

PRELIMINARY DRAINAGE REPORT

***LOT 29 VISTA BUSINESS PARK
1760 HORIZON AVENUE***

January 12, 2017

Prepared for:

Matthew McMullen

Prepared by:

SCOTT, COX & ASSOCIATES, INC.
consulting engineers - surveyors
1530 55th Street - Boulder, CO 80303
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Project No. 16536A

ENGINEER'S STATEMENT

I hereby certify that this report for the preliminary drainage design for Vista Business Park Lot 29 PUD Application was prepared under my direct supervision in accordance with the provisions of the City of Lafayette Standards and Specifications for the owners thereof.

Donald P. Ash, P.E.
Registered Professional Engineer
State of Colorado No. 36045

DRAFT

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INTRODUCTION

This report is submitted as the Preliminary Drainage Report of the existing and proposed conditions for Vista Business Park Lot 29, located at 1760 Horizon Avenue in the City of Lafayette. The majority of the site is located in the Southeast $\frac{1}{4}$ of the Northwest $\frac{1}{4}$ of Section 12 Township 1S, Range 69W of the 6th Principal Meridian in the City of Lafayette, County of Boulder, State of Colorado. The area of the project site is approximately 1.65 acres. The site is bounded by Horizon Avenue to the north, and commercial lots to the south, east and west. A vicinity map is included with this report.

This report is being prepared to accompany the Preliminary Plan/PUD Review application for the project. The purpose of this Preliminary Drainage Report and Plan is to address specific drainage issues related to the proposed site development. This study meets the requirements set forth in the Town of Lafayette Standards and Specifications.

EXISTING ON-SITE DRAINAGE

The 1.65 acre project site is currently undeveloped. Based on the National Flood Insurance Program Flood Insurance Rate Map, FIRM Panel 0850730080F dated August 18, 2004, the entire site is located within Zone X and is outside any mapped 100 year floodplain.

The site generally slopes from the southeast to northwest at slopes from 3% to 25%. Runoff from the site is broken into one (1) existing basin, H1.

Runoff from basin H1 drains via overland into Horizon Avenue ROW where it is conveyed southeast via curb and gutter to an existing storm inlet, which flows north to Rock Creek.

Existing storm sewer runs along the north side of the site. An existing 18" RCP runs within Horizon Avenue, flowing east, ultimately being conveyed to the Rock Creek wetland area, north of the site. An 18-inch storm sewer has been stubbed into the northwest corner of the site for the proposed Lot 29 development. An additional 18" storm sewer stub has been provided in the northeastern corner from the existing manhole. A 15-foot wide drainage easement runs along the eastern property line.

Existing drainage patterns are shown on the Grading and Drainage Plan that is included with this report. Runoff calculations for the existing basins have been attached in Appendix A. The total runoff from the existing site is calculated to be 0.43 cfs for the 5-year storm and 6.32 cfs for the 100-year storm.

OFF-SITE DRAINAGE

There is one (1) offsite basin contributing to the runoff for this site and has been designated basin OS1. Basin OS1 contains a small un-detained pervious portion of commercially developed Lot 27 and a major portion of undeveloped Lot 28. Proposed improvements will utilize driveway grade breaks and retaining walls to keep some offsite flows from entering the site, while the remainder will be directed to the onsite detention pond where release rates are controlled and pass offsite flows through the pond during major storm events, which is consistent with historic flow patterns.

PROPOSED ON-SITE DRAINAGE

The Grading and Drainage Plan shows the proposed site plan, on-site grading and overland flow directions. Under proposed conditions, the site will be broken into two (2) major basins, named P1 and P2.

Basin P1 is located in the northeastern portion of the site and contains mostly pervious landscaped areas. Runoff from within this basin drains via sheet flow north, offsite into the existing curb and gutter along Horizon Avenue.

Basin P2 is located in the central portion of the site and consists of the majority of the proposed site improvements. Runoff from within this basin will drain via sheetflow into proposed onsite drainage swales where it is conveyed to the proposed onsite Extended Detention Basin located in the southern corner of the site. Individual sub-basins within A2 have been delineated for hydraulic calculations.

Proposed drainage patterns are shown on the Grading and Drainage Plan that is included with this report. A runoff summary can be found in Table 1.

