Architectural
Structural
Geotechnical

RMG
Engineers / Architects

Materials Testing
Forensic
Civil/Planning

FINAL DRAINAGE REPORT

Foundation Lutheran Church

Towners Ave
Tract C, Paint Brush Hills Filing No. 13A
Falcon, Colorado

PREPARED FOR:

Colorado Commercial Construction
12325 Oracle Blvd, Suite 120
Colorado Springs, CO 80921

JOB NO. 191726

October 31, 2023

PCD File No. PPR2321

PCD File No. SF2321

SIGNATURE PAGE

TR C PAINT BRUSH HILLS, FILING NO. 13A

ENGINEER'S STATEMENT

This report and plan for the drainage design of Tract C, Paint Brush Hills Filing No. 13A was prepared by me (or under my direct supervision) and is correct to the best of my knowledge and belief. Said report and plan has been prepared in accordance with the El Paso County Drainage Criteria Manuals Volumes 1 and 2 and is in conformity with the master plan of the drainage basin. I understand that El Paso County does not and will not assume liability for drainage facilities designed by others. I accept responsibility for any liability caused by any negligent acts, errors or omissions on my part in the preparing this report.

Respectfully Submitted,

RMG – Rocky Mountain Group

David Walker, P.E.
Sr. Civil Project Manager

OWNER/DEVELOPER'S STATEMENT

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

Foundation Lutheran Church President, John Wohlrabe
Name of Owner/Developer, Title

Authorized Signature 10/30/23 Date

Foundation Lutheran Church
Business Name

10367 Mt. Evans Dr., Peyton, CO 80831
Address

EL PASO COUNTY STATEMENT

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

Joshua Palmer, P.E. Date
County Engineer / ECM Administrator

Conditions:

TABLE OF CONTENTS

I. PURPOSE

This report is a Final Drainage Report for Foundation Lutheran Church for the development of a church.

The purpose of this report is to identify on-site and off-site drainage patterns, assess stormwater conditions per delineated basin and sub-basins, demonstrate adequate design standards for storm water flow and release into the existing storm water system or right-of-way, and provide a narrative for any other drainage considerations related to the development of this parcel.

II. GENERAL LOCATION AND DESCRIPTION

A. LOCATION

The proposed development of Foundation Lutheran Church is located at the address of Towners Av in Falcon, Colorado in El Paso County within the Paint Brush Hills subdivision. The parcel schedule number is 5225208001 and the legal description is currently Tract C, Paint Brush Hills Filing No. 13A. The parcel is located in the West half of Section 25, Township 12 South, Range 65 West of the 6th P.M. El Paso County, Colorado. The site is bordered to the north by Londonderry Dr, to the east by Towners Ave, and to the south and west by residential single-family homes. The names and descriptions of surrounding platted developments can be seen on plan sets and appendix documents:

B. DESCRIPTION OF PROPERTY – EXISTING CONDITIONS

The project site is approximately 259,865 square feet (5.966 acres) and consists of undeveloped natural vegetation. There is existing curb and gutter along Londonderry Drive and Towners Avenue.

The existing percent imperviousness is approximately 0 percent on Tract C. The existing vegetation consists of shrubs and native grasses.

The existing topography consists of grades between 1 and 25 percent. Drainage patterns sheet flow south across the parcel to a drainage swale that directs flow to the southwest corner.

There is a F.E.S. outlet at the southeast corner of the site that is connected to a 24" RCP storm drain pipe that goes easterly under Towners Ave. A temporary swale runs across the site on the south portion towards the southwest corner, where an F.E.S. inlet is connect to a 36" RCP storm drain pipe. The 36" RCP storm drain pipe leaves the site in a southerly direction and goes to a regional detention facility located off-site known as Pond B1. The detention facility is within a platted tract of land with ownership and maintenance by the Paint Brush Hills Metropolitan District.

The site is not located within a streamside zone.

C. EXISTING SOILS

The soils indicative to the site are classified as Pring coarse sandy loam by the USDA Soil Conservation Service and are listed as NRCS (National Resources Conservation Service) Hydrologic Soil Group B. These soils have a moderate infiltration rate when thoroughly wet and have a moderate rate of water transmission. The USDA Soil Map is provided in the Appendix.

D. EXISTING DRAINAGE

This parcel is located in the Falcon Drainage Basin.

The project site does not lie within a designated flood plain according to information published in the Federal Emergency Management Agency Floodplain Map No. 08041C0551G, dated December 7, 2018. The FEMA Floodplain map is provided in the Appendix showing it lies within Zone X, a minimal flood hazard area.

There are no known non-stormwater discharges that contribute to the storm water systems on site and downstream, both private and public.

The existing drainage entering from off-site has been accounted for and has no impact to the development.

E. DESCRIPTION OF PROPERTY – PROPOSED CONDITIONS

The proposed development consists of a single story church approximately 9,600 square feet.

There is no existing vehicle entry access point to the property. The proposed development will have two vehicle entry access points, one access directly across from Triborough Trail and the other directly across from the entrance to the Paint Brush Hills Metro District Office.

The proposed development will require an approximate limits of disturbance, including the right of way improvements of pedestrian sidewalk with ADA curb ramps, curb cuts, and utility work of approximately 6.41 acres of drainage area. The limits of disturbance do not disturb the existing hillsides. The grading limits are kept within the setbacks wherever possible and the developed conditions remain consistent with the historical drainage pattern of the subdivision. A sub-basin delineation sheet for the proposed conditions is provided in the appendix.

III. DRAINAGE BASINS AND SUB-BASINS

A. EXISTING MAJOR DRAINAGE BASIN AND SUB-BASINS

According to the "Final Drainage Report for Paint Brush Hills – Phase 2 (Filing No. 13)", by Classic Consulting Engineers & Surveyors LLC dated June 2008:

> "At Design Point 10 (Q_5 = 11 cfs and Q_{100} = 21 cfs) and existing 24" RCP storm sewer will be allowed to continue to collect flows off of the undeveloped future school site. As stated in this

report, upon development of this school site, the maximum flow allowed to enter this facility will remain the (Q_5 = 11 cfs and Q_{100} = 21 cfs)."

"The release from Design Point 10 will temporarily travel across the south portion of the future commercial site within a swale towards Design Point 11. Upon development of this commercial area, it is anticipated that the temporary swale be removed and the 24" RCP be extended to Design Point 11. At this location, the maximum developed flow allowed to discharge from the commercial site is (Q_5 = 23 cfs and Q_{100} = 45 cfs). This flow, combined with the discharge from Design Point 10 equals the total developed flow allowed to enter the public storm system at Design Point 11 (Q_5 = 23 cfs and Q_{100} = 45 cfs). These flows are then conveyed in a southerly direction in a 36" RCP storm sewer."

