0.44	13.1%	85%	0.00	0.0%	32.1%
		F5	5.38	55%	3.33	34.0%	10%	2.05	3.8%	2%	0.00	0.0%	75%	0.00	0.0%	90%	0.00	0.0%	85%	0.00	0.0%	37.9%
		F6	6.69	55%	6.58	54.1%	10%	0.11	0.2%	2%	0.00	0.0%	75%	0.00	0.0%	90%	0.00	0.0%	85%	0.00	0.0%	54.3%
		F7	5.41	55%	5.41	55.0%	10%	0.00	0.0%	2%	0.00	0.0%	75%	0.00	0.0%	90%	0.00	0.0%	85%	0.00	0.0%	55.0%
		F8	1.20	55%	0.00	0.0%	10%	0.00	0.0%	2%	0.00	0.0%	75%	0.00	0.0%	90%	1.20	90.0%	85%	0.00	0.0%	90.0%
		OS9	25.01	55%	0.00	0.0%	10%	0.00	0.0%	5%	25.01	5.0%	75%	0.00	0.0%	90%	0.00	0.0%	85%	0.00	0.0%	5.0%
	EX WQ POND E	RE1	3.00	55%	0.00	0.0%	10%	0.00	0.0%	2%	0.99	0.7%	75%	0.00	0.0%	90%	2.01	60.3%	85%	0.00	0.0%	60.9%
		RE2a	5.16	55%	0.00	0.0%	10%	0.00	0.0%	2%	0.00	0.0%	75%	5.16	75.0%	90%	0.00	0.0%	85%	0.00	0.0%	75.0%
		RE2b	2.53	55%	0.00	0.0%	10%	0.00	0.0%	2%	0.19	0.2%	75%	1.50	44.5%	90%	0.84	29.9%	85%	0.00	0.0%	74.5%
		RE3	1.58	55%	0.00	0.0%	10%	0.00	0.0%	2%	0.62	0.8%	75%	0.00	0.0%	90%	0.96	54.8%	85%	0.00	0.0%	55.6%
		RE4	4.09	55%	0.00	0.0%	10%	0.00	0.0%	2%	0.00	0.0%	75%	4.09	75.0%	90%	0.00	0.0%	85%	0.00	0.0%	75.0%
		RE5	4.01	55%	0.00	0.0%	10%	0.00	0.0%	2%	0.00	0.0%	75%	4.01	75.0%	90%	0.00	0.0%	85%	0.00	0.0%	75.0%
	OFFSITE	OF2	0.65	55%	0.00	0.0%	25%	0.00	0.0%	2%	0.00	0.0%	75%	0.00	0.0%	90%	0.65	90.0%	85%	0.00	0.0%	90.0%
		OF7	1.40	45%	1.40	45.0%	10%	0.00	0.0%	5%	0.00	0.0%	75%	0.00	0.0%	90%	0.00	0.0%	85%	0.00	0.0%	45.0%
		OF8	1.33	45%	1.33	45.0%	10%	0.00	0.0%	5%	0.00	0.0%	75%	0.00	0.0%	90%	0.00	0.0%	85%	0.00	0.0%	45.0%
	EURV POND E		37.94																			55.6%
	EURV POND F		74.63																			37.6%
	EX WQ POND E		20.37																			71.4%
	OFFSITE		3.38																			53.7%
	TOTAL BADGER GULCH		136.3																			48.1%
OVERALL TOTAL HC & BG			715.9																			36.6%

COMPOSITE RUNOFF COEFFICIENT CALCULATIONS

Table 6-4. Runoff coefficient equations based on NRCS soil group and storm return period

NRCS Soil Group	Storm Return Period						
	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year	500-Year
A	$C_A = 0.84i^{1.302}$	$C_A = 0.86i^{1.278}$	$C_A = 0.87i^{1.232}$	$C_A = 0.84i^{1.124}$	$C_A = 0.85i+0.025$	$C_A = 0.78i+0.110$	$C_A = 0.65i+0.254$
B	$C_B = 0.84i^{1.100}$	$C_B = 0.86i^{1.088}$	$C_B = 0.81i+0.057$	$C_B = 0.63i+0.249$	$C_B = 0.56i+0.328$	$C_B = 0.47i+0.426$	$C_B = 0.37i+0.536$
C/D	$C_{C/D} = 0.83i^{1.122}$	$C_{C/D} = 0.82i+0.035$	$C_{C/D} = 0.74i+0.132$	$C_{C/D} = 0.56i+0.319$	$C_{C/D} = 0.49i+0.393$	$C_{C/D} = 0.41i+0.484$	$C_{C/D} = 0.32i+0.588$

Where:

i = % imperviousness (expressed as a decimal)

C_A = Runoff coefficient for Natural Resources Conservation Service (NRCS) HSG A soils

C_B = Runoff coefficient for NRCS HSG B soils

$C_{C/D}$ = Runoff coefficient for NRCS HSG C and D soils.

Subdivision: Ridgegate
Location: Lone Tree

Project Name: Phase II Drainage Report
Project No.: 15950.00
Calculated By: KAU
Date: 7/13/20

Designation	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)	$C_{5,A}$	$C_{5,B}$	$C_{5,C/D}$	$C_{100,A}$	$C_{100,B}$	$C_{100,C/D}$		
HAPPY CANYON (HC) - TREATED IN ON-SITE PONDS																	
EURV POND A	A0	3.10	68.0%	0.00	1.26	1.84	0%	41%	59%	0.53	0.56	0.59	0.64	0.75	0.76	0.58	0.76
	A1	6.58	25.0%	0.00	4.96	1.62	0%	75%	25%	0.15	0.19	0.24	0.31	0.54	0.59	0.20	0.55
	A2a	1.40	43.5%	0.00	0.00	1.40	0%	0%	100%	0.30	0.35	0.39	0.45	0.63	0.66	0.39	0.66
	A2b	2.68	62.7%	0.00	0.00	2.68	0%	0%	100%	0.47	0.52	0.55	0.60	0.72	0.74	0.55	0.74
	A3a	2.04	75.0%	0.00	0.00	2.04	0%	0%	100%	0.60	0.63	0.65	0.69	0.78	0.79	0.65	0.79
	A3b	8.57	54.4%	0.00	0.00	8.57	0%	0%	100%	0.40	0.44	0.48	0.53	0.68	0.71	0.48	0.71
	A3c	1.23	75.0%	0.00	0.00	1.23	0%	0%	100%	0.60	0.63	0.65	0.69	0.78	0.79	0.65	0.79
	A4	6.96	78.3%	0.00	0.00	6.96	0%	0%	100%	0.63	0.66	0.68	0.72	0.79	0.81	0.68	0.81
	A5	8.14	75.0%	0.00	0.00	8.14	0%	0%	100%	0.60	0.63	0.65	0.69	0.78	0.79	0.65	0.79
	A6a	5.03	74.2%	0.00	0.00	5.03	0%	0%	100%	0.59	0.62	0.64	0.69	0.77	0.79	0.64	0.79
	A6b	2.82	85.0%	0.00	0.00	2.82	0%	0%	100%	0.70	0.72	0.73	0.77	0.83	0.83	0.73	0.83
	A6c	2.24	55.0%	0.00	0.00	2.24	0%	0%	100%	0.40	0.45	0.49	0.54	0.68	0.71	0.49	0.71
	A6d	10.83	55.0%	0.00	0.00	10.83	0%	0%	100%	0.40	0.45	0.49	0.54	0.68	0.71	0.49	0.71
	A7	5.38	55.0%	0.00	0.00	5.38	0%	0%	100%	0.40	0.45	0.49	0.54	0.68	0.71	0.49	0.71
	A8	12.71	41.0%	0.00	0.00	12.71	0%	0%	100%	0.28	0.33	0.37	0.43	0.62	0.65	0.37	0.65
	A9a	4.31	81.8%	0.00	0.00	4.31	0%	0%	100%	0.67	0.69	0.71	0.75	0.81	0.82	0.71	0.82
	A9b	6.79	40.7%	0.00	0.00	6.79	0%	0%	100%	0.27	0.32	0.37	0.43	0.62	0.65	0.37	0.65
	A10	14.64	56.4%	0.00	0.00	14.64	0%	0%	100%	0.41	0.46	0.50	0.55	0.69	0.71	0.50	0.71
	A11a	2.14	90.0%	0.00	0.00	2.14	0%	0%	100%	0.75	0.77	0.77	0.81	0.85	0.85	0.77	0.85
	A11b	5.46	65.9%	0.00	0.00	5.46	0%	0%	100%	0.50	0.55	0.57	0.62	0.74	0.75	0.57	0.75
	A11c	5.76	55.0%	0.00	0.00	5.76	0%	0%	100%	0.40	0.45	0.49	0.54	0.68	0.71	0.49	0.71
	A12a	0.63	90.0%	0.00	0.00	0.63	0%	0%	100%	0.75	0.77	0.77	0.81	0.85	0.85	0.77	0.85
	A12b	1.16	90.0%	0.00	0.00	1.16	0%	0%	100%	0.75	0.77	0.77	0.81	0.85	0.85	0.77	0.85
	A12c	2.83	55.0%	0.00	0.00	2.83	0%	0%	100%	0.40	0.45	0.49	0.54	0.68	0.71	0.49	0.71
	A12d	4.77	54.0%	0.00	0.00	4.77	0%	0%	100%	0.39	0.44	0.48	0.53	0.68	0.70	0.48	0.70
	A13a	0.86	90.0%	0.00	0.00	0.86	0%	0%	100%	0.75	0.77	0.77	0.81	0.85	0.85	0.77	0.85
	A13b	0.85	90.0%	0.00	0.00	0.85	0%	0%	100%	0.75	0.77	0.77	0.81	0.85	0.85	0.77	0.85
	A14	13.90	19.8%	0.00	0.00	13.90	0%	0%	100%	0.11	0.15	0.20	0.26	0.52	0.56	0.20	0.56
	A15	2.74	67.0%	0.00	0.00	2.74	0%	0%	100%	0.52	0.56	0.58	0.63	0.74	0.76	0.58	0.76
	OS7a	6.75	5.0%	0.00	0.00	6.75	0%	0%	100%	0.02	0.03	0.08	0.15	0.45	0.50	0.08	0.50
	OS7b	6.56	5.0%	0.00	0.00	6.56	0%	0%	100%	0.02	0.03	0.08	0.15	0.45	0.50	0.08	0.50
	OS8	5.68	6.1%	0.00	0.00	5.68	0%	0%	100%	0.02	0.04	0.09	0.16	0.46	0.51	0.09	0.51
EURV POND B	B0	2.64	68.0%	0.00	0.06	2.58	0%	2%	98%	0.53	0.56	0.59	0.64	0.75	0.76	0.59	0.76
	B1a	5.62	57.4%	0.00	1.70	3.92	0%	30%	70%	0.42	0.47	0.51	0.56	0.70	0.72	0.50	0.71
	B1b	7.61	58.1%	0.00	5.88	1.73	0%	77%	23%	0.43	0.48	0.51	0.56	0.70	0.72	0.48	0.70
	B1c	2.71	84.3%	0.00	0.00	2.71	0%	0%	100%	0.69	0.71	0.73	0.77	0.82	0.83	0.73	0.83
	B1d	2.85	56.4%	0.00	0.00	2.85	0%	0%	100%	0.41	0.46	0.50	0.55	0.69	0.71	0.50	0.71
	B1e	6.28	55.0%	0.00	4.30	1.98	0%	68%	32%	0.40	0.45	0.49	0.54	0.68	0.71	0.46	0.69
	B1f	1.76	75.0%	0.00	0.00	1.76	0%	0%	100%	0.60	0.63	0.65	0.69	0.78	0.79	0.65	0.79
	B1g	3.31	55.0%	0.00	0.24	3.07	0%	7%	93%	0.40	0.45	0.49	0.54	0.68	0.71	0.48	0.71
	B2	8.15	55.0%	0.00	0.52	7.63	0%	6%	94%	0.40	0.45	0.49	0.54	0.68	0.71	0.48	0.71
	B3a	7.64	59.8%	0.00	2.72	4.92	0%	36%	64%	0.45	0.49	0.52	0.58	0.71	0.73	0.51	0.72
	B3b	1.68	55.0%	0.00	0.45	1.23	0%	27%	73%	0.40	0.45	0.49	0.54	0.68	0.71	0.48	0.70
	B4	4.08	52.4%	0.00	0.00	4.08	0%	0%	100%	0.38	0.43	0.47	0.52	0.67	0.70	0.47	0.70
	B5a	5.60	48.1%	0.00	0.58	5.02	0%	10%	90%	0.34	0.39	0.43	0.49	0.65	0.68	0.42	0.68
	B5b	5.20	72.4%	0.00	0.52	4.68	0%	10%	90%	0.57	0.61	0.63	0.68	0.77	0.78	0.63	0.78
	B5c	3.83	53.8%	0.00	2.18	1.65	0%	57%	43%	0.39	0.44	0.48	0.53	0.68	0.70	0.45	0.69
	B5d	3.76	55.0%	0.00	0.00	3.76	0%	0%	100%	0.40	0.45	0.49	0.54	0.68	0.71	0.49	0.71
	B6a	3.65	55.0%	0.00	0.00	3.65	0%	0%	100%	0.40	0.45	0.49	0.54	0.68	0.71	0.49	0.71
	B6b	2.38	55.0%	0.00	0.00	2.38	0%	0%	100%	0.40	0.45	0.49	0.54	0.68	0.71	0.49	0.71
	B7	4.23	55.3%	0.00	0.00	4.23	0%	0%	100%	0.40	0.45	0.49	0.54	0.69	0.71	0.49	0.71
	OS3	72.31	5.1%	0.00	4.19	68.12	0%	6%	94%	0.02	0.03	0.08	0.15	0.45	0.50	0.07	0.50
	OS2b	1.81	5.0%	0.00	0.00	1.81	0%	0%	100%	0.02	0.03	0.08	0.15	0.45	0.50	0.08	0.50
	OS4a	3.10	7.1%	0.00	3.00	0.10	0%	97%	3%	0.03	0.05	0.09	0.17	0.46	0.51	0.05	0.46
	OS4b	3.04	5.0%	0.00	0.00	3.04	0%	0%	100%	0.02	0.03	0.08	0.15	0.45	0.50	0.08	0.50
	OS5a	1.90	5.0%	0.00	0.00	1.90	0%	0%	100%	0.02	0.03	0.08	0.15	0.45	0.50	0.08	0.50
	OS5b	59.27	5.0%	0.00	0.00	59.27	0%	0%	100%	0.02	0.03	0.08	0.15	0.45	0.50	0.08	0.50
	OS5c	2.48	5.0%	0.00	0.00	2.48	0%	0%	100%	0.02	0.03	0.08	0.15	0.45	0.50	0.08	0.50
	OS5d	1.11	5.0%	0.00	0.00	1.11	0%	0%	100%	0.02	0.03	0.08	0.15	0.45	0.50	0.08	0.50
	OS6a	4.84	5.0%	0.00	0.00	4.84	0%	0%	100%	0.02	0.03	0.08	0.15	0.45	0.50	0.08	0.50
	OS6b	23.13	5.0%	0.00	0.00	23.13	0%	0%	100%	0.02	0.03	0.08	0.15	0.45	0.50	0.08	0.50
EURV POND C	C0	1.74	46.0%	0.00	0.00	1.74	0%	0%	100%	0.32	0.37	0.41	0.47	0.64	0.67	0.41	0.67
	C1a	2.43	81.7%	0.00	0.00	2.43	0%	0%	100%	0.66	0.69	0.70	0.75	0.81	0.82	0.70	0.82
	C1b	5.39	46.2%	0.00	0.00	5.39	0%	0%	100%	0.32	0.37	0.41	0.47	0.64	0.67	0.41	0.67
	OS1	10.85	5.0%	0.00	0.00	10.85	0%	0%	100%	0.02	0.03	0.08	0.15	0.45	0.50	0.08	0.50
	OS2a	39.42	5.0%	0.00	0.00	39.42	0%	0%	100%	0.02	0.03	0.08	0.15	0.45	0.50	0.08	0.50

COMPOSITE RUNOFF COEFFICIENT CALCULATIONS

Table 6-4. Runoff coefficient equations based on NRCS soil group and storm return period

NRCS Soil Group	Storm Return Period						
	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year	500-Year
A	$C_A = 0.84i^{1.302}$	$C_A = 0.86i^{1.278}$	$C_A = 0.87i^{1.232}$	$C_A = 0.84i^{1.124}$	$C_A = 0.85i+0.025$	$C_A = 0.78i+0.110$	$C_A = 0.65i+0.254$
B	$C_B = 0.84i^{1.140}$	$C_B = 0.86i^{1.088}$	$C_B = 0.81i+0.057$	$C_B = 0.63i+0.249$	$C_B = 0.56i+0.328$	$C_B = 0.47i+0.426$	$C_B = 0.37i+0.536$
C/D	$C_{C,D} = 0.83i^{1.132}$	$C_{C,D} = 0.82i+0.035$	$C_{C,D} = 0.74i+0.132$	$C_{C,D} = 0.56i+0.319$	$C_{C,D} = 0.49i+0.393$	$C_{C,D} = 0.41i+0.484$	$C_{C,D} = 0.32i+0.588$

Where:

i = % imperviousness (expressed as a decimal)

C_A = Runoff coefficient for Natural Resources Conservation Service (NRCS) HSG A soils

C_B = Runoff coefficient for NRCS HSG B soils

$C_{C,D}$ = Runoff coefficient for NRCS HSG C and D soils.

Subdivision: Ridgegate
Location: Lone Tree

Project Name: Phase II Drainage Report
Project No.: 15950.00
Calculated By: KAU
Date: 7/13/20

Designation	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)	$C_{5,A}$	$C_{5,B}$	$C_{5,C/D}$	$C_{100,A}$	$C_{100,B}$	$C_{100,C/D}$		
EURV POND R	R0	2.95	68.0%	0.00	2.06	0.89	0%	70%	30%	0.53	0.56	0.59	0.64	0.75	0.76	0.57	0.75
	R1	4.45	77.1%	0.00	0.00	4.45	0%	0%	100%	0.62	0.65	0.67	0.71	0.79	0.80	0.67	0.80
	RB1	0.87	67.5%	0.00	0.59	0.28	0%	68%	32%	0.52	0.56	0.59	0.64	0.74	0.76	0.57	0.75
	RB2	0.63	80.8%	0.00	0.41	0.22	0%	65%	35%	0.65	0.68	0.70	0.74	0.81	0.81	0.69	0.81
	RB3	0.28	59.2%	0.00	0.00	0.28	0%	0%	100%	0.44	0.49	0.52	0.57	0.70	0.73	0.52	0.73
	RB4	1.00	51.1%	0.00	0.00	1.00	0%	0%	100%	0.37	0.41	0.45	0.51	0.67	0.69	0.45	0.69
	RB5	1.96	44.4%	0.00	0.00	1.96	0%	0%	100%	0.31	0.36	0.40	0.46	0.63	0.67	0.40	0.67
	RB6	1.34	53.2%	0.00	0.00	1.34	0%	0%	100%	0.38	0.43	0.47	0.52	0.68	0.70	0.47	0.70
	RB8a	7.82	75.0%	0.00	0.00	7.82	0%	0%	100%	0.60	0.63	0.65	0.69	0.78	0.79	0.65	0.79
	RB8b	2.62	10.0%	0.00	0.00	2.62	0%	0%	100%	0.05	0.07	0.12	0.19	0.47	0.52	0.12	0.52
	RC1	2.33	30.3%	0.00	0.00	2.33	0%	0%	100%	0.19	0.23	0.28	0.35	0.57	0.61	0.28	0.61
	RC2	3.27	31.2%	0.00	0.00	3.27	0%	0%	100%	0.19	0.24	0.29	0.35	0.57	0.61	0.29	0.61
	RC3	1.10	52.9%	0.00	0.00	1.10	0%	0%	100%	0.38	0.43	0.47	0.52	0.68	0.70	0.47	0.70
	RC4	0.28	60.9%	0.00	0.00	0.28	0%	0%	100%	0.46	0.50	0.53	0.58	0.71	0.73	0.53	0.73
	RC7	9.32	85.0%	0.00	0.00	9.32	0%	0%	100%	0.70	0.72	0.73	0.77	0.83	0.83	0.73	0.83
	RC6a	0.75	90.0%	0.00	0.00	0.75	0%	0%	100%	0.75	0.77	0.77	0.81	0.85	0.85	0.77	0.85
	RC6b	2.29	75.0%	0.00	0.00	2.29	0%	0%	100%	0.60	0.63	0.65	0.69	0.78	0.79	0.65	0.79
	RC6c	1.45	90.0%	0.00	0.00	1.45	0%	0%	100%	0.75	0.77	0.77	0.81	0.85	0.85	0.77	0.85
	RC6d	0.66	75.0%	0.00	0.00	0.66	0%	0%	100%	0.60	0.63	0.65	0.69	0.78	0.79	0.65	0.79
	RC6e	0.36	75.0%	0.00	0.00	0.36	0%	0%	100%	0.60	0.63	0.65	0.69	0.78	0.79	0.65	0.79
	RC6f	3.47	61.4%	0.00	0.00	3.47	0%	0%	100%	0.46	0.51	0.54	0.59	0.71	0.74	0.54	0.74
	R2a	1.87	70.9%	0.00	0.63	1.24	0%	34%	66%	0.56	0.59	0.62	0.66	0.76	0.77	0.61	0.77
	R2b	1.18	75.0%	0.00	0.00	1.18	0%	0%	100%	0.60	0.63	0.65	0.69	0.78	0.79	0.65	0.79
	R2c	3.13	75.0%	0.00	0.38	2.75	0%	12%	88%	0.60	0.63	0.65	0.69	0.78	0.79	0.65	0.79
	R3	14.66	23.6%	0.00	4.00	10.66	0%	27%	73%	0.14	0.18	0.23	0.29	0.54	0.58	0.22	0.57
EURV POND D	D0	1.21	68.0%	0.00	0.00	1.21	0%	0%	100%	0.53	0.56	0.59	0.64	0.75	0.76	0.59	0.76
	D1	8.23	25.0%	0.00	0.51	7.72	0%	6%	94%	0.15	0.19	0.24	0.31	0.54	0.59	0.24	0.58
	D2	13.34	25.0%	0.00	7.67	5.67	0%	57%	43%	0.15	0.19	0.24	0.31	0.54	0.59	0.21	0.56
OFFSITE	OF1	2.28	90.0%	0.00	0.00	2.28	0%	0%	100%	0.75	0.77	0.77	0.81	0.85	0.85	0.77	0.85
	OF3	1.38	29.3%	0.00	0.00	1.38	0%	0%	100%	0.18	0.23	0.28	0.34	0.56	0.60	0.28	0.60
	OF4	0.57	45.0%	0.00	0.00	0.57	0%	0%	100%	0.31	0.36	0.40	0.46	0.64	0.67	0.40	0.67
	OF5	0.87	36.3%	0.00	0.30	0.57	0%	34%	66%	0.24	0.29	0.33	0.39	0.60	0.63	0.32	0.62
	OF6	0.33	45.0%	0.00	0.00	0.33	0%	0%	100%	0.31	0.36	0.40	0.46	0.64	0.67	0.40	0.67
EURV POND A		165.54	49.7%	0.00	6.22	159.32	0%	4%	96%	---	---	---	---	---	---	0.44	0.69
EURV POND B		255.97	22.3%	0.00	26.34	229.63	0%	10%	90%	---	---	---	---	---	---	0.21	0.57
EURV POND C		59.83	13.0%	0.00	0.00	59.83	0%	0%	100%	---	---	---	---	---	---	0.14	0.54
EURV POND R		70.04	57.0%	0.00	8.07	61.97	0%	12%	88%	---	---	---	---	---	---	0.40	0.53
EURV POND D		22.78	27.3%	0.00	8.18	14.60	0%	36%	64%	---	---	---	---	---	---	0.24	0.58
OFFSITE		5.43	58.5%	0.00	0.30	5.13	0%	6%	94%	---	---	---	---	---	---	0.51	0.72
TOTAL HAPPY CANYON		579.59	33.9%	0.00	49.11	530.48	0%	8%	92%	---	---	---	---	---	---	0.30	0.60
BADGER GULCH (GB) - TREATED IN ON-SITE PONDS																	
EURV POND E	E0	1.70	68.0%	0.00	1.70	0.00	0%	100%	0%	0.53	0.56	0.59	0.64	0.75	0.76	0.56	0.75
	E1	6.91	25.7%	0.00	6.27	0.64	0%	91%	9%	0.15	0.20	0.25	0.31	0.55	0.59	0.20	0.55
	E2a	2.80	90.0%	0.00	1.50	1.30	0%	54%	46%	0.75	0.77	0.77	0.81	0.85	0.85	0.77	0.85
	E2b	6.80	55.0%	0.00	2.25	4.55	0%	33%	67%	0.40	0.45	0.49	0.54	0.68	0.71	0.47	0.70
	E2c	1.36	90.0%	0.00	1.36	0.00	0%	100%	0%	0.75	0.77	0.77	0.81	0.85	0.85	0.77	0.85
	E3	3.99	55.0%	0.00	1.07	2.92	0%	27%	73%	0.40	0.45	0.49	0.54	0.68	0.71	0.48	0.70
	E4	4.77	55.0%	0.00	2.89	1.88	0%	61%	39%	0.40	0.45	0.49	0.54	0.68	0.71	0.46	0.69
	E5	0.45	90.0%	0.00	0.45	0.00	0%	100%	0%	0.75	0.77	0.77	0.81	0.85	0.85	0.77	0.85
	E6	3.68	57.4%	0.00	3.68	0.00	0%	100%	0%	0.42	0.47	0.51	0.56	0.70	0.72	0.47	0.70
	E7	1.64	75.0%	0.00	1.60	0.04	0%	98%	2%	0.60	0.63	0.65	0.69	0.78	0.79	0.63	0.78
	E8	3.84	55.0%	0.00	1.95	1.89	0%	51%	49%	0.40	0.45	0.49	0.54	0.68	0.71	0.47	0.70
EURV POND F	F0	2.53	84.6%	0.00	2.53	0.00	0%	100%	0%	0.69	0.72	0.73	0.77	0.82	0.83	0.72	0.82
	F1	11.50	55.0%	0.00	7.47	4.03	0%	65%	35%	0.40	0.45	0.49	0.54	0.68	0.71	0.46	0.69
	F2	7.82	55.0%	0.00	7.20	0.62	0%	92%	8%	0.40	0.45	0.49	0.54	0.68	0.71	0.45	0.69
	F3	6.07	55.0%	0.00	0.00	6.07	0%	0%	100%	0.40	0.45	0.49	0.54	0.68	0.71	0.49	0.71
	F4	3.02	32.1%	0.00	2.63	0.39	0%	87%	13%	0.20	0.25	0.30	0.36	0.58	0.62	0.26	0.58
	F5	5.38	37.9%	0.00	3.43	1.95	0%	64%	36%	0.25	0.30	0.35	0.41	0.60	0.64	0.32	0.62
	F6	6.69	54.3%	0.00	0.00	6.69	0%	0%	100%	0.40	0.44	0.48	0.53	0.68	0.71	0.48	0.71
	F7	5.41	55.0%	0.00	5.41	0.00	0%	100%	0%	0.40	0.45	0.49	0.54	0.68	0.71	0.45	0.68
	F8	1.20	90.0%	0.00	1.00	0.20	0%	83%	17%	0.75	0.77	0.77	0.81	0.85	0.85	0.77	0.85
	OS9	25.01	5.0%	0.00	9.50	15.51	0%	38%	62%	0.02	0.03	0.08	0.15	0.45	0.50	0.06	0.48
EXISTING WQ POND E	RE1	3.00	60.9%	0.00	0.00	3.00	0%	0%	100%	0.46	0.50	0.53	0.58	0.71	0.73	0.53	0.73
	RE2a	5.16	75.0%	0.00	0.00	5.16	0%	0%	100%	0.60	0.63	0.65	0.69	0.78	0.79	0.65	0.79
	RE2b	2.53	74.5%	0.00	0.00	2.53	0%	0%	100%	0.59	0.62	0.65	0.69	0.78	0.79	0.65	0.79
	RE3	1.58	55.6%	0.00	0.43	1.15	0%	27%	73%	0.41	0.45	0.49	0.54	0.69	0.71	0.48	0.71
	RE4	4.09	75.0%	0.00	1.97	2.12	0%	48%	52%	0.60	0.63	0.65	0.69	0.78	0.79	0.64	0.79
	RE5	4.01	75.0%	0.00	4.01	0.00	0%	100%	0%	0.60	0.63	0.65	0.69	0.78	0.79	0.63	0.78
OFFSITE	OF2	0.65	90.0%	0.00	0.65	0.00	0%	100%	0%	0.75	0.77	0.77	0.81	0.85	0.85	0.77	0.85
	OF7	1.40	45.0%	0.00	1.40	0.00	0%	100%	0%	0.31	0.36	0.40	0.46	0.64	0.67	0.36	0.64
	OF8	1.33	45.0%	0.00	1.33	0.00	0%	100%	0%	0.31	0.36	0.40	0.46	0.64	0.67	0.36	0.64
EURV POND E		37.94	55.6%	0.00	24.72	13.22	0%	65%	35%	---	---	---	---	---	---	0.47	0.70
EURV POND F		74.63	37.6%	0.00	39.17	35.46	0%	52%	48%	---	---	---	---	---	---	0.32	0.62
EX WQ POND E		20.37	71.4%	0.00	6.41	13.96	0%	31%	69%	---	---	---	---	---	---	0.61	0.77
OFFSITE		3.38	53.7%	0.00	3.38	0.00	0%	100%	0%	---	---	---	---	---	---	0.44	0.68
TOTAL BADGER GULCH		136.32	48.1%	0.00	73.68	62.64	0%	54%	46%	---	---	---	---	---	---	0.41	0.67
OVERALL ONSITE TOTAL		715.91	36.6%	0.00	122.79	593.12	0%	17%	83%	---	---	---	---	---	---	0.32	0.61

STANDARD FORM SF-2
TIME OF CONCENTRATION

Subdivision: Ridgegate
Location: Lone Tree

Project Name: Phase II Drainage Report
Project No.: 15950.00
Calculated By: KAU
Date: 7/13/20

Notes:

$$t_c = t_i + t_t \quad \text{Equation 6-2}$$

Where:

t_c = computed time of concentration (minutes)
t_i = overland (initial) flow time (minutes)
t_t = channelized flow time (minutes).

$$t_t = \frac{L_t}{60K\sqrt{S_o}} = \frac{L_t}{60V_t} \quad \text{Equation 6-4}$$

Where:

t_t = channelized flow time (travel time, min)
L_t = waterway length (ft)
S_o = waterway slope (ft/ft)
V_t = travel time velocity (ft/sec) = $K\sqrt{S_o}$
K = NRCS conveyance factor (see Table 6-2).

$$t_i = \frac{0.395(1.1-C_5)\sqrt{L_i}}{S_o^{0.33}} \quad \text{Equation 6-3}$$

Where:

t_i = overland (initial) flow time (minutes)
C_5 = runoff coefficient for 5-year frequency (from Table 6-4)
L_i = length of overland flow (ft)
S_o = average slope along the overland flow path (ft/ft).

$$t_c = (26-17i) + \frac{L_t}{60(14i+9)\sqrt{S_t}} \quad \text{Equation 6-5}$$

Where:

t_c = minimum time of concentration for first design point when less than t_c from Equation 6-1.
L_t = length of channelized flow path (ft)
i = imperviousness (expressed as a decimal)
S_t = slope of the channelized flow path (ft/ft).

Use a minimum t_c value of 5 minutes for urbanized areas and a minimum t_c value of 10 minutes for areas that are not considered urban. Use minimum values even when calculations result in a lesser time of concentration.

Table 6-2. NRCS Conveyance factors, K

Type of Land Surface	Conveyance Factor, K
Heavy meadow	2.5
Tillage/field	5
Short pasture and lawns	7
Nearly bare ground	10
Grassed waterway	15
Paved areas and shallow paved swales	20

SUB-BASIN DATA						INITIAL/OVERLAND (Ti)			TRAVEL TIME (Tt)					*tc* CHECK (URBANIZED BASINS)			FINAL
BASIN ID	D.A. (ac)	Hydrologic Soils Group	Imp. (%)	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)
ON-SITE BASINS - OUTFALL TO EURV PONDS																	
HAPPY CANYON (HC) ON-SITE																	
A0	3.10	B/C/D	68%	0.58	0.76	155	21.3%	4.2	231	0.5%	20.0	1.4	2.7	7.0	386.0	17.4	7.0
A1	6.58	B/C/D	25%	0.20	0.55	300	1.7%	23.7	510	1.2%	20.0	2.2	3.9	27.6	810.0	28.0	27.6
A2a	1.40	C/D	44%	0.39	0.66	114	11.1%	6.2	290	1.6%	20.0	2.6	1.9	8.1	404.0	21.1	8.1
A2b	2.68	C/D	63%	0.55	0.74	74	4.9%	5.1	700	2.4%	20.0	3.1	3.7	8.8	774.0	19.6	8.8
A3a	2.04	C/D	75%	0.65	0.79	80	2.0%	5.8	490	3.9%	20.0	3.9	2.1	7.9	570.0	15.4	7.9
A3b	8.57	C/D	54%	0.48	0.71	27	2.0%	4.6	2550	2.8%	20.0	3.3	12.7	17.3	2577.0	32.0	17.3
A3c	1.23	C/D	75%	0.65	0.79	80	2.0%	5.8	380	2.7%	20.0	3.3	1.9	7.7	460.0	15.2	7.7
A4	6.96	C/D	78%	0.68	0.81	86	2.0%	5.6	840	3.0%	20.0	3.5	4.1	9.7	926.0	16.7	9.7
A5	8.14	C/D	75%	0.65	0.79	40	2.0%	4.1	800	3.6%	20.0	3.8	3.5	7.6	840.0	16.8	7.6
A6a	5.03	C/D	74%	0.64	0.79	100	2.0%	6.6	1790	3.2%	20.0	3.6	8.3	14.9	1890.0	21.9	14.9
A6b	2.82	C/D	85%	0.73	0.83	10	2.0%	1.7	485	3.0%	20.0	3.5	2.3	4.0	495.0	13.8	5.0
A6c	2.24	C/D	55%	0.49	0.71	200	2.0%	12.5	300	3.3%	20.0	3.7	1.4	13.8	500.0	18.3	13.8
A6d	10.83	C/D	55%	0.49	0.71	100	2.0%	8.8	1390	3.1%	20.0	3.5	6.6	15.4	1490.0	24.5	15.4
A7	5.38	C/D	55%	0.49	0.71	80	2.0%	7.9	800	3.5%	20.0	3.7	3.6	11.4	880.0	20.9	11.4
A8	12.71	C/D	41%	0.37	0.65	145	7.8%	8.1	965	4.5%	20.0	4.2	3.8	11.9	1110.0	24.2	11.9
A9a	4.31	C/D	82%	0.71	0.82	27	2.0%	2.9	1436	3.5%	20.0	3.7	6.4	9.3	1463.0	18.3	9.3
A9b	6.79	C/D	41%	0.37	0.65	80	2.0%	9.4	1000	3.5%	20.0	3.7	4.5	13.8	1080.0	25.1	13.8
A10	14.64	C/D	56%	0.50	0.71	90	2.0%	8.2	1990	3.1%	20.0	3.5	9.5	17.7	2080.0	27.6	17.7
A11a	2.14	C/D	90%	0.77	0.85	27	2.0%	2.4	1000	4.5%	20.0	4.2	3.9	6.4	1027.0	14.3	6.4
A11b	5.46	C/D	66%	0.57	0.75	100	2.0%	7.5	1170	2.9%	20.0	3.4	5.7	13.3	1270.0	21.1	13.3
A11c	5.76	C/D	55%	0.49	0.71	27	2.0%	4.6	1060	3.4%	20.0	3.7	4.8	9.4	1087.0	22.4	9.4
A12a	0.63	C/D	90%	0.77	0.85	27	2.0%	2.4	375	2.0%	20.0	2.8	2.2	4.6	402.0	12.7	5.0
A12b	1.16	C/D	90%	0.77	0.85	27	2.0%	2.4	550	3.2%	20.0	3.6	2.6	5.0	577.0	13.1	5.0
A12c	2.83	C/D	55%	0.49	0.71	100	2.0%	8.8	745	3.0%	20.0	3.4	3.6	12.4	845.0	21.0	12.4
A12d	4.77	C/D	54%	0.48	0.70	300	2.9%	13.6	400	6.2%	20.0	5.0	1.3	15.0	700.0	18.4	15.0
A13a	0.86	C/D	90%	0.77	0.85	27	2.0%	2.4	410	2.0%	20.0	2.8	2.4	4.9	437.0	12.9	5.0
A13b	0.85	C/D	90%	0.77	0.85	27	2.0%	2.4	415	2.3%	20.0	3.1	2.3	4.7	442.0	12.8	5.0
A14	13.90	C/D	20%	0.20	0.56	233	7.2%	13.0	700	4.3%	20.0	4.1	2.8	15.8	933.0	27.4	15.8
A15	2.74	C/D	67%	0.58	0.76	217	5.2%	8.0	280	5.5%	20.0	4.7	1.0	9.0	497.0	15.7	9.0
OS7a	6.75	C/D	5%	0.08	0.50	500	26.5%	14.0	0	2.0%	5.0	0.7	0.0	14.0	500.0	25.2	14.0
OS7b	6.56	C/D	5%	0.08	0.50	460	23.7%	13.9	850	10.6%	5.0	1.6	8.7	22.7	1310.0	29.6	22.7
OS8	5.68	C/D	6%	0.09	0.51	440	18.0%	14.8	545	7.8%	5.0	1.4	6.5	21.3	985.0	28.3	21.3
B0	2.64	B/C/D	68%	0.59	0.76	125	21.1%	3.7	200	0.5%	20.0	1.4	2.4	6.1	325.0	17.0	6.1
B1a	5.62	B/C/D	57%	0.50	0.71	27	2.0%	4.5	1910	2.2%	20.0	3.0	10.8	15.3	1937.0	28.9	15.3
B1b	7.61	B/C/D	58%	0.48	0.70	80	2.0%	7.9	1200	2.8%	20.0	3.4	5.9	13.8	1280.0	23.0	13.8
B1c	2.71	C/D	84%	0.73	0.83	27	2.0%	2.8	963	1.5%	20.0	2.4	6.6	9.3	990.0	18.0	9.3
B1d	2.85	C/D	56%	0.50	0.71	15	2.0%	3.4	645	3.4%	20.0	3.7	2.9	6.3	660.0	19.9	6.3
B1e	6.28	B/C/D	55%	0.46	0.69	80	2.0%	8.2	1060	1.9%	20.0	2.8	6.3	14.5	1140.0	24.2	14.5
B1f	1.76	C/D	75%	0.65	0.79	75	2.0%	5.6	430	2.1%	20.0	2.9	2.5	8.1	505.0	15.8	8.1
B1g	3.31	B/C/D	55%	0.48	0.71	75	2.0%	7.7	600	1.4%	20.0	2.3	4.3	11.9	675.0	21.8	11.9
B2	8.15	B/C/D	55%	0.48	0.71	27	2.0%	4.6	1000	4.0%	20.0	4.0	4.2	8.8	1027.0	21.7	8.8
B3a	7.64	B/C/D	60%	0.51	0.72	27	2.0%	4.4	1640	1.8%	20.0	2.7	10.3	14.7	1667.0	27.7	14.7
B3b	1.68	B/C/D	55%	0.48	0.70	120	2.0%	9.8	940	4.0%	20.0	4.0	3.9	13.7	1060.0	21.3	13.7
B4	4.08	C/D	52%	0.47	0.70	100	2.0%	9.1	760	3.3%	20.0	3.6	3.5	12.6	860.0	21.3	12.6
B5a	5.60	B/C/D	48%	0.42	0.68	100	2.0%	9.7	1216	1.5%	20.0	2.4	8.4	18.1	1316.0	28.5	18.1
B5b	5.20	B/C/D	72%	0.63	0.78	27	2.0%	3.5	1560	1.9%	20.0	2.8	9.4	13.0	1587.0	23.6	13.0
B5c	3.83	B/C/D	54%	0.45	0.69	100	2.0%	9.3	1230	3.8%	20.0	3.9	5.3	14.5	1330.0	23.2	14.5
B5d	3.76	C/D	55%	0.49	0.71	15	2.0%	3.4	950	3.0%	20.0	3.5	4.6	8.0	965.0	22.1	8.0
B6a	3.65	C/D	55%	0.49	0.71	100	2.0%	8.8	1000	3.8%	20.0	3.9	4.3	13.1	1100.0	21.7	13.1
B6b	2.38	C/D	55%	0.49	0.71	100	2.0%	8.8	775	1.4%	20.0	2.3	5.5	14.3	875.0	23.2	14.3
B7	4.23	C/D	55%	0.49	0.71	50	25.0%	2.7	1100	5.3%	20.0	4.6	4.0	6.7	1150.0	21.4	6.7
OS3	72.31	B/C/D	5%	0.07	0.50	250	10.0%	13.7	3450	4.7%	5.0	1.1	53.0	66.7	3700.0	52.4	52.4
OS2b	1.81	C/D	5%	0.08	0.50	350	25.7%	11.8	0	2.0%	5.0	0.7	0.0	11.8	350.0	25.2	11.8
OS4a	3.10	B/C/D	7%	0.05	0.46	100	2.0%	15.1	375	4.7%	5.0	1.1	5.7	20.8	475.0	27.7	20.8
OS4b	3.04	C/D	5%	0.08	0.50	492	28.0%	13.6	0	2.0%	5.0	0.7	0.0	13.6	492.0	25.2	13.6
OS5a	1.90	C/D	5%	0.08	0.50	500	28.0%	13.8	0	2.0%	5.0	0.7	0.0	13.8	500.0	25.2	13.8
OS5b	59.27	C/D	5%	0.08	0.50	500	15.0%	16.9	2020	5.9%	5.0	1.2	27.7	44.6	2520.0	39.4	39.4
OS5c	2.48	C/D	5%	0.08	0.50	500	23.0%	14.7	260	21.2%	5.0	2.3	1.9	16.6	760.0	26.1	16.6
OS5d	1.11	C/D	5%	0.08	0.50	500	29.7%	13.5	0	2.0%	5.0	0.7	0.0	13.5	500.0	25.2	13.5
OS6a	4.84	C/D	5%	0.08	0.50	500	31.4%	13.3	0	2.0%	5.0	0.7	0.0	13.3	500.0	25.2	13.3
OS6b	23.13	C/D	5%	0.08	0.50	250	11.2%	13.2	1111	13.9%	5.0	1.9	9.9	23.1	1361.0	30.3	23.1
C0	1.74	C/D	46%	0.41	0.67	286	11.3%	9.4	70	0.5%	20.0	1.4	0.8	10.3	356.0	19.2	10.3
C1a	2.43	C/D	82%	0.70	0.82	27	2.0%	2.9	1015	3.7%	20.0	3.8	4.4	7.4	1042.0	16.4	7.4
C1b	5.39	C/D	46%	0.41	0.67	100	2.0%	9.9	580	1.7%	20.0	2.6	3.7	13.6	680.0	23.0	13.6
OS1	10.85	C/D	5%	0.08	0.50	350	31.9%	11.0	300	20.2%	5.0	2.2	2.2	13.3	650.0	26.3	13.3
OS2a	39.42	C/D	5%	0.08	0.50	100	25.0%	6.4	2590	6.4%	5.0	1.3	34.2	40.6	2690.0	42.8	40.6

STANDARD FORM SF-2
TIME OF CONCENTRATION

Subdivision: Ridgegate
Location: Lone Tree

Project Name: Phase II Drainage Report
Project No.: 15950.00
Calculated By: KAU
Date: 7/13/20

Notes:

$$t_c = t_i + t_t$$ Equation 6-2

Where:

t_c = computed time of concentration (minutes)
t_i = overland (initial) flow time (minutes)
t_t = channelized flow time (minutes).

$$t_t = \frac{L_t}{60K\sqrt{S_o}} = \frac{L_t}{60V_t}$$ Equation 6-4

Where:

t_t = channelized flow time (travel time, min)
L_t = waterway length (ft)
S_o = waterway slope (ft/ft)
V_t = travel time velocity (ft/sec) = $K\sqrt{S_o}$
K = NRCS conveyance factor (see Table 6-2).

Use a minimum t_c value of 5 minutes for urbanized areas and a minimum t_c value of 10 minutes for areas that are not considered urban. Use minimum values even when calculations result in a lesser time of concentration.

$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L_i}}{S_o^{0.33}}$$ Equation 6-3

Where:

t_i = overland (initial) flow time (minutes)
C_5 = runoff coefficient for 5-year frequency (from Table 6-4)
L_i = length of overland flow (ft)
S_o = average slope along the overland flow path (ft/ft).

$$t_c = (26 - 17i) + \frac{L_t}{60(14i + 9)\sqrt{S_t}}$$ Equation 6-5

Where:

t_c = minimum time of concentration for first design point when less than t_c from Equation 6-1.
L_t = length of channelized flow path (ft)
i = imperviousness (expressed as a decimal)
S_t = slope of the channelized flow path (ft/ft).

Table 6-2. NRCS Conveyance factors, K

Type of Land Surface	Conveyance Factor, K
Heavy meadow	2.5
Tillage/field	5
Short pasture and lawns	7
Nearly bare ground	10
Grassed waterway	15
Paved areas and shallow paved swales	20

SUB-BASIN DATA						INITIAL/OVERLAND (Ti)			TRAVEL TIME (Tt)					*tc* CHECK (URBANIZED BASINS)			FINAL
BASIN ID	D.A. (ac)	Hydrologic Soils Group	Imp. (%)	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)
ON-SITE BASINS - OUTFALL TO EURV PONDS																	
R0	2.95	B/C/D	68%	0.57	0.75	100	20.0%	3.5	200	0.5%	20.0	1.4	2.4	5.9	300.0	17.0	5.9
R1	4.45	C/D	77%	0.67	0.80	27	2.5%	3.0	1235	3.0%	20.0	3.5	5.9	8.9	1262.0	18.9	8.9
RB1	0.87	B/C/D	68%	0.57	0.75	67	3.4%	5.2	392	1.9%	20.0	2.8	2.4	7.6	459.0	17.1	7.6
RB2	0.63	B/C/D	81%	0.69	0.81	67	3.4%	4.1	392	1.9%	20.0	2.8	2.4	6.4	459.0	14.6	6.4
RB3	0.28	C/D	59%	0.52	0.73	48	2.0%	5.8	150	1.9%	20.0	2.7	0.9	6.7	198.0	17.0	6.7
RB4	1.00	C/D	51%	0.45	0.69	92	14.9%	4.6	393	1.8%	20.0	2.7	2.4	7.0	485.0	20.3	7.0
RB5	1.96	C/D	44%	0.40	0.67	90	18.1%	4.6	580	3.1%	20.0	3.5	2.7	7.4	670.0	22.1	7.4
RB6	1.34	C/D	53%	0.47	0.70	133	17.8%	5.1	179	2.5%	20.0	3.2	0.9	6.0	312.0	18.1	6.0
RB8a	7.82	C/D	75%	0.65	0.79	10	2.0%	2.0	735	5.8%	20.0	4.8	2.5	4.6	745.0	15.9	5.0
RB8b	2.62	C/D	10%	0.12	0.52	100	25.0%	6.1	425	3.6%	7.0	1.3	5.4	11.5	525.0	27.9	11.5
RC1	2.33	C/D	30%	0.28	0.61	33	3.4%	5.7	699	2.9%	20.0	3.4	3.4	9.1	732.0	26.0	9.1
RC2	3.27	C/D	31%	0.29	0.61	130	11.9%	7.4	1155	2.1%	20.0	2.9	6.7	14.0	1285.0	30.7	14.0
RC3	1.10	C/D	53%	0.47	0.70	110	1.8%	9.8	362	1.7%	20.0	2.6	2.3	12.2	472.0	19.9	12.2
RC4	0.28	C/D	61%	0.53	0.73	74	2.0%	7.0	126	0.8%	20.0	1.8	1.2	8.2	200.0	17.0	8.2
RC7	9.32	C/D	85%	0.73	0.83	10	2.0%	1.7	780	1.7%	20.0	2.6	5.0	6.7	790.0	16.3	6.7
RC6a	0.75	C/D	90%	0.77	0.85	27	2.0%	2.4	430	1.8%	20.0	2.7	2.7	5.1	457.0	13.2	5.1
RC6b	2.29	C/D	75%	0.65	0.79	50	2.0%	4.6	375	1.9%	20.0	2.8	2.2	6.8	425.0	15.6	6.8
RC6c	1.45	C/D	90%	0.77	0.85	27	2.0%	2.4	565	1.3%	20.0	2.3	4.1	6.5	592.0	14.5	6.5
RC6d	0.66	C/D	75%	0.65	0.79	80	2.0%	5.8	75	2.5%	20.0	3.2	0.4	6.2	155.0	13.7	6.2
RC6e	0.36	C/D	75%	0.65	0.79	80	2.0%	5.8	75	2.5%	20.0	3.2	0.4	6.2	155.0	13.7	6.2
RC6f	3.47	C/D	61%	0.54	0.74	27	2.0%	4.2	900	3.2%	20.0	3.6	4.2	8.4	927.0	20.3	8.4
R2a	1.87	C/D	71%	0.61	0.77	18	2.0%	3.0	350	2.5%	20.0	3.2	1.8	4.8	368.0	15.9	5.0
R2b	1.18	B/C/D	75%	0.65	0.79	100	11.2%	3.7	415	2.1%	20.0	2.9	2.4	6.0	515.0	15.7	6.0
R2c	3.13	B/C/D	75%	0.65	0.79	100	2.0%	6.5	1065	4.2%	20.0	4.1	4.3	10.8	1165.0	17.7	10.8
R3	14.66	B/C/D	24%	0.22	0.57	100	2.0%	12.7	1220	1.6%	20.0	2.5	8.1	20.9	1320.0	35.2	20.9
D0	1.21	C/D	68%	0.59	0.76	110	13.1%	4.1	65	0.5%	20.0	1.4	0.8	4.9	175.0	15.3	5.0
D1	8.23	B/C/D	25%	0.24	0.58	15	2.0%	4.8	700	1.7%	7.0	0.9	12.9	17.7	715.0	29.0	17.7
D2	13.34	B/C/D	25%	0.21	0.56	15	2.0%	4.9	1130	2.1%	7.0	1.0	18.4	23.3	1145.0	32.0	23.3
OF1	2.28	C/D	90%	0.77	0.85	29.5	2.0%	2.6	488	0.6%	20.0	1.5	5.3	7.8	517.5	15.6	7.8
OF3	1.38	C/D	29%	0.28	0.60	80	15.0%	5.5	0	2.0%	7.0	1.0	0.0	5.5	80.0	21.0	5.5
OF4	0.57	B/C/D	45%	0.40	0.67	80	15.0%	4.6	0	2.0%	7.0	1.0	0.0	4.6	80.0	18.4	5.0
OF5	0.87	C/D	36%	0.32	0.62	80	15.0%	5.2	0	2.0%	7.0	1.0	0.0	5.2	80.0	19.8	5.2
OF6	0.33	C/D	45%	0.40	0.67	80	15.0%	4.6	0	2.0%	7.0	1.0	0.0	4.6	80.0	18.4	5.0
EURV POND A	165.54	B/C/D	49.7%	0.44	0.69				4500	6.0%							
EURV POND B	255.97	B/C/D	22.3%	0.21	0.57				5800	5.0%							
EURV POND C	59.83	C/D	13.0%	0.14	0.54				2700	6.0%							
EURV POND R	70.04	B/C/D	57.0%	0.40	0.53				2100	5.0%							
EURV POND D	22.78	B/C/D	27.3%	0.24	0.58				1000	6.0%							
BADGER GULCH (BG) ON-SITE																	
E0	1.70	B/C/D	68%	0.56	0.75	166	18.0%	4.8	88	0.5%	20.0	1.4	1.0	5.8	254.0	15.6	5.8
E1	6.91	B/C/D	26%	0.20	0.55	10	2.0%	4.1	1260	2.6%	7.0	1.1	18.6	22.6	1270.0	31.9	22.6
E2a	2.80	B/C/D	90%	0.77	0.85	18	2.0%	2.0	1700	2.4%	20.0	3.1	9.1	11.1	1718.0	19.1	11.1
E2b	6.80	B/C/D	55%	0.47	0.70	18	2.0%	3.8	2100	1.6%	20.0	2.6	13.7	17.5	2118.0	33.0	17.5
E2c	1.36	B/C/D	90%	0.77	0.85	18	2.0%	2.0	830	2.5%	20.0	3.2	4.4	6.4	848.0	14.8	6.4
E3	3.99	B/C/D	55%	0.48	0.70	18	2.0%	3.8	800	1.8%	20.0	2.7	4.9	8.7	818.0	22.6	8.7
E4	4.77	B/C/D	55%	0.46	0.69	40	2.0%	5.8	765	1.8%	20.0	2.7	4.7	10.5	805.0	22.3	10.5
E5	0.45	B/C/D	90%	0.77	0.85	27	2.0%	2.5	400	2.8%	20.0	3.3	2.0	4.5	427.0	12.5	5.0
E6	3.68	B/C/D	57%	0.47	0.70	27	2.0%	4.7	580	2.5%	20.0	3.2	3.0	7.8	607.0	19.8	7.8
E7	1.64	B/C/D	75%	0.63	0.78	18	2.0%	2.9	375	4.4%	20.0	4.2	1.5	4.4	393.0	14.8	5.0
E8	3.84	B/C/D	55%	0.47	0.70	18	2.0%	3.9	1000	3.5%	20.0	3.7	4.5	8.3	1018.0	22.0	8.3
F0	2.53	B/C/D	85%	0.72	0.82	50	25.0%	1.7	290	0.5%	20.0	1.4	3.4	5.1	340.0	14.9	5.1
F1	11.50	C/D	55%	0.46	0.69	50	2.0%	6.5	1550	2.5%	20.0	3.1	8.2	14.7	1600.0	26.5	14.7
F2	7.82	C/D	55%	0.45	0.69	18	2.0%	3.9	1600	3.0%	20.0	3.5	7.7	11.6	1618.0	25.9	11.6
F3	6.07	B/C/D	55%	0.49	0.71	18	2.0%	3.7	1065	3.0%	20.0	3.4	5.1	8.9	1083.0	22.8	8.9
F4	3.02	B/C/D	32%	0.26	0.58	200	8.7%	10.6	500	1.8%	20.0	2.7	3.1	13.7	700.0	25.2	13.7
F5	5.38	B/C/D	38%	0.32	0.62	18	2.0%	4.8	750	4.2%	20.0	4.1	3.1	7.8	768.0	23.8	7.8
F6	6.69	C/D	54%	0.48	0.71	18	2.0%	3.8	1700	3.5%	20.0	3.7	7.6	11.4	1718.0	25.9	11.4
F7	5.41	B/C/D	55%	0.45	0.68	18	2.0%	4.0	650	3.1%	20.0	3.5	3.1	7.0	668.0	20.3	7.0
F8	1.20	B/C/D	90%	0.77	0.85	18	2.0%	2.0	850	3.3%	20.0	3.6	3.9	5.9	868.0	14.3	5.9
OS9	25.01	B/C/D	5%	0.06	0.48	500	19.0%	15.9	360	13.5%	5.0	1.8	3.3	19.2	860.0	26.8	19.2
RE1	3.00	B/C/D	61%	0.53	0.73	110	2.0%	8.5	1165	1.0%	20.0	2.0	9.7	18.2	1275.0	26.7	18.2
RE2a	5.16	B/C/D	75%	0.65	0.79	50	2.0%	4.6	1000	2.0%	20.0	2.8	5.9	10.5	1050.0	19.4	10.5
RE2b	2.53	C/D	75%	0.65	0.79	50	2.0%	4.6	250	4.4%	20.0	4.2	1.0	5.6	300.0	14.4	5.6
RE3	1.58	C/D	56%	0.48	0.71	97	2.0%	8.8	678	3.7%	20.0	3.8	2.9	11.7	775.0	20.0	11.7
RE4	4.09	C/D	75%	0.64	0.79	100	2.0%	6.6	650	3.7%	20.0	3.9	2.8	9.4	750.0	16.1	9.4
RE5	4.01	B/C/D	75%	0.63	0.78	100	2.0%	6.8	650	3.8%	20.0	3.9	2.8	9.6	750.0	16.1	9.6
OF2	0.65	B/C/D	90%	0.77	0.85	18	2.0%	2.0	260	2.4%	20.0	3.1	1.4	3.4	278.0	12.0	5.0
OF7	1.40	B/C/D	45%	0.36	0.64	80	15.0%	4.9	0	2.0%	7.0	1.0	0.0	4.9	80.0	18.4	5.0
OF8	1.33	B/C/D	45%	0.36	0.64	80	15.0%	4.9	0	2.0%	7.0	1.0	0.0	4.9	80.0	18.4	5.0
EURV POND E	37.94	B/C/D	56%	0.47	0.70				1500	2.0%							
EURV POND F	74.63	B/C/D	38%	0.32	0.62				2200	3.0%							
EX WQ POND E	20.37	B/C/D	71%	0.61	0.77				1175	5.0%							

STANDARD FORM SF-3
STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)

Subdivision: Ridgegate
Location: Lone Tree
Design Storm: 5-Year 1-hr Precipitation (in): 1.43

Project Name: Phase II Drainage Report
Project No.: 15950.00
Calculated By: KAU
Date: 7/13/20

Notes:
Street and Pipe C*A values are determined by Q/i using

STREET	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET			PIPE				TRAVEL TIME			REMARKS
		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 (in)	Velocity (fps)	Length (ft)	t_t (min)	
EURV POND A																							
Northeast Storm Line		A12a	0.63	0.77	5.0	0.49	4.85	2.4															
		A12b	1.16	0.77	5.0	0.90	4.85	4.4															
	A12c	A12c	2.83	0.49	12.4	1.38	3.54	4.9					4.9	1.4	2.4					3.1	230	1.2	
	A12d	A12d	4.77	0.48	15.0	2.28	3.25	7.4					7.4	2.3	2.4					3.1	80	0.4	
	1A								15.4	5.05	3.21	16.2				16.2	5.1	1.5	30	9.1	1330	2.4	
	2A	A10	14.64	0.50	17.7	7.28	3.00	21.8								21.8	7.3	1.5	30	9.8	240	0.4	
	3A								18.1	12.33	2.96	36.5				36.5	12.3	1.0	42	9.6	44		
		A11a	2.14	0.77	6.4	1.65	4.53	7.5															
	A11b	A11b	5.46	0.57	13.3	3.14	3.43	10.8					10.8	3.1	2.8					3.4	315	1.6	
	A11c	A11c	5.76	0.49	9.4	2.80	3.97	11.1					11.1	2.8	2.9					3.4	300	1.5	
	4A								18.1	19.92	2.96	59.0				59.0	19.9	0.5	48	8.4	1515	3.0	
Southwest Storm Line		A15	2.74	0.58	9.0	1.60	4.03	6.4								6.4	1.6	2.0	24	8.0	220	0.5	
		A13a	0.86	0.77	5.0	0.66	4.85	3.2															
		A13b	0.85	0.77	5.0	0.66	4.85	3.2															
		A14	13.90	0.20	15.8	2.74	3.17	8.7								8.7	2.7	1.5	30	7.6	25		
	5A								15.8	5.66	3.17	17.9				17.9	5.7	1.0	42	7.9	1385	2.9	
	OS7b	OS7b	6.56	0.08	22.7	0.50	2.63	1.3								1.3	0.5	2.0	24	4.9	700	2.4	
	OS8	OS8	5.68	0.09	21.3	0.48	2.72	1.3								1.3	0.5	3.0	18	5.7	555	1.6	
	6A	A8	12.71	0.37	11.9	4.72	3.61	17.0	25.0	5.70	2.49	14.2				14.2	5.7	1.0	42	7.4	440	1.0	
	7A								26.0	11.36	2.44	27.7				27.7	11.4	0.5	48	6.9	455	1.1	
		A9a	4.31	0.71	9.3	3.04	3.97	12.1															
		A9b	6.79	0.37	13.8	2.51	3.37	8.5															
	8A								27.1	16.91	2.38	40.2				40.2	16.9	0.5	66	7.5	50		
	9A	A7	5.38	0.49	11.4	2.61	3.66	9.6								9.6	2.6	2.0	24	8.9	300	0.6	
		A6a	5.03	0.64	14.9	3.23	3.26	10.5															
		A6b	2.82	0.73	5.0	2.06	4.85	10.0								10.0	2.1	2.5	24	9.6	100		
	A6c	A6c	2.24	0.49	13.8	1.09	3.37	3.7					3.7	1.1	3.5					3.8	1070	4.7	
	10A								18.6	6.38	2.92	18.6				18.6	6.4	1.0	30	8.1	50		
	11A								27.1	23.29	2.38	55.4				55.4	23.3	0.5	66	8.1	565	1.2	
	OS7a	OS7a	6.75	0.08	14.0	0.51	3.35	1.7					1.7	0.5	7.7					5.6	1000	3.0	
	A6d	A6d	10.83	0.49	15.4	5.26	3.21	16.9	17.0	5.77	3.05	17.6				17.6	5.8	1.0	42	7.9	950	2.0	
	A5	A5	8.14	0.65	7.6	5.29	4.28	22.6															
	12A								19.0	11.06	2.89	32.0				32.0	11.1	1.0	42	9.3	225	0.4	
		A3c	1.23	0.65	7.7	0.80	4.26	3.4								3.4	0.8	4.0	18	8.7	50		
	13A								19.0	11.86	2.89	34.3				34.3	11.9	0.5	42	7.3	960	2.2	
	14A	A4	6.96	0.68	9.7	4.71	3.92	18.5								18.5	4.7	1.5	42	9.2	250	0.5	
	15A								21.2	16.57	2.73	45.2				45.2	16.6	0.5	48	7.9	165	0.4	
	A3a	A3a	2.04	0.65	7.9	1.33	4.23	5.6					5.6	1.3	5.4					4.6	70	0.3	
		A3b	8.57	0.48	17.3	4.12	3.03	12.5															
	16A								21.6	22.02	2.70	59.5				59.5	22.0	0.5	42	8.3	50		
	17A								28.3	45.31	2.32	105.1				105.1	45.3	0.5	72	9.6	215	0.4	
		A2a	1.40	0.39	8.1	0.55	4.19	2.3															
		A2b	2.68	0.55	8.8	1.47	4.06	6.0															
	18A								28.7	47.33	2.30	108.9				108.9	47.3	0.5	72	9.8	1265	2.2	
Pond Inflow/Outfall	19A	A1	6.58	0.20	27.6	1.33	2.35	3.1								3.1	1.3	2.0	24	6.3	280	0.7	
	0A	A0	3.10	0.58	7.0	1.80	4.40	7.9															
		Overall Pond A Inflow							30.8	70.38	2.21	155.5				Per UD-Detention 66.9		0.5	81.24	8.5			

STANDARD FORM SF-3
STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)

Subdivision: Ridgegate
Location: Lone Tree
Design Storm: 5-Year 1-hr Precipitation (in): 1.43

Project Name: Phase II Drainage Report
Project No.: 15950.00
Calculated By: KAU
Date: 7/13/20

Notes:
Street and Pipe C*A values are determined by Q/i using

STREET	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET			PIPE				TRAVEL TIME			REMARKS
		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 (in)	Velocity (fps)	Length (ft)	t_t (min)	
EURV POND B																							
Southwest Storm Line	OS2b	OS2b	1.81	0.08	11.8	0.14	3.61	0.5					0.5	0.1	4.6					4.3	560	2.2	
	B5d	B5d	3.76	0.49	8.0	1.83	4.21	7.7	14.0	1.97	3.35	6.6				6.6	2.0	2.0	24	8.0	950	2.0	
	B5a	B5a	5.60	0.42	18.1	2.38	2.96	7.0								7.0	2.4	2.0	24	8.1	50		
	B5c	B5c	3.83	0.45	14.5	1.74	3.29	5.7								5.7	1.7	2.0	24	7.6	50		
	1B								18.1	6.09	2.96	18.0				18.0	6.1	1.0	30	8.1	260	0.5	
	2B	B5b	5.20	0.63	13.0	3.26	3.47	11.3	18.6	9.35	2.92	27.3				27.3	9.4	1.0	36	8.9	230	0.4	
	OS3	OS3	72.31	0.07	52.4	5.39	1.58	8.5								8.5	5.4	0.5	42	5.0	480	1.6	
	OS4a	OS4a	3.10	0.05	20.8	0.15	2.75	0.4															
	3B								54.0	5.54	1.55	8.6				8.6	5.5	0.5	48	4.9	50		
	4B								54.0	14.89	1.55	23.1				23.1	14.9	0.5	48	6.5	750	1.9	
	OS4b	OS4b	3.04	0.08	13.6	0.23	3.39	0.8					0.8	0.2	4.2					4.1	900	3.7	
	B2	B2	8.15	0.48	8.8	3.94	4.06	16.0	17.3	4.17	3.03	12.6				12.6	4.2	1.0	30	7.3	50		
	5B								55.9	19.06	1.51	28.8				28.8	19.1	0.5	48	6.9	750	1.8	
	OS5a	OS5a	1.90	0.08	13.8	0.14	3.38	0.5					0.5	0.1	3.5					3.7	600	2.7	
	OS5c	OS5c	2.48	0.08	16.6	0.19	3.09	0.6								0.6	0.2	3.0	18	4.5	50		
	OS5b	OS5b	59.27	0.08	39.4	4.50	1.90	8.6								8.6	4.5	0.5	42	5.0	50		
	OS5d	OS5d	1.11	0.08	13.5	0.08	3.41	0.3					0.3	0.1	1.6					2.5	360	2.4	
	B4	B4	4.08	0.47	12.6	1.90	3.51	6.7	15.9	1.98	3.16	6.3				6.3	2.0	2.0	24	7.9	80		
	6B								39.4	6.81	1.90	12.9				12.9	6.8	0.5	48	5.5	450	1.4	
	7B								57.7	25.87	1.48	38.3				38.3	25.9	0.5	66	7.3	750	1.7	
		B1d	2.85	0.50	6.3	1.42	4.55	6.5								6.5	1.4	2.5	18	8.8	50		
		B1e	6.28	0.46	14.5	2.89	3.29	9.5								9.5	2.9	1.5	24	8.0	185	0.4	
	8B	B1b	7.61	0.48	13.8	3.68	3.37	12.4	59.4	33.86	1.45	49.1				49.1	33.9	0.5	6'x5' RCBC 74.16	7.8	100	0.2	
Northeast Storm	OS6b	OS6b	23.13	0.08	23.1	1.76	2.60	4.6								4.6	1.8	1.0	36	5.3	185	0.6	
	OS6a	OS6a	4.84	0.08	13.3	0.37	3.44	1.3					1.3	0.4	1.2					2.2	1150	8.6	
	9B	B6b	2.38	0.49	14.3	1.16	3.32	3.9	23.7	3.29	2.57	8.5				8.5	3.3	1.0	42	6.3	150	0.4	
	10B	B6a	3.65	0.49	13.1	1.77	3.46	6.1	24.1	5.06	2.54	12.9				12.9	5.1	1.0	42	7.1	115	0.3	
	11B	B3b	1.68	0.48	13.7	0.80	3.38	2.7	24.4	5.86	2.53	14.8				14.8	5.9	1.0	42	7.5	150	0.3	
	B1g	B1g	3.31	0.48	11.9	1.60	3.60	5.8					5.8	1.6	2.3					3.0	275	1.5	
	12B	B3a	7.64	0.51	14.7	3.92	3.28	12.9	24.7	11.38	2.51	28.6				28.6	11.4	0.5	60	6.8	225	0.5	
		B1f	1.76	0.65	8.1	1.14	4.19	4.8								4.8	1.1	3.0	18	8.6	50		
	13B								25.2	12.52	2.48	31.0				31.0	12.5	0.5	60	7.0	870	2.1	
		B1a	5.62	0.50	15.3	2.78	3.22	9.0															
		B1c	2.71	0.73	9.3	1.97	3.97	7.8															
	14B								27.3	17.27	2.37	40.9				40.9	17.3	0.5	6'x6' RCBC 81.24	7.3	100	0.2	
Combined Lines	15B								59.7	51.13	1.45	74.1				74.1	51.1	0.5	7'x6' RCBC 87.75	8.6	500	1.0	
	16B	B7	4.23	0.49	6.7	2.06	4.46	9.2								9.2	2.1	1.5	30	7.7	100		
Pond Inflow/Outfall	0B	B0	2.64	0.59	6.1	1.56	4.59	7.2															
		Overall Pond B Inflow							60.6	54.75	1.44	78.8				Per UD-Detention 78.3		0.5	6'x6' RCBC 81.24	8.8			
EURV POND C																							
Southern Storm Line	OS1	OS1	10.85	0.08	13.3	0.82	3.44	2.8					2.8	0.8	7.2					5.4	275	0.9	
	OS2a	OS2a	39.42	0.08	40.6	3.00	1.87	5.6								5.6	3.0	1.0	36	5.7	1190	3.5	
		C1a	2.43	0.70	7.4	1.71	4.32	7.4															
	1C								44.0	5.53	1.77	9.8				9.8	5.5	1.0	48	6.5	157		
North Storm Line	2C	C1b	5.39	0.41	13.6	2.23	3.40	7.6								7.6	2.2	2.0	24	8.2	385	0.8	
Pond Inflow/Outfall	0C	C0	1.74	0.41	10.3	0.72	3.83	2.8															
		Overall Pond C Inflow							44.0	6.25	1.77	11.1				Per UD-Detention 11.1		0.5	42	5.3			

STANDARD FORM SF-3
STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)

Subdivision: Ridgegate
Location: Lone Tree
Design Storm: 5-Year 1-hr Precipitation (in): 1.43

Project Name: Phase II Drainage Report
Project No.: 15950.00
Calculated By: KAU
Date: 7/13/20

Notes:
Street and Pipe C*A values are determined by Q/i using

STREET	Design Point	DIRECT RUNOFF: Basin ID	Area (Ac)	Runoff Coeff.	t_c (min)	C*A (Ac)	I (in/hr)	Q (cfs)	TOTAL RUNOFF: tc (min)	C*A (ac)	I (in/hr)	Q (cfs)	STREET: Q_{street} (cfs)	C*A (ac)	Slope (%)	PIPE: Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (in)	TRAVEL TIME: Velocity (fps)	Length (ft)	t_t (min)	REMARKS
EURV POND D																							
Park Flows	1D	D2	13.34	0.21	23.3	2.82	2.59	7.3								7.3	2.8	1.5	30	7.2	840	1.9	
	2D	D1	8.23	0.24	17.7	1.95	2.99	5.8															
Pond Inflow/Outfall	0D	D0	1.21	0.59	5.0	0.72	4.85	3.5															
		Overall Pond D Inflow							25.3	5.49	2.48	13.6				Per UD-Detention 10.0		0.5	30	5.3			
EURV POND R																							
West Storm Line Connection	1R	R1	4.45	0.67	8.9	2.97	4.04	12.0								12.0	3.0	2.0	24	9.4	175	0.3	
Park Storm Line Connection	2R	R3	14.66	0.22	20.9	3.16	2.75	8.7															
East Storm Line Connection	3R	RC6a	0.75	0.77	5.1	0.58	4.82	2.8								2.8	0.6	4.0	18	8.3	350	0.7	
		R2a	1.87	0.61	5.0	1.14	4.85	5.5															
		R2b	1.18	0.65	6.0	0.77	4.61	3.5															
	R2c	R2c	3.13	0.65	10.8	2.03	3.75	7.6					7.6	2.0	2.3					3.0	250	1.4	
	4R								12.2	3.94	3.57	14.1				14.1	3.9	1.5	30	8.7	75		
	5R								12.2	4.52	3.57	16.1				16.1	4.5	1.5	30	9.0	540	1.0	
	R6b	RC6b	2.29	0.65	6.8	1.49	4.43	6.6								6.6	1.5	2.0	24	8.0	425	0.9	
	6R	RC6c	1.45	0.77	6.5	1.12	4.50	5.0	7.7	2.61	4.26	11.1				11.1	2.6	3.0	30	10.5	165	0.3	
	7R								13.2	7.13	3.44	24.5				24.5	7.1	1.0	36	8.7	300	0.6	
	8R	RC6d	0.66	0.65	6.2	0.43	4.57	2.0	13.8	7.56	3.38	25.6				25.6	7.6	1.0	36	8.8	140	0.3	
	9R	RC6e	0.36	0.65	6.2	0.23	4.57	1.1	14.0	7.79	3.35	26.1				26.1	7.8	1.0	36	8.8	192	0.4	
	10R	RC6f	3.47	0.54	8.4	1.87	4.13	7.7	14.4	9.66	3.31	32.0				32.0	9.7	1.0	36	9.3	300	0.5	
Existing Ridgegate Storm Line		Per Ridgegate Drainage Report (Basin C4)						0.6															
		RC4	0.28	0.53	8.2	0.15	4.17	0.6								Does not exceed Ridgegate Drainage Report Inflows							
		Per Ridgegate Drainage Report (DP C4)						29.7															
	RC4								14.9	9.81	3.25	31.9				Increased Flow (cfs) =			2.2				
		Per Ridgegate Drainage Report (DP C3)						30.5															
	RC3	RC3	1.10	0.47	12.2	0.52	3.57	1.9	14.9	10.33	3.25	33.6				Increased Flow (cfs) =			3.1				
Existing Utility Easement	R8b	RB8b	2.62	0.12	11.5	0.31	3.65	1.1															
Existing Ridgegate Storm Line	RC7	RC7	9.32	0.73	6.7	6.82	4.46	30.4															
		Per Ridgegate Drainage Report (DP C2)						36.2															
	RC2	RC2	3.27	0.29	14.0	0.95	3.35	3.2	14.0	8.08	3.35	27.1				Does not exceed Ridgegate Drainage Report Inflows							
		Per Ridgegate Drainage Report (DP C1)						59.6															
	RC1	RC1	2.33	0.28	9.1	0.66	4.01	2.6	14.9	19.07	3.25	62.0				Increased Flow (cfs) =			2.4				
Future Site	R8a	RB8a	7.82	0.65	5.0	5.08	4.85	24.6															
Existing Ridgegate Storm Line		Per Ridgegate Drainage Report (DP B1)						38.1															
	RB1	RB5	1.96	0.40	7.4	0.78	4.32	3.4	11.5	6.17	3.65	22.5				Does not exceed Ridgegate Drainage Report Inflows							
		Per Ridgegate Drainage Report (DP B2)						87.1															
	RB2	RB6	1.34	0.47	6.0	0.63	4.61	2.9	14.9	25.87	3.25	84.1				Does not exceed Ridgegate Drainage Report Inflows							
		Per Ridgegate Drainage Report (Basin B3)						2.3															
	RB3	RB3	0.28	0.52	6.7	0.15	4.46	0.7								Does not exceed Ridgegate Drainage Report Inflows							
		Per Ridgegate Drainage Report (DP B4)						89.2															
	RB4	RB4	1.00	0.45	7.0	0.45	4.39	2.0	14.9	26.47	3.25	86.0				Does not exceed Ridgegate Drainage Report Inflows							
		Per Ridgegate Drainage Report (Basin B2)						2.0															
		RB2	0.63	0.69	6.4	0.43	4.51	1.9								Does not exceed Ridgegate Drainage Report Inflows							
		Per Ridgegate Drainage Report (DP B5)						3.4															
	RB5	RB1	0.87	0.57	7.6	0.50	4.28	2.1	7.6	0.93	4.28	4.0				Increased Flow (cfs) =			0.6				
		Per Ridgegate Drainage Report (DP B6)						91.7															
	RB6								14.9	27.40	3.25	89.1				Does not exceed Ridgegate Drainage Report Inflows							
Pond Inflow/Outfall	0R	R0	2.95	0.57	5.9	1.69	4.63	7.8															
		Overall Pond R Inflow							20.9	35.22	2.75	96.9				Per UD-Detention 24.6		0.5	60	6.5			
EURV POND E																							
Southern Storm Line	E7	E7	1.64	0.63	5.0	1.03	4.85	5.0															
	E8	E8	3.84	0.47	8.3	1.79	4.14	7.4															
	1E	E5	0.45	0.77	5.0	0.35	4.85	1.7	8.3	3.17	4.14	13.1				13.1	3.2	2.0	24	9.6	350	0.6	
	2E								9.0	3.52	4.04	14.2				14.2	3.5	2.0	24	9.8	290	0.5	
	2E	E6	3.68	0.47	7.8	1.73	4.25	7.4	9.0	4.90	4.04	19.8				19.8	4.9	1.0	42	8.1	925	1.9	
Combined Storm Line	E4	E4	4.77	0.46	10.5	2.21	3.80	8.4								8.4	2.2	2.0	24	8.6	50		
	3E								10.9	7.11	3.74	26.6				26.6	7.1	1.0	36	8.9	525	1.0	
	4E	E3	3.99	0.48	8.7	1.90	4.07	7.7	11.9	9.01	3.61	32.5				32.5	9.0	1.0	42	9.3	900	1.6	
Eastern Storm Line		E2a	2.80	0.77	11.1	2.16	3.71	8.0															
	E2b	E2b	6.80	0.47	17.5	3.22	3.01	9.7					9.7	3.2	2.7					3.3	850	4.3	
		E2c	1.36	0.77	6.4	1.04	4.52	4.7															
	5E								21.8	6.42	2.69	17.3				17.3	6.4	1.5	30	9.3	50		
Park	E1	E1	6.91	0.20	22.6	1.39	2.63	3.7															
Pond Inflow/Outfall	0E	E0	1.70	0.56	5.8	0.96	4.65	4.5															
		Overall Pond E Inflow							22.6	17.78	2.63	46.8				Per UD-Detention 8.9		0.5	36	5.1			

STANDARD FORM SF-3
STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)

Subdivision: Ridgegate
Location: Lone Tree
Design Storm: 5-Year 1-hr Precipitation (in): 1.43

Project Name: Phase II Drainage Report
Project No.: 15950.00
Calculated By: KAU
Date: 7/13/20

Notes:
Street and Pipe C*A values are determined by Q/i using

STREET	Design Point	DIRECT RUNOFF: Basin ID	Area (Ac)	Runoff Coeff.	t_c (min)	C*A (Ac)	I (in/hr)	Q (cfs)	TOTAL RUNOFF: tc (min)	C*A (ac)	I (in/hr)	Q (cfs)	STREET: Q_{street} (cfs)	C*A (ac)	Slope (%)	PIPE: Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (in)	TRAVEL TIME: Velocity (fps)	Length (ft)	t_t (min)	REMARKS
EURV POND F																							
Southern Storm Line	F5	F5	5.38	0.32	7.8	1.70	4.23	7.2								7.2	1.7	1.5	24	7.3	50		
	OS9	OS9	25.01	0.06	19.2	1.49	2.88	4.3					4.2912	1.49	4.8764					4.4	890	3.4	
	F8	F8	1.20	0.77	5.9	0.92	4.62	4.3	22.5	2.41	2.64	6.4				6.4	2.4	1.0	36	5.9	50		
	1F								22.5	4.11	2.64	10.9				10.9	4.1	1.0	36	6.9	600	1.4	
	F7	F7	5.41	0.45	7.0	2.43	4.39	10.7								10.7	2.4	2.0	30	8.9	50		
	2F	F1	11.50	0.46	14.7	5.31	3.28	17.4	14.7	7.74	3.28	25.4				25.4	7.7	1.0	48	8.6	60		
	3F								24.0	11.85	2.55	30.2				30.2	11.9	0.5	48	7.0	750	1.8	
Northern Storm Line	F6	F6	6.69	0.48	11.4	3.21	3.67	11.8								11.8	3.2	1.5	30	8.3	50		
	4F	F4	3.02	0.26	13.7	0.77	3.39	2.6	13.7	3.98	3.39	13.5				13.5	4.0	1.5	30	8.6	600	1.2	
	5F	F3	6.07	0.49	8.9	2.95	4.05	11.9	14.9	6.93	3.26	22.6				22.6	6.9	1.0	36	8.5	300	0.6	
Combined Storm Line	6F								25.7	18.78	2.45	46.0				46.0	18.8	0.5	54	7.9	225	0.5	
	7F	F2	7.82	0.45	11.6	3.53	3.64	12.8	26.2	22.31	2.43	54.2				54.2	22.3	0.5	60	8.2	200	0.4	
Pond Inflow/Outfall	0F	F0	2.53	0.72	5.1	1.81	4.82	8.7															
		Overall Pond F Inflow							26.6	24.12	2.40	57.9				Per UD-Detention 25.6		0.5	66	6.5			
EX WQ POND E																							
Storm Line Connection	R6	RE2b	2.53	0.65	5.6	1.63	4.70	7.7								7.7	1.6	5.0	24	11.5	250	0.4	
	R7	RE2a	5.16	0.65	10.5	3.35	3.79	12.7	10.5	4.98	3.79	18.9				18.9	5.0	3.0	30	12.2	228	0.3	
Existing Ridgegate Storm Line	Per Ridgegate Drainage Report (DP E1) 20.0																						
	RE1	RE1	3.00	0.53	18.2	1.60	2.95	4.7	18.2	6.58	2.95	19.4				Does not exceed Ridgegate Drainage Report Inflows							
	Per Ridgegate Drainage Report (Basin E2-F) 18.3																						
	RE2	RE3	1.58	0.48	11.7	0.76	3.63	2.8								Does not exceed Ridgegate Drainage Report Inflows							
	Per Ridgegate Drainage Report (Basin E4-F) 10.6																						
	RE3	RE4	4.09	0.64	9.4	2.62	3.96	10.4								Does not exceed Ridgegate Drainage Report Inflows							
	Per Ridgegate Drainage Report (DP E2) 29.3																						
	RE4								18.2	9.96	2.95	29.4				Increased Flow (cfs) =			0.1				
Discharge to Pond	Per Ridgegate Drainage Report (Basin E5-F) 21.4																						
	RE5	RE5	4.01	0.63	9.6	2.52	3.94	9.9								Does not exceed Ridgegate Drainage Report Inflows							
Pond Inflow/Outfall	Per Ridgegate Drainage Report (DP E1) 44.7																						
	0E	Overall Ex Pond E Inflow							18.2	12.48	2.95	36.8				Does not exceed Ridgegate Drainage Report Inflows							
OFFSITE																							
Near Happy Canyon	OF1	OF1	2.28	0.77	7.8	1.76	4.23	7.4															
Near Badger Gulch	OF2	OF2	0.65	0.77	5.0	0.50	4.85	2.4															
Into Happy Canyon	OF3	OF3	1.38	0.28	5.5	0.38	4.74	1.8															
Into Happy Canyon	OF4	OF4	0.57	0.40	5.0	0.23	4.85	1.1															
Into Happy Canyon	OF5	OF5	0.87	0.32	5.2	0.28	4.81	1.3															
Into Happy Canyon	OF6	OF6	0.33	0.40	5.0	0.13	4.85	0.6															
Into Badger Gulch	OF7	OF7	1.40	0.36	5.0	0.51	4.85	2.5															
Into Badger Gulch	OF8	OF8	1.33	0.36	5.0	0.48	4.85	2.3															

STANDARD FORM SF-3
STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)