DRAINAGE DESIGN CRITERIA

As required in City of Lafayette Standards and Specifications (CLSS) for Drainage Improvements for all commercial Planned Urban Developments, hydrologic information was developed for an initial storm return period of 5-years and major storm return period of 100-years. The criteria and methodology used in determining the storm runoff peaks and volumes were those outlined in the CLSS, with guidance from the Urban Drainage and Flood Control District's (UDFCD) Urban Storm Drainage Criteria Manual (USDCM).

The design rainfall data used in this study was taken from the time-intensity-frequency curve for the City of Lafayette (Figure 1500-1 CLSS) as developed by Urban Drainage and Flood Control District (UD&FCD). Runoff calculations were obtained using the Rational Method as outlined in the CLSS for basins having less than 160 acres.

The Rational Formula is:

$$Q = CIA$$

Where: Q = Peak Discharge (cfs)
C = Runoff Coefficient (1500-4 CLSS)
I = Rainfall Intensity (in/hr) (Figure 1500-1 CLSS)
A = Drainage Basin Tributary Area (acres)

The existing and proposed conditions for the entire site were analyzed for the 5 and 100-year storm events. The results are shown in the following Table 1 and the relevant calculation sheets are provided in Appendix A.

Table 1

<u>Drainage Basin</u>	<u>Area</u> (acres)	<u>5-Year Peak</u> <u>Runoff</u> (cfs)	<u>100-year Peak</u> <u>Runoff</u> (cfs)
Historic	1.65	0.43	6.32
Developed	1.65	2.91	9.55
P1	0.28	0.19	1.14
P2	1.38	2.75	8.39
OS1	1.16	2.32	7.26

DETENTION STORAGE

A detention pond has been designed to mitigate the increase in runoff from the proposed development. The calculations for the detention pond and the limited release structure are enclosed in Appendix B.

A Type 2 Outlet with sand filter and limited release orifice plate provides the required 40-hour drain time for the water quality capture volume and limit release to historic 10-year and 100-year rates. Discharge will be conveyed through the existing 18-inch storm sewer that has been stubbed into the property. An earthen berm with concrete cutoff wall will provide an emergency overflow weir which pass flows of twice the maximum 100-year storm flows. The orifice plate meets the requirements for an extended detention basin and the 40-hour drain time as specified in the Urban Drainage and Flood Control District (UDFCD) Drainage Criteria Manual.

The required storage volume and release rates shall be those set forth in the City of Lafayette Standards and Specifications.

STORM WATER QUALITY AND EROSION CONTROL

Erosion control measures should be implemented prior to excavation or construction, and shall be maintained during all phases of the construction of the project. Erosion control measures will consist of silt fencing along the property being developed, tracking control measures at the access points to the site, hay bales at grass swales, inlet protection and re-vegetation with appropriate plant species.

The principal forms of storm water quality runoff enhancement is the utilization of the Extended Detention Basin and Sand Filter. Increased runoff due to the proposed developments will be detained within the basin and released at historic rates. The Water Quality Capture Volume and Excess Urban Runoff Volume will also be detained and released under historic conditions. The use of these measures as storm water quality runoff enhancement is consistent with the Urban Drainage and Flood Control District, Urban Storm Drainage Criteria Manual, Volume 3, Best Management Practices.

CONCLUSION

The primary consideration for this project was to design a drainage plan for the site to accommodate the proposed development plan without having an adverse impact on the surrounding properties. The drainage plan handles runoff from 5-year and 100-year storm events. All analyses were performed in accordance with the City of Lafayette Standards and Specifications.

APPENDIX A

DRAINAGE CALCULATIONS



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**Lot 29 - Vista Business Park
 0 Horizon Avenue, Lafayette, CO**