The parcel is delineated into sub-basins according to the existing and proposed grading for existing and developed conditions. A drainage plan of the delineated basins for existing conditions can be found in the Appendix.

Basin E is the entirety of the parcel to be redeveloped representing existing conditions in one on-site basin. The Final Drainage Report for Paint Brush Hills – Phase 2 (Filing No. 13), by Classic Consulting Engineers & Surveyors LLC dated June 2008 shows this property as sub-basin T and sub-basin S.

Sub-basin E-1 (6.41 ac.; Q_5 = 1.37 cfs, Q_{100} = 10.05 cfs) is the entire property that consists of all natural vegetation. The basin flows south across the parcel to a temporary swale that directs flow to the existing F.E.S. inlet in the southwest corner of the site, also known as Existing Point 1 (EP1).

Existing Point 1 (EP1) is the existing design point representing the F.E.S. in the southwest corner of the site that is connected to an existing 36" RCP storm drain pipe that runs southerly off-site and eventually drains into an existing detention facility known as Pond B1. The Final Drainage Report for Paint Brush Hills – Phase 2 (Filing No. 13), by Classic Consulting Engineers & Surveyors LLC dated June 2008 shows this as design point 11 with an allowable release rate of 23 cfs for the minor storm event (5-year storm) and 45 cfs for the major storm event (100-year storm).

Existing Point 2 (EP2) is the existing design point representing the F.E.S. outlet in the southeast corner of the site that is connected to an existing 24" RCP storm drain pipe under Towners Ave. The Final Drainage Report for Paint Brush Hills – Phase 2 (Filing No. 13), by Classic Consulting Engineers & Surveyors LLC dated June 2008 shows this as design point 10 with an allowable release rate of 11 cfs for the minor storm event (5-year storm) and 21 cfs for the major storm event (100-year storm).

B. DEVELOPED MAJOR DRAINAGE BASIN AND SUB-BASINS

Basin D is the entirety of the platted parcel representing developed conditions and consists of two on-site sub-basins. A Drainage Plan for developed conditions can be found in the Appendix C.

Sub-basin D-1 (1.57 ac.; Q_5 = 2.61 cfs, Q_{100} = 6.39 cfs) is the east side of the site consisting of asphalt pavement and concrete sidewalk. Runoff goes through the parking lot and exits on the

south side and flows through a grass swale before being captured via an area inlet, Design Point 1 (DP1).

Sub-basin D-2 (4.84 ac.; $Q_5 = 3.90$ cfs, $Q_{100} = 14.48$ cfs) is the west side of the site consisting of the church building, asphalt pavement, concrete sidewalk and a play field. Runoff goes through the parking lot and exits at the southwest corner and flows through a grass swale before being captured via an area inlet, Design Point 2 (DP2).

The Final Drainage Report for Paint Brush Hills – Phase 2 (Filing No. 13), by Classic Consulting Engineers & Surveyors LLC dated June 2008 states the maximum developed flow allowed to discharge from the commercial site is $Q_5 = 23$ cfs and $Q_{100} = 45$ cfs. The total peak runoff being discharged from the developed church site is $Q_5 = 17.51$ cfs and $Q_{100} = 41.87$ cfs. Due to the proposed development yielding less storm water runoff, no downstream facilities require alterations and it is anticipated that there will be no negative impacts to downstream facilities and developments.

IV. DRAINAGE DESIGN CRITERIA

A. REGULATIONS

The hydrologic and hydraulic calculations and design of the site conform to the El Paso County Drainage Criteria Manual as well as the Mile High Flood District Drainage Criteria Manual (August 2018).

B. DEVELOPMENT CRITERIA REFERENCE AND CONSTRAINTS

The parcel falls within the Falcon Drainage Basin. The runoff from this parcel will have no adverse effects on downstream infrastructure or facilities, streets, utilities, transit, or further development of adjacent lots. Relevant criteria for the calculations shown further include equations and design criteria for the rational method, volumes and runoff of various storms.

C. HYDROLOGICAL CRITERIA

The rational method was used to calculate the peak runoff of the delineated basin and sub-basins using the manuals referenced prior with the C, I and PI values from the Drainage Criteria Manual Volume I, Chapter 6 as well as the Colorado Springs designated IDF curve values. Specific calculations and tables are provided further with inputs including design rainfall, sub-basin acreage and percent imperviousness, runoff coefficients, one-hour rainfall depths, rainfall intensities, time of concentration, and peak discharge of various storm events. Weighted runoff coefficients were calculated for each basin and sub-basin due to the mix of impervious surfaces.

D. FOUR-STEP PROCESS

The selection of appropriate control measures is based on the characteristics of the site and potential pollutants. The Four-Step Process provides a method of going through the selection

process. The following applies the four-step process to the Development Plan for the Foundation Lutheran Church.

Step 1: Employ Runoff Reduction Practices

The Development Plan including the Landscape Plan utilizes landscaping areas for plantings and grass or mulch wherever possible without obstructing utilities or drainage ways. Given the proposed land use and desired density of the development, the required areas of the site is to be paved for vehicular and pedestrian access and the development of the structures and surrounding hardscape. Within the site, the storm water runoff is kept to the site limits via strategic grading, grass swales and landscaping.

Step 2: Provide Water Quality Capture Volume

The Final Drainage Report for Paint Brush Hills – Phase 2 (Filing No. 13), by Classic Consulting Engineers & Surveyors LLC dated June 2008 indicates a regional detention facility for this area. The detention facility was designed for water quality capture as well as full spectrum detention for the entirety of this site. The detention facility is within a platted tract of land with ownership and maintenance by the Paint Brush Hills Metropolitan District.

Step 3: Stabilize Drainage Ways

The drainage within the site is stabilized by way of pavement with curb and gutter to guide flow, as well as a grass-lined swales designed for a 100-year storm. There are no unstabilized drainage ways on this site. The unpaved, grass-lined swales are designed to convey on-site runoff.

All new and re-development projects are required to construct or participate in the funding of channel stabilization measures. Drainage basin fees paid, at the time of platting, go towards channel stabilization within the drainage basin.

Step 4: Implement Site Specific and Other Source Control BMPs

Site specific BMPS include a concrete wash out, stabilized staging area, and stockpile area are to be designated on site and surrounded with sediment control logs. Vehicle tracking control is to be implemented at both access points. Non-structural BMPs include street sweeping and instructions to the contractor to avoid tracking of mud and dirt off-site, compliance with dust control and construction site cleanup throughout the construction process. Permanent seeding and landscaping is to be done on all areas not slated for hardscape or structures. Storage/handling and spill containment controls are to be implemented per CDPHE regulations. No chemicals or other pollution materials are required for this project and will not be allowed on site. Fueling and minor maintenance of vehicles or equipment may be allowed only in stabilized staging areas with proper controls in place. No major maintenance of vehicles or equipment is to be performed on site. Any spills that occur are to be addressed according to the requirements of Colorado Department Public Health and Environment, Hazardous Materials and Waste Management Division. No groundwater and/or stormwater dewatering activities are proposed or expected for the proposed construction activities. Any waste disposal is to be done off-site at the designation of the contractor at a location

approved by El Paso County. Waste disposal, spill prevention, and response procedures are to be according to CDPHE and El Paso County standards.