Subdivision: Ridgegate
Location: Lone Tree
Design Storm: 100-Year 1-hr Precipitation (in): 2.60

Project Name: Phase II Drainage Report
Project No.: 15950.00
Calculated By: KAU
Date: 7/13/20

Notes:
Street and Pipe C*A values are determined by Q/i using

STREET	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET			PIPE				TRAVEL TIME			REMARKS
		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 (in)	Velocity (fps)	Length (ft)	t_t (min)	
EURV POND A																							
Northeast Storm Line		A12a	0.63	0.85	5.0	0.54	8.82	4.8															
		A12b	1.16	0.85	5.0	0.99	8.82	8.7															
	A12c	A12c	2.83	0.71	12.4	2.01	6.43	12.9					12.9	2.01	2.4					3.1	230	1.2	
	A12d	A12d	4.77	0.70	15.0	3.36	5.91	19.9					19.9	3.36	2.4					3.1	80	0.4	
	1A								15.4	6.90	5.83	40.2				40.2	6.9	1.5	30	11.4	1330	1.9	
	2A	A10	14.64	0.71	17.7	10.47	5.45	57.1								57.1	10.5	1.5	30	11.6	240	0.3	
	3A								18.0	17.37	5.39	93.6				93.6	17.4	1.0	42	11.9	44		
		A11a	2.14	0.85	6.4	1.83	8.23	15.1															
	A11b	A11b	5.46	0.75	13.3	4.12	6.24	25.7					25.7	4.12	2.8					3.4	315	1.6	
	A11c	A11c	5.76	0.71	9.4	4.09	7.22	29.5					29.5	4.09	2.9					3.4	300	1.5	
	4A								18.0	27.41	5.39	147.7				147.7	27.4	0.5	48	11.8	1515	2.1	
Southwest Storm Line		A15	2.74	0.76	9.0	2.08	7.34	15.3								15.3	2.1	2.0	24	10.0	220	0.4	
		A13a	0.86	0.85	5.0	0.73	8.82	6.4															
		A13b	0.85	0.85	5.0	0.73	8.82	6.4															
		A14	13.90	0.56	15.8	7.85	5.76	45.2								45.2	7.9	1.5	30	11.6	25		
	5A								15.8	11.39	5.76	65.6				65.6	11.4	1.0	42	11.1	1385	2.1	
	OS7b	OS7b	6.56	0.50	22.7	3.31	4.78	15.8								15.8	3.3	2.0	24	10.1	700	1.2	
	OS8	OS8	5.68	0.51	21.3	2.89	4.95	14.3								14.3	2.9	3.0	18	11.3	555	0.8	
	6A	A8	12.71	0.65	11.9	8.29	6.56	54.4	23.8	14.49	4.65	67.4				67.4	14.5	1.0	42	11.2	440	0.7	
	7A								24.5	25.88	4.58	118.5				118.5	25.9	0.5	48	9.4	455	0.8	
		A9a	4.31	0.82	9.3	3.53	7.23	25.5															
		A9b	6.79	0.65	13.8	4.42	6.13	27.1															
	8A								25.3	33.83	4.50	152.2				152.2	33.8	0.5	66	10.6	50		
	9A	A7	5.38	0.71	11.4	3.82	6.66	25.4								25.4	3.8	2.0	24	11.3	300	0.4	
		A6a	5.03	0.79	14.9	3.96	5.93	23.5															
		A6b	2.82	0.83	5.0	2.35	8.82	20.7								20.7	2.4	2.5	24	11.7	100	0.1	
	A6c	A6c	2.24	0.71	13.8	1.59	6.13	9.7					9.7	1.59	3.5439					3.8	1070	4.7	
	10A								18.6	7.90	5.31	41.9				41.9	7.9	1.0	30	9.5	50		
	11A								25.3	41.73	4.50	187.8				187.8	41.7	0.5	66	11.1	565	0.8	
	OS7a	OS7a	6.75	0.50	14.0	3.40	6.09	20.7					20.7	3.4	7.718					5.6	1000	3.0	
	A6d	A6d	10.83	0.71	15.4	7.69	5.83	44.8	17.0	11.09	5.55	61.5				61.5	11.1	1.0	42	11.0	950	1.4	
	A5	A5	8.14	0.79	7.6	6.44	7.78	50.1															
	12A								18.5	17.53	5.33	93.4				93.4	17.5	1.0	42	11.9	225	0.3	
		A3c	1.23	0.79	7.7	0.97	7.74	7.5								7.5	1.0	4.0	18	10.9	50		
	13A								18.5	18.50	5.33	98.6				98.6	18.5	0.5	42	10.3	960	1.6	
	14A	A4	6.96	0.81	9.7	5.60	7.12	39.9								39.9	5.6	1.5	42	11.4	250	0.4	
	15A								20.0	24.10	5.11	123.2				123.2	24.1	0.5	48	9.8	165	0.3	
	A3a	A3a	2.04	0.79	7.9	1.61	7.69	12.4					12.4	1.61	5.3714					4.6	70	0.3	
		A3b	8.57	0.71	17.3	6.06	5.50	33.3															
	16A								20.3	31.77	5.07	161.1				161.1	31.8	0.5	42	16.8	50		
	17A								26.1	73.50	4.42	324.9				324.9	73.5	0.5	72	11.5	215	0.3	
		A2a	1.40	0.66	8.1	0.93	7.62	7.1															
		A2b	2.68	0.74	8.8	1.99	7.38	14.7															
	18A								26.4	76.42	4.39	335.5				335.5	76.4	0.5	72	11.9	1265	1.8	
Pond Inflow/Outfall	19A	A1	6.58	0.55	27.6	3.65	4.28	15.6								15.6	3.7	2.0	24	10.1	280	0.5	
	0A	A0	3.10	0.76	7.0	2.34	8.00	18.7															
		Overall Pond A Inflow							28.2	109.82	4.23	464.5				Per UD-Detention 413.3		0.5	6'x6' RCBC 81.24	13.1		89%	= Outfall % of Pond Inflow (cfs)

STANDARD FORM SF-3
STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)

Subdivision: Ridgegate
Location: Lone Tree
Design Storm: 100-Year 1-hr Precipitation (in): 2.60

Project Name: Phase II Drainage Report
Project No.: 15950.00
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Date: 7/13/20

Notes:
Street and Pipe C*A values are determined by Q/i using

STREET	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET			PIPE				TRAVEL TIME			REMARKS
		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 (in)	Velocity (fps)	Length (ft)	t_t (min)	
EURV POND B																							
Southwest Storm Line	OS2b	OS2b	1.81	0.50	11.8	0.91	6.56	6.0					6.0	0.91	4.6429					4.3	560	2.2	
	B5d	B5d	3.76	0.71	8.0	2.67	7.65	20.4	14.0	3.58	6.09	21.8				20.4	2.7	2.0	24	10.8	950	1.5	
	B5a	B5a	5.60	0.68	18.1	3.80	5.38	20.4								20.4	3.8	2.0	24	10.8	50		
	B5c	B5c	3.83	0.69	14.5	2.64	5.99	15.8								15.8	2.6	2.0	24	10.1	50		
	1B								18.1	10.02	5.38	53.9				53.9	10.0	1.0	30	11.0	260	0.4	
	2B	B5b	5.20	0.78	13.0	4.05	6.31	25.6	18.5	14.07	5.33	75.0				75.0	14.1	1.0	36	10.6	230	0.4	
	OS3	OS3	72.31	0.50	52.4	36.29	2.88	104.5								104.5	36.3	0.5	42	10.9	480	0.7	
	OS4a	OS4a	3.10	0.46	20.8	1.43	5.01	7.2															
	3B								53.1	37.72	2.85	107.5				107.5	37.7	0.5	48	9.2	50		
	4B								53.1	43.49	2.85	123.9				123.9	43.5	0.5	48	9.9	750	1.3	
	OS4b	OS4b	3.04	0.50	13.6	1.53	6.17	9.4					9.4	1.53	4.1556					4.1	900	3.7	
	B2	B2	8.15	0.71	8.8	5.77	7.39	42.6	17.3	7.30	5.50	40.2				40.2	7.3	1.0	30	9.5	50		
	5B								54.4	50.79	2.81	142.7				142.7	50.8	0.5	54	10.0	750	1.3	
	OS5a	OS5a	1.90	0.50	13.8	0.96	6.14	5.9					5.9	0.96	3.5067					3.7	600	2.7	
	OS5c	OS5c	2.48	0.50	16.6	1.25	5.63	7.0								7.0	1.3	3.0	18	9.6	50		
	OS5b	OS5b	59.27	0.50	39.4	29.87	3.45	103.1								103.1	29.9	0.5	42	10.7	50		
	OS5d	OS5d	1.11	0.50	13.5	0.56	6.19	3.5					3.5	0.56	1.6083					2.5	360	2.4	
	B4	B4	4.08	0.70	12.6	2.85	6.39	18.2	15.9	3.41	5.75	19.6				19.6	3.4	2.0	24	10.7	80		
	6B								39.4	35.49	3.45	122.4				122.4	35.5	0.5	48	9.8	450	0.8	
	7B								55.7	86.28	2.76	238.1				238.1	86.3	0.5	66	11.4	750	1.1	
		B1d	2.85	0.71	6.3	2.04	8.27	16.9								16.9	2.0	2.5	18	10.7	50		
		B1e	6.28	0.69	14.5	4.35	5.99	26.1								26.1	4.4	1.5	24	10.0	185	0.3	
	8B	B1b	7.61	0.70	13.8	5.36	6.13	32.9	56.7	98.03	2.73	267.6				267.6	98.0	0.5	6'x5' RCBC 74.16	12.1	100		
Northeast Storm Line	OS6b	OS6b	23.13	0.50	23.1	11.66	4.73	55.2								55.2	11.7	1.0	36	10.6	185	0.3	
	OS6a	OS6a	4.84	0.50	13.3	2.44	6.25	15.3					15.3	2.44	1.2391					2.2	1150	8.6	
	9B	B6b	2.38	0.71	14.3	1.69	6.03	10.2	23.4	15.79	4.70	74.2				74.2	15.8	1.0	42	11.4	150	0.2	
	10B	B6a	3.65	0.71	13.1	2.59	6.29	16.3	23.6	18.38	4.68	86.0				86.0	18.4	1.0	42	11.8	115	0.2	
	11B	B3b	1.68	0.70	13.7	1.18	6.15	7.3	23.8	19.56	4.66	91.1				91.1	19.6	1.0	42	11.9	150	0.2	
	B1g	B1g	3.31	0.71	11.9	2.34	6.54	15.3					15.3	2.34	2.32					3.0	275	1.5	
	12B	B3a	7.64	0.72	14.7	5.51	5.97	32.9	24.0	27.41	4.64	127.2				127.2	27.4	0.5	60	10.1	225	0.4	
		B1f	1.76	0.79	8.1	1.39	7.61	10.6								10.6	1.4	3.0	18	10.7	50		
	13B								24.4	28.80	4.60	132.5				132.5	28.8	0.5	60	10.2	870	1.4	
		B1a	5.62	0.71	15.3	4.00	5.85	23.4															
		B1c	2.71	0.83	9.3	2.25	7.22	16.2															
	14B								25.8	35.05	4.45	156.0				156.0	35.1	0.5	6'x6' RCBC 81.24	10.7	100		
Combined Lines	15B								56.7	133.08	2.73	363.3				363.3	133.1	0.5	7'x6' RCBC 87.75	13.2	500	0.6	
	16B	B7	4.23	0.71	6.7	3.01	8.11	24.4								24.4	3.0	1.5	30	10.2	100		
Pond Inflow/Outfall	0B	B0	2.64	0.76	6.1	2.01	8.34	16.8															
		Overall Pond B Inflow							57.4	138.10	2.71	374.3				Per UD-Detention 371.4		0.5	6'x6' RCBC 81.24	13.0		99%	= Outfall % of Pond Inflow (cfs)
EURV POND C																							
Southern Storm Line	OS1	OS1	10.85	0.50	13.3	5.47	6.25	34.2					34.2	5.47	7.1564					5.4	275	0.9	
	OS2a	OS2a	39.42	0.50	40.6	19.87	3.39	67.4								67.4	19.9	1.0	36	10.8	1190	1.8	
		C1a	2.43	0.82	7.4	1.99	7.86	15.6															
	1C								42.4	27.33	1.81	49.5				49.5	27.3	1.0	48	10.4	157	0.3	
North Storm Line	2C	C1b	5.39	0.67	13.6	3.63	6.18	22.4								22.4	3.6	2.0	24	11.0	385	0.6	
Pond Inflow/Outfall	0C	C0	1.74	0.67	10.3	1.17	6.96	8.1															
		Overall Pond C Inflow							42.7	28.50	3.29	93.8				Per UD-Detention 83.2		0.5	42	8.7		89%	= Outfall % of Pond Inflow (cfs)
EURV POND D																							
Park Flows	1D	D2	13.34	0.56	23.3	7.50	4.71	35.3								35.3	7.5	1.5	30	11.1	840	1.3	
	2D	D1	8.23	0.58	17.7	4.80	5.44	26.1															
Pond Inflow/Outfall	0D	D0	1.21	0.76	5.0	0.92	8.82	8.1															
		Overall Pond D Inflow							24.6	13.22	4.57	60.4				Per UD-Detention 59.9		0.5	30	12.2		99%	= Outfall % of Pond Inflow (cfs)

STANDARD FORM SF-3
STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)

Subdivision: Ridgegate
Location: Lone Tree
Design Storm: 100-Year 1-hr Precipitation (in): 2.60

Project Name: Phase II Drainage Report
Project No.: 15950.00
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Notes:
Street and Pipe C*A values are determined by Q/i using

STREET	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET			PIPE				TRAVEL TIME			REMARKS
		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 (in)	Velocity (fps)	Length (ft)	t_t (min)	
EURV POND R																							
West Storm Line Connection	1R	R1	4.45	0.80	8.9	3.56	7.35	26.2								26.2	3.6	2.0	24	11.3	175	0.3	
Park Storm Line Connection	2R	R3	14.66	0.57	20.9	8.34	5.00	41.7															
East Storm Line Connection	3R	RC6a	0.75	0.85	5.1	0.64	8.76	5.6								5.6	0.6	4.0	18	10.0	350	0.6	
		R2a	1.87	0.77	5.0	1.44	8.82	12.7															
		R2b	1.18	0.79	6.0	0.93	8.37	7.8															
	R2c	R2c	3.13	0.79	10.8	2.47	6.82	16.8					16.8	2.47	2.3					3.0	250	1.4	
	4R								12.2	4.84	6.48	31.4				31.4	4.8	1.5	30	10.8	75	0.1	
	5R								12.3	5.48	6.46	35.4				35.4	5.5	1.5	30	11.1	540	0.8	
	R6b	RC6b	2.29	0.79	6.8	1.81	8.06	14.6								14.6	1.8	2.0	24	9.9	425	0.7	
	6R	RC6c	1.45	0.85	6.5	1.24	8.17	10.1	7.5	3.05	7.80	23.8				10.1	1.2	3.0	30	10.2	165	0.3	
	7R								13.1	8.53	6.28	53.6				53.6	8.5	1.0	36	10.5	300	0.5	
	8R	RC6d	0.66	0.79	6.2	0.52	8.31	4.3	13.6	9.05	6.18	55.9				55.9	9.1	1.0	36	10.6	140	0.2	
	9R	RC6e	0.36	0.79	6.2	0.28	8.31	2.3	13.8	9.33	6.13	57.2				57.2	9.3	1.0	36	10.6	192	0.3	
	10R	RC6f	3.47	0.74	8.4	2.55	7.51	19.2	14.1	11.88	6.07	72.1				72.1	11.9	1.0	36	10.2	300	0.5	
Existing Ridgegate Storm Line		Per Ridgegate Drainage Report (Basin C4)						1.5															
		RC4	0.28	0.73	8.2	0.21	7.59	1.6								Does not exceed Ridgegate Drainage Report Inflows							
	RC4	Per Ridgegate Drainage Report (DP C4)						86.3															
									14.6	12.09	5.98	72.3				Does not exceed Ridgegate Drainage Report Inflows							
	RC3	Per Ridgegate Drainage Report (DP C3)						89.1															
		RC3	1.10	0.70	12.2	0.77	6.49	5.0	14.6	12.86	5.98	76.9				Does not exceed Ridgegate Drainage Report Inflows							
Existing Utility Easement	R8b	RB8b	2.62	0.52	11.5	1.38	6.64	9.2															
Existing Ridgegate Storm Line	RC7	RC7	9.32	0.83	6.7	7.75	8.12	62.9															
	RC2	Per Ridgegate Drainage Report (DP C2)						80.4															
		RC2	3.27	0.61	14.0	2.00	6.09	12.2	14.0	11.13	6.09	67.8				Does not exceed Ridgegate Drainage Report Inflows							
	RC1	Per Ridgegate Drainage Report (DP C1)						160.0															
		RC1	2.33	0.61	9.1	1.42	7.30	10.4	14.6	25.41	5.98	152.0				Does not exceed Ridgegate Drainage Report Inflows							
Future Site	R8a	RB8a	7.82	0.79	5.0	6.19	8.82	54.6															
Existing Ridgegate Storm Line	RB1	Per Ridgegate Drainage Report (DP B1)						79.1															
		RB5	1.96	0.67	7.4	1.31	7.86	10.3	11.5	8.88	6.64	59.0				Does not exceed Ridgegate Drainage Report Inflows							
	RB2	Per Ridgegate Drainage Report (DP B2)						219.2															
		RB6	1.34	0.70	6.0	0.94	8.38	7.9	14.6	35.23	5.98	210.7				Does not exceed Ridgegate Drainage Report Inflows							
	RB3	Per Ridgegate Drainage Report (Basin B3)						5.9															
		RB3	0.28	0.73	6.7	0.20	8.11	1.6															
	RB4	Per Ridgegate Drainage Report (DP B4)						225.9															
		RB4	1.00	0.69	7.0	0.69	7.98	5.5	14.6	36.12	5.98	216.0				Does not exceed Ridgegate Drainage Report Inflows							
		Per Ridgegate Drainage Report (Basin B2)						2.0															
		RB2	0.63	0.81	6.4	0.51	8.21	4.2															
	RB5	Per Ridgegate Drainage Report (DP B5)						10.3															
		RB1	0.87	0.75	7.6	0.65	7.78	5.1	7.6	1.16	7.78	9.0				Does not exceed Ridgegate Drainage Report Inflows							
	RB6	Per Ridgegate Drainage Report (DP B6)						234.3															
									14.6	37.28	5.98	222.9				Does not exceed Ridgegate Drainage Report Inflows							
Pond Inflow/Outfall	0R	R0	2.95	0.75	5.9	2.22	8.43	18.7															
		Overall Pond R Inflow							20.9	51.40	5.00	257.0				Per UD-Detention 227.2		0.5	60	11.6		88%	= Outfall % of Pond Inflow (cfs)
EURV POND E																							
Southern Storm Line	E7	E7	1.64	0.78	5.0	1.28	8.82	11.3															
	E8	E8	3.84	0.70	8.3	2.68	7.53	20.2															
	1E	E5	0.45	0.85	5.0	0.38	8.82	3.4	8.3	4.34	7.53	32.7				32.7	4.3	2.0	24	11.6	350	0.5	
	2E								8.8	4.72	7.37	34.8				34.8	4.7	2.0	24	11.1	290	0.4	
	2E	E6	3.68	0.70	7.8	2.56	7.73	19.8	8.8	6.90	7.37	50.9				50.9	6.9	1.0	42	10.5	925	1.5	
	E4	E4	4.77	0.69	10.5	3.31	6.90	22.8								22.8	3.3	2.0	24	11.1	50		
Combined Storm Line	3E								10.5	10.21	6.90	70.4				70.4	10.2	1.0	36	10.7	525	0.8	
	4E	E3	3.99	0.70	8.7	2.81	7.41	20.8	11.3	13.02	6.69	87.1				87.1	13.0	1.0	42	11.8	900	1.3	
Eastern Storm Line		E2a	2.80	0.85	11.1	2.38	6.74	16.0															
	E2b	E2b	6.80	0.70	17.5	4.77	5.48	26.1					26.1	4.77	2.7259					3.3	850	4.3	
		E2c	1.36	0.85	6.4	1.15	8.22	9.5															
	5E								21.8	8.30	4.89	40.6				40.6	8.3	1.5	30	11.3	50		
Park	E1	E1	6.91	0.55	22.6	3.81	4.79	18.2															
Pond Inflow/Outfall	0E	E0	1.70	0.75	5.8	1.27	8.45	10.7															
		Overall Pond E Inflow							22.6	26.40	4.79	126.5				Per UD-Detention 120.0		0.5	36	17.0		95%	= Outfall % of Pond Inflow (cfs)

STANDARD FORM SF-3
STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)

Subdivision: Ridgegate
Location: Lone Tree
Design Storm: 100-Year 1-hr Precipitation (in): 2.60

Project Name: Phase II Drainage Report
Project No.: 15950.00
Calculated By: KAU
Date: 7/13/20

Notes:
Street and Pipe C*A values are determined by Q/i using

STREET	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET			PIPE				TRAVEL TIME			REMARKS
		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 (in)	Velocity (fps)	Length (ft)	t_t (min)	
EURV POND F																							
Southern Storm Line	F5	F5	5.38	0.62	7.8	3.32	7.70	25.6								25.6	3.3	1.5	24	10.0	50		
	OS9	OS9	25.01	0.48	19.2	12.08	5.23	63.2					63.178	12.1	4.9					4.4	890	3.4	
	F8	F8	1.20	0.85	5.9	1.02	8.40	8.6	22.5	13.10	4.80	62.9				62.9	13.1	1.0	36	10.7	50		
	1F								22.5	16.42	4.80	78.8				78.8	16.4	1.0	36	11.2	600	0.9	
	F7	F7	5.41	0.68	7.0	3.70	7.98	29.5								29.5	3.7	2.0	30	11.8	50		
	2F	F1	11.50	0.69	14.7	7.97	5.96	47.5	14.7	11.67	5.96	69.6				69.6	11.7	1.0	48	11.4	60		
	3F								23.4	28.09	4.70	132.0				132.0	28.1	0.5	48	10.5	750	1.2	
Northern Storm Line	F6	F6	6.69	0.71	11.4	4.73	6.68	31.6								31.6	4.7	1.5	30	10.8	50		
	4F	F4	3.02	0.58	13.7	1.76	6.16	10.8	13.7	6.49	6.16	40.0				40.0	6.5	1.5	30	11.3	600	0.9	
	5F	F3	6.07	0.71	8.9	4.31	7.36	31.7	14.6	10.80	5.98	64.6				64.6	6.0	1.0	36	10.7	300	0.5	
Combined Storm Line	6F								24.6	38.89	4.57	177.7				177.7	4.6	0.5	54	11.2	225	0.3	
	7F	F2	7.82	0.69	11.6	5.37	6.61	35.5	24.9	44.26	4.54	200.9				200.9	4.5	0.5	60	10.2	200	0.3	
Pond Inflow/Outfall	0F	F0	2.53	0.82	5.1	2.08	8.77	18.2															
		Overall Pond F Inflow							25.3	46.34	4.50	208.5				Per UD-Detention 199.4		0.5	66	11.2		96%	= Outfall % of Pond Inflow (cfs)
EX WQ POND E																							
Storm Line Connection	R6	RE2b	2.53	0.79	5.6	2.00	8.55	17.1								17.1	2.0	5.0	24	14.3	250	0.3	
	R7	RE2a	5.16	0.79	10.5	4.08	6.89	28.1	10.5	6.08	6.89	41.9				41.9	6.1	3.0	30	15.1	228	0.3	
Existing Ridgegate Storm Line	Per Ridgegate Drainage Report (DP E1)											45.2											
	RE1	RE1	3.00	0.73	18.2	2.20	5.36	11.8	18.2	8.28	5.36	44.4				Does not exceed Ridgegate Drainage Report Inflows							
	Per Ridgegate Drainage Report (Basin E2-F)							40.6															
	RE2	RE3	1.58	0.71	11.7	1.11	6.60	7.3								Does not exceed Ridgegate Drainage Report Inflows							
	Per Ridgegate Drainage Report (Basin E4-F)							23.6															
	RE3	RE4	4.09	0.79	9.4	3.21	7.20	23.1								Does not exceed Ridgegate Drainage Report Inflows							
	Per Ridgegate Drainage Report (DP E2)											67.3											
	RE4								18.2	12.60	5.36	67.5				Increased Flow (cfs) =			0.2				
Discharge to Pond	Per Ridgegate Drainage Report (Basin E5-F)							47.3															
	RE5	RE5	4.01	0.78	9.6	3.12	7.16	22.3								Does not exceed Ridgegate Drainage Report Inflows							
Pond Inflow/Outfall	Per Ridgegate Drainage Report (DP E2)											102.9											
	Overall Ex Pond E Inflow								18.2	15.72	5.36	84.3				Does not exceed Ridgegate Drainage Report Inflows							
OFFSITE																							
Near Happy Canyon	OF1	OF1	2.28	0.85	7.8	1.94	7.70	14.9															
Near Badger Gulch	OF2	OF2	0.65	0.85	5.0	0.55	8.82	4.9															
Into Happy Canyon	OF3	OF3	1.38	0.60	5.5	0.83	8.62	7.2															
Into Happy Canyon	OF4	OF4	0.57	0.67	5.0	0.38	8.82	3.4															
Into Happy Canyon	OF5	OF5	0.87	0.62	5.2	0.54	8.74	4.7															
Into Happy Canyon	OF6	OF6	0.33	0.67	5.0	0.22	8.82	1.9															
Into Badger Gulch	OF7	OF7	1.40	0.64	5.0	0.89	8.82	7.8															
Into Badger Gulch	OF8	OF8	1.33	0.64	5.0	0.85	8.82	7.5															

APPENDIX D

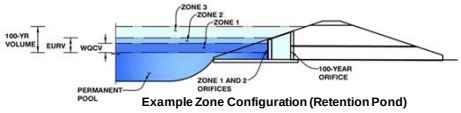
POND CALCULATIONS

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.03 (May 2020)

Project: PHASE II DRAINAGE REPORT FOR THE RIDGEGATE DEVELOPMENT

Basin ID: EURV POND A



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB	
Watershed Area =	165.5	acres
Watershed Length =	4,500	ft
Watershed Length to Centroid =	2,200	ft
Watershed Slope =	0.06	ft/ft
Watershed Imperviousness =	50%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	4.0%	percent
Percentage Hydrologic Soil Groups C/D =	96.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	Lone Tree - Municipal Court	

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) =	2.845	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	7.869	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.06 in.) =	7.494	acre-feet	1.06	inches
5-yr Runoff Volume (P1 = 1.43 in.) =	12.118	acre-feet	1.43	inches
10-yr Runoff Volume (P1 = 1.66 in.) =	15.236	acre-feet	1.66	inches
25-yr Runoff Volume (P1 = 1.68 in.) =	16.044	acre-feet		inches
50-yr Runoff Volume (P1 = 2.26 in.) =	24.262	acre-feet	2.26	inches
100-yr Runoff Volume (P1 = 2.6 in.) =	29.672	acre-feet	2.60	inches
500-yr Runoff Volume (P1 = 3.07 in.) =	36.525	acre-feet		inches
Approximate 2-yr Detention Volume =	6.147	acre-feet		
Approximate 5-yr Detention Volume =	9.771	acre-feet		
Approximate 10-yr Detention Volume =	11.148	acre-feet		
Approximate 25-yr Detention Volume =	10.687	acre-feet		
Approximate 50-yr Detention Volume =	13.244	acre-feet		
Approximate 100-yr Detention Volume =	15.465	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	2.845	acre-feet
Zone 2 Volume (EURV - Zone 1) =	5.025	acre-feet
Select Zone 3 Storage Volume (Optional) =		acre-feet
Total Detention Basin Volume =	7.869	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_{LW}) =	user	

Total detention volume is less than 100-year volume.

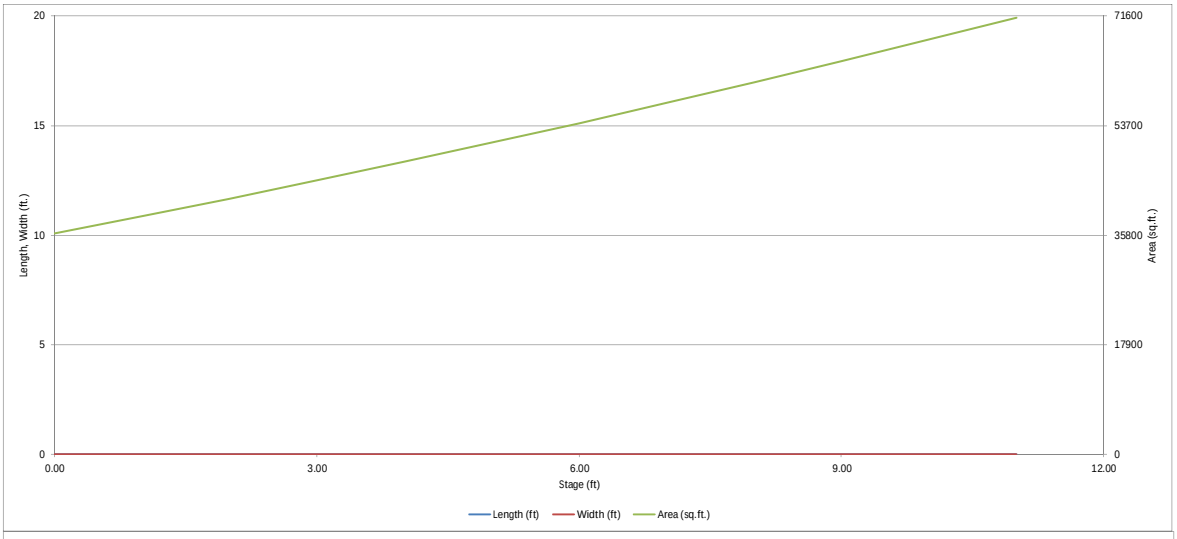
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	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

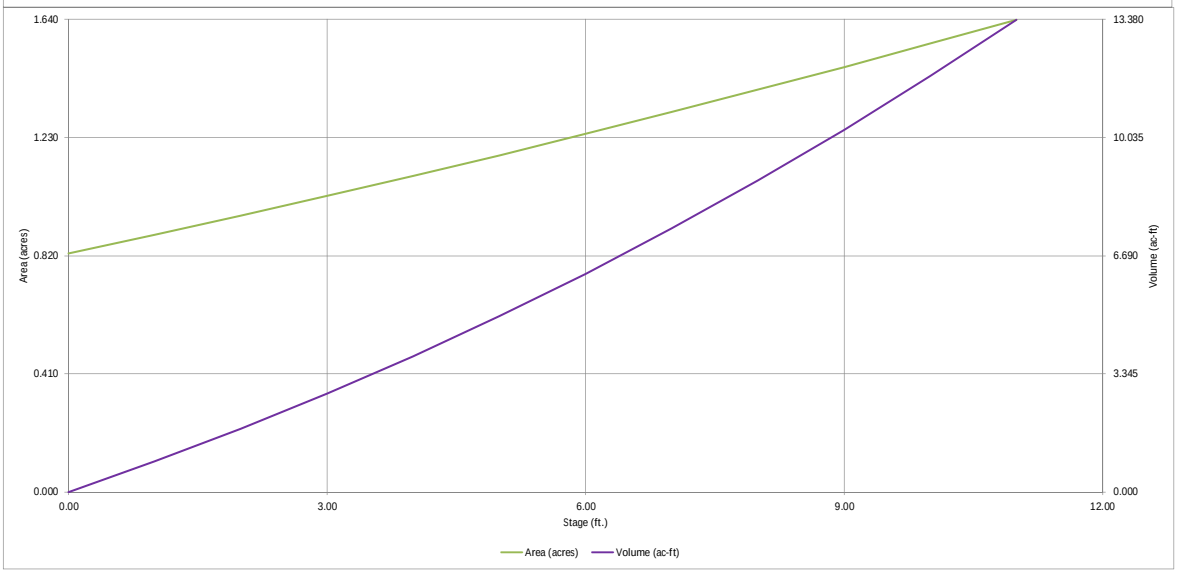
Depth Increment = ft

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	--	--	--	36,062	0.828		
5974	--	1.00	--	--	--	38,871	0.892	37,466	0.860
5975	--	2.00	--	--	--	41,761	0.959	77,782	1.786
5976	--	3.00	--	--	--	44,731	1.027	121,028	2.778
5977	--	4.00	--	--	--	47,782	1.097	167,285	3.840
5978	--	5.00	--	--	--	50,912	1.169	216,632	4.973
5979	--	6.00	--	--	--	54,124	1.243	269,150	6.179
5980	--	7.00	--	--	--	57,415	1.318	324,919	7.459
5981	--	8.00	--	--	--	60,787	1.395	384,020	8.816
5982	--	9.00	--	--	--	64,240	1.475	446,534	10.251
5983	--	10.00	--	--	--	67,773	1.556	512,540	11.766
5984	--	11.00	--	--	--	71,386	1.639	582,120	13.364

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.03 (May 2020)



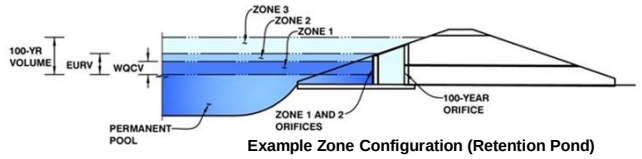


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.03 (May 2020)

Project: PHASE II DRAINAGE REPORT FOR THE RIDGEGATE DEVELOPMENT

Basin ID: EURV POND A



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.07	2.845	Orifice Plate
Zone 2 (EURV)	7.31	5.025	Circular Orifice
Zone 3			Weir&Pipe (Rect.)
Total (all zones)		7.869	

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 = 3.03 ft (relative to basin bottom at Stage = 0 ft)

Orifice Plate: Orifice Vertical Spacing = 12.10 inches

Orifice Plate: Orifice Area per Row = N/A inches

Calculated Parameters for Plate

WQ Orifice Area per Row = N/A ft^2

Elliptical Half-Width = N/A feet

Elliptical Slot Centroid = N/A feet

Elliptical Slot Area = N/A ft^2

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00							
Orifice Area (sq. inches)	25.00							

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

User Input: Vertical Orifice (Circular or Rectangular)

	Zone 2 Circular	Not Selected	
Invert of Vertical Orifice =			ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =			ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter =			inches

Calculated Parameters for Vertical Orific

	Zone 2 Circular	Not Selected
Vertical Orifice Area =		
Vertical Orifice Centroid =		

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	
Overflow Weir Front Edge Height, Ho =	7.31	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	50.00	N/A	feet
Overflow Weir Grate Slope =	0.00	N/A	H:V
Horiz. Length of Weir Sides =	6.00	N/A	feet
Overflow Grate Open Area % =	70%	N/A	%, grate open area/total area
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Wei

	Zone 3 Weir	Not Selected
Height of Grate Upper Edge, H_t =	7.31	N/A
Overflow Weir Slope Length =	6.00	N/A
Grate Open Area / 100-yr Orifice Area =	5.83	N/A
Overflow Grate Open Area w/o Debris =	210.00	N/A
Overflow Grate Open Area w/ Debris =	105.00	N/A

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

	Zone 3 Rectangular	Not Selected	
Depth to Invert of Outlet Pipe =	0.54	N/A	ft (distance below basin bottom at Stage = 0 ft)
Rectangular Orifice Width =	72.00	N/A	inches
Rectangular Orifice Height =	72.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plat

	Zone 3 Rectangular	Not Selected
Outlet Orifice Area =	36.00	N/A
Outlet Orifice Centroid =	3.00	N/A
Half-Central Angle of Restrictor Plate on Pipe =	N/A	N/A

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage= 9.00 ft (relative to basin bottom at Stage = 0 ft)

Spillway Crest Length = feet

Spillway End Slopes = H:V

Freeboard above Max Water Surface = feet

Calculated Parameters for Spillway

Spillway Design Flow Depth= feet

Stage at Top of Freeboard = feet

Basin Area at Top of Freeboard = acres

Basin Volume at Top of Freeboard = acre-ft

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
One-Hour Rainfall Depth (in) =	N/A	N/A	1.06	1.43	1.66	1.68	2.26	2.60
CUHP Runoff Volume (acre-ft) =	2.845	7.869	7.494	12.118	15.236	16.044	24.262	29.672
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	7.494	12.118	15.236	16.044	24.262	29.672
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	16.2	61.7	87.1	109.3	192.3	249.3
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A						
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.10	0.37	0.53	0.66	1.16	1.51
Peak Inflow Q (cfs) =	N/A	N/A	116.5	192.6	236.8	258.5	391.5	473.0
Peak Outflow Q (cfs) =	1.5	2.3	2.2	66.9	113.3	159.6	321.0	413.3
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	1.1	1.3	1.5	1.7	1.7
Structure Controlling Flow =	Plate	Overflow Weir 1	Plate	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	0.3	0.5	0.7	1.5	2.0
Max Velocity through Grate 2 (fps) =	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	65	64	65	63	62	58	56
Time to Drain 99% of Inflow Volume (hours) =	41	70	69	71	70	70	68	66
Maximum Ponding Depth (ft) =	3.07	7.31	6.75	7.73	7.91	8.06	8.51	8.74
Area at Maximum Ponding Depth (acres) =	1.03	1.34	1.30	1.37	1.39	1.40	1.44	1.45
Maximum Volume Stored (acre-ft) =	2.850	7.871	7.119	8.428	8.677	8.900	9.538	9.856

ie

ft^2
feet

ir

feet
feet

ft^2
ft^2

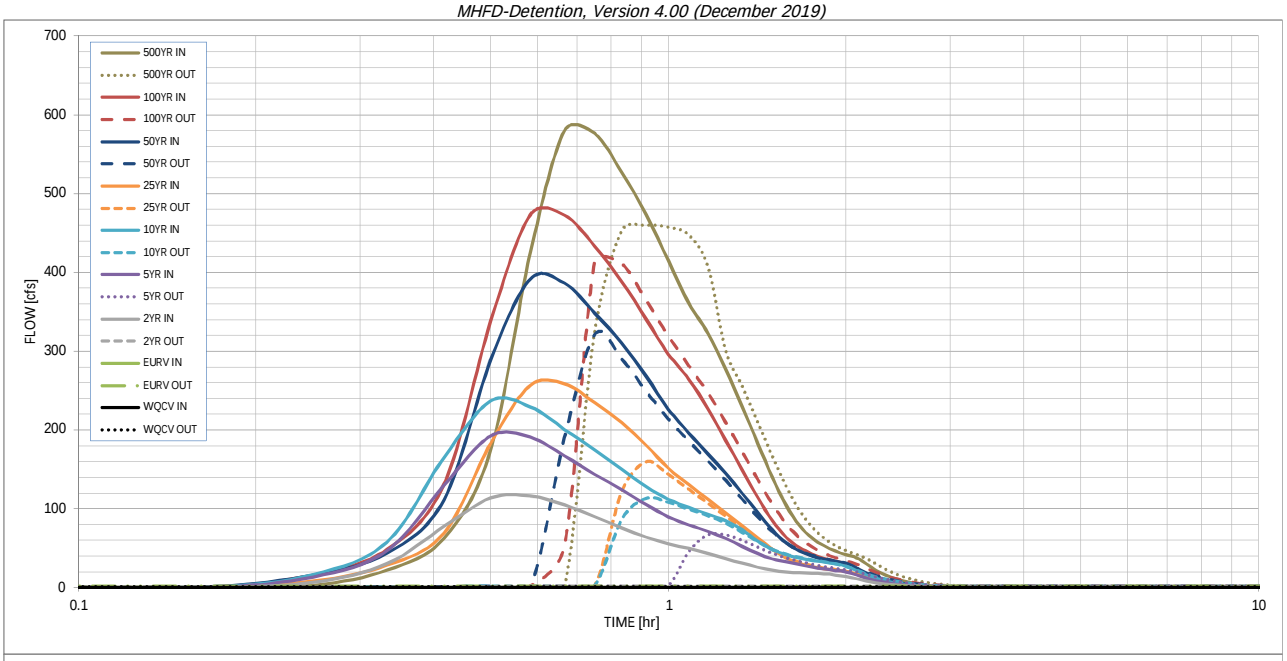
te

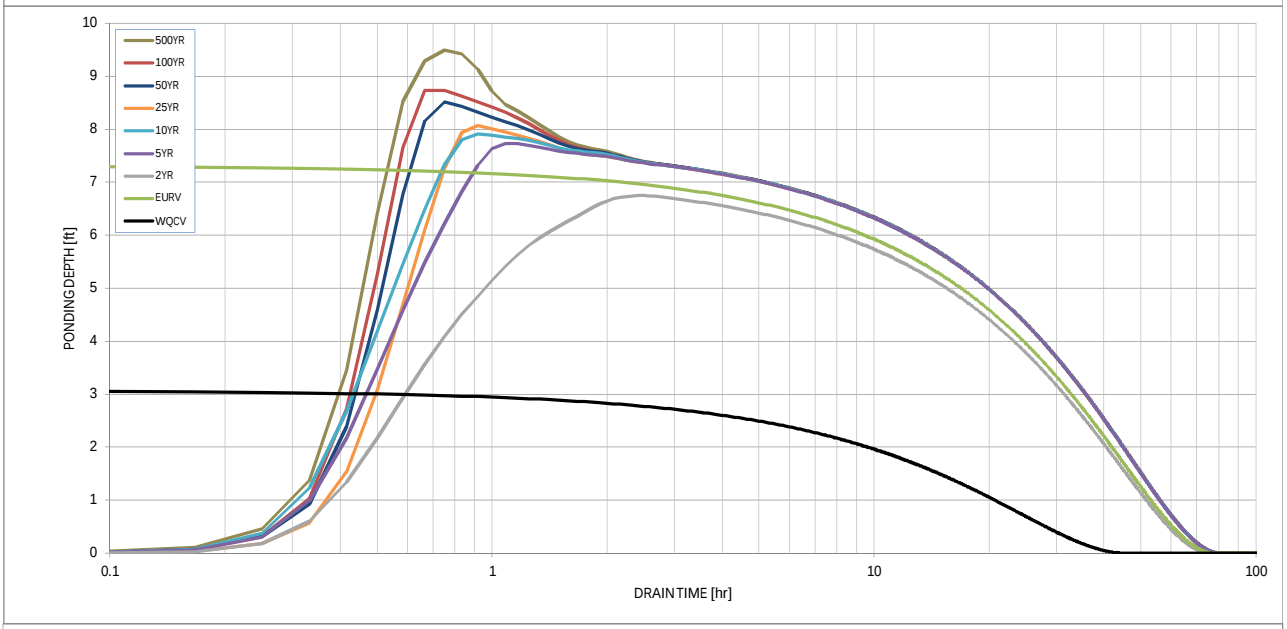
ft^2
feet
radians

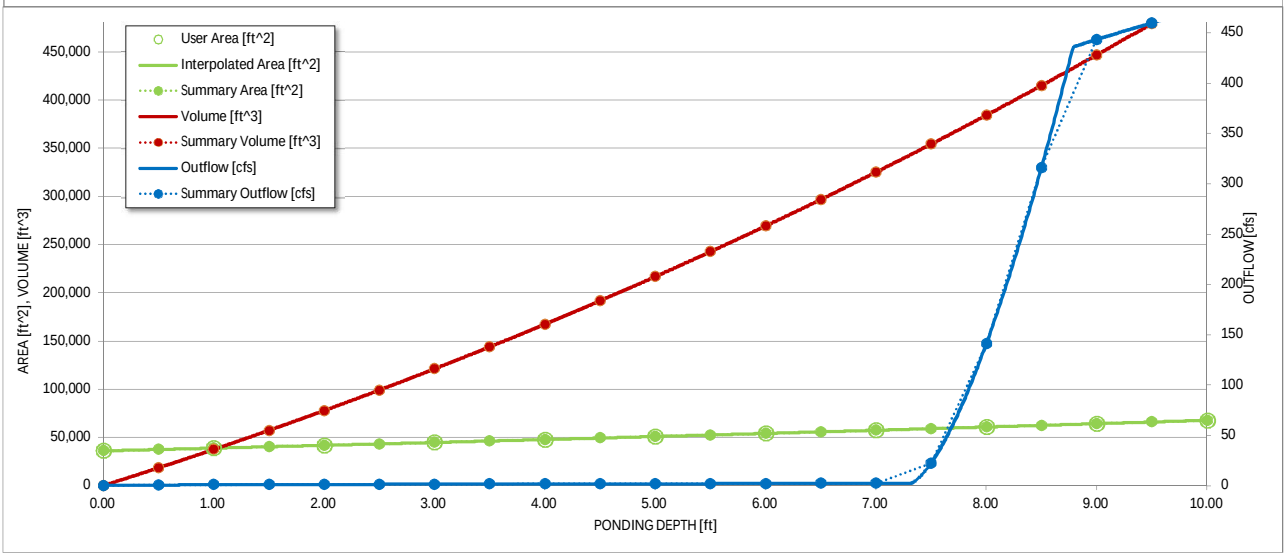
500 Year
3.07
36.525
36.525
317.8
1.92
579.9
459.5
1.4
Outlet Plate 1
2.2
N/A
53
65
9.49
1.51
10.968

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.00 (December 2019)







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	1.09	0.51	2.94
	0:15:00	0.00	0.00	6.64	13.48	16.69	8.25	15.98	16.09	22.17
	0:20:00	0.00	0.00	30.35	46.69	57.71	28.26	43.79	48.17	62.79
	0:25:00	0.00	0.00	77.54	130.00	165.28	69.43	111.71	131.03	174.91
	0:30:00	0.00	0.00	113.80	192.56	236.83	183.45	289.03	338.39	424.75
	0:35:00	0.00	0.00	116.49	190.94	229.47	256.62	391.48	473.00	579.87
	0:40:00	0.00	0.00	104.91	167.10	200.72	258.48	386.29	472.67	576.33
	0:45:00	0.00	0.00	89.95	143.81	174.68	234.46	348.36	433.09	527.29
	0:50:00	0.00	0.00	75.65	124.23	150.30	209.10	310.38	388.84	473.17
	0:55:00	0.00	0.00	64.14	105.31	128.04	180.66	268.50	340.84	414.61
	1:00:00	0.00	0.00	55.48	89.75	112.06	151.44	226.07	296.14	360.69
	1:05:00	0.00	0.00	49.58	79.47	101.70	130.37	196.13	264.53	322.80
	1:10:00	0.00	0.00	43.33	71.39	93.22	111.90	169.74	226.81	277.54
	1:15:00	0.00	0.00	36.87	62.41	84.99	94.84	145.04	187.13	229.89
	1:20:00	0.00	0.00	31.06	52.36	73.41	78.33	119.68	149.20	183.42
	1:25:00	0.00	0.00	25.88	43.24	59.43	62.96	95.47	114.20	140.13
	1:30:00	0.00	0.00	21.90	36.44	48.14	48.76	73.42	84.98	104.38
	1:35:00	0.00	0.00	19.66	32.80	41.60	37.45	56.51	63.68	78.70
	1:40:00	0.00	0.00	18.62	29.29	37.48	30.84	46.57	51.02	63.30
	1:45:00	0.00	0.00	18.04	25.94	34.53	26.69	40.16	42.86	53.28
	1:50:00	0.00	0.00	17.70	23.56	32.46	23.98	35.89	37.21	46.33
	1:55:00	0.00	0.00	16.09	21.80	30.38	22.12	32.94	33.24	41.44
	2:00:00	0.00	0.00	14.09	20.10	27.40	20.93	30.95	30.41	37.92
	2:05:00	0.00	0.00	11.28	16.22	21.78	17.07	25.11	24.17	30.14
	2:10:00	0.00	0.00	8.40	11.94	15.93	12.48	18.26	17.39	21.67
	2:15:00	0.00	0.00	6.26	8.81	11.61	9.18	13.35	12.75	15.85
	2:20:00	0.00	0.00	4.61	6.45	8.43	6.73	9.75	9.38	11.65
	2:25:00	0.00	0.00	3.36	4.63	6.09	4.88	7.05	6.85	8.50
	2:30:00	0.00	0.00	2.40	3.23	4.35	3.47	5.00	4.88	6.05
	2:35:00	0.00	0.00	1.67	2.24	3.08	2.48	3.57	3.49	4.33
	2:40:00	0.00	0.00	1.12	1.53	2.10	1.74	2.50	2.43	3.01
	2:45:00	0.00	0.00	0.68	0.98	1.31	1.13	1.61	1.57	1.93
	2:50:00	0.00	0.00	0.36	0.56	0.71	0.65	0.92	0.89	1.09
	2:55:00	0.00	0.00	0.15	0.26	0.31	0.30	0.42	0.40	0.49
	3:00:00	0.00	0.00	0.05	0.07	0.08	0.09	0.11	0.11	0.13
	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
	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 4.03 (May 2020)

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]
5973	0.00	36,062	0.828	0	0.000	0.00
5973.50	0.50	37,467	0.860	18,382	0.422	0.59
5974.00	1.00	38,871	0.892	37,466	0.860	0.84
5974.50	1.50	40,316	0.926	57,263	1.315	1.02
5975.00	2.00	41,761	0.959	77,782	1.786	1.18
5975.50	2.50	43,246	0.993	99,034	2.274	1.32
5976.00	3.00	44,731	1.027	121,028	2.778	1.45
5976.50	3.50	46,256	1.062	143,775	3.301	1.56
5977.00	4.00	47,782	1.097	167,285	3.840	1.67
5977.50	4.50	49,347	1.133	191,567	4.398	1.77
5978.00	5.00	50,912	1.169	216,632	4.973	1.87
5978.50	5.50	52,518	1.206	242,489	5.567	1.96
5979.00	6.00	54,124	1.243	269,150	6.179	2.05
5979.50	6.50	55,769	1.280	296,623	6.810	2.13
5980.00	7.00	57,415	1.318	324,919	7.459	2.21
5980.50	7.50	59,101	1.357	354,048	8.128	22.29
5981.00	8.00	60,787	1.395	384,020	8.816	140.78
5981.50	8.50	62,513	1.435	414,846	9.524	315.93
5982.00	9.00	64,240	1.475	446,534	10.251	443.29
5982.50	9.50	66,006	1.515	479,096	10.999	459.92
5983.00	10.00	67,773	1.556	512,540	11.766	475.97
5983.50	10.50	69,579	1.597	546,879	12.555	491.50
5984.00	11.00	71,386	1.639	582,120	13.364	506.55

For best results, include the stages of all grade slope changes (e.g. ISV and Floor) from the S-A-V table on Sheet 'Basin'.

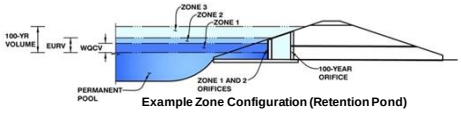
Also include the inverts of all outlets (e.g. vertical orifice, overflow grate, and spillway, where applicable).

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.03 (May 2020)

Project: PHASE II DRAINAGE REPORT FOR THE RIDGEGATE DEVELOPMENT

Basin ID: EURV POND B



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB	
Watershed Area =	256.0	acres
Watershed Length =	5,800	ft
Watershed Length to Centroid =	3,300	ft
Watershed Slope =	0.05	ft/ft
Watershed Imperviousness =	22%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	10.0%	percent
Percentage Hydrologic Soil Groups C/D =	90.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	Lone Tree - Municipal Court	

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) =	2.672	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	5.154	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.06 in.) =	5.493	acre-feet	1.06	inches
5-yr Runoff Volume (P1 = 1.43 in.) =	11.748	acre-feet	1.43	inches
10-yr Runoff Volume (P1 = 1.66 in.) =	16.307	acre-feet	1.66	inches
25-yr Runoff Volume (P1 = 1.68 in.) =	18.095	acre-feet		inches
50-yr Runoff Volume (P1 = 2.26 in.) =	30.308	acre-feet	2.26	inches
100-yr Runoff Volume (P1 = 2.6 in.) =	38.980	acre-feet	2.60	inches
500-yr Runoff Volume (P1 = 3.07 in.) =	49.343	acre-feet		inches
Approximate 2-yr Detention Volume =	3.803	acre-feet		
Approximate 5-yr Detention Volume =	7.219	acre-feet		
Approximate 10-yr Detention Volume =	8.751	acre-feet		
Approximate 25-yr Detention Volume =	8.968	acre-feet		
Approximate 50-yr Detention Volume =	11.243	acre-feet		
Approximate 100-yr Detention Volume =	14.621	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	2.672	acre-feet
Zone 2 Volume (EURV - Zone 1) =	2.482	acre-feet
Select Zone 3 Storage Volume (Optional) =		acre-feet
Total Detention Basin Volume =	5.154	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_{LW}) =	user	

Total detention volume is less than 100-year volume.

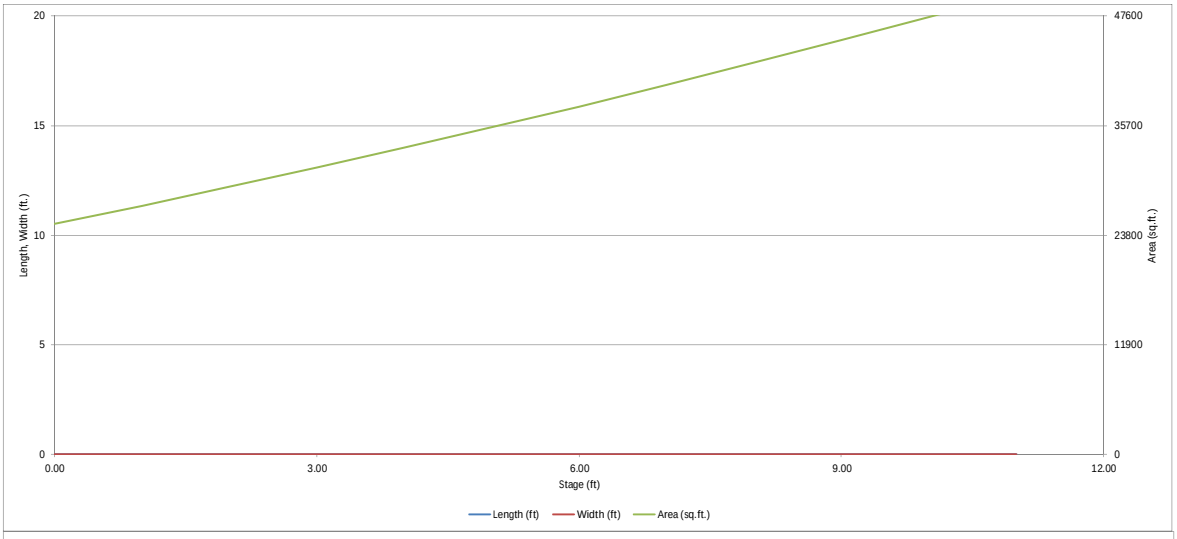
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	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

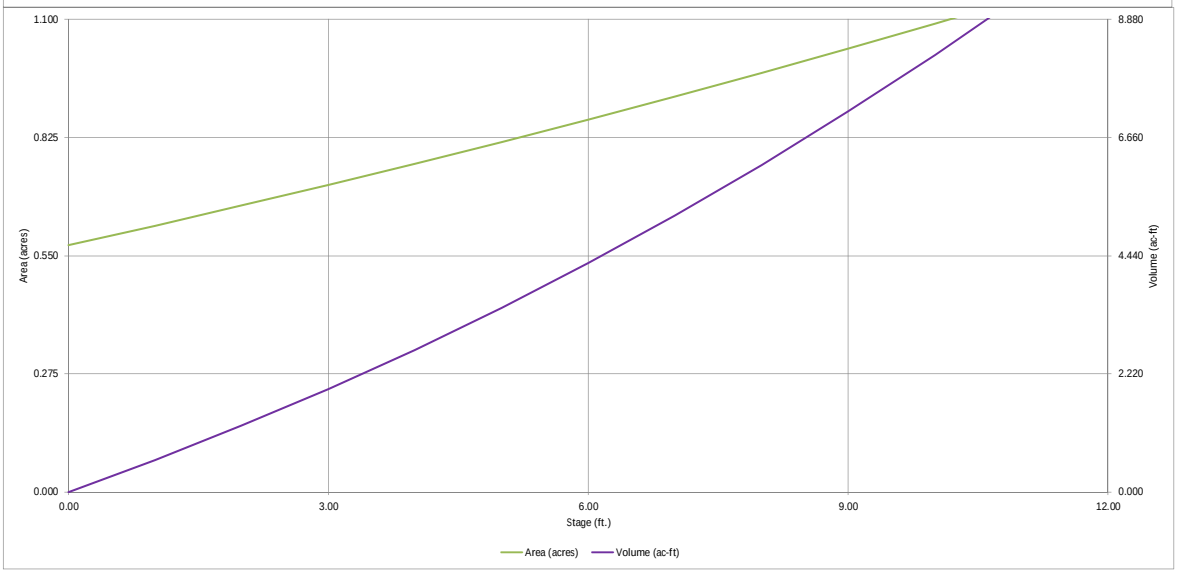
Depth Increment = ft

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	--	--	--	25,014	0.574		
6060	--	1.00	--	--	--	26,992	0.620	26,003	0.597
6061	--	2.00	--	--	--	29,029	0.666	54,013	1.240
6062	--	3.00	--	--	--	31,127	0.715	84,091	1.930
6063	--	4.00	--	--	--	33,286	0.764	116,298	2.670
6064	--	5.00	--	--	--	35,504	0.815	150,693	3.459
6065	--	6.00	--	--	--	37,783	0.867	187,336	4.301
6066	--	7.00	--	--	--	40,122	0.921	226,289	5.195
6067	--	8.00	--	--	--	42,522	0.976	267,611	6.144
6068	--	9.00	--	--	--	44,982	1.033	311,363	7.148
6069	--	10.00	--	--	--	47,502	1.090	357,605	8.209
6070	--	11.00	--	--	--	50,083	1.150	406,397	9.330

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.03 (May 2020)



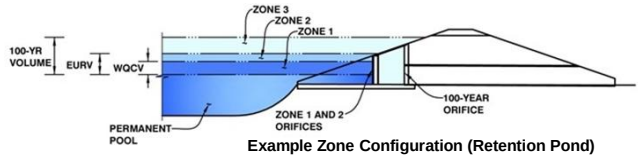


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.03 (May 2020)

Project: PHASE II DRAINAGE REPORT FOR THE RIDGEGATE DEVELOPMENT

Basin ID: EURV POND B



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	4.01	2.672	Orifice Plate
Zone 2 (EURV)	6.96	2.482	Circular Orifice
Zone 3			Weir&Pipe (Rect.)
Total (all zones)		5.154	

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

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

Calculated Parameters for Underdrain

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

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	N/A	ft^2
Depth at top of Zone using Orifice Plate =	3.03	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	12.10	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	N/A	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							
Orifice Area (sq. inches)	21.00							

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

User Input: Vertical Orifice (Circular or Rectangular)

	Zone 2 Circular	Not Selected				Zone 2 Circular	Not Selected
Invert of Vertical Orifice =			ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =			
Depth at top of Zone using Vertical Orifice =			ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =			
Vertical Orifice Diameter =			inches				

Calculated Parameters for Vertical Orific

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 =	6.96	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	6.96	N/A
Overflow Weir Front Edge Length =	44.00	N/A	feet	Overflow Weir Slope Length =	6.00	N/A
Overflow Weir Grate Slope =	0.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	6.16	N/A
Horiz. Length of Weir Sides =	6.00	N/A	feet	Overflow Grate Open Area w/o Debris =	184.80	N/A
Overflow Grate Open Area % =	70%	N/A	%, grate open area/total area	Overflow Grate Open Area w/ Debris =	92.40	N/A
Debris Clogging % =	50%	N/A	%			

Calculated Parameters for Overflow Wei

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

	Zone 3 Rectangular	Not Selected			Zone 3 Rectangular	Not Selected
Depth to Invert of Outlet Pipe =	0.59	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	30.00	N/A
Rectangular Orifice Width =	72.00	N/A	inches	Outlet Orifice Centroid =	2.50	N/A
Rectangular Orifice Height =	60.00		inches	Half-Central Angle of Restrictor Plate on Pipe =	N/A	N/A

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plat

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	9.00	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	feet
Spillway Crest Length =		feet	Stage at Top of Freeboard =	feet
Spillway End Slopes =		H:V	Basin Area at Top of Freeboard =	acres
Freeboard above Max Water Surface =		feet	Basin Volume at Top of Freeboard =	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
One-Hour Rainfall Depth (in) =	N/A	N/A	1.06	1.43	1.66	1.68	2.26	2.60
CUHP Runoff Volume (acre-ft) =	2.672	5.154	5.493	11.748	16.307	18.095	30.308	38.980
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	5.493	11.748	16.307	18.095	30.308	38.980
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	18.8	75.1	107.7	139.5	246.0	323.0
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A						
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.07	0.29	0.42	0.55	0.96	1.26
Peak Inflow Q (cfs) =	N/A	N/A	54.0	115.1	149.7	182.5	296.4	376.7
Peak Outflow Q (cfs) =	1.4	1.9	1.8	78.3	122.0	160.4	292.3	371.4
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	1.0	1.1	1.1	1.2	1.1
Structure Controlling Flow =	Plate	Overflow Weir 1	Plate	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	0.4	0.7	0.9	1.6	2.0
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	37	52	55	51	48	47	41	38
Time to Drain 99% of Inflow Volume (hours) =	40	56	59	57	56	55	52	50
Maximum Ponding Depth (ft) =	4.01	6.96	6.89	7.46	7.64	7.77	8.18	8.52
Area at Maximum Ponding Depth (acres) =	0.76	0.92	0.92	0.95	0.96	0.96	0.99	1.01
Maximum Volume Stored (acre-ft) =	2.677	5.158	5.094	5.624	5.786	5.920	6.310	6.659

ice

ft^2
feet

ir

feet
feet

ft^2
ft^2

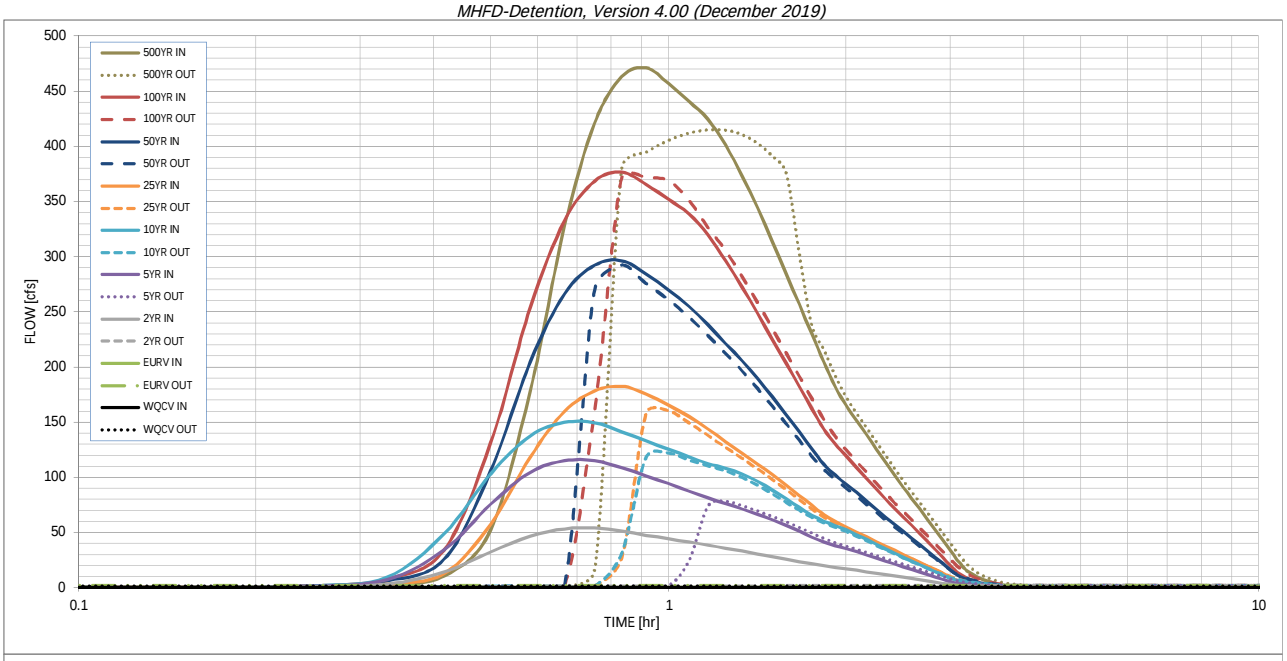
te

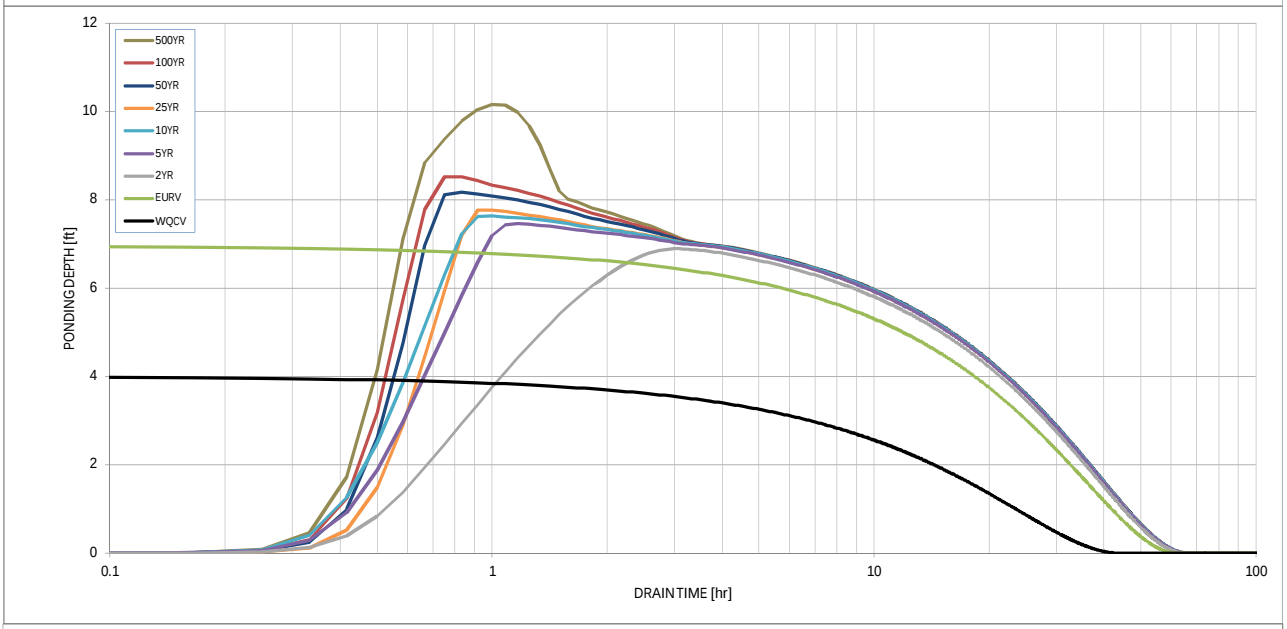
ft^2
feet
radians

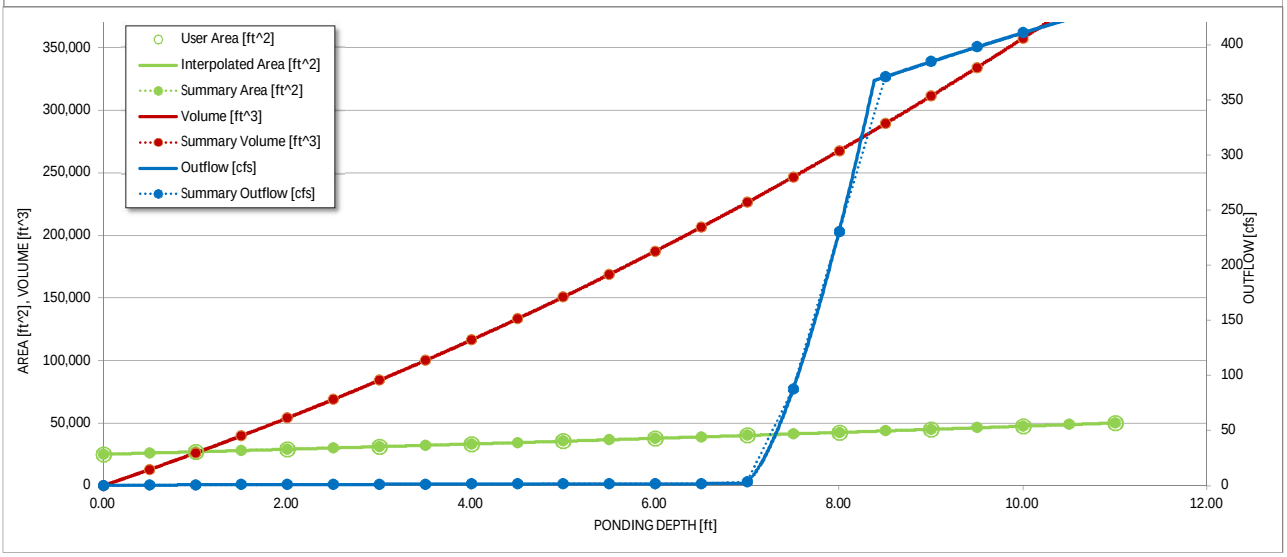
500 Year
3.07
49.343
49.343
411.9
1.61
471.2
415.0
1.0
Outlet Plate 1
2.2
N/A
34
48
10.16
1.10
8.385

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.00 (December 2019)







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	0.10	0.05	0.27
	0:15:00	0.00	0.00	0.59	1.20	1.49	0.74	1.51	1.49	2.20
	0:20:00	0.00	0.00	3.13	7.14	9.44	3.07	6.13	7.43	10.57
	0:25:00	0.00	0.00	14.20	34.09	48.59	12.61	25.64	34.14	52.44
	0:30:00	0.00	0.00	32.34	75.59	103.23	57.76	105.92	131.44	178.47
	0:35:00	0.00	0.00	46.64	104.52	137.65	118.36	204.65	253.91	327.36
	0:40:00	0.00	0.00	53.24	115.08	149.67	159.67	266.15	332.58	421.17
	0:45:00	0.00	0.00	54.00	114.83	149.50	178.38	292.21	368.47	463.05
	0:50:00	0.00	0.00	51.06	108.65	141.36	182.50	296.35	376.74	471.22
	0:55:00	0.00	0.00	47.42	101.36	132.95	175.40	284.23	365.25	457.07
	1:00:00	0.00	0.00	44.27	94.41	125.63	165.48	269.96	352.04	440.80
	1:05:00	0.00	0.00	41.39	87.53	118.58	155.13	254.89	338.90	424.52
	1:10:00	0.00	0.00	38.48	81.34	112.48	143.86	238.28	319.64	401.20
	1:15:00	0.00	0.00	35.66	76.12	108.08	132.13	221.24	296.03	373.07
	1:20:00	0.00	0.00	33.08	71.28	103.01	121.84	205.48	272.36	344.14
	1:25:00	0.00	0.00	30.63	66.32	96.17	112.03	189.19	248.29	313.99
	1:30:00	0.00	0.00	28.25	61.35	88.45	102.39	172.80	224.90	284.43
	1:35:00	0.00	0.00	25.93	56.40	80.54	92.95	156.71	203.13	256.77
	1:40:00	0.00	0.00	23.64	51.18	72.76	83.71	141.00	182.09	230.03
	1:45:00	0.00	0.00	21.46	45.78	65.57	74.70	125.88	162.04	204.67
	1:50:00	0.00	0.00	19.70	41.40	60.26	66.23	111.91	143.78	182.07
	1:55:00	0.00	0.00	18.31	38.13	56.16	59.90	101.86	130.26	165.29
	2:00:00	0.00	0.00	17.04	35.31	52.24	54.94	93.76	119.32	151.57
	2:05:00	0.00	0.00	15.73	32.49	48.04	50.43	86.14	109.05	138.57
	2:10:00	0.00	0.00	14.34	29.57	43.64	45.94	78.37	98.97	125.71
	2:15:00	0.00	0.00	12.96	26.72	39.30	41.70	70.97	89.39	113.44
	2:20:00	0.00	0.00	11.65	23.98	35.15	37.64	63.86	80.33	101.83
	2:25:00	0.00	0.00	10.40	21.35	31.23	33.75	57.11	71.86	90.99
	2:30:00	0.00	0.00	9.22	18.85	27.54	30.09	50.80	64.07	81.00
	2:35:00	0.00	0.00	8.09	16.43	24.05	26.54	44.70	56.48	71.29
	2:40:00	0.00	0.00	7.00	14.09	20.75	23.07	38.80	49.07	61.86
	2:45:00	0.00	0.00	5.92	11.81	17.55	19.66	33.02	41.75	52.54
	2:50:00	0.00	0.00	4.87	9.58	14.42	16.31	27.33	34.51	43.32
	2:55:00	0.00	0.00	3.85	7.42	11.36	13.01	21.73	27.34	34.22
	3:00:00	0.00	0.00	2.88	5.41	8.51	9.77	16.26	20.37	25.44
	3:05:00	0.00	0.00	2.09	3.95	6.54	6.75	11.31	14.12	17.91
	3:10:00	0.00	0.00	1.59	3.08	5.28	4.73	8.29	10.19	13.09
	3:15:00	0.00	0.00	1.28	2.49	4.33	3.43	6.23	7.52	9.74
	3:20:00	0.00	0.00	1.06	2.04	3.57	2.57	4.77	5.53	7.23
	3:25:00	0.00	0.00	0.89	1.67	2.93	1.94	3.66	4.06	5.34
	3:30:00	0.00	0.00	0.73	1.37	2.37	1.51	2.85	2.94	3.90
	3:35:00	0.00	0.00	0.60	1.11	1.89	1.16	2.18	2.09	2.79
	3:40:00	0.00	0.00	0.49	0.88	1.47	0.90	1.66	1.50	2.02
	3:45:00	0.00	0.00	0.40	0.69	1.13	0.70	1.29	1.18	1.57
	3:50:00	0.00	0.00	0.33	0.53	0.86	0.55	0.99	0.92	1.22
	3:55:00	0.00	0.00	0.26	0.40	0.66	0.43	0.78	0.74	0.98
	4:00:00	0.00	0.00	0.20	0.29	0.50	0.33	0.60	0.58	0.76
	4:05:00	0.00	0.00	0.15	0.20	0.37	0.25	0.45	0.43	0.57
	4:10:00	0.00	0.00	0.10	0.14	0.26	0.18	0.32	0.31	0.40
	4:15:00	0.00	0.00	0.07	0.09	0.16	0.12	0.22	0.21	0.27
	4:20:00	0.00	0.00	0.04	0.05	0.09	0.08	0.13	0.12	0.16
	4:25:00	0.00	0.00	0.02	0.03	0.04	0.04	0.07	0.06	0.08
	4:30:00	0.00	0.00	0.01	0.01	0.01	0.02	0.02	0.02	0.03
	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 4.03 (May 2020)

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]
5959.00	0.00	25,014	0.574	0	0.000	0.00
5959.50	0.50	26,003	0.597	12,754	0.293	0.50
5960.00	1.00	26,992	0.620	26,003	0.597	0.70
5960.50	1.50	28,011	0.643	39,754	0.913	0.86
5961.00	2.00	29,029	0.666	54,013	1.240	0.99
5961.50	2.50	30,078	0.690	68,790	1.579	1.11
5962.00	3.00	31,127	0.715	84,091	1.930	1.22
5962.50	3.50	32,206	0.739	99,925	2.294	1.31
5963.00	4.00	33,286	0.764	116,298	2.670	1.40
5963.50	4.50	34,395	0.790	133,218	3.058	1.49
5964.00	5.00	35,504	0.815	150,693	3.459	1.57
5964.50	5.50	36,643	0.841	168,730	3.874	1.65
5965.00	6.00	37,783	0.867	187,336	4.301	1.72
5965.50	6.50	38,952	0.894	206,520	4.741	1.79
5966.00	7.00	40,122	0.921	226,289	5.195	3.58
5966.50	7.50	41,322	0.949	246,650	5.662	87.48
5967.00	8.00	42,522	0.976	267,611	6.144	230.67
5967.50	8.50	43,752	1.004	289,179	6.639	370.82
5968.00	9.00	44,982	1.033	311,363	7.148	384.63
5968.50	9.50	46,242	1.062	334,169	7.671	397.96
5969.00	10.00	47,502	1.090	357,605	8.209	410.86
5969.50	10.50	48,792	1.120	381,679	8.762	423.36
5970.00	11.00	50,083	1.150	406,397	9.330	435.51

For best results, include the stages of all grade slope changes (e.g. ISV and Floor) from the S-A-V table on Sheet 'Basin'.

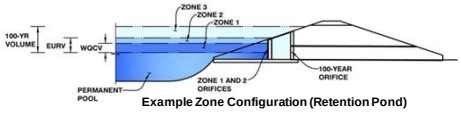
Also include the inverts of all outlets (e.g. vertical orifice, overflow grate, and spillway, where applicable).

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.03 (May 2020)

Project: PHASE II DRAINAGE REPORT FOR THE RIDGEGATE DEVELOPMENT

Basin ID: EURV POND C



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB	
Watershed Area =	59.8	acres
Watershed Length =	2,700	ft
Watershed Length to Centroid =	1,200	ft
Watershed Slope =	0.060	ft/ft
Watershed Imperviousness =	13%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	100.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	Lone Tree - Municipal Court	

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) =	0.415	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.661	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.06 in.) =	0.875	acre-feet	1.06	inches
5-yr Runoff Volume (P1 = 1.43 in.) =	2.282	acre-feet	1.43	inches
10-yr Runoff Volume (P1 = 1.66 in.) =	3.320	acre-feet	1.66	inches
25-yr Runoff Volume (P1 = 1.68 in.) =	3.763	acre-feet		inches
50-yr Runoff Volume (P1 = 2.26 in.) =	6.585	acre-feet	2.26	inches
100-yr Runoff Volume (P1 = 2.6 in.) =	8.632	acre-feet	2.60	inches
500-yr Runoff Volume (P1 = 3.07 in.) =	11.028	acre-feet		inches
Approximate 2-yr Detention Volume =	0.483	acre-feet		
Approximate 5-yr Detention Volume =	1.111	acre-feet		
Approximate 10-yr Detention Volume =	1.411	acre-feet		
Approximate 25-yr Detention Volume =	1.486	acre-feet		
Approximate 50-yr Detention Volume =	1.853	acre-feet		
Approximate 100-yr Detention Volume =	2.577	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.415	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.245	acre-feet
Select Zone 3 Storage Volume (Optional) =		acre-feet
Total Detention Basin Volume =	0.661	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_{LW}) =	user	

Total detention volume is less than 100-year volume.