Project #: 16536
 Date: 12/29/16
 By: GCW

Municipality: Lafayette	Runoff Coefficients										Initial Overland Time (t _i) t _i =0.395(1.1-C _e)L ^{1/2} S ^{1/3}			Travel Time (t _t) t _t =Length/(Velocity*60)				t _c Computed		t _c Urbanized Check		t _c Final		Rainfall Intensities (in/hr)		Flow Rates (cfs)							
	Parcel Size	C ₁	C ₂	C ₃	C ₄	C ₅	C ₆	C ₇	C ₈	C ₉	C ₁₀	Overland Flow (L _o) (ft)	Slope (ft/ft)	t _i (min)	Length (ft)	Slope (ft/ft)	C _v	Velocity (ft/s)	t _t (min)	t _c (min)	t _c (min)	t _c (min)	t _c (min)	t _c (min)	t _c (min)	t _c (min)	I ₁	I ₂	Q ₁	Q ₂			
Existing	1.65	0.02	0.07	0.21	0.52	2.00	392.0	0.059	20.7	0	0.0200	20	2.83	0.0	20.7	100	10.6	2.6	3.8	4.6	7.4	0.08	0.43	1.62	6.32	2.9	4.2	5.1	8.3	2.91	4.32	9.55	
P1	0.28	0.13	0.18	0.31	0.58	15.08	80.0	0.050	6.6	200	0.0200	20	2.83	1.2	7.7	280	7.7	2.9	4.2	5.1	8.3	1.81	2.91	4.32	9.55	2.5	3.7	4.4	7.2	0.09	0.19	0.38	1.14
P2	1.38	0.42	0.46	0.55	0.72	47.18	80.0	0.050	6.1	200	0.0200	20	2.83	1.2	7.3	280	7.3	3.0	4.3	5.2	8.5	1.74	2.75	3.96	8.39	3.0	4.3	5.2	8.5	1.74	2.75	3.96	8.39
OS1	1.16	0.40	0.44	0.53	0.71	45.00	150.0	0.200	5.4	250	0.0400	20	4.00	1.0	6.5	400	6.5	3.1	4.5	5.4	8.8	1.45	2.32	3.37	7.26	3.1	4.5	5.4	8.8	1.45	2.32	3.37	7.26

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consulting engineers - surveyors

PROJECT #: 16536
DATE: 12/29/16
BY: GCW

Historic

SURFACE	AREA	C ₂	C ₅	C ₁₀	C ₁₀₀	%IMP
HISTORIC	1.65	0.02	0.07	0.21	0.52	2.00
ROOFS	0.00	0.80	0.84	0.87	0.91	90.00
GRAVEL PACKED	0.00	0.36	0.40	0.50	0.69	40.00
DRIVES AND WALKS	0.00	0.80	0.84	0.87	0.91	90.00
TOTAL AREA	1.65	0.02	0.07	0.21	0.52	2.00

Developed

SURFACE	AREA	C ₂	C ₅	C ₁₀	C ₁₀₀	%IMP
LAWNS - CLAYEY	0.91	0.02	0.07	0.21	0.52	2.00
ROOFS	0.30	0.80	0.84	0.87	0.91	90.00
GRAVEL PACKED	0.00	0.36	0.40	0.50	0.69	40.00
DRIVES AND WALKS	0.45	0.80	0.84	0.87	0.91	90.00
TOTAL AREA	1.65	0.37	0.42	0.51	0.70	41.81

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P1

SURFACE	AREA	C ₂	C ₅	C ₁₀	C ₁₀₀	%IMP
LAWNS - CLAYEY	0.24	0.02	0.07	0.21	0.52	2.00
ROOFS	0.00	0.80	0.84	0.87	0.91	90.00
GRAVEL PACKED	0.00	0.36	0.40	0.50	0.69	40.00
DRIVES AND WALKS	0.04	0.80	0.84	0.87	0.91	90.00
TOTAL AREA	0.28	0.13	0.18	0.31	0.58	15.08

P2

SURFACE	AREA	C ₂	C ₅	C ₁₀	C ₁₀₀	%IMP
LAWNS - CLAYEY	0.67	0.02	0.07	0.21	0.52	2.00
ROOFS	0.30	0.80	0.84	0.87	0.91	90.00
GRAVEL PACKED	0.00	0.36	0.40	0.50	0.69	40.00
DRIVES AND WALKS	0.41	0.80	0.84	0.87	0.91	90.00
TOTAL AREA	1.38	0.42	0.46	0.55	0.72	47.18

OS1

SURFACE	AREA	C ₂	C ₅	C ₁₀	C ₁₀₀	%IMP
OFFSITE	1.16	0.40	0.44	0.53	0.71	45.00
ROOFS	0.00	0.80	0.84	0.87	0.91	90.00
GRAVEL PACKED	0.00	0.36	0.40	0.50	0.69	40.00
DRIVES AND WALKS	0.00	0.80	0.84	0.87	0.91	90.00
TOTAL AREA	1.16	0.40	0.44	0.53	0.71	45.00

for large basins. For the purpose of these specifications, areas of one square mile or less are defined as small basins.