An Erosion Control Plan showing BMPs for erosion and sediment control to be submitted separately.

V. DRAINAGE INFRASTRUCTURE COSTS AND FEES

A. DRAINAGE AND BRIDGE FEES

The development falls within the Falcon drainage basin (CHWS1400) which has a drainage basin fee of $37,256/acre and a bridge fee of $5,118/acre according to the El Paso County Drainage Basin 2023 fee schedule.

Drainage Basin Fee
The site has 1.36 acres of impervious area made up of building roof, driveway and parking lot.
1.36 Impervious acres X $37,256 = $50,668.16

Bridge Fee
1.36 Impervious acres X $5,118 = $6,960.48

Please provide breakdown of 1.36ac value and include the 95% percent impervious value which reduces it by 5%

Please see 3.13a Appdx L DCM VOL I within the ECM
The lot must be assessed drainage basin fees based on commercial zoning for the entire lot with an impervious area of 5.97ac x 95% imperviousness due to area available for development.
Areas not intended for future development or construction may be placed in a tract.
Its recommended to place the southern bottom half (~3.25ac) of the parcel into a tract.
This reduces drainage basin fees. If the southern half of the property is developed in the future then the tract would be platted and drainage basin fees assessed at that time.

VI. CONCLUSIONS

A. COMPLIANCE WITH STANDARDS

This Final Drainage Report is in conformance with the El Paso County Drainage Manual as well as the Mile High Flood District Drainage Criteria Manual. Grading practices for optimal drainage comply with the geotechnical investigative report and County standards. The development of Foundation Lutheran Church is within compliance and standards and meets the requirements for the drainage design.

From the Classic Consulting Engineers & Surveyors Report page 9 (included in the appendix) design the flow from the outlet of this site to be Q5 = 23 cfs and Q100 = 45 cfs, this report states the flow from this same location to be Q5 = 17.51 cfs and Q100 = 41.87 cfs. The results indicate less flow from this site then projected in the original design.

The proposed grading and drainage is within substantial conformance for the master drainage plan for the Subdivision and Drainage Basin. There is no impact on major drainage way planning studies within the larger drainage basin. No off-site drainage improvements are needed. Site runoff and storm drain and appurtenances will not adversely affect the downstream and surrounding developments, including the downstream detention ponds.

VII. REFERENCES

El Paso County Drainage Manual

Colorado Urban Drainage and Flood Control District Drainage Criteria Manual, Volume I (January 2016)

Colorado Urban Drainage and Flood Control District Drainage Criteria Manual, Volume III (April 2018)

Urban Storm Drainage Criteria Manual, Volume III (November, 2015)

FEMA Flood Map Service Center

United States Department of Agriculture National Resources Conservation Service

Final Drainage Report for Paint Brush Hills – Phase 2 (Filing No. 13), dated June 2008, prepared by Classic Consulting Engineers & Surveyors LLC

Final Drainage Report for Paint Brush Hills Filing No. 13A (Phased Final Plat – Phase 1), dated April 2013, prepared by Classic Consulting Engineers & Surveyors LLC

VIII. APPENDICES

Appendix A – Vicinity Map

Vicinity Map

Appendix B – Hydrologic and Hydraulic Computations

Project Number: 191726
Engineer: DGW
Date: 10/16/2023
Address: Towners Ave
Existing Conditions

Sub-Basin:	E-1	(IDF Curve Equations from Figure 6-5 of the DCM Volume 1)			
t_1 Duration:	26.44				
I_2	I_5	I_{10}	I_{25}	I_{50}	I_{100}
2.13798792	2.670799899	3.11609988	3.56139987	4.00669985	4.48250383

Hydrologic Soil Type:	B

Coefficient (Table 6-6)

Land Use or Surface Characteristic	Square Feet	Acreage	Coefficient $_2$	Coefficient $_5$	Coefficient $_{10}$	Coefficient $_{25}$	Coefficient $_{50}$	Coefficient $_{100}$	2 Yr: C_i * A_i	5 Yr: C_i * A_i	10 Yr: C_i * A_i	25 Yr: C_i * A_i	50 Yr: C_i * A_i	100 Yr: C_i * A_i	2 Yr C_c	5 Yr C_c	10 Yr C_c	25 Yr C_c	50 Yr C_c	100 Yr C_c
Roof	0	0.00	0.71	0.73	0.75	0.78	0.80	0.81	0.000	0.000	0.000	0.000	0.000	0.000	0.020	0.080	0.150	0.250	0.300	0.350
Pavement	0	0.00	0.89	0.90	0.92	0.94	0.95	0.96	0.000	0.000	0.000	0.000	0.000	0.000						
Lawn	279175	6.41	0.02	0.08	0.15	0.25	0.30	0.35	0.128	0.513	0.961	1.602	1.923	2.243						
A_t:	279175	6.41																		

Q Peak Flow (cfs) (Ci*A)

2 Year Q	5 Year Q	10 Year Q	25 Year Q	50 Year Q	100 Year Q
0.27	1.37	3.00	5.71	7.70	10.05

Design Points

Design Point	Q5	Q_{100}
E-1	1.37	10.05
Total Site	1.37	10.05

Time of Concentration $t_c = t_i + t_t$

3.2.1 - Overland (Initial) Flow Time

$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L}}{S^{0.33}} \qquad \text{(Eq. 6-8)}$$

Where:

t_i = overland (initial) flow time (min)
C_5 = runoff coefficient for 5-year frequency (see Table 6-6)
L = length of overland flow (300 ft maximum for non-urban land uses, 100 ft maximum for urban land uses)
S = average basin slope (ft/ft)

Note that in some urban watersheds, the overland flow time may be very small because flows quickly concentrate and channelize.