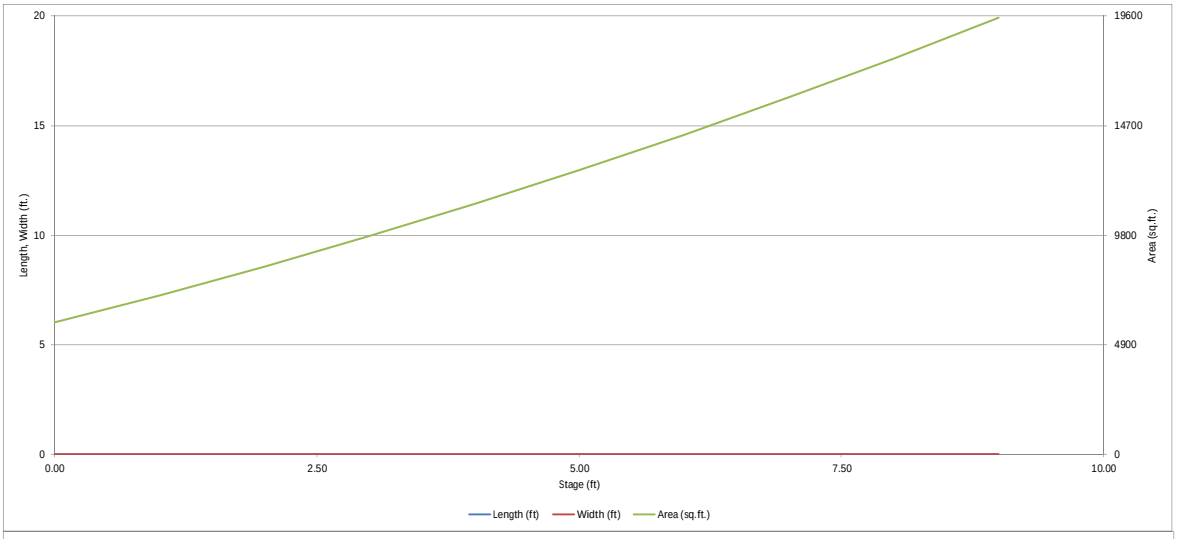
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	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

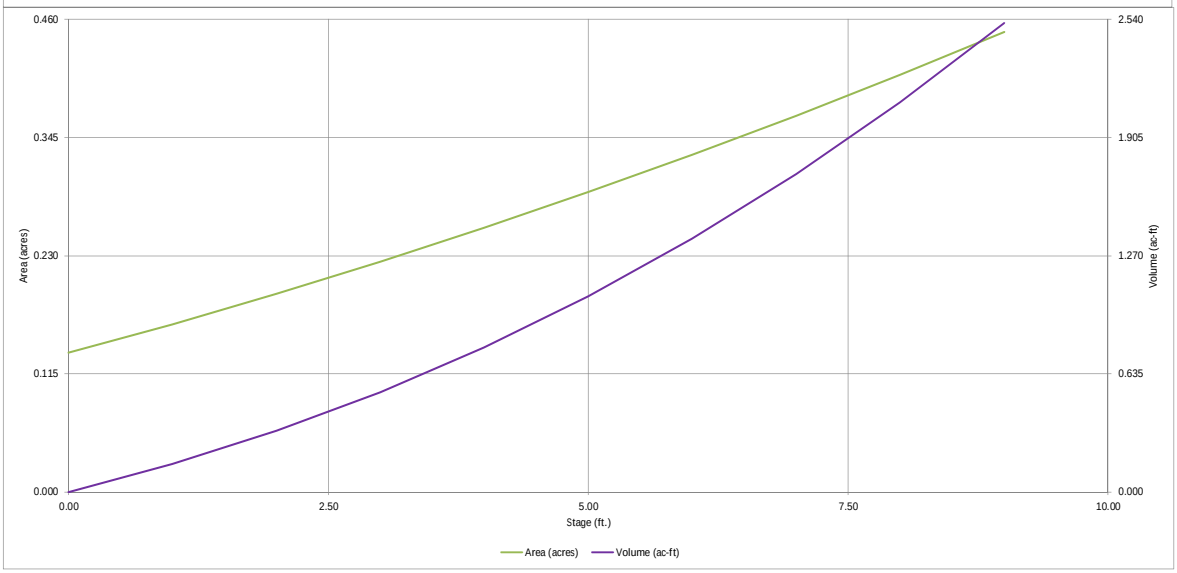
Depth Increment = ft

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	--	--	--	5,896	0.135		
6097	--	1.00	--	--	--	7,108	0.163	6,502	0.149
6098	--	2.00	--	--	--	8,395	0.193	14,253	0.327
6099	--	3.00	--	--	--	9,758	0.224	23,330	0.536
6100	--	4.00	--	--	--	11,195	0.257	33,806	0.776
6101	--	5.00	--	--	--	12,709	0.292	45,758	1.050
6102	--	6.00	--	--	--	14,297	0.328	59,261	1.360
6103	--	7.00	--	--	--	15,962	0.366	74,391	1.708
6104	--	8.00	--	--	--	17,701	0.406	91,222	2.094
6105	--	9.00	--	--	--	19,516	0.448	109,831	2.521

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.03 (May 2020)



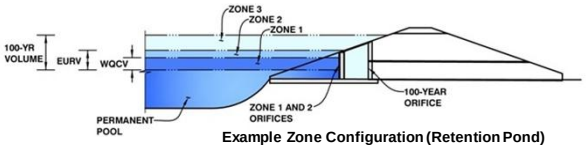


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.03 (May 2020)

Project: PHASE II DRAINAGE REPORT FOR THE RIDGEGATE DEVELOPMENT

Basin ID: EURV POND C



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.45	0.415	Orifice Plate
Zone 2 (EURV)	3.54	0.245	Circular Orifice
Zone 3			Weir&Pipe (Circular)
Total (all zones)		0.661	

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

			Calculated Parameters for Underdrain		
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

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)

			Calculated Parameters for Plate		
Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	N/A	ft²
Depth at top of Zone using Orifice Plate =	3.03	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	12.10	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	N/A	inches	Elliptical Slot Area =	N/A	ft²

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							
Orifice Area (sq. inches)	4.10							

	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 Circular	Not Selected		Calculated Parameters for Vertical Orifice	Zone 2 Circular	Not Selected	
Invert of Vertical Orifice =		N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =		N/A	ft²
Depth at top of Zone using Vertical Orifice =		N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =		N/A	feet
Vertical Orifice Diameter =		N/A	inches				

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		Calculated Parameters for Overflow Weir	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	3.54	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	3.54	N/A	feet
Overflow Weir Front Edge Length =	12.00	N/A	feet	Overflow Weir Slope Length =	5.00	N/A	feet
Overflow Weir Grate Slope =	0.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	5.94	N/A	
Horiz. Length of Weir Sides =	5.00	N/A	feet	Overflow Grate Open Area w/o Debris =	42.00	N/A	ft²
Overflow Grate Open Area % =	70%	N/A	%, grate open area/total area	Overflow Grate Open Area w/ Debris =	21.00	N/A	ft²
Debris Clogging % =	50%	N/A	%				

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

	Zone 3 Circular	Not Selected		Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate	Zone 3 Circular	Not Selected	
Depth to Invert of Outlet Pipe =	0.50	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	7.07	N/A	ft²
Circular Orifice Diameter =	36.00	N/A	inches	Outlet Orifice Centroid =	1.50	N/A	feet
				Half-Central Angle of Restrictor Plate on Pipe =	N/A	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

			Calculated Parameters for Spillway	
Spillway Invert Stage=	7.00	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	feet
Spillway Crest Length =		feet	Stage at Top of Freeboard =	feet
Spillway End Slopes =		H:V	Basin Area at Top of Freeboard =	acres
Freeboard above Max Water Surface =		feet	Basin Volume at Top of Freeboard =	acre-ft

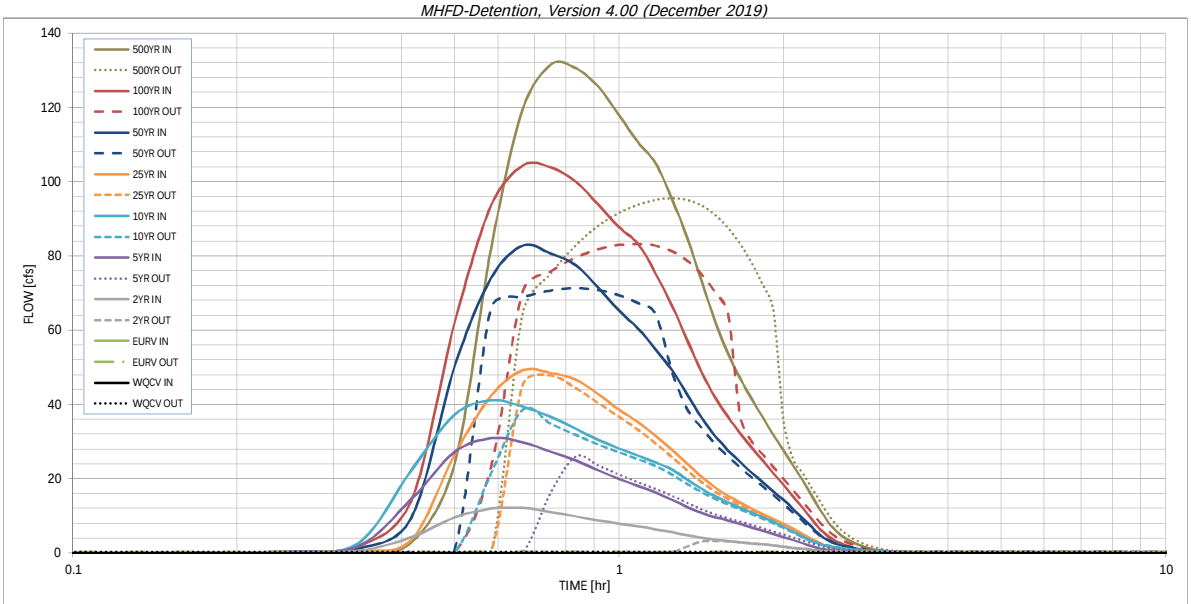
Routed Hydrograph Results

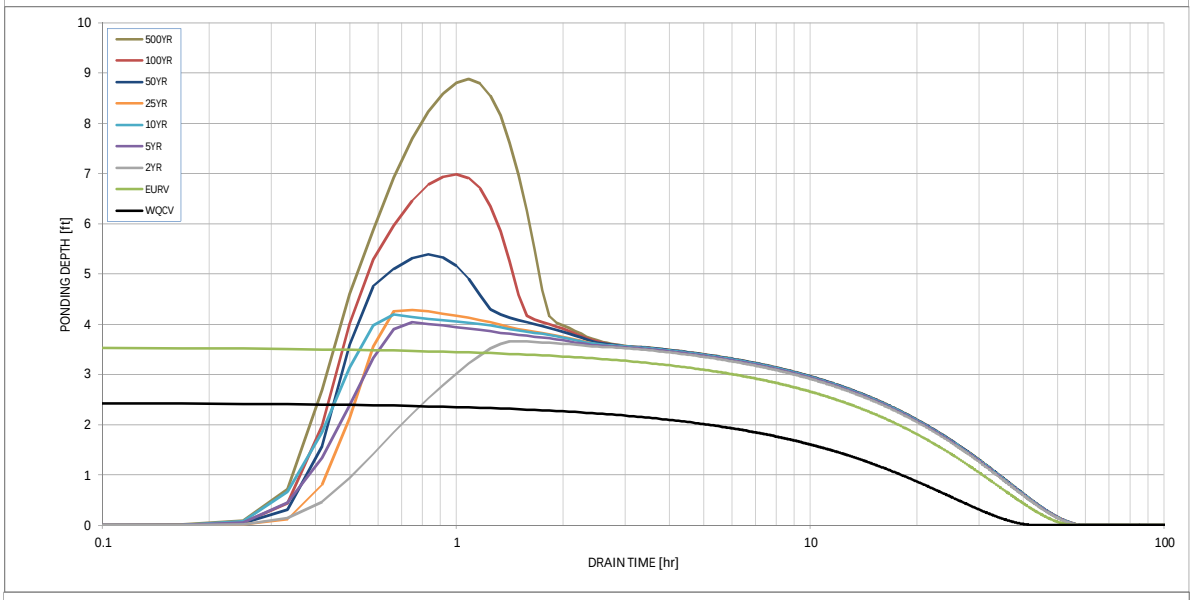
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

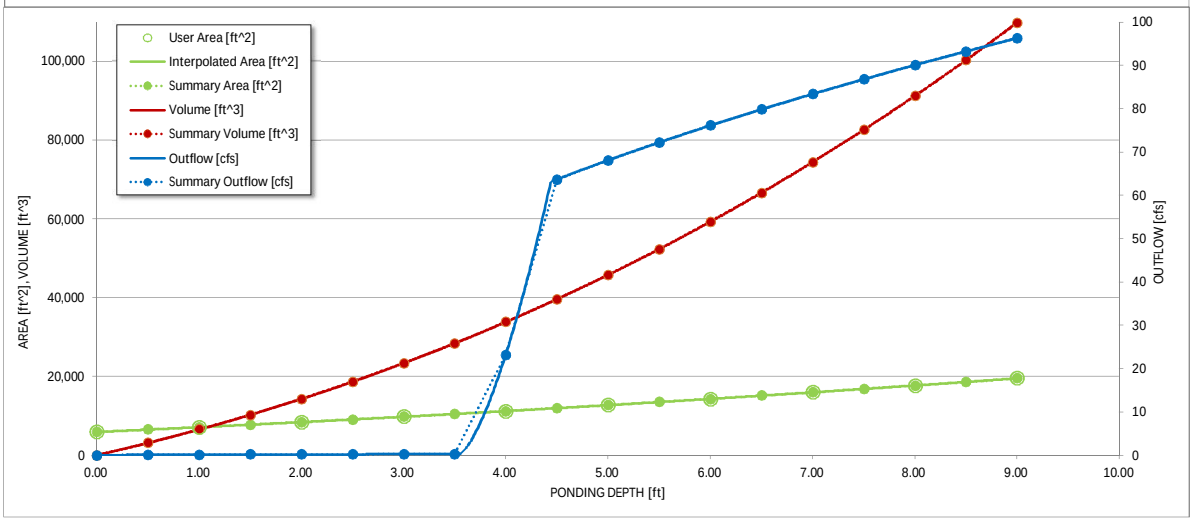
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.06	1.43	1.66	1.68	2.26	2.60	3.07
CUHP Runoff Volume (acre-ft) =	0.415	0.661	0.875	2.282	3.320	3.763	6.585	8.632	11.028
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.875	2.282	3.320	3.763	6.585	8.632	11.028
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	6.9	24.8	34.8	43.4	75.6	98.5	125.1
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.11	0.41	0.58	0.72	1.26	1.65	2.09
Peak Inflow Q (cfs) =	N/A	N/A	12.1	30.9	41.1	49.2	82.7	104.3	131.5
Peak Outflow Q (cfs) =	0.2	0.3	3.3	25.9	38.6	47.8	71.3	83.2	95.5
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	1.0	1.1	1.1	0.9	0.8	0.8
Structure Controlling Flow =	Plate	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Outlet Plate 1	Outlet Plate 1
Max Velocity through Grate 1 (fps) =	N/A	N/A	0.07	0.6	0.9	1.1	1.7	2.0	2.3
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) =	36	47	49	42	39	37	30	26	21
Time to Drain 99% of Inflow Volume (hours) =	40	51	53	50	48	47	43	40	38
Maximum Ponding Depth (ft) =	2.44	3.54	3.66	4.04	4.19	4.29	5.39	6.98	8.88
Area at Maximum Ponding Depth (acres) =	0.21	0.24	0.25	0.26	0.26	0.27	0.31	0.37	0.44
Maximum Volume Stored (acre-ft) =	0.415	0.661	0.688	0.784	0.823	0.849	1.164	1.697	2.463

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.00 (December 2019)







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	0.02	0.01	0.06
	0:15:00	0.00	0.00	0.13	0.26	0.32	0.16	0.30	0.30	0.41
	0:20:00	0.00	0.00	0.56	1.80	2.63	0.51	1.19	1.75	2.80
	0:25:00	0.00	0.00	4.19	14.44	22.23	3.49	9.47	14.04	23.78
	0:30:00	0.00	0.00	9.53	27.15	37.19	26.34	50.12	61.87	82.09
	0:35:00	0.00	0.00	11.90	30.86	41.07	42.31	73.95	93.48	119.41
	0:40:00	0.00	0.00	12.13	29.80	39.36	49.16	82.75	104.29	131.50
	0:45:00	0.00	0.00	11.03	27.23	36.61	48.42	80.59	103.80	130.50
	0:50:00	0.00	0.00	9.83	24.91	33.43	46.66	77.48	99.93	125.53
	0:55:00	0.00	0.00	8.74	22.22	30.39	42.69	71.39	93.77	117.89
	1:00:00	0.00	0.00	7.87	19.94	28.10	38.56	65.26	87.74	110.56
	1:05:00	0.00	0.00	7.18	18.04	26.19	35.23	60.40	83.18	104.96
	1:10:00	0.00	0.00	6.37	16.26	24.33	31.51	54.82	75.29	95.36
	1:15:00	0.00	0.00	5.55	14.34	22.45	27.78	49.17	66.67	84.88
	1:20:00	0.00	0.00	4.73	12.35	19.73	24.00	42.68	57.34	73.10
	1:25:00	0.00	0.00	4.04	10.74	17.20	20.45	36.44	48.69	62.23
	1:30:00	0.00	0.00	3.55	9.62	15.24	17.54	31.47	41.87	53.64
	1:35:00	0.00	0.00	3.18	8.74	13.63	15.32	27.64	36.63	46.99
	1:40:00	0.00	0.00	2.87	7.79	12.19	13.51	24.43	32.25	41.39
	1:45:00	0.00	0.00	2.58	6.86	10.88	11.91	21.58	28.35	36.39
	1:50:00	0.00	0.00	2.30	5.97	9.65	10.47	19.00	24.79	31.84
	1:55:00	0.00	0.00	1.99	5.12	8.41	9.12	16.57	21.46	27.57
	2:00:00	0.00	0.00	1.69	4.29	7.09	7.81	14.25	18.34	23.57
	2:05:00	0.00	0.00	1.37	3.43	5.74	6.47	11.80	15.21	19.52
	2:10:00	0.00	0.00	1.05	2.60	4.43	5.13	9.37	12.13	15.53
	2:15:00	0.00	0.00	0.74	1.80	3.23	3.82	7.02	9.12	11.66
	2:20:00	0.00	0.00	0.49	1.20	2.37	2.57	4.86	6.36	8.21
	2:25:00	0.00	0.00	0.33	0.86	1.83	1.68	3.37	4.40	5.79
	2:30:00	0.00	0.00	0.24	0.65	1.46	1.13	2.42	3.13	4.18
	2:35:00	0.00	0.00	0.19	0.51	1.15	0.78	1.77	2.22	3.01
	2:40:00	0.00	0.00	0.15	0.40	0.91	0.54	1.29	1.55	2.12
	2:45:00	0.00	0.00	0.11	0.31	0.70	0.38	0.93	1.05	1.46
	2:50:00	0.00	0.00	0.09	0.24	0.53	0.27	0.67	0.68	0.97
	2:55:00	0.00	0.00	0.07	0.18	0.39	0.19	0.47	0.43	0.63
	3:00:00	0.00	0.00	0.06	0.14	0.28	0.14	0.34	0.31	0.45
	3:05:00	0.00	0.00	0.05	0.10	0.20	0.11	0.25	0.23	0.33
	3:10:00	0.00	0.00	0.04	0.07	0.15	0.08	0.19	0.18	0.26
	3:15:00	0.00	0.00	0.03	0.05	0.12	0.06	0.15	0.14	0.20
	3:20:00	0.00	0.00	0.02	0.03	0.08	0.05	0.11	0.11	0.16
	3:25:00	0.00	0.00	0.01	0.02	0.06	0.03	0.08	0.08	0.11
	3:30:00	0.00	0.00	0.01	0.01	0.04	0.02	0.06	0.05	0.08
	3:35:00	0.00	0.00	0.01	0.01	0.02	0.01	0.04	0.03	0.05
	3:40:00	0.00	0.00	0.00	0.00	0.01	0.01	0.02	0.02	0.03
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01
	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

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.03 (May 2020)

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 [ft²]	Area [acres]	Volume [ft³]	Volume [ac-ft]	Total Outflow [cfs]
6096.00	0.00	5,896	0.135	0	0.000	0.00
6096.50	0.50	6,502	0.149	3,099	0.071	0.10
6097.00	1.00	7,108	0.163	6,502	0.149	0.14
6097.50	1.50	7,752	0.178	10,217	0.235	0.17
6098.00	2.00	8,395	0.193	14,253	0.327	0.19
6098.50	2.50	9,076	0.208	18,621	0.427	0.22
6099.00	3.00	9,758	0.224	23,330	0.536	0.24
6099.50	3.50	10,477	0.241	28,389	0.652	0.26
6100.00	4.00	11,195	0.257	33,806	0.776	23.15
6100.50	4.50	11,952	0.274	39,593	0.909	63.67
6101.00	5.00	12,709	0.292	45,758	1.050	68.07
6101.50	5.50	13,503	0.310	52,311	1.201	72.20
6102.00	6.00	14,297	0.328	59,261	1.360	76.10
6102.50	6.50	15,129	0.347	66,618	1.529	79.82
6103.00	7.00	15,962	0.366	74,391	1.708	83.37
6103.50	7.50	16,831	0.386	82,589	1.896	86.77
6104.00	8.00	17,701	0.406	91,222	2.094	90.05
6104.50	8.50	18,608	0.427	100,300	2.303	93.21
6105.00	9.00	19,516	0.448	109,831	2.521	96.27

For best results, include the stages of all grade slope changes (e.g. ISV and Floor) from the S-A-V table on Sheet 'Basin'.

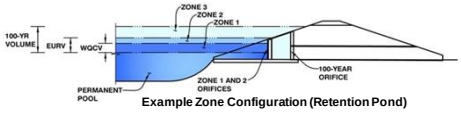
Also include the inverts of all outlets (e.g. vertical orifice, overflow grate, and spillway, where applicable).

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.03 (May 2020)

Project: PHASE II DRAINAGE REPORT FOR THE RIDGEGATE DEVELOPMENT

Basin ID: EURV POND D



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB	
Watershed Area =	22.8	acres
Watershed Length =	1,000	ft
Watershed Length to Centroid =	500	ft
Watershed Slope =	0.060	ft/ft
Watershed Imperviousness =	27%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	36.0%	percent
Percentage Hydrologic Soil Groups C/D =	64.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	Lone Tree - Municipal Court	

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) =	0.269	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.580	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.06 in.) =	0.523	acre-feet	1.06	inches
5-yr Runoff Volume (P1 = 1.43 in.) =	1.059	acre-feet	1.43	inches
10-yr Runoff Volume (P1 = 1.66 in.) =	1.445	acre-feet	1.66	inches
25-yr Runoff Volume (P1 = 1.68 in.) =	1.607	acre-feet		inches
50-yr Runoff Volume (P1 = 2.26 in.) =	2.656	acre-feet	2.26	inches
100-yr Runoff Volume (P1 = 2.6 in.) =	3.402	acre-feet	2.60	inches
500-yr Runoff Volume (P1 = 3.07 in.) =	4.303	acre-feet		inches
Approximate 2-yr Detention Volume =	0.412	acre-feet		
Approximate 5-yr Detention Volume =	0.715	acre-feet		
Approximate 10-yr Detention Volume =	0.903	acre-feet		
Approximate 25-yr Detention Volume =	0.920	acre-feet		
Approximate 50-yr Detention Volume =	1.155	acre-feet		
Approximate 100-yr Detention Volume =	1.452	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.269	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.311	acre-feet
Select Zone 3 Storage Volume (Optional) =		acre-feet
Total Detention Basin Volume =	0.580	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_{LW}) =	user	

Total detention volume is less than 100-year volume.

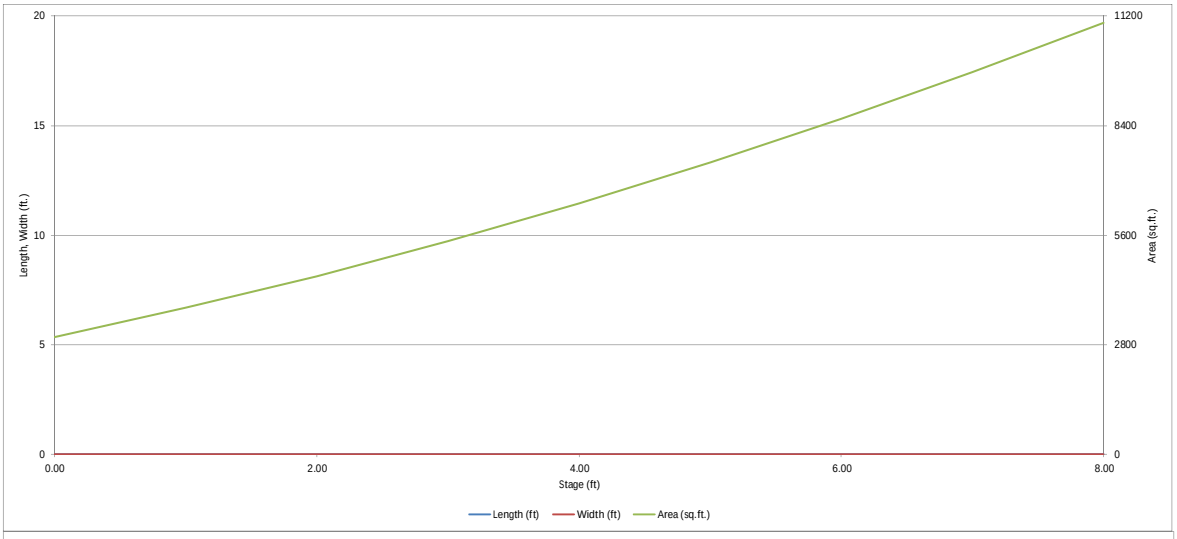
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	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

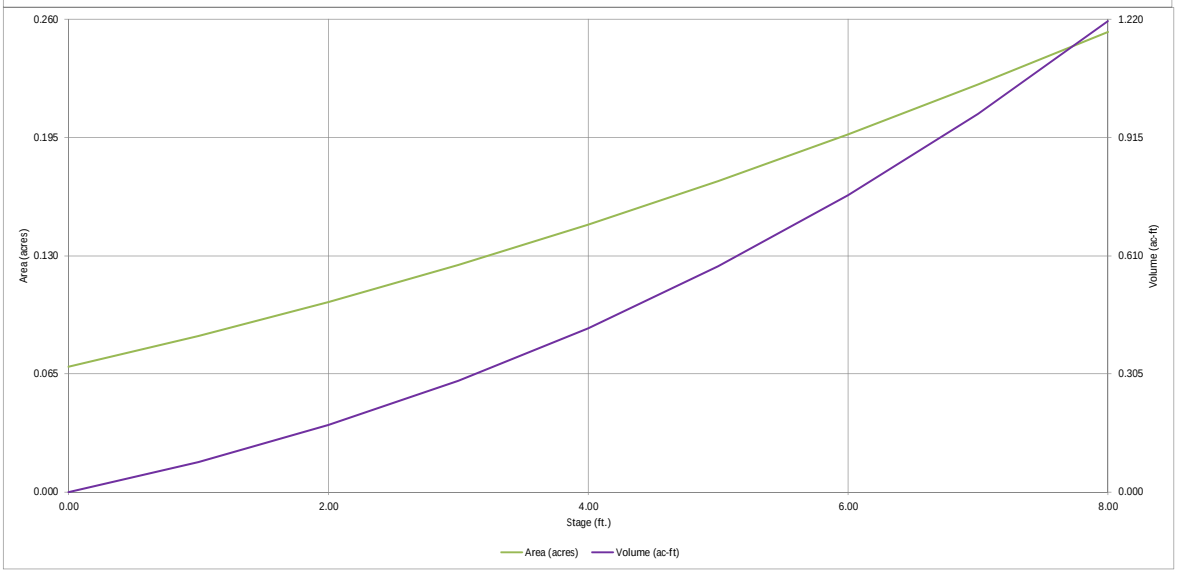
Depth Increment = ft

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	--	--	--	2,996	0.069		
6008	--	1.00	--	--	--	3,737	0.086	3,366	0.077
6009	--	2.00	--	--	--	4,552	0.104	7,511	0.172
6010	--	3.00	--	--	--	5,444	0.125	12,509	0.287
6011	--	4.00	--	--	--	6,410	0.147	18,436	0.423
6012	--	5.00	--	--	--	7,452	0.171	25,367	0.582
6013	--	6.00	--	--	--	8,569	0.197	33,377	0.766
6014	--	7.00	--	--	--	9,762	0.224	42,543	0.977
6015	--	8.00	--	--	--	11,030	0.253	52,939	1.215

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.03 (May 2020)



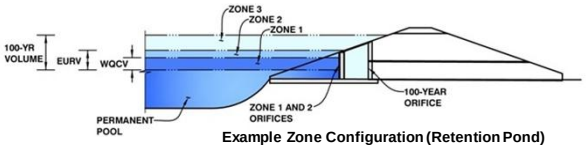


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.03 (May 2020)

Project: PHASE II DRAINAGE REPORT FOR THE RIDGEGATE DEVELOPMENT

Basin ID: EURV POND D



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.86	0.269	Orifice Plate
Zone 2 (EURV)	4.99	0.311	Circular Orifice
Zone 3			Weir&Pipe (Circular)
Total (all zones)		0.580	

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)

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	N/A	ft²
Depth at top of Zone using Orifice Plate =	3.03	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	12.10	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	N/A	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							
Orifice Area (sq. inches)	2.40							

	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 Circular	Not Selected			Zone 2 Circular	Not Selected	
Invert of Vertical Orifice =		N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =		N/A	ft²
Depth at top of Zone using Vertical Orifice =		N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =		N/A	feet
Vertical Orifice Diameter =		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 =	4.99	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	4.99	N/A	feet
Overflow Weir Front Edge Length =	9.00	N/A	feet	Overflow Weir Slope Length =	5.00	N/A	feet
Overflow Weir Grate Slope =	0.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	6.42	N/A	
Horiz. Length of Weir Sides =	5.00	N/A	feet	Overflow Grate Open Area w/o Debris =	31.50	N/A	ft²
Overflow Grate Open Area % =	70%	N/A	%, grate open area/total area	Overflow Grate Open Area w/ Debris =	15.75	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 Circular	Not Selected			Zone 3 Circular	Not Selected	
Depth to Invert of Outlet Pipe =	1.50	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	4.91	N/A	ft²
Circular Orifice Diameter =	30.00	N/A	inches	Outlet Orifice Centroid =	1.25	N/A	feet
				Half-Central Angle of Restrictor Plate on Pipe =	N/A	N/A	radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	6.25	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	feet
Spillway Crest Length =		feet	Stage at Top of Freeboard =	feet
Spillway End Slopes =		H:V	Basin Area at Top of Freeboard =	acres
Freeboard above Max Water Surface =		feet	Basin Volume at Top of Freeboard =	acre-ft

Calculated Parameters for Spillway

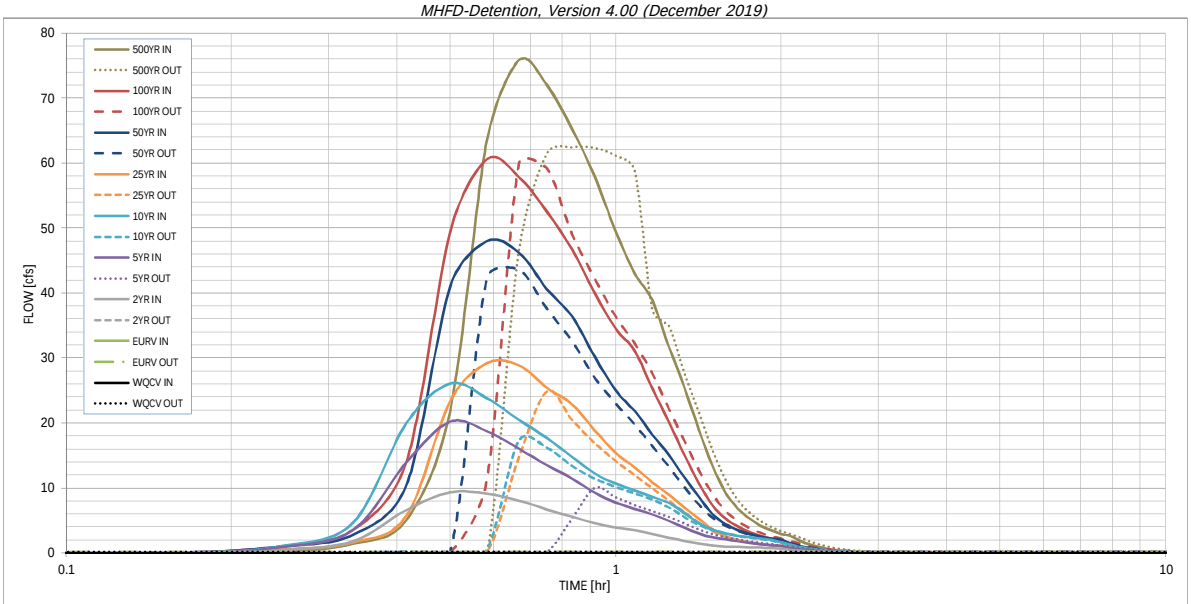
Routed Hydrograph Results

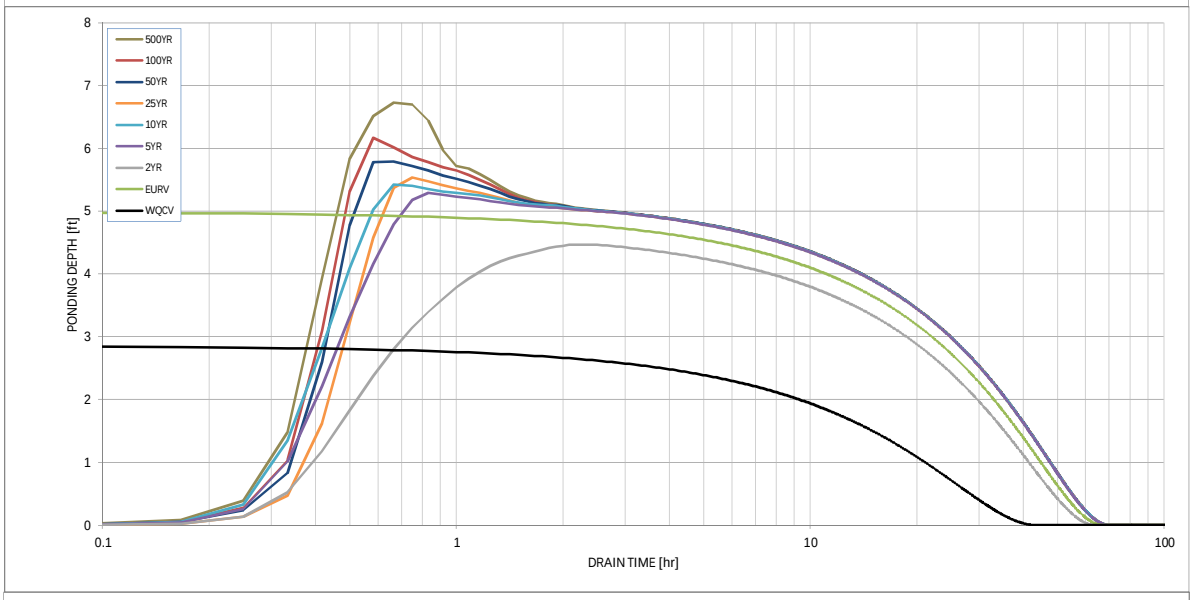
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

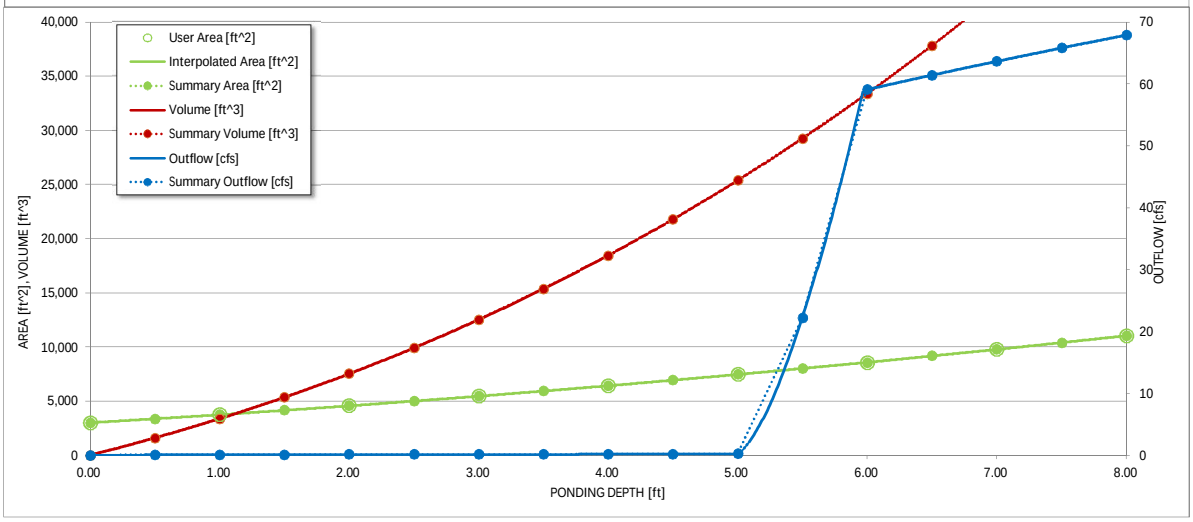
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.06	1.43	1.66	1.68	2.26	2.60	3.07
CUHP Runoff Volume (acre-ft) =	0.269	0.580	0.523	1.059	1.445	1.607	2.656	3.402	4.303
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.523	1.059	1.445	1.607	2.656	3.402	4.303
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	2.4	11.6	17.2	21.6	37.8	48.9	62.8
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.11	0.51	0.75	0.95	1.66	2.14	2.75
Peak Inflow Q (cfs) =	N/A	N/A	9.3	20.2	26.0	29.2	48.0	60.6	75.8
Peak Outflow Q (cfs) =	0.1	0.2	0.2	10.0	17.3	24.9	43.6	59.9	62.4
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.9	1.0	1.2	1.2	1.2	1.0
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	0.3	0.5	0.8	1.4	1.9	2.0
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) =	37	57	54	56	54	53	47	44	41
Time to Drain 99% of Inflow Volume (hours) =	40	61	58	62	61	60	57	56	54
Maximum Ponding Depth (ft) =	2.86	4.99	4.47	5.29	5.42	5.54	5.79	6.17	6.72
Area at Maximum Ponding Depth (acres) =	0.12	0.17	0.16	0.18	0.18	0.18	0.19	0.20	0.22
Maximum Volume Stored (acre-ft) =	0.270	0.581	0.493	0.631	0.656	0.678	0.725	0.798	0.915

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.00 (December 2019)







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	0.07	0.04	0.20
	0:15:00	0.00	0.00	0.45	0.90	1.12	0.55	1.05	1.08	1.42
	0:20:00	0.00	0.00	1.81	3.55	4.70	1.62	2.80	3.58	5.08
	0:25:00	0.00	0.00	6.63	13.94	20.02	5.75	10.47	14.05	21.82
	0:30:00	0.00	0.00	9.33	20.19	26.05	23.35	41.02	49.46	63.45
	0:35:00	0.00	0.00	9.09	18.70	23.79	29.19	47.97	60.55	75.79
	0:40:00	0.00	0.00	8.07	16.04	20.48	28.86	46.22	57.84	71.98
	0:45:00	0.00	0.00	6.69	13.49	17.69	25.41	40.57	52.49	65.23
	0:50:00	0.00	0.00	5.55	11.45	14.76	22.85	36.38	46.68	57.88
	0:55:00	0.00	0.00	4.58	9.26	12.22	18.84	30.16	39.95	49.53
	1:00:00	0.00	0.00	3.94	7.77	10.66	15.38	25.03	34.51	43.00
	1:05:00	0.00	0.00	3.50	6.78	9.60	13.15	21.80	31.10	38.82
	1:10:00	0.00	0.00	2.90	5.91	8.63	10.87	18.21	25.24	31.70
	1:15:00	0.00	0.00	2.36	4.92	7.68	8.93	15.09	20.17	25.51
	1:20:00	0.00	0.00	1.86	3.88	6.16	6.99	11.65	15.10	19.00
	1:25:00	0.00	0.00	1.42	2.98	4.58	5.28	8.62	10.74	13.47
	1:30:00	0.00	0.00	1.13	2.42	3.59	3.61	5.97	7.33	9.33
	1:35:00	0.00	0.00	0.98	2.15	3.04	2.59	4.46	5.31	6.85
	1:40:00	0.00	0.00	0.91	1.78	2.66	1.99	3.52	4.08	5.30
	1:45:00	0.00	0.00	0.87	1.51	2.39	1.62	2.90	3.23	4.22
	1:50:00	0.00	0.00	0.84	1.31	2.21	1.36	2.49	2.64	3.47
	1:55:00	0.00	0.00	0.72	1.17	1.99	1.21	2.22	2.22	2.94
	2:00:00	0.00	0.00	0.63	1.03	1.67	1.11	2.02	1.94	2.57
	2:05:00	0.00	0.00	0.47	0.76	1.23	0.82	1.48	1.38	1.83
	2:10:00	0.00	0.00	0.35	0.56	0.88	0.59	1.06	0.99	1.31
	2:15:00	0.00	0.00	0.26	0.41	0.63	0.43	0.76	0.72	0.95
	2:20:00	0.00	0.00	0.19	0.29	0.45	0.31	0.55	0.53	0.69
	2:25:00	0.00	0.00	0.14	0.20	0.32	0.22	0.39	0.38	0.49
	2:30:00	0.00	0.00	0.10	0.13	0.23	0.16	0.27	0.26	0.35
	2:35:00	0.00	0.00	0.07	0.09	0.16	0.11	0.19	0.19	0.24
	2:40:00	0.00	0.00	0.04	0.06	0.10	0.07	0.13	0.12	0.16
	2:45:00	0.00	0.00	0.02	0.04	0.06	0.05	0.08	0.07	0.09
	2:50:00	0.00	0.00	0.01	0.02	0.03	0.02	0.04	0.03	0.04
	2:55:00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01
	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
	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 4.03 (May 2020)

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 [ft²]	Area [acres]	Volume [ft³]	Volume [ac-ft]	Total Outflow [cfs]
6007.00	0.00	2,996	0.069	0	0.000	0.00
6007.50	0.50	3,367	0.077	1,591	0.037	0.06
6008.00	1.00	3,737	0.086	3,366	0.077	0.08
6008.50	1.50	4,145	0.095	5,337	0.123	0.10
6009.00	2.00	4,552	0.104	7,511	0.172	0.11
6009.50	2.50	4,998	0.115	9,898	0.227	0.13
6010.00	3.00	5,444	0.125	12,509	0.287	0.14
6010.50	3.50	5,927	0.136	15,352	0.352	0.15
6011.00	4.00	6,410	0.147	18,436	0.423	0.16
6011.50	4.50	6,931	0.159	21,771	0.500	0.17
6012.00	5.00	7,452	0.171	25,367	0.582	0.24
6012.50	5.50	8,010	0.184	29,233	0.671	22.18
6013.00	6.00	8,569	0.197	33,377	0.766	59.09
6013.50	6.50	9,165	0.210	37,811	0.868	61.41
6014.00	7.00	9,762	0.224	42,543	0.977	63.64
6014.50	7.50	10,396	0.239	47,582	1.092	65.80
6015.00	8.00	11,030	0.253	52,939	1.215	67.89

For best results, include the stages of all grade slope changes (e.g. ISV and Floor) from the S-A-V table on Sheet 'Basin'.

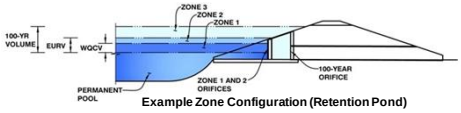
Also include the inverts of all outlets (e.g. vertical orifice, overflow grate, and spillway, where applicable).

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.03 (May 2020)

Project: PHASE II DRAINAGE REPORT FOR THE RIDGEGATE DEVELOPMENT

Basin ID: EURV POND E



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB	
Watershed Area =	38.0	acres
Watershed Length =	1,500	ft
Watershed Length to Centroid =	650	ft
Watershed Slope =	0.02	ft/ft
Watershed Imperviousness =	56%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	65.0%	percent
Percentage Hydrologic Soil Groups C/D =	35.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	Lone Tree - Municipal Court	

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) =	0.708	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	2.203	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.06 in.) =	1.786	acre-feet	1.06	inches
5-yr Runoff Volume (P1 = 1.43 in.) =	2.799	acre-feet	1.43	inches
10-yr Runoff Volume (P1 = 1.66 in.) =	3.475	acre-feet	1.66	inches
25-yr Runoff Volume (P1 = 1.68 in.) =	3.688	acre-feet		inches
50-yr Runoff Volume (P1 = 2.26 in.) =	5.504	acre-feet	2.26	inches
100-yr Runoff Volume (P1 = 2.6 in.) =	6.701	acre-feet	2.60	inches
500-yr Runoff Volume (P1 = 3.07 in.) =	8.240	acre-feet		inches
Approximate 2-yr Detention Volume =	1.577	acre-feet		
Approximate 5-yr Detention Volume =	2.351	acre-feet		
Approximate 10-yr Detention Volume =	2.905	acre-feet		
Approximate 25-yr Detention Volume =	2.783	acre-feet		
Approximate 50-yr Detention Volume =	3.461	acre-feet		
Approximate 100-yr Detention Volume =	3.935	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.708	acre-feet
Zone 2 Volume (EURV - Zone 1) =	1.496	acre-feet
Select Zone 3 Storage Volume (Optional) =		acre-feet
Total Detention Basin Volume =	2.203	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_{LW}) =	user	

Total detention volume is less than 100-year volume.

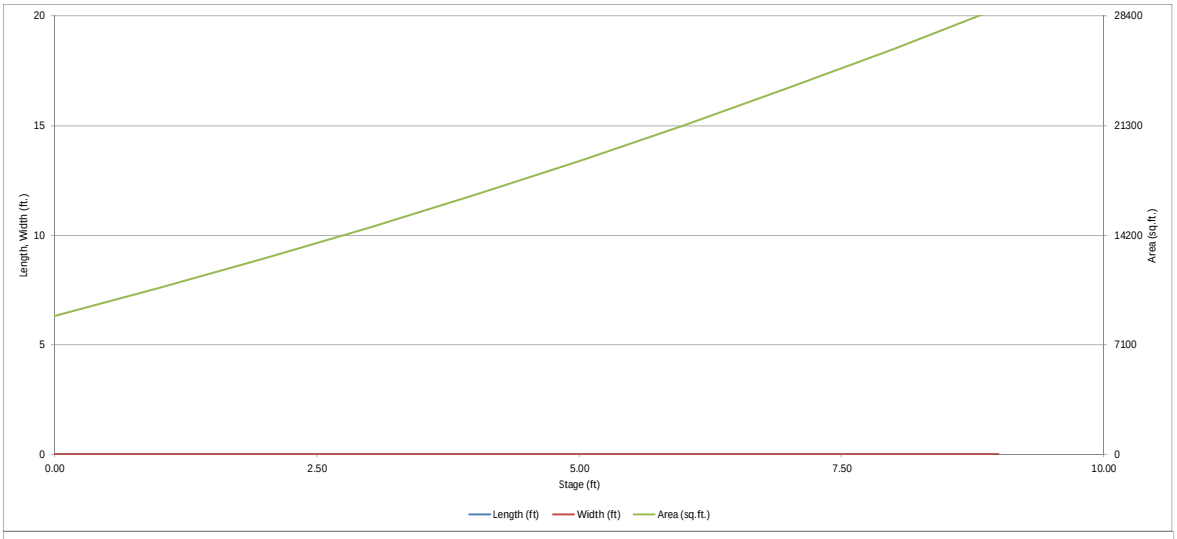
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	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

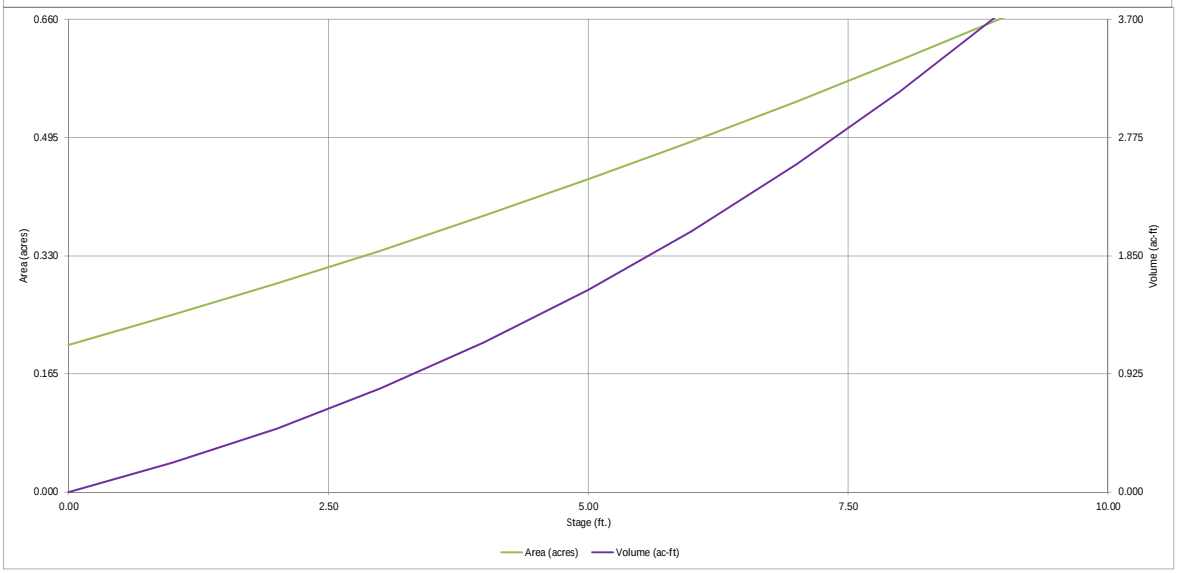
Depth Increment = ft

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	--	--	--	8,961	0.206		
6010	--	1.00	--	--	--	10,766	0.247	9,863	0.226
6011	--	2.00	--	--	--	12,675	0.291	21,584	0.496
6012	--	3.00	--	--	--	14,685	0.337	35,264	0.810
6013	--	4.00	--	--	--	16,797	0.386	51,005	1.171
6014	--	5.00	--	--	--	19,013	0.436	68,910	1.582
6015	--	6.00	--	--	--	21,331	0.490	89,082	2.045
6016	--	7.00	--	--	--	23,752	0.545	111,623	2.563
6017	--	8.00	--	--	--	26,275	0.603	136,637	3.137
6018	--	9.00	--	--	--	28,901	0.663	164,225	3.770

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.03 (May 2020)



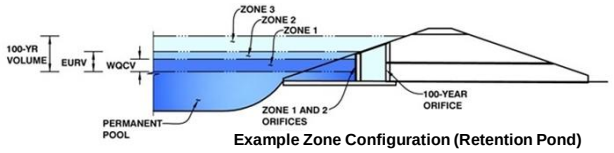


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.03 (May 2020)

Project: PHASE II DRAINAGE REPORT FOR THE RIDGEGATE DEVELOPMENT

Basin ID: EURV POND E



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.70	0.708	Orifice Plate
Zone 2 (EURV)	6.32	1.496	Circular Orifice
Zone 3			Weir&Pipe (Circular)
Total (all zones)		2.203	

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

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

Calculated Parameters for Underdrain

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

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	N/A	ft^2
Depth at top of Zone using Orifice Plate =	3.00	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	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							
Orifice Area (sq. inches)	6.50							

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

User Input: Vertical Orifice (Circular or Rectangular)

	Zone 2 Circular	Not Selected			Calculated Parameters for Vertical Orif: Zone 2 Circular	Not Selected
Invert of Vertical Orifice =		N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =		N/A
Depth at top of Zone using Vertical Orifice =		N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =		N/A
Vertical Orifice Diameter =		N/A	inches			

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			Calculated Parameters for Overflow W: Zone 3 Weir	Not Selected
Overflow Weir Front Edge Height, Ho =	6.32	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	6.32	N/A
Overflow Weir Front Edge Length =	46.00	N/A	feet	Overflow Weir Slope Length =	6.00	N/A
Overflow Weir Grate Slope =	0.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	15.37	N/A
Horiz. Length of Weir Sides =	6.00	N/A	feet	Overflow Grate Open Area w/o Debris =	193.20	N/A
Overflow Grate Open Area % =	70%	N/A	%, grate open area/total area	Overflow Grate Open Area w/ Debris =	96.60	N/A
Debris Clogging % =	50%	N/A	%			

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

	Zone 3 Circular	Not Selected			Calculated Parameters for Outlet Pipe w/ Flow Restriction Pla: Zone 3 Circular	Not Selected
Depth to Invert of Outlet Pipe =	0.50	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	12.57	N/A
Circular Orifice Diameter =	48.00	N/A	inches	Outlet Orifice Centroid =	2.00	N/A
				Half-Central Angle of Restrictor Plate on Pipe =	N/A	N/A

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	7.00	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=		feet
Spillway Crest Length =		feet	Stage at Top of Freeboard =		feet
Spillway End Slopes =		H:V	Basin Area at Top of Freeboard =		acres
Freeboard above Max Water Surface =		feet	Basin Volume at Top of Freeboard =		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 AI

Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.06	1.43	1.66	1.68	2.26	2.60
CUHP Runoff Volume (acre-ft) =	0.708	2.203	1.786	2.799	3.475	3.688	5.504	6.701
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	1.786	2.799	3.475	3.688	5.504	6.701
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	1.7	13.3	20.2	26.9	49.1	63.4
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A						
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.05	0.35	0.53	0.71	1.29	1.67
Peak Inflow Q (cfs) =	N/A	N/A	33.4	54.6	65.7	70.7	105.6	129.9
Peak Outflow Q (cfs) =	0.4	0.5	0.5	8.9	22.6	33.7	88.5	120.0
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.7	1.1	1.3	1.8	1.9
Structure Controlling Flow =	Plate	Overflow Weir 1	Plate	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	0.0	0.1	0.2	0.5	0.6
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	37	71	63	72	70	70	66	64
Time to Drain 99% of Inflow Volume (hours) =	40	77	68	78	77	77	75	74
Maximum Ponding Depth (ft) =	2.70	6.32	5.28	6.43	6.53	6.60	6.86	6.98
Area at Maximum Ponding Depth (acres) =	0.32	0.51	0.45	0.51	0.52	0.52	0.54	0.54
Maximum Volume Stored (acre-ft) =	0.710	2.205	1.706	2.261	2.312	2.344	2.481	2.546

ice

ft^2
feet

eir

feet
feet

ft^2
ft^2

ate

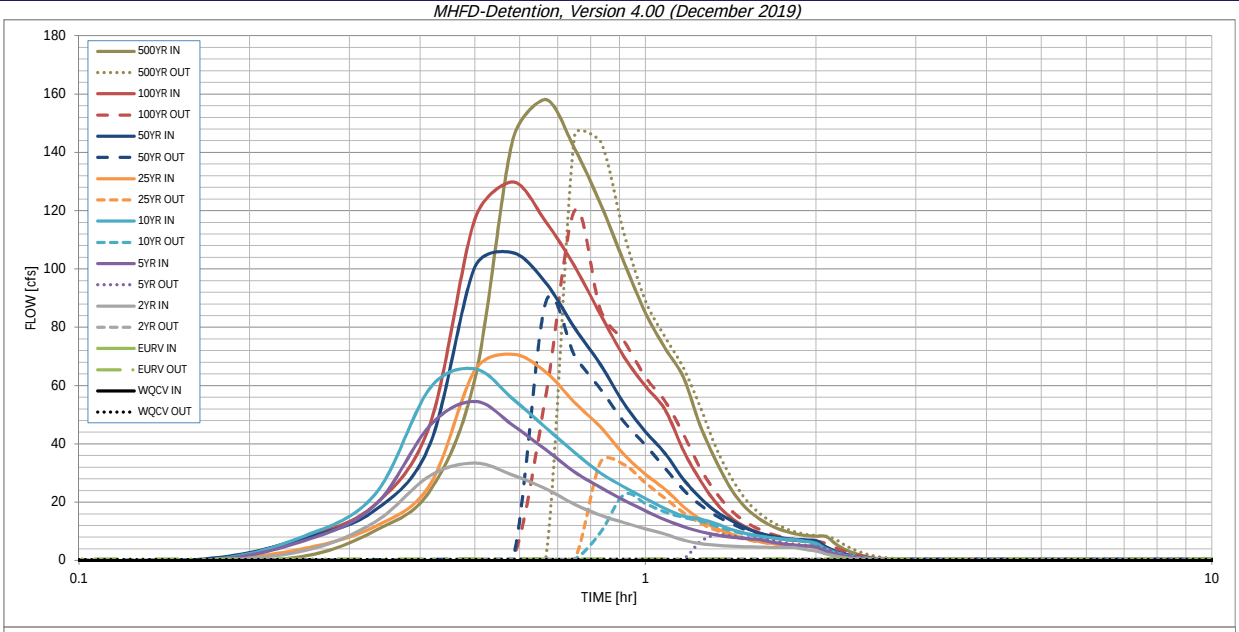
ft^2
feet
radians

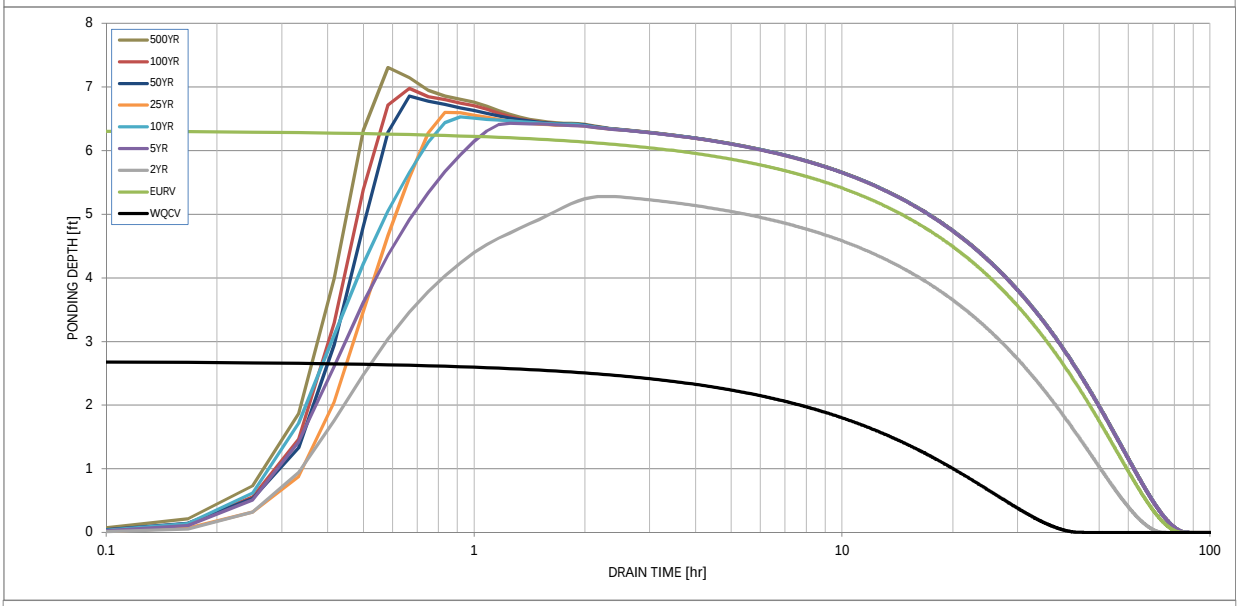
5).

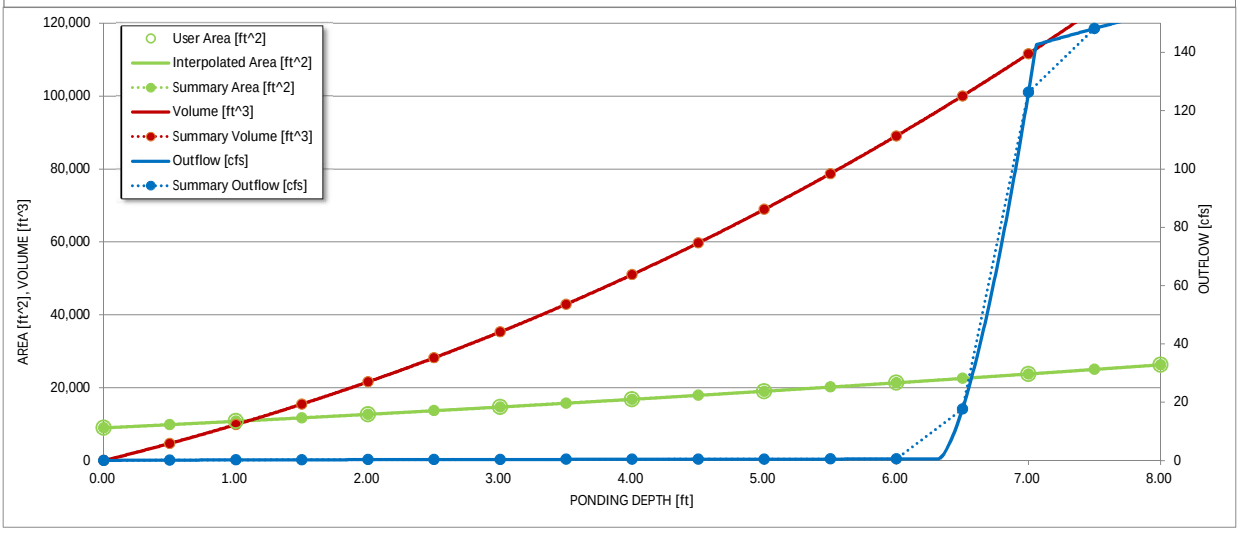
500 Year
3.07
8.240
8.240
81.5
2.14
158.1
145.8
1.8
Outlet Plate 1
0.8
N/A
61
72
7.31
0.56
2.729

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.00 (December 2019)







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	0.55	0.26	1.47
	0:15:00	0.00	0.00	3.35	6.78	8.38	4.15	7.68	7.91	10.21
	0:20:00	0.00	0.00	13.26	19.00	22.72	11.68	17.27	19.22	23.97
	0:25:00	0.00	0.00	29.08	46.34	59.17	26.02	39.96	46.81	62.40
	0:30:00	0.00	0.00	33.40	54.58	65.73	65.25	100.69	117.15	144.32
	0:35:00	0.00	0.00	29.29	46.37	55.41	70.71	105.58	129.87	158.12
	0:40:00	0.00	0.00	24.63	38.02	45.61	64.64	95.28	116.23	141.24
	0:45:00	0.00	0.00	19.26	30.33	37.02	54.15	79.75	100.86	122.27
	0:50:00	0.00	0.00	15.51	25.04	29.99	45.76	67.16	84.34	102.29
	0:55:00	0.00	0.00	12.98	20.65	25.23	36.34	53.81	69.88	84.93
	1:00:00	0.00	0.00	10.87	17.03	21.27	29.57	44.17	59.81	72.77
	1:05:00	0.00	0.00	9.05	13.97	17.82	24.39	36.71	51.70	62.89
	1:10:00	0.00	0.00	6.97	11.62	15.23	18.50	27.86	37.72	46.16
	1:15:00	0.00	0.00	5.81	9.93	14.22	14.14	21.45	27.46	34.06
	1:20:00	0.00	0.00	5.24	8.75	12.62	11.01	16.73	19.67	24.48
	1:25:00	0.00	0.00	4.90	8.00	10.67	9.09	13.76	14.65	18.28
	1:30:00	0.00	0.00	4.73	7.51	9.35	7.55	11.22	11.59	14.48
	1:35:00	0.00	0.00	4.61	7.19	8.44	6.51	9.49	9.56	11.94
	1:40:00	0.00	0.00	4.52	6.32	7.81	5.89	8.44	8.23	10.28
	1:45:00	0.00	0.00	4.46	5.68	7.39	5.47	7.70	7.34	9.17
	1:50:00	0.00	0.00	4.43	5.24	7.08	5.20	7.24	6.85	8.55
	1:55:00	0.00	0.00	3.76	4.94	6.61	5.05	6.98	6.69	8.33
	2:00:00	0.00	0.00	3.26	4.58	5.88	4.97	6.83	6.62	8.24
	2:05:00	0.00	0.00	2.24	3.14	4.03	3.42	4.69	4.57	5.69
	2:10:00	0.00	0.00	1.49	2.09	2.70	2.29	3.13	3.07	3.82
	2:15:00	0.00	0.00	0.98	1.36	1.79	1.54	2.09	2.05	2.55
	2:20:00	0.00	0.00	0.62	0.85	1.13	0.98	1.33	1.30	1.61
	2:25:00	0.00	0.00	0.37	0.54	0.70	0.62	0.84	0.82	1.02
	2:30:00	0.00	0.00	0.20	0.31	0.39	0.36	0.49	0.48	0.60
	2:35:00	0.00	0.00	0.08	0.15	0.18	0.18	0.24	0.23	0.28
	2:40:00	0.00	0.00	0.03	0.04	0.05	0.06	0.07	0.07	0.09
	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
	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

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.03 (May 2020)

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]
6009.00	0.00	8,961	0.206	0	0.000	0.00
6009.5	0.50	9,864	0.226	4,706	0.108	0.15
6010.0	1.00	10,766	0.247	9,863	0.226	0.22
6010.5	1.50	11,721	0.269	15,485	0.355	0.27
6011.0	2.00	12,675	0.291	21,584	0.496	0.31
6011.5	2.50	13,680	0.314	28,173	0.647	0.34
6012.0	3.00	14,685	0.337	35,264	0.810	0.38
6012.5	3.50	15,741	0.361	42,870	0.984	0.41
6013.0	4.00	16,797	0.386	51,005	1.171	0.43
6013.5	4.50	17,905	0.411	59,680	1.370	0.46
6014.0	5.00	19,013	0.436	68,910	1.582	0.49
6014.5	5.50	20,172	0.463	78,706	1.807	0.51
6015.0	6.00	21,331	0.490	89,082	2.045	0.53
6015.5	6.50	22,541	0.517	100,050	2.297	17.68
6016.0	7.00	23,752	0.545	111,623	2.563	126.32
6016.5	7.50	25,013	0.574	123,815	2.842	148.21
6017.0	8.00	26,275	0.603	136,637	3.137	154.26
6017.5	8.50	27,588	0.633	150,103	3.446	160.09
6018.0	9.00	28,901	0.663	164,225	3.770	165.70

For best results, include the stages of all grade slope changes (e.g. ISV and Floor) from the S-A-V table on Sheet 'Basin'.

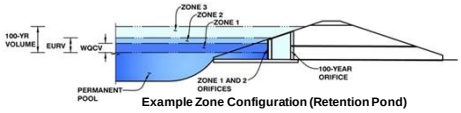
Also include the inverts of all outlets (e.g. vertical orifice, overflow grate, and spillway, where applicable).

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.03 (May 2020)

Project: PHASE II DRAINAGE REPORT FOR THE RIDGEGATE DEVELOPMENT

Basin ID: EURV POND F



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB	
Watershed Area =	74.6	acres
Watershed Length =	2,200	ft
Watershed Length to Centroid =	1,000	ft
Watershed Slope =	0.03	ft/ft
Watershed Imperviousness =	38%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	52.0%	percent
Percentage Hydrologic Soil Groups C/D =	48.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	Lone Tree - Municipal Court	

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) =	1.085	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	2.801	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.06 in.) =	2.426	acre-feet	1.06	inches
5-yr Runoff Volume (P1 = 1.43 in.) =	4.286	acre-feet	1.43	inches
10-yr Runoff Volume (P1 = 1.66 in.) =	5.586	acre-feet	1.66	inches
25-yr Runoff Volume (P1 = 1.68 in.) =	6.104	acre-feet		inches
50-yr Runoff Volume (P1 = 2.26 in.) =	9.667	acre-feet	2.26	inches
100-yr Runoff Volume (P1 = 2.6 in.) =	12.123	acre-feet	2.60	inches
500-yr Runoff Volume (P1 = 3.07 in.) =	15.182	acre-feet		inches
Approximate 2-yr Detention Volume =	1.982	acre-feet		
Approximate 5-yr Detention Volume =	3.162	acre-feet		
Approximate 10-yr Detention Volume =	3.972	acre-feet		
Approximate 25-yr Detention Volume =	3.920	acre-feet		
Approximate 50-yr Detention Volume =	4.905	acre-feet		
Approximate 100-yr Detention Volume =	5.882	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	1.085	acre-feet
Zone 2 Volume (EURV - Zone 1) =	1.716	acre-feet
Select Zone 3 Storage Volume (Optional) =		acre-feet
Total Detention Basin Volume =	2.801	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_{LW}) =	user	

Total detention volume is less than 100-year volume.

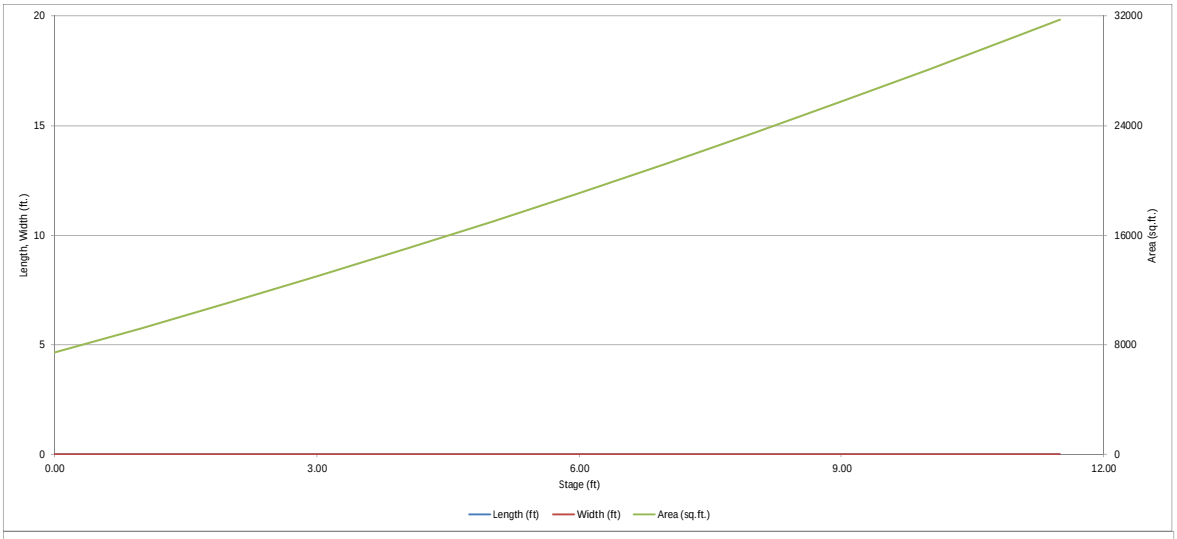
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	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

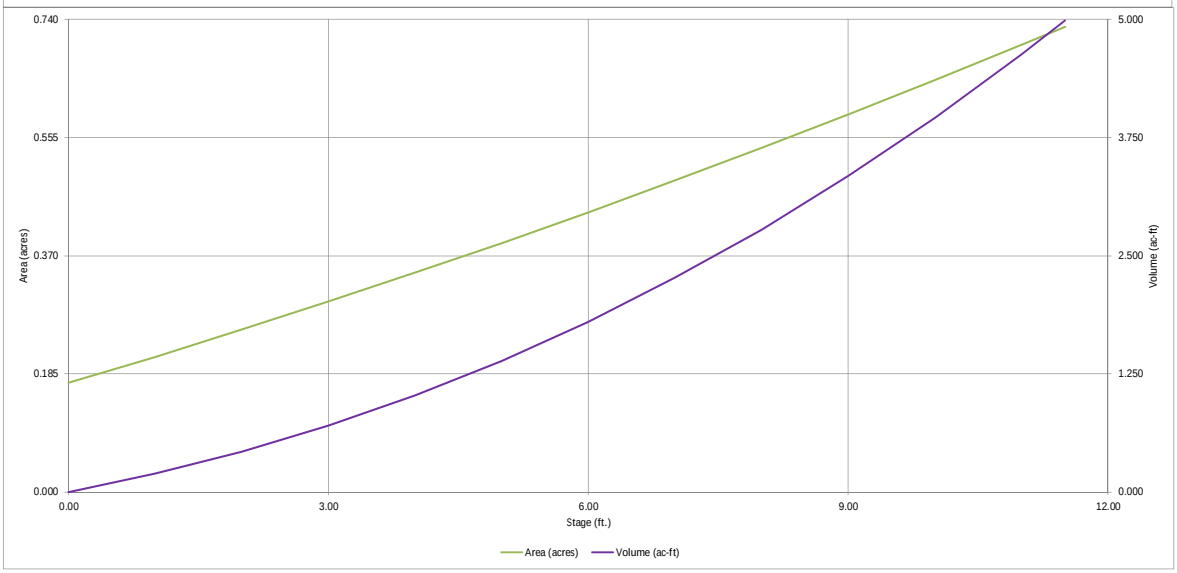
Depth Increment = ft

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	--	--	--	7,430	0.171		
6061	--	1.00	--	--	--	9,216	0.212	8,323	0.191
6062	--	2.00	--	--	--	11,065	0.254	18,463	0.424
6063	--	3.00	--	--	--	12,975	0.298	30,483	0.700
6064	--	4.00	--	--	--	14,948	0.343	44,445	1.020
6065	--	5.00	--	--	--	16,982	0.390	60,410	1.387
6066	--	6.00	--	--	--	19,080	0.438	78,441	1.801
6067	--	7.00	--	--	--	21,240	0.488	98,601	2.264
6068	--	8.00	--	--	--	23,462	0.539	120,952	2.777
6069	--	9.00	--	--	--	25,747	0.591	145,556	3.342
6070	--	10.00	--	--	--	28,093	0.645	172,476	3.960
6071	--	11.00	--	--	--	30,502	0.700	201,774	4.632
6071.5	--	11.50	--	--	--	31,730	0.728	217,332	4.989

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.03 (May 2020)



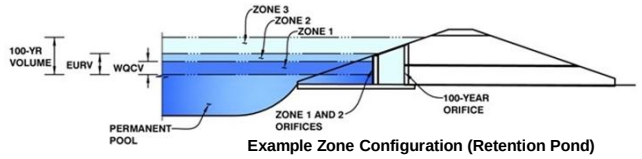


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.03 (May 2020)

Project: PHASE II DRAINAGE REPORT FOR THE RIDGEGATE DEVELOPMENT

Basin ID: EURV POND F



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	4.19	1.085	Orifice Plate
Zone 2 (EURV)	8.05	1.716	Circular Orifice
Zone 3			Weir&Pipe (Circular)
Total (all zones)		2.801	

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

			Calculated Parameters for Underdrain		
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

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)

			Calculated Parameters for Plate		
Invert 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 =	8.25	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	inches	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							
Orifice Area (sq. inches)	7.50							

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

User Input: Vertical Orifice (Circular or Rectangular)

	Zone 2 Circular	Not Selected		Calculated Parameters for Vertical Orific	Zone 2 Circular	Not Selected
Invert of Vertical Orifice =	3.64	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	0.00	N/A
Depth at top of Zone using Vertical Orifice =	7.11	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	0.02	N/A
Vertical Orifice Diameter =	0.38	N/A	inches			

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		Calculated Parameters for Overflow Wei	Zone 3 Weir	Not Selected
Overflow Weir Front Edge Height, Ho =	8.05	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	8.05	N/A
Overflow Weir Front Edge Length =	26.00	N/A	feet	Overflow Weir Slope Length =	6.00	N/A
Overflow Weir Grate Slope =	0.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	6.87	N/A
Horiz. Length of Weir Sides =	6.00	N/A	feet	Overflow Grate Open Area w/o Debris =	109.20	N/A
Overflow Grate Open Area % =	70%	N/A	%, grate open area/total area	Overflow Grate Open Area w/ Debris =	54.60	N/A
Debris Clogging % =	50%	N/A	%			

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

	Zone 3 Circular	Not Selected		Calculated Parameters for Outlet Pipe w/ Flow Restriction Pla	Zone 3 Circular	Not Selected
Depth to Invert of Outlet Pipe =	2.50	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	15.90	N/A
Circular Orifice Diameter =	54.00	N/A	inches	Outlet Orifice Centroid =	2.25	N/A
				Half-Central Angle of Restrictor Plate on Pipe =	N/A	N/A

User Input: Emergency Spillway (Rectangular or Trapezoidal)

			Calculated Parameters for Spillway		
Spillway Invert Stage=	9.50	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=		feet
Spillway Crest Length =		feet	Stage at Top of Freeboard =		feet
Spillway End Slopes =		H:V	Basin Area at Top of Freeboard =		acres
Freeboard above Max Water Surface =		feet	Basin Volume at Top of Freeboard =		acre-ft

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
One-Hour Rainfall Depth (in) =	N/A	N/A	1.06	1.43	1.66	1.68	2.26	2.60
CUHP Runoff Volume (acre-ft) =	1.085	2.801	2.426	4.286	5.586	6.104	9.667	12.123
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	2.426	4.286	5.586	6.104	9.667	12.123
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	4.8	28.8	43.0	55.6	101.0	130.3
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A						
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.06	0.39	0.58	0.75	1.35	1.75
Peak Inflow Q (cfs) =	N/A	N/A	40.0	76.3	96.7	107.3	170.7	211.6
Peak Outflow Q (cfs) =	0.5	0.7	0.7	25.6	48.9	74.8	156.3	199.4
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.9	1.1	1.3	1.5	1.5
Structure Controlling Flow =	Vertical Orifice 1	Overflow Weir 1	Vertical Orifice 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	0.2	0.4	0.7	1.4	1.8
Max Velocity through Grate 2 (fps) =	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	62	67	65	64	59	57
Time to Drain 99% of Inflow Volume (hours) =	41	72	66	73	72	72	69	67
Maximum Ponding Depth (ft) =	4.19	8.05	7.10	8.37	8.55	8.71	9.13	9.32
Area at Maximum Ponding Depth (acres) =	0.35	0.54	0.49	0.56	0.57	0.58	0.60	0.61
Maximum Volume Stored (acre-ft) =	1.086	2.804	2.308	2.974	3.075	3.172	3.419	3.533

ice

ft^2
feet

ir

feet
feet

ft^2
ft^2

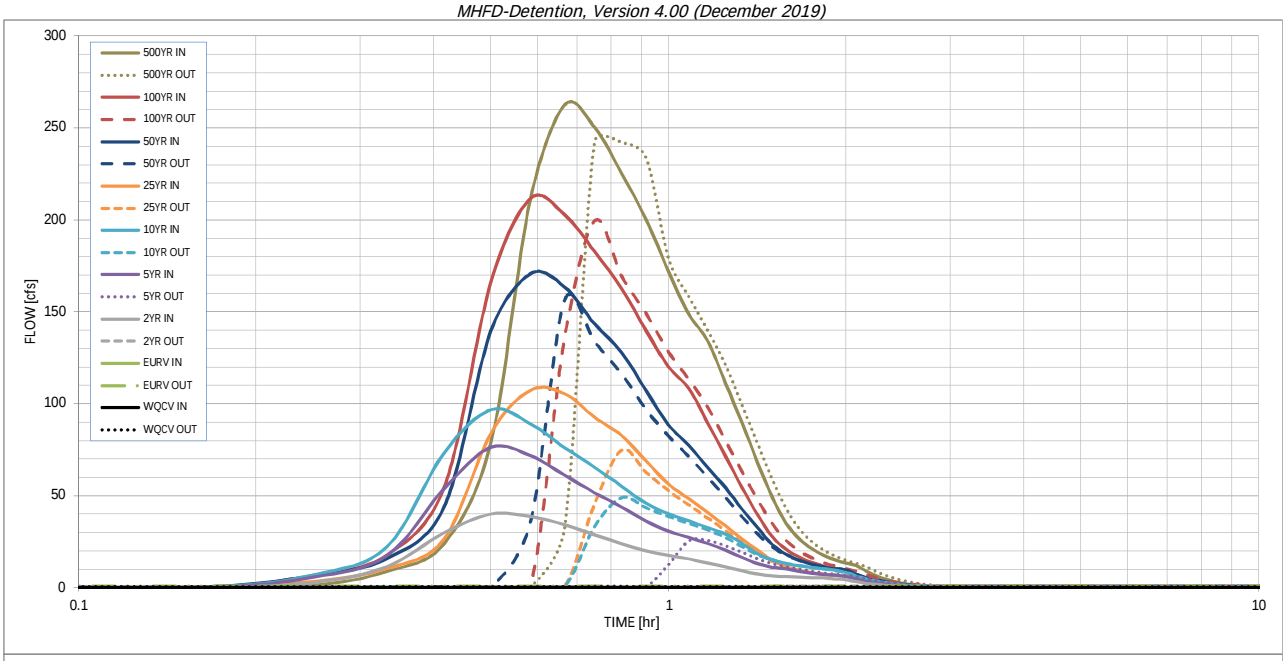
te

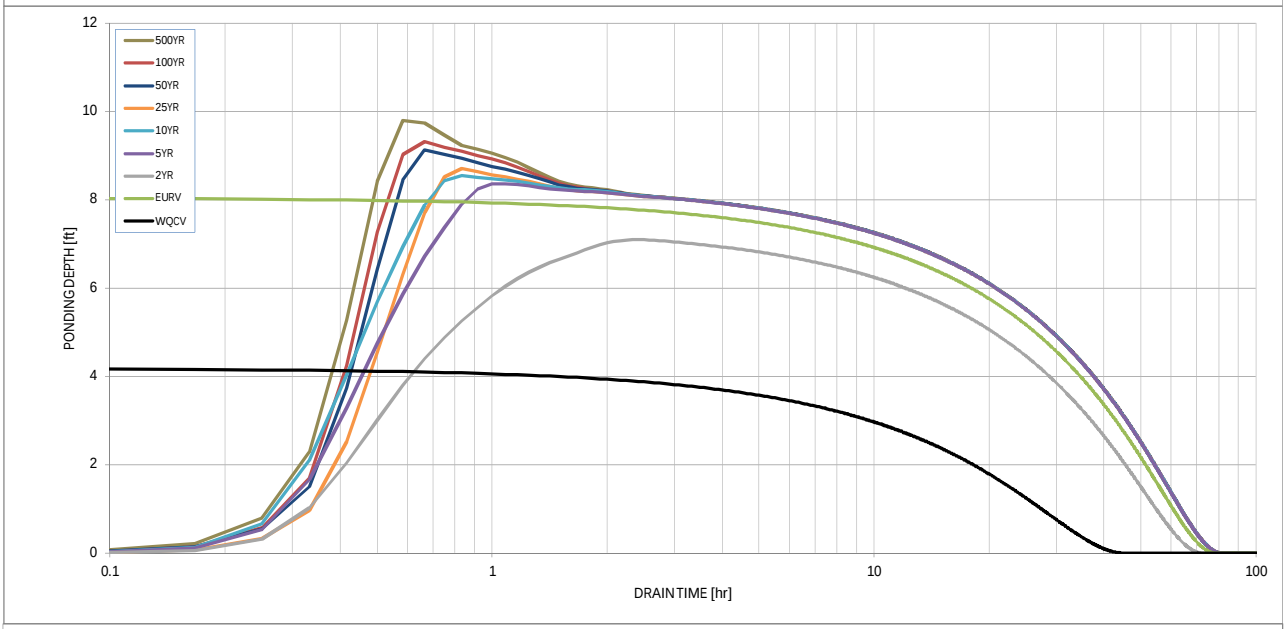
ft^2
feet
radians

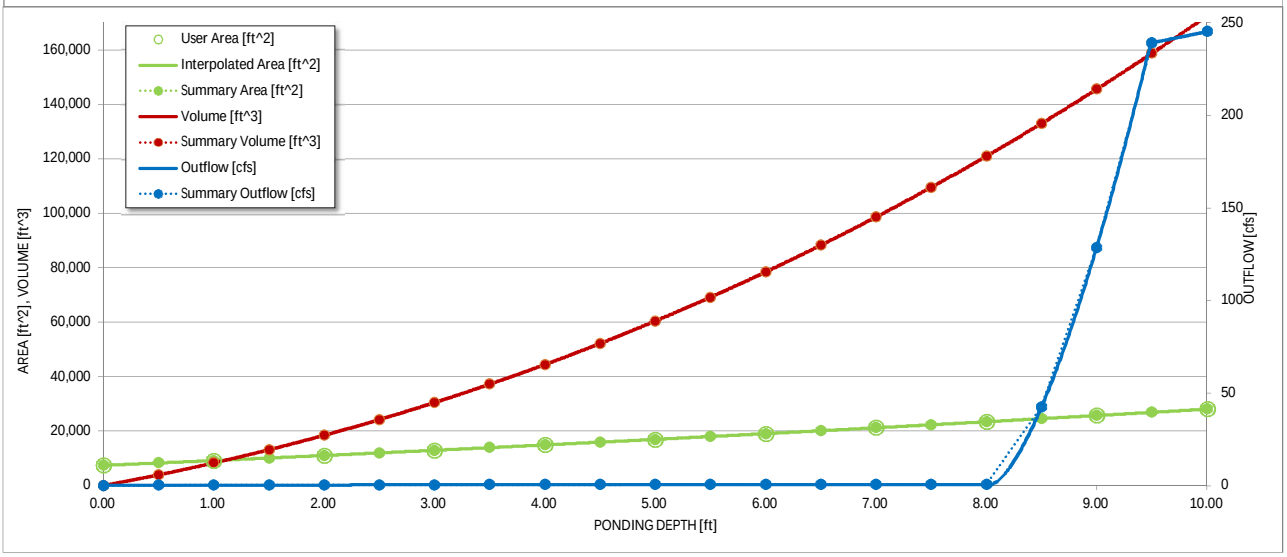
500 Year
3.07
15.182
15.182
167.5
2.25
262.4
242.7
1.4
Outlet Plate 1
2.2
N/A
53
66
9.79
0.63
3.825

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.00 (December 2019)







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	0.45	0.21	1.23
	0:15:00	0.00	0.00	2.72	5.56	6.90	3.41	6.46	6.61	8.77
	0:20:00	0.00	0.00	11.42	17.35	22.19	10.40	15.77	17.62	23.93
	0:25:00	0.00	0.00	29.81	53.87	73.32	26.48	43.71	54.30	78.53
	0:30:00	0.00	0.00	39.96	76.30	96.69	83.79	139.43	165.84	210.85
	0:35:00	0.00	0.00	38.70	71.75	89.14	107.27	170.68	211.58	262.43
	0:40:00	0.00	0.00	34.17	61.15	76.12	105.40	163.65	202.88	250.27
	0:45:00	0.00	0.00	28.63	51.54	65.54	92.64	143.40	182.77	225.32
	0:50:00	0.00	0.00	23.87	43.87	55.04	82.62	127.88	162.63	200.21
	0:55:00	0.00	0.00	20.02	36.10	45.78	68.85	107.12	139.75	172.07
	1:00:00	0.00	0.00	17.43	30.74	40.16	56.32	88.68	120.24	148.66
	1:05:00	0.00	0.00	15.62	27.16	36.26	48.35	77.26	108.21	134.02
	1:10:00	0.00	0.00	13.32	24.01	32.66	40.51	65.15	89.26	111.09
	1:15:00	0.00	0.00	11.12	20.29	29.11	33.56	54.23	71.50	89.60
	1:20:00	0.00	0.00	9.13	16.35	24.00	26.55	42.65	54.31	67.95
	1:25:00	0.00	0.00	7.48	12.99	18.46	20.39	32.40	39.39	49.22
	1:30:00	0.00	0.00	6.42	11.07	15.10	14.70	23.41	27.69	34.97
	1:35:00	0.00	0.00	5.89	10.17	13.18	11.32	18.14	20.76	26.45
	1:40:00	0.00	0.00	5.63	8.91	11.83	9.30	14.86	16.58	21.20
	1:45:00	0.00	0.00	5.49	7.88	10.86	8.04	12.72	13.65	17.52
	1:50:00	0.00	0.00	5.38	7.14	10.22	7.18	11.25	11.66	15.01
	1:55:00	0.00	0.00	4.75	6.60	9.42	6.66	10.30	10.24	13.21
	2:00:00	0.00	0.00	4.16	6.03	8.31	6.30	9.62	9.27	11.97
	2:05:00	0.00	0.00	3.19	4.59	6.25	4.81	7.28	6.89	8.89
	2:10:00	0.00	0.00	2.36	3.34	4.48	3.47	5.22	4.94	6.36
	2:15:00	0.00	0.00	1.74	2.43	3.21	2.51	3.75	3.58	4.59
	2:20:00	0.00	0.00	1.27	1.75	2.32	1.83	2.72	2.62	3.36
	2:25:00	0.00	0.00	0.91	1.22	1.65	1.29	1.92	1.86	2.38
	2:30:00	0.00	0.00	0.64	0.83	1.15	0.91	1.34	1.30	1.67
	2:35:00	0.00	0.00	0.44	0.57	0.80	0.65	0.95	0.92	1.17
	2:40:00	0.00	0.00	0.28	0.38	0.51	0.43	0.63	0.60	0.77
	2:45:00	0.00	0.00	0.16	0.23	0.29	0.26	0.37	0.35	0.45
	2:50:00	0.00	0.00	0.07	0.11	0.13	0.13	0.18	0.17	0.21
	2:55:00	0.00	0.00	0.03	0.04	0.04	0.04	0.06	0.05	0.06
	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
	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 4.03 (May 2020)

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]
6060.00	0.00	7,430	0.171	0	0.000	0.00
6060.50	0.50	8,323	0.191	3,938	0.090	0.18
6061.00	1.00	9,216	0.212	8,323	0.191	0.25
6061.50	1.50	10,141	0.233	13,162	0.302	0.31
6062.00	2.00	11,065	0.254	18,463	0.424	0.35
6062.50	2.50	12,020	0.276	24,235	0.556	0.40
6063.00	3.00	12,975	0.298	30,483	0.700	0.43
6063.50	3.50	13,961	0.321	37,218	0.854	0.47
6064.00	4.00	14,948	0.343	44,445	1.020	0.50
6064.50	4.50	15,965	0.367	52,173	1.198	0.54
6065.00	5.00	16,982	0.390	60,410	1.387	0.57
6065.50	5.50	18,031	0.414	69,163	1.588	0.59
6066.00	6.00	19,080	0.438	78,441	1.801	0.62
6066.50	6.50	20,160	0.463	88,251	2.026	0.65
6067.00	7.00	21,240	0.488	98,601	2.264	0.67
6067.50	7.50	22,351	0.513	109,499	2.514	0.69
6068.00	8.00	23,462	0.539	120,952	2.777	0.72
6068.50	8.50	24,604	0.565	132,969	3.053	42.40
6069.00	9.00	25,747	0.591	145,556	3.342	128.54
6069.50	9.50	26,920	0.618	158,723	3.644	239.12
6070.00	10.00	28,093	0.645	172,476	3.960	245.17
6070.50	10.50	29,297	0.673	186,824	4.289	251.08
6071.00	11.00	30,502	0.700	201,774	4.632	256.85
6071.50	11.50	31,730	0.728	217,332	4.989	262.50

For best results, include the stages of all grade slope changes (e.g. ISV and Floor) from the S-A-V table on Sheet 'Basin'.

