PRELIMINARY & FINAL DRAINAGE PLAN

CARRIAGE MEADOWS SOUTH
AT
LORSON RANCH
FILING NO. 2

DECEMBER, 2018
REV. OCTOBER 15, 2019
REV FEBRUARY 12, 2020

PUDSP 19-005

Prepared for:

Lorson, LLC
212 N. Wahsatch Ave, Suite 301
Colorado Springs, Colorado 80903
(719) 635-3200X

Prepared by:

Core Engineering Group, LLC
15004 1ST Avenue South
Burnsville, MN 55306
(719) 570-1100

Project No. 100.046

CORE
ENGINEERING GROUP

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ENGINEER'S STATEMENT

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

COLORADO REGISTERED RICHARD L. SCHINDLER 33997 2-12-2020 PROFESSIONAL ENGINEER

Richard L. Schindler, P.E. #33997 Date
For and on Behalf of Core Engineering Group, LLC

OWNER'S STATEMENT

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

Larson LLC 2/14/20

Business Name Date

By

VP

Title

212 N Wahsatch Ave.

Address

FLOODPLAIN STATEMENT

To the best of my knowledge and belief, this development is not located within a designated floodplain as shown on Flood Insurance Rate Map Panel No. 08041C0957 G, Dated December 7, 2018 (See Appendix A, FEMA FIRM Exhibit)

COLORADO REGISTERED RICHARD L. SCHINDLER 33997 2-12-2020 PROFESSIONAL ENGINEER

Richard L. Schindler, #33997, Date
For and on Behalf of Core Engineering Group, LLC

EL PASO COUNTY

Filed in accordance with the requirements of the El Paso County Land Development Code, Drainage Criteria Manual, Volume 1 and 2, and Engineering Criteria Manual, As Amended.

Jennifer Irvine Date
County Engineer/ECM Administrator

Conditions:

1.0 LOCATION and DESCRIPTION

Carriage Meadows South Townhomes at Lorson Ranch is located southeast of the intersection of Fontaine Boulevard and Carriage Meadows Drive in El Paso County Colorado. The site is located on approximately 5.32 acres of vacant land. Future plans are to develop this site into 50 single family attached (townhome) units. The land is currently owned by Lorson LLC nominee for Lorson North Dev Corp. Planned development of this area will consist of single-family attached units.

The site is located in the Northeast ¼ of Section 22 and the Northwest ¼ of Section 23, Township 15 South and Range 65 West of the 6th Principal Meridian; it is currently zoned RR3, Rural Residential District. The property is bounded on the north by the Fontaine Boulevard, on the east by the relocated Jimmy Camp Creek, a major Drainage conveyance system, on the west by Carriage Meadows Drive, on the south by Carriage Meadows South Filing No. 1, a single-family development. For reference, a vicinity map is included in Appendix A of this report.

Conformance with applicable Drainage Basin Planning Studies

There is an existing (unapproved) DBPS for Jimmy Camp Creek prepared by Wilson & Company in 1987, and is referenced in this report. The only major drainage improvements for this study area according to the 1987 Wilson study was the reconstruction of Jimmy Camp Creek which was completed in 2006.

Conformance with MDDP/PDR for Carriage Meadows South by Core Engineering Group

Core Engineering Group has an approved MDDP/PDR for Carriage Meadows South which covers this study area. This PDR/FDR conforms to the MDDP/PDR and is referenced in this report. All major infrastructure outlined in the MDDP/PDR has been constructed as part of the Carriage Meadows South Filing No. 1 final plat (SF 17-011). WQ/Detention Ponds G1.7, G1, G2, and G3 were constructed in 2017 which detains/treats all runoff from this site. Existing storm sewer infrastructure was extended to the SW corner of this site early in 2017.

Carriage Meadows South Filing No. 2 is located within the ***"Jimmy Camp Creek Drainage Basin"***, which is a fee basin and is part of the "Jimmy Camp Creek Drainage Basin Planning Study", prepared by Kiowa Engineering Corp., Colorado Springs, CO.

2.0 DRAINAGE CRITERIA

The supporting drainage design and calculations were performed in accordance with the City of Colorado Springs and El Paso County "Drainage Criteria Manual (DCM)", dated November, 1991, the El Paso County "Engineering Criteria Manual", and the UDFCD "Urban Storm Drainage Criteria Manual" Volumes 1, 2 and 3. No deviations from these published criteria are requested for this site. The proposed improvements to the Lorson Ranch Development will be in substantial compliance with the "Jimmy Camp Creek Drainage Basin Planning Study", prepared by Kiowa Engineering Corp., Colorado Springs, CO.

The Rational Method as outlined in Section 6.3.0 of the May 2014 "Drainage Criteria Manual" and in Section 3.2.8.F of the El Paso County "Engineering Criteria Manual" was used for basins less than 130 acres to determine the rainfall and runoff conditions for the proposed development of the site. The runoff rates for the 5-year initial storm and 100-year major design storm were calculated.

Current updates to the Drainage Criteria manual for El Paso County states the if detention is necessary, Full Spectrum Detention will be included in the design. Detention (Pond G1/G2) constructed as part of Carriage Meadows South at Lorson Ranch Filing No. 1 has been sized to provide full spectrum detention and water quality treatment for this development. See Appendix E for excerpts

of the Carriage Meadows South Filing No. Final Drainage Report for the pond spreadsheets and pond tributary area maps.

3.0 EXISTING HYDROLOGICAL CONDITIONS

The site is currently undeveloped with native vegetation (grass with no shrubs) and moderate slopes in a south-southwesterly direction to an existing CDOT type "D" inlet. Runoff is then directed westerly via 24" & 30" RCP's to an existing detention facility, located west side of Carriage Meadows Drive. These flows then continue west and south to WQ/Detention Pond G1. The soils across the site consists of the Ellicott loamy course sand, a deep somewhat excessively drained soil with 0 - 5% slopes, and the Manzanst (Manzanola) clay loam, also a deep well drained soil with 1 – 3% slopes according to the Soil Survey of El Paso County Area. A majority of these soils are type A/B, and a small portion consist of soil type C/D. These soil types will be used for the hydrologic conditions. No offsite drainage impacts this development. See Appendix A for SCS Soils Map.

Table 3.1: SCS Soils Survey.

Soil	Hydro. Group	Shrink/Swell Potential	Permeability	Surface Runoff Potential	Erosion Hazard
28-Ellicott Loamy Coarse Sand (1%)	A	Low	Rapid	Slow	High
52-Manzanst Clay Loam (59%)	C	Moderate to High	Slow	Medium	Moderate

The following on-site current condition basins are briefly discussed as follows:

Basin G1.1
This basin is located halfway between Carriage Meadows Drive and adjacent to realigned Jimmy Camp Creek. Runoff is directed southerly to an existing drainage swale that directs runoff to an existing CDOT type "D" inlet next to Carriage Meadows Drive. The peak flow from this 2.66 acre basin is 0.8cfs for the 5-year storm event and 5.6cfs for the 100-year storm event. This basin also accepts flow from basins G1.2 and G1.3.

Basin G1.2
Basin G1.2 is developed flow from a portion of Carriage Meadows South Filing No. 1 and runoff is directed northerly to the previously mentioned existing drainage swale and the CDOT type "D" inlet next to Carriage Meadows Drive. The peak flow from this 2.22 acre basin is 4.3cfs for the 5-year storm event and 9.5cfs for the 100-year storm event.

Basin G1.3
Basin G1.3 is developed flow from a portion of Carriage Meadows South Filing No. 1 and runoff is routed to Rubicon Drive and then directed northerly through basin G1.2 to the previously mentioned existing drainage swale and CDOT type "D" inlet next to Carriage Meadows Drive. The peak flow from this 0.45 acre basin is 0.8cfs for the 5-year storm event and 1.8cfs for the 100-year storm event.

Basin G1.4
This basin is located halfway between realigned Jimmy Camp Creek and adjacent to Carriage Meadows Drive. Runoff is directed southerly to an existing 15' type "R" inlet in Carriage Meadows Drive on the east side. The peak flow from this 4.16 acre basin is 4.8cfs for the 5-year storm event and 13.1cfs for the 100-year storm event. These flows are then routed westerly via a 24" & a 30" RCP to an existing detention facility (Pond G1.7), located west side of Carriage Meadows Drive

Existing Design Point 1
Existing Design Point 1 is located at an existing CDOT Type "D" inlet on the east side of Carriage Meadows Drive and accepts flow from Existing Basins G1.1-G1.3. The peak existing flow at this design point is 5.1cfs for the 5-year storm event and 15.1cfs for the 100-year storm event. This flow is less than the design flows of 14.9cfs/29.2cfs (see CMS Filing No. 1 FDR).

Existing Design Point 2
Existing Design Point 2 is the total existing pipe flow in an existing 30" RCP crossing under Carriage Meadows Drive. The runoff is from existing Basins G1.1-G1.4 and is collected by an existing 15' CDOT Type R inlet and a CDOT Type D inlet. The peak existing flow at this design point is 9.7cfs for the 5-year storm event and 27.7cfs for the 100-year storm event. This flow is less than the design flows of 24.3cfs/46.5cfs (see CMS Filing No. 1 FDR).

4.0 DEVELOPED HYDROLOGICAL CONDITIONS

Hydrology for the **Carriage Meadows South at Lorson Ranch Filing No. 2** drainage report was based on the City of Colorado Springs/El Paso County Drainage Criteria. Basins that lie within this project were determined and the 5-year and 100-year peak discharges for the developed conditions have been presented in this report. Based on these flows, storm inlets will be added if the street capacity is exceeded.

The time of concentration for each basin was developed using an overland, ditch, street and pipe flow components. The maximum overland flow length for developed conditions was limited to 100 feet. Travel time velocities ranged from 2 to 6 feet per second. The travel time calculations are included in the back of this report.

Runoff coefficients for the various land uses were obtained from the City of Colorado Springs/El Paso County Drainage Criteria Manual and were weighted for each basin.

The hydrology analysis necessary for sizing the storm sewer system is preliminary only and will be finalized when the construction documents are prepared.

Drainage concepts for each of the basins are briefly discussed as follow:

Basin G1.1
This basin is located on the east side of Rubicon Drive/Rubicon Heights; runoff from the proposed townhomes directs flow west to Rubicon Drive/Rubicon Heights. These flows are then routed southerly to design point 1; a proposed type "R" inlet located in a low spot on the east side of Rubicon Drive, this inlet will be discussed in greater detail under the hydraulic summary part of this report. The peak developed flow from this 1.34 acre basin is 3.5cfs for the 5-year storm event and 7.1cfs for the 100-year storm event. Runoff is then routed west in a proposed 24" RCP.

Basin G1.2
Basin G1.2 generates developed flow from a portion of Carriage Meadows South Filing No. 1, and runoff is directed westerly to Rubicon Drive then northerly to design point 1 and the previously mentioned proposed 10' type "R" inlet located in a low spot on the east side of Rubicon Drive, and will be discussed in greater detail under the hydraulic summary part of this report. The peak flow from this

1.31 acre basin is 2.9cfs for the 5-year storm event and 6.3cfs for the 100-year storm event. Runoff is then routed west in a proposed 24" RCP.

Basins G1.2a

This basin is located east of Rubicon Drive and west of realigned Jimmy Camp Creek; runoff from the proposed townhomes directs flow east to proposed area inlets and conveyed southerly and westerly via 12" and 15" PVC storm drain at a minimum of 0.80% slope to the storm sewer in Rubicon Drive. These inlets and pipe system will be discussed in greater detail under the hydraulic summary part of this report. The peak developed flow from this 1.25 acre basin is 1.1cfs for the 5-year storm event and 3.6cfs for the 100-year storm event. Runoff is then routed west in a proposed 24" RCP.

Basin G1.3

Basin G1.3 is located in Carriage Meadows South Filing No. 1 and directs runoff north to Mandan Drive and east to Rubicon Drive. These developed flows are collected in Rubicon Drive and routed north to design point 3; a proposed type "R" inlet located in a low spot on the west side of Rubicon Drive. This inlet will be discussed in greater detail under the hydraulic summary part of this report. The peak developed flow from this 0.45 acre basin is 0.8cfs for the 5-year storm event and 1.8cfs for the 100-year storm event. Runoff is then routed west in a proposed 24" RCP.

Basin G1.4

Basin G1.4 is located in Carriage Meadows South Filing No. 1 and directs runoff south to Mandan Drive and east to Rubicon Drive. These developed flows along with basin G1.3 flows are collected in Rubicon Drive and routed north to design point 3; a proposed type "R" inlet located in a low spot on the west side of Rubicon Drive. This inlet will be discussed in greater detail under the hydraulic summary part of this report. The peak developed flow from this 0.32 acre basin is 0.6cfs for the 5-year storm event and 1.4cfs for the 100-year storm event. Runoff is then routed west in a proposed 24" RCP.

Basin G1.5

This basin is located on the west side of Rubicon Heights; runoff from the proposed townhomes directs flow east to Rubicon Heights. These flows are then routed southerly to design point 3; a proposed type "R" inlet located in a low spot on the east side of Rubicon Drive, this inlet will be discussed in greater detail under the hydraulic summary part of this report. The peak developed flow from this 1.01 acre basin is 3.3cfs for the 5-year storm event and 6.3cfs for the 100-year storm event. Runoff is then routed west in a proposed 24" RCP.

Basin G1.5a

This basin is located on the west side of Rubicon Drive and includes a small developed area from Carriage Meadows South Filing No. 1; runoff from the proposed townhome site directs flow southerly, and runoff from Carriage Meadows South Filing No. 1 is directed northerly to a proposed 2' wide concrete curb chase at a minimum of 0.80% slope, this 0.5' deep chase has the capacity to convey the developed flows from basin G1.5a to the existing Type D inlet since a part of the basin flows directly to the inlet. This chase can also be used as an emergency conveyance system for any overflow from Rubicon Heights. This proposed concrete chase collects surface flows and routes them in a westerly direction to an existing CDOT type "D" inlet. The peak developed flow from this 1.01 acre basin is 2.4cfs for the 5-year storm event and 5.3cfs for the 100-year storm event. Runoff is then routed west in an existing 24" RCP.