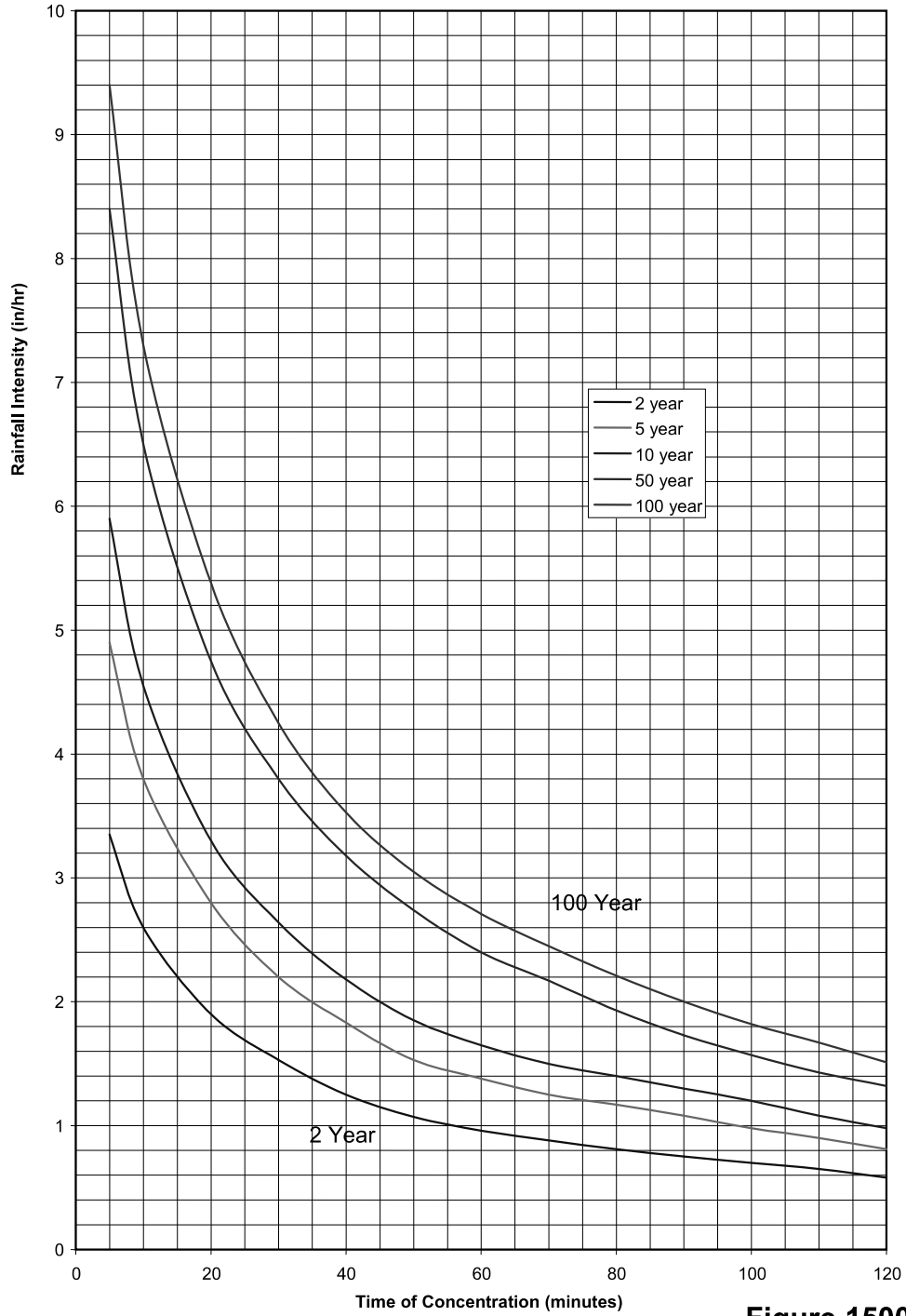


Figure 1500-1

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

NRCS Soil Group	Storm Return Period					
	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
A	$C_A = 0.89i$	$C_A = 0.93i$	$C_A = 0.94i$	$C_A = 0.944i$	$C_A = 0.95i$	$C_A = 0.81i + 0.154$
B	$C_B = 0.89i$	$C_B = 0.93i$	$C_B = 0.81i + 0.125$	$C_B = 0.70i + 0.23$	$C_B = 0.59i + 0.364$	$C_B = 0.49i + 0.454$
C/D	$C_{C/D} = 0.89i$	$C_{C/D} = 0.87i + 0.052$	$C_{C/D} = 0.74i + 0.2$	$C_{C/D} = 0.64i + 0.31$	$C_{C/D} = 0.54i + 0.418$	$C_{C/D} = 0.45i + 0.508$