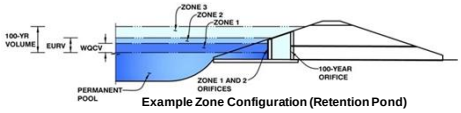
Also include the inverts of all outlets (e.g. vertical orifice, overflow grate, and spillway, where applicable).

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.03 (May 2020)

Project: PHASE II DRAINAGE REPORT FOR THE RIDGEGATE DEVELOPMENT

Basin ID: EURV POND R



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB	
Watershed Area =	70.0	acres
Watershed Length =	2,100	ft
Watershed Length to Centroid =	1,000	ft
Watershed Slope =	0.050	ft/ft
Watershed Imperviousness =	57%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	12.0%	percent
Percentage Hydrologic Soil Groups C/D =	88.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	Lone Tree - Municipal Court	

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) =	1.321	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	3.874	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.06 in.) =	3.515	acre-feet	1.06	inches
5-yr Runoff Volume (P1 = 1.43 in.) =	5.486	acre-feet	1.43	inches
10-yr Runoff Volume (P1 = 1.66 in.) =	6.800	acre-feet	1.66	inches
25-yr Runoff Volume (P1 = 1.68 in.) =	7.118	acre-feet		inches
50-yr Runoff Volume (P1 = 2.26 in.) =	10.561	acre-feet	2.26	inches
100-yr Runoff Volume (P1 = 2.6 in.) =	12.798	acre-feet	2.60	inches
500-yr Runoff Volume (P1 = 3.07 in.) =	15.672	acre-feet		inches
Approximate 2-yr Detention Volume =	3.010	acre-feet		
Approximate 5-yr Detention Volume =	4.639	acre-feet		
Approximate 10-yr Detention Volume =	5.346	acre-feet		
Approximate 25-yr Detention Volume =	5.089	acre-feet		
Approximate 50-yr Detention Volume =	6.293	acre-feet		
Approximate 100-yr Detention Volume =	7.194	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	1.321	acre-feet
Zone 2 Volume (EURV - Zone 1) =	2.553	acre-feet
Select Zone 3 Storage Volume (Optional) =		acre-feet
Total Detention Basin Volume =	3.874	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_{LW}) =	user	

Total detention volume is less than 100-year volume.

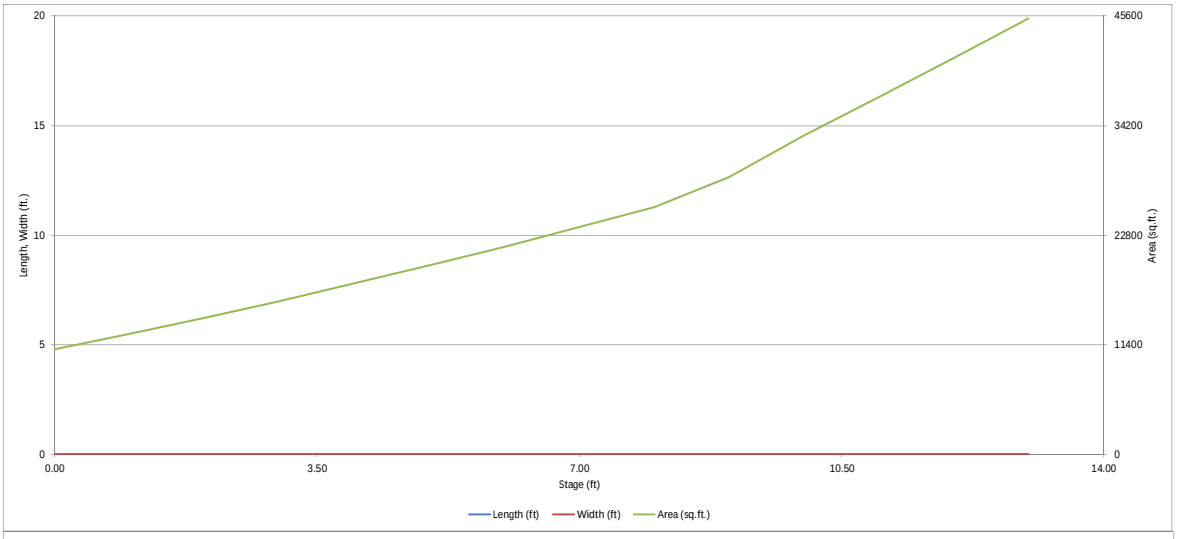
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	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

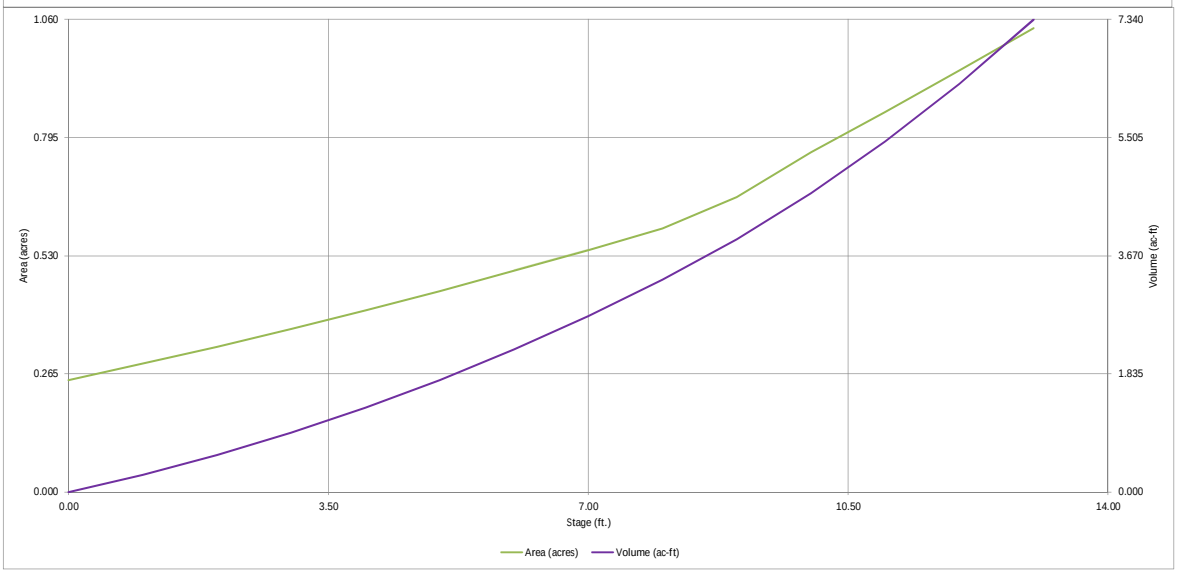
Depth Increment = ft

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	--	--	--	10,925	0.251		
5973	--	1.00	--	--	--	12,526	0.288	11,725	0.269
5974	--	2.00	--	--	--	14,198	0.326	25,087	0.576
5975	--	3.00	--	--	--	15,942	0.366	40,157	0.922
5976	--	4.00	--	--	--	17,756	0.408	57,006	1.309
5977	--	5.00	--	--	--	19,643	0.451	75,706	1.738
5978	--	6.00	--	--	--	21,600	0.496	96,327	2.211
5979	--	7.00	--	--	--	23,629	0.542	118,942	2.731
5980	--	8.00	--	--	--	25,730	0.591	143,621	3.297
5981	--	9.00	--	--	--	28,831	0.662	170,902	3.923
5982	--	10.00	--	--	--	33,172	0.762	201,903	4.635
5983	--	11.00	--	--	--	37,162	0.853	237,070	5.442
5984	--	12.00	--	--	--	41,223	0.946	276,263	6.342
5985	--	13.00	--	--	--	45,356	1.041	319,552	7.336

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.03 (May 2020)



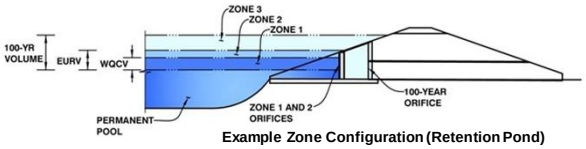


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.03 (May 2020)

Project: PHASE II DRAINAGE REPORT FOR THE RIDGEGATE DEVELOPMENT

Basin ID: EURV POND R



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	4.04	1.321	Orifice Plate
Zone 2 (EURV)	8.93	2.553	Circular Orifice
Zone 3			Weir&Pipe (Circular)
Total (all zones)		3.874	

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

			Calculated Parameters for Underdrain		
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

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)

			Calculated Parameters for Plate		
Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	N/A	ft²
Depth at top of Zone using Orifice Plate =	3.03	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	12.10	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	N/A	inches	Elliptical Slot Area =	N/A	ft²

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							
Orifice Area (sq. inches)	10.00							

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

User Input: Vertical Orifice (Circular or Rectangular)

	Zone 2 Circular	Not Selected		Calculated Parameters for Vertical Orifice	Zone 2 Circular	Not Selected	
Invert of Vertical Orifice =		N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =		N/A	ft²
Depth at top of Zone using Vertical Orifice =		N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =		N/A	feet
Vertical Orifice Diameter =		N/A	inches				

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		Calculated Parameters for Overflow Weir	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	8.93	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	8.93	N/A	feet
Overflow Weir Front Edge Length =	42.00	N/A	feet	Overflow Weir Slope Length =	6.00	N/A	feet
Overflow Weir Grate Slope =	0.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	8.98	N/A	
Horiz. Length of Weir Sides =	6.00	N/A	feet	Overflow Grate Open Area w/o Debris =	176.40	N/A	ft²
Overflow Grate Open Area % =	70%	N/A	%, grate open area/total area	Overflow Grate Open Area w/ Debris =	88.20	N/A	ft²
Debris Clogging % =	50%	N/A	%				

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

	Zone 3 Circular	Not Selected		Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate	Zone 3 Circular	Not Selected	
Depth to Invert of Outlet Pipe =	2.50	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	19.63	N/A	ft²
Circular Orifice Diameter =	60.00	N/A	inches	Outlet Orifice Centroid =	2.50	N/A	feet
				Half-Central Angle of Restrictor Plate on Pipe =	N/A	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

			Calculated Parameters for Spillway	
Spillway Invert Stage=	11.00	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	feet
Spillway Crest Length =		feet	Stage at Top of Freeboard =	feet
Spillway End Slopes =		H:V	Basin Area at Top of Freeboard =	acres
Freeboard above Max Water Surface =		feet	Basin Volume at Top of Freeboard =	acre-ft

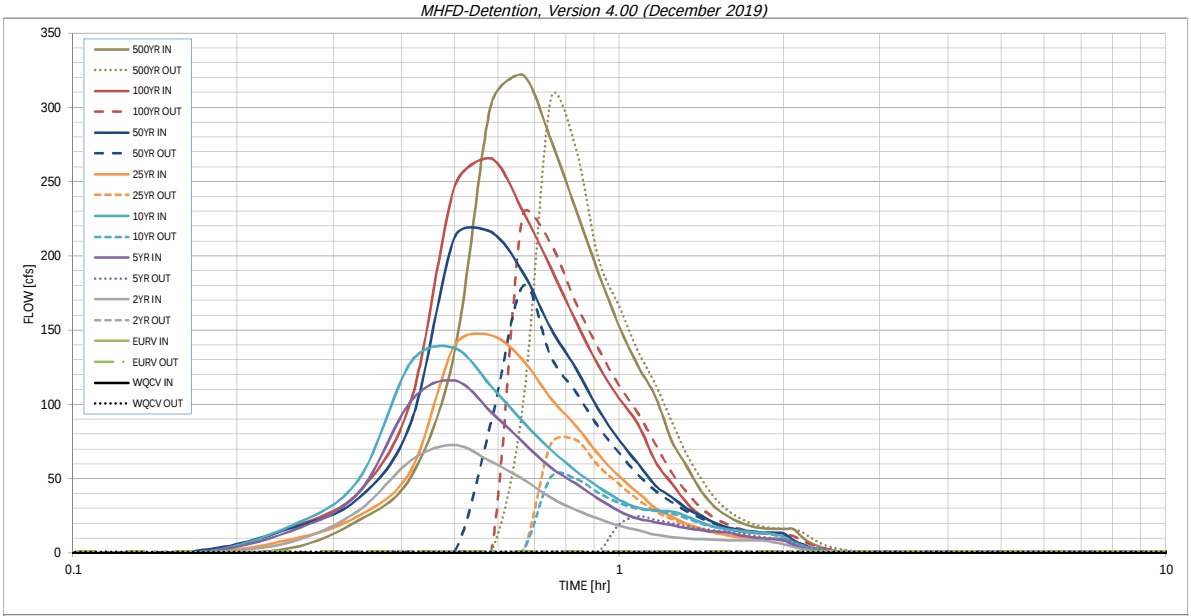
Routed Hydrograph Results

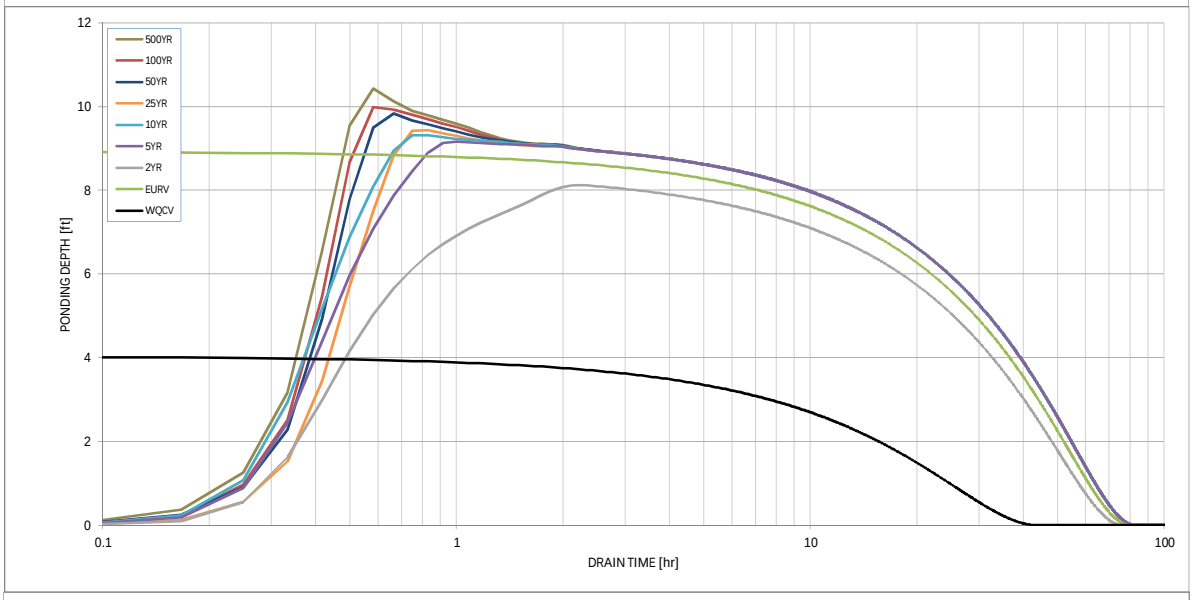
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

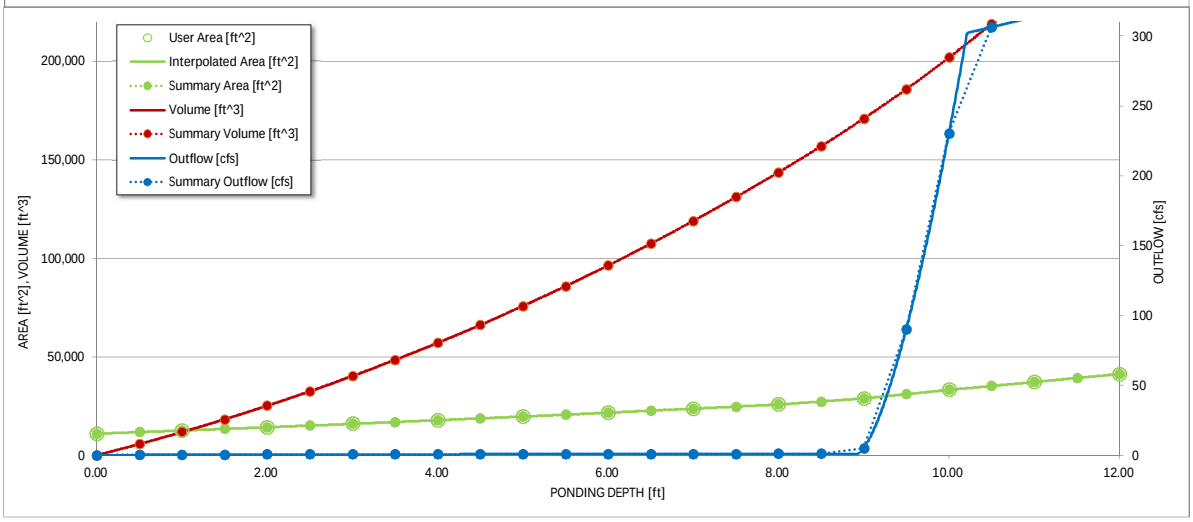
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.06	1.43	1.66	1.68	2.26	2.60	3.07
CUHP Runoff Volume (acre-ft) =	1.321	3.874	3.515	5.486	6.800	7.118	10.561	12.798	15.672
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	3.515	5.486	6.800	7.118	10.561	12.798	15.672
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	8.5	34.1	48.1	59.8	105.5	135.3	172.3
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.12	0.49	0.69	0.85	1.51	1.93	2.46
Peak Inflow Q (cfs) =	N/A	N/A	72.5	116.0	137.9	146.5	216.0	265.5	321.8
Peak Outflow Q (cfs) =	0.7	1.0	1.0	24.6	50.9	76.1	179.5	227.2	305.3
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.7	1.1	1.3	1.7	1.7	1.8
Structure Controlling Flow =	Plate	Overflow Weir 1	Plate	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	0.1	0.3	0.4	1.0	1.3	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) =	37	68	65	68	66	66	62	60	58
Time to Drain 99% of Inflow Volume (hours) =	40	73	70	74	73	73	71	70	69
Maximum Ponding Depth (ft) =	4.04	8.93	8.12	9.16	9.32	9.44	9.84	9.99	10.43
Area at Maximum Ponding Depth (acres) =	0.41	0.66	0.60	0.68	0.69	0.70	0.74	0.76	0.80
Maximum Volume Stored (acre-ft) =	1.325	3.877	3.363	4.031	4.133	4.217	4.507	4.627	4.963

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.00 (December 2019)







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	1.17	0.55	3.16
	0:15:00	0.00	0.00	7.19	14.54	17.99	8.90	16.43	16.93	21.79
	0:20:00	0.00	0.00	28.26	40.32	49.15	24.78	36.51	40.67	51.60
	0:25:00	0.00	0.00	62.41	102.48	128.73	56.00	88.23	103.03	135.17
	0:30:00	0.00	0.00	72.52	116.01	137.95	139.54	212.29	246.56	301.95
	0:35:00	0.00	0.00	61.42	94.98	112.19	146.49	215.95	265.52	321.78
	0:40:00	0.00	0.00	49.70	74.65	88.35	129.84	189.07	230.29	278.31
	0:45:00	0.00	0.00	37.21	57.51	69.58	104.16	151.23	191.84	231.50
	0:50:00	0.00	0.00	28.94	46.68	55.23	85.76	124.37	156.12	188.64
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DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.03 (May 2020)

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 [ft²]	Area [acres]	Volume [ft³]	Volume [ac-ft]	Total Outflow [cfs]
6072.00	0.00	10,925	0.251	0	0.000	0.00
6072.50	0.50	11,726	0.269	5,663	0.130	0.24
6073.00	1.00	12,526	0.288	11,725	0.269	0.33
6073.50	1.50	13,362	0.307	18,197	0.418	0.41
6074.00	2.00	14,198	0.326	25,087	0.576	0.47
6074.50	2.50	15,070	0.346	32,404	0.744	0.53
6075.00	3.00	15,942	0.366	40,157	0.922	0.58
6075.50	3.50	16,849	0.387	48,355	1.110	0.63
6076.00	4.00	17,756	0.408	57,006	1.309	0.67
6076.50	4.50	18,699	0.429	66,120	1.518	0.71
6077.00	5.00	19,643	0.451	75,706	1.738	0.75
6077.50	5.50	20,621	0.473	85,772	1.969	0.78
6078.00	6.00	21,600	0.496	96,327	2.211	0.82
6078.50	6.50	22,614	0.519	107,381	2.465	0.85
6079.00	7.00	23,629	0.542	118,942	2.731	0.88
6079.50	7.50	24,679	0.567	131,019	3.008	0.92
6080.00	8.00	25,730	0.591	143,621	3.297	0.95
6080.50	8.50	27,280	0.626	156,874	3.601	0.97
6081.00	9.00	28,831	0.662	170,902	3.923	4.84
6081.50	9.50	31,001	0.712	185,860	4.267	90.11
6082.00	10.00	33,172	0.762	201,903	4.635	230.16
6082.50	10.50	35,167	0.807	218,988	5.027	306.35
6083.00	11.00	37,162	0.853	237,070	5.442	313.56
6083.50	11.50	39,192	0.900	256,159	5.881	320.61
6084.00	12.00	41,223	0.946	276,263	6.342	327.50
6084.50	12.50	43,289	0.994	297,391	6.827	334.26
6085.00	13.00	45,356	1.041	319,552	7.336	340.88

For best results, include the stages of all grade slope changes (e.g. ISV and Floor) from the S-A-V table on Sheet 'Basin'.

Also include the inverts of all outlets (e.g. vertical orifice, overflow grate, and spillway, where applicable).

Design Procedure Form: Grass Buffer (GB)

UD-BMP (Version 3.07, March 2018) **Sheet 1 of 1**

Designer: JR Engineering
Company: Shea Homes
Date: July 9, 2020
Project: Ridgegate Development - Offsite Runoff into Happy Canyon/Badger Gulch (Per Lot)
Location: Interstate 25 and Ridgegate Parkway

1. Design Discharge A) 2-Year Peak Flow Rate of the Area Draining to the Grass Buffer	Q_2 = 0.2 cfs
2. Minimum Width of Grass Buffer	W_G = 4 ft
3. Length of Grass Buffer (14' or greater recommended)	L_G = 45 ft
4. Buffer Slope (in the direction of flow, not to exceed 0.1 ft / ft)	S_G = 0.060 ft / ft
5. Flow Characteristics (sheet or concentrated) A) Does runoff flow into the grass buffer across the entire width of the buffer?	(•) Yes ( ) No
B) Watershed Flow Length	F_L = 4 ft
C) Interface Slope (normal to flow)	S_I = 0.060 ft / ft
D) Type of Flow Sheet Flow: $F_L * S_I \leq 1$ Concentrated Flow: $F_L * S_I > 1$	SHEET FLOW
6. Flow Distribution for Concentrated Flows	(•) None (sheet flow) ( ) Slotted Curbing ( ) Level Spreader ( ) Other (Explain):
7 Soil Preparation (Describe soil amendment)	
8 Vegetation (Check the type used or describe "Other")	( ) Existing Xeric Turf Grass (•) Irrigated Turf Grass ( ) Other (Explain):
9. Irrigation (*Select None if existing buffer area has 80% vegetation AND will not be disturbed during construction.)	( ) Temporary ( ) Permanent (•) None*
10. Outflow Collection (Check the type used or describe "Other")	(•) Grass Swale ( ) Street Gutter ( ) Storm Sewer Inlet ( ) Other (Explain): Happy Canyon or Badger Gulch Drainage Way

Notes:

APPENDIX E

REFERENCE MATERIAL

MASTER DRAINAGE PLAN
FOR
RIDGEGATE – HAPPY CANYON CREEK AND BADGER GULCH DRAINAGE BASINS

February 2017
Revised May 2017

Prepared For:

Rampart Range Metropolitan District No. 1
8390 E. Crescent Parkway, Suite 500
Greenwood Village, CO 80111
Phone: (303) 779-4525
Fax: (303) 773-2050

Prepared By:

5/19/2017
Colin McKernan, PE

Reviewed By:

Carson Besgrove, PE

Merrick Job No. 65119103

MERRICK® & COMPANY

5970 Greenwood Plaza Blvd
Greenwood Village, CO 80111
Phone: (303) 751-0741
Fax (303) 964-3355

I. EXECUTIVE SUMMARY

The RidgeGate development is comprised of 3,514 acres in Lone Tree, Colorado. There are four major drainage basins within the RidgeGate development including Willow Creek, Cottonwood Creek, Happy Canyon Creek, and Badger Gulch. The overall master drainage plan for the RidgeGate development has been divided into three separate master drainage plans to address the four major drainage basins. This report serves as the Master Drainage Plan for the proposed RidgeGate development located within the Happy Canyon Creek and Badger Gulch Drainage Basins.

This report was authorized by the Rampart Range Metropolitan District No. 1 (RRMD1) to incorporate the latest hydrologic and hydraulic modeling software, incorporate the existing stormwater facilities, update the model to reflect current proposed land use, and provide an updated plan for future drainage improvements including the portion of RidgeGate located in the Happy Canyon Creek and Badger Gulch Basins east of Interstate 25 (I-25). Key updates in this report include:

- An updated development map with the latest proposed uses and drainage basins.
- Updated models using updated software including Colorado Urban Hydrograph Procedure (CUHP) and Storm Water Management Model (SWMM).
- New drainage analyses from I-25 to First Street/W. Parker Road including on-line 100-year peak shaving detention and off-line EURV water quality detention.

The SWMM model results for this report suggest that the objective of detaining the developed condition 100-year storm event to the allowable release rates from the 2014 MDP existing development values has been met and will continue to be met as the Happy Canyon Creek and Badger Gulch Basins continue to develop and drainage improvements are constructed per plan.

As development along Happy Canyon Creek and Badger Gulch progresses, channel stabilization will be evaluated and implemented as required to prevent erosion and maintain water quality. Channel stabilization will be addressed in future phase III drainage reports and associated development plans.

III. DRAINAGE BASINS AND SUB-BASINS

A. Major Drainage Basins

The Site is located in the middle reach of the Happy Canyon Creek Drainage Basin which is tributary to Cherry Creek. The drainage basin generally flows from southwest to northeast. There are no off-site major basins that are tributary to the Site. Badger Gulch is tributary to Happy Canyon Creek and is covered in more detail in the minor basin section to follow.

Once built out, the development will consist of residential mixed-use, commercial mixed-use, mixed-use urban neighborhood (known as "City Center"), rural residential, parks, and open space areas. Runoff in the fully developed condition will generally sheet flow to curb and gutter and/or individual on-site storm drainage collection systems where it will be routed to public storm inlets, through storm conveyance systems, through regional detention/water quality ponds, and will finally be conveyed to Happy Canyon Creek.

The Cottonwood Creek Drainage Basin is also adjacent to, and northwest of the Happy Canyon Creek Drainage Basin. According to the Cottonwood Creek Master Drainage Plan, proposed development will have an impact on the boundary between the Cottonwood Creek and Happy Canyon Creek Basins. The conceptual City Center, as currently proposed, will transfer runoff from 2.6 acres of land in the Cottonwood Creek Drainage Basin to the Happy Canyon Creek Drainage Basin.

The FHAD delineated a 100-year floodplain for Happy Canyon Creek that traverses the site from I-25 to First Street / W. Parker Road. Per the study and as shown in Table 3.1 (pg. 5), the 100-year 2-hour existing development discharge at Happy Canyon Creek and I-25 crossing was calculated as 4,899 cfs. The 100-year 2-hour existing development discharge at the Lincoln Avenue crossing downstream of the confluence with Badger Gulch was calculated as 7,079 cfs.

Historical calculations were not done with this report. Appendix B depicts the minor basins defined in the 2014 MDP. The CUHP and SWMM results for the existing development conditions from the 2014 MDP can also be found in Appendix B.

Table 3.1: Happy Canyon Creek Peak 100-year Runoff Comparison (cfs)

LOCATION	2014 FHAD/MDP*
I-25	4,899
Ridgegate Parkway	5,555
Lincoln Avenue U/S of Badger Gulch	5,897
Lincoln Avenue D/S of Badger Gulch	7,079

*Based on 100-year existing development conditions

Happy Canyon Creek within the site shows moderate channel erosion with some slight aggradation upstream of Ridgegate Parkway. Based on aerial imagery dating back to 1937 this reach of Happy Canyon Creek has been consistently stable laterally with virtually no change in sinuosity.

B. Minor Drainage Basins

The minor basins were established to define the proposed drainage patterns and runoff rates. Impervious values upstream of the site were maintained from the 2014 MDP when possible, unless updated to reflect approved drainage reports or changes to proposed development. The future land use impervious values from the 2014 MDP were used when areas of basins were outside areas that drain through RidgeGate. Impervious values within the site and directly east of I-25 are based on the RPDD4 and DTJ East Village Land Use Maps, shown in Appendix A, and future land use from the 2014 MDP, shown in Appendix B. The impervious values used for Basins A276 and A295 are taken directly from the 2014 MDP. The impervious calculations are presented in Appendix C along with the developed flow rates for each basin from the SWMM model. The developed flow rates for key design points are also summarized and presented in Table 4.1 (pg. 17).

Proposed Developed Minor Drainage Basins

The following describes each of the proposed developed minor basins in more detail. Outside of the RPDD4 map area, the basin names generally correspond with basin names from the 2014 MDP. The associated drainage basin map can be found in Appendix E.

Basin A215 (117.8 acres) is located southwest of Basin A240. The basin has not been changed from the 2014 MDP, and it is not within the proposed RidgeGate development.

Basin A230 (29.9 acres) is located west of Basin A240. The basin has not been changed from the 2014 MDP, and it is not within the proposed RidgeGate development.

Basin A235 (96.9 acres) is located northwest of Basin A240. The basin has not been changed from the 2014 MDP, and it is not within the proposed RidgeGate development.

Basin A240 (86.9 acres) is located in the furthest southwest region of the Site along Happy Canyon. Runoff from Basin A240 travels south to the north where it drains to SWMM node HC017 on Happy Canyon Creek. Approximately 21 acres of Basin A240 are zoned as open space and 2% imperviousness is assumed for the basin in the developed condition. A 13-acre portion of the basin is within the I-25 ROW. Approximately 14 acres are proposed as medium density residential. The remaining 40 acres are not within the proposed development and future developed runoff is assumed.

Basin A245 (33.1 acres) is located northwest of Basin A250. The basin has not been changed from the 2014 MDP, and it is not within the proposed RidgeGate development.

Basin A250 (35.5 acres) is adjacent to Basin A240 along Happy Canyon Creek in the southwest region of the Site. Runoff in the basin flows south to the north where it drains to SWMM node HC018 on Happy Canyon Creek. Approximately 24 acres of Basin A250 are zoned as open space and 2% imperviousness is assumed for the basin in the developed condition. A 7-acre portion of the basin is within the I-25 ROW. The remaining 5 acres of the basin are proposed as medium density residential.

Basin A260 (123.1 acres) is located north of Basin A250 and northwest of Basin A264. Runoff from Basin A260 travels southwest to the northeast where it drains to on-line 100-year peak shaving Pond 1_HC019 on Happy Canyon Creek. Runoff is further conveyed along Happy Canyon Creek to the outlet point of the basin, at SWMM node HC020. Approximately 48 acres of the proposed RidgeGate development is anticipated to drain into Happy Canyon Creek. A 15-acre portion of the basin is within the I-25 ROW, and the remaining 60 acres are not within the proposed development and existing development runoff is assumed. Approximately 17 acres of Basin A260 are zoned as open space and 2% imperviousness is assumed for the basin in the developed condition. Approximately 5 acres

in the northwest corner of Basin A260 are proposed as multi-use/commercial, and 8 acres in the southeast corner are proposed as medium density residential. A planned park of 15 acres is anticipated just upstream of the proposed roadway crossing at the north terminus of the basin.

Basin A263 (119.0 acres) is located east and adjacent to Basin A264 and south and adjacent to Basin A265. Runoff travels south to north where it drains to SWMM node HC320. Storm water from Basin A263 will be collected and routed through Basin A265 to off-line EURV Pond 2 before being further conveyed to Happy Canyon Creek at SWMM node HC020. Approximately 85 acres of the proposed RidgeGate development is anticipated to drain into SWMM node HC024. Of this, 53 acres is zoned as parks and open space, and 2% imperviousness is assumed for the proposed condition. Approximately 31 acres in the north portion of Basin A263 is proposed as low density residential. The remaining 34 acres are not within the proposed development and future developed runoff is assumed.

Basin A264 (108.1 acres) is located east and adjacent to Basins A240 and A250. Runoff travels south to the north where it drains to SWMM node HC220. Storm water from Basin A264 will be collected and routed through Basin A265 to off-line EURV Pond 2 before being further conveyed to Happy Canyon Creek at SWMM node HC020. In the developed condition, a roadway will run through the basin, providing access to future rural residential developments near Happy Canyon Creek, per the RPDD4. Approximately 54 acres of the proposed RidgeGate development is anticipated to drain from Basin A264. Of this, 6 acres of the southern portion of the minor basin are proposed as low density residential while 36 acres are proposed as medium density residential. The southernmost proposed are to be developed is zoned as 12 acres of parks and open space. The remaining 55 acres of Basin A264 are not within the proposed development, therefore future developed runoff is assumed for these areas.

Basin A265 (47.6 acres) is located north and adjacent to Basin A263. Runoff travels south to north where it drains to SWMM node HC120. Stormwater from Basin A265 will be collected and routed to off-line EURV Pond 2 before being further conveyed to Happy Canyon Creek at SWMM node HC020. In the developed condition, a roadway network will

run through the basin, providing access to an elementary school (7.5 acres) and the future low (17.5 acres) and medium (7.5 acres) density residential developments, per the DTJ Land Use Map. A small portion of 0.5 acres is proposed as multi-use/commercial in the northwest corner. 1.5 acres in the most northern portion of the basin is designated as park area.

Basin A270 (55.4 acres) is located northeast and adjacent to Basin A260. Runoff travels southwest to northeast where it drains to SWMM node HC021 on Happy Canyon Creek. The basin consists of a planned community park within the Happy Canyon Creek floodplain.

Basin A271 (23.3 acres) is located west and adjacent to Basin A275. Runoff drains southwest to northeast where it drains to SWMM node HC520. Stormwater will be collected and routed through Basin A275 to off-line EURV Pond 3 before being conveyed to Happy Canyon Creek at SWMM node HC020. Basin A271 is within the I-25 and Ridgegate Parkway ROW, and contains the ramp connecting the two roads. Basin A271 is not within the proposed RidgeGate development and future developed runoff is assumed.

Basin A275 (57.2 acres) is located west and adjacent to Basin A270. Runoff travels west to southeast where it drains to off-line EURV Pond 3 before being conveyed to Happy Canyon Creek at SWMM node HC020. The planned RidgeGate improvements within the basin consists of a 16-acre multi-use/commercial area between Ridgegate Parkway and South Havana Street. The remaining part of Basin A275 is not within the proposed RidgeGate development and future developed runoff is assumed.

Basin A276 (41.2 acres) is located north and adjacent to Basins A270 and A275. Runoff travels west to east where it drains to off-line EURV Pond 23 before being further conveyed to Happy Canyon Creek at SWMM node HC021. Basin A276 is within Lone Tree City Center and consists of proposed commercial and mixed-use districts.

Basin A280 (55.6 acres) is located east and adjacent to Basin A265. Runoff travels generally east to southwest where it drains to SWMM node HC420. Stormwater is collected and routed through Basin A265 to off-line EURV Pond 2 before being conveyed to Happy Canyon Creek at SWMM node HC020. The basin consists mostly of proposed low and

medium density residential development while the upper hillside remains as undeveloped open space.

Basin A282 (104.2 acres) is located northeast and adjacent to Basin A280. Runoff travels south to north where it drains to SWMM node HC121. Stormwater is routed along Ridgegate Parkway and collected at off-line EURV Pond 4 before being further conveyed to Happy Canyon Creek at SWMM node HC021. For the developed condition, the basin consists of multi-use/commercial, high density, medium density, and low density residential. A small portion of the basin consists of park and open space and 2% imperviousness is assumed.

Basin A285 (52.1 acres**)** is located east and adjacent to Basin A282. Runoff travels south to north where it drains to SWMM node HC327. Stormwater is collected and routed through Basin A314 to off-line EURV Pond 7 before being further conveyed to Happy Canyon Creek at SWMM node HC027. The basin consists of proposed low and medium density residential, as well as multi-function residential development.

Basin A290 (89.2 acres) is located northeast of basin A270 along Happy Canyon Creek. Runoff travels southwest to northeast, towards the existing Meridian development, where it drains to SWMM node HC023. Runoff from Basin A290 will be conveyed to off-line EURV Pond 6 before reaching Happy Canyon Creek, as well as on-line 100-year peak shaving Pond 5_HC022 before reaching the basin outlet at SWMM node HC023. Basin A290 consists of 18.5 acres of proposed medium density residential area, and 34 acres of proposed low density residential to the west of Happy Canyon Creek. The proposed developed area surrounding Happy Canyon Creek on the east side of the basin is zoned as parks and open space, and is approximately 30 acres. The remaining approximately 7 acres of Basin A290 are paved roads, primarily of which is Ridgegate Parkway.

Basin A291 (134.0 acres) is located northeast and adjacent to Basin A282 and east and adjacent to Basin A290. Runoff travels south to north where it drains to SWMM node HC127. Stormwater is collected and routed to off-line EURV Pond 7 before it is further conveyed to Happy Canyon Creek, downstream of Meridian Commons, at SWMM node HC027. For the developed condition, the basin consists of mixture of multi-use/commercial,

high density, medium density, and low density residential. A small portion of the basin consists of park and open space. There is approximately 10 acres in the south of the basin designated for institutional use.

Basin A295 (53.3 acres) is located northwest and adjacent to Basin A290. Runoff travels west to east where it drains to off-line EURV Pond 24 before being further conveyed to Happy Canyon Creek at SWMM node HC023. Basin A295 is within Lone Tree City Center, and consists of medium to high density residential districts as well as a portion of mixed-use development.

Basin A300 (83.6 acres) is located north of Basins A290 and A291. Basin A300 is comprised of the neighboring Meridian development and the Happy Canyon Creek floodplain area. No proposed improvements are anticipated within Basin A300 and only the basin boundary was modified from the 2014 MDP in order to match proposed grading. The built out basin drains to Happy Canyon Creek at SWMM node HC027.

Basin A305 (53.1 acres) is located northeast of Basin A291. Runoff drains south to northeast where it drains to SWMM node HC124. Stormwater is collected and routed to off-line EURV Pond 17 before it is further conveyed to Happy Canyon Creek at SWMM node HC024. The proposed development for Basin A305 consists mostly of medium density residential with a small amount of high density residential. The west border of the basin consists of parks and open space and contains off-line EURV Pond 7.

Basin A310 (37.1 acres) is located northeast of Basin A305 in the northeast region of the Site along Happy Canyon Creek. Runoff travels west to east where it drains to SWMM node HC125. Stormwater is collected and routed to off-line EURV Pond 18 before it is further conveyed to Happy Canyon Creek at SWMM node HC029. The southern portion of the basin consists of proposed middle school/high school area, while the northern portion consists of proposed multi-use/commercial area. The area surrounding Happy Canyon Creek in the center of the basin is zoned as parks and open space.

Basin A311 (37.9 acres) is located west of Basin A310 along Happy Canyon Creek. Runoff travels southwest to northeast where it drains to on-line 100-year peak shaving Pond

8_HC028 on Happy Canyon Creek. The northern half of the basin is proposed multi-use/commercial area, and the southern half surrounding the creek is designated as parks and open space area.

Basin A314 (78.3 acres) is located east and adjacent to Basin A291. Runoff travels south to north towards proposed park area, where it drains to SWMM node HC227. Stormwater is collected and conveyed to off-line EURV Pond 7 before being further conveyed to Happy Canyon Creek at SWMM node HC027. For the developed condition, the basin consists of multi-use/commercial area, and high density, medium density, low density, and multi-functional residential. A small portion of the basin consists of park and open space.

Basin A315 (36.8 acres) is located southwest of Basin A310. Runoff travels south to north where it drains to off-line EURV Pond 17 before being further conveyed to Happy Canyon Creek at SWMM node HC024. Basin A315 consists mostly of proposed middle school/high school area. The northern most portion approaching Happy Canyon Creek is designated as parks and open space.

Basin A320a (44.8 acres) is located in the furthest most northeast region of the Site along Happy Canyon Creek. Runoff travels southwest to northeast where it drains to off-line EURV Pond 18 before it is further conveyed to Happy Canyon Creek at SWMM node HC029. The southern portion of the basin consists of 8 acres of proposed middle school/high school area, and the northern portion consists of approximately 11 acres of multi-use/commercial area. The central area of the basin contains Happy Canyon Creek and the surrounding land is designated as parks and open space.

Basin A320b (11.9 acres) is located east and adjacent to Basin A320a along Happy Canyon Creek. Runoff travels southwest to northeast where it drains to Happy Canyon Creek at SWMM node SU_HC025. Basin A320b is not within the proposed RidgeGate development, and therefore future developed runoff is assumed.

Basin E150 (66.9 acres) is located on the southern edge of the proposed development and is southeast of Basin A263. Only 2 acres of the proposed RidgeGate development is anticipated to drain into Badger Gulch from Basin E150. The remaining area is not within

the development limits, and therefore future development runoff is assumed. Runoff travels southwest to northeast where it drains to SWMM node BG006 on Badger Gulch.

Basin E160 (130.5 acres) is located on the southern edge of the proposed development and is northeast of Basin E150 along Badger Gulch. Runoff travels south to north where it drains to off-line EURV Pond 19 before reaching Badger Gulch at SWMM node BG007. The basin consists of almost equal parts low density residential and parks and open space.

Basin E170 (60.3 acres) is located along Badger Gulch northeast of Basin E160. Runoff travels southwest to northeast where it drains to on-line 100-year peak shaving Pond 11_BG008. Basin E170 consists of 2 acres of proposed multi-functional residential and 27 acres of proposed low density residential area. The remaining land surrounds Badger Gulch and is zoned as parks and open space.

Basin E171 (35.5 acres) is located on the southern border of the Site and is east of Basin E160. Runoff travels south to north where it drains to SWMM node BG108. Stormwater is collected and routed through Basin E180 to off-line EURV Pond 10 before reaching Badger Gulch at on-line Pond11_BG008. Basin E171 is primarily composed of proposed low density residential area with a small portion of the basin on the top of the hill side designated as parks and open space.

Basin E180 (24.8 acres) is located north of Basin E171. Runoff travels south to north where it drains to off-line EURV Pond 10 before being routed to Badger Gulch at on-line Pond 11_BG008. Basin E180 is a mix of proposed low and medium density residential space. Off-line EURV Pond 10 is located in the northwest corner of the basin.

Basin E182 (79.7acres) is located east of Basin E180. Runoff travels south to north where it drains to off-line EURV Pond 12 before being further conveyed to Badger Gulch at SWMM node BG009. Off-line EURV Pond 12 is located in the designated park area with in the basin. The northeast portion of Basin E182, which is approximately 9.2 acres in size, is proposed area to be used for an elementary school. The remaining area of Basin E182 is proposed low and medium density residential space.

Basin E183 (120.4 acres) is located on the southern edge of the Site, and is south of Basin E182. Runoff travels south to north where it drains to SWMM node BG109. Stormwater is collected and routed through Basin E182 where it is directed to off-line EURV Pond 12 before reaching Badger Gulch at SWMM node BG009. Only 8 acres of the proposed RidgeGate development is anticipated to drain to Badger Gulch from Basin E183. This area is proposed low density residential. The remaining 112 acres are not within the development limits, therefore future development runoff is assumed.

Basin E184 (78.4 acres) is located on the southern border of the Site, and is west of and adjacent to Basin E183. Runoff travels south to northeast where it drains to SWMM node BG109. Stormwater is collected and routed through Basin E182 where it is directed to off-line EURV Pond 12 before reaching Badger Gulch at SWMM node BG009. 16 acres of Basin E184 is proposed as low density residential, and 7 acres is designated as parks and open space. The remaining area in Basin E184 is not within the development limits, and therefore future development runoff is assumed.

Basin E185 (45.3 acres) is located in the most southeast region of the development Site. Runoff travels south to north where it drains to SWMM node BG109. Stormwater is collected and routed through Basin E182 where it is directed to off-line EURV Pond 12 before reaching Badger Gulch at SWMM node BG009. 2 acres of the basin are designated for utilities, and 20 acres are proposed low density residential. The remaining land in Basin E185 is not within the development limits, and therefore future developed runoff is assumed.

Basin E190 (60.0 acres) is located north of Basins E180 and E182 along Badger Gulch. Runoff travels southwest to northeast where it drains to off-line EURV Pond 20 before reaching Badger Gulch at on-line 100-year peak shaving Pond 13_BG010. Pond 13_BG010 will be located in Basin E190 directly upstream of Ridgegate Parkway. A 15-acre portion of Basin E190 is proposed as multi-functional residential. The remaining area surrounding Badger Gulch is zoned as parks and open space.

Basin E200a (102.6 acres) is located east of Basin A314 along Badger Gulch. Runoff travels south to northeast where it drains to off-line EURV Pond 22 before reaching Badger Gulch at on-line 100-year peak shaving Pond 14_BG012. Basin E200a has a proposed area

of 9 acres for an elementary school, 11 acres of multi-use/commercial area, and a combined 35 acres of proposed multi-functional, high, medium, and low density residential. Area surrounding Badger Gulch is designated as parks and open space.

Basin E200b (23.5 acres) is located northeast and adjacent to Basin E200a along Badger Gulch. Runoff travels southwest to northeast where it drains to SWMM node BG013 on Badger Gulch. A small part of the basin contains proposed low density residential space and a portion of the proposed middle school/high school area. The majority of the basin is zoned as parks and open space.

Basin E200c (2.2 acres) is located east of Basin E200b along Badger Gulch. Runoff travels southwest to northeast where it reached Badger Gulch at SWMM node BG011. Basin E200c is not within the proposed RidgeGate development and therefore future developed runoff is assumed.

Basin E204a (33.7 acres) is located northeast and adjacent to Basin E182 along the eastern border of the Site. Runoff travels south to northeast where it drains to off-line EURV Pond 15 directly upstream of Ridgegate Parkway. Stormwater is collected and routed through Basin E205b where it is directed to Badger Gulch at SWMM node BG011. Basin E204a is composed of proposed low density and multi-functional residential space.

Basin E204b (8.4 acres) is located northeast and adjacent to Basin E204a. Runoff travels south to north to SWMM node BG111 before being further conveyed through Basin E205b to Badger Gulch at SWMM node BG011. Basin E204b is not within the proposed RidgeGate development and therefore future developed runoff is assumed.

Basin E205a (25.4 acres) is located north of Basin E204a and Ridgegate Parkway. Runoff travels south to north where it drains to SWMM node BG013 on Badger Gulch. Basin E205a is composed mostly of proposed multi-functional and low density residential with a small area of designated parks and open space.

Basin E205b (72.6) is located east and adjacent to Basin E205a. Runoff travels south to north where it drains to Badger Gulch at SWMM node BG011. Basin E205b is not within the proposed RidgeGate development, and therefore future developed runoff is assumed.

Basin E210a (33.1 acres) is located north and adjacent to Basin E200b along the eastern border of the Site. Runoff travels southwest to northeast where it drains to off-line EURV Pond 16 before being further conveyed to Happy Canyon Creek at SWMM node HC029. Pond 16 is located in the northeast corner of the basin. Basin E210a is composed of proposed middle school/high school area with a small portion in the southeast corner designated as parks and open space.

Basin E210b (64.9 acres) is located east and adjacent to Basin E210a along Badger Gulch. Runoff travels south to north where it reaches Badger Gulch at SWMM node BG999. Basin E210b is not within the proposed RidgeGate development, and therefore future developed runoff is assumed.

Basin E215 (15.6 acres) is located north and across Ridgegate Parkway from Basin E190. Runoff travels west to east where it drains to off-line EURV Pond 21 before reaching Badger Gulch at SWMM node BG_RG. A small reach of Badger Gulch is within Basin E215, and the surrounding area is designated parks and open space. The remaining area of Basin E215 is proposed multi-use/commercial area.

Basin F100a (32.4 acres) is located in the most southeast region of the Site, east and adjacent to Basin E182. Runoff travels south to north where it drains to EURV plus 100-year peak shaving Pond 9 before being conveyed off Site. Basin F100a is only proposed as low density residential.

Basin F100b (89.6 acres) is located east and adjacent to Basin F100a. Runoff travels south to northeast off Site. Basin F100b is not within the proposed RidgeGate development and therefore future developed runoff is assumed.

APPENDIX C – IMPERVIOUS, CUHP, AND SWMM CALCULATIONS

Merrick & Company
5970 Greenwood Plaza Blvd.
Greenwood Village, CO 80111
Ph: (303) 751-0741

Job Name: Happy Canyon Creek MDP
Job Number: 65119103
Date: 5/10/2017
By: J. Goldman

Happy Canyon Creek MDP

Composite Runoff Coefficient Calculations

Location: Ridgegate
Municipality: Douglas County/UDFCD
Minor Design Storm: N/A
Major Design Storm: 100
Soil Type: C/D

Basin Design Data		ROADS	SCHOOLS	UTIL	MF/RES	HD RES	MD RES	LD RES	MU/COM	PARK	P/OS	2014 MDP EXISTING DEVELOPMENT							
	I (%) =	100%	55%	85%	75%	50%	35%	25%	85%	10%	2%	2%	50%	75%	85%	95%			I (%)
Basin Name	SWMM Node	$A_{Paved\ Streets}$ (sf)	$A_{SCHOOL/INST}$ (sf)	A_{UTIL} (sf)	$A_{MF/RES}$ (sf)	$A_{HD\ RES}$ (sf)	$A_{MD\ RES}$ (sf)	$A_{LD\ RES}$ (sf)	$A_{Commercial/Mixed\ Use}$ (sf)	A_{PARK} (sf)	$A_{Open\ Space}$ (sf)	(sf)					A_{Total} (sf)	A_{Total} (ac)	Imp (%)
A240	A240						590,813				904,318	1,708,199	581,459				3,784,789	86.9	14.5%
A250	A250						216,756				947,035	81,746	299,576				1,545,113	35.5	15.9%
A260	A260	140,316					328,205		231,304	655,578	719,766	2,640,018	647,026				5,362,213	123.1	16.9%
A263	A263	56,124		33,166				1,353,550			2,284,824	1,457,094					5,184,758	119.0	9.6%
A264	A264	3,548					1,545,748	252,939			504,452	2,401,466					4,708,153	108.1	14.1%
A265	A265	573,636	326,700				326,700	762,300	19,602	64,241							2,073,179	47.6	52.2%
A270	A270	287,807								2,124,857							2,412,664	55.4	20.7%
A271	A271											149,749	866,507				1,016,256	23.3	42.9%
A275	A275	154,669							691,733						1,645,666		2,492,068	57.2	85.9%
A276	A276																1,794,672	41.2	81.8%
A280	A280	281,129					78,408	1,445,900		23,958	591,203						2,420,598	55.6	28.3%
A282	A282	1,266,737				819,364	373,745	1,075,932	603,742	158,679	240,059						4,538,257	104.2	57.5%
A285	A285	125,305			595,429		263,102	1,285,153									2,268,989	52.1	43.4%
A290	A290	305,432					805,424	1,493,672		354,578	926,559						3,885,666	89.2	26.1%
A291	A291	1,303,096	439,520			313,196	2,702,462		1,016,255		64,610						5,839,140	134.0	60.2%

Basin Design Data		ROADS	SCHOOLS	UTIL	MF/RES	HD RES	MD RES	LD RES	MU/COM	PARK	P/OS	2014 MDP EXISTING DEVELOPMENT							
	I (%) =	100%	55%	85%	75%	50%	35%	25%	85%	10%	2%	2%	50%	75%	85%	95%			I (%)
Basin Name	SWMM Node	$A_{Paved\ Streets}$ (sf)	$A_{SCHOOL/INST}$ (sf)	A_{UTIL} (sf)	$A_{MF/RES}$ (sf)	$A_{HD\ RES}$ (sf)	$A_{MD\ RES}$ (sf)	$A_{LD\ RES}$ (sf)	$A_{Commercial/Mixed\ Use}$ (sf)	A_{PARK} (sf)	$A_{Open\ Space}$ (sf)	(sf)					A_{Total} (sf)	A_{Total} (ac)	Imp (%)
A295	A295																2,321,748	53.3	56.3%
A300	A300										603,118		3,040,413				3,643,531	83.6	42.1%
A305	A305	301,980				182,516	1,536,361			208,217	81,893						2,310,967	53.1	41.3%
A310	A310	69,996	430,072						471,880		643,278						1,615,226	37.1	44.6%
A311	A311	80,356							776,923	220,414	498,011		73,498				1,649,202	37.9	49.1%
A314	A314	687,013			256,244	579,227	809,921		880,533	198,634							3,411,572	78.3	65.1%
A315	A315	41,144	1,475,865								84,504						1,601,513	36.8	53.4%
A320a	A320a		346,902						461,295		858,513					285,746	1,952,456	44.8	44.6%
A320b	A320b											516,937					516,937	11.9	2.0%
E150	E150			53,955				35,584			398,931	2,426,438					2,914,908	66.9	3.8%
E160	E160	147,471						3,055,003			2,277,905	206,307					5,686,686	130.5	16.9%
E170	E170	158,972			101,520			1,159,931		116,741	1,088,129						2,625,293	60.3	21.3%
E171	E171	128,626						1,282,249			133,355						1,544,230	35.5	29.3%
E180	E180	171,306					221,376	687,773									1,080,455	24.8	38.9%
E182	E182	389,886	400,884	87,120			448,811	1,510,514		634,360							3,471,575	79.7	36.9%
E183	E183	2,258						343,659			6,853	4,891,837					5,244,607	120.4	3.5%
E184	E184	53,794						715,117			295,900	2,348,346					3,413,157	78.4	8.4%
E185	E185	12,921		87,120				884,021				990,149					1,974,211	45.3	16.6%
E190	E190	594,236			645,995					123,275	1,249,736						2,613,242	60.0	42.7%
E200a	E200a	960,959	372,874		319,795	138,823	760,646	284,017	464,124	245,243	921,525						4,468,005	102.6	50.4%
E200b	E200b		228,840					31,345			762,977						1,023,162	23.5	14.6%
E200c	E200c											96,399					96,399	2.2	2.0%
E204a	E204a	66,989			386,616			1,013,187									1,466,792	33.7	41.6%

Basin Design Data		ROADS	SCHOOLS	UTIL	MF/RES	HD RES	MD RES	LD RES	MU/COM	PARK	P/OS	2014 MDP EXISTING DEVELOPMENT							
	I (%) =	100%	55%	85%	75%	50%	35%	25%	85%	10%	2%	2%	50%	75%	85%	95%			I (%)
Basin Name	SWMM Node	$A_{Paved\ Streets}$ (sf)	$A_{SCHOOL/INST}$ (sf)	A_{UTIL} (sf)	$A_{MF/RES}$ (sf)	$A_{HD\ RES}$ (sf)	$A_{MD\ RES}$ (sf)	$A_{LD\ RES}$ (sf)	$A_{Commercial/Mixed\ Use}$ (sf)	A_{PARK} (sf)	$A_{Open\ Space}$ (sf)	(sf)					A_{Total} (sf)	A_{Total} (ac)	Imp (%)
E204b	E204b												364,139				364,139	8.4	50.0%
E205a	E205a	70,741			264,616			716,011			55,565						1,106,933	25.4	40.6%
E205b	E205b											75,656	3,087,365				3,163,021	72.6	48.9%
E210a	E210a	111,504	1,239,874								90,247						1,441,625	33.1	55.2%
E210b	E210b											794,752	553,589	1,316,061	61,879		2,726,281	62.6	48.9%
E215	E215	136,894							483,679		57,064						677,637	15.6	81.0%
F100a	F100a							1,412,905									1,412,905	32.4	25.0%
F100b	F100b												3,904,801				3,904,801	89.6	50.0%
	TOTAL SITE	8,684,844	5,261,531	261,361	2,570,215	2,033,126	11,008,479	20,800,762	6,101,069	5,128,774	17,290,329	20,785,093	13,418,373	1,316,061	1,707,545	285,746	120,769,727	2772.5	32.9%

**Basins A276 and A295 percent impervious taken directly from 2014 MDP*

PROJECT: HAPPY CANYON CREEK MASTER DRAINAGE PLAN
PROJECT NO: 65119103

100YR-3HR DEVELOPED

Summary of CUHP Input Parameters (Version 2.0.0)

								Depression Storage		Horton's Infiltration Parameters			DCIA Level and Fractions			
Catchment Name/ID	SWMM Node/ID	Raingage Name/ID	Area (sq.mi.)	Dist. to Centroid (miles)	Length (miles)	Slope (ft./ft.)	Percent Imperv.	Pervious (inches)	Imperv. (inches)	Initial Rate (in./hr.)	Final Rate (in.hr.)	Decay Coeff. (1/sec.)	DCIA Level	Dir. Con'ct Imperv. Fraction	Receiv. Perv. Fraction	Percent Eff. Imperv.
A100	A100	100YR-3HR	0.114	0.256	0.670	0.053	43.1	0.50	0.10	3.00	0.50	0.0018	0.00	0.82	0.21	42.14
A105	A105	100YR-3HR	0.172	0.619	1.018	0.045	20.3	0.50	0.10	3.00	0.50	0.0018	0.00	0.41	0.13	19.11
A110	A110	100YR-3HR	0.121	0.098	0.413	0.046	48.0	0.50	0.10	3.00	0.50	0.0018	0.00	0.84	0.22	47.06
A120	A120	100YR-3HR	0.170	0.130	0.703	0.036	48.0	0.50	0.10	3.00	0.50	0.0018	0.00	0.84	0.22	47.06
A125	A125	100YR-3HR	0.117	0.251	0.534	0.035	48.0	0.50	0.10	3.00	0.50	0.0018	0.00	0.84	0.22	47.06
A130	A130	100YR-3HR	0.073	0.137	0.424	0.034	28.0	0.50	0.10	3.00	0.50	0.0018	0.00	0.56	0.16	26.74
A134	A134	100YR-3HR	0.186	0.295	0.667	0.047	29.0	0.50	0.10	3.00	0.50	0.0018	0.00	0.58	0.17	27.74
A135	A135	100YR-3HR	0.160	0.370	0.835	0.041	32.0	0.50	0.10	3.00	0.50	0.0018	0.00	0.64	0.18	30.78
A140	A140	100YR-3HR	0.182	0.237	0.772	0.045	32.0	0.50	0.10	3.08	0.51	0.0018	0.00	0.64	0.18	30.76
A150	A150	100YR-3HR	0.180	0.144	0.746	0.043	16.0	0.50	0.10	3.15	0.51	0.0018	0.00	0.32	0.12	14.87
A160	A160	100YR-3HR	0.167	0.210	0.598	0.049	11.0	0.50	0.10	3.23	0.52	0.0018	0.00	0.22	0.10	10.04
A170	A170	100YR-3HR	0.136	0.275	0.537	0.041	10.0	0.50	0.10	3.23	0.52	0.0018	0.00	0.20	0.10	9.09
A180	A180	100YR-3HR	0.133	0.158	0.761	0.038	10.0	0.50	0.10	3.38	0.53	0.0018	0.00	0.20	0.10	9.06
A190	A190	100YR-3HR	0.139	0.143	0.595	0.047	10.1	0.50	0.10	3.30	0.52	0.0018	0.00	0.20	0.10	9.17
A195	A195	100YR-3HR	0.118	0.503	0.884	0.040	14.0	0.50	0.10	3.15	0.51	0.0018	0.00	0.28	0.11	12.93
A200	A200	100YR-3HR	0.140	0.171	0.620	0.042	14.0	0.50	0.10	3.15	0.51	0.0018	0.00	0.28	0.11	12.93
A210	A210	100YR-3HR	0.130	0.456	0.808	0.033	20.0	0.50	0.10	3.00	0.50	0.0018	0.00	0.40	0.13	18.82
A215	A215	100YR-3HR	0.184	0.456	0.831	0.052	7.0	0.50	0.10	3.00	0.50	0.0018	0.00	0.14	0.07	6.35
A220	A220	100YR-3HR	0.150	0.203	0.916	0.036	18.6	0.50	0.10	3.00	0.50	0.0018	0.00	0.37	0.13	17.44
A230	A230	100YR-3HR	0.047	0.068	0.329	0.040	11.2	0.50	0.10	3.00	0.50	0.0018	0.00	0.22	0.10	10.27
A234	A234	100YR-3HR	0.133	0.288	0.500	0.054	12.3	0.50	0.10	3.00	0.50	0.0018	0.00	0.25	0.11	11.33
A235	A235	100YR-3HR	0.151	0.255	0.641	0.052	3.0	0.50	0.10	3.00	0.50	0.0018	0.00	0.06	0.03	2.70
A240	A240	100YR-3HR	0.136	0.439	0.881	0.052	14.5	0.50	0.10	3.00	0.50	0.0018	0.00	0.29	0.11	13.45
A245	A245	100YR-3HR	0.052	0.154	0.339	0.062	10.2	0.50	0.10	3.00	0.50	0.0018	0.00	0.20	0.10	9.32
A250	A250	100YR-3HR	0.055	0.181	0.407	0.035	15.9	0.50	0.10	3.00	0.50	0.0018	0.00	0.32	0.12	14.81
A260	A260	100YR-3HR	0.192	0.455	2.083	0.023	16.9	0.50	0.10	3.23	0.52	0.0018	0.00	0.34	0.12	15.73
A263	A263	100YR-3HR	0.186	0.257	0.638	0.052	9.6	0.50	0.10	3.15	0.51	0.0018	0.00	0.19	0.10	8.73
A264	A264	100YR-3HR	0.169	0.537	1.042	0.049	14.1	0.50	0.10	3.23	0.52	0.0018	0.00	0.28	0.11	13.02
A265	A265	100YR-3HR	0.074	0.286	0.630	0.052	52.2	0.50	0.10	3.15	0.51	0.0018	0.00	0.86	0.24	51.28
A270	A270	100YR-3HR	0.087	0.395	0.796	0.028	20.7	0.50	0.10	3.08	0.51	0.0018	0.00	0.41	0.13	19.49
A271	A271	100YR-3HR	0.036	0.070	0.308	0.055	42.9	0.50	0.10	3.08	0.51	0.0018	0.00	0.81	0.21	41.92
A275	A275	100YR-3HR	0.089	0.134	0.426	0.055	85.9	0.50	0.10	3.08	0.51	0.0018	0.00	0.95	0.35	85.43
A276	A276	100YR-3HR	0.064	0.126	0.518	0.039	81.8	0.50	0.10	3.00	0.50	0.0018	0.00	0.94	0.34	81.26
A280	A280	100YR-3HR	0.087	0.371	0.567	0.051	28.3	0.50	0.10	3.23	0.52	0.0018	0.00	0.57	0.16	26.98
A282	A282	100YR-3HR	0.163	0.259	0.798	0.051	57.5	0.50	0.10	3.23	0.52	0.0018	0.00	0.89	0.26	56.65

								Depression Storage		Horton's Infiltration Parameters			DCIA Level and Fractions			
Catchment Name/ID	SWMM Node/ID	Raingage Name/ID	Area (sq.mi.)	Dist. to Centroid (miles)	Length (miles)	Slope (ft./ft.)	Percent Imperv.	Pervious (inches)	Imperv. (inches)	Initial Rate (in./hr.)	Final Rate (in.hr.)	Decay Coeff. (1/sec.)	DCIA Level	Dir. Con'ct Imperv. Fraction	Receiv. Perv. Fraction	Percent Eff. Imperv.
A285	A285	100YR-3HR	0.081	0.320	0.665	0.047	43.4	0.50	0.10	3.00	0.50	0.0018	0.00	0.82	0.21	42.44
A290	A290	100YR-3HR	0.139	0.299	0.730	0.026	26.1	0.50	0.10	3.60	0.54	0.0018	0.00	0.52	0.15	24.69
A291	A291	100YR-3HR	0.209	0.573	0.932	0.031	60.2	0.50	0.10	3.00	0.50	0.0018	0.00	0.90	0.27	59.43
A295	A295	100YR-3HR	0.083	0.112	0.379	0.034	56.3	0.50	0.10	3.38	0.53	0.0018	0.00	0.88	0.26	55.41
A300	A300	100YR-3HR	0.131	0.301	0.665	0.023	42.1	0.50	0.10	3.53	0.54	0.0018	0.00	0.81	0.21	41.04
A305	A305	100YR-3HR	0.083	0.295	0.530	0.031	41.3	0.50	0.10	3.23	0.52	0.0018	0.00	0.81	0.20	40.29
A310	A310	100YR-3HR	0.058	0.190	0.549	0.016	44.6	0.50	0.10	4.05	0.57	0.0018	0.00	0.82	0.21	43.46
A311	A311	100YR-3HR	0.059	0.180	0.314	0.016	49.1	0.50	0.10	4.05	0.57	0.0018	0.00	0.85	0.23	48.00
A314	A314	100YR-3HR	0.122	0.470	0.797	0.028	65.1	0.50	0.10	3.15	0.51	0.0018	0.00	0.91	0.29	64.34
A315	A315	100YR-3HR	0.058	0.285	0.517	0.030	53.4	0.50	0.10	4.13	0.58	0.0018	0.00	0.87	0.24	52.34
A320a	A320a	100YR-3HR	0.070	0.126	0.383	0.016	44.6	0.50	0.10	4.05	0.57	0.0018	0.00	0.82	0.21	43.46
A320b	A320b	100YR-3HR	0.019	0.123	0.226	0.016	2.0	0.50	0.10	4.05	0.57	0.0018	0.00	0.04	0.02	1.76
A325	A325	100YR-3HR	0.133	0.248	0.650	0.022	71.1	0.50	0.10	3.75	0.55	0.0018	0.00	0.92	0.30	70.32
B100	B100	100YR-3HR	0.113	0.151	0.376	0.047	71.8	0.50	0.10	3.00	0.50	0.0018	0.00	0.92	0.31	71.12
B110	B110	100YR-3HR	0.129	0.199	0.530	0.048	28.5	0.50	0.10	3.00	0.50	0.0018	0.00	0.57	0.16	27.24
B120	B120	100YR-3HR	0.119	0.199	0.637	0.041	24.8	0.50	0.10	3.08	0.51	0.0018	0.00	0.50	0.15	23.53
B130	B130	100YR-3HR	0.112	0.234	0.911	0.037	10.8	0.50	0.10	3.23	0.52	0.0018	0.00	0.22	0.10	9.85
B134	B134	100YR-3HR	0.038	0.036	0.293	0.015	40.3	0.50	0.10	3.00	0.50	0.0018	0.00	0.80	0.20	39.33
B135	B135	100YR-3HR	0.196	0.416	0.847	0.040	15.8	0.50	0.10	3.00	0.50	0.0018	0.00	0.32	0.12	14.71
C100	C100	100YR-3HR	0.151	0.240	0.508	0.045	3.0	0.50	0.10	3.00	0.50	0.0018	0.00	0.06	0.03	2.70
C110	C110	100YR-3HR	0.164	0.168	0.631	0.050	9.0	0.50	0.10	3.00	0.50	0.0018	0.00	0.18	0.09	8.20
C120	C120	100YR-3HR	0.103	0.275	0.678	0.037	13.0	0.50	0.10	3.00	0.50	0.0018	0.00	0.26	0.11	12.00
C125	C125	100YR-3HR	0.176	0.413	0.859	0.043	8.0	0.50	0.10	3.00	0.50	0.0018	0.00	0.16	0.08	7.27
C130	C130	100YR-3HR	0.174	0.222	0.629	0.033	36.0	0.50	0.10	3.00	0.50	0.0018	0.00	0.72	0.19	34.87
C140	C140	100YR-3HR	0.085	0.117	0.585	0.038	26.0	0.50	0.10	3.00	0.50	0.0018	0.00	0.52	0.15	24.74
C150	C150	100YR-3HR	0.091	0.272	0.631	0.024	3.0	0.50	0.10	3.00	0.50	0.0018	0.00	0.06	0.03	2.70
C153	C153	100YR-3HR	0.195	0.250	0.712	0.044	33.0	0.50	0.10	3.00	0.50	0.0018	0.00	0.66	0.18	31.80
C154	C154	100YR-3HR	0.152	0.212	0.537	0.040	43.0	0.50	0.10	3.00	0.50	0.0018	0.00	0.82	0.21	42.04
C155	C155	100YR-3HR	0.119	0.312	0.651	0.045	31.0	0.50	0.10	3.00	0.50	0.0018	0.00	0.62	0.17	29.76
C159	C159	100YR-3HR	0.172	0.240	0.684	0.049	29.0	0.50	0.10	3.00	0.50	0.0018	0.00	0.58	0.17	27.74
C160	C160	100YR-3HR	0.179	0.123	0.541	0.050	8.0	0.50	0.10	3.00	0.50	0.0018	0.00	0.16	0.08	7.27
C170	C170	100YR-3HR	0.169	0.296	0.865	0.032	11.0	0.50	0.10	3.00	0.50	0.0018	0.00	0.22	0.10	10.08
C175	C175	100YR-3HR	0.157	0.346	0.799	0.045	8.0	0.50	0.10	3.00	0.50	0.0018	0.00	0.16	0.08	7.27
C180	C180	100YR-3HR	0.069	0.129	0.622	0.041	15.0	0.50	0.10	3.00	0.50	0.0018	0.00	0.30	0.12	13.93
C185	C185	100YR-3HR	0.174	0.414	0.816	0.049	10.5	0.50	0.10	3.00	0.50	0.0018	0.00	0.21	0.10	9.60
C190	C190	100YR-3HR	0.119	0.269	0.766	0.031	15.0	0.50	0.10	3.00	0.50	0.0018	0.00	0.30	0.12	13.93
D100	D100	100YR-3HR	0.187	0.282	0.680	0.040	9.0	0.50	0.10	3.00	0.50	0.0018	0.00	0.18	0.09	8.20
D110	D110	100YR-3HR	0.175	0.283	0.619	0.030	11.0	0.50	0.10	3.00	0.50	0.0018	0.00	0.22	0.10	10.08
D120	D120	100YR-3HR	0.115	0.104	0.607	0.047	10.0	0.50	0.10	3.00	0.50	0.0018	0.00	0.20	0.10	9.12
D130	D130	100YR-3HR	0.125	0.282	0.592	0.050	24.0	0.50	0.10	3.00	0.50	0.0018	0.00	0.48	0.15	22.76
E100	E100	100YR-3HR	0.151	0.294	0.702	0.030	2.0	0.50	0.10	3.00	0.50	0.0018	0.00	0.04	0.02	1.80
E105	E105	100YR-3HR	0.082	0.212	0.480	0.039	2.0	0.50	0.10	3.00	0.50	0.0018	0.00	0.04	0.02	1.80

								Depression Storage		Horton's Infiltration Parameters			DCIA Level and Fractions			
Catchment Name/ID	SWMM Node/ID	Raingage Name/ID	Area (sq.mi.)	Dist. to Centroid (miles)	Length (miles)	Slope (ft./ft.)	Percent Imperv.	Pervious (inches)	Imperv. (inches)	Initial Rate (in./hr.)	Final Rate (in.hr.)	Decay Coeff. (1/sec.)	DCIA Level	Dir. Con'ct Imperv. Fraction	Receiv. Perv. Fraction	Percent Eff. Imperv.
E110	E110	100YR-3HR	0.129	0.196	0.468	0.045	2.0	0.50	0.10	3.00	0.50	0.0018	0.00	0.04	0.02	1.80
E120	E120	100YR-3HR	0.121	0.202	0.661	0.042	2.0	0.50	0.10	3.00	0.50	0.0018	0.00	0.04	0.02	1.80
E125	E125	100YR-3HR	0.115	0.304	0.574	0.050	2.0	0.50	0.10	3.00	0.50	0.0018	0.00	0.04	0.02	1.80
E130	E130	100YR-3HR	0.129	0.145	0.691	0.045	2.0	0.50	0.10	3.00	0.50	0.0018	0.00	0.04	0.02	1.80
E135	E135	100YR-3HR	0.159	0.329	0.676	0.048	2.0	0.50	0.10	3.00	0.50	0.0018	0.00	0.04	0.02	1.80
E140	E140	100YR-3HR	0.142	0.137	0.530	0.034	2.0	0.50	0.10	3.00	0.50	0.0018	0.00	0.04	0.02	1.80
E150	E150	100YR-3HR	0.104	0.182	0.537	0.052	3.8	0.50	0.10	3.08	0.51	0.0018	0.00	0.08	0.04	3.42
E155	E155	100YR-3HR	0.198	0.464	0.859	0.051	2.0	0.50	0.10	3.00	0.50	0.0018	0.00	0.04	0.02	1.80
E160	E160	100YR-3HR	0.204	0.247	0.634	0.038	16.9	0.50	0.10	3.83	0.56	0.0018	0.00	0.34	0.12	15.60
E170	E170	100YR-3HR	0.094	0.286	0.571	0.060	21.3	0.50	0.10	3.90	0.56	0.0018	0.00	0.43	0.14	19.88
E171	E171	100YR-3HR	0.055	0.126	0.349	0.060	29.3	0.50	0.10	3.90	0.56	0.0018	0.00	0.59	0.17	27.82
E180	E180	100YR-3HR	0.039	0.177	0.472	0.025	38.9	0.50	0.10	4.20	0.58	0.0018	0.00	0.78	0.20	37.66
E182	E182	100YR-3HR	0.125	0.250	0.479	0.039	36.9	0.50	0.10	3.60	0.54	0.0018	0.00	0.74	0.19	35.68
E183	E183	100YR-3HR	0.188	0.485	1.072	0.054	3.5	0.50	0.10	3.38	0.53	0.0018	0.00	0.07	0.04	3.13
E184	E184	100YR-3HR	0.123	0.401	0.794	0.053	8.4	0.50	0.10	3.75	0.55	0.0018	0.00	0.17	0.08	7.53
E185	E185	100YR-3HR	0.071	0.207	0.517	0.039	16.6	0.50	0.10	3.60	0.54	0.0018	0.00	0.33	0.12	15.36
E190	E190	100YR-3HR	0.094	0.190	0.650	0.026	42.7	0.50	0.10	3.75	0.55	0.0018	0.00	0.81	0.21	41.60
E200a	E200a	100YR-3HR	0.160	0.283	0.680	0.023	50.4	0.50	0.10	3.75	0.55	0.0018	0.00	0.85	0.23	49.36
E200b	E200b	100YR-3HR	0.037	0.173	0.347	0.023	14.6	0.50	0.10	3.75	0.55	0.0018	0.00	0.29	0.11	13.39
E200c	E200c	100YR-3HR	0.003	0.053	0.105	0.023	2.0	0.50	0.10	3.75	0.55	0.0018	0.00	0.00	0.02	1.76
E204a	E204a	100YR-3HR	0.053	0.170	0.465	0.029	41.6	0.50	0.10	3.00	0.50	0.0018	0.00	0.81	0.20	40.63
E204b	E204b	100YR-3HR	0.013	0.114	0.268	0.029	50.0	0.50	0.10	3.00	0.50	0.0018	0.00	0.85	0.23	49.08
E205a	E205a	100YR-3HR	0.040	0.194	0.292	0.032	40.6	0.50	0.10	3.15	0.51	0.0018	0.00	0.80	0.20	39.60
E205b	E205b	100YR-3HR	0.113	0.262	0.606	0.032	48.9	0.50	0.10	3.15	0.51	0.0018	0.00	0.84	0.23	47.95
E210a	E210a	100YR-3HR	0.052	0.192	0.420	0.016	55.2	0.50	0.10	3.83	0.56	0.0018	0.00	0.88	0.25	54.22
E210b	E210b	100YR-3HR	0.101	0.396	0.637	0.016	48.9	0.50	0.10	3.83	0.56	0.0018	0.00	0.84	0.23	47.83
E215	E215	100YR-3HR	0.024	0.110	0.253	0.030	81.0	0.50	0.10	4.13	0.58	0.0018	0.00	0.94	0.33	80.34
F100a	F100a	100YR-3HR	0.051	0.076	0.230	0.031	25.0	0.50	0.10	3.00	0.50	0.0018	0.00	0.50	0.15	23.75
F100b	F100b	100YR-3HR	0.140	0.267	0.535	0.031	50.0	0.50	0.10	3.00	0.50	0.0018	0.00	0.85	0.23	49.08
F110	F110	100YR-3HR	0.164	0.167	0.424	0.023	52.5	0.50	0.10	3.00	0.50	0.0018	0.00	0.86	0.24	51.61
F120	F120	100YR-3HR	0.194	0.377	0.668	0.028	55.6	0.50	0.10	3.08	0.51	0.0018	0.00	0.88	0.25	54.74
F125	F125	100YR-3HR	0.109	0.254	0.623	0.025	50.0	0.50	0.10	3.68	0.55	0.0018	0.00	0.85	0.23	48.97
F130	F130	100YR-3HR	0.167	0.287	0.624	0.022	51.4	0.50	0.10	3.68	0.55	0.0018	0.00	0.86	0.24	50.39

Note: Blue highlighted cells indicate basins that have been added or altered in size/ shape, or
% impervious for Ridgegate Development

PROJECT: HAPPY CANYON CREEK MASTER DRAINAGE PLAN
PROJECT NO: 65119103

100YR-3HR DEVELOPED

Summary of Unit Hydrograph Parameters Used By Program and Calculated Results (Version 2.0.0)