Basin G1.6

This basin is located on the west side of Carriage Meadows Drive, and the runoff from these proposed townhomes is directed east to Carriage Meadows Drive. Flows are then routed southerly in Carriage Meadows Drive to design point 6; an existing 15' type "R" inlet located in a low spot on the east side of Carriage Meadows Drive, this inlet will be discussed in greater detail under the hydraulic summary part of this report. The peak developed flow from this 2.50 acre basin is 5.8cfs for the 5-year storm event

and 11.7cfs for the 100-year storm event. Runoff is then routed west in an existing 30" RCP to existing detention pond G1.7

Basin G1.7

Basin G1.7 is located in Carriage Meadows South Filing No. 1 and directs runoff southerly to Mandan Drive and westerly/northerly to Carriage Meadows Drive. These developed flows are then collected in Carriage Meadows Drive and routed north to design point 6; an existing 15' type "R" inlet located in a low spot on the east side of Carriage Meadows Drive, this inlet will be discussed in greater detail under the hydraulic summary part of this report. The peak developed flow from this 0.25 acre basin is 0.5cfs for the 5-year storm event and 1.1cfs for the 100-year storm event. Runoff is then routed west in an existing 30" RCP to existing detention pond G1.7

5.0 HYDRAULIC SUMMARY

The sizing of the hydraulic structures was prepared by using the *StormSewers* computer software programs developed by Intellisolve, which conforms to the methods outlined in the "City of Colorado Springs/El Paso County Drainage Criteria Manual". The CDOT Type R inlets were sized using Xcel spreadsheets developed by Denver Urban Drainage & Flood Control District. The street capacity of Rubicon Drive is 7.5cfs/31.2cfs for the 5/100 year storm events. Runoff from basins tributary to the street do not exceed the street capacity to convey runoff at Design Points 1 & 3.

It is the intent of this Preliminary and Final Drainage Report to use the proposed curb/gutter and storm sewer to convey runoff to the existing detention pond G1.7. Inlet size and location are as shown on the developed conditions drainage map. See Appendix C for detailed hydraulic calculations and the storm sewer model.

Design Point 1

Design point 1 includes upstream flow from basins G1.1 and G1.2 and the combined peak flow at this low point on the east side of Rubicon Drive was used to size the proposed 10' type "R" inlet. Design point 1 contains 2.65 acres and generates a peak developed flow of 5.9cfs for the 5-year storm event and 12.4cfs for the 100-year storm event. Inlet DP-1 is a 10' type "R" inlet. The 5.9cfs for the 5-year event requires a ponding depth of 0.44' (5.3") and the 12.4cfs for the 100-year event requires a ponding depth of 0.59' (7.1"). These flows will be routed westerly via proposed 24" RCP, this pipe is designed to handle the flow from this design point. The street capacity is not exceeded at this design point.

Design Point 2

Design point 2 is pipe flow under Rubicon Drive and includes upstream flow from basins G1.1, G1.2 and G1.2a, and the combined peak flow at this low point on the east side of Rubicon Drive was used to size the proposed 24" RCP at a minimum of 0.50%. Design point 2 contains 3.90 acres and generates a peak developed flow of 6.3cfs for the 5-year storm event and 14.4cfs for the 100-year storm event. These flows will be routed westerly via proposed 24" RCP at a minimum of 0.50% slope and is designed to handle the flow from this design point.

Design Point 3

Design point 3 includes upstream flow from basins G1.3, G1.4 and G1.5 and the combined peak flow at this low point on the west side of Rubicon Drive was used to size the proposed 5' type "R" inlet. Design point 3 contains 1.78 acres and generates a peak developed flow of 4.4cfs for the 5-year storm event and 8.7cfs for the 100-year storm event. Inlet DP-3 is a 5' type "R" inlet. The 4.4cfs for the 5-year event requires a ponding depth of 0.46' (5.5") and the 8.7cfs for the 100-year event requires a ponding depth of 0.63' (7.6"). These flows will be routed westerly via proposed 24" RCP, this pipe is designed to handle the flow from this design point. The street capacity is not exceeded at this design point.

Design Point 4
Design point 4 is pipe flow for the proposed 24" RCP from Rubicon Drive to the existing CDOT type "D" inlet, and includes upstream flow from basins G1.1 through G1.5, and the combined peak flow at this location on the west side of Rubicon Drive was used to size the proposed 24" RCP at a minimum slope of 0 .50%. Design point 4 contains 5.68 acres and generates a peak developed flow of 9.7cfs for the 5-year storm event and 21.3cfs for the 100-year storm event. These flows will be routed westerly via proposed 24" RCP at a minimum of 0.50% slope and is designed to handle the flow from this design point.

Design Point 5
Design point 5 is the pipe and overland flow from basins G1.1 through G1.5a, contains 6.69 acres and generates a peak developed flow of 11.5cfs for the 5-year storm event and 25.2cfs for the 100-year storm event. These flows will be routed westerly via an existing 24 RCP at 0.80% slope designed to handle the flow from this design point. Runoff then continues west to existing detention pond G1.7. The existing storm sewer has been designed to handle 14.9cfs/29.2cfs per the Carriage Meadows South Filing 1 FDR.

Design Point 6
Design point 6 includes upstream flow from basins G1.6 and G1.7, and the combined peak flow at this low point on the east side of Carriage Meadows Drive was used to verify the size and capacity of the existing 15' type "R" inlet. Design point 6 contains 2.75 acres and generates a peak developed flow of 6.2cfs for the 5-year storm event and 12.7cfs for the 100-year storm event. Inlet DP-6 is an existing 15' type "R" inlet. The 6.2cfs for the 5-year event requires a ponding depth of 0.43' (5.1") and the 12.7cfs for the 100-year event requires a ponding depth of 0.55' (6.6"). These flows will be routed westerly via existing 30" RCP at 0.80% slope, this pipe is designed to handle the flow from this design point. Runoff then continues to existing detention pond G1.7.

Design Point 7
Design point 7 is the total peak flow from this development, which includes basins G1.1 through G1.7, contains 9.44 acres and generates a peak developed flow of 17.2cfs for the 5-year storm event and 36.8cfs for the 100-year storm event. These flows will be routed westerly via existing 30" RCP at 0.80% slope, this pipe has been designed to handle these peak flows. Runoff then continues to existing detention pond G1.7. Pond G1.7 is only a detention pond constructed to reduce the flows from future commercial areas west of Carriage Meadows Drive. Runoff from this design point flows south through Pond G1.7 and into Pond G1/G2 which is a full spectrum detention pond including WQ treatment designed to treat all the developed runoff from this development. The existing storm sewer has been designed to handle 24.3cfs/46.5cfs per the Carriage Meadows South Filing 1 FDR.

6.0 DETENTION AND WATER QUALITY POND

All Detention and water quality necessary for Carriage Meadows South Townhomes is provided in existing Detention (Pond G1/G2) constructed as part of Carriage Meadows South at Lorson Ranch Filing No. 1. Additional detention and water quality is not required at this time. The pond outlet structure in Pond G1/G2 has been constructed and is sized to provide water quality for the development of this site. See Appendix E for Excerpts from the FDR

The total site area is 5.32 acres and is contained within the 96-acre tributary area of Detention Pond G1/G2. See Appendix E for pond watershed and spreadsheets.

7.0 FOUR STEP PROCESS

The site has been developed to minimize wherever possible the rate of developed runoff that will leave the site and to provide water quality management for the runoff produced by the site as proposed on

the development plan. The following four step process should be considered and incorporated into the storm water collection system and storage facilities where applicable.

Step 1: Employ Runoff Reduction Practices

Carriage Meadows South at Lorson Ranch Filing No. 2 has employed several methods of reducing runoff.

- The street configuration was laid out to minimize the length of streets. Many streets are straight and perpendicular resulting in lots with less wasted space.
- Open space tracts of land act as a buffer between lots and Jimmy Camp Creek
- Jimmy Camp Creek has a natural sand bottom and vegetated slopes has been preserved through this site
- All developed areas drain to WQ ponds.
- Lorson Ranch Metro District requires the townhome association to maintain landscaping
- Full Spectrum Detention Pond G1/G2 has been constructed to provide detention and water quality for this subdivision. The full spectrum detention pond mimics existing storm discharges

Step 2: Stabilize Drainageways

Jimmy Camp Creek is a major drainageway located east of this site. JCC has been stabilized per county criteria in 2006. The design included a natural sand channel bottom and armored sides.

Step 3: Provide Water Quality Control Volume (WQCV)

Treatment and slow release of the water quality capture volume (WQCV) is required. Carriage Meadows South at Lorson Ranch Filing No. 2 will utilize existing Pond G1/G2 which is a full spectrum stormwater detention pond including Water Quality Capture Volume and a full spectrum detention/WQ outlet structure.

Step 4: Consider Need for Industrial and Commercial BMP's or Other Specialized BMP's

This site is a residential site and does not contain commercial or industrial development. There are no potential sources of contaminants that could be introduced to the County's MS4. During construction the source control will be provided with the proper installation of erosion control BMPs to limit erosion and transport of sediment. Area disturbed by construction will be seeded and mulched. Cut and fill slopes will be reseeded, and the slopes equal to or greater than three-to-one will be protected with erosion control fabric. Silt fences will be placed at the bottom of re-vegetated and rough graded slopes. Inlet protection will be used around proposed inlets. In addition, temporary sediment basins will be constructed so runoff will be treated prior to discharge. Construction BMPs in the form of vehicle tracking control, sediment basins, concrete washout area, rock socks, buffers, and silt fences will be utilized to protect receiving waters.

8.0 DRAINAGE AND BRIDGE FEES

Carriage Meadows South Filing No. 2 is located within the Jimmy Camp Creek drainage basin which is currently a fee basin in El Paso County. Current El Paso County regulations require drainage and bridge fees to be paid for platting of land as part of the plat recordation process. Lorson Ranch Metro District will be constructing the major drainage infrastructure as part of the district improvements.

Carriage Meadows South Townhomes contains approximately 5.32 acres. The 5.32 acres has already paid drainage/bridge fees in 2017 as part of the Carriage Meadows South Filing No. 1 final plat. The following table provides a breakdown of the drainage fees that have been paid for this site.

The 2017 drainage fees were $15,720, bridge fees are $735 and Drainage Surety fees are $7,000 per impervious acre and were calculated as follows:

Table 8.1: 2017 Drainage/Bridge Fees Paid For This Site

Type of Land Use	Total Area (ac)	Imperviousness	Drainage Fee	Bridge Fee	Surety Fee
Residential	5.32	65%	$54,360	$2,542	$24,206
		Total	$54,360	$2,542	$24,206

Table 8.2: Public Drainage Facility Costs (non-reimbursable)

Item	Quantity	Unit	Unit Cost	Item Total
24" Storm	293	LF	$40	$11,720
Inlets	2	EA	$3,0000	$6,000
			Subtotal	$17,720
			Eng/Cont 15%)	$2,658
			Total Est. Cost	$20,378

Table 8.3: Private Drainage Facility Costs (non-reimbursable)

Item	Quantity	Unit	Unit Cost	Item Total
12" PVC	490	LF	$20	$9,800.00
15" PVC	156	LF	$25	$3,900.00
Area Inlets	7	EA	$150	$1,050.00
			Subtotal	$14,750.00
			Eng/Cont 15%)	$2,212.50
			Total Est. Cost	$16,960.50

9.0 CONCLUSIONS

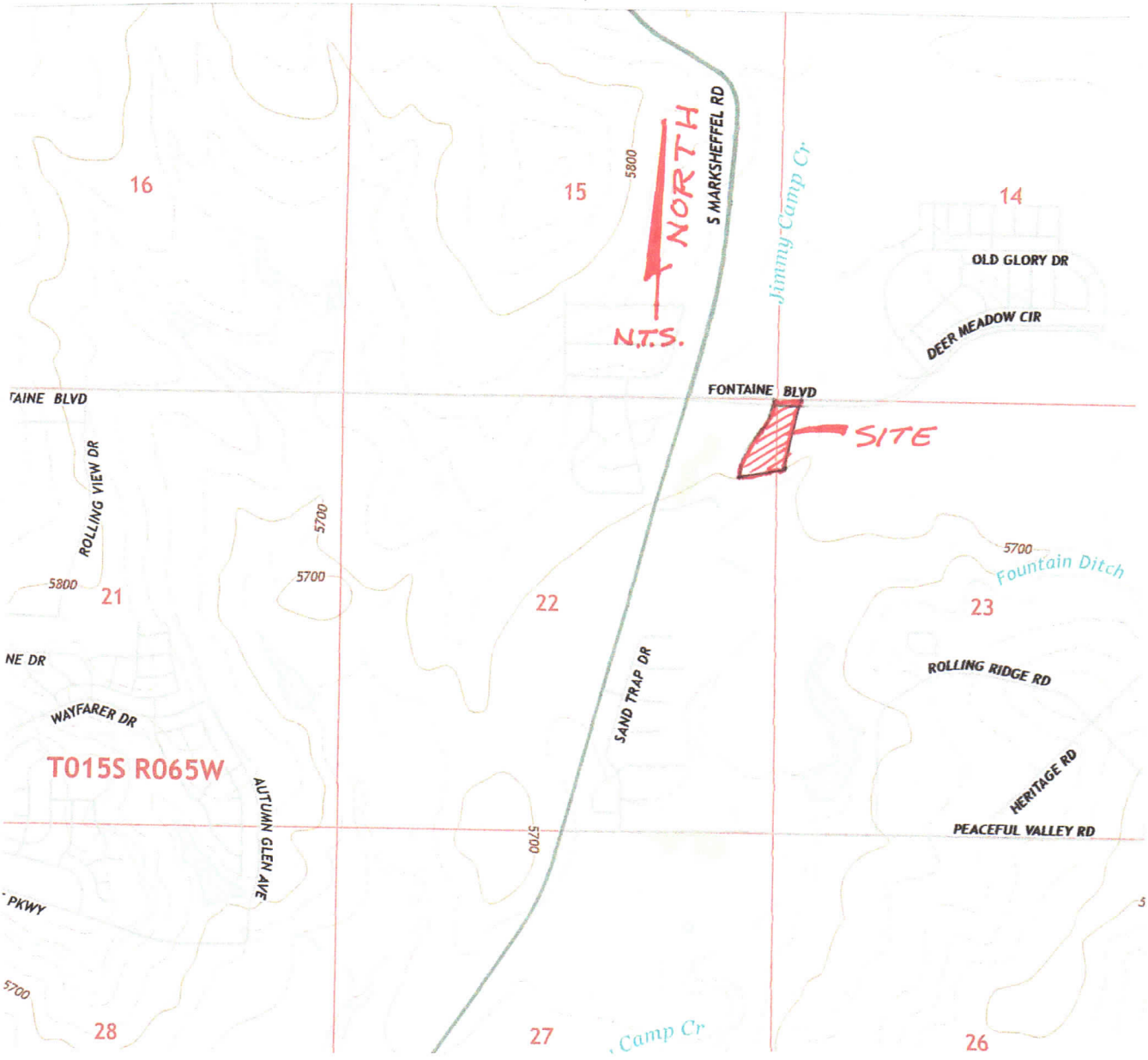
This drainage report has been prepared in accordance with the City of Colorado Springs/El Paso County Drainage Criteria Manual. The proposed development and drainage infrastructure will not cause adverse impacts to adjacent properties or properties located downstream. Several key aspects of the development discussed above are summarized as follows:

- Developed runoff will be conveyed via curb/gutter and storm sewer facilities
- Jimmy Camp Creek has been realigned within this study area

10.0 REFERENCES

1. City of Colorado Springs/El Paso County Drainage Criteria Manual DCM
2. Soil Survey of El Paso County Area, Colorado by USDA, SCS
3. Jimmy Camp Creek Drainage Basin Planning Study, 1987, Wilson & Co.
4. City of Colorado Springs “Drainage Criteria Manual, Volume 2
5. El Paso County “Engineering Criteria Manual”
6. BoCC Resolution No. 15-042-El Paso County Adoption of Chapter 6 and Section 3.2.1 Chapter 13 of the City of Colorado Springs Drainage Criteria Manual Dated May, 2014
7. MDDP/PDR for Carriage Meadows South at Lorson Ranch, Dated June, 2016, revised March, 2017 by Core Engineering Group
8. Final Drainage Report for Fontaine Boulevard, Old Glory Drive, and Marksheffel Road Phase 1 Improvements, Dated February 6, 2006, Revised September 7, 2006, by Pentacor Engineering.
9. Final Drainage Report for Carriage Meadows Filing No. 1, Approved September 7, 2017, by Core Engineering.