Sub-Basin:	E-1	
L (initial time):	300	ft
S (initial time):	0.034	ft/ft

Composite Runoff Coefficient Calculation:

$C_c = (C_1A_1 + C_2A_2 + C_3A_3 + ...C_iA_i) / A_t$

Land Use or Surface Characteristic	Square Feet	Acreage	C_5
Roof	0	0.00	0.73
Pavement	0	0.00	0.90
Lawn	279175	6.41	0.08
Total :	279175	6.41	

C_c = 0.08

$t_i = (0.395*(1.1-C_5)*sqrt(L))/(S^0.33)$

t_i = 21.30 mins

3.2.2 Travel Time

For catchments with overland and channelized flow, the time of concentration needs to be considered in combination with the travel time, t_t, which is calculated using the hydraulic properties of the swale, ditch, or channel. For preliminary work, the overland travel time, t_t, can be estimated with the help of Figure 6-25 or Equation 6-9 (Guo 1999).

$$V = C_v S_w^{0.5} \qquad \text{(Eq. 6-9)}$$

Where:

V = velocity (ft/s)
C_v = conveyance coefficient (from Table 6-7)
S_w = watercourse slope (ft/ft)

Conveyance Coeff.:	10	
Slope (travel time):	0.03	ft/ft
$V = C_v S_w^{0.5}$	1.73	ft/s
L (travel time):	534	ft
$t_t = L/V$ =	308.31	sec.
t_t =	5.14	min.

Table 6-7. Conveyance Coefficient, C_v

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

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

$t_c = t_i + t_t$ = 26.44 min.

3.2.4 Minimum Time of Concentration

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

Final t_c: 26.44 min.

Project Number: 191726
Engineer: DGW
Date: 10/16/2023
Address: Towner's Ave
Proposed Conditions

Sub-Basin:	D-1	(IDF Curve Equations from Figure 6-5 of the DCM Volume 1)			
t_t Duration:	10.31				
I_2	I_5	I_{10}	I_{25}	I_{50}	I_{100}
3.258739438	4.083511897	4.76426388	5.44501586	6.12576785	6.85585999

Hydrologic Soil Type:	B

Coefficient (Table 6-6)

Land Use or Surface Characteristic	Square Feet	Acreage	Coefficient $_2$	Coefficient $_5$	Coefficient $_{10}$	Coefficient $_{25}$	Coefficient $_{50}$	Coefficient $_{100}$	2 Yr: $C_t * A_t$	5 Yr: $C_t * A_t$	10 Yr: $C_t * A_t$	25 Yr: $C_t * A_t$	50 Yr: $C_t * A_t$	100 Yr: $C_t * A_t$	2 Yr C_t	5 Yr C_t	10 Yr C_t	25 Yr C_t	50 Yr C_t	100 Yr C_t
Roof	298	0.01	0.71	0.73	0.75	0.78	0.80	0.81	0.005	0.005	0.005	0.005	0.005	0.006	0.368	0.408	0.458	0.526	0.560	0.594
Pavement	27107	0.62	0.89	0.90	0.92	0.94	0.95	0.96	0.554	0.560	0.573	0.585	0.591	0.597						
Lawn	40883	0.94	0.02	0.08	0.15	0.25	0.30	0.35	0.019	0.075	0.141	0.235	0.282	0.328						
A_t:	68288	1.57																		

Q Peak Flow (cfs)(Ci*A)

2 Year Q	5 Year Q	10 Year Q	25 Year Q	50 Year Q	100 Year Q
1.88	2.61	3.42	4.49	5.38	6.39

Sub-Basin:	D-2	(IDF Curve Equations from Figure 6-5 of the DCM Volume 1)			
t_t Duration:	12.36				
I_2	I_5	I_{10}	I_{25}	I_{50}	I_{100}
3.042449441	3.810877447	4.44619035	5.08150326	5.71681617	6.39783411

Hydrologic Soil Type:	B

Coefficient (Table 6-6)

Land Use or Surface Characteristic	Square Feet	Acreage	Coefficient $_2$	Coefficient $_5$	Coefficient $_{10}$	Coefficient $_{25}$	Coefficient $_{50}$	Coefficient $_{100}$	2 Yr: $C_t * A_t$	5 Yr: $C_t * A_t$	10 Yr: $C_t * A_t$	25 Yr: $C_t * A_t$	50 Yr: $C_t * A_t$	100 Yr: $C_t * A_t$	2 Yr C_t	5 Yr C_t	10 Yr C_t	25 Yr C_t	50 Yr C_t	100 Yr C_t
Roof	9335	0.21	0.71	0.73	0.75	0.78	0.80	0.81	0.152	0.156	0.161	0.167	0.171	0.174	0.145	0.197	0.260	0.348	0.392	0.436
Pavement	22813	0.52	0.89	0.90	0.92	0.94	0.95	0.96	0.466	0.471	0.482	0.492	0.498	0.503						
Lawn	178739	4.10	0.02	0.08	0.15	0.25	0.30	0.35	0.082	0.328	0.615	1.026	1.231	1.436						
A_t:	210887	4.84																		

Q Peak Flow (cfs)(Ci*A)

2 Year Q	5 Year Q	10 Year Q	25 Year Q	50 Year Q	100 Year Q
2.28	3.90	5.99	9.18	11.64	14.48

Time of Concentration $t_c = t_i + t_t$

3.2.1 - Overland (Initial) Flow Time

$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L}}{S^{0.33}} \qquad \text{(Eq. 6-8)}$$

Where:

t_i = overland (initial) flow time (min)
C_5 = runoff coefficient for 5-year frequency (see Table 6-6)
L = length of overland flow (300 ft maximum for non-urban land uses, 100 ft maximum for urban land uses)
S = average basin slope (ft/ft)

Note that in some urban watersheds, the overland flow time may be very small because flows quickly concentrate and channelize.

Sub-Basin:	D-1	
L (initial time):	100	ft
S (initial time):	0.074	ft/ft

Composite Runoff Coefficient Calculation:

$C_c = (C_1A_1 + C_2A_2 + C_3A_3 + ...C_iA_i)/A_t$

Land Use or Surface Characteristic	Square Feet	Acreage	C_5
Roof	0	0.00	0.73
Pavement	27107	0.62	0.90
Lawn	40883	0.94	0.08
Total :	67990	1.56	

C_c = 0.41

$t_i = (0.395*(1.1-C_5)*sqrt(L))/(S^0.33)$

t_i = 6.46 mins

3.2.2 Travel Time

For catchments with overland and channelized flow, the time of concentration needs to be considered in combination with the travel time, t_t, which is calculated using the hydraulic properties of the swale, ditch, or channel. For preliminary work, the overland travel time, t_t, can be estimated with the help of Figure 6-25 or Equation 6-9 (Guo 1999).

$$V = C_v S_w^{0.5} \qquad \text{(Eq. 6-9)}$$

Where:

V = velocity (ft/s)
C_v = conveyance coefficient (from Table 6-7)
S_w = watercourse slope (ft/ft)

Conveyance Coeff.:	20	
Slope (travel time):	0.015	ft/ft
$V = C_v S_w^{0.5}$	2.45	ft/s
L (travel time):	565	ft
$t_t = L/V$ =	230.66	sec.
t_t =	3.84	min.
$t_c = t_i + t_t$ =	10.31	min.