Where:

i = % imperviousness (expressed as a decimal)

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

C_B = Runoff coefficient for NRCS HSG B soils

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

The values for various catchment imperviousness and storm return periods are presented graphically in Figures 6-1 through 6-3, and are tabulated in Table 6-5. These coefficients were developed for the Denver region to work in conjunction with the time of concentration recommendations in Section 2.4. Use of these coefficients and this procedure outside of the semi-arid climate found in the Denver region may not be valid. The UD-Rational Excel workbook performs all the needed calculations to find the runoff coefficient given the soil type and imperviousness and the reader may want to take advantage of this macro-enabled Excel workbook that is available for download from the UDFCD's website www.udfcd.org.

See Examples 7.1 and 7.2 that illustrate the Rational Method.

Table 6-3. Recommended percentage imperviousness values

Land Use or Surface Characteristics	Percentage Imperviousness (%)
Business:	
Downtown Areas	95
Suburban Areas	75
Residential:	
Single-family	
2.5 acres or larger	12
0.75 – 2.5 acres	20
0.25 – 0.75 acres	30
0.25 acres or less	45
Apartments	75
Industrial:	
Light areas	80
Heavy areas	90
Parks, cemeteries	10
Playgrounds	25
Schools	55
Railroad yard areas	50
Undeveloped Areas:	
Historic flow analysis	2
Greenbelts, agricultural	2
Off-site flow analysis (when land use not defined)	45
Streets:	
Paved	100
Gravel (packed)	40
Drive and walks	90
Roofs	90
Lawns, sandy soil	2
Lawns, clayey soil	2

APPENDIX B

DETENTION CALCULATIONS

100-YR VOLUME

Reference UDFCD Manual - Volume 2, Page 12-18

1. Basin Storage Volume

A. Imperviousness Ratio ($I = I_a / 100$)

$I_A = 41.81\%$

$i = 0.418$

B. Contributing Watershed

$A = 1.65$ Acres

C. 100-YR Detention Volume (V_{100})

$V_{100, C/D} = P_{100} [3.06 \times i^{1.286} + 0.402 \times i^{0.286}]$

$V_{100} = 1.115$ in / acre

D. Design Volume

Volume = $(V_{100} / 12) * \text{Area} * 1.2$

Volume = 0.1845 acre - feet

For Extended Detention type pond

8,037 cubic feet

100-YR DETENTION VOLUME (V_{100}) = 8,037 cubic feet

Excess Urban Runoff Volume

Reference UDFCD Manual - Volume 2, Page 12-18

1. Basin Storage Volume

A. Imperviousness Ratio ($I = I_a / 100$)

$$I_A = 41.81\%$$

$$i = 0.418$$

B. Contributing Watershed

$$A = 1.65 \text{ Acres}$$

C. Excess Urban Runoff Volume (EURV)

$$EURV_{C/D} = 1.2 \times i^{1.08}$$

$$EURV = 0.468 \text{ in / acre}$$

D. Design Volume

$$\text{Volume} = (EURV / 12) * \text{Area} * 1.2$$

For Extended Detention type pond

$$\text{Volume} = 0.0774 \text{ acre - feet}$$

$$3,373 \text{ cubic feet}$$

$$\text{EXCESS URBAN RUNOFF VOLUME (EURV)} = \boxed{3,373 \text{ cubic feet}}$$

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BY: GCW

Water Quality Capture Volume

Reference UDFCD Manual - Volume 3, Page 3-5

1. Basin Storage Volume

A. Imperviousness Ratio ($I = I_a / 100$)

$$I_A = 41.81\%$$

$$i = 0.418$$

B. Contributing Watershed

$$A = 1.65 \text{ Acres}$$

C. Water Quality Capture Volume (WQCV)

$$WQCV = 1.0 \times (0.91 \times i^3 - 1.19 \times i^2 + 0.78 \times i)$$

$$WQCV = 0.185 \text{ in / acre}$$

D. Design Volume

$$\text{Volume} = (WQCV / 12) \times \text{Area} \times 1.2$$

For Extended Detention type pond

$$\text{Volume} = 0.0305 \text{ acre - feet}$$

$$1,331 \text{ cubic feet}$$

$$\text{WATER QUALITY CAPTURE VOLUME (WQCV)} = \boxed{1,331 \text{ cubic feet}}$$