APPENDIX A – VICINTIY MAP, SOILS MAP, FEMA MAP



CORE
ENGINEERING GROUP

15004 1st Avenue South
Burnsville, MN 55306
PH: 719.570.1100
CONTACT: RICHARD L. SCHINDLER, P.E.
EMAIL: RichS@ceg1.com

CARRIAGE MEADOWS SOUTH TOWNHOMES
VICINITY MAP

SCALE:	DATE:	FIGURE NO.
NTS	Nov. 29, 2018	1

Custom Soil Resource Report
Soil Map

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

N

Meters
0 15 30 60 90

Feet
0 50 100 200 300

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

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 16, 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: Apr 12, 2017—Nov 17, 2017

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
28	Ellicott loamy coarse sand, 0 to 5 percent slopes	3.9 A	75.8%
52	Manzanst clay loam, 0 to 3 percent slopes	1.2 C	24.2%
Totals for Area of Interest		**5.1**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however,

onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

El Paso County Area, Colorado

28—Ellicott loamy coarse sand, 0 to 5 percent slopes

Map Unit Setting

National map unit symbol: 3680
Elevation: 5,500 to 6,500 feet
Mean annual precipitation: 13 to 15 inches
Mean annual air temperature: 47 to 50 degrees F
Frost-free period: 125 to 145 days
Farmland classification: Not prime farmland

Map Unit Composition

Ellicott and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Ellicott

Setting

Landform: Flood plains, stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy alluvium

Typical profile

A - 0 to 4 inches: loamy coarse sand
C - 4 to 60 inches: stratified coarse sand to sandy loam

Properties and qualities

Slope: 0 to 5 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat excessively drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Frequent
Frequency of ponding: None
Available water storage in profile: Low (about 4.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7w
Hydrologic Soil Group: A
Ecological site: Sandy Bottomland LRU's A & B (R069XY031CO)
Other vegetative classification: SANDY BOTTOMLAND (069AY031CO)
Hydric soil rating: No

Minor Components

Fluvaquentic haplaquoll

Percent of map unit:
Landform: Swales
Hydric soil rating: Yes

Other soils

Percent of map unit:
Hydric soil rating: No

Pleasant

Percent of map unit:
Landform: Depressions
Hydric soil rating: Yes

52—Manzanst clay loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2w4nr
Elevation: 4,060 to 6,660 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 130 to 170 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Manzanst and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Manzanst

Setting

Landform: Terraces, drainageways
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear, concave
Parent material: Clayey alluvium derived from shale

Typical profile

A - 0 to 3 inches: clay loam
Bt - 3 to 12 inches: clay
Btk - 12 to 37 inches: clay
Bk1 - 37 to 52 inches: clay
Bk2 - 52 to 79 inches: clay

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 15 percent

Gypsum, maximum in profile: 3 percent
Salinity, maximum in profile: Slightly saline (4.0 to 7.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 10.0
Available water storage in profile: High (about 9.0 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 4c
Hydrologic Soil Group: C
Ecological site: Saline Overflow (R067BY037CO)
Hydric soil rating: No

Minor Components

Ritoazul

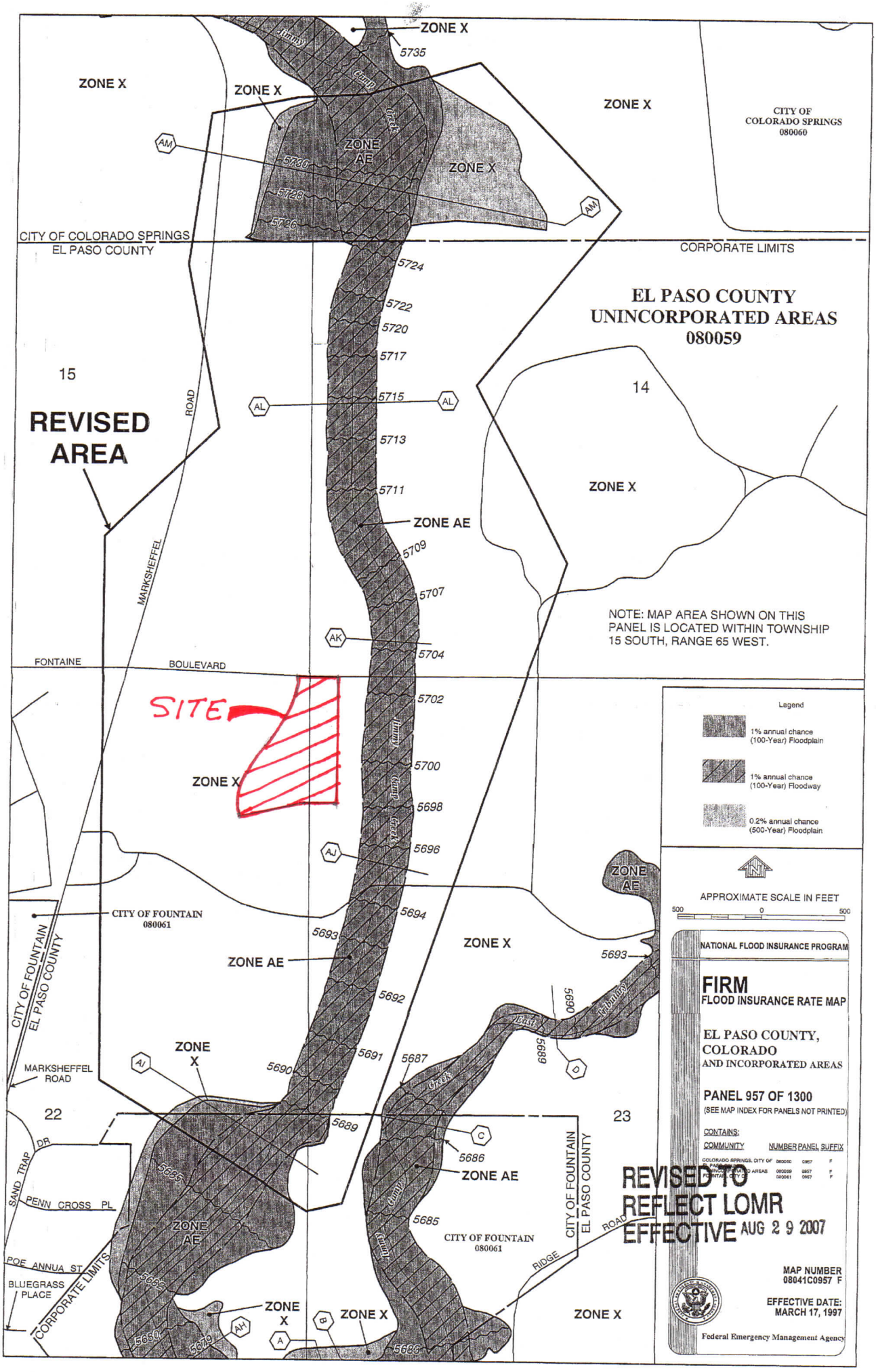
Percent of map unit: 7 percent
Landform: Drainageways, interfluves
Landform position (three-dimensional): Rise
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: Clayey Plains (R067BY042CO)
Hydric soil rating: No

Arvada

Percent of map unit: 6 percent
Landform: Interfluves, drainageways
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: Salt Flat (R067XY033CO)
Hydric soil rating: No

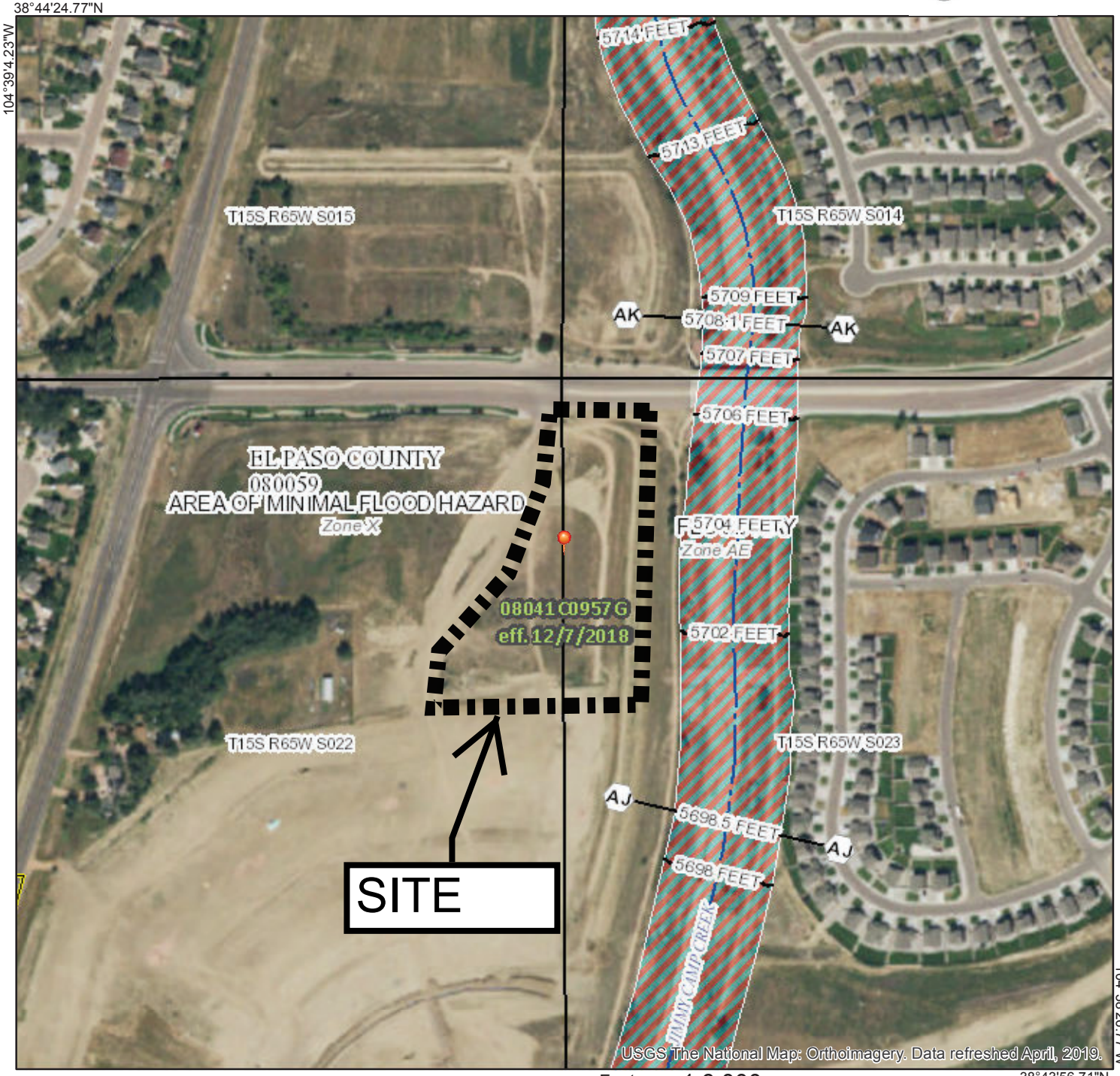
Wiley

Percent of map unit: 2 percent
Landform: Interfluves
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: Loamy Plains (R067BY002CO)
Hydric soil rating: No


ZONE X
ZONE X
ZONE X
ZONE X
CITY OF COLORADO SPRINGS 080060
5735
Fountain Creek
ZONE AE
AM
5730
5728
5726
CITY OF COLORADO SPRINGS
EL PASO COUNTY
CORPORATE LIMITS
EL PASO COUNTY UNINCORPORATED AREAS 080059
5724
5722
5720
5717
5715
AL
5713
5711
ZONE AE
5709
5707
AK
5704
15
14
REVISED AREA
MARKSHEFFEL ROAD
ZONE X
NOTE: MAP AREA SHOWN ON THIS PANEL IS LOCATED WITHIN TOWNSHIP 15 SOUTH, RANGE 65 WEST.
FONTAINE BOULEVARD
SITE
5702
ZONE X
5700
5698
5696
AJ
Legend
1% annual chance (100-Year) Floodplain
1% annual chance (100-Year) Floodway
0.2% annual chance (500-Year) Floodplain
ZONE AE
APPROXIMATE SCALE IN FEET
500 0 500
CITY OF FOUNTAIN 080061
CITY OF FOUNTAIN EL PASO COUNTY
5694
5693
ZONE AE
ZONE X
5693
5692
5690
5689
Fountain Creek
MARKSHEFFEL ROAD
ZONE X
AI
5691
5690
5687
D
NATIONAL FLOOD INSURANCE PROGRAM
FIRM
FLOOD INSURANCE RATE MAP
EL PASO COUNTY, COLORADO AND INCORPORATED AREAS
PANEL 957 OF 1300
(SEE MAP INDEX FOR PANELS NOT PRINTED)
CONTAINS:
COMMUNITY NUMBER PANEL SUFFIX
COLORADO SPRINGS, CITY OF 080060 0957 F
EL PASO COUNTY UNINCORPORATED AREAS 080059 0957 F
FOUNTAIN, CITY OF 080061 0957 F
22
23
SAND TRAP DR
PENN CROSS PL
POE ANNUA ST
BLUEGRASS PLACE
CORPORATE LIMITS
5689
C
5686
ZONE AE
5685
ZONE AE
CITY OF FOUNTAIN 080061
CITY OF FOUNTAIN EL PASO COUNTY
RIDGE ROAD
REVISED TO REFLECT LOMR EFFECTIVE AUG 29 2007
5682
5680
5679
ZONE X
AH
A
B
ZONE X
5686
ZONE X
MAP NUMBER 08041C0957 F
EFFECTIVE DATE: MARCH 17, 1997
Federal Emergency Management Agency