Table 6-7. Conveyance Coefficient, C_v

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

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

3.2.4 Minimum Time of Concentration

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

Final t_c: 10.31 min.

Time of Concentration $t_c = t_i + t_t$

3.2.1 - Overland (Initial) Flow Time

$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L}}{S^{0.33}} \qquad \text{(Eq. 6-8)}$$

Where:

t_i = overland (initial) flow time (min)
C_5 = runoff coefficient for 5-year frequency (see Table 6-6)
L = length of overland flow (300 ft maximum for non-urban land uses, 100 ft maximum for urban land uses)
S = average basin slope (ft/ft)

Note that in some urban watersheds, the overland flow time may be very small because flows quickly concentrate and channelize.

Sub-Basin:	D-2	
L (initial time):	100	ft
S (initial time):	0.068	ft/ft

Composite Runoff Coefficient Calculation:

$C_c = (C_1A_1 + C_2A_2 + C_3A_3 + ...C_iA_i)/A_t$

Land Use or Surface Characteristic	Square Feet	Acreage	C_5
Roof	9632.7689	0.22	0.73
Pavement	22813	0.52	0.90
Lawn	178739	4.10	0.08
Total :	211185	4.85	

C_c = 0.20

$t_i = (0.395*(1.1-C_5)*sqrt(L))/(S^0.33)$

t_i = 8.65 mins

3.2.2 Travel Time

For catchments with overland and channelized flow, the time of concentration needs to be considered in combination with the travel time, t_t, which is calculated using the hydraulic properties of the swale, ditch, or channel. For preliminary work, the overland travel time, t_t, can be estimated with the help of Figure 6-25 or Equation 6-9 (Guo 1999).

$$V = C_v S_w^{0.5} \qquad \text{(Eq. 6-9)}$$

Where:

V = velocity (ft/s)
C_v = conveyance coefficient (from Table 6-7)
S_w = watercourse slope (ft/ft)

Conveyance Coeff.:	20	
Slope (travel time):	0.023	ft/ft
$V = C_v S_w^{0.5}$	3.03	ft/s
L (travel time):	676	ft
$t_t = L/V$ =	222.87	sec.
t_t =	3.71	min.

Table 6-7. Conveyance Coefficient, C_v

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

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

$t_c = t_i + t_t$ = 12.36 min.

3.2.4 Minimum Time of Concentration

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

Final t_c: 12.36 min.

Design Procedure Form: Grass Swale (GS)

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

Designer: DG Walker
Company: RMG
Date: October 30, 2023
Project: FLC
Location: Paint Brush Hills Filing No. 13A GS DP-1

1. Design Discharge for 2-Year Return Period	Q_2 = 1.88 cfs
2. Hydraulic Residence Time	
A) : Length of Grass Swale	L_S = 270.0 ft
B) Calculated Residence Time (based on design velocity below)	T_{HR} = 4.6 minutes
3. Longitudinal Slope (vertical distance per unit horizontal)	
A) Available Slope (based on site constraints)	S_{avail} = 0.008 ft / ft
B) Design Slope	S_D = 0.029 ft / ft
4. Swale Geometry	
A) Channel Side Slopes (Z = 4 min., horiz. distance per unit vertical)	Z = 4.00 ft / ft
B) Bottom Width of Swale (enter 0 for triangular section)	W_B = 3.50 ft
5. Vegetation A) Type of Planting (seed vs. sod, affects vegetal retardance factor)	Choose One: ○Grass From Seed ◉Grass From Sod
6. Design Velocity (0.9 ft / s maximum for desirable 5-minute residence time)	V_2 = 0.99 ft / s
7. Design Flow Depth (1 foot maximum)	D_2 = 0.38 ft
A) Flow Area	A_2 = 1.9 sq ft
B) Top Width of Swale	W_T = 6.5 ft
C) Froude Number (0.50 maximum)	F = 0.32
D) Hydraulic Radius	R_H = 0.29
E) Velocity-Hydraulic Radius Product for Vegetal Retardance	VR = 0.28
F) Manning's n (based on SCS vegetal retardance curve D for sodded grass)	n = 0.110
G) Cumulative Height of Grade Control Structures Required	H_D = 0.00 ft
8. Underdrain (Is an underdrain necessary?)	Choose One: ○YES ◉NO
9. Soil Preparation (Describe soil amendment)	
10. Irrigation	Choose One: ○Temporary ◉Permanent

Notes:
SWALE ALONG THE EAST PROPERTY LINE

Design Procedure Form: Grass Swale (GS)

UD-BMP (Version 3.07, March 2018)

Designer: DG Walker
Company: RMG
Date: October 30, 2023
Project: FLC
Location: Paint Brush Hills Filing No. 13A DP-2