		Unit Hydrograph Parameters and Results									Excess Precip.		Storm Hydrograph			
Catchment Name/ID	User Comment for Catchment	CT	Cp	W50 (min.)	W50 Before Peak	W75 (min.)	W75 Before Peak	Time to Peak (min.)	Peak (cfs)	Volume (c.f)	Excess (inches)	Excess (c.f.)	Time to Peak (min.)	Peak Flow (cfs)	Total Volume (c.f.)	Runoff per Unit Area (cfs/acre)
A100		0.092	0.188	19.9	3.17	10.3	2.24	5.3	172	265,635	2.01	534,784	39.0	180	534,733	2.46
A105		0.112	0.166	53.3	7.08	27.7	5.00	11.8	97	400,194	1.69	676,754	55.0	124	676,741	1.12
A110		0.090	0.204	9.2	1.75	4.8	1.24	2.9	392	280,317	2.08	583,746	35.0	298	583,502	3.86
A120		0.090	0.238	12.4	2.57	6.5	1.82	4.3	410	394,526	2.08	821,579	36.0	364	821,233	3.35
A125		0.090	0.201	17.7	3.05	9.2	2.15	5.1	198	271,954	2.08	566,329	38.0	202	566,231	2.70
A130		0.103	0.117	23.7	2.43	12.3	1.72	4.0	92	169,524	1.80	304,738	41.0	95	304,746	2.02
A134		0.102	0.182	25.0	3.80	13.0	2.68	6.3	224	432,231	1.81	783,051	42.0	237	783,048	1.99
A135		0.099	0.181	31.4	4.67	16.3	3.30	7.8	153	371,991	1.85	689,731	45.0	178	689,715	1.73
A140		0.099	0.192	22.4	3.61	11.6	2.55	6.0	244	423,473	1.85	782,381	41.0	252	782,311	2.16
A150		0.118	0.172	23.4	3.39	12.2	2.39	5.6	231	417,549	1.62	674,928	41.0	222	674,934	1.93
A160		0.126	0.173	26.0	3.75	13.5	2.65	6.3	193	388,904	1.54	598,879	43.0	186	598,853	1.74
A170		0.129	0.161	32.4	4.30	16.8	3.04	7.2	126	315,491	1.53	481,549	46.0	129	481,524	1.49
A180		0.129	0.160	30.2	4.01	15.7	2.83	6.7	132	309,985	1.51	467,947	45.0	132	467,918	1.54
A190		0.129	0.162	23.8	3.26	12.4	2.30	5.4	176	323,273	1.52	491,117	42.0	163	491,101	1.83
A195		0.121	0.144	57.5	6.67	29.9	4.72	11.1	62	275,020	1.59	437,021	56.0	77	437,019	1.01
A200		0.121	0.156	26.5	3.47	13.8	2.45	5.8	158	324,737	1.59	516,023	43.0	156	515,994	1.75
A210		0.112	0.146	50.7	5.98	26.4	4.23	10.0	77	301,737	1.69	509,020	53.0	96	509,011	1.16
A215		0.139	0.170	49.3	6.72	25.6	4.75	11.2	112	427,469	1.51	647,235	54.0	130	647,225	1.11
A220		0.114	0.165	32.2	4.38	16.8	3.09	7.3	140	349,316	1.67	582,587	45.0	153	582,560	1.58
A230		0.125	0.138	14.9	1.88	7.7	1.33	3.1	94	108,703	1.57	170,432	37.0	76	170,407	2.53
A234		0.124	0.162	28.5	3.84	14.8	2.72	6.4	140	309,381	1.58	489,618	44.0	142	489,605	1.66
A235		0.153	0.165	37.0	4.99	19.3	3.52	8.3	123	351,616	1.46	514,953	48.0	128	514,931	1.32
A240		0.120	0.162	44.7	5.87	23.2	4.15	9.8	91	315,447	1.61	508,544	51.0	107	508,531	1.24
A245		0.128	0.140	20.3	2.48	10.5	1.76	4.1	77	120,249	1.55	186,933	40.0	68	186,919	2.05
A250		0.118	0.145	24.4	3.01	12.7	2.13	5.0	68	128,865	1.63	210,186	42.0	67	210,174	1.88
A260		0.116	0.166	79.5	10.45	41.3	7.38	17.4	73	446,853	1.62	724,281	68.0	100	724,275	0.81
A263		0.131	0.159	32.9	4.32	17.1	3.05	7.2	170	431,970	1.53	660,806	46.0	176	660,799	1.48
A264		0.121	0.165	53.6	7.09	27.9	5.01	11.8	95	392,403	1.58	620,878	55.0	115	620,872	1.07
A265		0.088	0.171	21.5	3.12	11.2	2.21	5.2	104	172,788	2.13	368,456	39.0	115	368,408	2.42
A270		0.111	0.165	42.8	5.72	22.3	4.04	9.5	61	201,055	1.69	339,569	51.0	73	339,568	1.31
A271		0.092	0.162	8.5	1.36	4.4	0.96	2.3	128	84,518	2.00	169,441	35.0	91	169,447	3.91
A275		0.076	0.162	11.1	1.68	5.8	1.19	2.8	241	207,537	2.62	544,195	35.0	229	543,911	4.01
A276		0.077	0.145	14.6	1.93	7.6	1.36	3.2	132	149,544	2.56	383,519	36.0	142	383,437	3.44
A280		0.102	0.172	27.0	3.87	14.1	2.73	6.4	96	201,828	1.78	359,447	43.0	103	359,430	1.86

		Unit Hydrograph Parameters and Results									Excess Precip.		Storm Hydrograph			
Catchment Name/ID	User Comment for Catchment	CT	Cp	W50 (min.)	W50 Before Peak	W75 (min.)	W75 Before Peak	Time to Peak (min.)	Peak (cfs)	Volume (c.f)	Excess (inches)	Excess (c.f.)	Time to Peak (min.)	Peak Flow (cfs)	Total Volume (c.f.)	Runoff per Unit Area (cfs/acre)
A282		0.085	0.172	22.3	3.25	11.6	2.29	5.4	219	378,246	2.20	833,859	40.0	251	833,841	2.41
A285		0.092	0.145	29.4	3.58	15.3	2.53	6.0	83	189,082	2.02	381,466	43.0	98	381,462	1.89
A290		0.105	0.172	32.9	4.64	17.1	3.28	7.7	127	323,806	1.71	555,326	46.0	141	555,322	1.59
A291		0.084	0.166	40.7	5.47	21.1	3.86	9.1	155	486,595	2.26	1,097,732	49.0	220	1,097,730	1.64
A295		0.086	0.151	13.2	1.83	6.9	1.29	3.0	189	193,592	2.18	421,724	36.0	175	421,631	3.28
A300		0.093	0.169	29.4	4.12	15.3	2.91	6.9	133	303,468	1.96	594,724	44.0	155	594,677	1.86
A305		0.093	0.147	28.0	3.47	14.6	2.45	5.8	89	192,581	1.97	379,490	42.0	102	379,474	1.92
A310		0.091	0.160	24.4	3.30	12.7	2.33	5.5	71	134,602	1.96	263,968	41.0	78	263,954	2.09
A311		0.089	0.160	17.7	2.48	9.2	1.75	4.1	100	137,577	2.03	279,320	37.0	99	279,347	2.62
A314		0.082	0.161	35.3	4.66	18.4	3.29	7.8	104	284,298	2.32	659,140	46.0	144	659,125	1.84
A315		0.087	0.158	24.0	3.21	12.5	2.27	5.3	72	133,584	2.09	279,497	41.0	81	279,484	2.20
A320a		0.091	0.149	18.3	2.39	9.5	1.69	4.0	115	162,624	1.96	318,921	38.0	112	318,903	2.51
A320b		0.156	0.078	45.9	3.05	23.9	2.15	5.1	12	43,197	1.33	57,629	50.0	12	57,626	1.03
A325		0.080	0.162	24.1	3.29	12.5	2.32	5.5	166	309,892	2.38	738,255	40.0	206	738,227	2.41
B100		0.080	0.234	8.4	1.81	4.4	1.28	3.0	405	263,637	2.42	638,306	33.0	317	637,617	4.36
B110		0.102	0.153	22.0	2.89	11.4	2.04	4.8	176	299,948	1.80	541,294	40.0	177	541,208	2.14
B120		0.106	0.139	28.6	3.35	14.9	2.37	5.6	125	275,415	1.75	480,806	43.0	133	480,782	1.76
B130		0.126	0.145	43.0	5.08	22.3	3.59	8.5	78	260,477	1.54	400,405	50.0	88	400,393	1.22
B134		0.093	0.110	12.2	1.33	6.3	0.94	2.2	94	88,677	1.97	175,034	35.0	79	175,062	3.24
B135		0.118	0.176	41.4	5.89	21.5	4.16	9.8	142	455,812	1.63	742,838	50.0	166	742,823	1.32
C100		0.153	0.153	35.8	4.51	18.6	3.19	7.5	126	350,106	1.46	512,741	47.0	130	512,722	1.35
C110		0.133	0.155	28.1	3.64	14.6	2.58	6.1	175	379,959	1.54	584,850	43.0	173	584,834	1.65
C120		0.122	0.145	39.0	4.63	20.3	3.27	7.7	79	239,824	1.59	381,790	48.0	89	381,784	1.34
C125		0.136	0.169	49.0	6.64	25.5	4.69	11.1	108	409,255	1.53	624,788	54.0	126	624,786	1.12
C130		0.096	0.168	23.6	3.35	12.3	2.37	5.6	221	404,678	1.91	773,562	41.0	237	773,541	2.13
C140		0.105	0.151	19.7	2.59	10.3	1.83	4.3	129	196,914	1.77	348,475	39.0	123	348,479	2.27
C150		0.153	0.153	49.2	6.07	25.6	4.29	10.1	55	211,249	1.46	309,380	53.0	63	309,377	1.08
C153		0.098	0.182	23.3	3.56	12.1	2.52	5.9	251	454,046	1.87	848,359	41.0	265	848,377	2.12
C154		0.092	0.141	23.4	2.84	12.2	2.01	4.7	195	353,382	2.01	710,942	40.0	214	710,848	2.19
C155		0.100	0.155	29.5	3.81	15.3	2.69	6.3	121	275,415	1.84	506,743	43.0	136	506,704	1.79
C159		0.102	0.164	25.2	3.47	13.1	2.45	5.8	205	400,311	1.81	725,222	42.0	217	725,227	1.97
C160		0.136	0.159	22.4	3.03	11.6	2.14	5.1	240	416,643	1.53	636,067	41.0	219	636,022	1.91
C170		0.126	0.146	48.0	5.69	25.0	4.02	9.5	105	391,506	1.57	612,787	52.0	124	612,790	1.15
C175		0.136	0.150	48.1	5.85	25.0	4.13	9.7	98	364,557	1.53	556,549	53.0	113	556,545	1.13
C180		0.119	0.130	27.7	3.06	14.4	2.16	5.1	74	159,395	1.62	258,042	43.0	75	258,020	1.71
C185		0.127	0.161	45.6	5.92	23.7	4.18	9.9	114	403,679	1.56	629,152	52.0	133	629,149	1.19
C190		0.119	0.150	40.3	4.93	20.9	3.48	8.2	88	275,299	1.62	445,678	49.0	101	445,671	1.33
D100		0.133	0.170	35.8	4.98	18.6	3.52	8.3	157	435,391	1.54	670,172	47.0	168	670,161	1.40
D110		0.126	0.168	35.2	4.85	18.3	3.43	8.1	149	406,165	1.57	635,732	47.0	161	635,707	1.44
D120		0.129	0.158	21.2	2.88	11.0	2.03	4.8	162	266,773	1.55	414,004	41.0	147	413,939	2.00

		Unit Hydrograph Parameters and Results									Excess Precip.		Storm Hydrograph			
Catchment Name/ID	User Comment for Catchment	CT	Cp	W50 (min.)	W50 Before Peak	W75 (min.)	W75 Before Peak	Time to Peak (min.)	Peak (cfs)	Volume (c.f)	Excess (inches)	Excess (c.f.)	Time to Peak (min.)	Peak Flow (cfs)	Total Volume (c.f.)	Runoff per Unit Area (cfs/acre)
D130		0.107	0.160	27.2	3.65	14.1	2.58	6.1	138	290,795	1.74	506,543	43.0	146	506,547	1.82
E100		0.156	0.165	48.2	6.40	25.1	4.52	10.7	94	350,826	1.45	509,498	53.0	105	509,487	1.09
E105		0.156	0.150	35.5	4.40	18.4	3.11	7.3	70	191,501	1.45	278,113	47.0	71	278,117	1.35
E110		0.156	0.161	30.4	4.06	15.8	2.87	6.8	128	300,808	1.45	436,857	45.0	125	436,826	1.50
E120		0.156	0.159	37.5	4.89	19.5	3.45	8.1	97	281,967	1.45	409,494	48.0	101	409,488	1.30
E125		0.156	0.158	41.2	5.30	21.4	3.75	8.8	84	266,727	1.45	387,361	50.0	89	387,351	1.22
E130		0.156	0.161	31.8	4.22	16.5	2.99	7.0	122	299,205	1.45	434,529	46.0	120	434,518	1.46
E135		0.156	0.166	44.5	5.97	23.1	4.22	9.9	107	369,226	1.45	536,219	52.0	118	536,211	1.16
E140		0.156	0.163	28.6	3.89	14.9	2.75	6.5	149	330,243	1.45	479,605	44.0	142	479,584	1.57
E150		0.150	0.156	30.1	3.91	15.7	2.76	6.5	104	242,751	1.47	355,751	45.0	102	355,737	1.52
E155		0.156	0.172	56.0	7.68	29.1	5.43	12.8	106	460,783	1.45	669,186	57.0	124	669,187	0.98
E160		0.117	0.171	28.9	4.09	15.0	2.89	6.8	211	473,715	1.56	739,287	44.0	212	739,200	1.62
E170		0.111	0.165	25.8	3.58	13.4	2.53	6.0	109	218,889	1.62	354,107	42.0	108	354,090	1.79
E171		0.101	0.165	12.6	1.90	6.6	1.34	3.2	132	128,865	1.74	223,783	36.0	105	223,727	2.95
E180		0.094	0.146	22.2	2.79	11.5	1.97	4.7	52	90,024	1.86	167,682	40.0	53	167,657	2.14
E182		0.095	0.146	24.1	3.00	12.5	2.12	5.0	155	289,311	1.88	542,734	41.0	164	542,676	2.05
E183		0.151	0.170	61.4	8.32	31.9	5.88	13.9	92	437,052	1.43	623,456	60.0	108	623,437	0.90
E184		0.135	0.158	46.8	5.98	24.4	4.23	10.0	78	284,592	1.45	412,226	52.0	86	412,214	1.10
E185		0.117	0.172	23.8	3.44	12.4	2.43	5.7	89	164,439	1.58	259,516	42.0	84	259,510	1.86
E190		0.092	0.154	24.8	3.22	12.9	2.28	5.4	114	217,770	1.95	425,227	41.0	124	425,169	2.07
E200a		0.089	0.167	27.8	3.87	14.5	2.74	6.5	173	372,438	2.07	770,354	42.0	205	770,325	2.00
E200b		0.120	0.085	42.5	3.07	22.1	2.17	5.1	26	85,305	1.53	130,933	48.0	28	130,925	1.21
E200c		0.156	0.036	41.2	1.45	21.4	1.03	2.4	3	7,986	1.37	10,907	47.0	2	10,907	1.12
E204a		0.093	0.145	20.6	2.61	10.7	1.84	4.3	77	122,331	1.99	243,698	39.0	80	243,692	2.36
E204b		0.089	0.077	23.6	1.69	12.3	1.20	2.8	17	30,492	2.11	64,363	40.0	19	64,345	2.22
E205a		0.093	0.113	22.4	2.24	11.6	1.58	3.7	53	92,202	1.97	181,303	40.0	56	181,281	2.21
E205b		0.089	0.166	23.8	3.33	12.4	2.35	5.6	143	263,538	2.09	549,488	41.0	162	549,479	2.23
E210a		0.086	0.149	21.9	2.80	11.4	1.98	4.7	71	120,153	2.14	256,723	39.0	78	256,681	2.37
E210b		0.089	0.164	35.5	4.78	18.5	3.38	8.0	86	235,452	2.04	480,572	46.0	109	480,555	1.68
E215		0.077	0.121	12.5	1.46	6.5	1.03	2.4	59	56,628	2.52	142,972	35.0	57	142,950	3.68
F100a		0.106	0.095	17.3	1.56	9.0	1.10	2.6	88	117,612	1.76	206,501	37.0	79	206,459	2.44
F100b		0.089	0.170	22.1	3.19	11.5	2.25	5.3	190	325,248	2.11	686,534	40.0	211	686,491	2.36
F110		0.087	0.163	17.3	2.48	9.0	1.75	4.1	283	380,494	2.15	816,622	37.0	291	816,638	2.78
F120		0.086	0.171	28.7	4.06	14.9	2.87	6.8	203	449,632	2.19	982,818	43.0	253	982,732	2.04
F125		0.089	0.157	26.5	3.49	13.8	2.46	5.8	123	252,625	2.07	522,183	42.0	143	522,158	2.06
F130		0.088	0.167	27.1	3.78	14.1	2.67	6.3	185	388,369	2.09	810,906	42.0	219	810,883	2.04

Note: Blue highlighted cells indicate basins that have been added or altered in size/ shape, or % impervious for Ridgegate Development

PROJECT: HAPPY CANYON CREEK MASTER DRAINAGE PLAN
PROJECT NO: 65119103

100YR-2HR DEVELOPED

Summary of CUHP Input Parameters (Version 2.0.0)

								Depression Storage		Horton's Infiltration Parameters			DCIA Level and Fractions			
Catchment Name/ID	SWMM Node/ID	Raingage Name/ID	Area (sq.mi.)	Dist. to Centroid (miles)	Length (miles)	Slope (ft./ft.)	Percent Imperv.	Pervious (inches)	Imperv. (inches)	Initial Rate (in./hr.)	Final Rate (in.hr.)	Decay Coeff. (1/sec.)	DCIA Level	Dir. Con'ct Imperv. Fraction	Receiv. Perv. Fraction	Percent Eff. Imperv.
A100	A100	100YR-2HR	0.114	0.256	0.670	0.053	43.1	0.50	0.10	3.00	0.50	0.0018	0.00	0.82	0.21	42.14
A105	A105	100YR-2HR	0.172	0.619	1.018	0.045	20.3	0.50	0.10	3.00	0.50	0.0018	0.00	0.41	0.13	19.11
A110	A110	100YR-2HR	0.121	0.098	0.413	0.046	48.0	0.50	0.10	3.00	0.50	0.0018	0.00	0.84	0.22	47.06
A120	A120	100YR-2HR	0.170	0.130	0.703	0.036	48.0	0.50	0.10	3.00	0.50	0.0018	0.00	0.84	0.22	47.06
A125	A125	100YR-2HR	0.117	0.251	0.534	0.035	48.0	0.50	0.10	3.00	0.50	0.0018	0.00	0.84	0.22	47.06
A130	A130	100YR-2HR	0.073	0.137	0.424	0.034	28.0	0.50	0.10	3.00	0.50	0.0018	0.00	0.56	0.16	26.74
A134	A134	100YR-2HR	0.186	0.295	0.667	0.047	29.0	0.50	0.10	3.00	0.50	0.0018	0.00	0.58	0.17	27.74
A135	A135	100YR-2HR	0.160	0.370	0.835	0.041	32.0	0.50	0.10	3.00	0.50	0.0018	0.00	0.64	0.18	30.78
A140	A140	100YR-2HR	0.182	0.237	0.772	0.045	32.0	0.50	0.10	3.08	0.51	0.0018	0.00	0.64	0.18	30.76
A150	A150	100YR-2HR	0.180	0.144	0.746	0.043	16.0	0.50	0.10	3.15	0.51	0.0018	0.00	0.32	0.12	14.87
A160	A160	100YR-2HR	0.167	0.210	0.598	0.049	11.0	0.50	0.10	3.23	0.52	0.0018	0.00	0.22	0.10	10.04
A170	A170	100YR-2HR	0.136	0.275	0.537	0.041	10.0	0.50	0.10	3.23	0.52	0.0018	0.00	0.20	0.10	9.09
A180	A180	100YR-2HR	0.133	0.158	0.761	0.038	10.0	0.50	0.10	3.38	0.53	0.0018	0.00	0.20	0.10	9.06
A190	A190	100YR-2HR	0.139	0.143	0.595	0.047	10.1	0.50	0.10	3.30	0.52	0.0018	0.00	0.20	0.10	9.17
A195	A195	100YR-2HR	0.118	0.503	0.884	0.040	14.0	0.50	0.10	3.15	0.51	0.0018	0.00	0.28	0.11	12.93
A200	A200	100YR-2HR	0.140	0.171	0.620	0.042	14.0	0.50	0.10	3.15	0.51	0.0018	0.00	0.28	0.11	12.93
A210	A210	100YR-2HR	0.130	0.456	0.808	0.033	20.0	0.50	0.10	3.00	0.50	0.0018	0.00	0.40	0.13	18.82
A215	A215	100YR-2HR	0.184	0.456	0.831	0.052	7.0	0.50	0.10	3.00	0.50	0.0018	0.00	0.14	0.07	6.35
A220	A220	100YR-2HR	0.150	0.203	0.916	0.036	18.6	0.50	0.10	3.00	0.50	0.0018	0.00	0.37	0.13	17.44
A230	A230	100YR-2HR	0.047	0.068	0.329	0.040	11.2	0.50	0.10	3.00	0.50	0.0018	0.00	0.22	0.10	10.27
A234	A234	100YR-2HR	0.133	0.288	0.500	0.054	12.3	0.50	0.10	3.00	0.50	0.0018	0.00	0.25	0.11	11.33
A235	A235	100YR-2HR	0.151	0.255	0.641	0.052	3.0	0.50	0.10	3.00	0.50	0.0018	0.00	0.06	0.03	2.70
A240	A240	100YR-2HR	0.136	0.439	0.881	0.052	14.5	0.50	0.10	3.00	0.50	0.0018	0.00	0.29	0.11	13.45
A245	A245	100YR-2HR	0.052	0.154	0.339	0.062	10.2	0.50	0.10	3.00	0.50	0.0018	0.00	0.20	0.10	9.32
A250	A250	100YR-2HR	0.055	0.181	0.407	0.035	15.9	0.50	0.10	3.00	0.50	0.0018	0.00	0.32	0.12	14.81
A260	A260	100YR-2HR	0.192	0.455	2.083	0.023	16.9	0.50	0.10	3.23	0.52	0.0018	0.00	0.34	0.12	15.73
A263	A263	100YR-2HR	0.186	0.257	0.638	0.052	9.6	0.50	0.10	3.15	0.51	0.0018	0.00	0.19	0.10	8.73
A264	A264	100YR-2HR	0.169	0.537	1.042	0.049	14.1	0.50	0.10	3.23	0.52	0.0018	0.00	0.28	0.11	13.02
A265	A265	100YR-2HR	0.074	0.286	0.630	0.052	52.2	0.50	0.10	3.15	0.51	0.0018	0.00	0.86	0.24	51.28
A270	A270	100YR-2HR	0.087	0.395	0.796	0.028	20.7	0.50	0.10	3.08	0.51	0.0018	0.00	0.41	0.13	19.49
A271	A271	100YR-2HR	0.036	0.070	0.308	0.055	42.9	0.50	0.10	3.08	0.51	0.0018	0.00	0.81	0.21	41.92
A275	A275	100YR-2HR	0.089	0.134	0.426	0.055	85.9	0.50	0.10	3.08	0.51	0.0018	0.00	0.95	0.35	85.43
A276	A276	100YR-2HR	0.064	0.126	0.518	0.039	81.8	0.50	0.10	3.00	0.50	0.0018	0.00	0.94	0.34	81.26
A280	A280	100YR-2HR	0.087	0.371	0.567	0.051	28.3	0.50	0.10	3.23	0.52	0.0018	0.00	0.57	0.16	26.98

								Depression Storage		Horton's Infiltration Parameters			DCIA Level and Fractions			
Catchment Name/ID	SWMM Node/ID	Raingage Name/ID	Area (sq.mi.)	Dist. to Centroid (miles)	Length (miles)	Slope (ft./ft.)	Percent Imperv.	Pervious (inches)	Imperv. (inches)	Initial Rate (in./hr.)	Final Rate (in.hr.)	Decay Coeff. (1/sec.)	DCIA Level	Dir. Con'ct Imperv. Fraction	Receiv. Perv. Fraction	Percent Eff. Imperv.
A282	A282	100YR-2HR	0.163	0.259	0.798	0.051	57.5	0.50	0.10	3.23	0.52	0.0018	0.00	0.89	0.26	56.65
A285	A285	100YR-2HR	0.081	0.320	0.665	0.047	43.4	0.50	0.10	3.00	0.50	0.0018	0.00	0.82	0.21	42.44
A290	A290	100YR-2HR	0.139	0.299	0.730	0.026	26.1	0.50	0.10	3.60	0.54	0.0018	0.00	0.52	0.15	24.69
A291	A291	100YR-2HR	0.209	0.573	0.932	0.031	60.2	0.50	0.10	3.00	0.50	0.0018	0.00	0.90	0.27	59.43
A295	A295	100YR-2HR	0.083	0.112	0.379	0.034	56.3	0.50	0.10	3.38	0.53	0.0018	0.00	0.88	0.26	55.41
A300	A300	100YR-2HR	0.131	0.301	0.665	0.023	42.1	0.50	0.10	3.53	0.54	0.0018	0.00	0.81	0.21	41.04
A305	A305	100YR-2HR	0.083	0.295	0.530	0.031	41.3	0.50	0.10	3.23	0.52	0.0018	0.00	0.81	0.20	40.29
A310	A310	100YR-2HR	0.058	0.190	0.549	0.016	44.6	0.50	0.10	4.05	0.57	0.0018	0.00	0.82	0.21	43.46
A311	A311	100YR-2HR	0.059	0.180	0.314	0.016	49.1	0.50	0.10	4.05	0.57	0.0018	0.00	0.85	0.23	48.00
A314	A314	100YR-2HR	0.122	0.470	0.797	0.028	65.1	0.50	0.10	3.15	0.51	0.0018	0.00	0.91	0.29	64.34
A315	A315	100YR-2HR	0.058	0.285	0.517	0.030	53.4	0.50	0.10	4.13	0.58	0.0018	0.00	0.87	0.24	52.34
A320a	A320a	100YR-2HR	0.070	0.126	0.383	0.016	44.6	0.50	0.10	4.05	0.57	0.0018	0.00	0.82	0.21	43.46
A320b	A320b	100YR-2HR	0.019	0.123	0.226	0.016	2.0	0.50	0.10	4.05	0.57	0.0018	0.00	0.04	0.02	1.76
A325	A325	100YR-2HR	0.133	0.248	0.650	0.022	71.1	0.50	0.10	3.75	0.55	0.0018	0.00	0.92	0.30	70.32
B100	B100	100YR-2HR	0.113	0.151	0.376	0.047	71.8	0.50	0.10	3.00	0.50	0.0018	0.00	0.92	0.31	71.12
B110	B110	100YR-2HR	0.129	0.199	0.530	0.048	28.5	0.50	0.10	3.00	0.50	0.0018	0.00	0.57	0.16	27.24
B120	B120	100YR-2HR	0.119	0.199	0.637	0.041	24.8	0.50	0.10	3.08	0.51	0.0018	0.00	0.50	0.15	23.53
B130	B130	100YR-2HR	0.112	0.234	0.911	0.037	10.8	0.50	0.10	3.23	0.52	0.0018	0.00	0.22	0.10	9.85
B134	B134	100YR-2HR	0.038	0.036	0.293	0.015	40.3	0.50	0.10	3.00	0.50	0.0018	0.00	0.80	0.20	39.33
B135	B135	100YR-2HR	0.196	0.416	0.847	0.040	15.8	0.50	0.10	3.00	0.50	0.0018	0.00	0.32	0.12	14.71
C100	C100	100YR-2HR	0.151	0.240	0.508	0.045	3.0	0.50	0.10	3.00	0.50	0.0018	0.00	0.06	0.03	2.70
C110	C110	100YR-2HR	0.164	0.168	0.631	0.050	9.0	0.50	0.10	3.00	0.50	0.0018	0.00	0.18	0.09	8.20
C120	C120	100YR-2HR	0.103	0.275	0.678	0.037	13.0	0.50	0.10	3.00	0.50	0.0018	0.00	0.26	0.11	12.00
C125	C125	100YR-2HR	0.176	0.413	0.859	0.043	8.0	0.50	0.10	3.00	0.50	0.0018	0.00	0.16	0.08	7.27
C130	C130	100YR-2HR	0.174	0.222	0.629	0.033	36.0	0.50	0.10	3.00	0.50	0.0018	0.00	0.72	0.19	34.87
C140	C140	100YR-2HR	0.085	0.117	0.585	0.038	26.0	0.50	0.10	3.00	0.50	0.0018	0.00	0.52	0.15	24.74
C150	C150	100YR-2HR	0.091	0.272	0.631	0.024	3.0	0.50	0.10	3.00	0.50	0.0018	0.00	0.06	0.03	2.70
C153	C153	100YR-2HR	0.195	0.250	0.712	0.044	33.0	0.50	0.10	3.00	0.50	0.0018	0.00	0.66	0.18	31.80
C154	C154	100YR-2HR	0.152	0.212	0.537	0.040	43.0	0.50	0.10	3.00	0.50	0.0018	0.00	0.82	0.21	42.04
C155	C155	100YR-2HR	0.119	0.312	0.651	0.045	31.0	0.50	0.10	3.00	0.50	0.0018	0.00	0.62	0.17	29.76
C159	C159	100YR-2HR	0.172	0.240	0.684	0.049	29.0	0.50	0.10	3.00	0.50	0.0018	0.00	0.58	0.17	27.74
C160	C160	100YR-2HR	0.179	0.123	0.541	0.050	8.0	0.50	0.10	3.00	0.50	0.0018	0.00	0.16	0.08	7.27
C170	C170	100YR-2HR	0.169	0.296	0.865	0.032	11.0	0.50	0.10	3.00	0.50	0.0018	0.00	0.22	0.10	10.08
C175	C175	100YR-2HR	0.157	0.346	0.799	0.045	8.0	0.50	0.10	3.00	0.50	0.0018	0.00	0.16	0.08	7.27
C180	C180	100YR-2HR	0.069	0.129	0.622	0.041	15.0	0.50	0.10	3.00	0.50	0.0018	0.00	0.30	0.12	13.93
C185	C185	100YR-2HR	0.174	0.414	0.816	0.049	10.5	0.50	0.10	3.00	0.50	0.0018	0.00	0.21	0.10	9.60
C190	C190	100YR-2HR	0.119	0.269	0.766	0.031	15.0	0.50	0.10	3.00	0.50	0.0018	0.00	0.30	0.12	13.93
D100	D100	100YR-2HR	0.187	0.282	0.680	0.040	9.0	0.50	0.10	3.00	0.50	0.0018	0.00	0.18	0.09	8.20
D110	D110	100YR-2HR	0.175	0.283	0.619	0.030	11.0	0.50	0.10	3.00	0.50	0.0018	0.00	0.22	0.10	10.08
D120	D120	100YR-2HR	0.115	0.104	0.607	0.047	10.0	0.50	0.10	3.00	0.50	0.0018	0.00	0.20	0.10	9.12
D130	D130	100YR-2HR	0.125	0.282	0.592	0.050	24.0	0.50	0.10	3.00	0.50	0.0018	0.00	0.48	0.15	22.76

								Depression Storage		Horton's Infiltration Parameters			DCIA Level and Fractions			
Catchment Name/ID	SWMM Node/ID	Raingage Name/ID	Area (sq.mi.)	Dist. to Centroid (miles)	Length (miles)	Slope (ft./ft.)	Percent Imperv.	Pervious (inches)	Imperv. (inches)	Initial Rate (in./hr.)	Final Rate (in.hr.)	Decay Coeff. (1/sec.)	DCIA Level	Dir. Con'ct Imperv. Fraction	Receiv. Perv. Fraction	Percent Eff. Imperv.
E100	E100	100YR-2HR	0.151	0.294	0.702	0.030	2.0	0.50	0.10	3.00	0.50	0.0018	0.00	0.04	0.02	1.80
E105	E105	100YR-2HR	0.082	0.212	0.480	0.039	2.0	0.50	0.10	3.00	0.50	0.0018	0.00	0.04	0.02	1.80
E110	E110	100YR-2HR	0.129	0.196	0.468	0.045	2.0	0.50	0.10	3.00	0.50	0.0018	0.00	0.04	0.02	1.80
E120	E120	100YR-2HR	0.121	0.202	0.661	0.042	2.0	0.50	0.10	3.00	0.50	0.0018	0.00	0.04	0.02	1.80
E125	E125	100YR-2HR	0.115	0.304	0.574	0.050	2.0	0.50	0.10	3.00	0.50	0.0018	0.00	0.04	0.02	1.80
E130	E130	100YR-2HR	0.129	0.145	0.691	0.045	2.0	0.50	0.10	3.00	0.50	0.0018	0.00	0.04	0.02	1.80
E135	E135	100YR-2HR	0.159	0.329	0.676	0.048	2.0	0.50	0.10	3.00	0.50	0.0018	0.00	0.04	0.02	1.80
E140	E140	100YR-2HR	0.142	0.137	0.530	0.034	2.0	0.50	0.10	3.00	0.50	0.0018	0.00	0.04	0.02	1.80
E150	E150	100YR-2HR	0.104	0.182	0.537	0.052	3.8	0.50	0.10	3.08	0.51	0.0018	0.00	0.08	0.04	3.42
E155	E155	100YR-2HR	0.198	0.464	0.859	0.051	2.0	0.50	0.10	3.00	0.50	0.0018	0.00	0.04	0.02	1.80
E160	E160	100YR-2HR	0.204	0.247	0.634	0.038	16.9	0.50	0.10	3.83	0.56	0.0018	0.00	0.34	0.12	15.60
E170	E170	100YR-2HR	0.094	0.286	0.571	0.060	21.3	0.50	0.10	3.90	0.56	0.0018	0.00	0.43	0.14	19.88
E171	E171	100YR-2HR	0.055	0.126	0.349	0.060	29.3	0.50	0.10	3.90	0.56	0.0018	0.00	0.59	0.17	27.82
E180	E180	100YR-2HR	0.039	0.177	0.472	0.025	38.9	0.50	0.10	4.20	0.58	0.0018	0.00	0.78	0.20	37.66
E182	E182	100YR-2HR	0.125	0.250	0.479	0.039	36.9	0.50	0.10	3.60	0.54	0.0018	0.00	0.74	0.19	35.68
E183	E183	100YR-2HR	0.188	0.485	1.072	0.054	3.5	0.50	0.10	3.38	0.53	0.0018	0.00	0.07	0.04	3.13
E184	E184	100YR-2HR	0.123	0.401	0.794	0.053	8.4	0.50	0.10	3.75	0.55	0.0018	0.00	0.17	0.08	7.53
E185	E185	100YR-2HR	0.071	0.207	0.517	0.039	16.6	0.50	0.10	3.60	0.54	0.0018	0.00	0.33	0.12	15.36
E190	E190	100YR-2HR	0.094	0.190	0.650	0.026	42.7	0.50	0.10	3.75	0.55	0.0018	0.00	0.81	0.21	41.60
E200a	E200a	100YR-2HR	0.160	0.283	0.680	0.023	50.4	0.50	0.10	3.75	0.55	0.0018	0.00	0.85	0.23	49.36
E200b	E200b	100YR-2HR	0.037	0.173	0.347	0.023	14.6	0.50	0.10	3.75	0.55	0.0018	0.00	0.29	0.11	13.39
E200c	E200c	100YR-2HR	0.003	0.053	0.105	0.023	2.0	0.50	0.10	3.75	0.55	0.0018	0.00	0.00	0.02	1.76
E204a	E204a	100YR-2HR	0.053	0.170	0.465	0.029	41.6	0.50	0.10	3.00	0.50	0.0018	0.00	0.81	0.20	40.63
E204b	E204b	100YR-2HR	0.013	0.114	0.268	0.029	50.0	0.50	0.10	3.00	0.50	0.0018	0.00	0.85	0.23	49.08
E205a	E205a	100YR-2HR	0.040	0.194	0.292	0.032	40.6	0.50	0.10	3.15	0.51	0.0018	0.00	0.80	0.20	39.60
E205b	E205b	100YR-2HR	0.113	0.262	0.606	0.032	48.9	0.50	0.10	3.15	0.51	0.0018	0.00	0.84	0.23	47.95
E210a	E210a	100YR-2HR	0.052	0.192	0.420	0.016	55.2	0.50	0.10	3.83	0.56	0.0018	0.00	0.88	0.25	54.22
E210b	E210b	100YR-2HR	0.101	0.396	0.637	0.016	48.9	0.50	0.10	3.83	0.56	0.0018	0.00	0.84	0.23	47.83
E215	E215	100YR-2HR	0.024	0.110	0.253	0.030	81.0	0.50	0.10	4.13	0.58	0.0018	0.00	0.94	0.33	80.34
F100a	F100a	100YR-2HR	0.051	0.076	0.230	0.031	25.0	0.50	0.10	3.00	0.50	0.0018	0.00	0.50	0.15	23.75
F100b	F100b	100YR-2HR	0.140	0.267	0.535	0.031	50.0	0.50	0.10	3.00	0.50	0.0018	0.00	0.85	0.23	49.08
F110	F110	100YR-2HR	0.164	0.167	0.424	0.023	52.5	0.50	0.10	3.00	0.50	0.0018	0.00	0.86	0.24	51.61
F120	F120	100YR-2HR	0.194	0.377	0.668	0.028	55.6	0.50	0.10	3.08	0.51	0.0018	0.00	0.88	0.25	54.74
F125	F125	100YR-2HR	0.109	0.254	0.623	0.025	50.0	0.50	0.10	3.68	0.55	0.0018	0.00	0.85	0.23	48.97
F130	F130	100YR-2HR	0.167	0.287	0.624	0.022	51.4	0.50	0.10	3.68	0.55	0.0018	0.00	0.86	0.24	50.39

PROJECT: HAPPY CANYON CREEK MASTER DRAINAGE PLAN
PROJECT NO: 65119103

100YR-2HR DEVELOPED

Summary of Unit Hydrograph Parameters Used By Program and Calculated Results (Version 2.0.0)

		Unit Hydrograph Parameters and Results									Excess Precip.		Storm Hydrograph			
Catchment Name/ID	User Comment for Catchment	CT	Cp	W50 (min.)	W50 Before Peak	W75 (min.)	W75 Before Peak	Time to Peak (min.)	Peak (cfs)	Volume (c.f)	Excess (inches)	Excess (c.f.)	Time to Peak (min.)	Peak Flow (cfs)	Total Volume (c.f.)	Runoff per Unit Area (cfs/acre)
A100		0.092	0.188	19.9	3.17	10.3	2.24	5.3	172	265,635	2.01	534,784	39.0	180	534,733	2.46
A105		0.112	0.166	53.3	7.08	27.7	5.00	11.8	97	400,194	1.69	676,754	55.0	124	676,741	1.12
A110		0.090	0.204	9.2	1.75	4.8	1.24	2.9	392	280,317	2.08	583,746	35.0	298	583,502	3.86
A120		0.090	0.238	12.4	2.57	6.5	1.82	4.3	410	394,526	2.08	821,579	36.0	364	821,233	3.35
A125		0.090	0.201	17.7	3.05	9.2	2.15	5.1	198	271,954	2.08	566,329	38.0	202	566,231	2.70
A130		0.103	0.117	23.7	2.43	12.3	1.72	4.0	92	169,524	1.80	304,738	41.0	95	304,746	2.02
A134		0.102	0.182	25.0	3.80	13.0	2.68	6.3	224	432,231	1.81	783,051	42.0	237	783,048	1.99
A135		0.099	0.181	31.4	4.67	16.3	3.30	7.8	153	371,991	1.85	689,731	45.0	178	689,715	1.73
A140		0.099	0.192	22.4	3.61	11.6	2.55	6.0	244	423,473	1.85	782,381	41.0	252	782,311	2.16
A150		0.118	0.172	23.4	3.39	12.2	2.39	5.6	231	417,549	1.62	674,928	41.0	222	674,934	1.93
A160		0.126	0.173	26.0	3.75	13.5	2.65	6.3	193	388,904	1.54	598,879	43.0	186	598,853	1.74
A170		0.129	0.161	32.4	4.30	16.8	3.04	7.2	126	315,491	1.53	481,549	46.0	129	481,524	1.49
A180		0.129	0.160	30.2	4.01	15.7	2.83	6.7	132	309,985	1.51	467,947	45.0	132	467,918	1.54
A190		0.129	0.162	23.8	3.26	12.4	2.30	5.4	176	323,273	1.52	491,117	42.0	163	491,101	1.83
A195		0.121	0.144	57.5	6.67	29.9	4.72	11.1	62	275,020	1.59	437,021	56.0	77	437,019	1.01
A200		0.121	0.156	26.5	3.47	13.8	2.45	5.8	158	324,737	1.59	516,023	43.0	156	515,994	1.75
A210		0.112	0.146	50.7	5.98	26.4	4.23	10.0	77	301,737	1.69	509,020	53.0	96	509,011	1.16
A215		0.139	0.170	49.3	6.72	25.6	4.75	11.2	112	427,469	1.51	647,235	54.0	130	647,225	1.11
A220		0.114	0.165	32.2	4.38	16.8	3.09	7.3	140	349,316	1.66	580,371	45.0	153	580,343	1.58
A230		0.125	0.138	14.9	1.88	7.7	1.33	3.1	94	108,703	1.57	170,182	37.0	76	170,157	2.53
A234		0.124	0.162	28.5	3.84	14.8	2.72	6.4	140	309,381	1.58	488,759	44.0	142	488,747	1.66
A235		0.153	0.165	37.0	4.99	19.3	3.52	8.3	123	351,616	1.46	514,895	48.0	128	514,873	1.32
A240		0.120	0.162	44.7	5.87	23.2	4.15	9.8	91	315,447	1.61	507,327	51.0	107	507,315	1.24
A245		0.128	0.140	20.3	2.48	10.5	1.76	4.1	77	120,249	1.55	186,704	40.0	68	186,690	2.05
A250		0.118	0.145	24.4	3.01	12.7	2.13	5.0	68	128,865	1.63	209,589	42.0	67	209,576	1.88
A260		0.116	0.166	79.5	10.45	41.3	7.38	17.4	73	446,853	1.62	721,940	68.0	100	721,935	0.81
A263		0.131	0.159	32.9	4.32	17.1	3.05	7.2	170	431,970	1.53	660,076	46.0	176	660,069	1.48
A264		0.121	0.165	53.6	7.09	27.9	5.01	11.8	95	392,403	1.58	619,448	55.0	115	619,442	1.07
A265		0.088	0.171	21.5	3.12	11.2	2.21	5.2	104	172,788	2.09	361,335	39.0	115	361,288	2.42
A270		0.111	0.165	42.8	5.72	22.3	4.04	9.5	61	201,055	1.68	337,989	51.0	73	337,988	1.31
A271		0.092	0.162	8.5	1.36	4.4	0.96	2.3	128	84,518	1.97	166,733	35.0	91	166,738	3.91
A275		0.076	0.162	11.1	1.68	5.8	1.19	2.8	241	207,537	2.55	528,635	35.0	229	528,359	4.01
A276		0.077	0.145	14.6	1.93	7.6	1.36	3.2	132	149,544	2.49	372,934	36.0	142	372,854	3.44
A280		0.102	0.172	27.0	3.87	14.1	2.73	6.4	96	201,828	1.77	356,483	43.0	103	356,465	1.86

		Unit Hydrograph Parameters and Results									Excess Precip.		Storm Hydrograph			
Catchment Name/ID	User Comment for Catchment	CT	Cp	W50 (min.)	W50 Before Peak	W75 (min.)	W75 Before Peak	Time to Peak (min.)	Peak (cfs)	Volume (c.f)	Excess (inches)	Excess (c.f.)	Time to Peak (min.)	Peak Flow (cfs)	Total Volume (c.f.)	Runoff per Unit Area (cfs/acre)
A282		0.085	0.172	22.3	3.25	11.6	2.29	5.4	219	378,246	2.16	816,159	40.0	251	816,141	2.41
A285		0.092	0.145	29.4	3.58	15.3	2.53	6.0	83	189,082	1.98	375,318	43.0	98	375,314	1.89
A290		0.105	0.172	32.9	4.64	17.1	3.28	7.7	127	323,806	1.70	551,281	46.0	141	551,277	1.59
A291		0.084	0.166	40.7	5.47	21.1	3.86	9.1	155	486,595	2.21	1,073,545	49.0	220	1,073,543	1.64
A295		0.086	0.151	13.2	1.83	6.9	1.29	3.0	189	193,592	2.13	412,914	36.0	175	412,823	3.28
A300		0.093	0.169	29.4	4.12	15.3	2.91	6.9	133	303,468	1.93	585,229	44.0	155	585,182	1.86
A305		0.093	0.147	28.0	3.47	14.6	2.45	5.8	89	192,581	1.94	373,608	42.0	102	373,592	1.92
A310		0.091	0.160	24.4	3.30	12.7	2.33	5.5	71	134,602	1.93	259,437	41.0	78	259,424	2.09
A311		0.089	0.160	17.7	2.48	9.2	1.75	4.1	100	137,577	1.99	274,083	37.0	99	274,109	2.62
A314		0.082	0.161	35.3	4.66	18.4	3.29	7.8	104	284,298	2.26	643,693	46.0	144	643,678	1.84
A315		0.087	0.158	24.0	3.21	12.5	2.27	5.3	72	133,584	2.05	273,826	41.0	81	273,813	2.20
A320a		0.091	0.149	18.3	2.39	9.5	1.69	4.0	115	162,624	1.93	313,447	38.0	112	313,429	2.51
A320b		0.156	0.078	45.9	3.05	23.9	2.15	5.1	12	43,197	1.33	57,626	50.0	12	57,623	1.03
A325		0.080	0.162	24.1	3.29	12.5	2.32	5.5	166	309,892	2.32	719,623	40.0	206	719,595	2.41
B100		0.080	0.234	8.4	1.81	4.4	1.28	3.0	405	263,637	2.36	622,274	33.0	317	621,602	4.36
B110		0.102	0.153	22.0	2.89	11.4	2.04	4.8	176	299,948	1.79	536,826	40.0	177	536,741	2.14
B120		0.106	0.139	28.6	3.35	14.9	2.37	5.6	125	275,415	1.73	477,700	43.0	133	477,675	1.76
B130		0.126	0.145	43.0	5.08	22.3	3.59	8.5	78	260,477	1.54	399,848	50.0	88	399,836	1.22
B134		0.093	0.110	12.2	1.33	6.3	0.94	2.2	94	88,677	1.94	172,407	35.0	79	172,435	3.24
B135		0.118	0.176	41.4	5.89	21.5	4.16	9.8	142	455,812	1.63	740,752	50.0	166	740,736	1.32
C100		0.153	0.153	35.8	4.51	18.6	3.19	7.5	126	350,106	1.46	512,683	47.0	130	512,664	1.35
C110		0.133	0.155	28.1	3.64	14.6	2.58	6.1	175	379,959	1.54	584,285	43.0	173	584,269	1.65
C120		0.122	0.145	39.0	4.63	20.3	3.27	7.7	79	239,824	1.59	381,046	48.0	89	381,040	1.34
C125		0.136	0.169	49.0	6.64	25.5	4.69	11.1	108	409,255	1.53	624,308	54.0	126	624,306	1.12
C130		0.096	0.168	23.6	3.35	12.3	2.37	5.6	221	404,678	1.89	763,943	41.0	237	763,923	2.13
C140		0.105	0.151	19.7	2.59	10.3	1.83	4.3	129	196,914	1.76	346,034	39.0	123	346,037	2.27
C150		0.153	0.153	49.2	6.07	25.6	4.29	10.1	55	211,249	1.46	309,345	53.0	63	309,342	1.08
C153		0.098	0.182	23.3	3.56	12.1	2.52	5.9	251	454,046	1.85	839,291	41.0	265	839,308	2.12
C154		0.092	0.141	23.4	2.84	12.2	2.01	4.7	195	353,382	1.98	699,586	40.0	214	699,493	2.19
C155		0.100	0.155	29.5	3.81	15.3	2.69	6.3	121	275,415	1.82	501,889	43.0	136	501,851	1.79
C159		0.102	0.164	25.2	3.47	13.1	2.45	5.8	205	400,311	1.80	719,048	42.0	217	719,052	1.97
C160		0.136	0.159	22.4	3.03	11.6	2.14	5.1	240	416,643	1.53	635,578	41.0	219	635,533	1.91
C170		0.126	0.146	48.0	5.69	25.0	4.02	9.5	105	391,506	1.56	611,918	52.0	124	611,921	1.15
C175		0.136	0.150	48.1	5.85	25.0	4.13	9.7	98	364,557	1.53	556,122	53.0	113	556,117	1.13
C180		0.119	0.130	27.7	3.06	14.4	2.16	5.1	74	159,395	1.61	257,384	43.0	75	257,362	1.71
C185		0.127	0.161	45.6	5.92	23.7	4.18	9.9	114	403,679	1.56	628,336	52.0	133	628,332	1.19
C190		0.119	0.150	40.3	4.93	20.9	3.48	8.2	88	275,299	1.61	444,542	49.0	101	444,535	1.33
D100		0.133	0.170	35.8	4.98	18.6	3.52	8.3	157	435,391	1.54	669,526	47.0	168	669,514	1.40
D110		0.126	0.168	35.2	4.85	18.3	3.43	8.1	149	406,165	1.56	634,831	47.0	161	634,805	1.44
D120		0.129	0.158	21.2	2.88	11.0	2.03	4.8	162	266,773	1.55	413,515	41.0	147	413,450	2.00

		Unit Hydrograph Parameters and Results									Excess Precip.		Storm Hydrograph			
Catchment Name/ID	User Comment for Catchment	CT	Cp	W50 (min.)	W50 Before Peak	W75 (min.)	W75 Before Peak	Time to Peak (min.)	Peak (cfs)	Volume (c.f)	Excess (inches)	Excess (c.f.)	Time to Peak (min.)	Peak Flow (cfs)	Total Volume (c.f.)	Runoff per Unit Area (cfs/acre)
D130		0.107	0.160	27.2	3.65	14.1	2.58	6.1	138	290,795	1.73	503,471	43.0	146	503,475	1.82
E100		0.156	0.165	48.2	6.40	25.1	4.52	10.7	94	350,826	1.45	509,472	53.0	105	509,461	1.09
E105		0.156	0.150	35.5	4.40	18.4	3.11	7.3	70	191,501	1.45	278,099	47.0	71	278,103	1.35
E110		0.156	0.161	30.4	4.06	15.8	2.87	6.8	128	300,808	1.45	436,835	45.0	125	436,804	1.50
E120		0.156	0.159	37.5	4.89	19.5	3.45	8.1	97	281,967	1.45	409,474	48.0	101	409,467	1.30
E125		0.156	0.158	41.2	5.30	21.4	3.75	8.8	84	266,727	1.45	387,342	50.0	89	387,332	1.22
E130		0.156	0.161	31.8	4.22	16.5	2.99	7.0	122	299,205	1.45	434,507	46.0	120	434,496	1.46
E135		0.156	0.166	44.5	5.97	23.1	4.22	9.9	107	369,226	1.45	536,192	52.0	118	536,184	1.16
E140		0.156	0.163	28.6	3.89	14.9	2.75	6.5	149	330,243	1.45	479,580	44.0	142	479,559	1.57
E150		0.150	0.156	30.1	3.91	15.7	2.76	6.5	104	242,751	1.47	355,687	45.0	102	355,673	1.52
E155		0.156	0.172	56.0	7.68	29.1	5.43	12.8	106	460,783	1.45	669,152	57.0	124	669,153	0.98
E160		0.117	0.171	28.9	4.09	15.0	2.89	6.8	211	473,715	1.56	736,806	44.0	212	736,719	1.62
E170		0.111	0.165	25.8	3.58	13.4	2.53	6.0	109	218,889	1.61	352,286	42.0	108	352,269	1.79
E171		0.101	0.165	12.6	1.90	6.6	1.34	3.2	132	128,865	1.72	221,754	36.0	105	221,699	2.95
E180		0.094	0.146	22.2	2.79	11.5	1.97	4.7	52	90,024	1.83	165,183	40.0	53	165,159	2.14
E182		0.095	0.146	24.1	3.00	12.5	2.12	5.0	155	289,311	1.85	535,509	41.0	164	535,453	2.05
E183		0.151	0.170	61.4	8.32	31.9	5.88	13.9	92	437,052	1.43	623,358	60.0	108	623,339	0.90
E184		0.135	0.158	46.8	5.98	24.4	4.23	10.0	78	284,592	1.45	411,858	52.0	86	411,846	1.10
E185		0.117	0.172	23.8	3.44	12.4	2.43	5.7	89	164,439	1.57	258,685	42.0	84	258,679	1.86
E190		0.092	0.154	24.8	3.22	12.9	2.28	5.4	114	217,770	1.92	418,290	41.0	124	418,233	2.07
E200a		0.089	0.167	27.8	3.87	14.5	2.74	6.5	173	372,438	2.03	755,688	42.0	205	755,660	2.00
E200b		0.120	0.085	42.5	3.07	22.1	2.17	5.1	26	85,305	1.53	130,599	48.0	28	130,591	1.21
E200c		0.156	0.036	41.2	1.45	21.4	1.03	2.4	3	7,986	1.37	10,907	47.0	2	10,907	1.12
E204a		0.093	0.145	20.6	2.61	10.7	1.84	4.3	77	122,331	1.96	239,927	39.0	80	239,922	2.36
E204b		0.089	0.077	23.6	1.69	12.3	1.20	2.8	17	30,492	2.07	63,174	40.0	19	63,157	2.22
E205a		0.093	0.113	22.4	2.24	11.6	1.58	3.7	53	92,202	1.94	178,547	40.0	56	178,525	2.21
E205b		0.089	0.166	23.8	3.33	12.4	2.35	5.6	143	263,538	2.05	539,508	41.0	162	539,499	2.23
E210a		0.086	0.149	21.9	2.80	11.4	1.98	4.7	71	120,153	2.09	251,395	39.0	78	251,354	2.37
E210b		0.089	0.164	35.5	4.78	18.5	3.38	8.0	86	235,452	2.00	471,656	46.0	109	471,640	1.68
E215		0.077	0.121	12.5	1.46	6.5	1.03	2.4	59	56,628	2.45	139,010	35.0	57	138,988	3.68
F100a		0.106	0.095	17.3	1.56	9.0	1.10	2.6	88	117,612	1.74	205,152	37.0	79	205,111	2.44
F100b		0.089	0.170	22.1	3.19	11.5	2.25	5.3	190	325,248	2.07	673,858	40.0	211	673,816	2.36
F110		0.087	0.163	17.3	2.48	9.0	1.75	4.1	283	380,494	2.10	800,823	37.0	291	800,838	2.78
F120		0.086	0.171	28.7	4.06	14.9	2.87	6.8	203	449,632	2.14	962,690	43.0	253	962,606	2.04
F125		0.089	0.157	26.5	3.49	13.8	2.46	5.8	123	252,625	2.03	512,337	42.0	143	512,313	2.06
F130		0.088	0.167	27.1	3.78	14.1	2.67	6.3	185	388,369	2.05	795,218	42.0	219	795,195	2.04

NORTH

600 0 600 1200

1 inch = 600 feet

LEGEND

- C13-B / 6.4 | 37.2 — BASIN ID; BASIN PERCENT IMPERVIOUS; BASIN AREA (ACRES)
- 15C — DESIGN POINT
- POND 1 — POND
- J1 / 15A — SWMM CONVEYANCE ELEMENT; SWMM NODE
- EXISTING MAJOR BASIN BOUNDARY
- EXISTING SUB-BASIN BOUNDARY
- PROPOSED SUB-BASIN BOUNDARY
- EXISTING TRACT LINE
- PROPOSED TRACT LINE
- SECTION LINE
- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- EXISTING STORM SEWER
- PROPOSED STORM SEWER
- FLOW DIRECTION

LAND USE

- LD RES
- MF RES
- MD RES
- HD RES
- MU/COM
- SCHOOL/ INST
- P/OS
- CMTY PARK
- PARK

MERRICK & COMPANY

REVISIONS:

REV	REVISION DESCRIPTION	DATE

DESIGN BY:	CM
DRAWN BY:	JG
CHECKED BY:	CB
APPROVED BY:	CM

HAPPY CANYON CREEK MASTER DRAINAGE PLAN

OVERALL DRAINAGE MAP DEVELOPED CONDITION

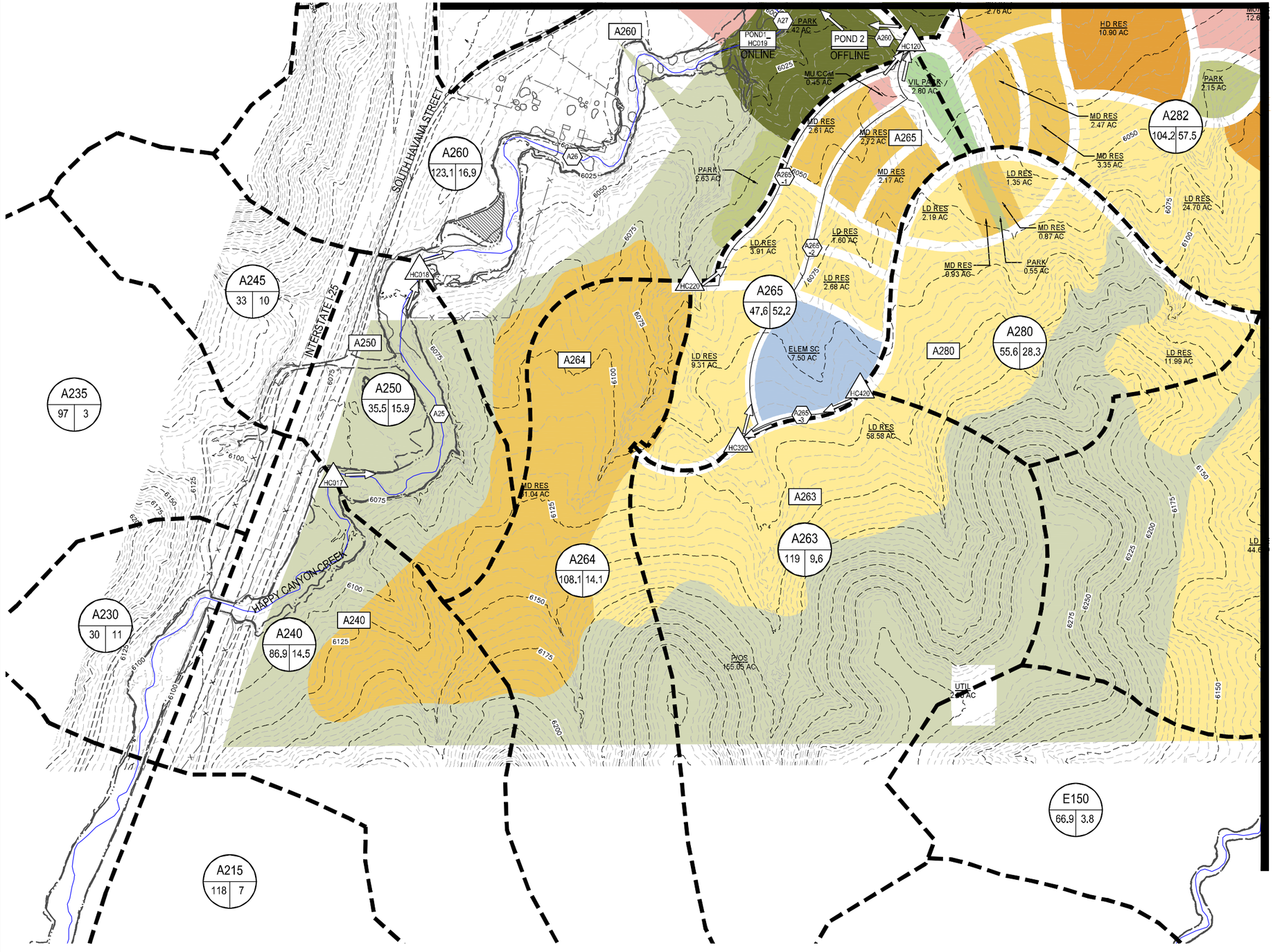
JOB NO: 65119103

DATE: 11/23/2016

SHEET: DR-1

MATCH LINE - SEE SHEET DR-4

MATCH LINE - SEE SHEET DR-3



NORTH

300 0 300 600

1 inch = 300 feet

LEGEND

- C13-B / 6.4 | 37.2 — BASIN ID; BASIN PERCENT IMPERVIOUS
- BASIN AREA (ACRES)
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- EXISTING STORM SEWER
- PROPOSED STORM SEWER
- FLOW DIRECTION

LAND USE

- LD RES
- MF RES
- MD RES
- HD RES
- MU/COM
- SCHOOL/ INST
- P/OS
- CMTY PARK
- PARK

MERRICK & COMPANY

REVISIONS:

REV	REVISION DESCRIPTION

DESIGN BY:	CM
DRAWN BY:	JG
CHECKED BY:	CB
APPROVED BY:	CM

HAPPY CANYON CREEK MASTER DRAINAGE PLAN

DEVELOPED DRAINAGE MAP SOUTHWEST PART

JOB NO: 65119103

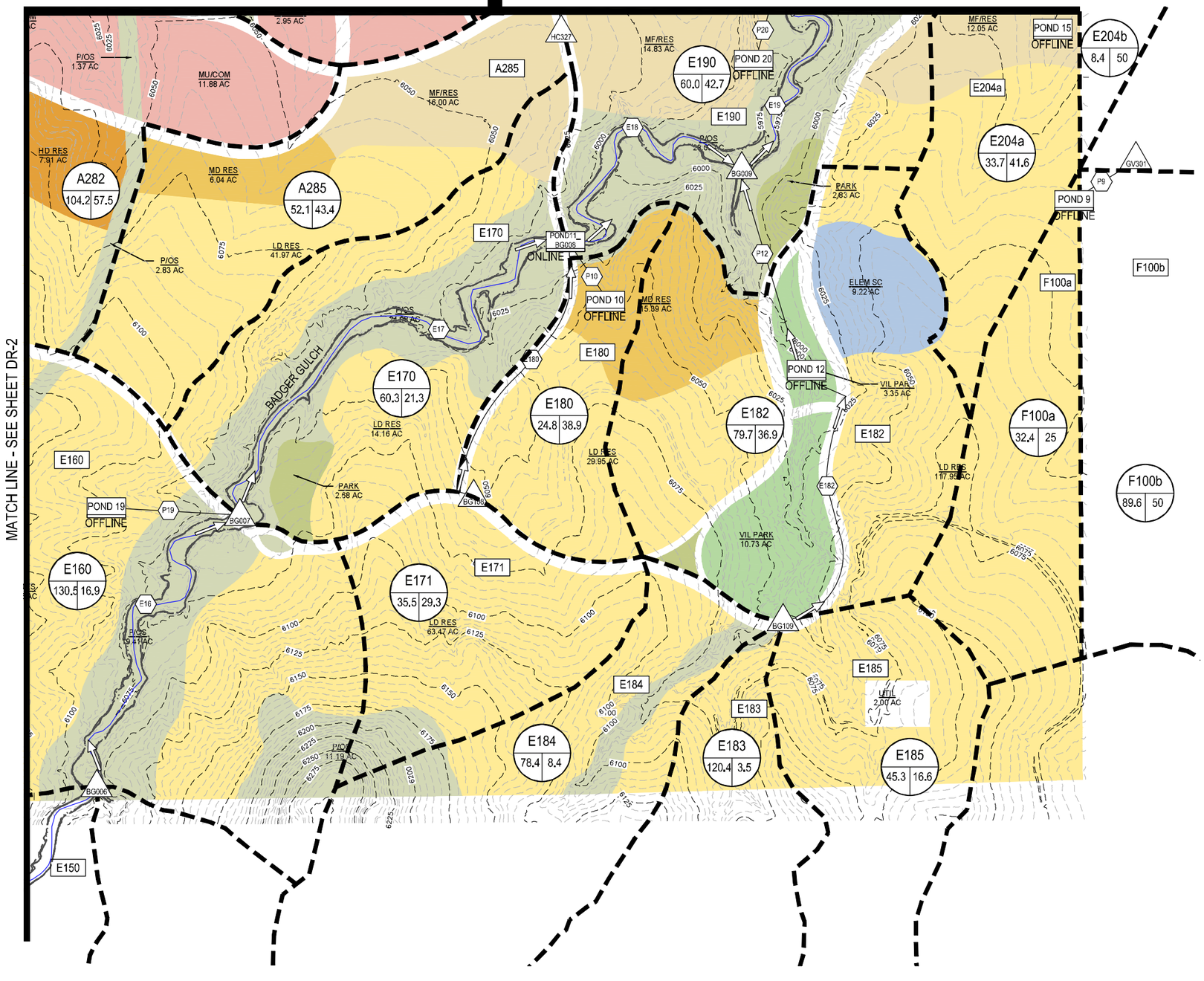
DATE: 11/23/2016

SHEET: DR-2

MATCH LINE - SEE SHEET DR-4

MATCH LINE - SEE SHEET DR-5

MATCH LINE - SEE SHEET DR-2



NORTH

300 0 300 600

1 inch = 300 feet

LEGEND

- C13-B / 6.4 / 37.2 — BASIN ID; BASIN PERCENT IMPERVIOUS; BASIN AREA (ACRES)
- 15C — DESIGN POINT
- POND 1 — POND
- J1 — SWMM CONVEYANCE ELEMENT
- 15A — SWMM NODE
- EXISTING MAJOR BASIN BOUNDARY
- EXISTING SUB-BASIN BOUNDARY
- PROPOSED SUB-BASIN BOUNDARY
- EXISTING TRACT LINE
- PROPOSED TRACT LINE
- SECTION LINE
- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- EXISTING STORM SEWER
- PROPOSED STORM SEWER
- FLOW DIRECTION

LAND USE

- LD RES
- MF RES
- MD RES
- HD RES
- MU/COM
- SCHOOL/ INST
- P/OS
- CMTY PARK
- PARK

MERRICK & COMPANY

REVISIONS:

NO.	DATE	CHECKED BY:	APPROVED BY:	REV REVISION DESCRIPTION

DESIGN BY: CM
DRAWN BY: JG
CHECKED BY: CB
APPROVED BY: CM

HAPPY CANYON CREEK MASTER DRAINAGE PLAN

DEVELOPED DRAINAGE MAP SOUTHEAST PART

JOB NO: 65119103
DATE: 11/23/2016
SHEET: DR-3

LEGEND

- BASIN ID
- BASIN PERCENT IMPERVIOUS
- BASIN AREA (ACRES)
- DESIGN POINT
- POND
- SWMM CONVEYANCE ELEMENT
- SWMM NODE
- EXISTING MAJOR BASIN BOUNDARY
- EXISTING SUB-BASIN BOUNDARY
- PROPOSED SUB-BASIN BOUNDARY
- EXISTING TRACT LINE
- PROPOSED TRACT LINE
- SECTION LINE
- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- EXISTING STORM SEWER
- PROPOSED STORM SEWER
- FLOW DIRECTION

LAND USE

- LD RES
- MF RES
- MD RES
- HD RES
- MU/COM
- SCHOOL/ INST
- P/OS
- CMTY PARK
- PARK

NORTH
300 0 300 600
1 Inch = 300 Feet

MERRICK & COMPANY

REVISIONS:

REV	REVISION DESCRIPTION	DATE	CHECKED BY	APPROVED

DESIGN BY:	CM
DRAWN BY:	JG
CHECKED BY:	CB
APPROVED BY:	CM

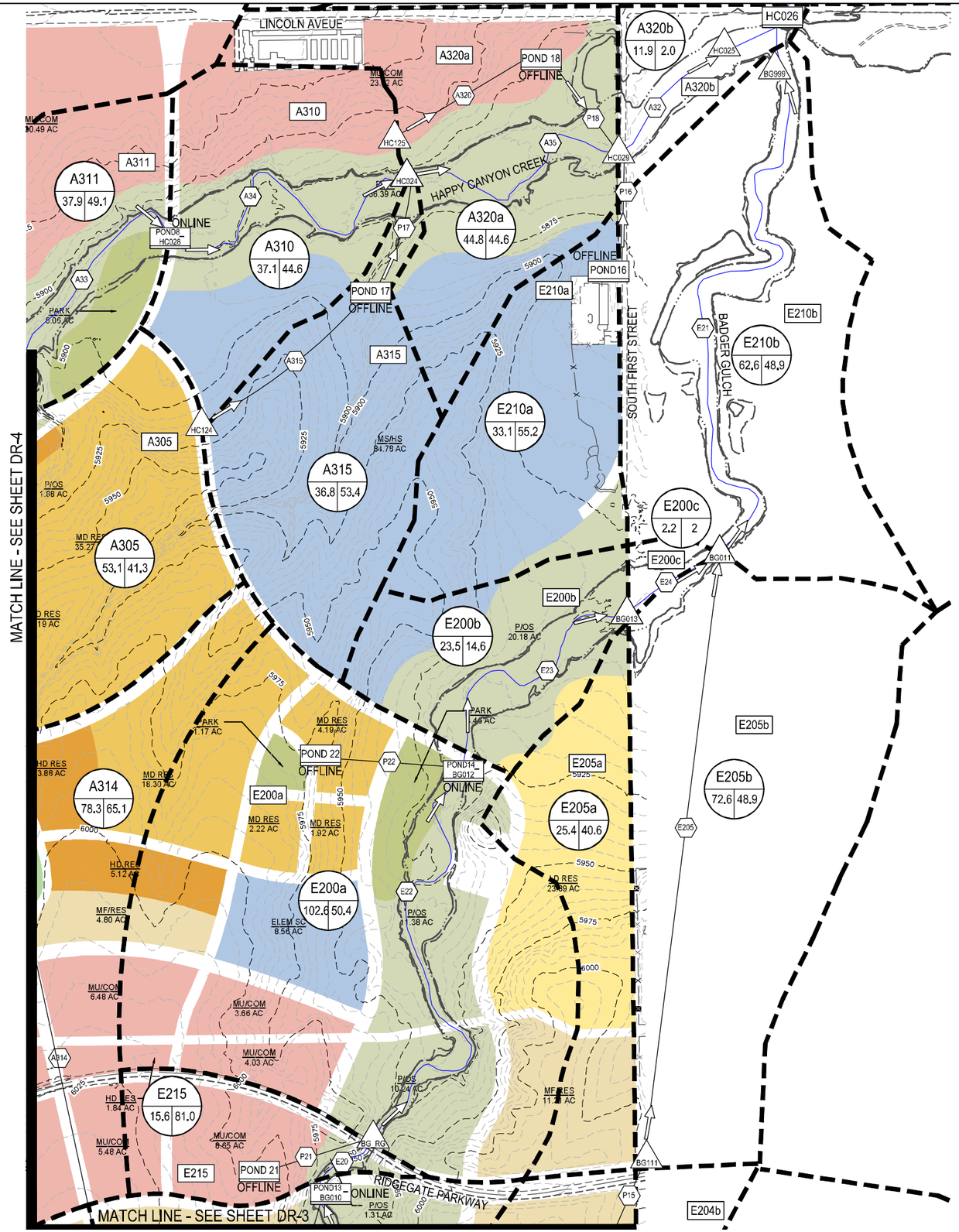
HAPPY CANYON CREEK MASTER DRAINAGE PLAN

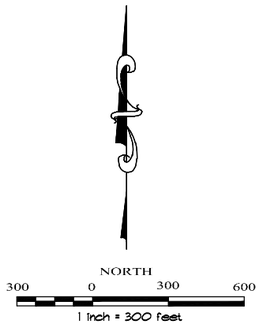
DEVELOPED DRAINAGE MAP NORTHWEST PART

JOB NO: 65119103

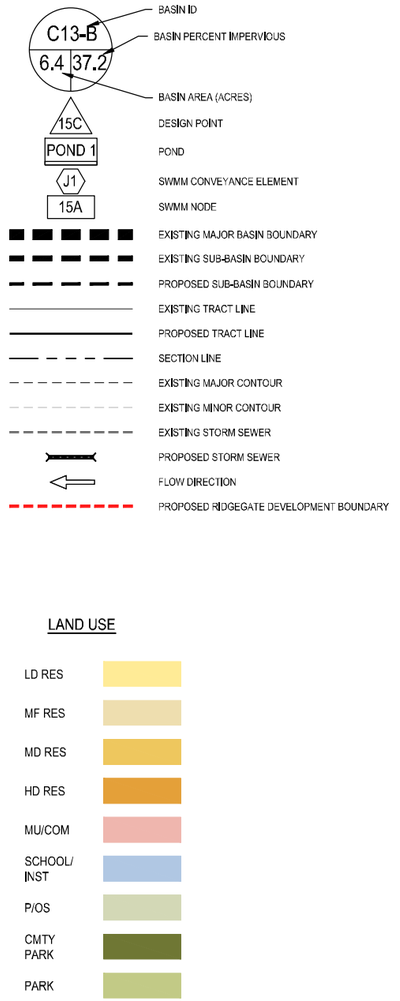
DATE: 11/23/2016

SHEET: DR-4





LEGEND



LAND USE

MERRICK & COMPANY

REVISIONS:

REV	REVISION DESCRIPTION	DRAWN BY	CHECKED BY	APPVD'D BY

DESIGN BY: CM
DRAWN BY: JG
CHECKED BY: CB
APPROVED BY: CM

HAPPY CANYON CREEK MASTER DRAINAGE PLAN

DEVELOPED DRAINAGE MAP NORTHEAST PART

JOB NO: 65119103
DATE: 11/23/2016
SHEET: DR-5

PHASE III DRAINAGE REPORT
FOR
RIDGEGATE PARKWAY EXPANSION – PHASE I
LONE TREE, CO

October 2018

Prepared For:

City of Lone Tree
9220 Kimmer Dr., Suite 100
Lone Tree, Colorado 80124
Phone: (303) 708-1818

Prepared By:

MERRICK® & COMPANY

5970 Greenwood Plaza Blvd
Greenwood Village, CO 80111
Phone: (303) 751-0741

Merrick Job No. 65119564

Basin B1	
Location:	South side of Ridgegate Parkway
Existing Conditions:	Existing roadway
Existing Flow Pattern:	Drainage from this basin generally flows from east to west. Flows are captured by the existing storm system and conveyed to the existing water quality pond.
Proposed Conditions:	Phase II construction will add a cycle track on the south side of the roadway.
Proposed Flow Pattern:	Drainage will generally flow from east to west. Flows will be captured by the existing and proposed storm system and conveyed to Water Quality Pond B.

Basin B2	
Location:	North side of Ridgegate Parkway
Existing Conditions:	Existing ground
Existing Flow Pattern:	Drainage from this basin generally flows from east to west. Flows are captured by the existing storm system and conveyed to the existing water quality pond.
Proposed Conditions:	Ridgegate Parkway roadway expansion, curb and gutter, and sidewalk to be constructed in Phase I
Proposed Flow Pattern:	Drainage will generally flow from east to west. Flows will be captured by the proposed storm system and conveyed to Water Quality Pond B.

Basin B3	
Location:	South side of Ridgegate Parkway
Existing Conditions:	Existing roadway
Existing Flow Pattern:	Drainage from this basin generally flows from east to west. Flows are captured by the existing storm system and conveyed to the existing water quality pond. The existing flow pattern will be maintained until Phase II construction.
Proposed Conditions:	Phase II construction will add a cycle track on the south side of the roadway.
Proposed Flow Pattern:	Drainage will generally flow from east to west. The existing storm system will be upsized during Phase II construction to accommodate the flows for future development, which will be captured by the proposed storm system and conveyed to Water Quality Pond B.

Basin B3-F is the future, full build-out condition of Basin B3. In the future, the proposed development south of Basin B3 will minimize the tributary area for Basin B3-F.

Basin B4	
Location:	North side of Ridgegate Parkway
Existing Conditions:	Existing ground
Existing Flow Pattern:	Drainage from this basin generally flows from east to west. Flows are captured by the existing storm system and conveyed to the existing water quality pond.
Proposed Conditions:	Ridgegate Parkway roadway expansion, curb and gutter, and sidewalk to be constructed in Phase I
Proposed Flow Pattern:	Drainage will generally flow from east to west. Flows will be captured by the proposed storm system and conveyed to Water Quality Pond B.

Basin B5	
Location:	South side of Ridgegate Parkway
Existing Conditions:	Existing roadway
Existing Flow Pattern:	Drainage from this basin generally flows from east to west. Flows are captured by the existing storm system and conveyed to the existing water quality pond. The existing flow pattern will be maintained until Phase II construction.
Proposed Conditions:	Phase II construction will add a cycle track on the south side of the roadway.
Proposed Flow Pattern:	Drainage will generally flow from east to west. The existing storm system will be upsized during Phase II construction to accommodate the flows for future development, which will be captured by the proposed storm system and conveyed to Water Quality Pond B.

Basin B5-F is the future, full build-out condition of Basin B5. In the future, the proposed development south of Basin B5 will minimize the tributary area for Basin B5-F.

Basin B6	
Location:	North side of Ridgegate Parkway
Existing Conditions:	Existing ground
Existing Flow Pattern:	Drainage from this basin generally flows from east to west. Flows are captured by the existing storm system and conveyed to the existing water quality pond.
Proposed Conditions:	Ridgegate Parkway roadway expansion, curb and gutter, and sidewalk to be constructed in Phase I
Proposed Flow Pattern:	Drainage will generally flow from east to west. Flows will be captured by the proposed storm system and conveyed to Water Quality Pond B.

Basin B8-F is a future proposed basin located on the south side of Ridgegate Parkway. In the future, Basin B8-F will be a commercial site that will connect into the proposed storm system at design point B1.

Major Basin C is broken up into 4 minor basins that cover the area on the western edge of the couplet and a portion of the southern couplet. Flows from these basins are captured by existing and proposed inlets and conveyed to Water Quality Pond B by proposed and existing storm sewer. Major Basin C will be constructed in *Ridgegate Parkway Expansion – Phase II* but is included with this report to size the storm system accordingly.

Basin C1	
Location:	North side of Ridgegate Parkway
Existing Conditions:	Existing ground and existing roadway
Existing Flow Pattern:	Drainage from this basin generally flows from east to west. Flows are captured by the existing storm system and conveyed to the existing water quality pond.
Proposed Conditions:	Ridgegate Parkway roadway expansion and a portion of the north couplet, curb and gutter, and sidewalk to be constructed in Phase II
Proposed Flow Pattern:	Drainage will generally flow from east to west. Flows will be captured by the proposed storm system and conveyed to Water Quality Pond B.

Basin C2	
Location:	South side of Ridgegate Parkway
Existing Conditions:	Existing ground and existing roadway
Existing Flow Pattern:	Drainage from this basin generally flows from south to north. Flows are captured by the existing storm system and conveyed to the existing water quality pond.
Proposed Conditions:	Ridgegate Parkway roadway expansion and a portion of the southern couplet, curb and gutter, and cycle track to be constructed in Phase II
Proposed Flow Pattern:	Drainage will generally flow from east to west. Flows will be captured by the proposed storm system and conveyed to Water Quality Pond B.

Basin C2-F is the future, full build-out condition of Basin C2. In the future, the proposed development south of Basin C2 will minimize the tributary area for Basin C2-F.

Basin C3	
Location:	South couplet of Ridgegate Parkway
Existing Conditions:	Existing ground
Existing Flow Pattern:	Drainage from this basin generally flows from south to north. Flows are overland through the basin, eventually captured by an existing culvert and bypassed under Ridgegate Parkway.
Proposed Conditions:	Ridgegate Parkway south couplet, curb and gutter, and cycle track to be constructed in Phase II
Proposed Flow Pattern:	Drainage will generally flow from east to west. Flows will be captured by the proposed storm system and conveyed to Water Quality Pond B.

Basin C3-F is the future, full build-out condition of Basin C3. In the future, the proposed development south of Basin C3 will minimize the tributary area for Basin C3-F.

Basin C4	
Location:	South couplet of Ridgegate Parkway
Existing Conditions:	Existing ground
Existing Flow Pattern:	Drainage from this basin generally flows from south to north. Flows are overland through the basin, eventually captured by an existing culvert and bypassed under Ridgegate Parkway.
Proposed Conditions:	Ridgegate Parkway south couplet, curb and gutter, and cycle track to be constructed in Phase II
Proposed Flow Pattern:	Drainage will generally flow from east to west. Flows will be captured by the proposed storm system and conveyed to Water Quality Pond B.

Basin C5-O	
Location:	South of southern couplet of Ridgegate Parkway
Existing Conditions:	Existing ground
Existing Flow Pattern:	Drainage from this basin generally flows from south to north. Flows are overland through the basin, eventually captured by an existing culvert and bypassed under Ridgegate Parkway.
Proposed Conditions:	No proposed development in Phase I or Phase II
Proposed Flow Pattern:	Drainage will generally flow from south to north. Flows will be captured by the proposed storm system and conveyed to Water Quality Pond B.

Basin C6-F is located south of Ridgegate Parkway and is comprised of a future medium density and low density residential development. Once constructed, the development will tie into the proposed Phase II storm system stub out near the high point of the south couplet.

Basin C7-F is located south of Ridgegate Parkway and is comprised of a future commercial development. Once constructed, the development will tie into the proposed Phase II storm system at design point C2.

Basins B1-B6 and C1-C4 will all flow through a combination of proposed and/or existing storm sewer to Water Quality Pond B. Water Quality Pond B is discussed in Section III.E Water Quality Enhancement.

III. DRAINAGE DESIGN CRITERIA

A. Regulations

The UDFCD Drainage Criteria Manual (UD-DCM), and the Douglas County Drainage Design and Technical Criteria Manual (DC-DCM) were used in the preparation of this report. The DC-DCM was the primary manual used for design and the UD-DCM was used when referenced by the DC-DCM.

B. Drainage Studies, Outfall Systems Plans, Site Constraints

There are five previous drainage studies that were referenced for the design of *Ridgegate Parkway Expansion – Phase I.*

The two main governing documents for drainage improvements in the Happy Canyon Creek and Badger Gulch Drainage Basins of the RidgeGate Development are the MDP-14 and MDP-17. This report is in compliance with both of the master drainage reports.

The Phase III Drainage Study for the Ridgegate Parkway East/Mainstreet Extension, from Peoria Street to Meridian Village Parkway, by FHU was approved for the original Ridgegate Parkway roadway project. The *Ridgegate Parkway Expansion* drainage design utilizes some of the existing infrastructure designed in the FHU report.

The Phase III Drainage Report for Ridgegate Parkway & Peoria Street Extensions Phase I, by TST Inc. was approved for the original Ridgegate Parkway and Peoria Street intersection

Table IV.1: A Basins – Area and Discharge

Basin	Area (ac)	Q_5 (cfs)	Q_{100} (cfs)
A1	2.50	6.7	14.5
A2	2.43	4.8	10.7
A3	1.36	1.9	5.2
A4	2.42	1.7	6.8
A5	0.31	0.7	1.5
A6	1.79	1.3	5.8
A7	0.07	0.3	0.5
A8	0.22	0.7	1.4
A9	1.09	3.0	6.4
A10	3.20	1.9	9.1
A11	0.77	2.1	4.6
A12	0.98	3.3	6.7
A13	1.31	3.3	7.7

Basin B1 flows are captured by an existing 10' Type R inlet on the west end of the basin.

Basin B2 flows are captured by a proposed 10' Type R inlet on the west end of the basin.

Basin B3 flows are captured by an existing 10' Type R inlet on the west end of the basin. For Phase I, the existing storm system will continue to convey flows to Pond B.

Basin B3-F flows are captured by a proposed 10' Type R inlet on the west end of the basin. For Phase II, the existing storm system will be abandoned and the proposed 10' Type R inlet will connect to the proposed storm sewer system.

Basin B4 flows are captured by a proposed 10' Type R inlet on the west end of the basin.

Basin B5 flows are captured by an existing 10' Type R inlet on the west end of the basin. For Phase I, the existing storm system will continue to convey flows to Pond B.

Basin B5-F flows are captured by a proposed 10' Type R inlet on the west end of the basin. For Phase II, the existing storm system will be abandoned and the proposed 10' Type R inlet will connect to the proposed storm sewer system.

Basin B6 flows are captured by a proposed 10' Type R inlet on the west end of the basin.

Basin B8-F flows will be captured by a future storm system and tie into the Ridgegate Parkway storm system at design point B1.

Basin B areas and flows are summarized in Table IV.2:

Table IV.2: B Basins – Area and Discharge

Basin	Area (ac)	Q_5 (cfs)	Q_{100} (cfs)
B1	1.91	1.9	7.1
B2	0.63	2.0	4.3
B3	1.58	2.4	7.8
B3-F	1.03	2.3	5.9
B4	1.00	2.2	6.1
B5	2.15	2.6	8.5
B5-F	1.10	3.3	7.1
B6	1.34	3.1	8.3
B8-F	11.87	35.1	72.6

Basin C1 flows are captured by a proposed 10' Type R inlet on the west end of the basin.