STAGE STORAGE 12-29-16.txt

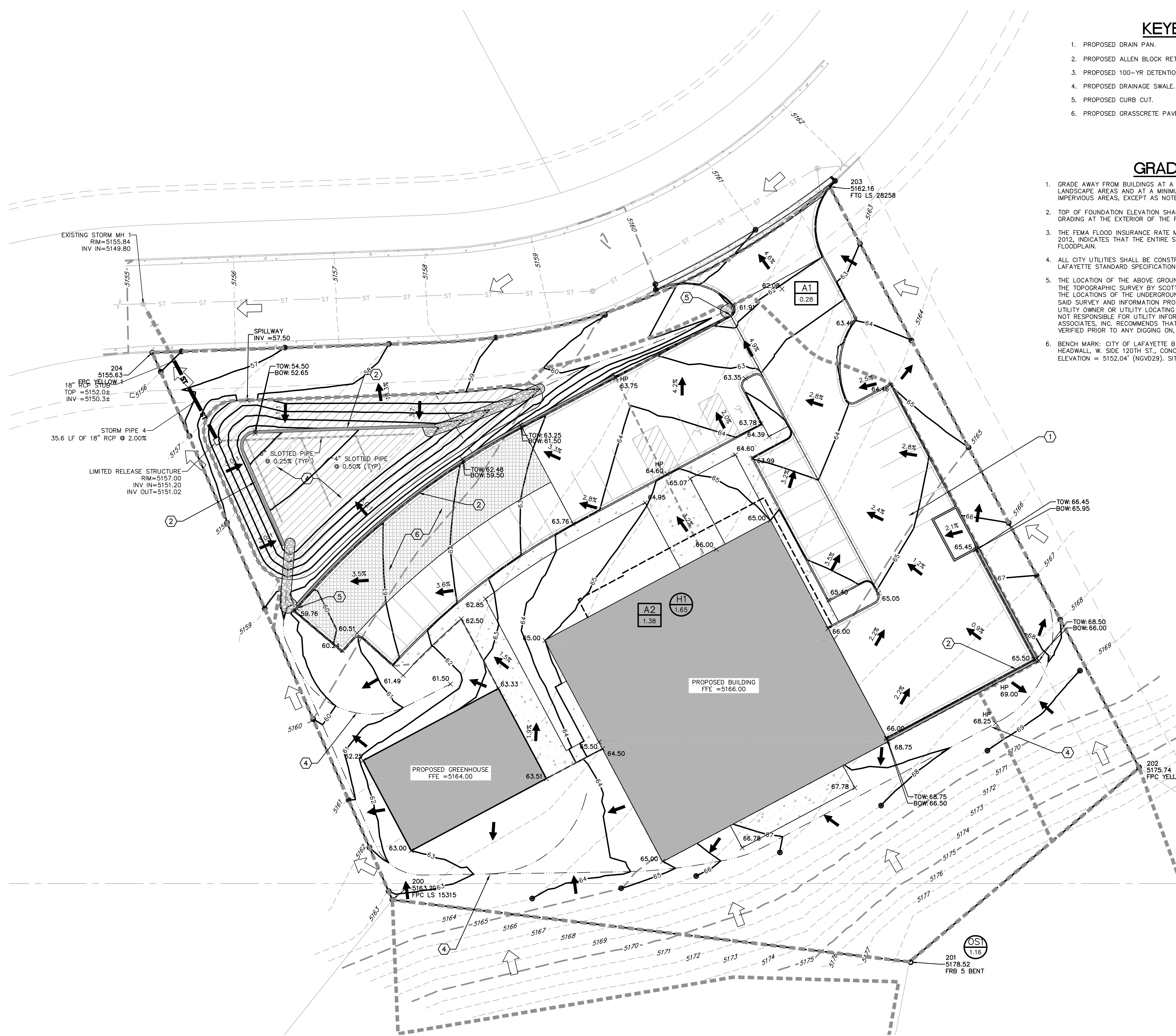
Onsite Detention Stage-Storage

Project: Lot 29 - Vista Business Park
 Basin Description: P2

Contour Incremental Elevation Volume Conic (cu. ft)	Contour Cumulative Area Volume (sq. ft) Conic (cu. ft)	Depth (ft)	Incremental Volume Avg. End (cu. ft)	Cumulative Volume Avg. End (cu. ft)
5,152.75 N/A	26 0.0	N/A	N/A	0.0
5,153.00 14.6	98 14.6	0.25	15.5	15.5
5,153.25 37.1	206 51.7	0.25	38.0	53.5
5,153.50 69.4	356 121.1	0.25	70.2	123.7
5,153.75 112.5	550 233.6	0.25	113.3	237.1
5,154.00 165.9	784 399.5	0.25	166.8	403.8
5,154.25 229.6	1,060 629.1	0.25	230.5	634.3
5,154.50 305.0	1,387 934.0	0.25	305.9	940.2
5,154.75 396.0	1,790 1330.1	0.25	397.1	1337.3
5,154.75 0.0	8 1330.1	0.00	0.0	1337.3
5,155.00 183.3	2,063 1513.4	0.25	258.8	1596.1
5,155.25 533.6	2,207 2046.9	0.25	533.7	2129.8
5,155.50 571.3	2,365 2618.2	0.25	571.4	2701.2
5,155.75 612.5	2,537 3230.7	0.25	612.6	3313.8
5,156.00 657.3	2,723 3888.0	0.25	657.4	3971.2
5,156.25 705.0	2,918 4593.0	0.25	705.1	4676.4
5,156.50 754.9	3,122 5347.8	0.25	755.0	5431.4