National Flood Hazard Layer FIRMette

FEMA



Legend

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

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

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

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

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

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

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

N

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

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

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 10/14/2019 at 9:45:48 AM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

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

APPENDIX B – HYDROLOGY CALCULATIONS

CORE ENGINEERING GROUP

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

Calculated By: Leonard Beasley
Date: November 1, 2018
Checked By: Leonard Beasley

Job No: 100.046
Project: Carriage Meadows South Townhomes
Design Storm: **5 & 100 - Year Event, Current Conditions**

Street or Basin	Design Point	Direct Runoff							Total Runoff				Street		Pipe			Travel Time			Remarks
		Area Design	Area (A)	Runoff Coeff. (C)	t_c	CA	i	Q	t_c	$\sum$ (CA)	i	Q	Slope	Street Flow	Design Flow	Slope	Pipe Size	Length	Velocity	t_t	
			ac.		min.		in/hr	cfs	min		in/hr	cfs	%	cfs	cfs	%	in	ft	ft/sec	min	
G1.1			2.66	0.08	14.3	0.21	3.59	0.8													
G1.2			2.22	0.45	8.8	1.00	4.31	4.3													
G1.3			0.45	0.45	10.7	0.20	4.02	0.8													
	1	5.33							14.3	1.41	3.59	5.1									
G1.4			4.16	0.33	15.5	1.37	3.47	4.8													
	2	9.49							15.5	2.79	3.47	9.7									
100 - Year Event, Pre-Developed Conditions																					
G1.1			2.66	0.35	14.3	0.93	6.02	5.6													
G1.2			2.22	0.59	8.8	1.31	7.24	9.5													
G1.3			0.45	0.59	10.7	0.27	6.75	1.8													
	1	5.33							14.3	2.51	6.02	15.1									
G1.4			4.16	0.54	15.5	2.25	5.83	13.1													
	2	9.49							15.5	4.75	5.83	27.7									

CORE ENGINEERING GROUP

Standard Form SF-1. Time of Concentration-Existing

Calculated By: Leonard Beasley
Date: November 1, 2018
Checked By: Leonard Beasley

Job No: 100.046
Project: Carriage Meadows South Townhomes

Sub-Basin Data				Initial Overland Time (t_i)				Travel Time (t_t)					t_c Check (urbanized Basins)		Final t_c
BASIN or DESIGN	C_5	AREA (A) acres	NRCS Convey.	LENGTH (L) feet	SLOPE (S) %	VELOCITY (V) ft/sec	T_i minutes	LENGTH (L) feet	SLOPE (S) %	VELOCITY (V) ft/sec	T_t minutes	Computed t_c Minutes	TOTAL LENGTH (L) feet	Regional tc tc=(L/180)+10 minutes	USDCM Recommended $t_c=t_i+t_t$ (min)
G1.1	0.08	2.66	7.0	40.00	20.00%	0.15	4.34	741.00	0.94%	0.68	18.20	22.54	781.00	14.34	14.34
G1.2	0.45	2.22	7.0	71.00	16.90%	0.30	3.89	143.00	1.75%	0.93	2.57				
			20.0					253.00	0.79%	1.78	2.37	8.84	467.00	12.59	8.84
G1.3	0.45	0.45	20.0	100.00	2.40%	0.19	8.82	178.00	0.60%	1.55	1.91	10.74	278.00	11.54	10.74
G1.4	0.15	5.22	20.0	255.00	2.55%	0.21	20.18	735.00	0.93%	1.93	6.35	26.54	990.00	15.50	15.50

CORE ENGINEERING GROUP
15004 1st Avenue South
Burnsville, MN 55306

PROJECT NAME: Carriage Meadows South Townhomes
PROJECT NUMBER: 100.046
ENGINEER: LAB
DATE: November 1, 2018

Preliminary Drainage Plan
PRE-DEVELOPED CONDITIONS COEFFICIENT "C" CALCULATIONS

BASIN	Soil No.	Hydro Group	Area	Cover (%)	C5	Wtd. C5	C100	Wtd. C100	Impervious	Type of Cover
G1.4		B/C	1.13	27.16%	0.90	0.24	0.96	0.26	65.0%	Existing Hard Surface
		C	0.46	11.06%	0.15	0.02	0.50	0.06	65.0%	Natural Ground Cover
		B	2.39	57.45%	0.08	0.05	0.35	0.20	65.0%	Natural Ground Cover
		B	0.18	4.33%	0.45	0.02	0.59	0.03	7.0%	Exist. Single Family
			4.16	100.00%		0.33		0.54		

CORE ENGINEERING GROUP

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

Calculated By: Leonard Beasley
Date: November 1, 2018
Checked By: Leonard Beasley

Job No: 100.046
Project: Carriage Meadows South Townhomes
Design Storm: **5 - Year Event, Proposed Conditions**

Street or Basin	Design Point	Direct Runoff							Total Runoff				Street		Pipe			Travel Time		
		Area Design	Area (A)	Runoff Coeff. (C)	t_c	CA	i	Q	t_c	Σ (CA)	i	Q	Slope	Street Flow	Design Flow	Slope	Pipe Size	Length	Velocity	t_t
		ac.			min.		in/hr	cfs	min		in/hr	cfs	%	cfs	cfs	%	in	ft	ft/sec	min
G1.1			1.34	0.63	9.9	0.84	4.14	3.5												
G1.2			1.31	0.45	6.1	0.59	4.88	2.9												
(G1.1-G1.2)	**1**	2.65							9.9	1.43	4.14	5.9								
G1.2a			1.25	0.24	14.0	0.30	3.62	1.1												
(G1.1-G1.2a)	**2**	3.90							14.0	1.73	3.62	6.3								
G1.3			0.45	0.45	10.7	0.20	4.02	0.8												
G1.4			0.32	0.45	8.1	0.14	4.45	0.6												
G1.5			1.01	0.73	7.9	0.74	4.48	3.3												
(G1.3-G1.5)	**3**	1.78							10.7	1.08	4.02	4.4								
(G1.1-G1.5)	**4**	5.68							15.7	2.82	3.46	9.7								
G1.5a			1.01	0.51	6.6	0.52	4.74	2.4												
(G1.1-G1.5a)	**5**	6.69							15.7	3.33	3.46	11.5								
G1.6			2.50	0.61	12.6	1.53	3.78	5.8												
G1.7			0.25	0.45	7.2	0.11	4.62	0.5												
(G1.6-G1.7)	**6**	2.75							12.6	1.64	3.78	6.2								
(G1.1-G1.7)	**7**	9.44							15.7	4.97	3.46	17.2								

CORE ENGINEERING GROUP

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

Calculated By: Leonard Beasley
Date: November 1, 2018
Checked By: Leonard Beasley

Job No: 100.046
Project: Carriage Meadows South Townhomes
Design Storm: **5 - Year Event, Proposed Conditions**

Street or Basin	Design Point	Direct Runoff							Total Runoff				Street		Pipe			Travel Time			Remarks
		Area Design	Area (A)	Runoff Coeff. (C)	t_c	CA	i	Q	t_c	$\sum$ (CA)	i	Q	Slope	Street Flow	Design Flow	Slope	Pipe Size	Length	Velocity	t_t	
			ac.		min.		in/hr	cfs	min		in/hr	cfs	%	cfs	cfs	%	in	ft	ft/sec	min	
G1.1			1.34	0.63	9.9	0.84	4.14	3.5													
G1.2			1.31	0.45	6.1	0.59	4.88	2.9													
(G1.1-G1.2)	**1**	2.65							9.9	1.43	4.14	5.9									
G1.2a			1.25	0.24	14.0	0.30	3.62	1.1													
(G1.1-G1.2a)	**2**	3.90							14.0	1.73	3.62	6.3									
G1.3			0.45	0.45	10.7	0.20	4.02	0.8													
G1.4			0.32	0.45	8.1	0.14	4.45	0.6													
G1.5			1.01	0.73	7.9	0.74	4.48	3.3													
(G1.3-G1.5)	**3**	1.78							10.7	1.08	4.02	4.4									
(G1.1-G1.5)	**4**	5.68							15.7	2.82	3.46	9.7									
G1.5a			1.01	0.51	6.6	0.52	4.74	2.4													
(G1.1-G1.5a)	**5**	6.69							15.7	3.33	3.46	11.5									
G1.6			2.50	0.61	12.6	1.53	3.78	5.8													
G1.7			0.25	0.45	7.2	0.11	4.62	0.5													
(G1.6-G1.7)	**6**	2.75							12.6	1.64	3.78	6.2									
(G1.1-G1.7)	**7**	9.44							15.7	4.97	3.46	17.2									

CORE ENGINEERING GROUP

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

Calculated By: Leonard Beasley
Date: November 7, 2018
Checked By: Leonard Beasley

Job No: 100.046
Project: Carriage Meadows South Townhomes
Design Storm: **100 - Year Event, Proposed Conditions**

Street or Basin	Design Point	Direct Runoff							Total Runoff				Street		Pipe			Travel Time			Remarks
		Area Design	Area (A)	Runoff Coeff. (C)	t_c	CA	i	Q	t_c	$\sum$ (CA)	i	Q	Slope	Street Flow	Design Flow	Slope	Pipe Size	Length	Velocity	t_t	
		ac.		min.		in/hr	cfs	min		in/hr	cfs	%	cfs	cfs	%	in	ft	ft/sec	min	
G1.1			1.34	0.76	9.9	1.02	6.95	7.1													
G1.2			1.31	0.59	6.1	0.77	8.19	6.3													
(G1.1-G1.2)	**1**	2.65							9.9	1.79	6.95	12.4									
G1.2a			1.25	0.47	14.0	0.59	6.08	3.6													
(G1.1-G1.2a)	**2**	3.90							14.2	2.38	6.05	14.4									
G1.3			0.45	0.59	10.7	0.27	6.75	1.8													
G1.4			0.32	0.59	8.1	0.19	7.47	1.4													
G1.5			1.01	0.83	7.9	0.84	7.52	6.3													
(G1.3-G1.5)	**3**	1.78							10.7	1.29	6.75	8.7									
(G1.1-G1.5)	**4**	5.68							15.7	3.67	5.80	21.3									
G1.5a			1.01	0.66	6.6	0.67	7.96	5.3													
(G1.1-G1.5a)	**5**	6.69							15.7	4.34	5.80	25.2									
G1.6			2.50	0.74	12.6	1.85	6.34	11.7													
G1.7			0.25	0.59	7.2	0.15	7.75	1.1													
(G1.6-G1.7)	**6**	2.75							12.6	2.00	6.34	12.7									
(G1.1-G1.7)	**7**	9.44							15.7	6.34	5.80	36.8									

CORE ENGINEERING GROUP
15004 1st Avenue South
Burnsville, MN 55306

PROJECT NAME: *Carriage Meadows South Townhomes*
PROJECT NUMBER: *100.046*
ENGINEER: *LAB*
DATE: *November 7, 2018*

Preliminary Drainage Plan
PROPOSED CONDITIONS COEFFICIENT "C" CALCULATIONS

BASIN	Soil No.	Hydro Group	Area	Cover (%)	C5	Wtd. C5	C100	Wtd. C100	Impervious	Type of Cover
G1.1		B	0.44	32.84%	0.08	0.03	0.35	0.11	0.0%	Grass
		B	0.90	67.16%	0.90	0.60	0.96	0.64	100.0%	Hard Surface
			1.34	100.00%		0.63		0.76	67.2%	
G1.2a		B	1.00	80.00%	0.08	0.06	0.35	0.28	0.0%	Grass
		B	0.25	20.00%	0.90	0.18	0.96	0.19	100.0%	Hard Surface
			1.25	100.00%		0.24		0.47	20.0%	
G1.5		B	0.21	20.79%	0.08	0.02	0.35	0.07	0.0%	Grass
		B	0.80	79.21%	0.90	0.71	0.96	0.76	100.0%	Hard Surface
			1.01	100.00%		0.73		0.83	79.2%	
G1.5a		B	0.34	33.66%	0.08	0.03	0.35	0.12	0.0%	Grass
		B	0.25	24.75%	0.45	0.11	0.59	0.15	65.0%	Existing Residential
		B	0.42	41.58%	0.90	0.37	0.96	0.40	100.0%	Hard Surface
			1.01	100.00%		0.51		0.66	57.7%	
G1.6		B	0.66	26.40%	0.08	0.02	0.35	0.09	0.0%	Grass
		C	0.39	15.60%	0.45	0.07	0.59	0.09	65.0%	Existing Residential
		B/C	1.45	58.00%	0.90	0.52	0.96	0.56	100.0%	Hard Surface
			2.50	100.00%		0.61		0.74	68.1%	