Basin C2 flows are captured by an existing 10' Type R inlet on the west end of the basin. For Phase I, the existing storm system will continue to convey flows to Pond B.

Basin C2-F flows are captured by a proposed 10' Type R inlet on the west end of the basin. For Phase II, the existing storm system will be abandoned and the proposed 10' Type R inlet will connect to the proposed storm sewer system.

Basin C3 flows are captured by a proposed 10' Type R inlet on the west end of the basin.

Basin C3-F flows are captured by a proposed 10' Type R inlet on the west end of the basin.

Basin C4 flows are captured by a proposed 10' Type R inlet on the east end of the basin.

Basin C5-O flows are captured by a proposed concrete FES to be installed in Phase II on the north end of the basin. In the future, this basin will be replaced by basins C6-F and C7-F.

Basin C6-F flows will be captured by a future storm system and tie into the Ridgegate Parkway storm system at the storm stub just east of the high point in the south couplet.

Basin C7-F flows will be captured by a future storm system and tie into the Ridgegate Parkway storm system at design point C2.

Basin C areas and flows are summarized in Table IV.3:

Table IV.3: C Basins – Area and Discharge

Basin	Area (ac)	Q_5 (cfs)	Q_{100} (cfs)
C1	1.86	2.7	8.9
C2	3.73	2.9	12.1
C2-F	1.76	3.5	9.0
C3	2.22	1.5	6.1
C3-F	0.97	2.2	5.5
C4	0.26	0.6	1.5
C5-O	27.94	2.4	41.3
C6-F	24.11	29.4	85.5
C7-F	14.26	33.1	72.8

Riprap and concrete mats will be used for energy dissipation at the storm outfall into each pond, the pond outfall pipes, and the emergency spillways.

Runoff from the ponds will be conveyed by pipe or emergency spillway to Happy Canyon Creek.

B. Stormwater Storage Facilities

No stormwater storage facilities are proposed with the development of *Ridgegate Parkway Expansion – Phase I*. Water quality ponds are proposed to provide water quality for the existing and proposed roadway.

Merrick & Company
5970 Greenwood Plaza Blvd.
Greenwood Village, CO 80111
Ph: (303) 751-0741

Job Name: Ridgegate Parkway Expansion
Job Number: 65119564
Date: 9/26/2018
By: A. Jenne

Ridgegate Parkway Expansion

Composite Runoff Coefficient Calculations

Location: Douglas County
Municipality: Douglas County
Minor Design Storm: 5
Major Design Storm: 100
Soil Type: C/D

Runoff Coefficient (UDFCD Vol 1, Chp 6, Sec. 2.5.1)

NRCS Soil Group	Storm Return Period					
	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
A	C=0.84i^1.302	C=0.86i^1.276	C=0.87i^1.232	C=0.84i^1.124	C=0.85i+0.025	C=0.78i+0.110
B	C=0.84i^1.169	C=0.86i^1.088	C=0.81i+0.057	C=0.63i+0.249	C=0.56i+0.328	C=0.47i+0.426
C/D	C=0.83i^1.122	C=0.82i+0.035	C=0.74i+0.132	C=0.56i+0.319	C=0.49i+0.393	C=0.41i+0.484

Basin Design Data

	I (%) =											i (%)	Runoff Coeff's			
Basin Name	Design Point	$A_{paved\ streets}$ (sf)	$A_{drives/walks}$ (sf)	$A_{MU/COM/FIRE}$ (sf)	$A_{MF/RES}$ (sf)	$A_{MD\ RES}$ (sf)	$A_{LD\ RES}$ (sf)	$A_{lscape\ (B\ soil)}$ (sf)	$A_{lscape\ (C/D\ soil)}$ (sf)	A_{Total} (sf)	A_{Total} (ac)	Imp (%)	C2	C5	C10	C100
										83,395	1.91	31.7%	0.23	0.30	0.37	0.61
										27,442	0.63	82.1%	0.67	0.71	0.74	0.82
										68,898	1.58	39.2%	0.29	0.36	0.42	0.64
										45,056	1.03	58.9%	0.46	0.52	0.57	0.73
										43,421	1.00	52.1%	0.40	0.46	0.52	0.70
										93,684	2.15	40.6%	0.30	0.37	0.43	0.65
										48,016	1.10	77.2%	0.62	0.67	0.70	0.80
										58,328	1.34	54.1%	0.42	0.48	0.53	0.71
										516,895	11.87	85.0%	0.69	0.73	0.76	0.83
	Pond B	90,947	81,338	0	0	0	0	0	202,883	375,168	8.61	44.8%	0.34	0.40	0.46	0.67

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Date: 9/26/2018
By: A. Jenne

Ridgegate Parkway Expansion

Time of Concentration Calculations

Location: Douglas County
Municipality: Douglas County
Minor Design Storm: 5
Major Design Storm: 100
Soil Type: C/D

$t_i=(0.395(1.1-C_5)(L_i^{0.5}))/(S_o^{0.33})$
$t_t=L_t/(60V_t)$
Urban $t_c=(26-17i)+L_t/(60(14i+9)*(S_T^{.5}))$

Sub-Basin Data					Initial Overland Time (t_i)			Travel Time (t_t) t_t=Length/(Velocity x 60)						t_c Comp	tc Urbanized Check ON			t_c Final
Basin Name	Design Point	A_{Total} (ac)	i (%)	C5			t_i (min)				C_v	Velocity (fps)	t_t (min)	Time of Conc $t_i + t_t = t_c$	L_t (ft)	S_T (%)	Urban t_c	Min t_c
B1	-	1.91	31.7%	0.30			11.9				20	2.6	2.3	14.1	656.0	4.2%	24.6	14.1
B2	-	0.63	82.1%	0.71			3.9				20	2.8	2.4	6.3	459.0	2.1%	14.6	6.3
B3	-	1.58	39.2%	0.36			5.6				20	2.8	2.4	8.0	514.0	3.6%	22.4	8.0
B3-F	-	1.03	58.9%	0.52			5.0				20	2.8	2.4	7.4	441.0	2.0%	19.0	7.4
B4	-	1.00	52.1%	0.46			4.6				20	2.7	2.4	7.0	485.0	2.9%	0.0	5.0
B5	-	2.15	40.6%	0.37			11.2				20	3.3	2.9	14.1	892.0	4.3%	24.0	14.1
B5-F	-	1.10	77.2%	0.67			4.0				20	3.3	2.9	6.9	659.0	2.9%	16.1	6.9
B6	-	1.34	54.1%	0.48			5.0				20	3.2	0.9	6.0	312.0	6.5%	0.0	5.0
B8-F	-	11.87	85.0%	0.73			5.4				20	2.8	5.3	10.7	1000.0	2.0%	8.9	8.9

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Date: 9/26/2018
By: A. Jenne

Ridgegate Parkway Expansion

Developed Storm Runoff Calculations

Design Storm : **5 Year**

Point Hour Rainfall (P_1) : **1.43**

$I = (28.5\ P1) / ((10 + TC)^{0.786})$

	Direct Runoff							Total Runoff				Inlets			Pipe					Pipe/Swale Travel Time				
	Design Point	Area (ac)	Runoff Coeff	tc (min)	C*A (ac)	I (in/hr)	Q (cfs)			I (in/hr)	Q (cfs)								Approx. Max Pipe Capacity (cfs)		Velocity (fps)	tt (min)	Total Time (min)	
PHASE I																								
	-	1.34	0.48	5.0	0.64	4.85	3.1												18.7		2.6	0.19	5.19	
	-	1.00	0.46	5.0	0.46	4.85	2.2												10.5		1.9	0.26	5.26	
	B4			Combined Flows (B6, B4)						4.79	5.3								222.5		1.5	2.21	7.47	
	-	2.15	0.37	14.1	0.79	3.34	2.6												11.1		2.2	3.15	17.25	
	-	1.58	0.36	8.0	0.56	4.20	2.4												11.3		2.0	0.14	8.14	
	B3			Combined Flows (B5, B3)						3.03	4.1								27.7		2.6	2.52	19.78	
	-	1.91	0.30	14.1	0.57	3.34	1.9												11.0		1.6	0.19	14.29	
	B7			Combined Flows (B5, B3, B1)						2.83	5.4								27.9		3.5	0.24	20.01	
	-	0.63	0.71	6.3	0.45	4.54	2.0												10.5		1.7	0.29	6.59	
	B5			Combined Flows (B5, B3-B1)						2.81	6.7								42.2		3.4	1.00	21.02	
	B6			Combined Flows (B6-B1)						2.74	9.5								85.4		3.5	0.63	21.65	
PHASE II																								
	C1			Combined Flows (C5-O-C1)						1.33	5.1								181.7		20.2	0.45	50.82	
	-	1.34	0.48	5.0	0.64	4.85	3.1												18.7		2.6	0.19	5.19	
	-	2.15	0.37	14.1	0.79	3.34	2.6												11.1		2.2	3.15	17.25	
	B2			Combined Flows (C, B6-B5)						1.61	8.5								246.4		2.4	2.75	53.57	
	-	1.00	0.46	5.0	0.46	4.85	2.2												10.5		1.9	0.26	5.26	
	-	1.58	0.36	8.0	0.56	4.20	2.4												11.3		2.0	0.14	8.14	
	B4			Combined Flows (C, B6-B3)						1.56	9.8								222.5		2.8	1.19	54.77	
	-	0.63	0.71	6.3	0.45	4.54	2.0												10.5		1.7	0.29	6.59	
	-	1.91	0.30	14.1	0.57	3.34	1.9												11.0		1.6	0.19	14.29	
	B5			Combined Flows (B2-B1)						3.32	3.4								42.2		1.7	1.99	16.28	
	B6			Combined Flows (C, B6-B1)						1.54	11.2								85.4		4.1	0.53	55.30	

MERRICK & COMPANY
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Ridgegate Parkway Expansion

Developed Storm Runoff Calculations

Design Storm : **5 Year**

Point Hour Rainfall (P_1) : **1.43**

$I = (28.5\ P1) / ((10 + TC)^{0.786})$

	Direct Runoff							Total Runoff				Inlets			Pipe					Pipe/Swale Travel Time				
	Design Point	Area (ac)	Runoff Coeff	tc (min)	C*A (ac)	I (in/hr)	Q (cfs)			I (in/hr)	Q (cfs)								Approx. Max Pipe Capacity (cfs)		Velocity (fps)	tt (min)	Total Time (min)	
FUTURE																								
	C1			Combined Flows (C7-F-C1)						2.73	59.6								181.7		58.2	0.16	20.03	
	-	1.34	0.48	5.0	0.64	4.85	3.1												18.8		2.6	0.19	5.19	
	-	11.87	0.73	8.9	8.69	4.04	35.1												94.3		14.9	0.04	8.94	
	-	1.10	0.67	6.9	0.74	4.42	3.3																	
	B1			Combined Flows (B8-F, B5-F)						4.04	38.1								118.0		16.1	0.07	9.01	
	B2			Combined Flows (C, B8-F, B6, B5-F)						2.73	87.1								246.4		24.6	0.27	21.44	
	-	1.00	0.46	5.0	0.46	4.85	2.2												10.5		1.9	0.26	5.26	
	-	1.03	0.52	7.4	0.54	4.32	2.3												26.2		2.0	0.56	7.96	
	B4			Combined Flows (C, B8-F-B3-F)						2.71	89.2								222.5		25.2	0.13	21.57	
	-	1.91	0.30	14.1	0.57	3.34	1.9												11.0		1.6	0.19	14.29	
	-	0.63	0.71	6.3	0.45	4.54	2.0												10.5		1.7	0.29	6.59	
	B5			Combined Flows (B2-B1)						3.32	3.4								42.2		1.7	1.99	16.28	
	B6			Combined Flows (C,B8-F-B1)						2.70	91.7								260.4		23.3	0.07	21.65	

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Merrick & Company
5970 Greenwood Plaza Blvd.
Greenwood Village, CO 80111
Ph: (303) 751-0741

Job Name: Ridgegate Parkway Expansion
Job Number: 65119564
Date: 9/26/2018
By: A. Jenne

Ridgegate Parkway Expansion

Developed Storm Runoff Calculations

Design Storm : **10 Year**

Point Hour Rainfall (P_1) : **1.66**

	Direct Runoff							Total Runoff				Pipe					Pipe/Swale Travel Time				
	Design Point	Area (ac)	Runoff Coeff	tc (min)	C*A (ac)	I (in/hr)	Q (cfs)			I (in/hr)	Q (cfs)					Approx. Max Pipe Capacity (cfs)		Velocity (fps)	tt (min)	Total Time (min)	
PHASE I																					
	-	1.34	0.53	5.0	0.71	5.63	4.0									18.7		2.6	0.19	5.19	
	-	1.00	0.52	5.0	0.52	5.63	2.9									10.5		1.9	0.26	5.26	
	B4					Combined Flows (B6, B4)				5.55	6.8					222.5		1.9	1.71	6.97	
	-	2.15	0.43	14.1	0.93	3.88	3.6									11.1		2.2	3.15	17.25	
	-	1.58	0.42	8.0	0.67	4.88	3.3									11.3		2.0	0.14	8.14	
	B3					Combined Flows (B5, B3)				3.52	5.6					27.7		3.6	1.84	19.10	
	-	1.91	0.37	14.1	0.70	3.88	2.7									11.0		1.6	0.19	14.29	
	B7					Combined Flows (B5, B3, B1)				3.34	7.7					27.9		4.9	0.17	19.26	
	-	0.63	0.74	6.3	0.47	5.27	2.5									10.5		1.7	0.29	6.59	
	B5					Combined Flows (B5, B3-B1)				3.33	9.2					42.2		4.7	0.73	19.99	
	B6					Combined Flows (B6-B1)				3.27	13.0					85.4		4.7	0.46	20.45	
PHASE II																					
	C1					Combined Flows (C5-O-C1)				1.77	12.5					181.7		20.2	0.45	50.82	
	-	1.34	0.53	5.0	0.71	5.63	4.0									18.7		2.6	0.19	5.19	
	-	2.15	0.43	14.1	0.93	3.88	3.6									11.1		2.2	3.15	17.25	
	B2					Combined Flows (C, B6-B5)				1.87	16.4					246.4		4.6	1.43	52.25	
	-	1.00	0.52	5.0	0.52	5.63	2.9									10.5		1.9	0.26	5.26	
	-	1.58	0.42	8.0	0.67	4.88	3.3									11.3		2.0	0.14	8.14	
	B4					Combined Flows (C, B6-B3)				1.84	18.2					222.5		5.2	0.64	52.89	
	-	0.63	0.74	6.3	0.47	5.27	2.5									10.5		1.7	0.29	6.59	
	-	1.91	0.37	14.1	0.70	3.88	2.7									11.0		1.6	0.19	14.29	
	B5					Combined Flows (B2-B1)				3.85	4.5					42.2		2.3	1.48	15.77	
	B6					Combined Flows (C, B6-B1)				1.83	20.2					85.4		7.4	0.30	53.18	
FUTURE																					
	C1					Combined Flows (C7-F-C1)										181.7		58.2	0.16	20.03	
	-	1.34	0.53	5.0	0.71	5.63	4.0									18.8		2.6	0.19	5.19	
	-	11.87	0.76	8.9	9.03	4.70	42.4									94.3		18.0	0.03	8.93	
	-	1.10	0.70	6.9	0.78	5.13	4.0														
	B1					Combined Flows (B8-F, B5-F)				4.69	46.0					118.0		19.5	0.06	8.99	
	B2					Combined Flows (C, B8-F, B6, B5-F)				3.21	111.0					246.4		31.4	0.21	20.90	
	-	1.00	0.52	5.0	0.52	5.63	2.9									10.5		1.9	0.26	5.26	
	-	1.03	0.57	7.4	0.59	5.01	2.9									26.2		2.0	0.56	7.96	
	B4					Combined Flows (C, B8-F-B3-F)				3.19	113.9					222.5		32.2	0.10	21.00	
	-	1.91	0.37	14.1	0.70	3.88	2.7									11.0		1.6	0.19	14.29	
	-	0.63	0.74	6.3	0.47	5.27	2.5									10.5		1.7	0.29	6.59	
	B5					Combined Flows (B2-B1)				3.85	4.5					42.2		2.3	1.48	15.77	
	B6					Combined Flows (C,B8-F-B1)				3.18	117.3					260.4		29.9	0.06	21.06	

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Date: 9/26/2018
By: A. Jenne

Ridgegate Parkway Expansion

Developed Storm Runoff Calculations

Design Storm : **100 Year** Point Hour Rainfall (P_1) : **2.60** $I = (28.5\ P1) / ((10 + TC)^{0.786})$

	Direct Runoff							Total Runoff				Inlets			Pipe					Pipe/Swale Travel Time				
	Design Point	Area (ac)	Runoff Coeff	tc (min)	C*A (ac)	I (in/hr)	Q (cfs)			I (in/hr)	Q (cfs)								Approx. Max Pipe Capacity (cfs)		Velocity (fps)	tt (min)	Total Time (min)	
PHASE I																								
	-	1.34	0.71	5.0	0.95	8.82	8.3												18.7		6.6	0.07	5.07	
	-	1.00	0.70	5.0	0.70	8.82	6.1												10.5		6.0	0.08	5.08	
	B4			Combined Flows (B6, B4)						8.78	14.4								222.5		4.1	0.81	5.89	
	-	2.15	0.65	14.1	1.40	6.08	8.5												11.1		7.1	0.99	15.09	
	-	1.58	0.64	8.0	1.02	7.64	7.8												11.3		6.9	0.04	8.04	
	B3			Combined Flows (B5, B3)						5.89	14.2								27.7		9.1	0.73	15.82	
	-	1.91	0.61	14.1	1.18	6.08	7.1												11.0		6.6	0.05	14.15	
	B7			Combined Flows (B5, B3, B1)						5.75	20.7								27.9		13.2	0.06	15.88	
	-	0.63	0.82	6.3	0.52	8.26	4.3												10.5		4.9	0.10	6.40	
	B5			Combined Flows (B5, B3-B1)						5.74	23.6								42.2		12.0	0.28	16.17	
	B6			Combined Flows (B6-B1)						5.69	32.8								85.4		11.9	0.18	16.35	
PHASE II																								
	C1			Combined Flows (C5-O-C1)						2.95	55.5								181.7		20.2	0.45	50.82	
	-	1.34	0.71	5.0	0.95	8.82	8.3												18.7		6.6	0.07	5.07	
	-	2.15	0.65	14.1	1.40	6.08	8.5												11.1		7.1	0.99	15.09	
	B2			Combined Flows (C, B6-B5)						2.93	62.1								246.4		17.6	0.38	51.20	
	-	1.00	0.70	5.0	0.70	8.82	6.1												10.5		6.0	0.08	5.08	
	-	1.58	0.64	8.0	1.02	7.64	7.8												11.3		6.9	0.04	8.04	
	B4			Combined Flows (C, B6-B3)						2.92	66.8								222.5		18.9	0.17	51.37	
	-	0.63	0.82	6.3	0.52	8.26	4.3												10.5		4.9	0.10	6.40	
	-	1.91	0.61	14.1	1.18	6.08	7.1												11.0		6.6	0.05	14.15	
	B5			Combined Flows (B2-B1)						6.07	10.3								42.2		5.2	0.65	14.80	
	B6			Combined Flows (C, B6-B1)						2.91	71.6								85.4		26.0	0.08	51.46	

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Date: 9/26/2018
By: A. Jenne

Ridgegate Parkway Expansion

Developed Storm Runoff Calculations

Design Storm : **100 Year** Point Hour Rainfall (P_1) : **2.60** $I = (28.5\ P1) / ((10 + TC)^{0.786})$

	Direct Runoff							Total Runoff				Inlets			Pipe					Pipe/Swale Travel Time				
	Design Point	Area (ac)	Runoff Coeff	tc (min)	C*A (ac)	I (in/hr)	Q (cfs)			I (in/hr)	Q (cfs)								Approx. Max Pipe Capacity (cfs)		Velocity (fps)	tt (min)	Total Time (min)	
FUTURE																								
	C1			Combined Flows (C7-F-C1)						5.13	160.0								181.7		58.2	0.16	20.03	
	-	1.34	0.71	5.0	0.95	8.82	8.3												18.8		6.6	0.07	5.07	
	-	11.87	0.83	8.9	9.88	7.35	72.6												94.3		30.8	0.02	8.92	
	-	1.10	0.80	6.9	0.88	8.03	7.1																	
	B1			Combined Flows (B8-F, B5-F)						7.35	79.1								118.0		33.6	0.03	8.95	
	B2			Combined Flows (C, B8-F, B6, B5-F)						5.11	219.2								246.4		62.0	0.11	20.14	
	-	1.00	0.70	5.0	0.70	8.82	6.1												10.5		6.0	0.08	5.08	
	-	1.03	0.73	7.4	0.75	7.85	5.9												26.2		6.9	0.16	7.56	
	B4			Combined Flows (C, B8-F-B3-F)						5.10	225.9								222.5		63.9	0.05	20.19	
	-	1.91	0.61	14.1	1.18	6.08	7.1												11.0		6.6	0.05	14.15	
	-	0.63	0.82	6.3	0.52	8.26	4.3												10.5		4.9	0.10	6.40	
	B5			Combined Flows (B2-B1)						6.07	10.3								42.2		5.2	0.65	14.80	
	B6			Combined Flows (C,B8-F-B1)						5.09	234.3								260.4		59.6	0.03	20.22	

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By: G. LEE

Ridgegate Parkway Expansion

Composite Runoff Coefficient Calculations

Location: Douglas County
Municipality: Douglas County
Minor Design Storm: 5
Major Design Storm: 100
Soil Type: C/D

Runoff Coefficient (UDFCD Vol 1, Chp 6, Sec. 2.5.1)

NRCS Soil Group	Storm Return Period					
	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
A	C=0.84i^1.302	C=0.86i^1.276	C=0.87i^1.232	C=0.84i^1.124	C=0.85i+0.025	C=0.78i+0.110
B	C=0.84i^1.169	C=0.86i^1.088	C=0.81i+0.057	C=0.63i+0.249	C=0.56i+0.328	C=0.47i+0.426
C/D	C=0.83i^1.122	C=0.82i+0.035	C=0.74i+0.132	C=0.56i+0.319	C=0.49i+0.393	C=0.41i+0.484

Basin Design Data

	I (%) =											i (%)	Runoff Coeff's			
Basin Name	Design Point	$A_{paved\ streets}$ (sf)	$A_{drives/walks}$ (sf)	$A_{MU/COM/FIRE}$ (sf)	$A_{MF/RES}$ (sf)	$A_{MD\ RES}$ (sf)	$A_{LD\ RES}$ (sf)	$A_{lscape\ (C/D\ soil)}$ (sf)	$A_{lscape\ (C/D\ soil)}$ (sf)	A_{Total} (sf)	A_{Total} (ac)	Imp (%)	C2	C5	C10	C100
										101,574	2.33	31.6%	0.23	0.29	0.37	0.61
										157,050	3.61	28.9%	0.21	0.27	0.35	0.60
										71,064	1.63	61.4%	0.48	0.54	0.59	0.74
										91,289	2.10	28.9%	0.21	0.27	0.35	0.60
										37,290	0.86	67.9%	0.54	0.59	0.63	0.76
										10,975	0.25	68.2%	0.54	0.59	0.64	0.76
										1,217,202	27.94	2.0%	0.01	0.05	0.15	0.49
										1,050,302	24.11	47.5%	0.36	0.42	0.48	0.68
										620,974	14.26	76.1%	0.61	0.66	0.70	0.80
	Pond B	66,215	44,493	0	0	0	0	0	1,467,382	1,578,090	36.23	8.6%	0.05	0.11	0.20	0.52

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Ridgegate Parkway Expansion

Time of Concentration Calculations

Location: Douglas County
Municipality: Douglas County
Minor Design Storm: 5
Major Design Storm: 100
Soil Type: C/D

$t_i=(0.395(1.1-C_5)(L_i^{0.5}))/(S_o^{0.33})$
$t_t=L_t/(60V_t)$
Urban $t_c=(26-17i)+L_t/(60(14i+9)*(S_T^{.5}))$

Sub-Basin Data					Initial Overland Time (t_i)			Travel Time (t_t) t_t=Length/(Velocity x 60)						t_c Comp	tc Urbanized Check ON			t_c Final
Basin Name	Design Point	A_{Total} (ac)	i (%)	C5			t_i (min)				C_v	Velocity (fps)	t_t (min)	Time of Conc $t_i + t_t = t_c$	L_t (ft)	S_T (%)	Urban t_c	Min t_c
C1	-	2.33	31.6%	29.4%			5.6				20	3.4	3.4	9.1	732.0	2.9%	26.0	9.1
C2	-	3.61	28.9%	0.27			14.4				20	3.6	3.5	17.9	1055.0	3.9%	27.9	17.9
C2-F	-	1.63	61.4%	0.54			5.9				20	3.6	3.5	9.4	807.0	3.1%	19.9	9.4
C3	-	2.10	28.9%	0.27			20.9				20	2.4	3.0	23.8	734.0	1.7%	28.3	23.8
C3-F	-	0.86	67.9%	0.59			5.1				20	2.4	1.9	7.0	331.0	1.6%	16.8	7.0
C4	-	0.25	68.2%	0.59			6.3				20	1.8	1.2	7.5	200.0	1.1%	16.1	7.5
C5-O	-	27.94	2.0%	0.05			25.1				7	1.2	26.1	51.2	2300.0	3.1%	49.1	49.1
C6-F	-	24.11	47.5%	0.42			9.8				20	4.0	9.4	19.2	2347.0	3.9%	30.6	19.2
C7-F	-	14.26	76.1%	0.66			6.4				20	4.0	6.1	12.5	1555.0	3.8%	19.8	12.5

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Job Name: Ridgegate Parkway Expansion
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Date: 9/26/2018
By: G. LEE

Ridgegate Parkway Expansion

Developed Storm Runoff Calculations

Design Storm : **5 Year**

Point Hour Rainfall (P_1) : **1.43**

$I = (28.5\ P1) / ((10 + TC)^{0.786})$

	Direct Runoff							Total Runoff				Inlets			Pipe					Pipe/Swale Travel Time				
	Design Point	Area (ac)	Runoff Coeff	tc (min)	C*A (ac)	I (in/hr)	Q (cfs)			I (in/hr)	Q (cfs)	Inlet Type							Approx. Max Pipe Capacity (cfs)		Velocity (fps)	tt (min)	Total Time (min)	
PHASE II																								
	-	27.94	0.05	49.1	1.44	1.65	2.4												58.0		1.2	0.92	50.02	
	-	0.25	0.59	7.5	0.15	4.30	0.6												29.7		0.5	4.27	11.77	
	C5				Combined Flows (C5-O-C4)					1.63	2.6								66.7		1.1	6.89	56.92	
	-	2.10	0.27	23.8	0.57	2.56	1.5												29.7		1.2	0.25	24.05	
	C3				Combined Flows (C5-O, C4, C3)					1.50	3.2								180.0		1.2	11.09	68.00	
	-	3.61	0.27	17.9	0.98	2.98	2.9												98.3		1.2	0.91	18.81	
	-	2.33	0.29	9.1	0.68	4.01	2.7												29.7		2.3	0.21	9.31	
	C1				Combined Flows (C5-O-C1)					1.33	5.1								181.7		1.8	4.96	72.97	
FUTURE																								
	-	24.11	0.42	19.2	10.23	2.87	29.4												71.2		12.5	0.20	19.40	
	-	0.25	0.59	7.5	0.15	4.30	0.6												29.7		0.5	0.57	8.07	
	C4				Combined Flows (C6-F-C4)					2.86	29.7								74.9		12.6	0.77	20.17	
	-	0.86	0.59	7.0	0.51	4.40	2.2												29.7		1.2	0.25	7.25	
	C3				Combined Flows (C6-F, C4, C3-F)					2.80	30.5								111.6		12.9	1.01	21.17	
	-	14.26	0.66	12.50	9.40	3.53	33.1												94.3		14.1	0.04	12.54	
	-	1.63	0.54	9.40	0.88	3.96	3.5																	
	C2				Combined Flows (C7-F,C2-F)					3.52	36.2								98.3		15.4	0.09	12.63	
	-	2.33	0.29	9.1	0.68	4.01	2.7												29.7		2.3	0.21	9.31	
	C1				Combined Flows (C7-F-C1)					2.73	59.6								181.7		21.7	0.42	21.60	

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Ridgegate Parkway Expansion

Developed Storm Runoff Calculations

Design Storm : **10 Year**

Point Hour Rainfall (P_1) : **1.66**

	Direct Runoff							Total Runoff				Pipe					Pipe/Swale Travel Time				
	Design Point	Area (ac)	Runoff Coeff	tc (min)	C*A (ac)	I (in/hr)	Q (cfs)			I (in/hr)	Q (cfs)					Approx. Max Pipe Capacity (cfs)		Velocity (fps)	tt (min)	Total Time (min)	
PHASE II																					
	-	27.94	0.15	49.1	4.10	1.92	7.9									58.0		4.0	0.28	49.38	
	-	0.25	0.64	7.5	0.16	4.99	0.8									29.7		0.5	4.27	11.77	
	C5				Combined Flows (C5-O-C4)					1.91	8.1					66.7		3.5	2.19	51.57	
	-	2.10	0.35	23.8	0.72	2.97	2.2									29.7		1.2	0.25	24.05	
	C3				Combined Flows (C5-O, C4, C3)					1.86	9.3					180.0		3.4	3.87	55.44	
	-	3.61	0.35	17.9	1.25	3.46	4.3									98.3		1.2	0.91	18.81	
	-	2.33	0.37	9.1	0.85	4.66	4.0									29.7		2.3	0.21	9.31	
	C1				Combined Flows (C5-O-C1)					1.77	12.5					181.7		4.6	2.01	57.44	
FUTURE																					
	-	24.11	0.48	19.2	11.65	3.34	38.9									71.2		16.5	0.15	19.35	
	-	0.25	0.64	7.5	0.16	4.99	0.8									29.7		0.5	0.57	8.07	
	C4				Combined Flows (C6-F-C4)					3.32	39.2					74.9		16.7	0.58	19.93	
	-	0.86	0.63	7.0	0.54	5.10	2.8									29.7		1.2	0.25	7.25	
	C3				Combined Flows (C6-F, C4, C3-F)					3.27	40.4					111.6		17.2	0.76	20.69	
	-	14.26	0.70	12.50	9.91	4.09	40.6									94.3		17.2	0.03	12.53	
	-	1.63	0.59	9.40	0.96	4.60	4.4														
	C2				Combined Flows (C7-F,C2-F)					4.09	44.4					98.3		18.9	0.07	12.60	
	-	2.33	0.37	9.1	0.85	4.66	4.0									29.7		2.3	0.21	9.31	
	C1				Combined Flows (C7-F-C1)					3.21	77.2					181.7		28.1	0.33	21.02	

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Greenwood Village, CO 80111
Ph: (303) 751-0741

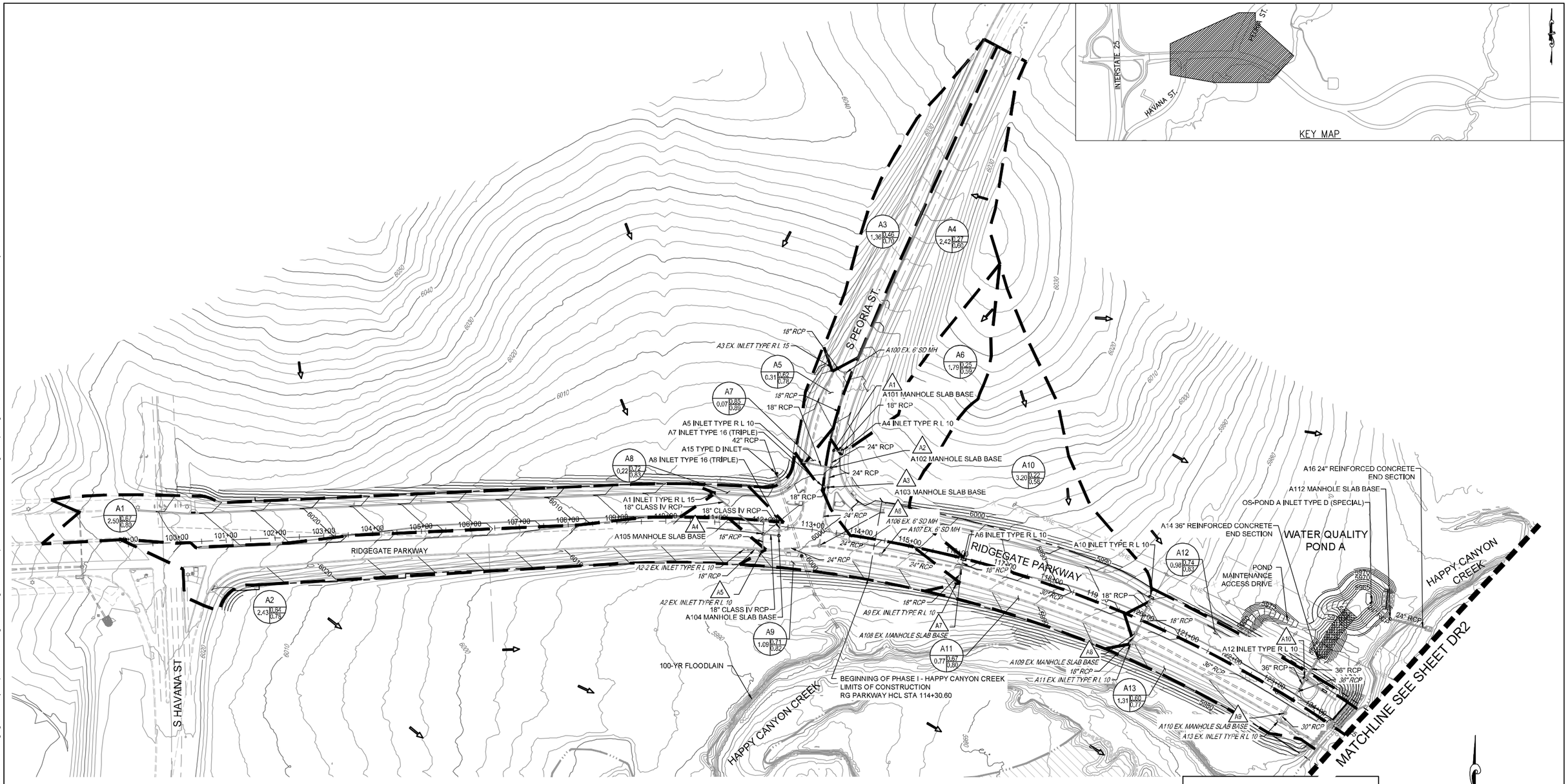
Job Name: Ridgegate Parkway Expansion
Job Number: 65119564
Date: 9/26/2018
By: G. LEE

Ridgegate Parkway Expansion

Developed Storm Runoff Calculations

Design Storm : **100 Year** Point Hour Rainfall (P_1) : **2.60** I = (28.5 P1) / ((10 + TC)^0.786)

	Direct Runoff							Total Runoff				Inlets			Pipe					Pipe/Swale Travel Time				
	Design Point	Area (ac)	Runoff Coeff	tc (min)	C*A (ac)	I (in/hr)	Q (cfs)			I (in/hr)	Q (cfs)	Inlet Type							Approx. Max Pipe Capacity (cfs)		Velocity (fps)	tt (min)	Total Time (min)	
PHASE II																								
	-	27.94	0.49	49.1	13.75	3.00	41.3												58.0		21.0	0.05	49.15	
	-	0.25	0.76	7.5	0.19	7.81	1.5												29.7		1.3	1.82	9.32	
	C5				Combined Flows (C5-O-C4)					3.00	41.8								66.7		17.8	0.43	49.58	
	-	2.10	0.60	23.8	1.26	4.66	5.9												29.7		3.9	0.08	23.88	
	C3				Combined Flows (C5-O, C4, C3)					2.98	45.4								180.0		16.5	0.79	50.37	
	-	3.61	0.60	17.9	2.17	5.41	11.8												98.3		3.5	0.32	18.22	
	-	2.33	0.61	9.1	1.43	7.29	10.4												29.7		6.3	0.08	9.18	
	C1				Combined Flows (C5-O-C1)					2.95	55.5								181.7		20.2	0.45	50.82	
FUTURE																								
	-	24.11	0.68	19.2	16.36	5.22	85.5												71.2		36.3	0.07	19.27	
	-	0.25	0.76	7.5	0.19	7.81	1.5												29.7		1.3	0.24	7.74	
	C4				Combined Flows (C6-F-C4)					5.21	86.3								74.9		36.6	0.26	19.53	
	-	0.86	0.76	7.0	0.65	7.99	5.2												29.7		3.9	0.08	7.08	
	C3				Combined Flows (C6-F, C4, C3-F)					5.18	89.1								111.6		37.8	0.34	19.88	
	-	14.26	0.80	12.50	11.35	6.41	72.8												94.3		30.9	0.02	12.52	
	-	1.63	0.74	9.40	1.20	7.20	8.6																	
	C2				Combined Flows (C7-F,C2-F)					6.41	80.4								98.3		34.1	0.04	12.56	
	-	2.33	0.61	9.1	1.43	7.29	10.4												29.7		6.3	0.08	9.18	
	C1				Combined Flows (C7-F-C1)					5.13	160.0								181.7		58.2	0.16	20.03	



LEGEND

- BASIN ID
- 5-YEAR RUNOFF COEFFICIENT
- 100-YEAR RUNOFF COEFFICIENT
- BASIN AREA (ACRES)
- DESIGN POINT
- PROPOSED FLOW OF WATER
- EXISTING FLOW OF WATER
- PROPOSED MANHOLE AND STORM SEWER
- EXISTING MANHOLE AND STORM SEWER
- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- 4920 PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- PROPOSED BASIN BOUNDARY
- INTERIM BASIN BOUNDARY

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NOTE:
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PRELIMINARY
NOT FOR CONSTRUCTION

City of Lone Tree

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Engineering Division Acceptance Block

100' 0 50' 100' 200'
1" = 100' HOR.

Computer File Information		Sheet Revisions	
Print Date: 9/26/18		Date:	Comments
Drawing File Name: 9564 Drainage Map.dwg			
Horiz. Scale: AS SHOWN Vert. Scale: AS SHOWN			

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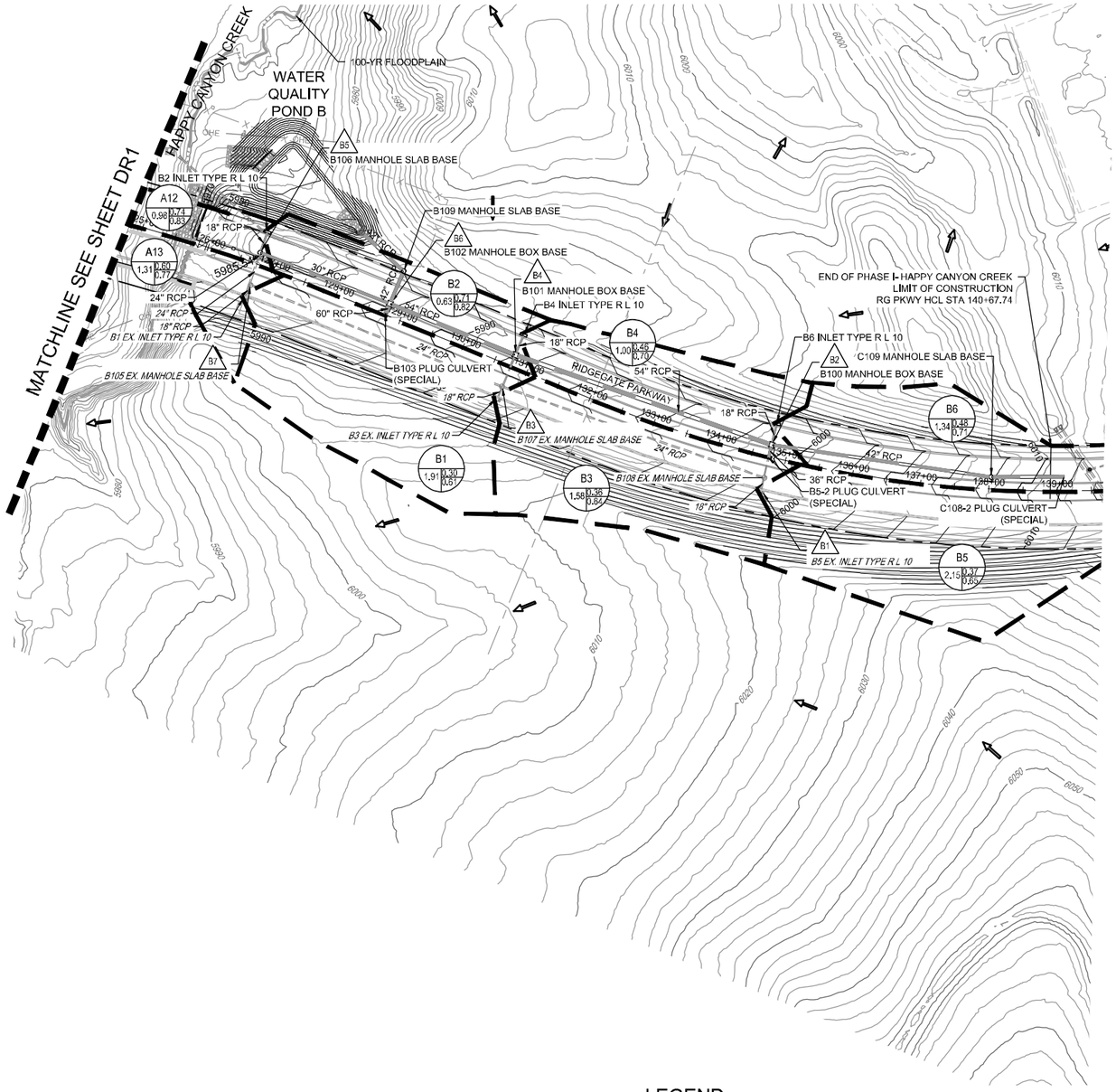
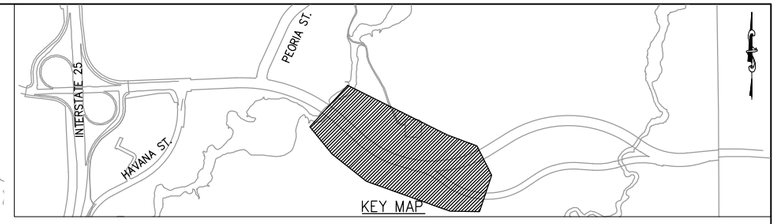
PH: (303) 751-0741

As Constructed	RIDGEGATE PARKWAY EXPANSION DRAINAGE MAP	Project No./Code
No Revisions:		21911
Revised:	Designer: / QC Review:	
Detailer: / Approved:		
Void:	Sheet Subset: / Subset Sheet:	Sheet Number: DR1





LEGEND

- BASIN ID
- A3 — 1.46 — 0.47 — 0.62 — 5-YEAR RUNOFF COEFFICIENT — 100-YEAR RUNOFF COEFFICIENT — BASIN AREA (ACRES)
- A1 — DESIGN POINT
- PROPOSED FLOW OF WATER
- EXISTING FLOW OF WATER
- PROPOSED MANHOLE AND STORM SEWER
- EXISTING MANHOLE AND STORM SEWER
- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- 4920 — PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- PROPOSED BASIN BOUNDARY
- INTERIM BASIN BOUNDARY

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As Constructed	RIDGEGATE PARKWAY EXPANSION PHASE I DRAINAGE MAP (BASINS FOR INLET SIZING)			Project No./Code
No Revisions:				21911
Revised:	Designer:		QC Review:	
Void:	Detailer:		Approved:	
	Sheet Subset:	Subset Sheet:		Sheet Number: DR2-PH1

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MATCHLINE SEE SHEET DR1

HAPPY CANYON CREEK

WATER QUALITY POND B

100-YR FLOODPLAIN

B106 MANHOLE SLAB BASE

B2 INLET TYPE R L 10

B109 MANHOLE SLAB BASE

B102 MANHOLE BOX BASE

B101 MANHOLE BOX BASE

B4 INLET TYPE R L 10

B1 EX. INLET TYPE R L 10

B105 EX. MANHOLE SLAB BASE

B104 PLUG CULVERT (SPECIAL)

B107 EX. MANHOLE SLAB BASE

C6 PLUG CULVERT (SPECIAL)

B5-PH2 INLET TYPE R L 10

END OF PHASE I- HAPPY CANYON CREEK
LIMIT OF CONSTRUCTION
RG PKWY HCL STA 140+67.74

B6 INLET TYPE R L 10

C109 MANHOLE SLAB BASE

B100 MANHOLE BOX BASE

C1 INLET TYPE R L 10

C108 MANHOLE BOX BASE

C111 30" REINFORCED CONCRETE END SECTION

C5 PLUG CULVERT (SPECIAL)

C110 30" REINFORCED CONCRETE END SECTION

C2 INLET TYPE R L 10

C107 MANHOLE SLAB BASE

C3 INLET TYPE R L 10

C106 MANHOLE SLAB BASE

C4 INLET TYPE R L 10

C101 MANHOLE SLAB BASE

C105 MANHOLE SLAB BASE

C102 MANHOLE SLAB BASE

C104 MANHOLE SLAB BASE

C103 30" REINFORCED CONCRETE END SECTION

C100 PLUG CULVERT (SPECIAL)

RIDGEGATE PARKWAY

FUTURE IMPROVEMENTS BY OTHERS

KEY MAP

INTERSTATE 25

HAVANA ST.

PEORIA ST.

A12 0.98 0.74 0.83

A13 1.31 0.80 0.77

B2 0.83 0.71 0.82

B4 1.00 0.46 0.70

B6 1.34 0.48 0.71

B1 1.91 0.30 0.61

B3 1.58 0.36 0.64

B5 2.15 0.37 0.65

C1 2.33 0.29 0.61

C2 3.61 0.27 0.60

C3 2.10 0.27 0.66

C4 0.25 0.59 0.76

C5-O 27.94 0.05 0.45

LEGEND

- BASIN ID
- A3 / 1.45 / 0.43 / 0.77 — 5-YEAR RUNOFF COEFFICIENT / 100-YEAR RUNOFF COEFFICIENT / BASIN AREA (ACRES)
- A1 — DESIGN POINT
- PROPOSED FLOW OF WATER
- EXISTING FLOW OF WATER
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CITY OF LONE TREE

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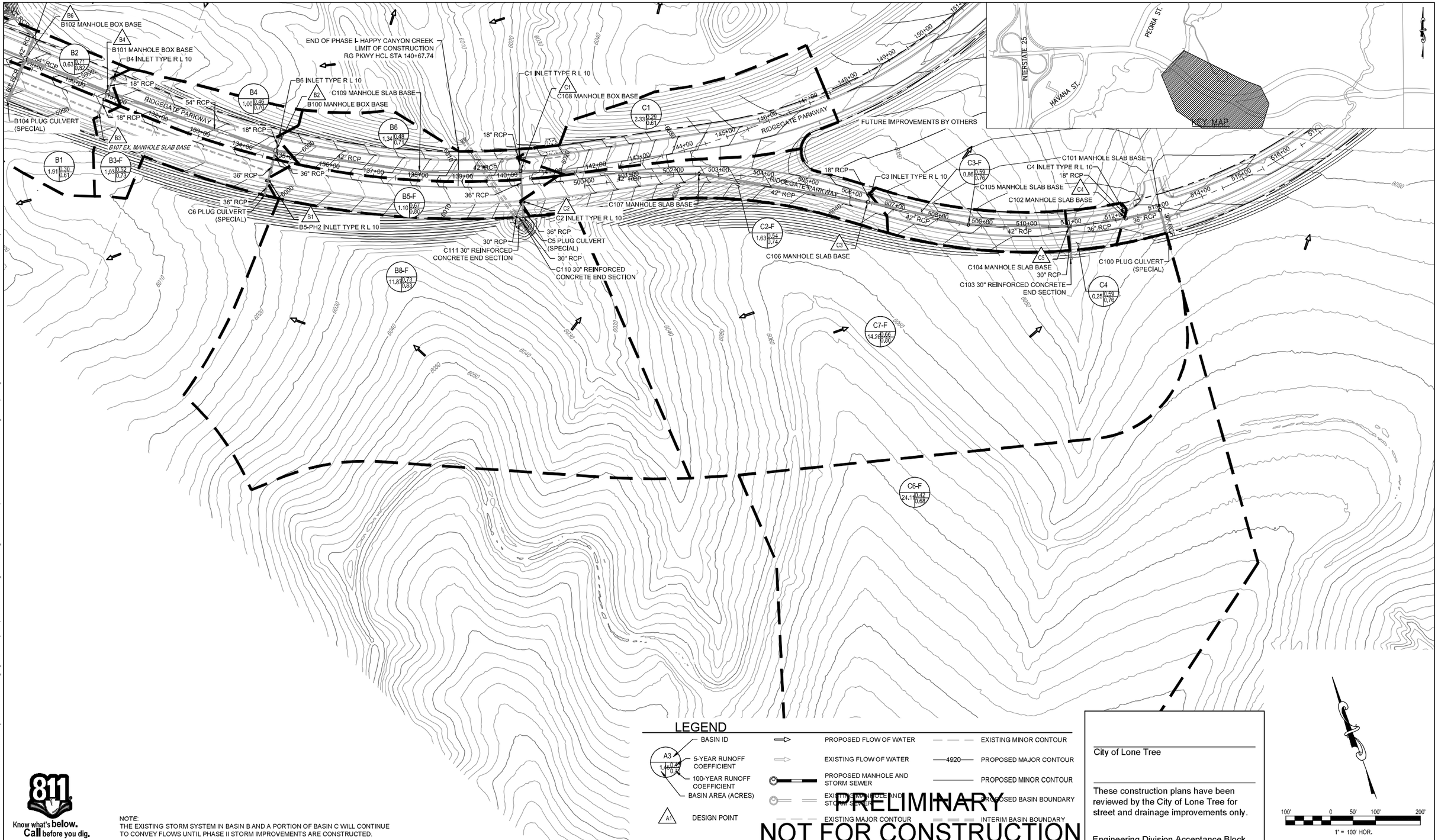
As Constructed	RIDGEGATE PARKWAY EXPANSION PHASE II DRAINAGE MAP (BASINS FOR INLET SIZING)		Project No./Code
No Revisions:			21911
Revised:	Designer:	QC Review:	
Void:	Detailer:	Approved:	
	Sheet Subset:	Subset Sheet:	Sheet Number: DR2-PH2



LEGEND

- BASIN ID
- 5-YEAR RUNOFF COEFFICIENT
- 100-YEAR RUNOFF COEFFICIENT
- BASIN AREA (ACRES)
- DESIGN POINT
- PROPOSED FLOW OF WATER
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Print Date: 9/26/18		Date:	Comments
Drawing File Name: 9564 Drainage Map.dwg			
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As Constructed

No Revisions:

Revised:

Void:

RIDGEGATE PARKWAY EXPANSION
FUTURE DRAINAGE MAP
(BASINS FOR PIPE SIZING)

Designer:		QC Review:	
Detailer:		Approved:	
Sheet Subset:		Subset Sheet:	

Project No./Code: 21911

Sheet Number: DR3

File Location:Q:\DEN\Projects\5087-02-RRMD Overall East\Projects\9564-Ridgegate Pkwy Expansion\Design\Drainage\Basin Maps\PHASE II\9564 Drainage Map.dwg Plot Date:9/26/2018 2:02 PM Last Saved By: CDAVIDS

PHASE III DRAINAGE REPORT
FOR
RIDGEGATE PARKWAY EXPANSION – PHASE II
LONE TREE, CO

October 2018

Prepared For:

City of Lone Tree
9220 Kimmer Dr., Suite 100
Lone Tree, Colorado 80124
Phone: (720) 509-1241

Prepared By:

MERRICK® & COMPANY

5970 Greenwood Plaza Blvd
Greenwood Village, CO 80111
Phone: (303) 751-0741

Merrick Job No. 65119564

Basin E1	
Location:	South couplet, east of western future couplet road
Existing Conditions:	Native grass
Existing Flow Pattern:	Drainage from this basin generally sheet flows south to north.
Proposed Conditions:	Roadway, curb and gutter, and sidewalks
Proposed Flow Pattern:	Drainage will generally flow from west to east. Flows will be captured by the proposed storm system and conveyed to Water Quality Pond E.

Basin E2-O	
Location:	South of the south couplet road
Existing Conditions:	Native grass
Existing Flow Pattern:	Drainage from this basin generally sheet flows south to north.
Proposed Conditions:	Native grass and roadside swale to divert offsite, undeveloped flows
Proposed Flow Pattern:	Drainage will generally flow from west to east. Flows will be captured by the proposed roadside swale and conveyed to Badger Gulch.

Basin E2-F is a portion of the future, full build-out condition of Basin E2. In the future, the proposed development will likely increase impervious and minimize the tributary area of Basin E2.

Basin E3	
Location:	South couplet, west of the proposed Badger Gulch Bridge
Existing Conditions:	Native grass
Existing Flow Pattern:	Drainage from this basin generally sheet flows west to east.
Proposed Conditions:	Roadway, curb and gutter, and sidewalks
Proposed Flow Pattern:	Drainage will generally flow from west to east. Flows will be captured by the proposed storm system and conveyed to Water Quality Pond E.

Basin E4-F is a portion of the future, full build-out condition of Basin E2. In the future, the proposed development will likely increase impervious and minimize the tributary area of Basin E2.

Basin E5-F is the future, full build-out condition of high density residential parcel as defined by DTJ. Basin E5-F is used to determine the size of Water Quality Pond E.

Major Basin F is broken up into 4 minor basins that covers the areas east of Badger Gulch. Flows from these basins are captured by existing and proposed inlets and conveyed to Water Quality Pond F by proposed and existing storm sewer.

Basin F1	
Location:	South couplet, east of the proposed Badger Gulch Bridge
Existing Conditions:	Native grass
Existing Flow Pattern:	Drainage from this basin generally sheet flows east to west.
Proposed Conditions:	Roadway, curb and gutter, and sidewalks
Proposed Flow Pattern:	Drainage will generally flow from west to east. Flows will be captured by the proposed storm system and conveyed to Water Quality Pond F.

Basin F2	
Location:	Ridgegate Parkway, east of the existing Badger Gulch Bridge
Existing Conditions:	Existing roadway
Existing Flow Pattern:	Drainage from this basin generally flows from east to west. Flows are captured by the existing storm system and conveyed to an existing water quality pond.
Proposed Conditions:	Roadway expansion, curb and gutter, and sidewalks
Proposed Flow Pattern:	Drainage will generally flow from east to west. Flows will be captured by the proposed storm system and conveyed to Water Quality Pond F.

Basin E5-F flows are captured by a future storm system that is anticipated to outfall at Water Quality Pond E.

Basin E areas and flows are summarized in Table IV.2:

Table IV.2: E Basins – Area and Discharge

Basin	Area (ac)	Q_5 (cfs)	Q_{100} (cfs)
E1	2.43	4.3	10.2
E2-O	15.95	1.3	23.2
E2-F	8.14	18.3	40.6
E3	1.29	2.9	6.9
E4-F	4.10	10.6	23.6
E5-F	8.53	21.4	47.3

Basin F1 flows are captured by a 10' Type R inlet in sump in the center of the basin.

Basin F2 flows are captured by a 10' Type R inlet at the northwest end of the basin.

Basin F3 flows are captured by a 10' Type R inlet at the west end of the basin.

Basin F4 flows are captured by a 10' Type R inlet at the west end of the basin.

Basin F areas and flows are summarized in Table IV.3:

Table IV.3: F Basins – Area and Discharge

Basin	Area (ac)	Q_5 (cfs)	Q_{100} (cfs)
F1	2.33	4.0	10.6
F2	0.60	1.0	2.9
F3	0.58	1.7	3.6
F4	7.35	2.1	18.3

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Job Name: Ridgegate Parkway Expansion
Job Number: 65119564
Date: 10/5/2018
By: G. LEE

Ridgegate Parkway Expansion

Composite Runoff Coefficient Calculations

Location: Douglas County
Municipality: Douglas County
Minor Design Storm: 5
Major Design Storm: 100
Soil Type: C/D

Runoff Coefficient (UDFCD Vol 1, Chp 6, Sec. 2.5.1)

NRCS Soil Group	Storm Return Period					
	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
A	C=0.84i^1.302	C=0.86i^1.276	C=0.87i^1.232	C=0.84i^1.124	C=0.85i+0.025	C=0.78i+0.110
B	C=0.84i^1.169	C=0.86i^1.088	C=0.81i+0.057	C=0.63i+0.249	C=0.56i+0.328	C=0.47i+0.426
C/D	C=0.83i^1.122	C=0.82i+0.035	C=0.74i+0.132	C=0.56i+0.319	C=0.49i+0.393	C=0.41i+0.484

Basin Design Data

	I (%) =											i (%)	Runoff Coeff's			
Basin Name	Design Point	A_{paved} streets (sf)	$A_{drives/walks}$ (sf)	$A_{MU/COM/FIRE}$ (sf)	$A_{MF/RES}$ (sf)	$A_{MD\ RES}$ (sf)	$A_{LD\ RES}$ (sf)	$A_{lscape\ (B\ soil)}$ (sf)	$A_{lscape\ (C/D\ soil)}$ (sf)	A_{Total} (sf)	A_{Total} (ac)	Imp (%)	C2	C5	C10	C100
										106,038	2.43	67.9%	0.54	0.59	0.63	0.76
										694,570	15.95	2.0%	0.01	0.05	0.15	0.49
										354,703	8.14	75.0%	0.60	0.65	0.69	0.79
										56,187	1.29	68.2%	0.54	0.59	0.64	0.76
										178,581	4.10	75.0%	0.60	0.65	0.69	0.79
										371,373	8.53	75.0%	0.60	0.65	0.69	0.79
	WQ Pond E	60,836	53,898	0	904,657	0	0	0	47,491	1,066,882	24.49	73.9%	0.59	0.64	0.68	0.79

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Job Number: 65119564
Date: 10/5/2018
By: G. LEE

Ridgegate Parkway Expansion

Time of Concentration Calculations

Location: Douglas County
Municipality: Douglas County
Minor Design Storm: 5
Major Design Storm: 100
Soil Type: C/D

$t_i=(0.395(1.1-C_5)(L_i^{0.5}))/(S_O^{0.33})$
$t_t=L_t/(60V_t)$
Urban $t_c=(26-17i)+L_t/(60(14i+9)*(S_O^{.5}))$

Sub-Basin Data					Initial Overland Time (t_i)			Travel Time (t_t) t_t=Length/(Velocity x 60)						t_c Comp	tc Urbanized Check ON			t_c Final
Basin Name	Design Point	A_{Total} (ac)	i (%)	C5			t_i (min)				C_v	Velocity (fps)	t_t (min)	Time of Conc $t_i + t_t = t_c$	L_t (ft)	S_O (%)	Urban t_c	Min t_c
E1	-	2.43	67.9%	0.59			7.8				20	2.0	9.7	17.5	1275.0	1.1%	25.6	17.5
E2-O	-	15.95	2.0%	0.05			31.7				7	1.1	24.9	56.6	2108.0	2.4%	50.2	50.2
E2-F	-	8.14	75.0%	0.65			6.5				20	2.8	6.5	13.0	1198.0	2.0%	20.5	13.0
E3	-	1.29	68.2%	0.59			7.2				20	3.8	2.9	10.2	775.0	3.4%	18.2	10.2
E4-F	-	4.10	75.0%	0.65			6.5				20	4.1	2.7	9.2	762.0	3.9%	16.5	9.2
E5-F	-	8.53	75.0%	0.65			6.5				20	5.1	3.6	10.1	1196.0	5.9%	17.4	10.1

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Job Name: Ridgegate Parkway Expansion
Job Number: 65119564
Date: 10/10/2018
By: G. LEE

Ridgegate Parkway Expansion

Developed Storm Runoff Calculations

Design Storm : **5 Year**

Point Hour Rainfall (P_1) : **1.43**

$I = (28.5\ P1) / ((10 + TC)^{0.786})$

	Direct Runoff							Total Runoff				Inlets			Pipe					Pipe/Swale Travel Time				
	Design Point	Area (ac)	Runoff Coeff	tc (min)	C*A (ac)	I (in/hr)	Q (cfs)			I (in/hr)	Q (cfs)								Approx. Max Pipe Capacity (cfs)		Velocity (fps)	tt (min)	Total Time (min)	
	-	15.95	0.05	50.2	0.82	1.63	1.3																	
	-	2.43	0.59	17.5	1.44	3.01	4.3												10.5		3.7	0.42	17.92	
	-	8.14	0.65	13.0	5.29	3.47	18.3												58.0		9.3	0.10	13.10	
	E1				Combined Flows (E1-E2-F)					2.98	20.0								76.5		10.2	1.16	19.08	
	-	1.29	0.59	10.2	0.77	3.84	2.9												10.5		2.5	0.12	10.32	
	-	4.10	0.65	9.2	2.66	3.99	10.6												32.0		6.8	0.13	9.33	
	E2				Combined Flows (E1-E4-F)					2.88	29.3								194.1		12.4	0.49	19.57	
	-	8.53	0.65	10.1	5.54	3.85	21.4																	
					Combined Flows (E1-E5-F)					2.84	44.7													

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Merrick & Company
5970 Greenwood Plaza Blvd.
Greenwood Village, CO 80111
Ph: (303) 751-0741

Job Name: Ridgegate Parkway Expansion
Job Number: 65119564
Date: 10/10/2018
By: G. LEE

Ridgegate Parkway Expansion

Developed Storm Runoff Calculations

Design Storm : **10 Year**

Point Hour Rainfall (P_1) : **1.66**

	Direct Runoff							Total Runoff				Pipe					Pipe/Swale Travel Time				
	Design Point	Area (ac)	Runoff Coeff	tc (min)	C*A (ac)	I (in/hr)	Q (cfs)			I (in/hr)	Q (cfs)					Approx. Max Pipe Capacity (cfs)		Velocity (fps)	tt (min)	Total Time (min)	
	-	15.95	0.15	50.2	2.34	1.89	4.4														
	-	2.43	0.63	17.5	1.54	3.50	5.4									10.5		8.1	0.19	17.69	
	-	8.14	0.69	13.0	5.59	4.02	22.5									58.0		11.5	0.08	13.08	
	E1				Combined Flows (E1-E2-F)					3.48	24.8					76.5		12.6	0.94	18.63	
	-	1.29	0.64	10.2	0.82	4.46	3.7									10.5		4.3	0.07	10.27	
	-	4.10	0.69	9.2	2.82	4.64	13.1									32.0		8.3	0.11	9.31	
	E2				Combined Flows (E1-E4-F)					3.39	36.5					194.1		15.5	0.39	19.02	
	-	8.53	0.69	10.1	5.86	4.47	26.2														
					Combined Flows (E1-E5-F)					3.35	55.7										

Merrick & Company
5970 Greenwood Plaza Blvd.
Greenwood Village, CO 80111
Ph: (303) 751-0741

Job Name: Ridgegate Parkway Expansion
Job Number: 65119564
Date: 10/10/2018
By: G. LEE

Ridgegate Parkway Expansion

Developed Storm Runoff Calculations

Design Storm : **100 Year**

Point Hour Rainfall (P_1) : **2.60**

$I = (28.5\ P1) / ((10 + TC)^{0.786})$

	Direct Runoff							Total Runoff				Inlets			Pipe					Pipe/Swale Travel Time				
	Design Point	Area (ac)	Runoff Coeff	tc (min)	C*A (ac)	I (in/hr)	Q (cfs)			I (in/hr)	Q (cfs)								Approx. Max Pipe Capacity (cfs)		Velocity (fps)	tt (min)	Total Time (min)	
	-	15.95	0.49	50.2	7.85	2.96	23.2																	
	-	2.43	0.76	17.5	1.86	5.48	10.2												10.5		8.1	0.19	17.69	
	-	8.14	0.79	13.0	6.45	6.30	40.6												58.0		20.7	0.04	13.04	
	E1				Combined Flows (E1-E2-F)					5.45	45.2								76.5		23.0	0.51	18.21	
	-	1.29	0.76	10.2	0.99	6.98	6.9												10.5		4.3	0.07	10.27	
	-	4.10	0.79	9.2	3.24	7.26	23.6												32.0		15.0	0.06	9.26	
	E2				Combined Flows (E1-E4-F)					5.37	67.3								194.1		28.5	0.21	18.42	
	-	8.53	0.79	10.1	6.75	7.01	47.3																	
					Combined Flows (E1-E5-F)					5.34	102.9													

Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Thursday, Aug 30 2018

Pond E Outfall Pipe

Invert Elev Dn (ft)	=	5959.12
Pipe Length (ft)	=	81.40
Slope (%)	=	0.87
Invert Elev Up (ft)	=	5959.83
Rise (in)	=	30.0
Shape	=	Circular
Span (in)	=	30.0
No. Barrels	=	1
n-Value	=	0.013
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Square edge w/headwall (C)
Coeff. K,M,c,Y,k	=	0.0098, 2, 0.0398, 0.67, 0.5

Embankment

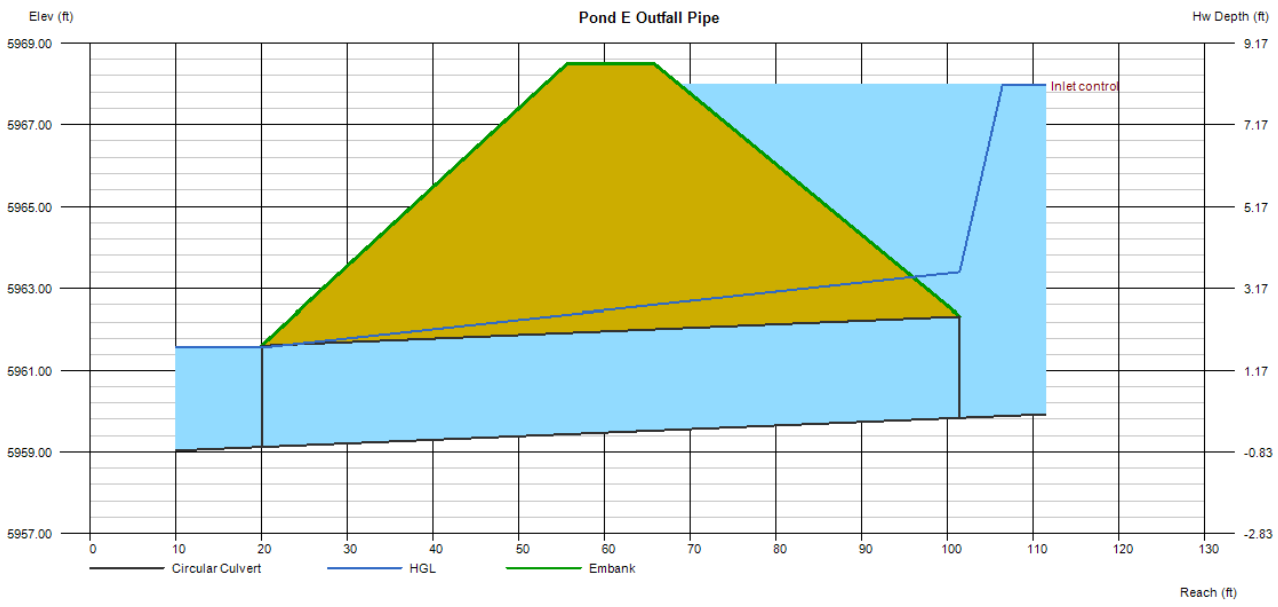
Top Elevation (ft)	=	5968.50
Top Width (ft)	=	10.00
Crest Width (ft)	=	25.00

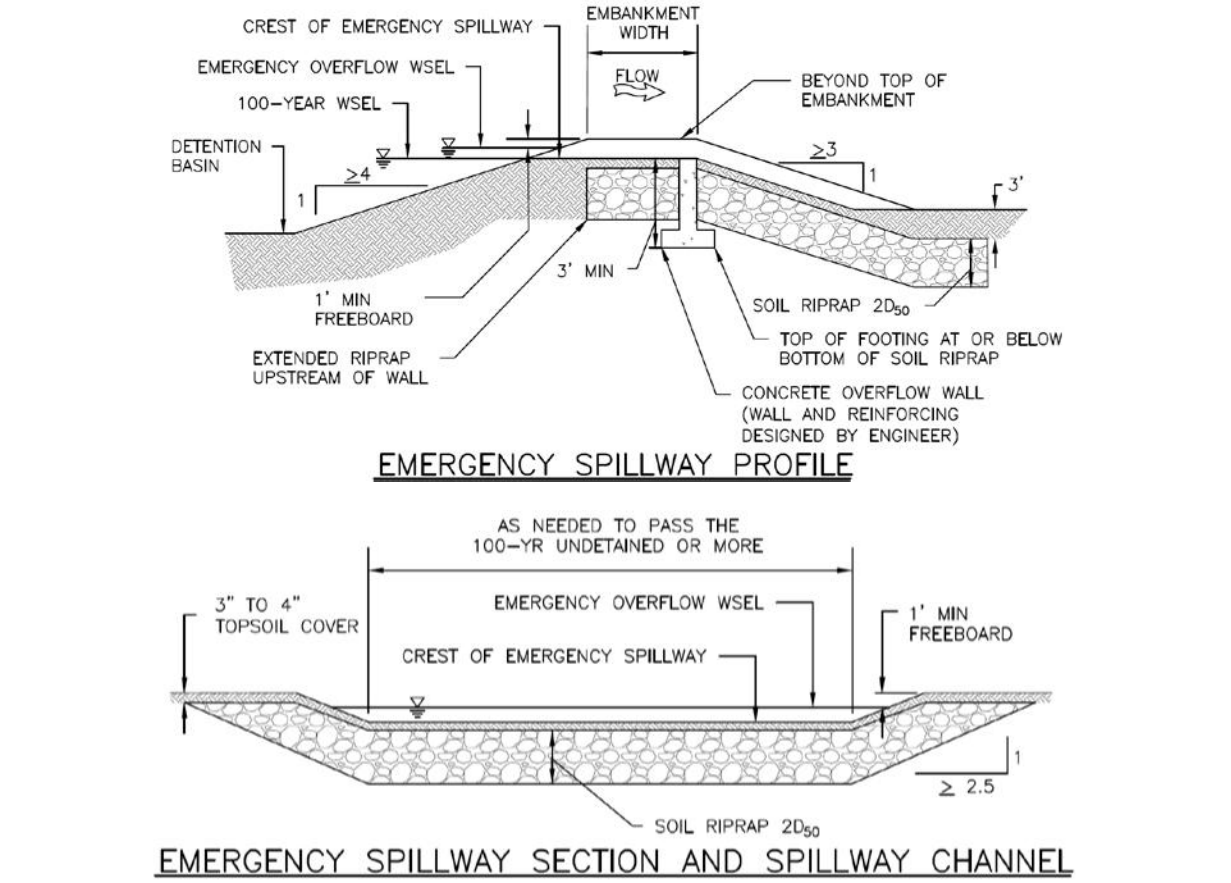
Calculations

Qmin (cfs)	=	62.60
Qmax (cfs)	=	62.60
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	62.60
Qpipe (cfs)	=	62.60
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	12.81
Veloc Up (ft/s)	=	12.75
HGL Dn (ft)	=	5961.57
HGL Up (ft)	=	5963.40
Hw Elev (ft)	=	5967.97
Hw/D (ft)	=	3.25
Flow Regime	=	Inlet Control





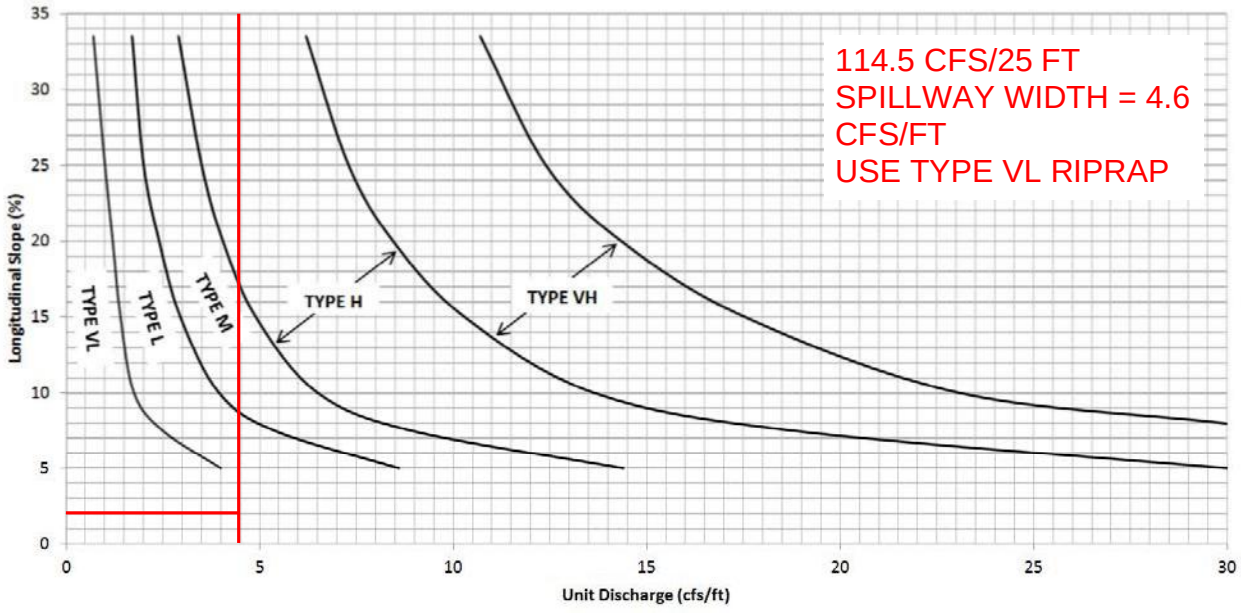
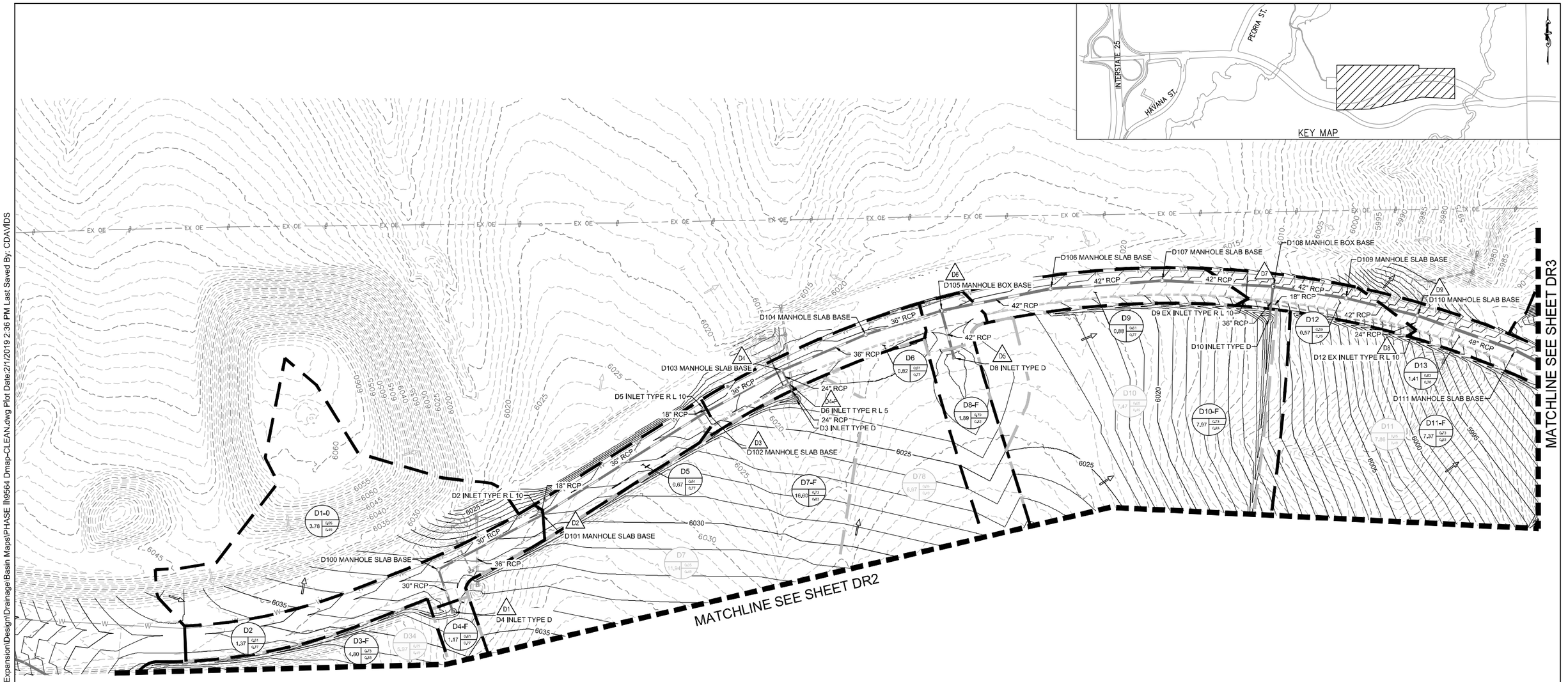


Figure 12-21. Embankment protection details and rock sizing chart (adapted from Arapahoe County)



LEGEND

- BASIN ID
- 5-YEAR RUNOFF COEFFICIENT
- 100-YEAR RUNOFF COEFFICIENT
- BASIN AREA (ACRES)
- DESIGN POINT
- PROPOSED FLOW OF WATER
- EXISTING FLOW OF WATER
- PROPOSED MANHOLE AND STORM SEWER
- EXISTING MANHOLE AND STORM SEWER
- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- FUTURE BASIN BOUNDARY
- PROPOSED BASIN BOUNDARY

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

City of Lone Tree

These construction plans have been reviewed by the City of Lone Tree for street and drainage improvements only.

Engineering Division Acceptance Block

100' 0 50' 100' 200'

1" = 100' HOR.

Computer File Information		Sheet Revisions	
Print Date: 2/1/19		Date:	Comments
Drawing File Name: 9564 Dmap-CLEAN.dwg			
Horiz. Scale: AS SHOWN Vert. Scale: AS SHOWN			

CITY OF LONE TREE

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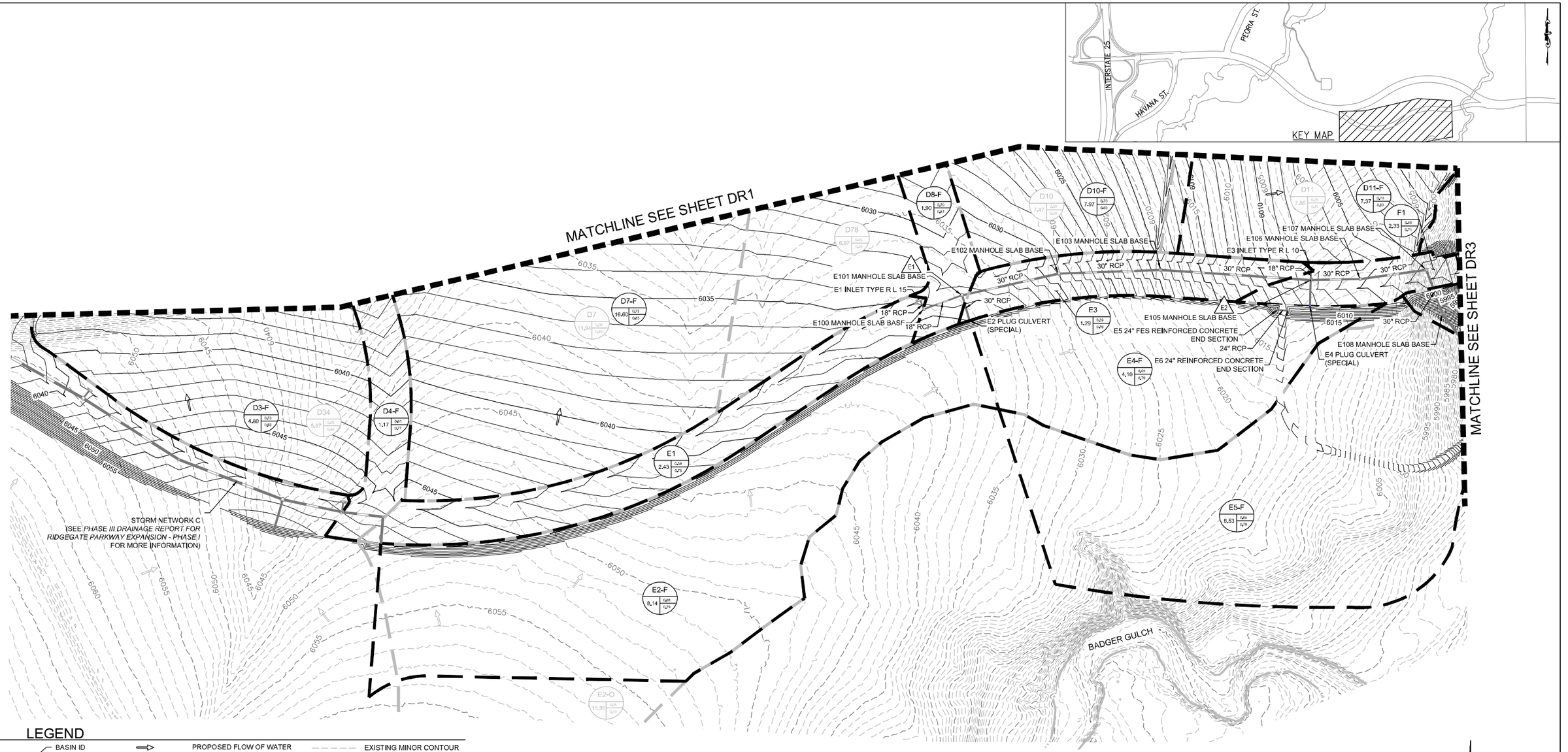
As Constructed	RIDGEGATE PARKWAY EXPANSION DRAINAGE MAP			Project No./Code
No Revisions:				----
Revised:	Designer:		QC Review:	
Void:	Detailer:		Approved:	
	Sheet Subset:	Subset Sheet:		Sheet Number: DR1

File Location: C:\DEN\Projects\5087-02-RRMD Overall East\Projects\9564-Ridgegate Pkwy Expansion\Design\Drainage\Basin Maps\PHASE II\9564 Dmap-CLEAN.dwg Plot Date: 2/1/2019 2:36 PM Last Saved By: CDAVIDS



LEGEND

- BASIN ID
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Print Date: 2/1/19		Date:	Comments
Drawing File Name: 9564 Dmap-CLEAN.dwg			
Horiz. Scale: AS SHOWN Vert. Scale: AS SHOWN			

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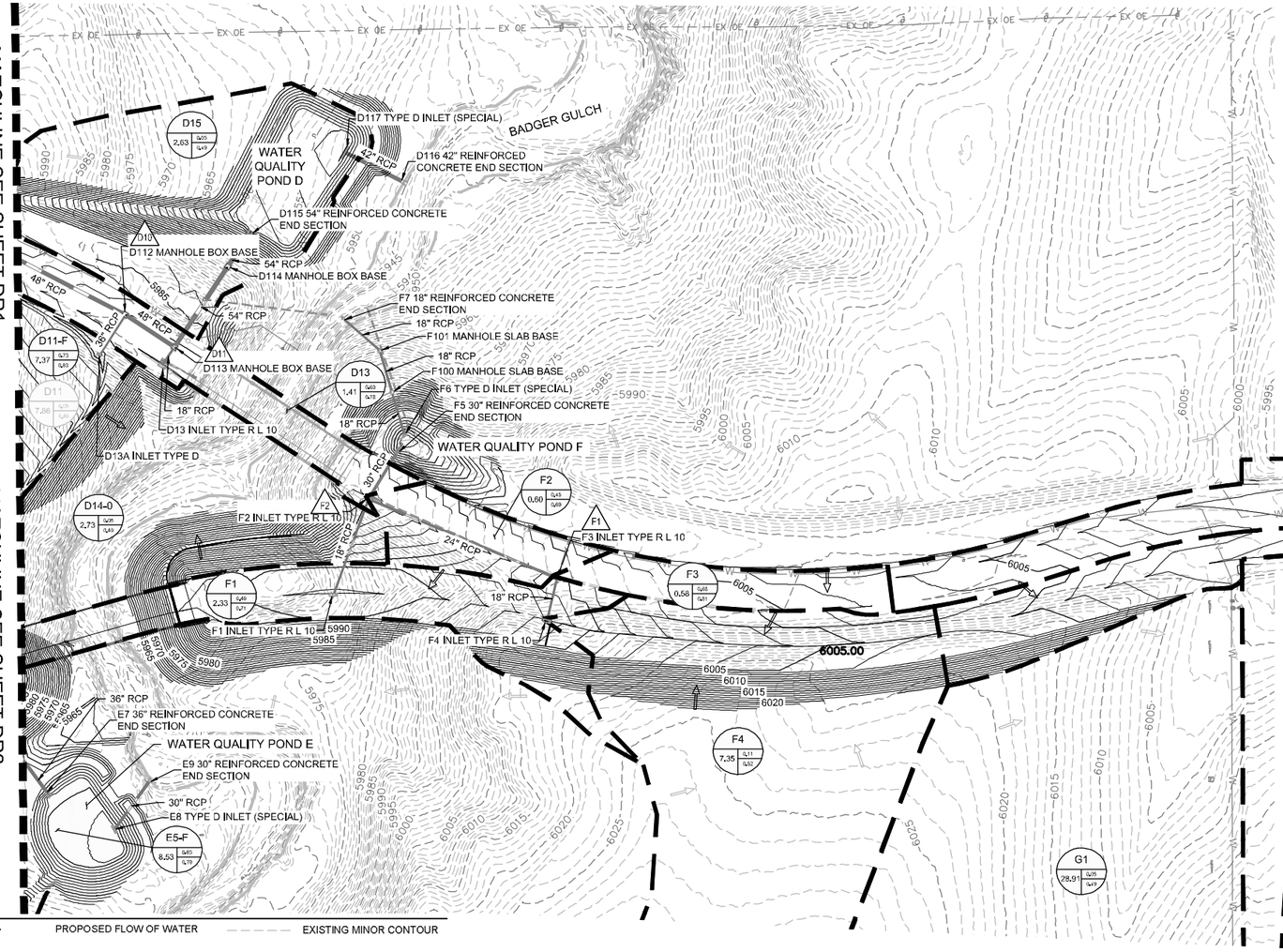
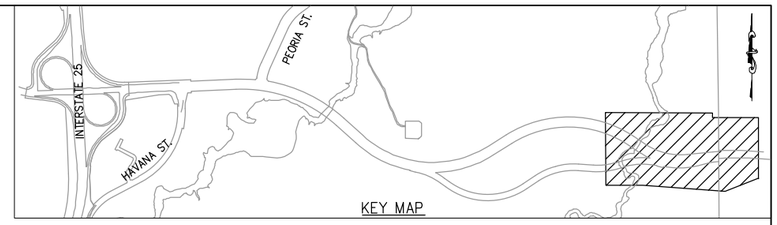
As Constructed	RIDGEGATE PARKWAY EXPANSION DRAINAGE MAP			Project No./Code
No Revisions:				----
Revised:	Designer:		QC Review:	
Void:	Detailer:		Approved:	
	Sheet Subset:	Subset Sheet:		Sheet Number: DR2

File Location:C:\DEN\Projects\5087-02-RRMD Overall East\Projects\9564-Ridgegate Pkwy Expansion\Design\Drainage Basin Maps\PHASE II\9564 Dmap-CLEAN.dwg Plot Date:2/1/2019 2:36 PM Last Saved By: CDAVIDS





LEGEND

- BASIN ID
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- 100-YEAR RUNOFF COEFFICIENT
- BASIN AREA (ACRES)
- DESIGN POINT
- PROPOSED FLOW OF WATER
- EXISTING FLOW OF WATER
- PROPOSED MANHOLE AND STORM SEWER
- EXISTING MANHOLE AND STORM SEWER
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100' 0 50' 100' 200'
1" = 100' HOR.