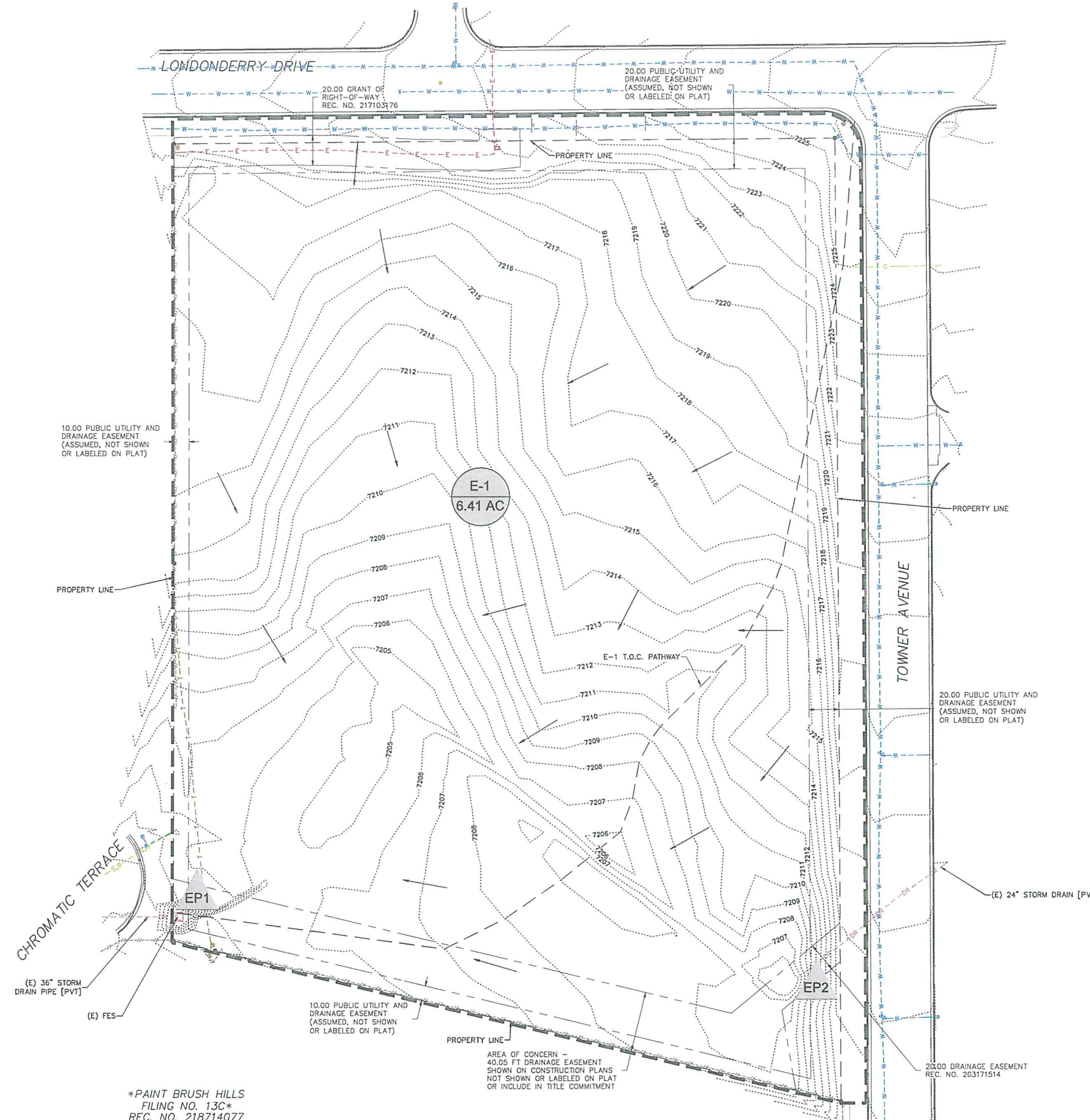
1. Design Discharge for 2-Year Return Period	Q_2 = 2.28 cfs
2. Hydraulic Residence Time	
A) : Length of Grass Swale	L_S = 270.0 ft
B) Calculated Residence Time (based on design velocity below)	T_{HR} = 4.6 minutes
3. Longitudinal Slope (vertical distance per unit horizontal)	
A) Available Slope (based on site constraints)	S_{avail} = 0.008 ft / ft
B) Design Slope	S_D = 0.029 ft / ft
4. Swale Geometry	
A) Channel Side Slopes (Z = 4 min., horiz. distance per unit vertical)	Z = 4.00 ft / ft
B) Bottom Width of Swale (enter 0 for triangular section)	W_B = 5.50 ft
5. Vegetation A) Type of Planting (seed vs. sod, affects vegetal retardance factor)	Choose One: ○Grass From Seed ◉Grass From Sod
6. Design Velocity (0.9 ft / s maximum for desirable 5-minute residence time)	V_2 = 0.98 ft / s
7. Design Flow Depth (1 foot maximum)	D_2 = 0.34 ft
A) Flow Area	A_2 = 2.3 sq ft
B) Top Width of Swale	W_T = 8.2 ft
C) Froude Number (0.50 maximum)	F = 0.32
D) Hydraulic Radius	R_H = 0.28
E) Velocity-Hydraulic Radius Product for Vegetal Retardance	VR = 0.27
F) Manning's n (based on SCS vegetal retardance curve D for sodded grass)	n = 0.112
G) Cumulative Height of Grade Control Structures Required	H_D = 0.00 ft
8. Underdrain (Is an underdrain necessary?)	Choose One: ○YES ◉NO
9. Soil Preparation (Describe soil amendment)	
10. Irrigation	Choose One: ○Temporary ◉Permanent

Notes:
SWALE ALONG THE EAST PROPERTY LINE

Appendix C – Drainage Maps

LEGEND

DESCRIPTION	SYMBOL
EX. CONCRETE PAVEMENT	
EX. ASPHALT PAVEMENT	
EX. GRAVEL ROAD	
PROP. STRUCTURE/BUILDING	
PROP. CONCRETE PAVEMENT	
PROP. ASPHALT PAVEMENT	
PROP. CONCRETE SIDEWALK	
PROP. GRASS FIELD	
EX. CONTOUR	
PROP. CONTOUR	
DRAINAGE SUB-BASIN BOUNDARY	
PROPERTY LINE	
TIME OF CONCENTRATION LINE	
BASIN IDENTIFIER	D-1
AREA IN ACRES	X.XX AC
DESIGN POINT ID	1
FLOW ARROW	



Graphic Scale

0 20 40 80

In Feet: 1" = 40'

DESIGN POINT	FLOW (CFS)
EP1	Q_5 = 1.37 Q_{100} = 10.05
EP2	Q_5 = 11 Q_{100} = 21

PCD FILE NO. PPR2321

RMG Engineers / Architects
Architecture Structural Geotechnical
Materials Testing Forensics Civil/Planning
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COLORADO LICENSED PROFESSIONAL ENGINEER DAVID GERALD WALKER 10/31/23 51909

FOUNDATION LUTHERAN CHURCH

9960 TOWNERS AVE
FALCON, COLORADO

COLORADO COMMERIAL CONSTRUCTION, INC.