CORE ENGINEERING GROUP

Standard Form SF-1. Time of Concentration-Proposed

Calculated By: Leonard Beasley
Date: May 23, 2016
Checked By: Leonard Beasley

Job No: 100.030
Project: Carriage Meadows South

Sub-Basin Data				Initial Overland Time (t_i)				Travel Time (t_t)					t_c Check (urbanized Basins)		Final t_c
BASIN or DESIGN	C_5	AREA (A) acres	NRCS Convey.	LENGTH (L) feet	SLOPE (S) %	VELOCITY (V) ft/sec	T_i minutes	LENGTH (L) feet	SLOPE (S) %	VELOCITY (V) ft/sec	T_t minutes	Computed t_c Minutes	TOTAL LENGTH (L) feet	Regional tc tc=(L/180)+10 minutes	USDCM Recommended $T_c=T_i+T_t$ (min)
G1.1	0.63	1.34	15.0	80.00	9.25%	0.37	3.65	76.00	0.80%	1.34	0.94				
			20.0					640.00	1.00%	2.00	5.33	9.93	796.00	14.42	9.93
G1.2	0.45	1.31	15.0	47.00	21.70%	0.27	2.92	144.00	2.15%	2.20	1.09				
			20.0					244.00	0.98%	1.98	2.05	6.06	435.00	12.42	6.06
G1.2a	0.24	1.25	15.0	100.00	9.60%	0.23	7.38	623.00	0.88%	1.41	7.38	14.76	723.00	14.02	14.02
DP-2	0.24	3.90	15.0	100.00	9.60%	0.23	7.36	623.00	0.88%	1.41	7.38				
			24"					36.00	0.50%	5.09	0.12	14.86	759.00	14.22	14.22
G1.3	0.45	0.45	20.0	100.00	2.40%	0.19	8.82	178.00	0.60%	1.55	1.91	10.74	278.00	11.54	10.74
G1.4	0.45	0.32	20.0	44.00	2.73%	0.13	5.61	261.00	0.77%	1.75	2.48	8.09	305.00	11.69	8.09
G1.5	0.73	1.01	20.0	36.00	2.00%	0.19	3.20	596.00	1.11%	2.11	4.71	7.92	632.00	13.51	7.92
DP-4	0.24	3.90	15.0	100.00	9.60%	0.23	7.36	623.00	0.88%	1.41	7.38				
			24"					36.00	0.50%	5.09	0.12				
			24"					258.00	0.50%	5.09	0.84	15.70	1017.00	15.65	15.65
G1.5a	0.51	1.01	20.0	15.00	2.00%	0.08	3.29	256.00	1.45%	2.41	1.77				
			20.0					182.00	0.93%	1.93	1.57	6.64	453.00	12.52	6.64
G1.6	0.61	2.50	20.0	20.00	2.00%	0.11	3.16	1215.00	1.14%	2.14	9.48	12.64	1235.00	16.86	12.64
G1.7	0.45	0.25	20.0	44.00	2.73%	0.13	5.61	206.00	1.12%	2.12	1.62	7.23	250.00	11.39	7.23

APPENDIX C – HYDRAULIC CALCULATIONS

Table 1: Street Capacities (100-year capacity is only ½ of street)

Street Slope	Residential Local		Residential Collector		Principal Arterial	
	5-year	100-year	5-year	100-year	5-year	100-year
0.5%	6.3	26.4	9.7	29.3	9.5	28.5
0.6%	6.9	28.9	10.6	32.1	10.4	31.2
0.7%	7.5	31.2	11.5	34.6	11.2	33.7
0.8%	8.0	33.4	12.3	37.0	12.0	36.0
0.9%	8.5	35.4	13.0	39.3	12.7	38.2
1.0%	9.0	37.3	13.7	41.4	13.4	40.2
1.4%	10.5	44.1	16.2	49.0	15.9	47.6
1.8%	12.0	45.4	18.4	50.4	18.0	50.4
2.2%	13.3	42.8	19.4	47.5	19.5	47.5
2.6%	14.4	40.7	18.5	45.1	18.5	45.1
3.0%	15.5	39.0	17.7	43.2	17.8	43.2
3.5%	16.7	37.2	16.9	41.3	17.0	41.3
4.0%	17.9	35.7	16.2	39.7	16.3	29.7
4.5%	19.0	34.5	15.7	38.3	15.7	38.3
5.0%	19.9	33.4	15.2	37.1	15.2	37.1

Note: all flows are in cfs (cubic feet per second

Channel Report

Hydraflow Express by Intelisolve — Thursday, Dec 13 2018, 12:57 PM

2' curb chase (Basin G1.5a)

Rectangular

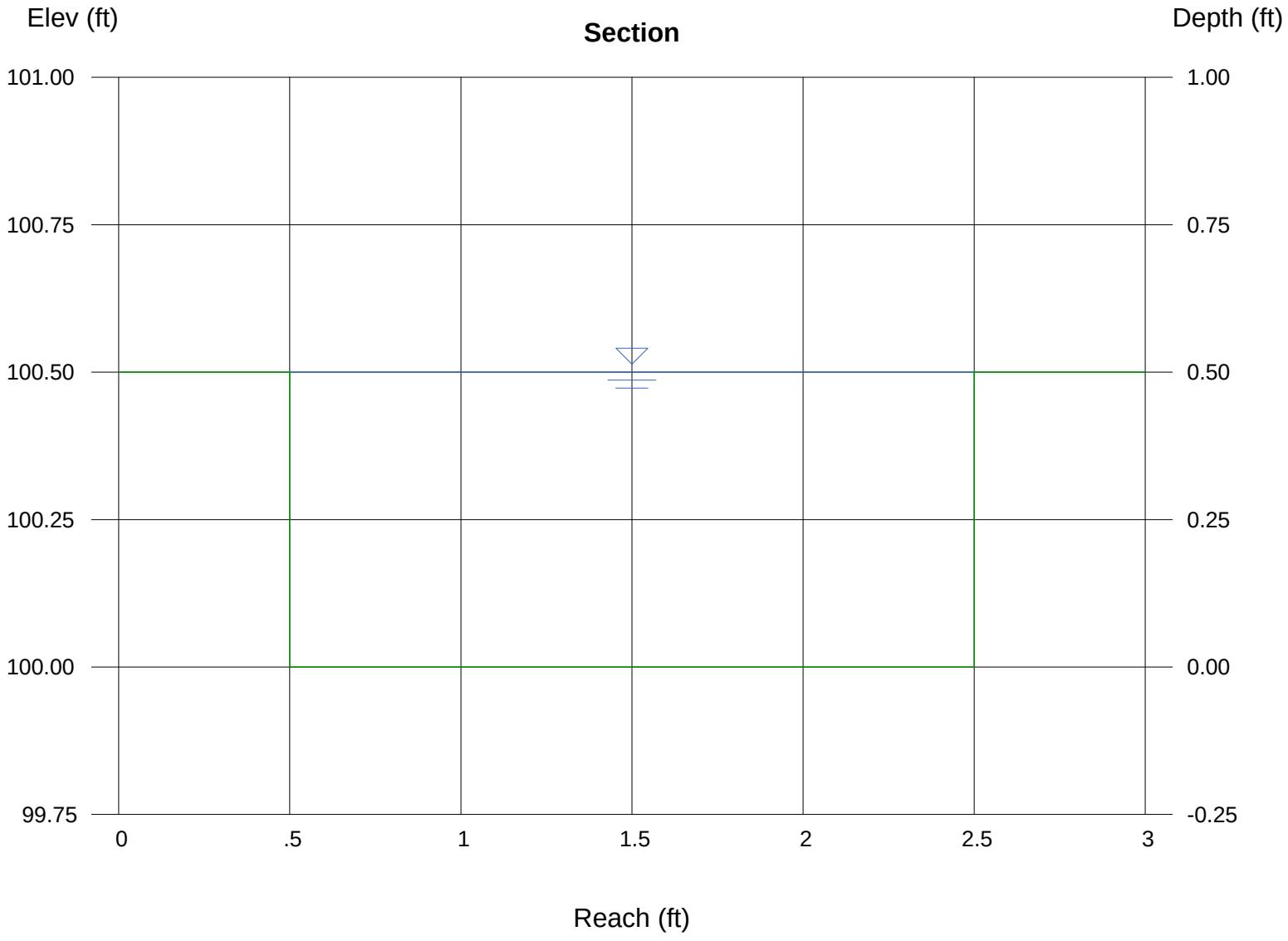
Botom Width (ft)	= 2.00
Total Depth (ft)	= 0.50
Invert Elev (ft)	= 100.00
Slope (%)	= 0.80
N-Value	= 0.013

Calculations

Compute by:	Q vs Depth
No. Increments	= 10

Highlighted

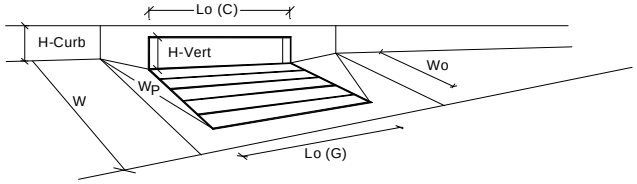
Depth (ft)	= 0.50
Q (cfs)	= 4.913
Area (sqft)	= 1.00
Velocity (ft/s)	= 4.91
Wetted Perim (ft)	= 3.00
Crit Depth, Yc (ft)	= 0.50
Top Width (ft)	= 2.00
EGL (ft)	= 0.88



INLET IN A SUMP OR SAG LOCATION

Project = Carriage Meadows South Townhomes #100.046

Inlet ID = DP-1

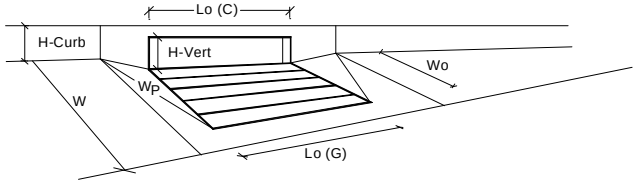


Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Inlet Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from 'Q-Allow')	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	5.3	7.1	inches
Grate Information		MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	10.00	10.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Grate Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	N/A	N/A	
Clogging Factor for Multiple Units	Clog =	N/A	N/A	
Grate Capacity as a Weir (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	N/A	N/A	cfs
Interception with Clogging	Q_{wa} =	N/A	N/A	cfs
Grate Capacity as a Orifice (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	N/A	N/A	cfs
Interception with Clogging	Q_{oa} =	N/A	N/A	cfs
Grate Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	N/A	N/A	cfs
Interception with Clogging	Q_{ma} =	N/A	N/A	cfs
Resulting Grate Capacity (assumes clogged condition)	**Q_{Grate} =**	**N/A**	**N/A**	**cfs**
Curb Opening Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	1.25	1.25	
Clogging Factor for Multiple Units	Clog =	0.06	0.06	
Curb Opening as a Weir (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	6.31	13.26	cfs
Interception with Clogging	Q_{wa} =	5.92	12.43	cfs
Curb Opening as an Orifice (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	18.39	21.06	cfs
Interception with Clogging	Q_{oa} =	17.24	19.75	cfs
Curb Opening Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	10.02	15.54	cfs
Interception with Clogging	Q_{ma} =	9.39	14.57	cfs
Resulting Curb Opening Capacity (assumes clogged condition)	**Q_{Curb} =**	**5.92**	**12.43**	**cfs**
Resultant Street Conditions		MINOR	MAJOR	
Total Inlet Length	L =	10.00	10.00	feet
Resultant Street Flow Spread (based on sheet *Q-Allow* geometry)	T =	15.8	23.1	ft.>T-Crown
Resultant Flow Depth at Street Crown	d_{CROWN} =	0.0	1.5	inches
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**5.9**	**12.4**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	5.9	12.4	cfs

INLET IN A SUMP OR SAG LOCATION

Project = Carriage Meadows South Townhomes #100.046

Inlet ID = DP-3

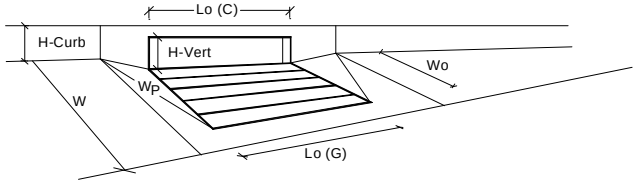


Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Inlet Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from 'Q-Allow')	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	5.6	7.6	inches
				☐ Override Depths
Grate Information		MINOR	MAJOR	
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Grate Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	N/A	N/A	
Clogging Factor for Multiple Units	Clog =	N/A	N/A	
Grate Capacity as a Weir (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	N/A	N/A	cfs
Interception with Clogging	Q_{wa} =	N/A	N/A	cfs
Grate Capacity as a Orifice (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	N/A	N/A	cfs
Interception with Clogging	Q_{oa} =	N/A	N/A	cfs
Grate Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	N/A	N/A	cfs
Interception with Clogging	Q_{ma} =	N/A	N/A	cfs
Resulting Grate Capacity (assumes clogged condition)	**Q_{Grate} =**	**N/A**	**N/A**	**cfs**
Curb Opening Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	1.00	1.00	
Clogging Factor for Multiple Units	Clog =	0.10	0.10	
Curb Opening as a Weir (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	5.09	10.00	cfs
Interception with Clogging	Q_{wa} =	4.58	9.00	cfs
Curb Opening as an Orifice (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	9.43	10.95	cfs
Interception with Clogging	Q_{oa} =	8.49	9.85	cfs
Curb Opening Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	6.44	9.73	cfs
Interception with Clogging	Q_{ma} =	5.80	8.76	cfs
Resulting Curb Opening Capacity (assumes clogged condition)	**Q_{Curb} =**	**4.58**	**8.76**	**cfs**
Resultant Street Conditions		MINOR	MAJOR	
Total Inlet Length	L =	5.00	5.00	feet
Resultant Street Flow Spread (based on sheet *Q-Allow* geometry)	T =	17.0	25.5	ft.>T-Crown
Resultant Flow Depth at Street Crown	d_{CROWN} =	0.0	2.0	inches
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**4.6**	**8.8**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	4.4	8.7	cfs