Computer File Information		Sheet Revisions	
Print Date: 2/1/19		Date:	Comments
Drawing File Name: 9564 Dmap-CLEAN.dwg			
Horiz. Scale: AS SHOWN Vert. Scale: AS SHOWN			

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As Constructed
No Revisions:
Revised:
Void:

RIDGEGATE PARKWAY EXPANSION DRAINAGE MAP

Designer:		QC Review:	
Detailer:		Approved:	
Sheet Subset:	Subset Sheet:		

Project No./Code

Sheet Number: DR3

File Location:Q:\DEN\Projects\50\87-02-RRMD Overall East\Projects\9564-Ridgegate Pkwy Expansion\Design\Drainage Basin Maps\PHASE II\9564 Dmap-CLEAN.dwg Plot Date:2/1/2019 2:36 PM Last Saved By: CDAVIDS

Happy Canyon Creek
Flood Hazard Area Delineation (FHAD)

July 2014

URBAN DRAINAGE AND FLOOD CONTROL DISTRICT

DOUGLAS COUNTY COLORADO

CITY OF LONE TREE

Town of Parker COLORADO

Southeast Metro Stormwater Authority

MULLER

SECTION 2 – STUDY AREA DESCRIPTION

2.1 Project Area

Happy Canyon Creek originates in the City of Castle Pines, south of the Denver metropolitan area and west of I-25. The creek flows in a northeasterly direction through unincorporated Douglas County, crossing I-25 near Surrey Ridge. It then passes through the RidgeGate PDD in the City of Lone Tree before joining with its major tributary, Badger Gulch, just south of Lincoln Avenue within the Meridian International Business Center. North of Lincoln, Happy Canyon Creek flows through Grandview Estates, then through the Compark development adjacent to E-470. Compark extends to the Douglas-Arapahoe county line, and is primarily within the Town of Parker's current and future annexation boundaries. Happy Canyon Creek then enters Arapahoe County in the Dove Valley Business Park, crosses Jordan Road into the Southcreek subdivision, and finally joins with Cherry Creek just south of Broncos Parkway in the Cherry Creek Valley Ecological Park. Table 2-1 contains the names and lengths of the eight major reaches identified within the watershed boundary. Watershed limits, tributary channels, jurisdictional boundaries, and major landmarks are shown in Figure 2-2.

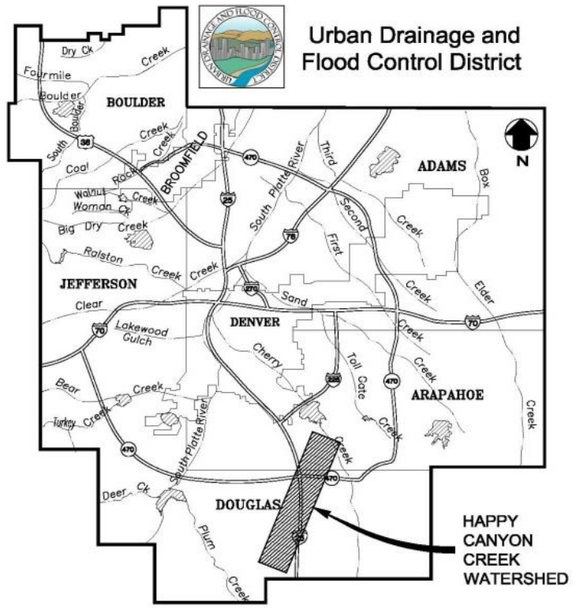


Figure 2-1. Vicinity Map

The Happy Canyon Creek watershed is approximately 10.2 miles in length and has an average width of 2.1 miles for most of its length, tapering to 0.5 miles wide at the north end. The total area is 17.5 square miles or 11,200 acres. Approximately 40% of this area is developed. The highest and lowest points are 6680 and 5668 feet above mean sea level, respectively; the average watershed slope is 1.8%. Underlying soils are hydrologic group C through much of the watershed, with type B soils increasing to the north and a few small areas of type A near the Douglas-Arapahoe county line. A map of soil classifications is included in Appendix B.

Happy Canyon Creek is UDFCD Project Reuse watershed No. 4609; Badger Gulch is Project Reuse watershed #4610.

The FHAD project area includes Happy Canyon Creek from the confluence with Cherry Creek to the northern boundary of the City of Castle Pines; the portion of the Green Acres Tributary in Arapahoe County, and Badger Gulch. Approximately 11.3 miles of the Happy Canyon Creek, 0.5 miles of Green Acres Tributary, and 4.9 miles of Badger Gulch were included in the hydraulic model.

Table 2-1
Major Drainageway Inventory

Major Drainageway	Confluence at Mainstem Reach	Length (mi)
Happy Canyon Creek	N/A	12.8 (11.3 modeled)
Beverly Hills Tributary	*Reach 2 – Douglas County South*	*1.2*
Oak Ridge Tributary	*Reach 3 – I-25 Right-of-Way*	*1.3*
Oak Hills Tributary	*Reach 3 – I-25 Right-of-Way*	*3.0*
Badger Gulch	Reach 7 – Grandview Estates	4.9
Grandview Tributary	*Reach 7 – Grandview Estates*	*2.1*
Stonegate Tributary	*Reach 8 – Compark*	*2.3*
Green Acres Tributary	Reach 9 – Arapahoe County	3.7 (0.5 modeled)

Italicized entries were not hydraulically modeled in this study.

2.2 Land Use

Land use within the Happy Canyon Creek watershed varies considerably by location, from agricultural and open space to high-density city center. Existing development conditions are generally based on visual assessment of the aerial photography provided by UDFCD, and future development conditions are based on information provided by project sponsors and stakeholders, including planning documents, zoning, master drainage plans, and direct input. In a few cases, roads were identified separately in land use analysis: the I-25 and E-470 corridors are reflected as 50% impervious to reflect separation between travel lanes and additional right-of-way included in the corridor, while Castle Pines Parkway, RidgeGate Parkway, and Lincoln Avenue are assumed 100% impervious (50% build-out of RidgeGate Parkway is reflected in the existing condition). All other existing or planned roads are assumed to be accounted for in the impervious values of adjacent development.

The overall existing weighted impervious value for the Happy Canyon Creek watershed is 15.9%. Future development is projected to increase watershed imperviousness to 36.3%. The interactive hydrology map in Appendix B shows existing and future land use boundaries and impervious values (Figures B-1 and B-2).

DATE: JUL 22, 2014 TIME: 5:20 PM

NAME: P:\12-010.01 Happy Canyon Creek MDP & FHAD UDFCD\FHAD\CAD\12010-WATERSHED MAP.dwg

No.	DATE	REVISIONS	APPR.

MULLER ENGINEERING CO., INC.
CONSULTING ENGINEERS
777 SOUTH WADSWORTH BLVD. 4-100
LAKEWOOD, COLORADO
80226 (303) 988-4939

PROJECT NO. 12-010.01

DESIGN	ASP
DRAWN	SAR
CHECK	JTW

HAPPY CANYON CREEK
FLOOD HAZARD AREA DELINEATION

WATERSHED MAP

DATE: JULY 2014

FIGURE NO. 2-2

Upper Watershed: West of I-25

The upper watershed includes approximately one third of the total area and is essentially fully developed. The City of Castle Pines is primarily small lot residential, with some medium lot residential and a small commercial area along Castle Pines Parkway near I-25. Small lot residential developments were grouped by density based on visual assessment, and an average % impervious was assigned to each group ranging from 40% to 60%. Undeveloped commercial parcels, golf courses, and other open space areas were assigned 2%, school sites were assigned 50%, and commercial areas were assigned 80%. Outside of Castle Pines, unincorporated Douglas County is dominated by large lot residential. Areas were separated into two groups based on lot size and average imperviousness values of 10% and 15% were calculated for the two groups. For future conditions, undeveloped areas were assumed to develop according to the surrounding areas.

The weighted impervious values for the upper watershed are 21.6 % for existing development and 22.5 % for future development.

Middle Watershed: I-25 to Lincoln Avenue

The middle watershed, which represents nearly half of the total watershed area, is largely undeveloped. This area will see significant growth, however, within the planned RidgeGate development in the City of Lone Tree's jurisdiction. RidgeGate is a 3500 acre planned development that extends from the eastern edge of Lone Tree west across I-25 to Yosemite Street. Land use within RidgeGate will run the gamut from an ultra-dense city center just east of I-25 to rural residential and dedicated open space. Within the Happy Canyon Creek watershed, future land use is based on the PDD document and is largely residential mixed use. Impervious values for the various mixed use/residential planning areas were calculated based on maximum allowable ratios of commercial and multi-family residential development indicated in the PDD, with 85% applied to commercial areas, 80% for multi-family residential, and 50% for single family residential in the remaining area. Other land uses and their associated % impervious values within RidgeGate include city center (95%), commercial mixed use (85%), institutional (50%), rural residential (15%), central community park (10%), and open space (2%). RidgeGate Parkway, which has been constructed at half of its ultimate design width, is reflected as 50% impervious in the existing condition and 100% in the future.

South of RidgeGate, unincorporated Douglas County is zoned for agricultural use. This area is slated for another planned development, Freshfields, under the same landowner/developer as RidgeGate; however, planning for Freshfields has not yet begun and development is not expected to begin until RidgeGate is built out. Because that timeline exceeds the expected life of this plan, no future development is reflected.

Several other planned developments are located within the middle watershed. Surrounded on three sides by RidgeGate, Meridian Commons is a mixed-use/residential filing of the Meridian International Business Center (Meridian). East of Lone Tree, Meridian Filing No. 7 is under active development. Sierra Ridge is located along the west side of Chambers Road and is currently undeveloped. Future land use for each of these planned developments is based on master drainage plans.

Overall weighted impervious values for the middle watershed are 9.8 % for existing development and 36.8 % for future development.

Lower Watershed: Lincoln Avenue to Cherry Creek

North of Lincoln Avenue, Happy Canyon Creek bisects Grandview Estates, an established large lot residential area in unincorporated Douglas County. Impervious values are set at 15% for both existing and future conditions. East of Grandview Estates, Chambers Reservoir is currently under construction. For the purpose of this study, the reservoir is assumed complete and is reflected as 100% impervious. West of Peoria Street lies additional Meridian planned development. Undeveloped industrial/business parks are located between Meridian and Grandview Estates. North of Grandview Estates, the Compark planned development spans both sides of E-470 to the Douglas-Arapahoe County line. Portions of Compark north of E-470 are within the Town of Parker; the area south of E-470 is a proposed annexation to the Town. Future impervious values for Meridian and Compark planned development areas are based on master drainage plans. Industrial/business parks are assumed to develop to 80% impervious.

North of Compark, the Happy Canyon Creek watershed crosses into Arapahoe County. The Dove Valley Business Park stretches from the county line to Jordan Road and is largely undeveloped. Future development is reflected as 80% impervious. East of Jordan Road, the creek is flanked by residential development in the Southcreek subdivision.

Weighted impervious values for the lower watershed are 19.6% for existing development and 54.2% for future development.

2.3 Reach Description

The Happy Canyon Creek channel character varies widely along its length. The character of each segment is heavily influenced by the surrounding land use; because land use varies by jurisdiction, the creek is easily divided into nine distinct reaches at the jurisdictional boundaries. A description of each reach follows; reach limits are shown in Figures B-1 and B-2.

Happy Canyon Creek Reach 1 – Castle Pines

Within the City of Castle Pines, Happy Canyon Creek lies within a dedicated open space corridor adjacent to Monarch Boulevard. The channel is generally stable and well-vegetated, with significant wetland growth supported by a base flow. Five online regional detention ponds are located within Castle Pines on Happy Canyon Creek and its tributaries; the ponds are maintained by the Castle Pines North Metro District (CPNMD). The two mainstem ponds are located at Castle Pines Parkway

Happy Canyon Creek Reach 2

Happy Canyon Creek Reach 3

Happy Canyon Creek Reach 4

(CPNMD Pond #11) and near the city limit (CPNMD Pond #12). In the lower portion of the reach downstream of Pond #12, Happy Canyon Creek has not been stabilized and is experiencing severe bank erosion and channel degradation as relatively clear water from the stabilized channel upstream enters an unimproved, natural channel. Reach 1 is not included in the FHAD study area.

Happy Canyon Creek Reach 2 – Douglas County South

Immediately downstream of Castle Pines, the severe channel degradation observed in the lower portion of Reach 1 continues over a distance of approximately 850 feet, then transitions to a moderately stable, well-vegetated stream as it passes through large lot development in unincorporated Douglas County. Any future stabilization of the eroded areas will have the potential to shift the degradation downstream as it reduces the quantity of sediment being supplied to downstream reaches. UDFCD and Douglas County have implemented a project that constructed several low-flow grade control structures downstream of Oak Hills Drive.

Major crossings include a box culvert at Oak Hills Drive and a small double-barrel CMP culvert at Clydesdale Road. Because the channel is located on private property through most of this reach, access is limited.

Happy Canyon Creek Reach 3 – I-25 Corridor

Reach 3 is located adjacent to the west side of I-25 and is overall the most damaged reach of Happy Canyon Creek. There is severe erosion downstream of the confluence with the Oak Hills Tributary, and the channel is constricted between I-25 and Surrey Drive with steep banks on both sides and failed slope paving along the east (I-25) bank. At the downstream end of this reach, bridges allow Happy Canyon Creek to cross under I-25 and Havana Street.

Happy Canyon Creek Reach 4 – Lone Tree South

East of I-25, Reach 4 is characterized by wide meanders and fairly dense natural vegetation in the overbanks. In many areas, the creek is flanked by high bluffs on one side, with an open, gentle floodplain on the other. The upper portion of the reach shows moderate channel erosion; this transitions to slight aggradation in the middle of the reach. The RidgeGate property is currently used for livestock operations; damage to the channel from the cattle is apparent, with trampled banks unable to support vegetation immediately adjacent to the channel. The recently constructed RidgeGate Parkway crosses the creek via a bridge.

Happy Canyon Creek Reach 5

Happy Canyon Creek Reach 6

Happy Canyon Creek Reach 7

Happy Canyon Creek Reach 5 – Meridian Commons

Midway between RidgeGate Parkway and Lincoln Avenue, a 2700' reach of Happy Canyon Creek runs adjacent to Meridian Commons, passing back and forth along the property line between Meridian Commons and RidgeGate. Though the natural channel character mimics reach 4, this reach is fenced off from livestock. As a result, the overall channel health is much improved, with healthy wetland vegetation along the low flow channel. This reach was stabilized during development with several check structures and a sloping grouted boulder drop structure at the downstream end.

Happy Canyon Creek Reach 6 – Lone Tree North

Beyond Meridian Commons, Happy Canyon again runs through Lone Tree in the future RidgeGate area to West Parker Road at the city limit. With the continuation of unrestricted livestock access in Lone Tree, creekside vegetation is again limited and bank stability suffers. The channel bottom is moderately stable with evidence of substantial sediment transport. The crossing at West Parker Road is a bridge. *Note: West Parker Road, from Lincoln Avenue south in Lone Tree, was renamed to First Street in 2012. However, consistent with historical knowledge and most of the available area maps, the West Parker Road name has been used throughout this report.*

Happy Canyon Creek Reach 7 – Douglas County North (Grandview Estates)

Beyond West Parker Road, Happy Canyon Creek crosses through a corner of Meridian Village in unincorporated Douglas County before passing through the Lincoln Avenue bridge and into Grandview Estates. The Meridian Village portion of the reach has been stabilized with two sloping grouted boulder drop structures and is in good condition. Grandview Estates is a large lot residential development north of Lincoln Avenue in unincorporated Douglas County. A segment of the reach, from Lincoln Avenue to Birch Avenue, is located within Douglas County Open Space. The remainder of reach 7 crosses private residential lots with no drainage easement and limited channel access. There is a bridge crossing at Birch Avenue and a triple 48" CMP culvert crossing at Dogwood Avenue. The base flow disappears within this reach, and there is evidence of aggradation in the wide, sandy channel bottom.

Reach 7 was the subject of a 2001 study and initial phase of design by HDR, Inc. for Douglas County and UDFCD. The HDR project had "dual goals of flood control and bank and streambed stabilization." At the time, there were numerous flooding concerns related to the Dogwood crossing and the Grandview Tributary, as well as channel and bank stabilization issues and aesthetic considerations due to debris that had been placed along the banks by the residents in stabilization efforts. Several projects have been completed since the HDR study.

Happy Canyon Creek Reach 8 – Town of Parker

Happy Canyon Creek takes a sharp turn to the east as it exits Grandview Estates, and meanders widely before crossing under dual bridges at E-470. The dry, sandy bottom continues through this reach, and the channel takes a sharp turn to the west before crossing under a bridge at Chambers Road. This bend was stabilized with soil riprap toe protection during the Chambers Road bridge construction. There is very little if any wetland vegetation in this reach, as there is no base flow to support it. Reach 8 is primarily undeveloped at this point, but lies within several planned developments. A future bridge crossing for Belford Avenue, just south of E-470, will connect two proposed Town of Parker annexations: Compark Village South and Chambers Highpoint, located on the west and east sides of the creek, respectively. North of E-470, various filings of Compark are located within current Town of Parker boundaries. Drainage tracts and/or easements have been, or will be, dedicated throughout the planned developments. The channel invert through Compark has been stabilized with drop structures at each crossing and several check structures.

Happy Canyon Creek Reach 8

Happy Canyon Creek Reach 9 – Arapahoe County

The final reach of Happy Canyon Creek extends from the Douglas-Arapahoe County line to its confluence with Cherry Creek. West of Jordan Road, it passes through the Dove Valley Business Park, which is largely undeveloped. Channel stabilization measures and an access trail have been implemented along one developed parcel that is adjacent to the creek, and there is a sloping grouted boulder drop structure upstream of the bridge at Jordan Road. East of Jordan Road, the creek is located in a wide Arapahoe County open space tract between two built out residential developments that are part of the Southcreek subdivision. Three sloping grouted boulder drop structures and a concrete box culvert pedestrian crossing were constructed with the development.

Happy Canyon joins Cherry Creek just upstream of the Broncos Parkway bridge, within the Cherry Creek Valley Ecological Park. Historically, the creek paralleled the east side of Jordan Road for a distance before turning to the east toward Cherry Creek. In 1975, the channel was realigned and the confluence moved approximately 2000' upstream to its current location. The channel character in reach 9 is unappealing, with its wide sandy bottom, straight alignment, and dry, upland plains vegetation.

Happy Canyon Creek Reach 9

Badger Gulch Reach 1 – Upper Watershed
The upstream limits of Badger Gulch lie less than a half-mile north of Hess Road in Douglas County. From the headwaters, Badger Gulch flows in a narrow and winding natural channel. The channel is presently stable, though evidence of historic bank erosion and degradation, likely exacerbated by past overgrazing, is evident throughout. Much of the upper Badger Gulch reach is inaccessible private property.

Badger Gulch Reach 2 – Meridian Village
About a mile from the mainstem confluence, the longitudinal grade of Badger Gulch begins to flatten. The steep overbanks of the upper watershed give way to flat, rolling grades with relatively little evidence of degradation. Within a half-mile of the confluence, Badger Gulch enters an engineered trapezoidal channel constructed as part of the Meridian Village development. At the time of the site survey, the civil site work had been partially completed and home construction had begun. A new channel crossing at Bristleridge Drive was installed as part of the development.

Badger Gulch Reach 2

Green Acres Tributary – Arapahoe County
The Green Acres Tributary within Arapahoe County has a very similar characteristic to Reach 8 of Happy Canyon Creek – a dry sandy channel with little to no wetland vegetation. There are no crossings of the tributary within the study limits.

Table 2-2
Major Crossing Inventory

Crossing Location	Reach	Type
HAPPY CANYON CREEK		
Oak Hills Drive	Reach 2 – Douglas County South	Double 6'x8' Box Culvert
Clydesdale Road	Reach 2 – Douglas County South	Double 72" CMP Culvert
Interstate 25	Reach 3 – I-25 Corridor	Single Span Bridge
I-25 Frontage Road	Reach 3 – I-25 Corridor	Single Span Bridge
RidgeGate Parkway	Reach 4 – Lone Tree South	Single Span Bridge
West Parker Road/First Street	Reach 6 – Lone Tree North	Double Span Bridge
Lincoln Avenue	Reach 6 – Lone Tree North	Triple Span Bridge
Birch Avenue	Reach 7 – Grandview Estates	Double Span Bridge
Dogwood Avenue	Reach 7 – Grandview Estates	Triple 48" CMP
E-470	Reach 8 – Compark	Two Single Span Bridges
Chambers Road	Reach 8 – Compark	Single Span Bridge
Jordan Road	Reach 9 – Arapahoe County	Single Span Bridge
BADGER GULCH		
RidgeGate Parkway	Badger Gulch Reach 1	Triple Span Bridge
Bristleridge Drive	Badger Gulch Reach 2	36' Conspan Arch

2.4 Flood History

There is limited information on history of flooding along Happy Canyon Creek, though there are many published accounts of flooding on nearby Cherry Creek. Much of the Happy Canyon Creek channel is located within open space tracts that provide adequate floodplain capacity; areas of flood concern are primarily located within Grandview Estates. Residents mentioned various high flow events causing overtopping of local streets and/or flood waters approaching their homes over the years; the 1993 OSP indicates previous accounts of road overtopping during heavy rainfall events. There are no stream gages on Happy Canyon Creek.

2.5 Environmental Assessment

Wetland zones are present along much of Happy Canyon Creek, though they markedly decrease in the downstream portions of the watershed where there is no base flow. An inventory of wetland and riparian areas is included in Appendix E.

The 1993 OSP includes correspondence from the Colorado Division of Wildlife (DOW) regarding wildlife habitat within the watershed. The DOW described three different zones of vegetation with

varying wildlife value. The lower zone, from Lincoln Avenue to Cherry Creek, was described as relatively dry with sparse riparian vegetation and only marginal wildlife value. The potential for creation of wetlands was noted, as the floodplain is wide and open. The middle zone, from I-25 to Lincoln Avenue, was described as the most valuable reach for wildlife, with "a broad band of riparian vegetation including an abundance of willows and cottonwoods." The DOW commented on the desire to protect this reach in as natural a state as possible, not only for habitat benefit, but also for water quality through a meandering riparian ribbon. The upper zone, from Castle Pines to I-25, was seen as less valuable to wildlife than the middle zone, with less extensive riparian vegetation in the ponderosa pine forest. Wetland vegetation within Castle Pines seems to have increased substantially since this time. Overall, the value of maintaining a preserved open space corridor through the drainageway was emphasized for the benefit of wildlife habitat. This approach is in line with the local jurisdictions' policies of floodplain preservation and creation of open space corridors.

No federally threatened or endangered species have been identified within the project area; however, a project site-specific review should be conducted prior to implementing any recommended improvements. In addition, any work along the creek corridor should consider non-protected species in the area and avoid impacts during sensitive periods such as nesting/mating season.

SECTION 3 – HYDROLOGIC ANALYSIS

3.1 Overview

In watersheds where hydrologic models exist, master planning efforts generally utilize the existing models as a starting point for baseline hydrology, with revisions made as necessary to reflect changes in the watershed and to update the models to current software. For Happy Canyon Creek, hydrologic models from the 1993 OSP were provided by UDFCD. Electronic AutoCAD or GIS files were not available for the subwatershed delineation. While reviewing and attempting to recreate the boundaries based on the Hydrological Basin Map from the 1993 report, it became apparent that a number of changes would need to be made in order to reflect recent or upcoming development, position design points at desired locations such as detention ponds and road crossings, and to meet as closely as possible UDFCD's guidelines on subwatershed size, which include a target size of 90-100 acres with a maximum size of 130 acres. As a result, though the 1993 boundaries were used as a guide, a new subwatershed delineation was performed. These watersheds were evaluated using UDFCD's Colorado Urban Hydrograph Procedure (CUHP) 2005, version 1.3.3 (release date January 2010). Hydrographs generated in CUHP were then routed through the Environmental Protection Agency's (EPA) Storm Water Management Model (SWMM), version 5.0.021. Due to the numerous changes that would have been needed to reflect the updated delineation, the design team elected to create a new SWMM model as well rather than update the previous model. This facilitated numerous improvements to the model to make it more user-friendly with the current software, including a revised naming scheme for subwatersheds, conveyance elements, and design points; layout of the SWMM model elements in the graphical user interface (GUI) over a background image of the watershed; and updating SWMM node elevations to match the project mapping.

Draft baseline hydrology for Happy Canyon Creek was submitted to UDFCD for review in July 2012. Comments were received in August, and the final baseline hydrology was resubmitted and accepted in October 2012.

3.2 Design Rainfall

One-hour point rainfall depths for the 2-, 5-, 10-, 25-, 50-, and 100-year storm events were obtained from UDFCD rainfall maps for the project area and compared with the values used in the 1993 OSP. Current values are slightly lower than those used in 1993 for all but the 50-year storm, as shown in Table 3-1. Because the Happy Canyon Creek watershed is greater than 10 square miles, UDFCD criteria require use of a 3-hour storm with area adjustment. In order to calculate the 3-hour storm distribution, 6-hour point rainfall depths were also obtained from UDFCD rainfall maps and are included in Table 3-1. Design rainfall distributions for both the 2-hour and 3-hour storm were then calculated within CUHP based on the distributions identified in the Urban Storm Drainage Criteria Manual (USDCM), with the areal adjustment also incorporated into the 3-hour distribution.

Table 3-1
Point Rainfall Depths

Storm Event	Rainfall Depth (in)		
	One-Hour (1993 OSP)	One-Hour	Six-Hour
2-year	1.06	0.95	1.42
5-year	1.43	1.40	1.97
10-year	1.66	1.63	2.26
25-year	N/A	1.98	2.80
50-year	2.26	2.28	3.06
100-year	2.60	2.58	3.42

Table 3-2
Area Adjustment Factors

	10-20 Square Mile Area Adjustment Factor	
Time (min)	2-, 5-, and 10-Year Design Rainfall	25-, 50-, and 100-Year Design Rainfall
5	1.00	1.00
10	1.00	1.00
15	1.00	1.00
20	0.90	1.00
25	0.90	0.90
30	0.90	0.90
35	1.00	0.90
40	1.00	1.00
45	1.00	1.00
50	1.00	1.00
55	1.00	1.00
60	1.00	1.00
65-120	1.00	1.00
125-180	1.00	1.00

Area adjustment factors for the 3-hour design storm are shown in Table 3-2; rainfall distributions for both design storm durations and all return periods are listed in Table B-1, Appendix B.

3.3 Subwatershed Characteristics

Subwatershed characteristics were defined according to the revised delineation and current mapping and land use information. For each subwatershed, the flow path from the highest point in the basin was determined from the project mapping and used to define the length and distance to centroid. The length-weighted slope along the flow path was then calculated according to the method described in the USDCM. Existing and future imperviousness was determined based on the land use assumptions outlined in Section 2.2. Hydrologic soil group classifications were determined via the Natural Resources Conservation Service Web Soil Survey, and weighted values were calculated for initial and final infiltration rates as well as for the Horton's decay coefficient. Depression losses in pervious and impervious areas were set at 0.5 and 0.1, respectively, to match the values used in the 1993 OSP.

A total of 130 subwatersheds were defined. Areas ranged from 24 acres to 129 acres, with an average size of 86 acres.

3.4 Hydrograph Routing

A new SWMM model was created for routing of the hydrographs generated in CUHP. Channel geometry was approximated from the project mapping, utilizing 2' interval topography north of Lincoln Avenue and along the main stem south of Lincoln, and 5' interval topography in the remainder of the watershed. Where only 5' topography was available, channel geometry used in the 1993 OSP was referenced as well. Pipe elements were defined along tributary channels in locations where review of design plans indicated that the channel is or will be piped for long distances. An overflow channel was added for the Grandview Tributary from Lincoln Avenue to the confluence with Happy Canyon Creek; storm sewer was installed in this reach in 2010, but the capacity is less than the 100-year event until a planned detention pond upstream of Lincoln Avenue is constructed. All other piped reaches were assumed to carry the 100-year event; pipe diameters were set large enough to not constrict flow in the SWMM model. SWMM determines channel slopes based on the segment length and elevations of upstream and downstream nodes; node elevations were defined based on the project mapping. Manning's n values were calculated according to the procedures outlined in the USDCM. Design points were placed at the downstream end of each subwatershed, with additional points included to reflect flow rates before and after the confluence with each tributary channel.

Fourteen existing regional detention ponds have been identified as eligible for inclusion in the baseline hydrology. Five of these are located in the City of Castle Pines and are maintained by the Castle Pines North Metro District: CPNMD Ponds #9, #10, #11, #12, and #20. Ponds #9 and #10 are located on the Oak Hills Tributary, just upstream and downstream of Monarch Blvd, respectively. Both ponds are 10-Yr/100-Yr ponds with a reinforced concrete pipe (RCP) flared end section (FES) controlling the lower stage and a drop box controlling the upper stage. Design reports and as-built drawings were utilized to generate the storage and discharge curves.

CPNMD Pond #20 is located on the Monarch Tributary, which joins the Oak Hills Tributary near the city limit. Pond #20 was constructed as a water quality (WQ)/10-Year/100-Year pond; however, the water quality orifice has been removed. Record drawings and the Phase III Drainage Report were used to determine the storage and discharge curves; discharge is based on the current condition (no water quality orifice). Pond #20 is UDFCD maintenance eligible; the remaining nine facilities are not.

CPNMD Pond #11 is located on the main stem of Happy Canyon Creek, just upstream of Castle Pines Parkway. This pond was included in the 1993 OSP baseline hydrology, but has been retrofitted since that time to a 10-Year/100-Year pond, with three large diameter orifices providing the first stage control and a drop box with orifice plates on the three outlet pipes providing second stage control. The storage curve was defined based on the 2' interval project channel topography, and the discharge curve was generated with UDFCD's UD-Detention spreadsheet based on measurements and elevations from the project crossing survey.

CPNMD Pond #12 is located downstream of Pond #11 at the Castle Pines city limit. A weir upstream of the outlet seems to provide flow measurement capabilities; the outlet is a quintuple pipe single stage outlet. The storage curve was defined based on the 2' interval project channel topography, and the discharge curve was generated with UD-Detention based on measurements and elevations from the project crossing survey.

The Meridian Metropolitan District owns and maintains six ponds located in various filings of the Meridian International Business Center. Meridian Village Pond 1 is located just south of Lincoln Avenue adjacent to the confluence of Happy Canyon Creek and Badger Gulch. This offline facility has three cells that are designed to function as a single pond; the storage curve was taken from the Phase III Drainage Report and the discharge curve was generated with UD-Detention based on the construction drawings.

Stepping Stone Ponds D1 and D3 are located on the Grandview Tributary in Meridian Filing No. 7 to the south of RidgeGate Parkway/Main Street. These ponds are under construction at the time of this report. Storage curves are from the Phase III Drainage Report, and discharge curves were generated with UD-Detention based on the construction drawings.

Meridian Ponds 4A, 4B, and 4C are located on the Green Acres Tributary in Meridian Filings 4/5, adjacent to Peoria Street. An interim version of Pond 4A is currently in place, but plans have been approved for the expansion and addition of two additional ponds in series. They are included in the baseline hydrology because construction is expected to occur during the timeframe of this master

plan. Storage and discharge curves are based on information provided in the Phase III Master Drainage Report.

Another facility on the Green Acres Tributary is the E-470 Pond, located immediately upstream of its namesake. It is unclear if this facility was intentionally designed as a pond or if it merely provides inadvertent storage; the pond is controlled by a 12'x10' concrete box culvert with no formal outlet structure, and provides little peak flow attenuation. However, because the pond was included in the 1993 OSP baseline hydrology, it has been included in the baseline hydrology for this MDP.

Finally, the Stonegate Tributary has two online regional detention ponds: the Stonegate Pond and the Chambers Reservoir WQ Pond. The Stonegate Pond is located at the southwest corner of Lincoln Avenue and Chambers Road. It was initially constructed as a WQ/10-Year/100-Year pond to provide treatment for Chambers Road, but is being expanded and converted to full spectrum detention for the upstream portion of the Sierra Ridge planned development. The baseline hydrology reflects the expanded FSD version of the pond, which is under construction at the time of this report. The storage curve was taken from the Phase III Drainage Report, and the discharge curve was generated with UD-Detention based on the construction drawings.

The Chambers WQ Pond is a full spectrum detention pond recently constructed just upstream of the in-progress Chambers Reservoir. Storage and discharge curves were taken from the Phase III Drainage Report for the Chambers Dam & Reservoir.

Stage-area and stage-discharge curves for all detention ponds are included in Table B-3, Appendix B.

For each return period and each development condition, the SWMM model was run with both a 2-hour and a 3-hour design storm applied uniformly over the entire watershed. Results from the 2-hour run were used for all design points in all tributary basins and for all main stem design points upstream of Badger Gulch. Results from the 3-hour model run were used for all main stem design points downstream of Badger Gulch, where the accumulated drainage area exceeds 10 square miles.

3.5 Previous Studies

Happy Canyon Creek was previously analyzed in the 1977 FHAD and the 1993 OSP. The FHAD included a portion of Badger Gulch and established the regulatory FEMA flow rates. Hydrographs were based on a 24-hour design storm with a Type IIA SCS rainfall distribution; peak discharges were calculated with the Soil Conservation Service's computer programs WSP2 and TR20. According to the 1993 OSP, the FHAD study assumed fairly uniform land use throughout the watershed, with a future development weighted average of 20% impervious. The study extended upstream to I-25.

The 1993 OSP utilized 2-hour and 3-hour design storms. Hydrographs were generated with the PC version of CUHP and routed through UDSWM2-PC. The future development imperviousness was 28%. The two design storms were applied differently in the OSP than in this study: the 3-hour storm results were used for all main stem design points, including those above Badger Gulch.

Table 3-4 includes peak flow rates from both studies. Regulatory flow rates in Douglas County mirror the FHAD. The Arapahoe County FIS lists a single flow rate of 3690 cfs for the 100-year event on Happy Canyon Creek. The source of this flow rate is unknown: it does not match any known studies, and documentation within the FIS is unclear. Examination of the FEMA effective mapped floodplain within Arapahoe County at the confluence of Cherry Creek with Happy Canyon Creek indicates that it is based on the 1993 OSP future development condition, which has a 100-year peak of 7303 cfs.

3.6 Model Calibration

Standard practice for master planning studies on previously studied watersheds includes calibration of the hydrologic model to reconcile the results within 10% of the previously published data. This practice ensures that changes in baseline hydrology are due to changes within the watershed or updates to criteria rather than differences in software. Calibration is generally done through adjustment of Cp and/or Ct values in CUHP, which impact the peak flow rates and the time to peak, respectively. This study targeted the 1993 OSP existing condition peak flow rates for reconciliation. A calibration model was prepared that mimicked the 1993 existing conditions impervious values and utilized the same 100-year 2-hour and 3-hour rainfall distributions as the 1993 OSP. Initial results were significantly higher, with a downstream 100-year peak of 7500 cfs vs. 5279 in the 1993 OSP. The models compared favorably upstream of the Oak Hills Tributary. Because this study utilized newly created models rather than modifications of the previous models, the 1993 CUHP and SWMM data was converted to the current software utilizing UDFCD's CUHP SWMM Converter. This converted model indicated a downstream peak flow rate of 6200 cfs, indicating that the difference is partially attributed to software differences and partially attributed to the model construction, which may include differences in watershed discretization, definition of subwatershed parameters, or definition of SWMM element parameters. An overall review of subwatershed and SWMM element parameters was conducted to verify that no large-scale, persistent differences existed between the 1993 and current models; the two seemed comparable.

As another point of reference, results were compared with the unit peak flow rates for Cottonwood Creek as published in a 2010 OSP. The Cottonwood Creek watershed abuts the Happy Canyon Creek watershed to the north and has similar characteristics to the Happy Canyon Creek watershed. To avoid differences based on development conditions and detention in the watershed, the historic conditions Cottonwood Creek model was used for comparison; this model reflects 2% impervious throughout the watershed and no detention facilities. (Weighted average imperviousness for the 1993 existing conditions model is 5.4%). Cottonwood Creek's watershed area is approximately 8 square miles, so the peaks are based on a 2-hour design storm with no areal adjustment. Unit peak flows for Cottonwood Creek were determined based on accumulated drainage area, then applied to

the drainage area at various design points on Happy Canyon Creek and plotted against 2-hour design storm results for the calibration model. This comparison indicated a difference of 10-15% between the Oak Hills Tributary and Badger Gulch, with good correlation upstream of the Oak Hills Tributary.

At the direction of UDFCD, Cp values were adjusted in CUHP for all subwatersheds except those contributing to the design point immediately upstream of the Oak Hills Tributary confluence. Several trials indicated that an adjustment factor of 0.65 (multiplied with the normal calculated Cp values) provided good correlation between the 2-hour design storm calibration model and the Cottonwood Creek historic conditions model. This factor was then applied to the 3-hour design storm and the results compared with the 1993 OSP published values. The calibrated model peak flow rates range from 25% lower than the 1993 OSP at the upstream end of the watershed to 22% higher at the downstream end of the watershed. Results of the calibration effort are indicated in Table 3-3; a peak flow diagram of the various models utilized is included at the end of Appendix B.

Table 3-3
Model Calibration

				A	B	C	D	E		F		G	
Station (ft)	**Location**	**Tributary Area (ac)**	**Cottonwood OSP unit peak for similar drainage area (cfs/ac)**	**1993 Published Values (cfs)**	**1993 Model, Current Software (cfs)**	**Unadjusted Calibration Model (3-Hour) (cfs)**	**Unadjusted Calibration Model (2-Hour) (cfs)**	**Cottonwood OSP equivalent peaks (cfs)**	**Delta (D-E)/E (%)**	**Calibrated Model (2-Hour) (cfs)**	**Delta (F-E)/E (%)**	**Calibrated Model (3-Hour) (cfs)**	**Delta (G-A)/A (%)**
0	Cherry Creek			5279	6200	7501	9650			8589		6750	28%
2600	Green Acres Tributary (D/S)			5357	6262	7514	9666			8590		6752	26%
2600	Green Acres Tributary (U/S)			4940	5710	6903	8875			7866		6182	25%
10500	Stonegate Tributary (D/S)			4961	5735	7005	9011			7979		6269	26%
10500	Stonegate Tributary (U/S)			4961	5735	6896	8865			7848		6167	24%
16200	Grandview Tributary (D/S)			4939	5626	6847	8804			7774		6109	24%
16200	Grandview Tributary (U/S)			4939	5626	6523	8374			7388		5812	18%
20100	Badger Gulch (D/S)			4705	5355	6467	8302			7319		5756	22%
20100	Badger Gulch (U/S)			3831	4350	5057	6494			5813		4565	19%
22600				3831	4350	5055	6491			5811		4562	19%
32000	RidgeGate Parkway	5233	1.08	3873	4241	4831	6191	5652	10%	5519	-2%	4337	12%
43600	I-25	4209	1.15	3922	3947	4324	5511	4840	14%	4889	1%	3854	-2%
46100	Oak Hills Tributary (D/S)	3965	1.15	3733	3784	4155	5289	4560	16%	4699	3%	3706	-1%
46100	Oak Hills Tributary (U/S)	2014	1.37	2318	2352	2085	2699	2759	-2%	2699	-2%	2085	-10%
54500	Oak Hills Drive			1780	1694	1765	2279			2279		1765	-1%
54500				1185	1059	1238	1616			1616		1238	4%
61000	Castle Pines Parkway			835	723	762	968			968		762	-9%
62500	Pond 353 Outflow			385	327	344	414			414		344	-11%
62500	Pond 353 Inflow			688	470	548	766			766		548	-20%

Note: all peak flow rates shown are based on a 100-year storm and 1993 existing development conditions.

3.7 Results of Analysis

Once the calibration effort was completed, the model was updated to reflect current existing and future development conditions, current rainfall point values and distributions, and to incorporate existing regional detention facilities described in Section 3.4. Happy Canyon Creek was then analyzed for the 2-, 5-, 10-, 25-, 50-, and 100-year storm events under existing and future development conditions, and with both 3-hour and 2-hour design storms. Peak flow rates at each design point are listed in Table B-4. Runoff volumes and accumulated drainage areas at key locations are listed in Tables B-5 and B-6. Hydrographs at key locations for the 2-year and 100-year events are shown in Figures B-6 and B-7. Peak flow profiles for all storm events on the main stem of Happy Canyon Creek are shown in Figures B-8 and B-9. All tables and figures reflect 3-hour storm results downstream of Lincoln Avenue (confluence with Badger Gulch) and 2-hour storm results for the remainder of the watershed.

Table 3-4 summarizes the results in comparison to the previous studies. The current study indicates peak flow rates averaging 25% higher than the 1993 OSP. Upstream of Lincoln Avenue, this is primarily due to the use of a 2-hour design storm versus the 3-hour design storm used in the 1993 OSP. Downstream of Lincoln Avenue, both studies use a 3-hour design storm; higher peak flow rates are due in part to the increases seen in the calibration effort, described above, and in part to the increased development projections (future imperviousness of 28% in the 1993 OSP versus 36% in the current study.)

In comparison with the 1977 FHAD, the current study predicts nearly 40% greater peak flow rates. These differences are attributed primarily to the different design rainfalls used (SCS 24-hour rainfall distribution in the FHAD versus 2-hour and 3-hour storms per current USDCM guidelines) and to the increased development projections (20% future imperviousness in the FHAD versus 36% in the current study).

Table 3-4
Comparison to Previous Studies

Location	FHAD Cross Section	OSP Design Point	Current Design Point	1977 FHAD 100-Yr (cfs)	1993 OSP 2-Yr Existing (cfs)	1993 OSP 100-Yr Existing (cfs)	1993 OSP 2-Yr Future (cfs)	1993 OSP 100-Yr Future (cfs)	Current Study 2-Yr Existing (cfs)	Current Study 100-Yr Existing (cfs)	Current Study 2-Yr Future (cfs)	Current Study 100-Yr Future (cfs)	% Increase from 1993 OSP*	% Increase from 1977 FHAD*
Cherry Creek	60	228	HC999	6744	63	5279	741	7303	322	8161	836	9234	26%	37%
Jordan Road	56	217	HC036	6800	73	5357	741	7344	326	8166	828	9228	26%	36%
E-470	49	213	HC033	5700	89	4961	467	6523	309	7702	652	8474	30%	49%
Dogwood Ave / Grandview Trib	43	208	HC029	5650	97	4939	428	6390	313	7502	624	8245	29%	46%
Lincoln Avenue D/S of Badger Gulch	33A	207	HC026	5520	102	4705	346	6044	311	7079	572	7663	27%	39%
Lincoln Avenue U/S of Badger Gulch	33	190	HC025	4070	103	3831	231	4729	316	5897	465	6247	32%	53%
RidgeGate Parkway	11	186	HC021	4240	118	3873	224	4771	370	5555	452	5726	20%	35%
I-25	3	179	HC016	4390	139	3922	227	4739	407	4899	433	4920	4%	12%
Oak Hills Tributary		160	HC014		141	3733	222	4527	407	4700	430	4708	4%	
Oak Hills Drive		172	HC009		117	1780	119	2030	352	2598	372	2591	28%	
Castle Pines Parkway (1300' N)		165	HC004		85	835	85	910	251	1259	251	1259	38%	

*Comparisons are based on 100-Yr Future development conditions

3.8 Comparison of Existing and Future Development Conditions

It is FEMA policy that Floodplain Insurance Rate Maps (FIRMs) reflect watershed conditions at the time the study is conducted, not projected future conditions. However, it is UDFCD policy to prepare FHADs based on future development conditions in order to guide the limits of development along major drainageways. FEMA will accept hydrologic studies based on future development if the following criteria are met: 1) the future development peak flow rate exceeds the existing condition peak flow rate by no more than 30-percent, and 2) the water surface elevation (WSEL) generated by the future development peak flow rate exceeds the WSEL of the existing condition peak flow rate by no more than 0.5-feet. If these criteria are not met, the floodplain mapping set forth in the FHAD cannot be submitted for acceptance by FEMA, and a separate DFIRM analysis must be conducted based on the existing development conditions.

Comparison of the existing and future development peak flow rates for Happy Canyon Creek and Badger Gulch indicate that the future development peak flow rates never exceed the existing development peak flow rates by more than 30-percent. Estimated future development WSELs remain within 0.5-feet of existing development WSELs along most of the study length, with minor and sporadic exceedances at the downstream end of Happy Canyon Creek, between Chambers Road and the Cherry Creek Confluence. This information was presented to the project sponsors at the progress meeting in August 2012. The project sponsors determined that the results are within the guidelines, such that a separate DFIRM analysis is not required for regulatory purposes.

The comparison figure for the 30-percent and 0.5-foot criteria has been included in Appendix C. No separate hydraulic analysis was conducted using the existing conditions flowrates.

SECTION 4 – HYDRAULIC ANALYSIS

4.1 Overview

Hydraulic modeling and floodplain delineation was performed for 11.3 miles of the Happy Canyon Creek mainstem and 4.9 miles of Badger Gulch. The United States Army Corps of Engineers (USACE) maintains the Hydraulic Engineering Center (HEC) which publishes the 1-D hydraulic modeling software *River Analysis System (HEC-RAS).* The most recent version of the software, 4.1.0 dated January 2010, was used for the hydraulic analysis. Results of the HEC-RAS analysis have been published in tabular form as the Floodplain and Floodway Data Tables in Appendix D. Flood maps showing the 100- and 500-year floodplains based on the HEC-RAS output have been included in Appendix F. Flood profiles based on the same output have been included in Appendix G.

4.2 Evaluation of Existing Facilities

The Happy Canyon Creek and Badger Gulch channels are generally well-defined, resulting in few problems related to capacity. Areas with poorly defined or insufficient conveyance are generally confined to the mainstem channel downstream of Lincoln Ave. The area of Grandview Estates, in particular, was noted as having an undersized channel, resulting in many structures in the floodplain (see Section 4.3).

Channel capacity was determined by modeling the channel in HEC-RAS using 502 cross-sections at an average spacing of 180-feet. Pursuant to the UDFCD DFHAD Guidelines (July, 2012), the Happy Canyon Creek and Badger Gulch centerlines uniformly follow the low-flow path rather than the floodplain flow path. In most cases the two are coincident; however, in areas where the main path of major flood flows differs from the low-flow centerline, the reach lengths are conservatively estimated based on the longer low-flow path. With the exception of an area of particular sinuosity south of RidgeGate Parkway, distances between adjacent cross-sections do not exceed 500-feet, in accordance with the requirements of the DFHAD Guidelines (July, 2012). In the area noted, cross section spacing was increased to simplify the modeling at UDFCD's request. Left and right overbank reach lengths were determined initially with the aid of software, and have been adjusted as necessary, particularly in areas with sharp channel radii.

Bank stations have been set to model a narrow (typically 10 to 15-feet wide) main channel with vegetated overbanks in most locations, so that the channel typically conveys the 2-year flow or less before spilling into the overbanks. While an effort was made to keep the horizontal layout of the hydraulic cross-sections straight, some cross-sections were "bent" at one or more locations to remain generally perpendicular to the centerline alignment and the overall flood flow areas in highly meandering reaches. In some cases, the BFE lines are shown "bent" to reflect the prevailing direction of overbank flows.

Ineffective flow areas were added as indicated by the presence of structures or the surrounding topography of the channel. Contraction and expansion coefficients are typically 0.1 and 0.3, respectively, however, these values were increased to 0.3 and 0.5 adjacent to many hydraulic structures. Cross-sections surrounding the hydraulic structures were placed so as to model the expansion and contraction losses into the structure in accordance with the HEC-RAS Hydraulic Reference Manual (typically a 2:1 expansion and 1:1 contraction). Hydraulic structures were incorporated based on the ground survey information.

Portions of mainstem Happy Canyon Creek and Badger Gulch are sandy, ephemeral streams, with poor density and quality of stream-side vegetation. With the anticipation of a more consistent base flow and the associated increase in vegetation, Manning's 'n' values were generally selected on the high end of typical ranges. This will allow for minimal future maintenance requirements to sustain conveyance capacity while providing for a healthier stream corridor. In areas where capacity is limited, lower to mid-range 'n' values were selected in consideration of the additional maintenance that may be performed to maintain conveyance capacity.

Figure 4-1 shows an area where healthy existing vegetation was modeled with no adjustment to the roughness values. Figures 4-2 and 4-3 show the lower watershed where the roughness values were increased slightly to account for a more stable existing infrastructure. A summary of the selected 'n' values along with a description of each reach has been provided in Appendix C.

Figure 4-1 - Reach 2 – Douglas County South
Meandering with slight incision. Dense, healthy vegetation with some vertical banks.
Manning's 'n': 0.1 (overbank) / 0.05 (channel)

Figure 4-2 - Reach 4 – Lone Tree South
Overgrazed area with sparse short vegetation
Mid-Range Manning's 'n': 0.035 (overbank) / 0.03 (channel)
High-Range Manning's 'n': 0.045 (overbank) / 0.035 (channel)

Figure 4-3 - Reach 8 – Town of Parker
Sparse, bunchy vegetation with sandy, aggraded low-flow
Mid-Range Manning's 'n': 0.03 (overbank) / 0.03 (channel)
High-Range Manning's 'n': 0.04 (overbank) / 0.035 (channel)

Bridges and culvert crossings were modeled in HEC-RAS using the bridge routine. A total of fourteen major roadway crossings and three minor crossings were identified and surveyed within the study reach. Two of the major crossings are on Badger Gulch, and the remainder are at various locations along the mainstem. Of the seventeen identified crossings, sixteen were modeled using HEC-RAS bridge or culvert routines. The exception is the E-470 trail crossing, which is a low-flow crossing consisting of (2) 24" CMP culverts beneath a concrete trail. These culverts tend be largely blocked due to accumulated debris; the channel cross section at 10749 was set based on the concrete trail elevation, and no conveyance through the culverts was considered. Bridge and culvert modeling routines are based on ground survey points and measurements, and supplemented by measurements and observations during a field visit in October 2012. Major structure capacities are summarized in Table 4-1. Additional information regarding spill flow analysis at overtopping structures can be found in Section 4.3, below.

Floodplain delineation was accomplished with the aid of terrain modeling software. The hydraulic cross-sections were exported to a HEC-RAS GIS file (.sdf), with each of the cross-sections at the appropriate WSEL (either 100-year or 500-year). The terrain modeling software was used to interpolate water surface elevations between the hydraulic sections, and this information was then translated into a floodplain boundary. The delineation was reviewed and adjusted by hand where necessary.

The floodway locations were discussed with the project sponsors prior to the preliminary submittal. Since the majority of Happy Canyon Creek is contained in a well-defined channel, floodways have generally been set coincident to the floodplain with no additional analysis performed. In certain areas of overbank flooding (particularly within the Grandview Estates development), separate floodways have been computed. In these areas, the floodway was delineated for a 0.5-foot rise for both hydraulic grade line and energy grade line.

Floodway analysis on Badger Gulch was conducted in one area: downstream of Bristleridge Drive in the vicinity of a detention pond adjacent to the channel. No separate floodway analysis was conducted for the Green Acres Tributary.

Table 4-1
Capacity of Major Structures

Location	Station	I.D.	Structure Description	Overtopping 10-Yr	50-Yr	100-Yr	500-Yr
HAPPY CANYON CREEK							
Jordan Rd.	2600	23	Single 100-ft Span Concrete Bridge			x[4]	x[4]
Chambers Rd.	7300	22	Single 100-ft Span Concrete Bridge				x[1]
E-470	10500	21	Single 132-ft Span Concrete Bridge				
Dogwood Ave.	15800	19	Triple 48" CMP	x[1]	x	x	x
Birch Ave.	18500	18	Double 34-ft Span Steel Bridge			x	x
Lincoln Ave.	20080	17	Triple 42-ft Span Concrete Bridge			x[2]	x[2]
W. Parker Rd.	21250	16	Double 57-ft Span Concrete Bridge		x	x	x
RidgeGate Pkwy.	32000	14	Single 135' Span Concrete Bridge				
Havana St.	43200	13	Single 111' Span Concrete Bridge				
I-25	43400	12	Single 62' Span Concrete Bridge				x[3]
Clydesdale Road	48100	11	Double 72" CMP	x[1]	x	x	x
Oak Hills Drive	54950	10	Double 8' x 6' CBC		x	x	x
BADGER GULCH							
Bristleridge Dr.	132400		Single 36' Conspan Arch				x
RidgeGate Pkwy.	138100		Triple 72-ft Span Concrete Bridge				

Notes:

1. Indicates minor overtopping with ponding on top of the structure.
2. Overtopping flows proceed east into the Meridian Detention Ponds before spilling onto Lincoln Ave.
3. Shallow flooding onto I-25 (unlikely IEFA due to traffic barrier). No overtopping of roadway crown.
4. Overtopping south of bridge caused by a side spill in the channel upstream; bridge capacity is adequate.

4.3 Flood Hazards

In areas where a portion of the channel or existing crossing structure was determined to possess insufficient capacity for any of the peak flow profiles, a special hydraulic analysis was performed to determine the approximate extent and peak volume of the overtopping. This analysis consisted of either a spill flow HEC-RAS model, open channel and weir flow calculations, or a visual approximation of the spill flow extent for minor spill areas. The results of the flood hazard investigation can be grouped broadly into categories: 1) overtopping, for localized overtopping of a bridge, culvert, or embankment, and 2) side spill, generally in areas with insufficient main channel capacities. The paragraphs below summarize each flood hazard area identified. The results of the special analyses used to predict the overtopping potential of each hazard area have been included in Appendix C.

Areas of Overtopping:

- Chambers Rd., Sta. 73+00: 500-year ponding approaches the roadway crown but does not overtop the road.

- Dogwood Ave., Sta. 159+00: The crossing is severely undersized, with capacity estimated at less than the 2-year event.

- Birch Ave., Sta. 185+00: The existing bridge is overtopped in flood events exceeding the 50-year return interval. The 100- and 500-year events overtop the bridge just to the west of the bridge rail. The 500-year also spills to the east along Birch Ave., and fills a sump just south of the road. The flow will also overtop 3rd St. and proceed northeast, reconnecting with the floodplain near Dogwood Ave. A normal depth model was created to determine the amount of overtopping east of the mainstem, using a headwater taken from the mainstem HEC-RAS model.

- Lincoln Avenue, Sta. 202+00: There is an existing pond spillway approximately 50-feet upstream of the Lincoln Avenue bridge. The existing bridge is a hydraulic constriction, causing significant backwater in the 100- and 500-year events. There is also a major detention facility east of the bridge crossing (part of the Meridian Village development), with an emergency spillway discharging into Happy Canyon Creek just south of the bridge opening. The 100- and 500- year WSELs in Happy Canyon exceed the elevation of the emergency spillway, and will cause a backwater into the pond at peak flows. Though the narrow width of the spillway weir may limit the ability for the WSELs to fully equalize, a major event on Happy Canyon could damage the embankment and therefore allow equalization to occur. In anticipation of this scenario, the channel overbank south-east of the Lincoln Avenue bridge has been modeled as effective conveyance, and an overtopping weir has been set between Lincoln Avenue and the existing pond. This overtopping weir follows the pond embankment east of Happy Canyon to the Meridian Village Parkway intersection. Overtopping flows in the 100- and 500- year events will spill through the pond and over the Lincoln Avenue embankment, before rejoining the Happy Canyon mainstem to the north. No existing structures were identified within the path of overtopping.

- West Parker Road, Sta. 212+50: The existing bridge is offset from the location of the existing low point in the roadway profile. In the 50-year peak flow and above, overtopping flows will cross the roadway north of the bridge crossing and spill back into the mainstem.

- North Clydesdale Road, Sta. 481+00: The crossing is severely undersized for the 10-year peak flowrate and above. The steep roadway fill slope is susceptible to erosion should overtopping occur.

- West Oak Hills Drive, Sta. 550+00: The crossing is undersized for the 50-year peak flow and above. Overtopping flows will spread into the open field to the east of the mainstem before spilling back into the mainstem farther north.

- Bristleridge Drive, Sta. 1324+00: The Conspan arch located under the crossing conveys the 100-year peak flows. The road overtops in the 500-year peak flow.

Areas of Channel Overflow or Side Spill:

- Left Overbank near Southcreek Residential Development, Station 15+00: Channel overflow occurs in the 500-year storm near the southwest end of the neighborhood. The overflow was determined by analyzing the ineffective flow area in the left overbank at Cross Section 1500 in HEC-RAS. Given this area and the velocity in the channel at this section, hand-calculations determined that an approximate flow of 57 cfs spills onto Joplin Court beginning at Station 17+00. The 500-year overflow was delineated based on topographic data from the GESC plans for "South Creek Filing No. 7", completed in May 2005 by Carroll & Lange, Inc. Shallow flooding is conveyed along Joplin Court until it spills northwest onto Broncos Parkway at Station 6+00.

- Right Overbank at the Joint Water Purification Plan (JWPP), Station 35+00: Recent channel improvements in this area post-date the 2008 LiDAR survey. Additional ground survey was obtained to model a new concrete trail, a small floodwall, and the Happy Canyon Creek channel cross-section. In addition, overlot grading of the parcel and paved access roads to the treatment plant were added to the model using design plans for "Dove Valley V, Filing No. 2" provided by SEMSWA. The Happy Canyon Creek thalweg based on the ground survey was found to be 1.0 to 1.5-feet lower than the LiDAR mapping had indicated. Channel overflow occurs in the 100- and 500-year storms. Overflow was computed using a lateral weir in HEC-RAS following the profile of high ground in Dove Valley design plans. The 100-year flow is relatively minor and does not appear to threaten the treatment plant structure. Shallow flooding will proceed east across Jordan Road. The 100-year flooding ponds at the bottom of the sag vertical curve in Jordan Road, while the 500-year shallow flooding proceeds east down Nichols Avenue

- Grandview Estates, Sta. 130+00: In the 100- and 500-year peak flows, 5th Street will overtop and shallow flooding will occur in a low area east of the mainstem. Shallow flooding was computed using normal depth calculations for the overflow channel based on the starting WSEL from HEC-RAS. The limits shown in the flood maps reflect these normal depths.

- Interstate 25, Sta. 435+00: The channel will overflow to the north just upstream of I-25 in the 500-year peak flow. Shallow flooding was computed using weir calculations based on the headwater in the channel at the overflow location. The overtopping flow is distributed to a series of three cross culverts north of the Happy Canyon bridge; it is then conveyed through the culverts under I-25 to rejoin the Happy Canyon floodplain.

Threatened Structures:

Structures showing a high probability of inundation during the 100- or 500-year peak floods have been identified on the flood maps with a red or purple hatch. Many of the threatened structures were not surveyed; therefore, the delineation is approximate based on the LiDAR or aerial topography available. A summary of structures threatened by a 100-year event is included as Table C-4 in Appendix C.

Flooding hazards from other sources not studied as part of this FHAD may threaten structures within the study area. In particular, the Grandview Tributary is mapped as Zone X (shaded) between Birch Avenue and Dogwood Avenue, just east of the mainstem. The flooding hazards from the Grandview Tributary, as well as other named and unnamed tributaries within the watershed, have not been identified in this FHAD.

4.4 Previous Analyses

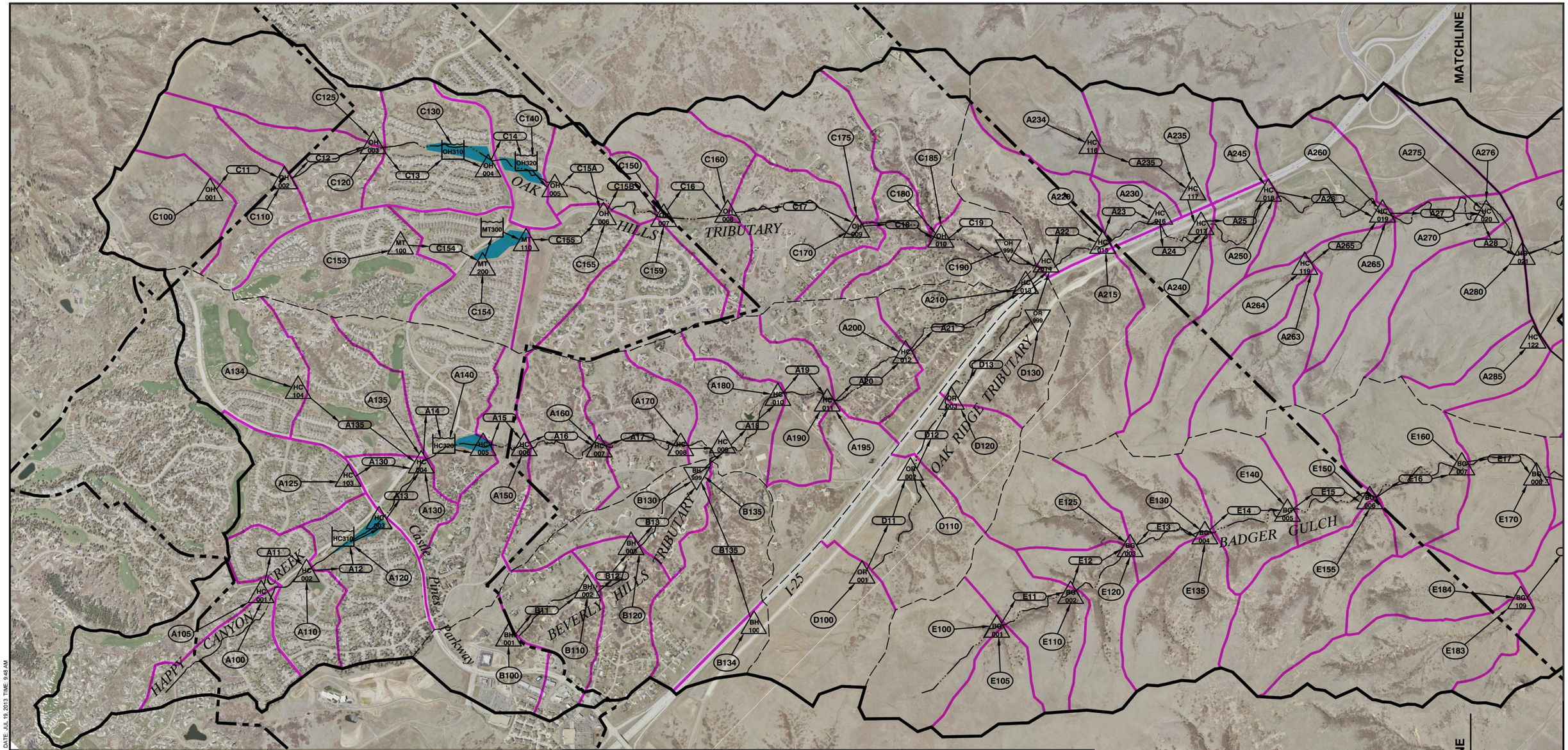
The WSEL obtained from the preliminary FHAD HEC-RAS model was compared to the following studies. See the accompanying documentation for copies of the comparison tables.

- FEMA regulatory WSEL at Sections A thru AB: The regulatory elevations were taken from the latest Douglas County FIS study, except for XS R through AB, which were modified by a LOMR in 2006 and were taken from a copy of that LOMR report (FEMA Case No. 06-08-B443P). The horizontal locations of the regulatory sections were determined from GIS data provided by Douglas County, and are shown on the floodplain maps in Appendix F. The FHAD study water surfaces are generally 1.0 to 1.5-feet over the FIS water surfaces due to the increase in peak flow rates in the current study. The largest differences in water surface occur at regulatory Sections K and X (FHAD Study XS 15746 and 21209). Both sections are located close to road crossings: Section K is directly downstream of the Dogwood Crossing, and Section X is similarly located downstream of the West Parker Road/First Street crossing. These increases in water surface elevation are likely attributable to an increase in peak flowrates between studies, as discussed in Section 3.

- 2011 RidgeGate Parkway Badger Gulch LOMR (11-08-0846P): The LOMR for the RidgeGate Parkway Crossing of Badger Gulch was performed in 2011 by FHU, Inc. Except for immediately downstream of the RidgeGate Parkway bridge, the FHAD water surface elevations are generally 0.5-feet to 1.5-feet lower than the corresponding LOMR water surfaces. The differences are attributable to the reduced peak flowrates modeled in the FHAD study. The LOMR used a peak Q_{100} = 1,870 cfs, while the FHAD study peak Q_{100} is between 1,531 cfs and 1,571 cfs within the LOMR project reach.

- 2011 RidgeGate Parkway Happy Canyon Creek Mainstem LOMR (11-08-0846P) : The LOMR for the RidgeGate Parkway Crossing of Happy Canyon Creek was performed in 2011 by FHU, Inc. A comparison with the FHAD shows the FHAD water surface elevations generally exceed the LOMR WSELs by several feet. The FHAD peak 100-year flowrates at the RidgeGate Crossing are more than 1,400 cfs higher than the LOMR flowrates; the increased flowrates account for much of the difference. The greatest difference in water surface occurs at the upstream face of the RidgeGate bridge. It should be noted that the FHAD model indicates the RidgeGate bridge will have still have ample (over 8-feet) freeboard in the 100-year event.

- 2006 Grandview Estates LOMR (06-08-B443P): The LOMR for channel improvements in the Grandview Estates reach was completed by ICON Engineering in 2006. A comparison with the FHAD shows the FHAD water surface elevations exceed the LOMR by between 0.5 and 3.0-feet. These differences are primarily attributable to the increase in peak flowrates (approximately 50% higher than the FIS).



Map Controls (Select from Below):

- Study Area Map
- Soil Survey Map
- Existing Land Use Map
- Future Land Use Map
- Subwatersheds Boundaries Map
- Baseline Hydrology SWMM Routing Map

The Map Controls set the visibility of the layers automatically for the selected map. Additional layer control is available through the "Layers" Navigation Panel which can be accessed from the View Menu under Navigation Panels. In the Panel, the visibility of layers and layer groups can be changed by clicking the square left of the layer/group. An eye in the square indicated that the layer is on. An empty square indicates that the layer is off. Layer groups can be expanded and reduced by clicking the +/- symbol left of the layer/group.

Map Legend

- Watershed Boundary
- Major Basin Boundary
- Sub-basin Boundary
- Jurisdiction Boundary
- Existing Regional Detention
- Reach Delimeter
- Subwatershed Label (BASIN ID / AREA (AC) / Ex % Imp / Fu % Imp)
- Design Point (BH 001)
- SWMM Subwatershed (B100)
- Conveyance Element (A12)
- Detention Facility (OH310)
- Outfall (BH 999)

Soil Type

A, B, C/D

Imperviousness (%)

2	50	20	80
5	60	25	85
10	70	30	95
15	75	40	100

No.	DATE	REVISIONS	APPR.

MULLER ENGINEERING CO., INC.
CONSULTING ENGINEERS
777 SOUTH WADSWORTH BLVD. 4-100
LAKEWOOD, COLORADO
80226 (303) 988-4939
PROJECT NO. 12-010.01

DESIGN MDC
DRAWN JHK
CHECK JTW

HAPPY CANYON CREEK
MAJOR DRAINAGEWAY PLAN

INTERACTIVE HYDROLOGY MAP
BASELINE HYDROLOGY SWMM ROUTING

DATE JULY 2013
FIGURE NO. B-1

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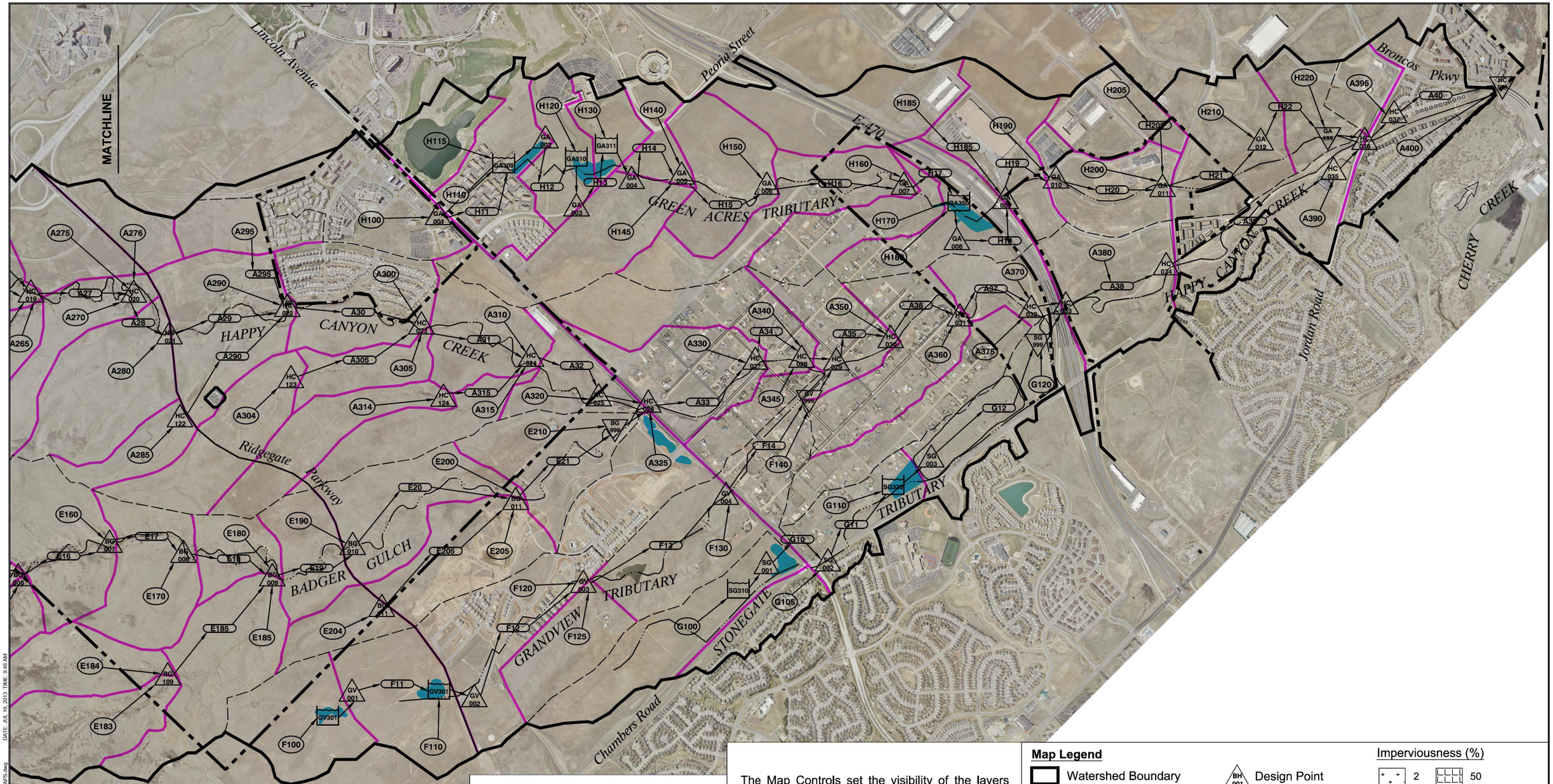

Map Controls (Select from Below):

- Study Area Map
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- Future Land Use Map
- Subwatershed Boundaries Map
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Map Legend

- Watershed Boundary
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- Subwatershed Label (BASIN ID / AREA (AC) / Ex % Imp / Fu % Imp)
- Design Point (BH 001)
- SWMM Subwatershed (B100)
- Conveyance Element (A12)
- Detention Facility (OH310)
- Outfall (BH 999)

Soil Type

A, B, C/D

Imperviousness (%)

2	50	40	100
5	60		
10	70		
15	75		
20	80		
25	85		
30	95		

No.	DATE	REVISIONS	APPR.