SHEET NAME: EXISTING SUB-BASIN ANALYSIS

PROJECT STATUS: FINAL DRAINAGE REPORT

ENG: DGW
DRAWN: AMH/FHZ
CHECKED: TPT
DATE: 10/31/2023

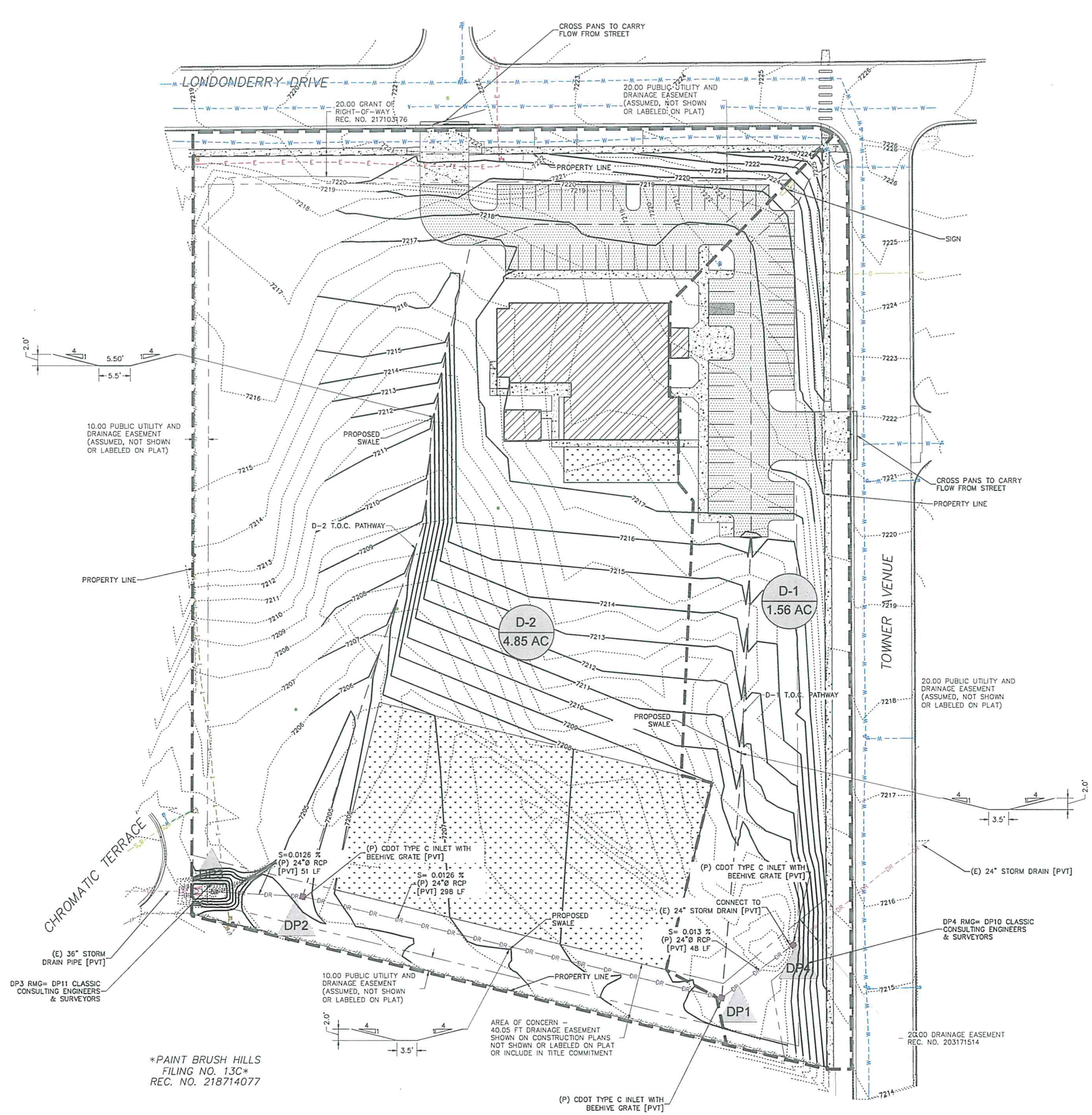
#	REVISION	DATE

JOB NO. 191726

SHEET NO. 01 of 02

LEGEND

DESCRIPTION	SYMBOL
EX. CONCRETE PAVEMENT	
EX. ASPHALT PAVEMENT	
EX. GRAVEL ROAD	
PROP. STRUCTURE/BUILDING	
PROP. CONCRETE PAVEMENT	
PROP. ASPHALT PAVEMENT	
PROP. CONCRETE SIDEWALK	
PROP. GRASS FIELD	
EX. CONTOUR	
PROP. CONTOUR	
DRAINAGE SUB-BASIN BOUNDARY	
PROPERTY LINE	
TIME OF CONCENTRATION LINE	
BASIN IDENTIFIER	D-1
AREA IN ACRES	X.XX AC
DESIGN POINT ID	1
FLOW ARROW	



Graphic Scale

In Feet: 1" = 40'

DESIGN POINT	FLOW (CFS)
DP1	Q_5 = 2.61 Q_{100} = 6.39
DP2	Q_5 = 3.90 Q_{100} = 14.48
DP3	Q_5 = 17.51 Q_{100} = 41.87
DP4	Q_5 = 11 CFS Q_{100} = 21 CFS

PCD FILE NO. PPR2321

RMG Engineers / Architects
Architecture Structural Geotechnical
Materials Testing Forensics Civil / Planning
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COLORADO LICENSED PROFESSIONAL ENGINEER DAVID GERALD WALKER 10/31/23 51909

FOUNDATION LUTHERAN CHURCH

9960 TOWNERS AVE
FALCON, COLORADO

COLORADO COMMERIAL CONSTRUCTION, INC.

SHEET NAME: PROPOSED SUB-BASIN ANALYSIS

PROJECT STATUS: FINAL DRAINAGE REPORT

ENG: DGW
DRAWN: AMH/FHZ
CHECKED: TPT
DATE: 10/31/2023

#	REVISION	DATE

JOB NO. 191726

SHEET NO. 02 of 02

Appendix D – FEMA Floodplain Map

National Flood Hazard Layer FIRMette

FEMA

104°37'40"W 38°58'52"N

0 250 500 1,000 1,500 2,000 Feet

1:6,000

104°37'2"W 38°58'24"N

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, Are of 1% annual chance flood with averag depth less than one foot or with draina areas of less than one square mile *Zon*
- 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*

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

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
- 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