INLET IN A SUMP OR SAG LOCATION

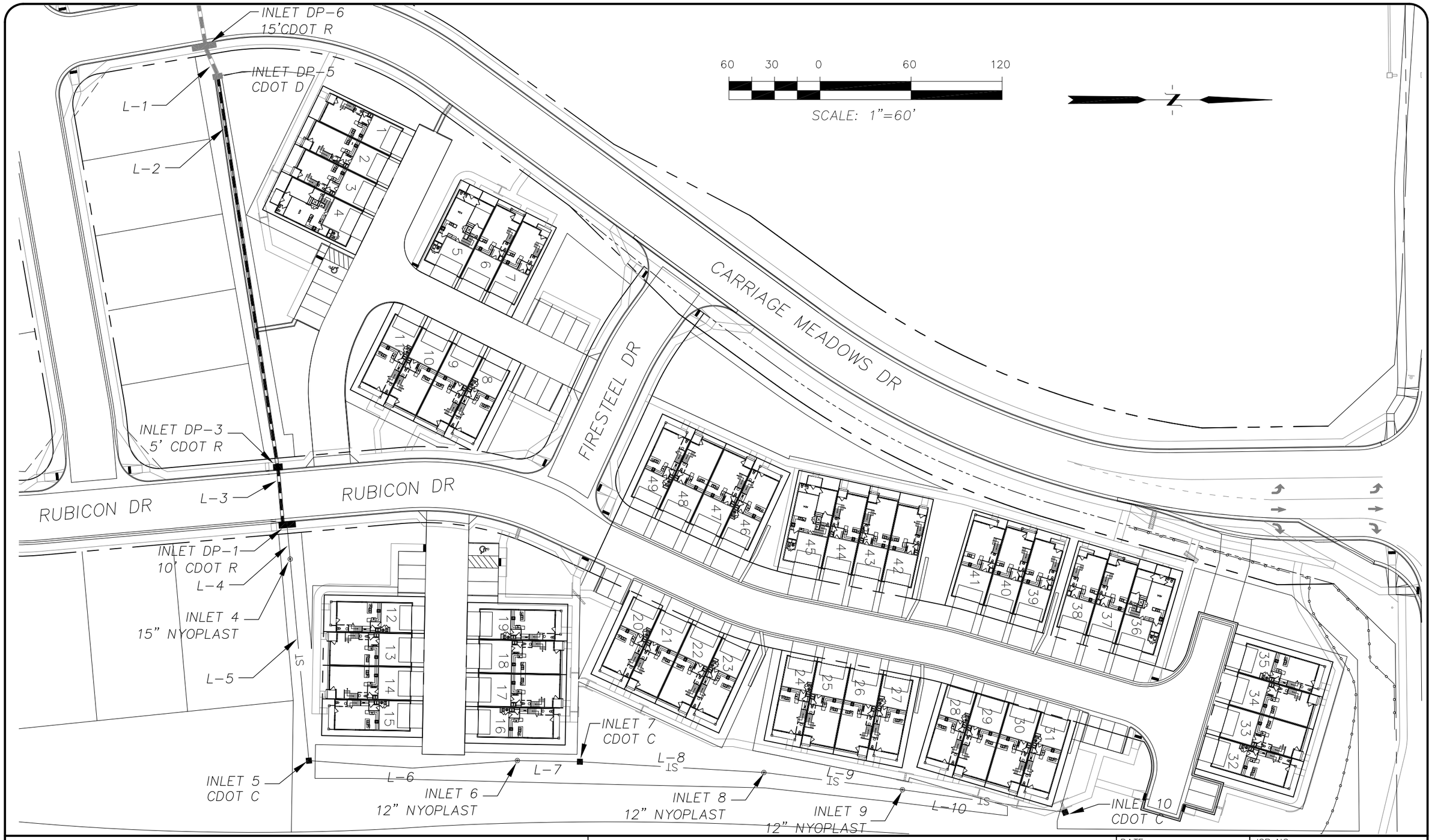
Project = Carriage Meadows South Townhomes #100.046

Inlet ID = Existing 15' CDOT Type "R" Inlet @ DP-6



Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Inlet Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from 'Q-Allow')	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	5.1	6.6	inches
				☐ Override Depths
Grate Information		MINOR	MAJOR	
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	15.00	15.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Grate Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	N/A	N/A	
Clogging Factor for Multiple Units	Clog =	N/A	N/A	
Grate Capacity as a Weir (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	N/A	N/A	cfs
Interception with Clogging	Q_{wa} =	N/A	N/A	cfs
Grate Capacity as a Orifice (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	N/A	N/A	cfs
Interception with Clogging	Q_{oa} =	N/A	N/A	cfs
Grate Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	N/A	N/A	cfs
Interception with Clogging	Q_{ma} =	N/A	N/A	cfs
Resulting Grate Capacity (assumes clogged condition)	**Q_{Grate} =**	**N/A**	**N/A**	**cfs**
Curb Opening Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	1.31	1.31	
Clogging Factor for Multiple Units	Clog =	0.04	0.04	
Curb Opening as a Weir (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	6.49	13.32	cfs
Interception with Clogging	Q_{wa} =	6.21	12.73	cfs
Curb Opening as an Orifice (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	27.14	30.71	cfs
Interception with Clogging	Q_{oa} =	25.96	29.36	cfs
Curb Opening Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	12.34	18.81	cfs
Interception with Clogging	Q_{ma} =	11.80	17.98	cfs
Resulting Curb Opening Capacity (assumes clogged condition)	**Q_{Curb} =**	**6.21**	**12.73**	**cfs**
Resultant Street Conditions		MINOR	MAJOR	
Total Inlet Length	L =	15.00	15.00	feet
Resultant Street Flow Spread (based on sheet *Q-Allow* geometry)	T =	15.0	21.4	ft.>T-Crown
Resultant Flow Depth at Street Crown	d_{CROWN} =	0.0	1.0	inches
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**6.2**	**12.7**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	6.2	12.7	cfs

APPENDIX D – STORM SEWER SCHEMATIC



P: □100□100.046□Drainage□100.046-StmSchematic.dwg Feb 12, 2020 - 4:30pm

CORE ENGINEERING GROUP

15004 1ST AVENUE S.
BURNSVILLE, MN 55306
PH: 719.570.1100
CONTACT: RICHARD L. SCHINDLER, P.E.
EMAIL: Rich@ceg1.com

CARRIAGE MEADOWS SOUTH AT LORSON RANCH
FILING NO. 2
STORM DRAIN SCHEMATIC PLAN

DATE:	JOB NO:
FEB, 2020	100.046
SCALE: H: 1"=60' V:	FIGURE NO: 1

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line size (in)	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line slope (%)	HGL down (ft)	HGL up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns line No.
1	L1, 17.5', Exist. 24" R	11.50	24 c	17.5	5694.23	5694.37	0.801	5695.51	5695.58	0.00	5695.58	End
2	L2, 258'-24"RCP	9.70	24 c	257.9	5694.47	5695.76	0.500	5695.95	5696.86	n/a	5696.86 j	1
3	L3, 36'-24" RCP	6.30	24 c	38.3	5695.86	5696.05	0.496	5697.09	5697.10	0.00	5697.10	2
4	L4, 23'-15" PVC	1.30	15 c	23.0	5696.78	5696.96	0.783	5697.31	5697.42	n/a	5697.42 j	3
5	L5, 133'-15"PVC	1.00	15 c	133.4	5697.07	5698.14	0.803	5697.57	5698.54	n/a	5698.54 j	4
6	L6, 138'-12" PVC	0.90	12 c	137.7	5698.44	5699.54	0.799	5698.80	5699.94	n/a	5699.94	5
7	L7, 41'-12" PVC	0.80	12 c	41.2	5699.64	5699.97	0.801	5700.07	5700.35	n/a	5700.35 j	6
8	L8, 12"-121' PVC	0.70	12 c	121.0	5700.07	5701.04	0.802	5700.47	5701.40	n/a	5701.40 j	7
9	L9, 92'-12" PVC	0.60	12 c	91.8	5701.14	5701.88	0.806	5701.51	5702.21	n/a	5702.21 j	8
10	L10, 98'-12" PVC	0.50	12 c	97.8	5701.98	5702.76	0.797	5702.31	5703.06	n/a	5703.06 j	9

Project File: 100.0465yr.stm | Number of lines: 10 | Run Date: 12-13-2018

NOTES: c = cir; e = ellip; b = box; Known Qs only ; j - Line contains hyd. jump.

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line size (in)	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line slope (%)	HGL down (ft)	HGL up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns line No.
1	L1, 17.5'-Exist.24" R	25.20	24 c	17.5	5694.23	5694.37	0.801	5696.23*	5696.45*	0.00	5696.45	End
2	L2, 258'-24" RCP	21.30	24 c	257.9	5694.47	5695.76	0.500	5696.73*	5699.02*	0.00	5699.02	1
3	L3, 36'-22" RCP	14.40	24 c	38.3	5695.86	5696.05	0.496	5699.41*	5699.57*	0.00	5699.57	2
4	L4, 23'-15" PVC	4.00	15 c	23.0	5696.78	5696.96	0.783	5699.73*	5699.82*	0.00	5699.82	3
5	L5, 133'-15" PVC	3.40	15 c	133.4	5697.07	5698.14	0.803	5699.86*	5700.23*	0.00	5700.23	4
6	L6, 138'-12" PVC	3.00	12 c	137.7	5698.44	5699.54	0.799	5700.23*	5701.21*	0.00	5701.21	5
7	L7, 41'-12" PVC	2.80	12 c	41.2	5699.64	5699.97	0.801	5701.24*	5701.49*	0.00	5701.49	6
8	L8, 121'-12" PVC	2.40	12 c	121.0	5700.07	5701.04	0.802	5701.55	5702.03	0.00	5702.03	7
9	L9, 92'-12" PVC	2.00	12 c	91.8	5701.14	5701.88	0.806	5702.07	5702.48	n/a	5702.48 j	8
10	L10, 98'-12" PVC	1.60	12 c	97.8	5701.98	5702.76	0.797	5702.67	5703.30	n/a	5703.30 j	9

Project File: 100.046100yr.stm | Number of lines: 10 | Run Date: 12-13-2018

NOTES: c = cir; e = ellip; b = box; Return period = 100 Yrs. ; *Surcharged (HGL above crown). ; j - Line contains hyd. jump.

APPENDIX E – Carriage Meadows South at Lorson Ranch FDR Full Spectrum Pond G1/G2

FINAL DRAINAGE PLAN

CARRIAGE MEADOWS SOUTH
AT
LORSON RANCH FILING NO. 1

SF 17-011

AUGUST 10, 2017

Prepared for:

Lorson, LLC
212 N. Wahsatch Ave, Suite 301
Colorado Springs, Colorado 80903
(719) 635-3200

Prepared by:

Core Engineering Group, LLC
15004 1ST Avenue South
Burnsville, MN 55306
(719) 570-1100

Project No. 100.030

CORE
ENGINEERING GROUP

TABLE OF CONTENTS

ENGINEER'S STATEMENT

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

Richard L. Schindler, P.E. #33997 Date
For and on Behalf of Core Engineering Group, LLC

OWNER'S STATEMENT

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

Lorson, LLC 8/29/17
Date

By
Jeff Mark

Title
Manager

Address
212 N. Wahsatch Avenue, Suite 301, Colorado Springs, CO 80903

FLOODPLAIN STATEMENT

To the best of my knowledge and belief, this development is located within a designated floodplain as shown on Flood Insurance Rate Map Panel No. 08041C0957 F, Dated March 17, 1997, Revised to Reflect LOMR Effective Aug. 29, 2007. (See Appendix A, FEMA FIRM Exhibit)

Richard L. Schindler, #33997, Date
For and on Behalf of Core Engineering Group, LLC

EL PASO COUNTY

Filed in accordance with the requirements of the El Paso County Land Development Code, Drainage Criteria Manual, Volume 1 and 2, and Engineering Criteria Manual, As Amended.

Approved
By:Jennifer Irvine, County Engineer
Date:09/07/2017
El Paso County Department of Public Works

(Jennifer Irvine), County Engineer / ECM Administrator Date

Conditions:

the two pipes have a total capacity of 28.6cfs in the 100-year storm event. See Appendix E for the drainage memo from HDR regarding design of the two 24" storm sewer culverts.

Design Point 32

Design Point 32 is the total flow in the 36" pipe to Jimmy Camp Creek. The total flow consists of flow from Pond G1/G2 and Pond G3 and is 4.5cfs in the 5-year storm event and 65.7cfs in the 100-year storm event. All flow discharges to Jimmy Camp Creek onto a rip rap pad. The existing flow to Jimmy Camp per the UDCF pre-development flow rates are 69cfs in the 100-year storm event. The proposed runoff rate is less than the pre-development flow rate and is in conformance with the MDDP/Preliminary Drainage Report for Carriage Meadows South at Lorson Ranch prepared by Core Engineering Group [11]

6.0 DETENTION AND WATER QUALITY PONDS

Detention and Storm Water Quality for Carriage Meadows South at Lorson Ranch Filing No. 1 is required per El Paso County criteria. We have implemented the Full Spectrum approach for detention for Carriage Meadows South at Lorson Ranch Filing No. 1 per the Denver Urban Drainage Districts specifications. There is one interim detention pond and two permanent full spectrum ponds proposed for this development. The interim detention pond does not have full spectrum or water quality features and is strictly to slightly reduce runoff so the downstream storm sewer (48" Storm Sewer) can accommodate the increased flows from the developed conditions. The two permanent full spectrum ponds incorporate storm water quality features. The detention ponds in Carriage Meadows South at Lorson Ranch Filing No. 1 will be owned and maintained by the Lorson Ranch Metropolitan District.

Interim Pond G1.7 (Interim District Pond)

This is an interim detention pond located north of the residential areas and west of Carriage Meadows Drive. If the Brownsville Subdivision No. 2 develops as part of Lorson Ranch all or a portion of this pond could be moved to a more effective location to the southwest. Interim Pond G1.7 reduces the size of the downstream storm sewer to a 48" diameter that flows south to Swale G1.8. The smaller size outfall pipe is necessary to maintain cover over the pipe. This pond was modeled in Hydraflow and does not include water quality features. Pond G1.7's developed inflow hydrograph has a 35 minute duration and the outflow hydrograph stores and drains the pond volume in around 110 minutes. Pond G1.7 will fill and drain out in less than two hours because of the large 48" diameter storm sewer outfall pipe. Pond G1.7 does not overdetain runoff when compared to existing conditions. When development occurs upstream of this interim pond the pond must be updated to meet El Paso County requirements for full spectrum ponding.

- Incoming flows: 107cfs/196cfs in the 5-year and 100-year storm event
- Detained flows: 62.7cfs/95cfs in the 5-year and 100-year storm event
- Pipe Outlet: 48" RCP at 0.5%
- 5-yr WSEL= 5695.10, 100-yr WSEL=5696.94
- Volume: 1.22 ac-ft storage in 5-year, 2.40 acre-ft storage in 100-year

Swale G1.8 (District Facility)

This swale is located west of the residential areas adjacent to Marksheffel Road. The swale does have some storage volume in it which is why it is included in the hydraulic calculations. If the Brownsville Subdivision No. 2 develops as part of Lorson Ranch all or a portion of this swale could be moved to a more effective location or changed into a pond. Swale G1.8 helps reduces the size of storm sewer necessary to convey drainage from Design Point 6 to Pond G1. This swale was modeled in Hydraflow and does not include water quality features.