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LAKEWOOD, COLORADO
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PROJECT NO. 12-010.01

DESIGN MDC
DRAWN JHK
CHECK JTW

HAPPY CANYON CREEK
MAJOR DRAINAGEWAY PLAN

INTERACTIVE HYDROLOGY MAP
BASELINE HYDROLOGY SWMM ROUTING

DATE: JULY 2013
FIGURE NO. B-2

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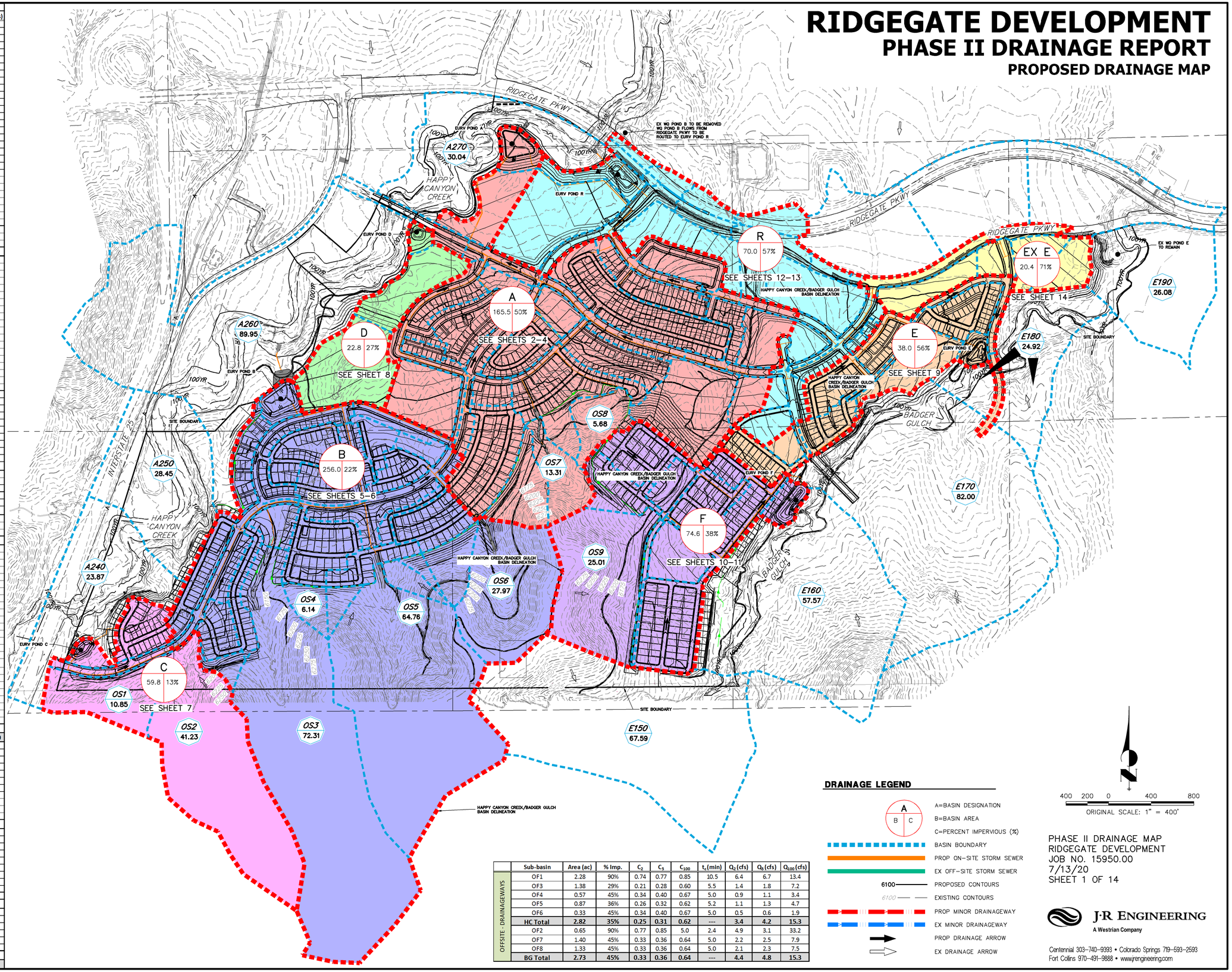
APPENDIX F

DRAINAGE MAP

RIDGEGATE DEVELOPMENT
PHASE II DRAINAGE REPORT
PROPOSED DRAINAGE MAP

BASIN SUMMARY TABLE

	Sub-basin	Area (ac)	% Imp.	C_5	C_{100}	t_c (min)	Q_5 (cfs)	Q_{100} (cfs)
EURV POND A	A0	3.10	68%	0.58	0.76	7.0	7.9	18.8
	A1	6.58	25%	0.20	0.55	27.6	3.1	15.6
	A2a	1.40	44%	0.39	0.66	8.1	2.3	7.1
	A2b	2.68	63%	0.55	0.74	8.8	6.0	14.7
	A3a	2.04	75%	0.65	0.79	7.9	5.6	12.4
	A3b	8.57	54%	0.48	0.71	17.3	12.5	33.3
	A3c	1.23	75%	0.65	0.79	7.7	3.4	7.5
	A4	6.96	78%	0.68	0.81	9.7	18.5	39.9
	A5	8.14	75%	0.65	0.79	7.6	22.6	50.1
	A6a	5.03	74%	0.64	0.79	14.9	10.5	23.5
	A6b	2.82	85%	0.73	0.83	5.0	10.0	20.7
	A6c	2.24	55%	0.49	0.71	13.8	3.7	9.7
	A6d	10.83	55%	0.49	0.71	15.4	16.9	44.8
	A7	5.38	55%	0.49	0.71	11.4	9.6	25.4
	A8	12.71	41%	0.37	0.65	11.9	17.0	54.4
	A9a	4.31	82%	0.71	0.82	9.3	12.1	25.5
	A9b	6.79	41%	0.37	0.65	13.8	8.4	27.1
	A10	14.64	56%	0.50	0.71	17.7	21.8	57.0
	A11a	2.14	90%	0.77	0.85	6.4	7.5	15.0
	A11b	5.46	66%	0.57	0.75	13.3	10.8	25.7
	A11c	5.76	55%	0.49	0.71	9.4	11.1	29.5
	A12a	0.63	90%	0.77	0.85	5.0	2.4	4.7
	A12b	1.16	90%	0.77	0.85	5.0	4.3	8.7
	A12c	2.83	55%	0.49	0.71	12.4	4.9	12.9
	A12d	4.77	54%	0.48	0.70	15.0	7.4	19.9
	A13a	0.86	90%	0.77	0.85	5.0	3.2	6.5
	A13b	0.85	90%	0.77	0.85	5.0	3.2	6.4
	A14	13.90	20%	0.20	0.56	15.8	8.7	45.2
	A15	2.74	67%	0.58	0.76	9.0	6.4	15.3
	OS7a	6.75	5%	0.08	0.50	14.0	1.7	20.7
	OS7b	6.56	5%	0.08	0.50	22.7	1.3	15.8
	OS8	5.68	6%	0.09	0.51	21.3	1.3	14.3
	Basin A Total	165.54	50%	0.44	0.69		155.5	464.5
EURV POND B	B0	264%	68%	0.59	0.76	6.1	7.2	16.8
	B1a	562%	57%	0.50	0.71	15.3	9.0	23.4
	B1b	7.61	58%	0.48	0.70	13.3	12.4	32.9
	B1c	2.71	84%	0.73	0.83	9.3	7.8	16.2
	B1d	2.85	56%	0.50	0.71	6.3	6.4	16.9
	B1e	6.28	55%	0.46	0.69	14.5	9.5	26.0
	B1f	1.76	75%	0.65	0.79	8.1	4.8	10.6
	B1g	3.31	55%	0.48	0.71	11.9	5.8	15.3
	B2	8.15	55%	0.48	0.71	8.8	16.0	42.7
	B3a	7.64	60%	0.51	0.72	14.7	12.9	32.9
	B3b	1.68	55%	0.48	0.70	13.7	2.7	7.3
	B4	4.08	52%	0.47	0.70	12.6	6.7	18.2
	B5a	5.60	48%	0.42	0.68	18.1	7.0	20.4
	B5b	5.20	72%	0.63	0.78	13.0	11.3	25.6
	B5c	3.83	54%	0.45	0.69	14.5	5.7	15.8
	B5d	3.76	55%	0.49	0.71	8.0	7.7	20.4
	B6a	3.65	55%	0.49	0.71	13.1	6.1	16.3
	B6b	2.38	55%	0.49	0.71	14.3	3.8	10.2
	B7	4.23	55%	0.49	0.71	6.7	9.2	24.4
EURV POND B	OS3	72.31	5%	0.07	0.50	52.4	8.5	104.5
	OS2b	1.81	5%	0.08	0.50	11.8	0.5	6.0
	OS4a	3.10	7%	0.05	0.46	20.8	0.4	7.2
	OS4b	3.04	5%	0.08	0.50	13.6	0.8	9.5
	OS5a	1.90	5%	0.08	0.50	13.8	0.5	5.9
	OS5b	59.27	5%	0.08	0.50	39.4	8.6	103.1
	OS5c	2.48	5%	0.08	0.50	16.6	0.6	7.0
	OS5d	1.11	5%	0.08	0.50	13.5	0.3	3.5
	OS6a	4.84	5%	0.08	0.50	13.3	1.3	15.2
	OS6b	23.13	5%	0.08	0.50	23.1	4.6	55.1
	Basin B Total	255.97	22%	0.21	0.57		78.8	374.3
EURV POND C	C0	1.74	46%	0.41	0.67	10.3	2.7	8.2
	C1a	2.43	82%	0.70	0.82	7.4	7.4	15.6
	C1b	5.39	46%	0.41	0.67	13.6	7.6	22.4
	OS1	10.85	5%	0.08	0.50	13.3	2.8	34.2
	OS2a	39.42	5%	0.08	0.50	40.6	5.6	67.4
	Basin C Total	59.83	13%	0.14	0.54		11.1	93.8
EURV POND D	D0	1.21	68%	0.59	0.76	5.0	3.5	8.1
	D1	8.23	25%	0.24	0.58	17.7	5.8	26.1
	D2	13.34	25%	0.21	0.56	23.3	7.3	35.3
	Basin D Total	22.78	27%	0.24	0.58		13.6	60.4
EURV POND R	R0	2.95	68%	0.57	0.75	5.9	7.8	18.7
	R1	4.45	77%	0.67	0.80	8.9	12.0	26.2
	RB1	0.87	68%	0.57	0.75	7.6	2.1	5.1
	RB2	0.63	81%	0.69	0.81	6.4	2.0	4.2
	RB3	0.28	59%	0.52	0.73	6.7	0.6	1.7
	RB4	1.00	51%	0.45	0.69	7.0	2.0	5.5
	RB5	1.96	44%	0.40	0.67	7.4	3.4	10.3
	RB6	1.34	53%	0.47	0.70	6.0	2.9	7.9
	RB8a	7.82	75%	0.65	0.79	5.0	24.7	54.6
	RB8b	2.62	10%	0.12	0.52	11.5	1.1	9.1
	RC1	2.33	30%	0.28	0.61	9.1	2.6	10.3
	RC2	3.27	31%	0.29	0.61	14.0	3.2	12.2
	RC3	1.10	53%	0.47	0.70	12.2	1.8	5.0
	RC4	0.28	61%	0.53	0.73	8.2	0.6	1.6
	RC7	9.32	85%	0.73	0.83	6.7	30.4	63.0
	RC6a	0.75	90%	0.77	0.85	5.1	2.8	5.6
	RC6b	2.29	75%	0.65	0.79	6.8	6.6	14.6
	RC6c	1.45	90%	0.77	0.85	6.5	5.0	10.1
	RC6d	0.66	75%	0.65	0.79	6.2	2.0	4.3
	RC6e	0.36	75%	0.65	0.79	6.2	1.1	2.4
	RC6f	3.47	61%	0.54	0.74	8.4	7.7	19.2
	R2a	1.87	71%	0.61	0.77	5.0	5.5	12.7
	R2b	1.18	75%	0.65	0.79	6.0	3.5	7.8
	R2c	3.13	75%	0.65	0.79	10.8	7.6	16.9
	R3	14.66	24%	0.22	0.57	20.9	8.7	41.7
	Basin R Total	70.04	57%	0.40	0.53		96.9	257.0
On-site HC Pond Total		**1148.32**	**34%**	**0.30**	**0.60**	**---**	**355.9**	**1250.0**
EURV POND E	E0	1.70	68%	0.56	0.75	5.8	4.5	10.7
	E1	6.91	26%	0.20	0.55	22.6	3.6	18.2
	E2a	2.80	90%	0.77	0.85	11.1	8.0	16.1
	E2b	6.80	55%	0.47	0.70	17.5	9.7	26.1
	E2c	1.36	90%	0.77	0.85	6.4	4.7	9.5
	E3	3.99	55%	0.48	0.70	8.7	7.7	20.8
	E4	4.77	55%	0.46	0.69	10.5	8.4	22.8
	E5	0.45	90%	0.77	0.85	5.0	1.7	3.4
	E6	3.68	57%	0.47	0.70	7.8	7.4	19.8
	E7	1.64	75%	0.63	0.78	5.0	5.0	11.3
	E8	3.84	55%	0.47	0.70	8.3	7.4	20.1
	Basin E Total	37.94	56%	0.47	0.70		46.8	126.5
EURV POND F	F0	2.53	85%	0.72	0.82	5.1	8.7	18.3
	F1	11.50	55%	0.46	0.69	14.7	17.4	47.5
	F2	7.82	55%	0.45	0.69	11.6	12.9	35.5
	F3	6.07	55%	0.49	0.71	8.9	11.9	31.7
	F4	3.02	32%	0.26	0.58	13.7	2.6	10.8
	F5	5.38	38%	0.32	0.62	7.8	7.2	25.5
	F6	6.69	54%	0.48	0.71	11.4	11.8	31.6
	F7	5.41	55%	0.45	0.68	7.0	10.7	29.5
	F8	1.20	90%	0.77	0.85	5.9	4.3	8.6
	OS9	25.01	5%	0.06	0.48	19.2	4.3	63.2
	Basin F Total	74.63	38%	0.32	0.62		57.9	208.5
EX WQ POND E	RE1	3.00	61%	0.53	0.73	18.2	4.7	11.8
	RE2a	5.16	75%	0.65	0.79	10.5	12.7	28.1
	RE2b	2.53	75%	0.65	0.79	5.6	7.7	17.1
	RE3	1.58	56%	0.48	0.71	11.7	2.8	7.4
	RE4	4.09	75%	0.64	0.79	9.4	10.4	23.1
	RE5	4.01	75%	0.63	0.78	9.6	9.9	22.4
	Ex. Basin E Total	20.37	71%	0.61	0.77		36.8	84.3
On-site BG Pond Total		**265.88**	**48%**	**0.41**	**0.67**	**---**	**141.5**	**419.2**



	Sub-basin	Area (ac)	% Imp.	C_2	C_3	C_{100}	t_c (min)	Q_2 (cfs)	Q_5 (cfs)	Q_{100} (cfs)
OFFSITE - DRAINAGEWAYS	OF1	2.28	90%	0.74	0.77	0.85	10.5	6.4	6.7	13.4
	OF3	1.38	29%	0.21	0.28	0.60	5.5	1.4	1.8	7.2
	OF4	0.57	45%	0.34	0.40	0.67	5.0	0.9	1.1	3.4
	OF5	0.87	36%	0.26	0.32	0.62	5.2	1.1	1.3	4.7
	OF6	0.33	45%	0.34	0.40	0.67	5.0	0.5	0.6	1.9
	HC Total	**2.82**	**35%**	**0.25**	**0.31**	**0.62**	**---**	**3.4**	**4.2**	**15.3**
	OF2	0.65	90%	0.77	0.85	5.0	2.4	4.9	3.1	33.2
	OF7	1.40	45%	0.33	0.36	0.64	5.0	2.2	2.5	7.9
	OF8	1.33	45%	0.33	0.36	0.64	5.0	2.1	2.3	7.5
	BG Total	**2.73**	**45%**	**0.33**	**0.36**	**0.64**	**---**	**4.4**	**4.8**	**15.3**

DRAINAGE LEGEND

- A=BASIN DESIGNATION
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- BASIN BOUNDARY
- PROP ON-SITE STORM SEWER
- EX OFF-SITE STORM SEWER
- 6100 PROPOSED CONTOURS
- 6100 EXISTING CONTOURS
- PROP MINOR DRAINAGEWAY
- EX MINOR DRAINAGEWAY
- PROP DRAINAGE ARROW
- EX DRAINAGE ARROW

N

400 200 0 400 800

ORIGINAL SCALE: 1" = 400'

PHASE II DRAINAGE MAP
RIDGEGATE DEVELOPMENT
JOB NO. 15950.00
7/13/20
SHEET 1 OF 14

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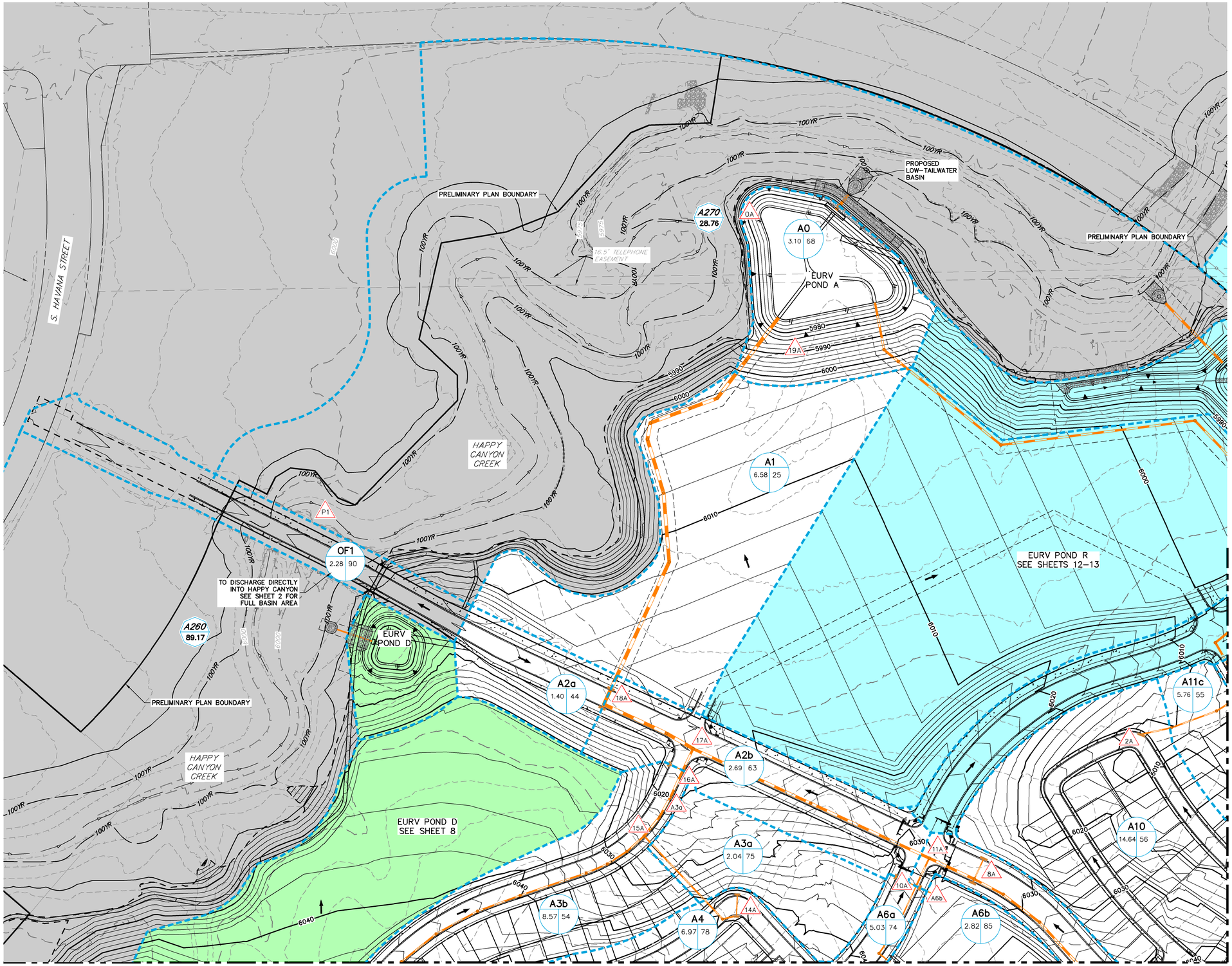
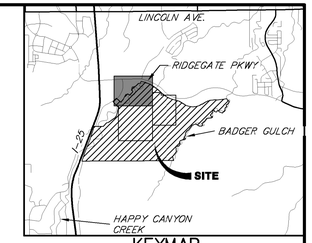
RIDEGATE DEVELOPMENT

PHASE II DRAINAGE REPORT - EURV POND A





KEYMAP

SCALE: 1"=5000'

DESIGN POINT TABLE

	Design Point	Q_5 (cfs)	Q_{100} (cfs)
Happy Canyon (HC)			
EURV POND A	1A	16.2	40.2
	2A	21.8	57.1
	3A	36.5	93.6
	4A	59.0	147.7
	5A	17.9	65.6
	6A	14.2	67.4
	7A	27.7	118.5
	8A	40.2	152.2
	9A	9.6	25.4
	10A	18.6	41.9
	11A	55.4	187.8
	12A	32.0	93.4
	13A	34.3	98.6
	14A	18.5	39.9
	15A	45.2	123.2
	16A	59.5	161.1
	17A	105.1	324.9
	18A	108.9	335.5
	19A	3.1	15.6
	A3a	5.6	12.4
	A6c	3.7	9.7
	A6d	17.6	61.5
	A11b	10.8	25.7
	A11c	11.1	29.5
	A12c	4.9	12.9
	A12d	7.4	19.9
	OS7a	1.7	20.7
	OS7b	1.3	15.8
	OS8	1.3	14.3
	0A	155.5	464.5
	Outfall	**66.9**	**413.3**

100 50 0 100 200

ORIGINAL SCALE: 1" = 100'

DRAINAGE LEGEND

- A=BASIN DESIGNATION
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- BASIN BOUNDARY
- PROP ON-SITE STORM SEWER
- EX OFF-SITE STORM SEWER
- 6100 PROPOSED CONTOURS
- 6100 EXISTING CONTOURS
- PROP MINOR DRAINAGEWAY
- EX MINOR DRAINAGEWAY
- PROP DRAINAGE ARROW
- EX DRAINAGE ARROW

PHASE II DRAINAGE MAP-EURV POND A
RIDGEGATE DEVELOPMENT
JOB NO. 15950.00
7/13/20
SHEET 2 OF 14

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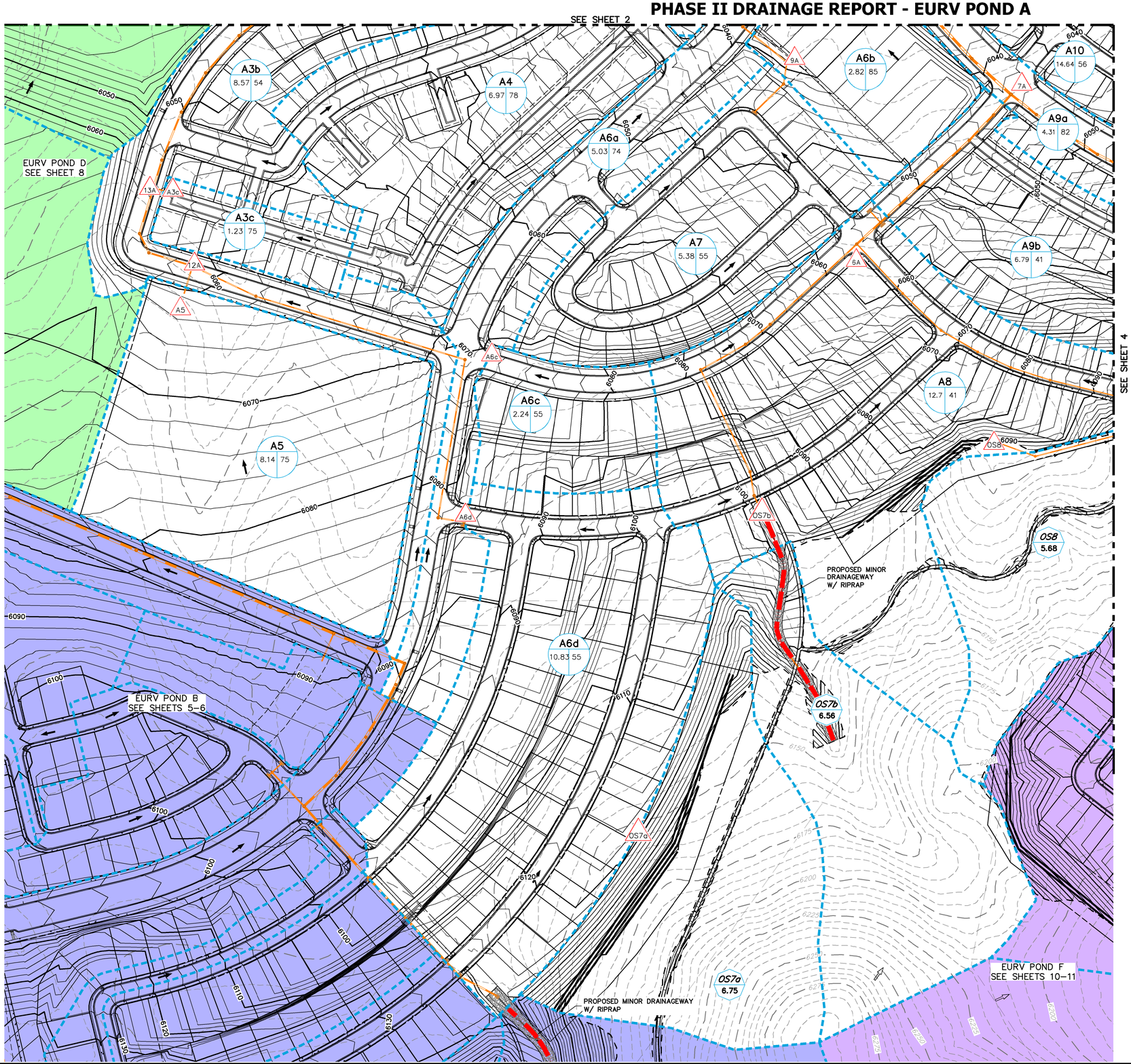
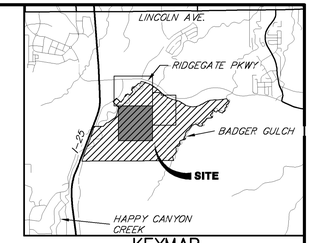
RIDEGATE DEVELOPMENT

PHASE II DRAINAGE REPORT - EURV POND A





KEYMAP
SCALE: 1"=5000'

DESIGN POINT TABLE

	Design Point	Q_5 (cfs)	Q_{100} (cfs)
Happy Canyon (HC)			
EURV POND A	1A	16.2	40.2
	2A	21.8	57.1
	3A	36.5	93.6
	4A	59.0	147.7
	5A	17.9	65.6
	6A	14.2	67.4
	7A	27.7	118.5
	8A	40.2	152.2
	9A	9.6	25.4
	10A	18.6	41.9
	11A	55.4	187.8
	12A	32.0	93.4
	13A	34.3	98.6
	14A	18.5	39.9
	15A	45.2	123.2
	16A	59.5	161.1
	17A	105.1	324.9
	18A	108.9	335.5
	19A	3.1	15.6
	A3a	5.6	12.4
	A6c	3.7	9.7
	A6d	17.6	61.5
	A11b	10.8	25.7
	A11c	11.1	29.5
	A12c	4.9	12.9
	A12d	7.4	19.9
	OS7a	1.7	20.7
	OS7b	1.3	15.8
	OS8	1.3	14.3
	0A	155.5	464.5
	Outfall	**66.9**	**413.3**

N

100 50 0 100 200
ORIGINAL SCALE: 1" = 100'

DRAINAGE LEGEND

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- EX OFF-SITE STORM SEWER
- 6100 PROPOSED CONTOURS
- 6100 EXISTING CONTOURS
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- EX MINOR DRAINAGEWAY
- PROP DRAINAGE ARROW
- EX DRAINAGE ARROW

PHASE II DRAINAGE MAP–EURV POND A
RIDGEGATE DEVELOPMENT
JOB NO. 15950.00
7/13/20
SHEET 3 OF 14

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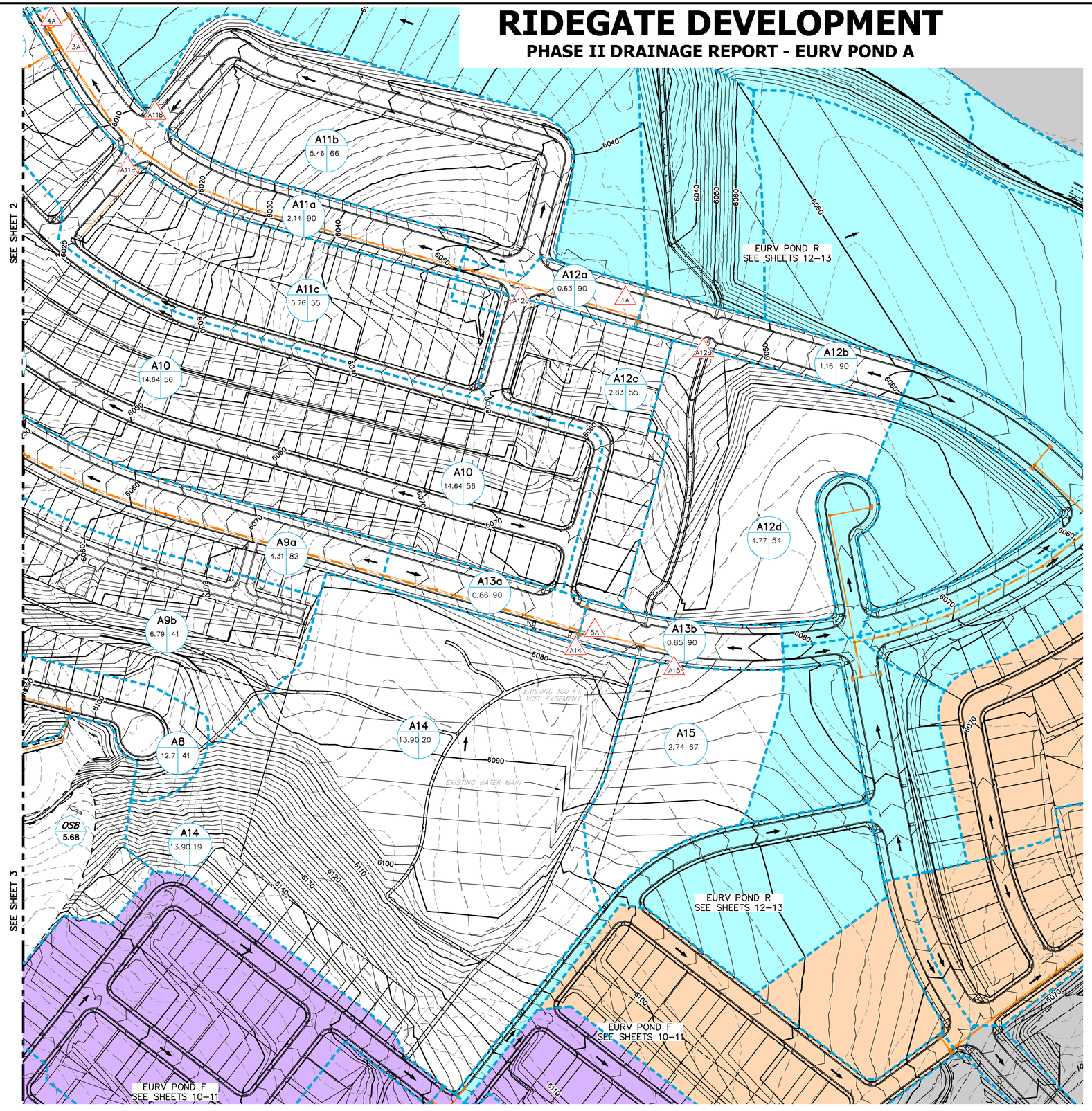
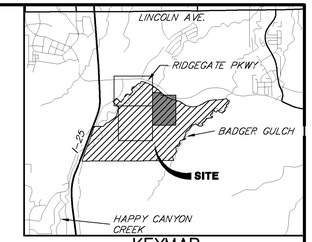
RIDEGATE DEVELOPMENT

PHASE II DRAINAGE REPORT - EURV POND A





KEYMAP
SCALE: 1"=5000'

DESIGN POINT TABLE

	Design Point	Q_5 (cfs)	Q_{100} (cfs)
Happy Canyon (HC)			
EURV POND A	1A	16.2	40.2
	2A	21.8	57.1
	3A	36.5	93.6
	4A	59.0	147.7
	5A	17.9	65.6
	6A	14.2	67.4
	7A	27.7	118.5
	8A	40.2	152.2
	9A	9.6	25.4
	10A	18.6	41.9
	11A	55.4	187.8
	12A	32.0	93.4
	13A	34.3	98.6
	14A	18.5	39.9
	15A	45.2	123.2
	16A	59.5	161.1
	17A	105.1	324.9
	18A	108.9	335.5
	19A	3.1	15.6
	A3a	5.6	12.4
	A6c	3.7	9.7
	A6d	17.6	61.5
	A11b	10.8	25.7
	A11c	11.1	29.5
	A12c	4.9	12.9
	A12d	7.4	19.9
	OS7a	1.7	20.7
	OS7b	1.3	15.8
	OS8	1.3	14.3
	0A	155.5	464.5
	Outfall	**66.9**	**413.3**

100 50 0 100 200
ORIGINAL SCALE: 1" = 100'

DRAINAGE LEGEND

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- EX OFF-SITE STORM SEWER
- 6100 PROPOSED CONTOURS
- 6100 EXISTING CONTOURS
- PROP MINOR DRAINAGEWAY
- EX MINOR DRAINAGEWAY
- PROP DRAINAGE ARROW
- EX DRAINAGE ARROW

PHASE II DRAINAGE MAP–EURV POND A
RIDGEGATE DEVELOPMENT
JOB NO. 15950.00
7/13/20
SHEET 4 OF 14

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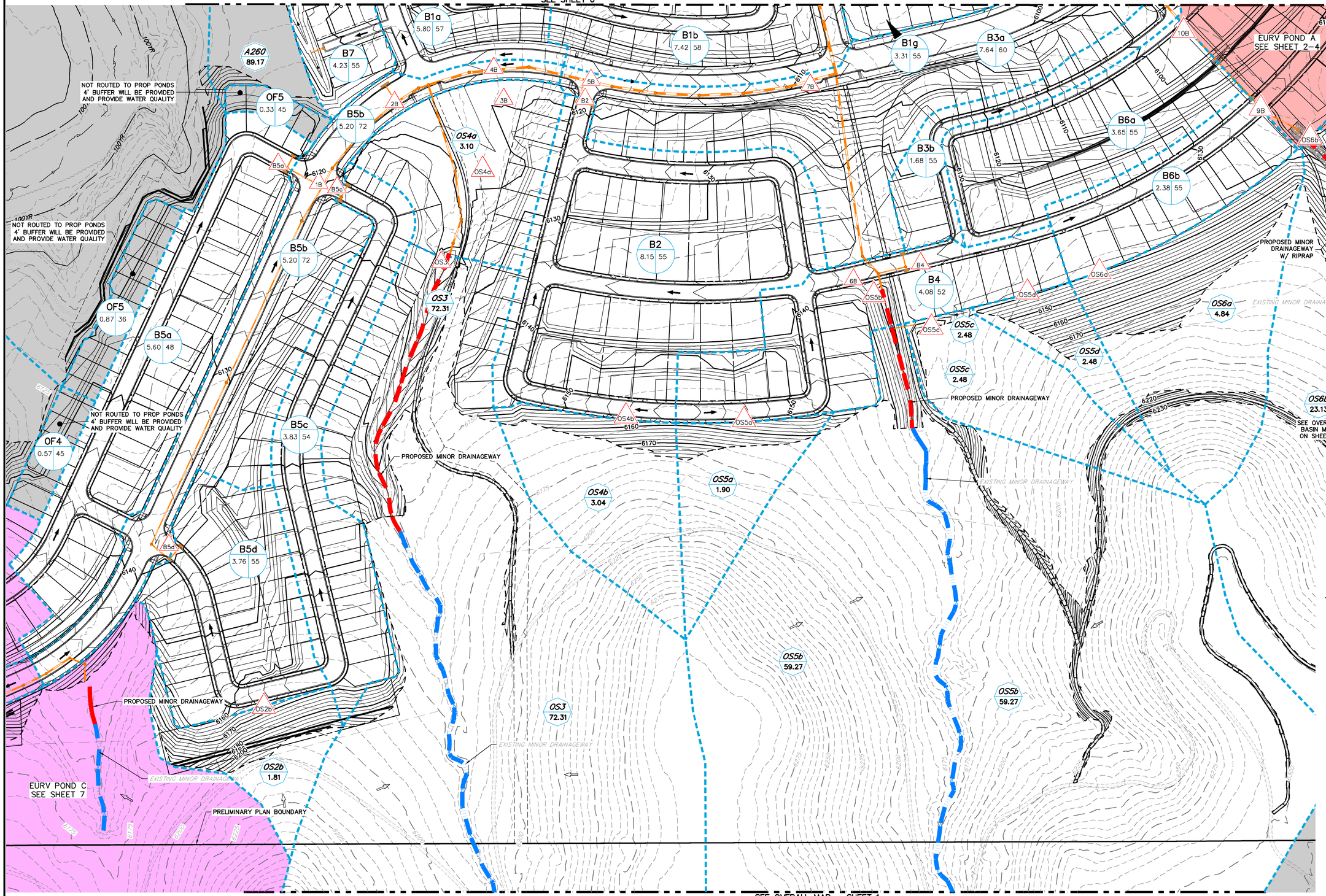
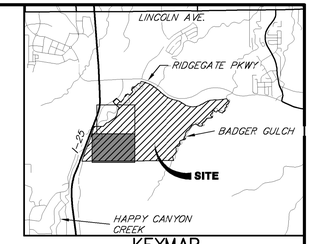
RIDGEGATE DEVELOPMENT

PHASE II DRAINAGE REPORT - EURV POND B





KEYMAP

SCALE: 1"=5000'

DESIGN POINT TABLE

	Design Point	Q_5 (cfs)	Q_{100} (cfs)
Happy Canyon (HC)			
EURV POND B	1B	18.0	53.9
	2B	27.3	75.0
	3B	8.6	107.5
	4B	23.1	123.9
	5B	28.8	142.7
	6B	12.9	122.4
	7B	38.3	238.1
	8B	49.1	267.6
	9B	8.5	74.2
	10B	12.9	86.0
	11B	2.7	7.3
	12B	28.6	127.2
	13B	31.0	132.5
	14B	40.9	156.0
	13B	31.0	132.5
	14B	40.9	156.0
	15B	74.1	363.3
	16B	9.2	24.4
	B1g	5.8	15.3
	B2	12.6	40.2
	B4	6.7	18.2
	B5a	7.0	20.4
	B5c	5.7	15.8
	B5d	7.7	20.4
	OS2b	0.5	6.0
	OS3	8.5	104.5
	OS4a	0.4	7.2
	OS4b	0.8	9.4
	OS5a	0.5	5.9
	OS5b	8.6	103.1
	OS5c	0.6	7.0
	OS5d	0.3	3.5
	OS6a	1.3	15.3
	OS6b	4.6	55.2
	0B	78.8	374.3
	Outfall	78.3	371.4

100 50 0 100 200

ORIGINAL SCALE: 1" = 100'

DRAINAGE LEGEND

- A=BASIN DESIGNATION
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- 6100 EXISTING CONTOURS
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- EX MINOR DRAINAGEWAY
- PROP DRAINAGE ARROW
- EX DRAINAGE ARROW

PHASE II DRAINAGE MAP-EURV POND B
RIDGEGATE DEVELOPMENT
JOB NO. 15950.00
7/13/20
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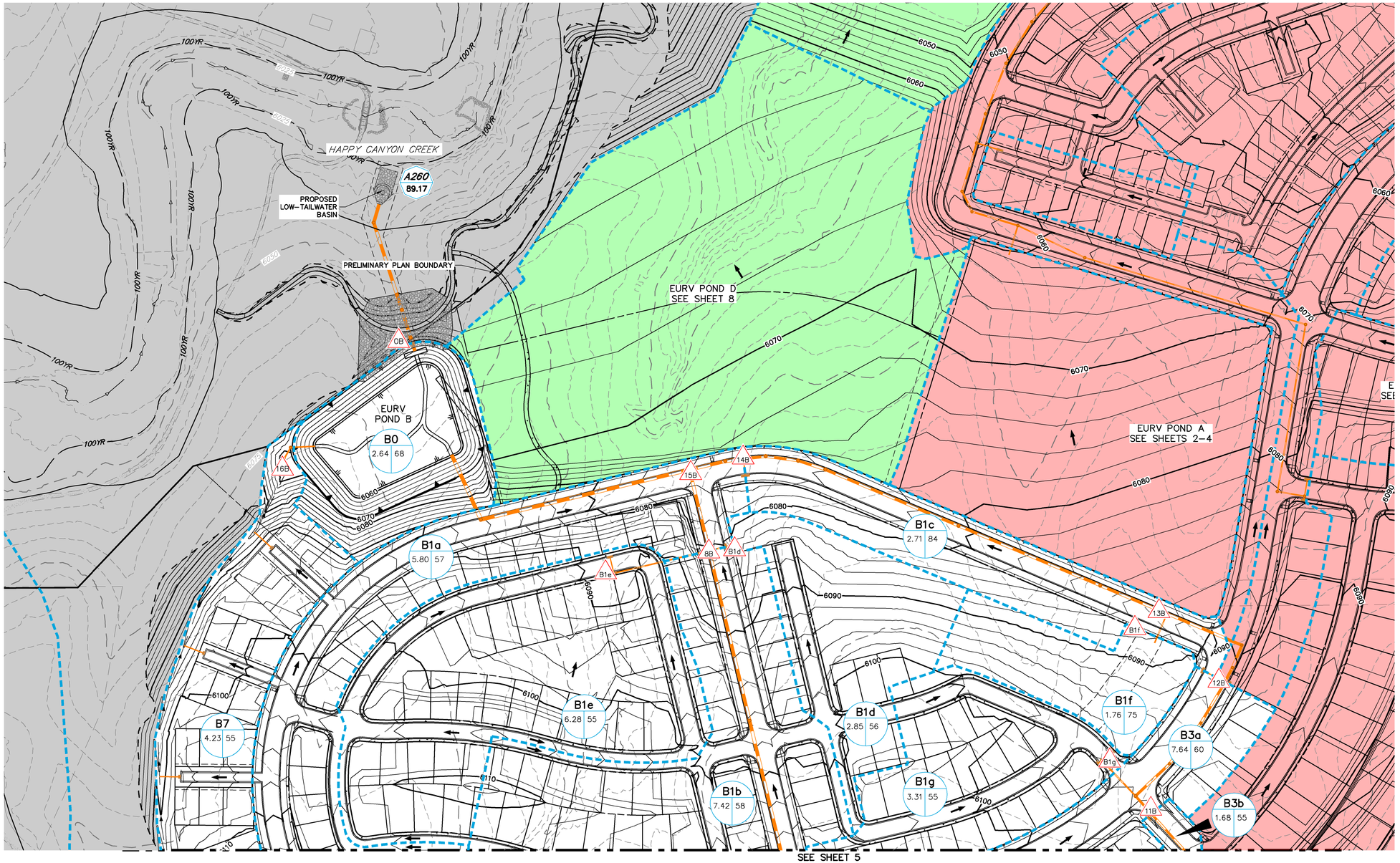
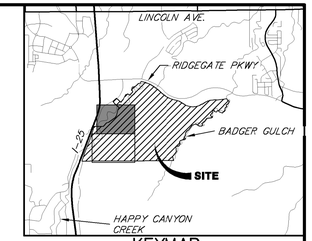
RIDEGATE DEVELOPMENT

PHASE II DRAINAGE REPORT - EURV POND B





KEYMAP
SCALE: 1"=5000'

DESIGN POINT TABLE

	Design Point	Q_5 (cfs)	Q_{100} (cfs)
Happy Canyon (HC)			
EURV POND B	1B	18.0	53.9
	2B	27.3	75.0
	3B	8.6	107.5
	4B	23.1	123.9
	5B	28.8	142.7
	6B	12.9	122.4
	7B	38.3	238.1
	8B	49.1	267.6
	9B	8.5	74.2
	10B	12.9	86.0
	11B	2.7	7.3
	12B	28.6	127.2
	13B	31.0	132.5
	14B	40.9	156.0
	13B	31.0	132.5
	14B	40.9	156.0
	15B	74.1	363.3
	16B	9.2	24.4
	B1g	5.8	15.3
	B2	12.6	40.2
	B4	6.7	18.2
	B5a	7.0	20.4
	B5c	5.7	15.8
	B5d	7.7	20.4
	OS2b	0.5	6.0
	OS3	8.5	104.5
	OS4a	0.4	7.2
	OS4b	0.8	9.4
	OS5a	0.5	5.9
	OS5b	8.6	103.1
	OS5c	0.6	7.0
	OS5d	0.3	3.5
	OS6a	1.3	15.3
	OS6b	4.6	55.2
	0B	78.8	374.3
	Outfall	**78.3**	**371.4**

N

100 50 0 100 200
ORIGINAL SCALE: 1" = 100'

DRAINAGE LEGEND

- A=BASIN DESIGNATION
- B=BASIN AREA
- C=PERCENT IMPERVIOUS (%)
- BASIN BOUNDARY
- PROP ON-SITE STORM SEWER
- EX OFF-SITE STORM SEWER
- 6100 PROPOSED CONTOURS
- 6100 EXISTING CONTOURS
- PROP MINOR DRAINAGEWAY
- EX MINOR DRAINAGEWAY
- PROP DRAINAGE ARROW
- EX DRAINAGE ARROW

PHASE II DRAINAGE MAP-EURV POND B
RIDGEGATE DEVELOPMENT
JOB NO. 15950.00
7/13/20
SHEET 6 OF 14

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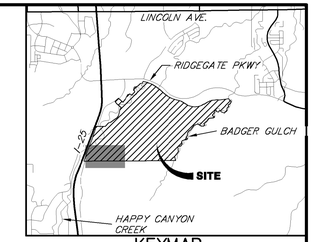
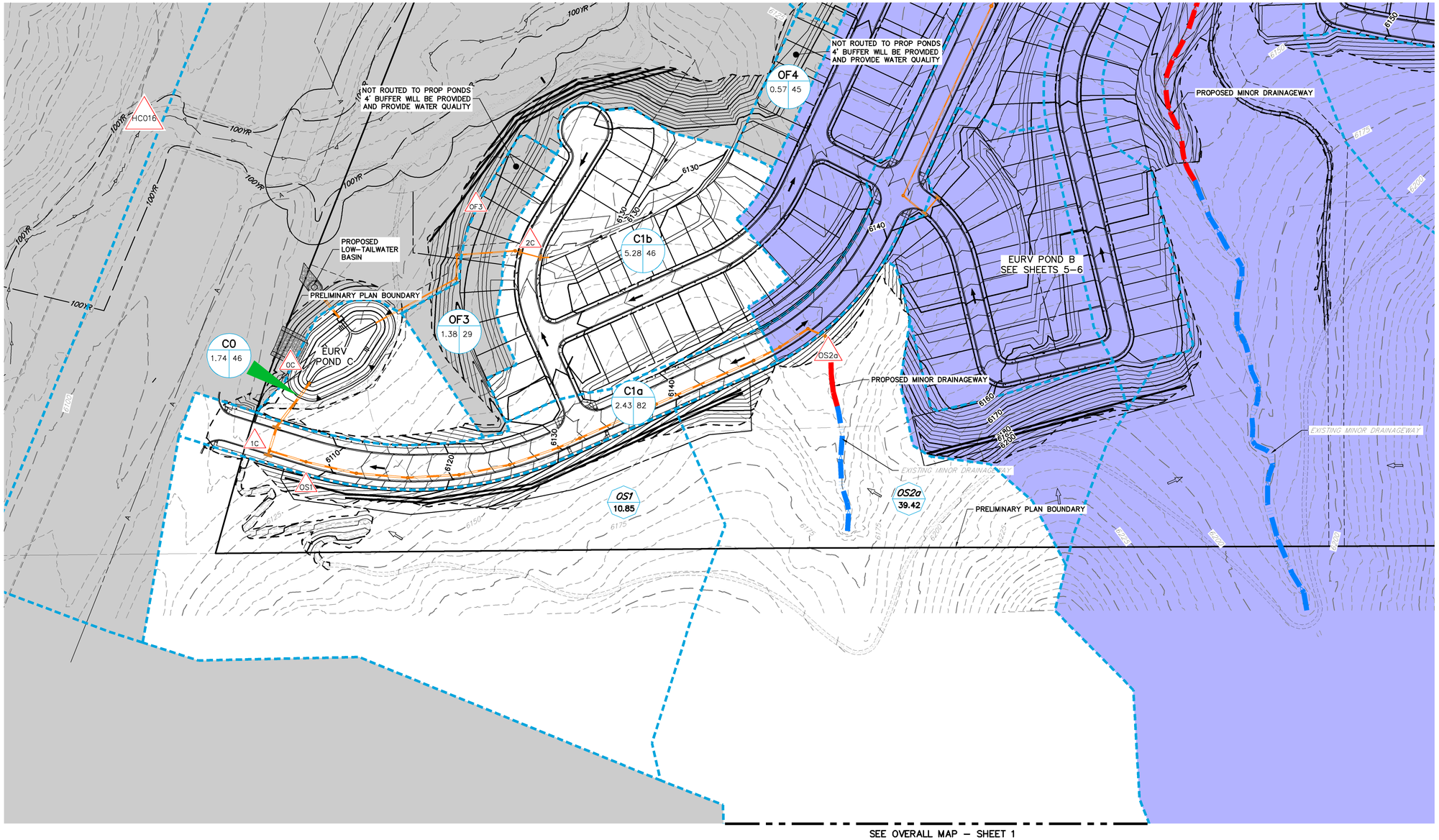
RIDEGATE DEVELOPMENT

PHASE II DRIANAGE REPORT - EURV POND C



KEYMAP
SCALE: 1"=5000'



SEE OVERALL MAP – SHEET 1

DESIGN POINT TABLE			
	Design Point	Q_5 (cfs)	Q_{100} (cfs)
Happy Canyon (HC)			
EURV POND C	1C	9.3	47.0
	2C	7.6	22.4
	OS1	2.8	34.2
	OS2a	5.3	63.8
	OC	10.5	88.6
	Outfall	**10.5**	**83.2**

N

100 50 0 100 200

ORIGINAL SCALE: 1" = 100'

DRAINAGE LEGEND

- A=BASIN DESIGNATION
- B=BASIN AREA
- C=PERCENT IMPERVIOUS (%)
- BASIN BOUNDARY
- PROP ON-SITE STORM SEWER
- EX OFF-SITE STORM SEWER
- 6100 PROPOSED CONTOURS
- 6100 EXISTING CONTOURS
- PROP MINOR DRAINAGEWAY
- EX MINOR DRAINAGEWAY
- PROP DRAINAGE ARROW
- EX DRAINAGE ARROW

PHASE II DRAINAGE MAP–EURV POND C
RIDGEGATE DEVELOPMENT
JOB NO. 15950.00
7/13/20
SHEET 7 OF 14

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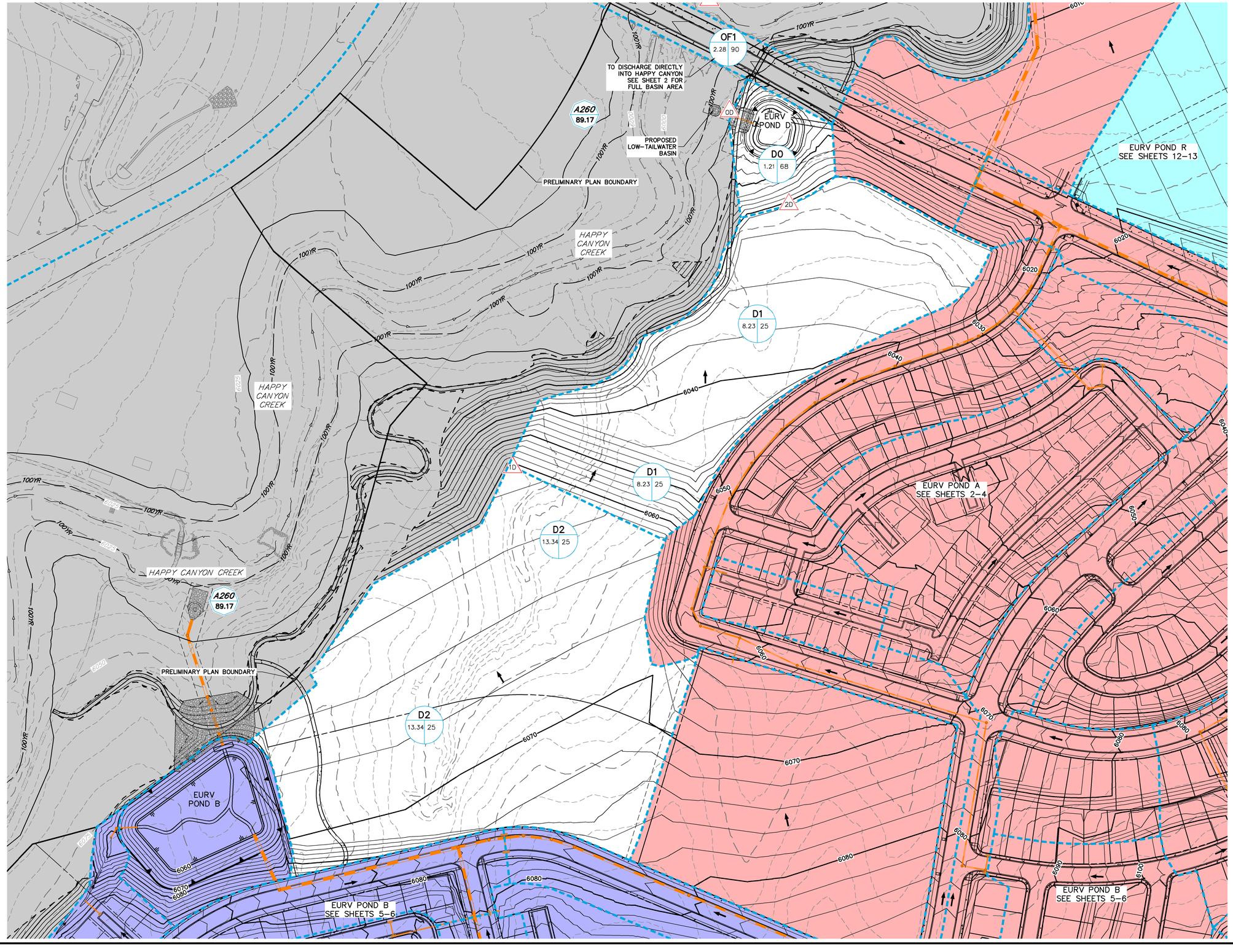
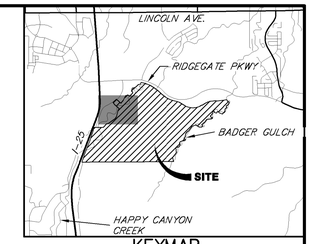
RIDEGATE DEVELOPMENT

PHASE II DRAINAGE REPORT - EURV POND D





KEYMAP

SCALE: 1"=5000'

DESIGN POINT TABLE			
	Design Point	Q_5 (cfs)	Q_{100} (cfs)
Happy Canyon (HC)			
EURV POND D	1D	7.3	35.3
	2D	5.8	26.1
	0D	13.7	60.7
	Outfall	**10.0**	**59.9**

100 50 0 100 200

ORIGINAL SCALE: 1" = 100'

DRAINAGE LEGEND

- A=BASIN DESIGNATION
- B=BASIN AREA
- C=PERCENT IMPERVIOUS (%)
- BASIN BOUNDARY
- PROP ON-SITE STORM SEWER
- EX OFF-SITE STORM SEWER
- 6100 PROPOSED CONTOURS
- 6100 EXISTING CONTOURS
- PROP MINOR DRAINAGEWAY
- EX MINOR DRAINAGEWAY
- PROP DRAINAGE ARROW
- EX DRAINAGE ARROW

PHASE II DRAINAGE MAP-EURV POND D
RIDGEGATE DEVELOPMENT
JOB NO. 15950.00
7/13/20
SHEET 8 OF 14

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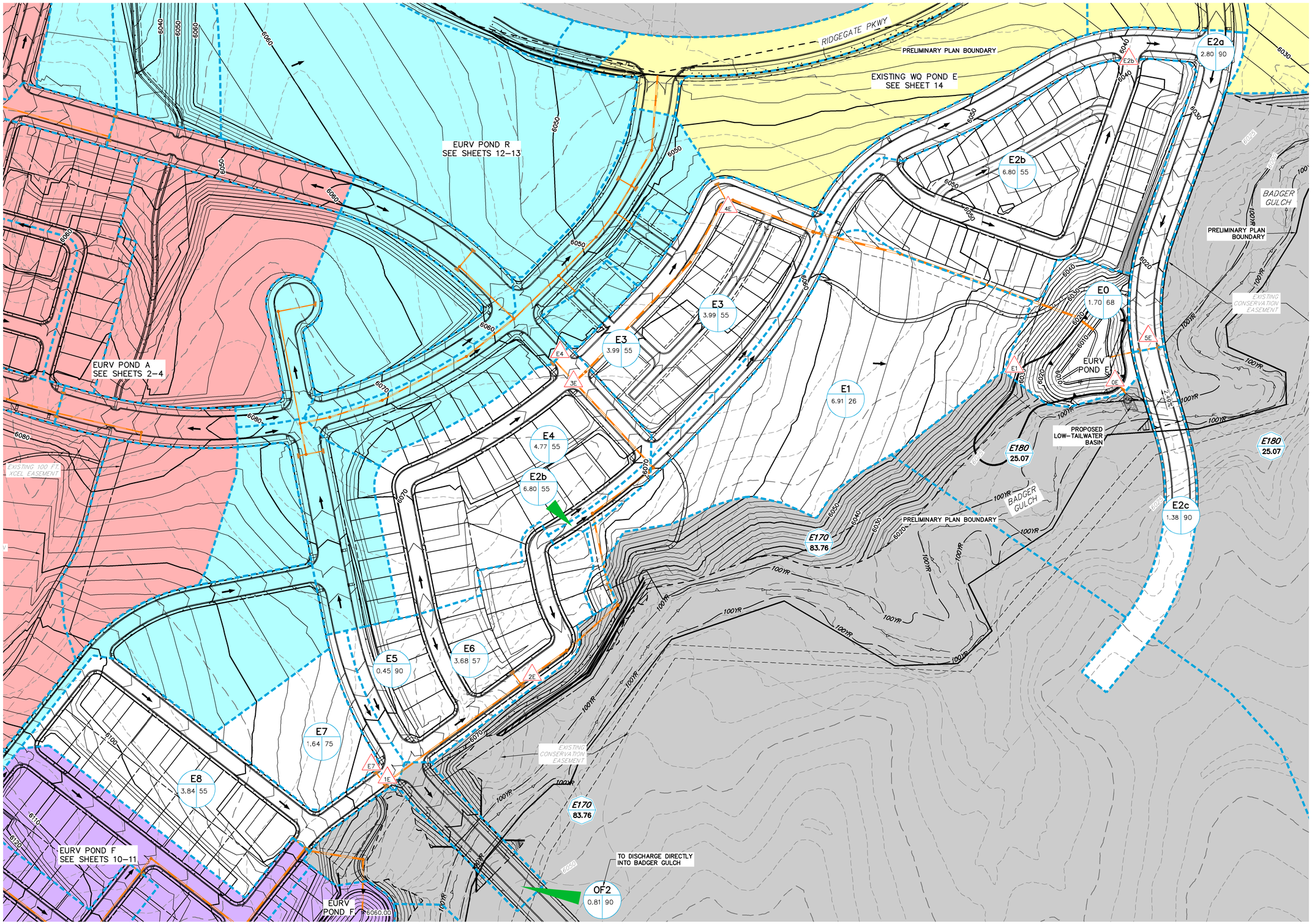
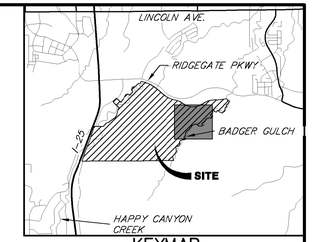
RIDEGATE DEVELOPMENT

PHASE II DRAINAGE REPORT - EURV POND E





KEYMAP
SCALE: 1"=5000'

DESIGN POINT TABLE			
	Design Point	Q_5 (cfs)	Q_{100} (cfs)
Badger Gulch (BG)			
EURV POND E	1E	13.1	32.7
	2E	14.2	34.8
	3E	26.6	70.4
	4E	32.5	87.1
	5E	17.3	40.6
	E1	3.7	18.2
	E2b	9.7	26.1
	E4	8.4	22.8
	E7	5.0	11.3
	E8	7.4	20.2
	0E	46.8	126.5
	Outfall	8.9	120.0

100 50 0 100 200
ORIGINAL SCALE: 1" = 100'

DRAINAGE LEGEND

- A / B C — A=BASIN DESIGNATION; B=BASIN AREA; C=PERCENT IMPERVIOUS (%)
- BASIN BOUNDARY
- PROP ON–SITE STORM SEWER
- EX OFF–SITE STORM SEWER
- 6100 — PROPOSED CONTOURS
- 6100 — EXISTING CONTOURS
- PROP MINOR DRAINAGEWAY
- EX MINOR DRAINAGEWAY
- PROP DRAINAGE ARROW
- EX DRAINAGE ARROW

PHASE II DRAINAGE MAP–EURV POND E
RIDGEGATE DEVELOPMENT
JOB NO. 15950.00
7/13/20
SHEET 9 OF 14

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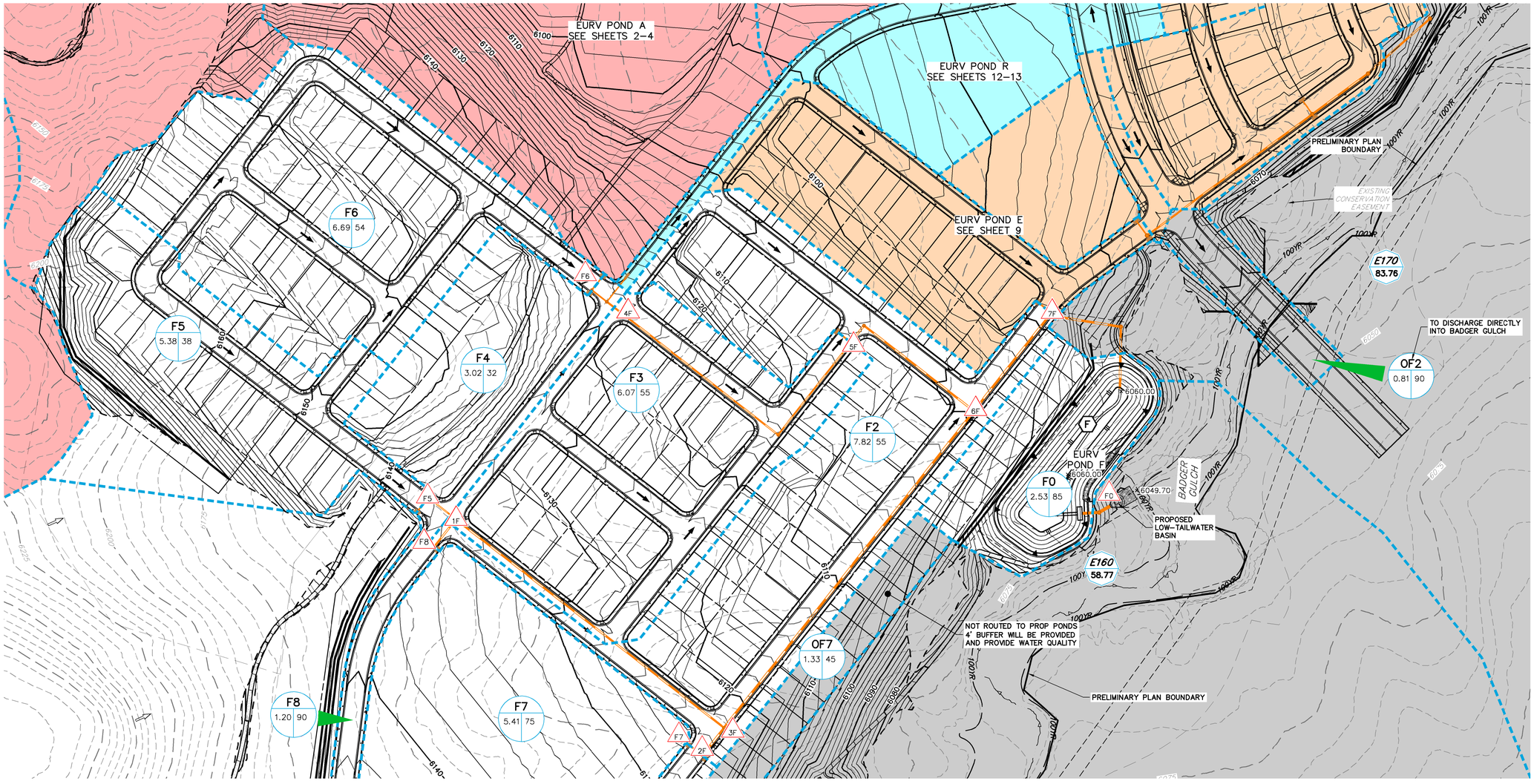
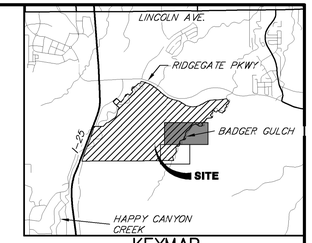
PHASE II DRAINAGE REPORT - EURV POND F



DESIGN POINT TABLE			
	Design Point	Q_5 (cfs)	Q_{100} (cfs)
Badger Gulch (BG)			
EURV POND F	1F	10.9	78.8
	2F	25.4	69.6
	3F	30.2	132.0
	4F	13.5	40.0
	5F	22.6	64.6
	6F	46.0	177.7
	7F	54.2	200.9
	F5	7.2	25.6
	F6	11.8	31.6
	F7	10.7	29.5
	F8	6.4	62.9
	OS9	4.3	63.2
	OF	57.9	208.5
	Outfall	25.6	199.4



KEYMAP
SCALE: 1"=5000'

N

100 50 0 100 200
ORIGINAL SCALE: 1" = 100'

DRAINAGE LEGEND

- A=BASIN DESIGNATION
- B=BASIN AREA
- C=PERCENT IMPERVIOUS (%)
- BASIN BOUNDARY
- PROP ON-SITE STORM SEWER
- EX OFF-SITE STORM SEWER
- 6100 PROPOSED CONTOURS
- 6100 EXISTING CONTOURS
- PROP MINOR DRAINAGEWAY
- EX MINOR DRAINAGEWAY
- PROP DRAINAGE ARROW
- EX DRAINAGE ARROW

PHASE II DRAINAGE MAP-EURV POND F
RIDGEGATE DEVELOPMENT
JOB NO. 15950.00
7/13/20
SHEET 10 OF 14

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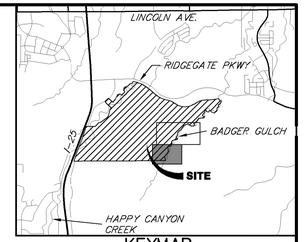
SEE OVERALL MAP - SHEET 1

SEE SHEET 11

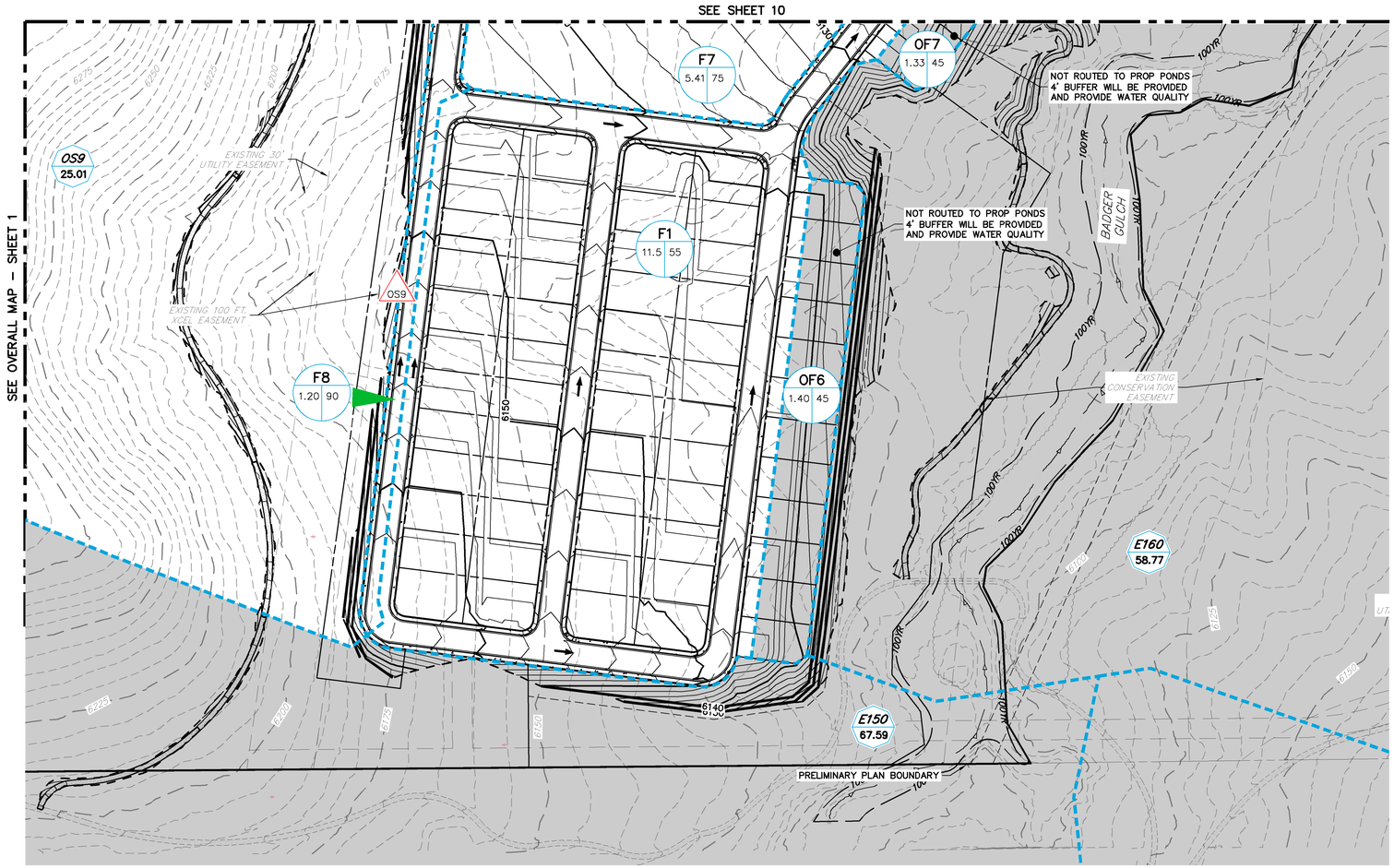
RIDEGATE DEVELOPMENT

PHASE II DRAINAGE REPORT - EURV POND F



KEYMAP

SCALE: 1"=5000'



DESIGN POINT TABLE

	Design Point	Q_5 (cfs)	Q_{100} (cfs)
Badger Gulch (BG)			
EURV POND F	1F	10.9	78.8
	2F	25.4	69.6
	3F	30.2	132.0
	4F	13.5	40.0
	5F	22.6	64.6
	6F	46.0	177.7
	7F	54.2	200.9
	F5	7.2	25.6
	F6	11.8	31.6
	F7	10.7	29.5
	F8	6.4	62.9
	OS9	4.3	63.2
	OF	57.9	208.5
	Outfall	**25.6**	**199.4**

100 50 0 100 200

ORIGINAL SCALE: 1" = 100'

DRAINAGE LEGEND

- A=BASIN DESIGNATION
- B=BASIN AREA
- C=PERCENT IMPERVIOUS (%)
- BASIN BOUNDARY
- PROP ON-SITE STORM SEWER
- EX OFF-SITE STORM SEWER
- 6100 PROPOSED CONTOURS
- 6100 EXISTING CONTOURS
- PROP MINOR DRAINAGEWAY
- EX MINOR DRAINAGEWAY
- PROP DRAINAGE ARROW
- EX DRAINAGE ARROW

PHASE II DRAINAGE MAP–EURV POND F
RIDGEGATE DEVELOPMENT
JOB NO. 15950.00
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SHEET 11 OF 14

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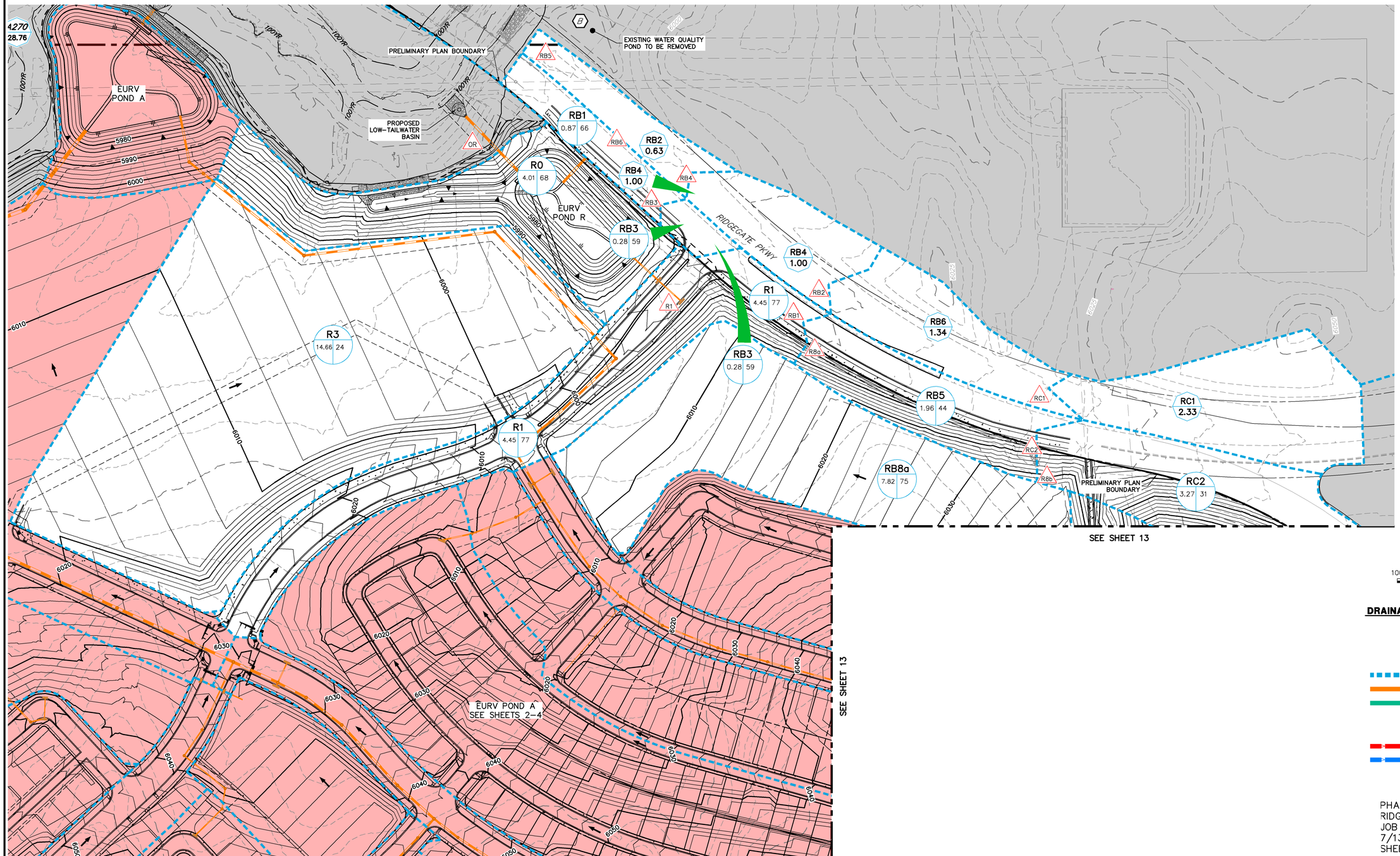
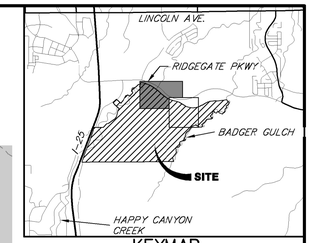
RIDEGATE DEVELOPMENT

PHASE II DRAINAGE REPORT - EURV POND R





KEYMAP
SCALE: 1"=5000'

DESIGN POINT TABLE

	Design Point	Q_5 (cfs)	Q_{100} (cfs)
Happy Canyon (HC)			
EURV POND R	1R	12.0	26.2
	2R	8.7	41.7
	3R	2.8	5.6
	4R	14.1	31.4
	5R	16.1	35.4
	6R	11.1	23.8
	7R	24.5	53.6
	8R	25.6	55.9
	9R	26.1	57.2
	10R	32.0	72.1
	RB1	22.5	59.0
	RB2	84.1	210.7
	RB3	0.7	1.6
	RB4	86.0	216.0
	RB5	4.0	9.0
	RB6	89.1	222.9
	RC1	62.0	152.0
	RC2	27.1	67.8
	RC3	33.6	76.9
	RC4	31.9	72.3
	RC7	30.4	62.9
	R2c	7.6	16.8
	R6b	6.6	14.6
	R8a	24.6	54.6
	R8b	1.1	9.2
	0R	96.9	257.0
	Outfall	**24.6**	**227.2**

100 50 0 100 200
ORIGINAL SCALE: 1" = 100'

DRAINAGE LEGEND

- A=BASIN DESIGNATION
- B=BASIN AREA
- C=PERCENT IMPERVIOUS (%)
- BASIN BOUNDARY
- PROP ON-SITE STORM SEWER
- EX OFF-SITE STORM SEWER
- 6100 PROPOSED CONTOURS
- 6100 EXISTING CONTOURS
- PROP MINOR DRAINAGEWAY
- EX MINOR DRAINAGEWAY
- PROP DRAINAGE ARROW
- EX DRAINAGE ARROW

PHASE II DRAINAGE MAP-EURV POND R
RIDGEGATE DEVELOPMENT
JOB NO. 15950.00
7/13/20
SHEET 12 OF 14

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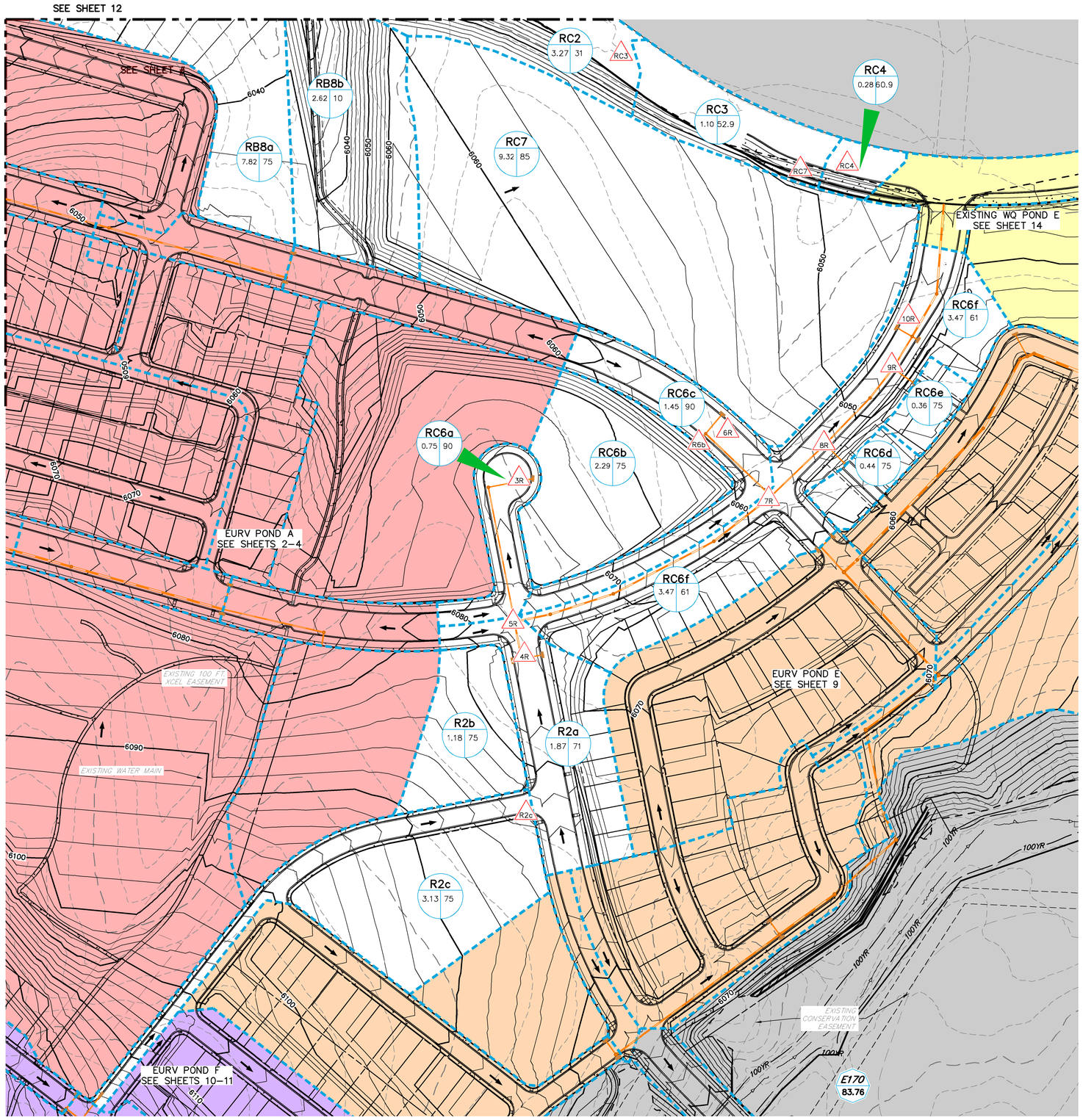
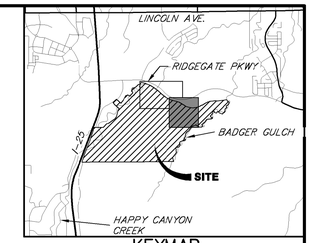
RIDEGATE DEVELOPMENT

PHASE II DRAINAGE REPORT - EURV POND R





KEYMAP
SCALE: 1"=5000'

DESIGN POINT TABLE

	Design Point	Q_5 (cfs)	Q_{100} (cfs)
Happy Canyon (HC)			
EURV POND R	1R	12.0	26.2
	2R	8.7	41.7
	3R	2.8	5.6
	4R	14.1	31.4
	5R	16.1	35.4
	6R	11.1	23.8
	7R	24.5	53.6
	8R	25.6	55.9
	9R	26.1	57.2
	10R	32.0	72.1
	RB1	22.5	59.0
	RB2	84.1	210.7
	RB3	0.7	1.6
	RB4	86.0	216.0
	RB5	4.0	9.0
	RB6	89.1	222.9
	RC1	62.0	152.0
	RC2	27.1	67.8
	RC3	33.6	76.9
	RC4	31.9	72.3
	RC7	30.4	62.9
	R2c	7.6	16.8
	R6b	6.6	14.6
	R8a	24.6	54.6
	R8b	1.1	9.2
	0R	96.9	257.0
	Outfall	**24.6**	**227.2**

100 50 0 100 200
ORIGINAL SCALE: 1" = 100'

DRAINAGE LEGEND

- A=BASIN DESIGNATION
- B=BASIN AREA
- C=PERCENT IMPERVIOUS (%)
- BASIN BOUNDARY
- PROP ON-SITE STORM SEWER
- EX OFF-SITE STORM SEWER
- 6100 PROPOSED CONTOURS
- 6100 EXISTING CONTOURS
- PROP MINOR DRAINAGEWAY
- EX MINOR DRAINAGEWAY
- PROP DRAINAGE ARROW
- EX DRAINAGE ARROW

PHASE II DRAINAGE MAP-EURV POND R
RIDGEGATE DEVELOPMENT
JOB NO. 15950.00
7/13/20
SHEET 13 OF 14

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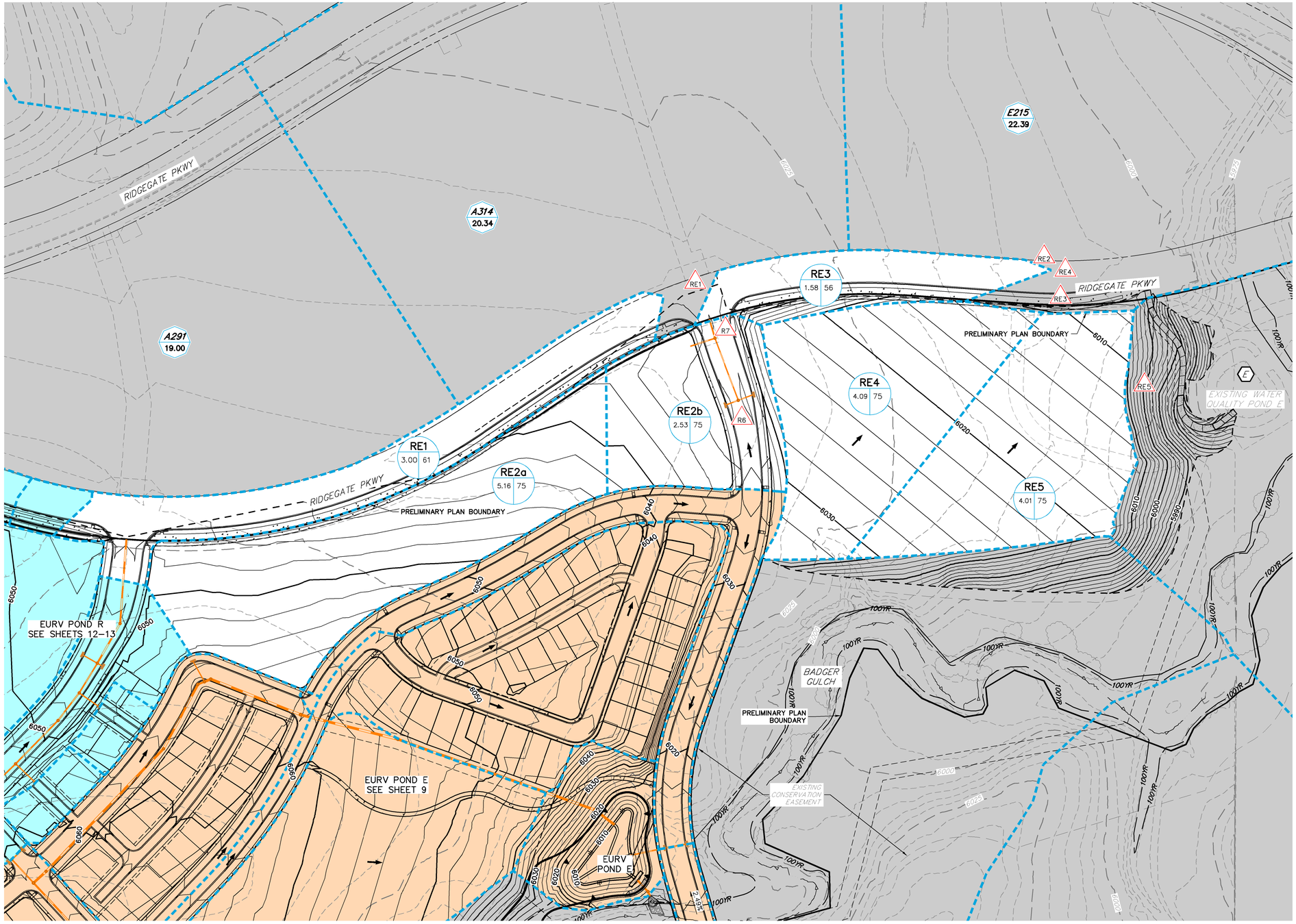
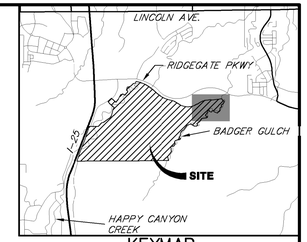
RIDGEGATE DEVELOPMENT

PHASE II DRAINAGE REPORT - EX. WQ POND E





KEYMAP
SCALE: 1"=5000'

DESIGN POINT TABLE			
	Design Point	Q_5 (cfs)	Q_{100} (cfs)
Badger Gulch (BG)			
EX WQ POND E	R6	7.7	17.1
	R7	18.9	41.9
	RE1	19.4	44.4
	RE2	2.8	7.3
	RE3	10.4	23.1
	RE4	29.4	67.5
	RE5	9.9	22.3
	OE	36.8	84.3
	Outfall	**36.8**	**62.6**

N

100 50 0 100 200
ORIGINAL SCALE: 1" = 100'

DRAINAGE LEGEND

- A=BASIN DESIGNATION
- B=BASIN AREA
- C=PERCENT IMPERVIOUS (%)
- BASIN BOUNDARY
- PROP ON-SITE STORM SEWER
- EX OFF-SITE STORM SEWER
- 6100 — PROPOSED CONTOURS
- 6100 — EXISTING CONTOURS
- PROP MINOR DRAINAGEWAY
- EX MINOR DRAINAGEWAY
- PROP DRAINAGE ARROW
- EX DRAINAGE ARROW

PHASE II DRAINAGE MAP–EX. WQ POND E
RIDGEGATE DEVELOPMENT
JOB NO. 15950.00
7/13/20
SHEET 14 OF 14

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