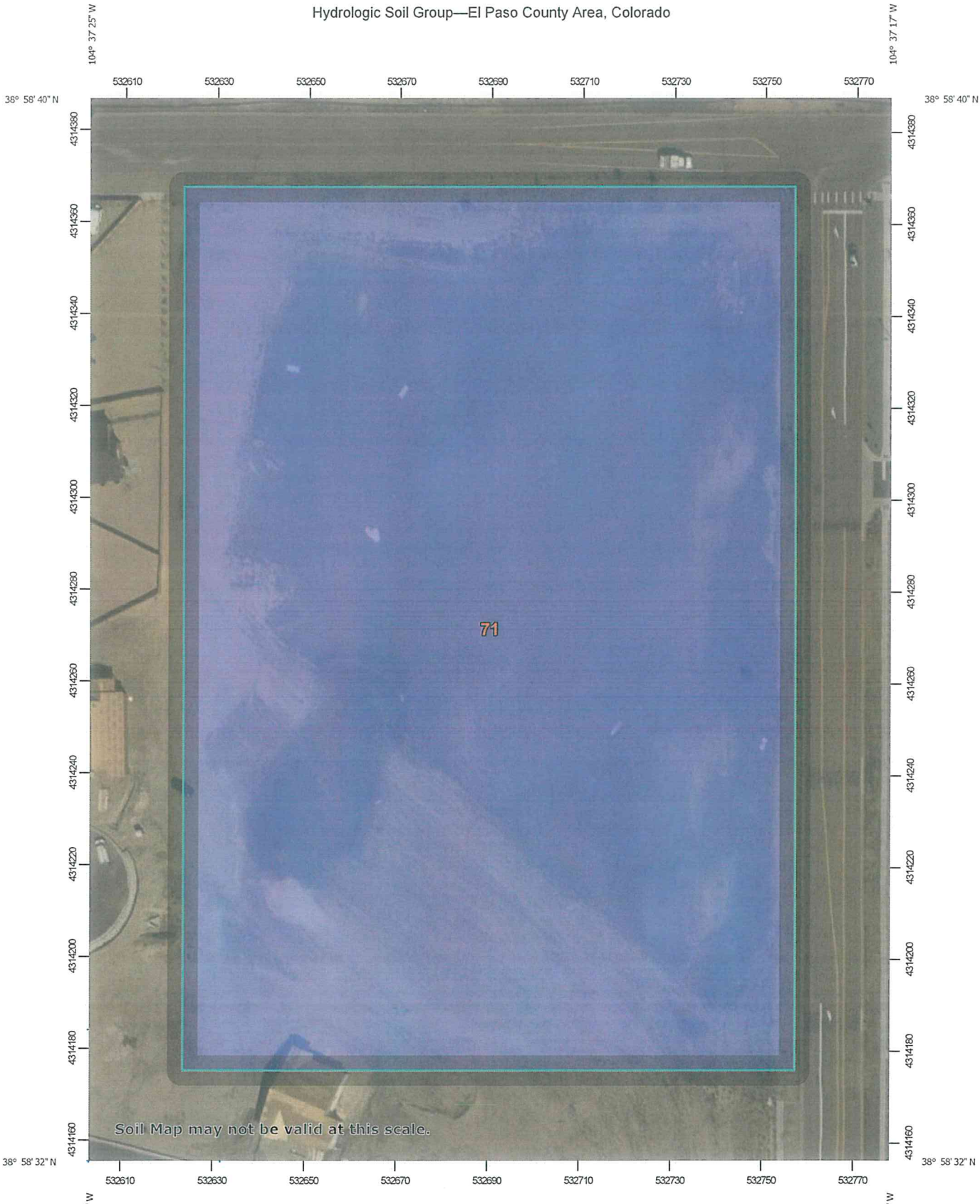
The pin displayed on the map is an approxima point selected by the user and does not repres an authoritative property location.

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 2/14/2023 at 1:11 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

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

Appendix E – USDA Soils Survey Map



Map Scale: 1:1,130 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 Rating Polygons
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

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

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 20, Sep 2, 2022

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

Date(s) aerial images were photographed: Sep 11, 2018—Oct 20, 2018

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

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
71	Pring coarse sandy loam, 3 to 8 percent slopes	B	6.4	100.0%
Totals for Area of Interest			**6.4**	**100.0%**

Description

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

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

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

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

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

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

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

Rating Options

Aggregation Method: Dominant Condition

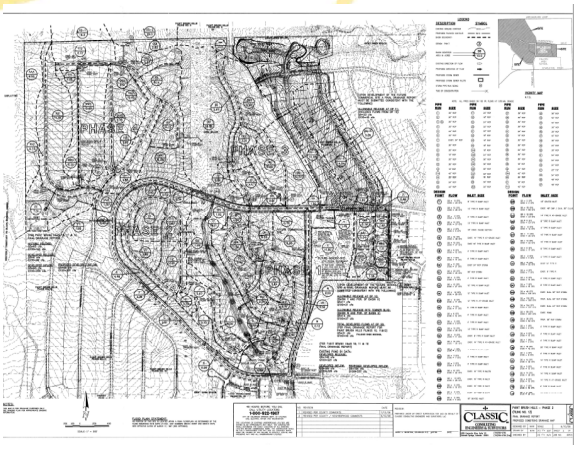
Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Phase 1 Storm Facilities

Basins J and L are tributary to Design Points 8 (Q_5 = 6 cfs and Q_{100} = 12 cfs) and 9 (Q_5 = 7 cfs and Q_{100} = 14 cfs), where a 4' Type R sump inlet and a 6' Type R sump inlet are proposed, respectively. These facilities will completely accept both the 5-year and 100-year developed flows at this sump condition. The total collected flows are then conveyed via a 30" RCP storm sewer directly into the existing detention pond at the northwest corner of Londonderry and Towner. A rip-rap dissipater will be installed to minimize erosion. The emergency overlflow route at this location is 1.0' maximum ponding and then spill over the highpoint and around the corner towards Londonderry Drive.

At Design Point 10 (Q_5 = 11 cfs and Q_{100} = 21 cfs) an existing 24" RCP storm sewer will be allowed to continue to collect flows off of the undeveloped future school site. As stated in this report, upon development of this school site, the maximum flow allowed to enter this facility will remain the (Q_5 = 11 cfs and Q_{100} = 21 cfs). The remaining developed school site is anticipated to drain directly into Towner without exceeding the following: (Q_5 = 14 cfs and Q_{100} = 27 cfs). The downstream existing 14' Type R at-grade inlet will adequately accept a portion of these flows as previously designed as a part of the Paint Brush Hills Filing No. 10 construction. Any developed flows from this school site above and beyond these specified will need to be detained on-site. The release from Design Point 10 will temporarily travel across the south portion of the future commercial site within a swale towards Design Point 11. Upon development of this commercial area, it is anticipated that the temporary swale be removed and the 24" RCP be extended to Design Point 11. At this location, the maximum developed flow allowed to discharge from the commercial site is (Q_5 = 21 cfs and Q_{100} = 43 cfs). This flow, combined with the discharge from Design Point 10 equals the total developed flow allowed to enter the public storm system at Design Point 11 (Q_5 = 23 cfs and Q_{100} = 45 cfs). These flows are then conveyed in a southerly direction in a 36" RCP storm sewer.



V3 Drainage Report - Final.pdf Markup Summary

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Rectangle (1)

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Author: Christina Prete
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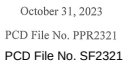

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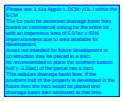

Subject: Text Box
Page Label: 10
Author: eschoenheit
Date: 11/8/2023 6:02:02 PM
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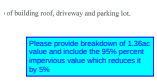
Please see 3.13a Appdx L DCM VOL I within the ECM
The lot must be assessed drainage basin fees based on commercial zoning for the entire lot with an impervious area of 5.97ac x 95% imperviousness due to area available for development.
Areas not intended for future development or construction may be placed in a tract.
Its recommended to place the southern bottom half (~3.25ac) of the parcel into a tract.
This reduces drainage basin fees. If the southern half of the property is developed in the future then the tract would be platted and drainage basin fees assessed at that time.



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Status:
Color:
Layer:
Space:

Please provide breakdown of 1.36ac value and include the 95% percent impervious value which reduces it by 5%