- Incoming flows: 74cfs/120cfs in the 5-year and 100-year storm event
- Detained flows: 52.8cfs/105cfs in the 5-year and 100-year storm event
- Pipe Outlet: 42" RCP at 0.5%
- 5-yr WSEL= 5692.86, 100-yr WSEL=5694.33

- Volume: 0.9 ac-ft storage in 5-year, 1.48 acre-ft storage in 100-year

Hydraulic Design of the "G1" portion of Pond G1/G2 (District Facility)

This analysis was added to provide a hydraulic model of the "G1" side of Pond G1/G2 to ensure the storm sewer interconnection pipes were sized adequately. See Pond G1/G2 for full spectrum calculations. The hydraulic model utilized the storage volume in Pond G1.7 and Swale G1.8 (tributary areas) and the site runoff directly entering the G1 side to determine the total flow entering the G1 side. The G1 side (north of Lorson Boulevard) was then hydraulically modeled in Hydraflow to determine the flow in the interconnect pipe flowing to the G2 side (south). The interconnection pipe will also serve as an emergency overflow with a capacity of over 120cfs. In addition, a sideyard overflow swale will also be constructed which has a capacity of 100cfs.

- Incoming flows: 56cfs/113.5cfs in the 5-year and 100-year storm event
- Outflow to "G2" side: 28cfs at elevation 5687.92 in the 5-year storm event
- Outflow to "G2" side: 58cfs at elevation 5689.12 in the 100-year storm event
- Volume: 2.25 ac-ft storage in 5-year, 3.79 acre-ft storage in 100-year
- Pipe Outlet: 48" RCP at 0.4%

Detention Pond G1/G2 (Full Spectrum Design), (District Facility)

This is an on-site permanent full spectrum detention pond that includes water quality. Pond G1/G2 is designed as a single pond in the UDCF Full Spectrum spreadsheets. The full spectrum print outs are in the appendix of this report. See map in appendix for watershed areas. This pond is sized to provide full spectrum and water quality for the Brownsville Subdivision No. 2 should it become a part of Lorson Ranch.

- Watershed Ares: 96 acres
- Watershed Imperviousness: 79%
- Hydrologic Soils Group A, B, C/D
- Zone 1 WQCV: 2.301 ac-ft, WSEL: 5683.93
- Zone 2 EURV: 8.104 ac-ft, WSEL: 5686.29
- Zone 3 (100-yr): 12.881ac-ft, WSEL: 5687.93
- Pipe Outlet: 36" RCP at 0.4%
- 5-yr outflow = 4.2cfs, 100-yr outflow = 55.6cfs

Detention Pond G3 (Full Spectrum Design), (District Facility)

This is an on-site permanent full spectrum detention pond that includes water quality. Pond G3 is designed per the UDCF Full Spectrum spreadsheets. The full spectrum print outs are in the appendix of this report. See map in appendix for watershed areas.

- Watershed Ares: 6.02 acres
- Watershed Imperviousness: 65%
- Hydrologic Soils Group B
- Zone 1 WQCV: 0.11 ac-ft, WSEL: 5684.94
- Zone 2 EURV: 0.39 ac-ft, WSEL: 5686.41
- Zone 3 (100-yr): 0.51 ac-ft, WSEL: 5686.98
- Pipe Outlet: 18" RCP at 0.5%
- 5-yr outflow = 0.3cfs, 100-yr outflow = 10.1cfs

Water Quality Design

Water Quality for all the G1, G2, and G3 basins is provided in the on-site full spectrum ponds. The G4 and G5 basins are from the backyards of residential lots and open space and have been reduced in area as much as possible. The WQ for the G6 basins is provided by an existing sand filter basin in the east barrow ditch of Marksheffel Road near the SW corner of this site. The sand filter basin was constructed as part of the Marksheffel Road project by El Paso County. The sand filter basin was designed for all of Marksheffel Road but we have diverted most of the northern sections of Marksheffel Road (Basins G1.8a/b) into Pond G1/G2 which will allow the flows in the G6 basins to be treated by the existing sand filter basin. The main reason for diverting runoff is that there is not enough elevation difference to construct a pond in the SW corner with a suitable outfall.

7.0 DRAINAGE AND BRIDGE FEES

Carriage Meadows South at Lorson Ranch Filing No. 1 is located within the Jimmy Camp Creek drainage basin which is currently a fee basin in El Paso County. Current El Paso County regulations require drainage and bridge fees to be paid for platting of land as part of the plat recordation process. Lorson Ranch Metro District has negotiated a development agreement with El Paso County which defines major drainage infrastructure to be constructed as part of the district.

Lorson Ranch Metro District will compile and submit to the county on a yearly basis the Drainage and bridge fees for the approved plats, and shall show all credits they have received for the same yearly time frame.

Carriage Meadows South at Lorson Ranch Filing No. 1 contains 106.64 acres. The 106.64 acres will be assessed Drainage, Bridge and Surety fees. This project consists of 34.02 acres of open space (7% impervious), 13.69 acres of commercial (95% impervious), and the remaining 58.93 acres is residential (65% impervious) for a total impervious percentage of 50.4%

The 2017 drainage fees are $15,720, bridge fees are $735 and Drainage Surety fees are $7,000 per impervious acre. The fees are due at plat recordation and are calculated as follows:

Table 1: Drainage/Bridge Fees

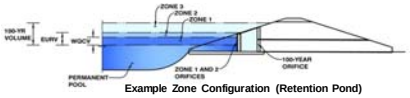
Type of Land Use	Total Area (ac)	Imperviousness	Drainage Fee	Bridge Fee	Surety Fee
Residential	58.93	65%	$602,657	$28,177	$268,359
Open Space	34.02	7%	$37,435	$1,750	$16,669
Commercial	13.69	95%	$204,446	$9,559	$91,038
		Total	$844,538	$39,486	$376,066

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: Carriage Meadows South at Lorson Ranch

Basin ID: Pond G1/G2 Full Spectrum Detention (v3.07)



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	EDB	
Watershed Area =	96.00	acres
Watershed Length =	3,730	ft
Watershed Slope =	0.008	ft/ft
Watershed Imperviousness =	79.00%	percent
Percentage Hydrologic Soil Group A =	46.0%	percent
Percentage Hydrologic Soil Group B =	23.0%	percent
Percentage Hydrologic Soil Groups C/D =	31.0%	percent
Desired WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	
Water Quality Capture Volume (WQCV) =	2.577	acre-feet
Excess Urban Runoff Volume (EURV) =	8.814	acre-feet
2-yr Runoff Volume (P1 = 1.16 in.) =	6.842	acre-feet
5-yr Runoff Volume (P1 = 1.44 in.) =	8.912	acre-feet
10-yr Runoff Volume (P1 = 1.68 in.) =	10.804	acre-feet
25-yr Runoff Volume (P1 = 1.92 in.) =	13.017	acre-feet
50-yr Runoff Volume (P1 = 2.16 in.) =	14.962	acre-feet
100-yr Runoff Volume (P1 = 2.42 in.) =	17.363	acre-feet
500-yr Runoff Volume (P1 = 0 in.) =	0.000	acre-feet
Approximate 2-yr Detention Volume =	6.451	acre-feet
Approximate 5-yr Detention Volume =	8.419	acre-feet
Approximate 10-yr Detention Volume =	10.033	acre-feet
Approximate 25-yr Detention Volume =	11.239	acre-feet
Approximate 50-yr Detention Volume =	11.916	acre-feet
Approximate 100-yr Detention Volume =	12.731	acre-feet

Optional User Override 1-hr Precipitation

1.16	inches
1.44	inches
1.68	inches
1.92	inches
2.16	inches
2.42	inches
	inches

Stage-Storage Calculation

Zone 1 Volume (WQCV) =	2.577	acre-feet
Zone 2 Volume (EURV - Zone 1) =	6.236	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	3.918	acre-feet
Total Detention Basin Volume =	12.731	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	**user**	acre-feet

Depth Increment = 1 ft

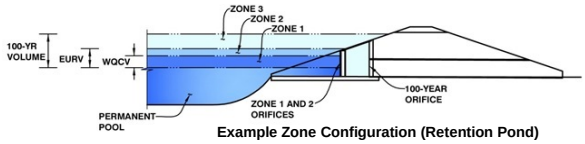
Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	561	0.013		
5682.33	--	0.33	--	--	--	43,673	1.003	6,866	0.158
5683	--	1.00	--	--	--	47,723	1.096	37,437	0.859
5684	--	2.00	--	--	--	91,223	2.094	106,477	2.444
5685	--	3.00	--	--	--	108,717	2.496	207,357	4.760
5686	--	4.00	--	--	--	116,519	2.675	319,975	7.346
5-yr=5686.69	--	4.69	--	--	--	123,570	2.837	402,805	9.247
5687	--	5.00	--	--	--	126,736	2.909	441,603	10.138
5688	--	6.00	--	--	--	133,533	3.065	571,737	13.125
100-yr=5688.48	--	6.48	--	--	--	138,115	3.171	636,933	14.622
5689	--	7.00	--	--	--	142,697	3.276	709,944	16.298
5690	--	8.00	--	--	--	146,770	3.369	854,678	19.621

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project:

Basin ID:



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.06	2.577	Orifice Plate
Zone 2 (EURV)	4.54	6.236	Orifice Plate
Zone 3 (100-year)	5.88	3.918	Weir&Pipe (Restrict)
		12.731	Total

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

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

Calculated Parameters for Underdrain

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

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	1.536E-01	ft^2
Depth at top of Zone using Orifice Plate =	4.54	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	18.20	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	22.12	sq. inches (use rectangular openings)	Elliptical Slot Area =	N/A	ft^2

Calculated Parameters for Plate

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	1.51	3.03					
Orifice Area (sq. inches)	22.12	22.12	22.12					

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

User Input: Vertical Orifice (Circular or Rectangular)

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

Calculated Parameters for Vertical Orifice

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

	Zone 3 Weir	Not Selected			Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	4.15	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	5.82	N/A	feet
Overflow Weir Front Edge Length =	4.00	N/A	feet	Over Flow Weir Slope Length =	10.14	N/A	feet
Overflow Weir Slope =	6.00	N/A	H:V (enter zero for flat grate)	Grate Open Area / 100-yr Orifice Area =	4.02	N/A	should be ≥ 4
Horiz. Length of Weir Sides =	10.00	N/A	feet	Overflow Grate Open Area w/o Debris =	28.39	N/A	ft^2
Overflow Grate Open Area % =	70%	N/A	%, grate open area/total area	Overflow Grate Open Area w/ Debris =	14.19	N/A	ft^2
Debris Clogging % =	50%	N/A	%				

Calculated Parameters for Overflow Weir

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

	Zone 3 Restrictor	Not Selected			Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.20	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	7.07	N/A	ft^2
Outlet Pipe Diameter =	36.00	N/A	inches	Outlet Orifice Centroid =	1.50	N/A	feet
Restrictor Plate Height Above Pipe Invert =	36.00		inches	Half-Central Angle of Restrictor Plate on Pipe =	3.14	N/A	radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

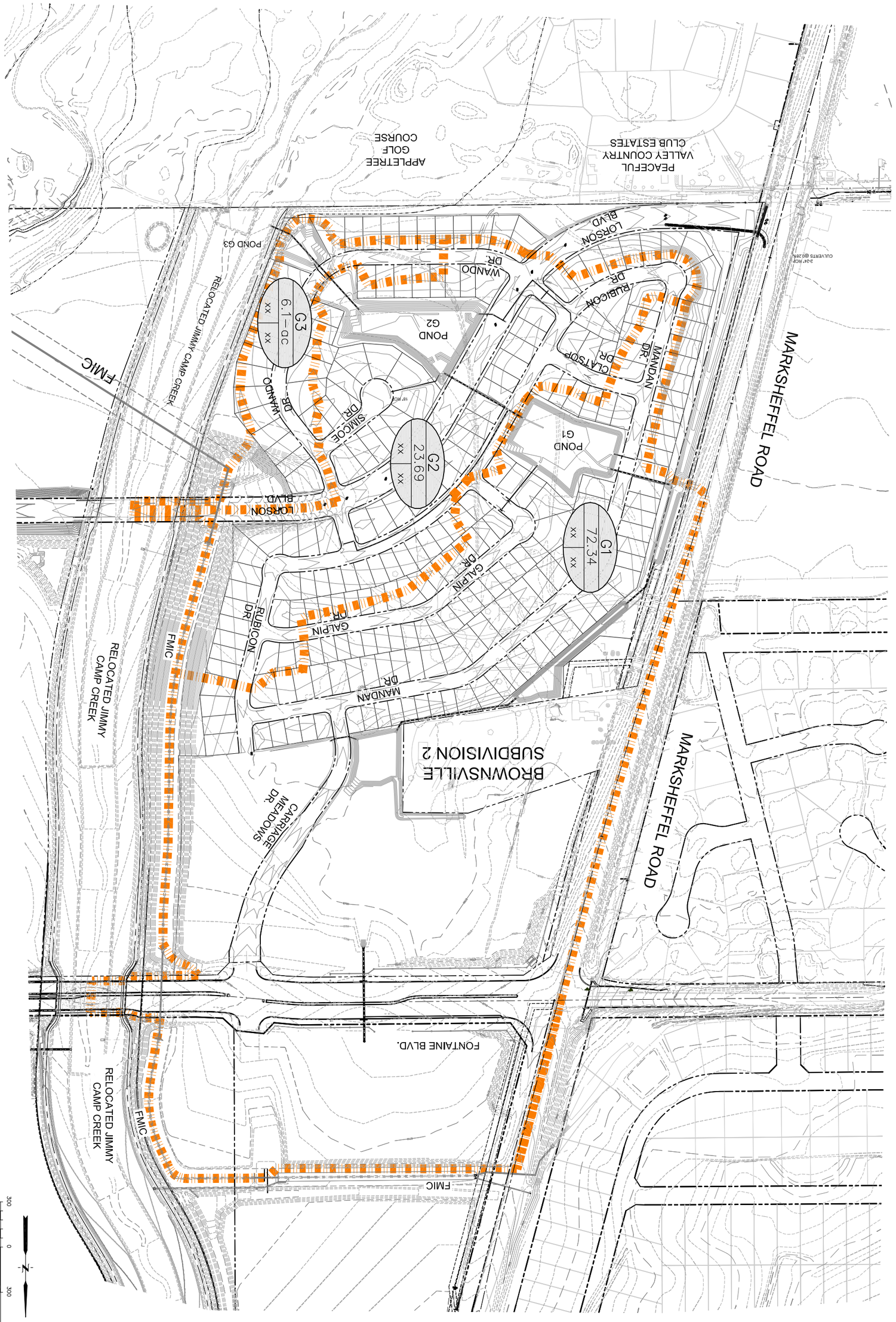
User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	8.00	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	1.15	feet
Spillway Crest Length =	50.00	feet	Stage at Top of Freeboard =	10.15	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	3.37	acres
Freeboard above Max Water Surface =	1.00	feet			

Calculated Parameters for Spillway

Routed Hydrograph Results

Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.16	1.44	1.68	1.92	2.16	2.42	0.00
Calculated Runoff Volume (acre-ft) =	2.577	8.814	6.842	8.912	10.804	13.017	14.962	17.363	0.000
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	2.577	8.806	6.841	8.905	10.803	13.008	14.953	17.352	#N/A
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.01	0.03	0.11	0.29	0.44	0.65	0.00
Predevelopment Peak Q (cfs) =	0.0	0.0	0.5	2.9	10.2	27.6	42.0	62.5	0.0
Peak Inflow Q (cfs) =	31.0	103.1	80.7	104.3	125.7	150.4	171.9	199.4	#N/A
Peak Outflow Q (cfs) =	1.5	4.0	3.0	4.2	10.4	22.8	36.7	55.6	#N/A
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	1.4	1.0	0.8	0.9	0.9	#N/A
Structure Controlling Flow =	Plate	Overflow Grate 1	Plate	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	#N/A
Max Velocity through Grate 1 (fps) =	N/A	0.01	N/A	0.0	0.2	0.7	1.1	1.8	#N/A
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	#N/A
Time to Drain 97% of Inflow Volume (hours) =	38	62	57	62	63	62	61	60	#N/A
Time to Drain 99% of Inflow Volume (hours) =	**40**	67	61	67	69	69	69	68	#N/A
Maximum Ponding Depth (ft) =	1.93	4.29	3.60	4.32	4.80	5.25	5.58	5.93	#N/A
Area at Maximum Ponding Depth (acres) =	2.01	2.74	2.60	2.75	2.86	2.95	3.00	3.05	#N/A
Maximum Volume Stored (acre-ft) =	2.301	8.104	6.290	8.186	9.532	10.870	11.852	12.881	#N/A



DETENTION POND WATERSHEDS
DRAINAGE PLAN
CARRIAGE MEADOWS SOUTH

DATE	JANUARY, 2017
PROJECT NO.	100.030
SHEET NUMBER	1
TOTAL SHEETS:	1

DRAWN: RLS
DESIGNED: LAB
CHECKED: LAB

NO.	DESCRIPTION	DATE

PROJECT:
CARRIAGE MEADOWS SOUTH
FILING NO. 1
FONTAINE BLVD. – OLD GLORY DRIVE
EL PASO COUNTY, COLORADO

PREPARED FOR:
LORSON, LLC
212 N. WAHSATCH AVE., SUITE 301
COLORADO SPRINGS, COLORADO 80903
(719) 635-3200
CONTACT: JEFF MARK

CORE
ENGINEERING GROUP
15004 1ST AVE. S.
BURNSVILLE, MN 55306
PH: 719.570.1100
CONTACT: RICHARD L. SCHINDLER, P.E.
EMAIL: Rich@ceg1.com

MAP POCKET

LEGEND

BASIN BOUNDARY

BASIN DESIGN POINT

BASIN
X AC
X.X | X.X

BASIN I.D.
ACREAGE
5 YR/100 YR CFS

DIRECTION OF FLOW

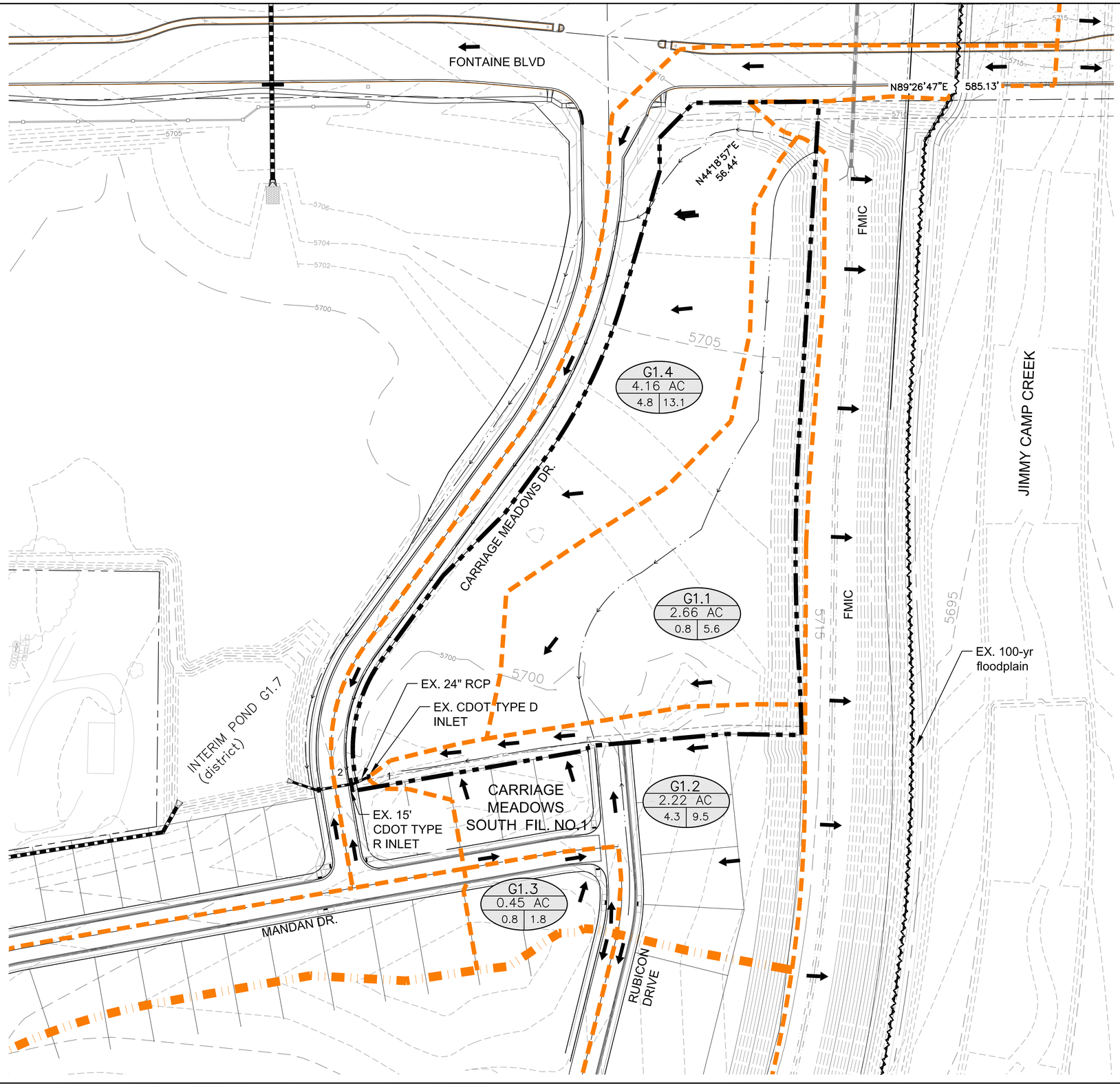
6690 EXISTING CONTOUR

TIME OF CONCTRATION

PROJECT SITE

100-YR FLOODPLAIN

DESIGN POINT SUMMARY TABLE				
DESIGN POINT	BASIN	DRAINAGE AREA (AC)	RUNOFF 5 YR (CFS)	RUNOFF 100 YR (CFS)
1	G1.1–G1.3	5.33	5.1	15.1
2	G1.1–G1.4	9.49	9.7	27.7



N

60 30 0 60 120

SCALE: 1"=60'

CORE ENGINEERING GROUP
15004 1ST AVENUE S.
BURNSVILLE, MN 55306
PH: 719.570.1100
CONTACT: RICHARD L SCHINDLER, P.E.
EMAIL: rlsdesq1.com

NO. | DESCRIPTION | DATE

PREPARED FOR:
LORSON LLC
212 NORTH WAHSATCH AVE, SUITE 301
COLORADO SPRINGS, COLORADO 80903 (719) 635-3200
CONTACT: JEFF MARK

PROJECT:
CARRIAGE MEADOWS SOUTH FILING NO. 2
FONTAINE BLVD – CARRIAGE MEADOWS DRIVE
EL PASO COUNTY, COLORADO

DRAWN: LAB
DESIGNED: LAB
CHECKED: RLS

EXISTING CONDITIONS CARRIAGE MEADOWS SOUTH AT LORSON RANCH FILING NO. 2

DATE:
FEBRUARY, 2020

PROJECT NO.
100.046

SHEET NUMBER
1

TOTAL SHEETS: 1

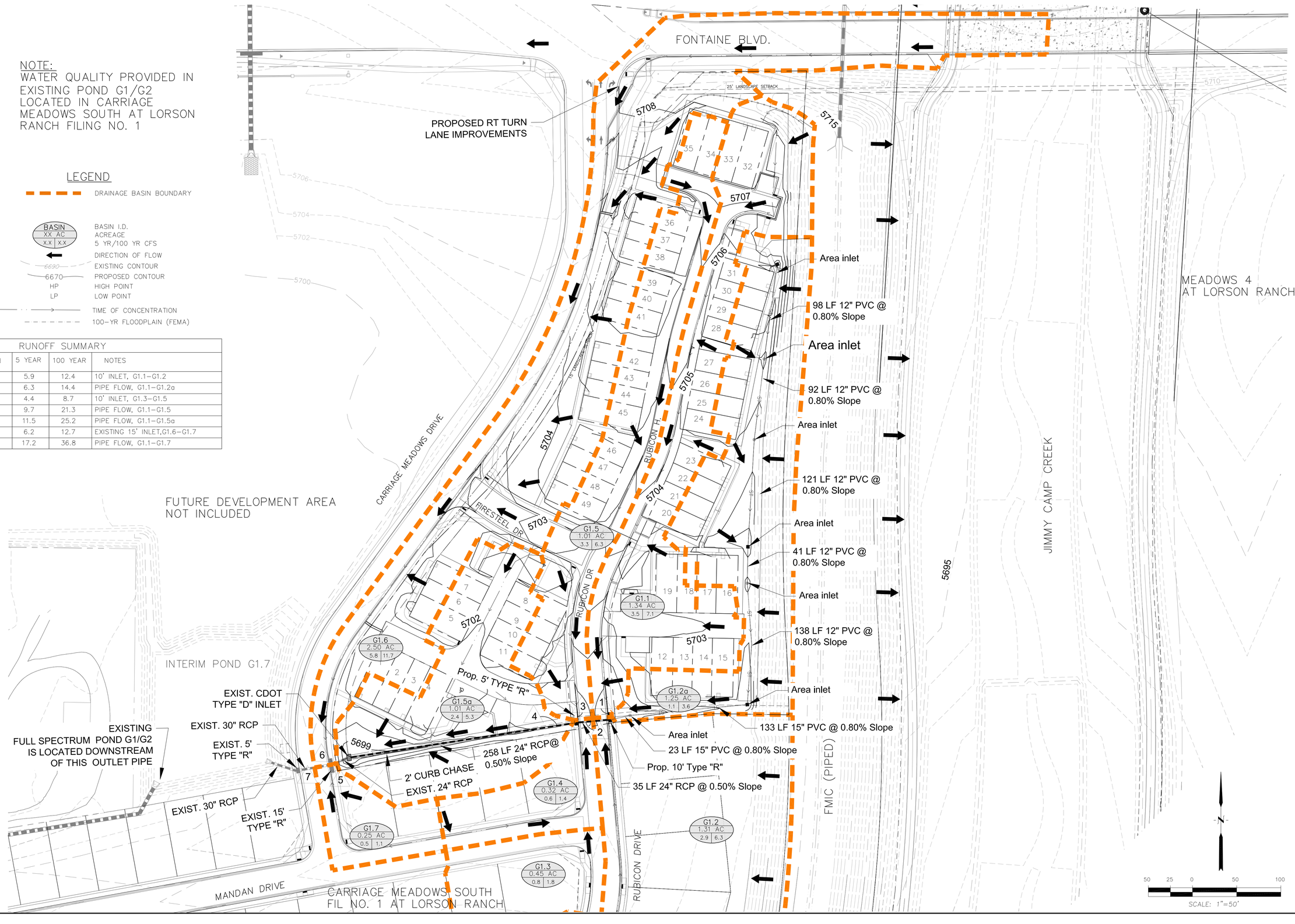
NOTE:
WATER QUALITY PROVIDED IN EXISTING POND G1/G2 LOCATED IN CARRIAGE MEADOWS SOUTH AT LORSON RANCH FILING NO. 1

LEGEND

- DRAINAGE BASIN BOUNDARY
- BASIN I.D. / ACREAGE / 5 YR/100 YR CFS (BASIN XX AC, X.X | X.X)
- DIRECTION OF FLOW
- 6690 EXISTING CONTOUR
- 6670 PROPOSED CONTOUR
- HP HIGH POINT
- LP LOW POINT
- TIME OF CONCENTRATION
- 100-YR FLOODPLAIN (FEMA)

RUNOFF SUMMARY

DESIGN POINT	5 YEAR	100 YEAR	NOTES
1	5.9	12.4	10' INLET, G1.1-G1.2
2	6.3	14.4	PIPE FLOW, G1.1-G1.2a
3	4.4	8.7	10' INLET, G1.3-G1.5
4	9.7	21.3	PIPE FLOW, G1.1-G1.5
5	11.5	25.2	PIPE FLOW, G1.1-G1.5a
6	6.2	12.7	EXISTING 15' INLET,G1.6-G1.7
7	17.2	36.8	PIPE FLOW, G1.1-G1.7



CORE ENGINEERING GROUP
15004 1ST AVE. S.
BURNSVILLE, MN 55306
PH: 719.570.1100
CONTACT: RICHARD L. SCHINDLER, P.E.
EMAIL: Rich@eeg1.com

PREPARED FOR:
LORSON, LLC
212 N. WAHSATCH AVE., SUITE 301
COLORADO SPRINGS, COLORADO 80903
(719) 635-3200
CONTACT: JEFF MARK

PROJECT:
CARRIAGE MEADOWS SOUTH FILING NO. 2
FONTAINE BLVD-CARRIAGE MEADOWS DRIVE
EL PASO COUNTY, COLORADO

NO. | DESCRIPTION | DATE

DRAWN: RLS
DESIGNED: LAB
CHECKED: LAB

DEVELOPED CONDITIONS CARRIAGE MEADOWS SOUTH AT LORSON RANCH FIL NO. 2

DATE
FEBRUARY, 2020

PROJECT NO.
100.046

SHEET NUMBER
1

TOTAL SHEETS: 1