5,156.75	3,333	0.25	806.8	6238.2

STAGE STORAGE 12-29-16.txt

806.7	6154.5				
5,157.00		3,552	0.25	860.6	7098.8
860.4	7015.0				
5,157.25		3,778	0.25	916.2	8015.0
916.0	7931.0				
5,157.50		4,011	0.25	973.6	8988.6
973.5	8904.5				



KEYED NOTES

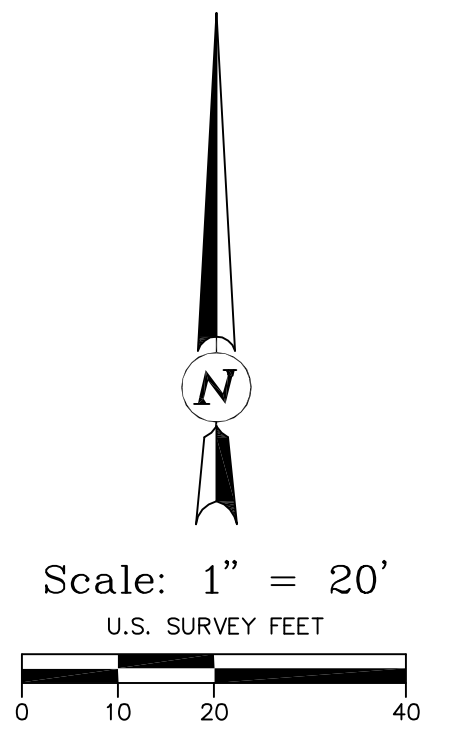
1. PROPOSED DRAIN PAN.
2. PROPOSED ALLEN BLOCK RETAINING WALL. 3' MAX HEIGHT.
3. PROPOSED 100-YR DETENTION POND.
4. PROPOSED DRAINAGE SWALE.
5. PROPOSED CURB CUT.
6. PROPOSED GRASSCRETE PAVEMENT.

GRADING NOTES

1. GRADE AWAY FROM BUILDINGS AT A MINIMUM 10% SLOPE IN THE FIRST 10 FEET AT LANDSCAPE AREAS AND AT A MINIMUM 2% SLOPE IN THE FIRST 10 FEET AT IMPERVIOUS AREAS, EXCEPT AS NOTED.
2. TOP OF FOUNDATION ELEVATION SHALL BE SET AT LEAST 8" ABOVE THE PROPOSED GRADING AT THE EXTERIOR OF THE FOUNDATION AT LANDSCAPE AREAS.
3. THE FEMA FLOOD INSURANCE RATE MAP, PANEL 08013C04131, DATED DECEMBER 18, 2012, INDICATES THAT THE ENTIRE SITE IS OUTSIDE OF ANY MAPPED 500 YEAR FLOODPLAIN.
4. ALL CITY UTILITIES SHALL BE CONSTRUCTED IN ACCORDANCE WITH THE CITY OF LAFAYETTE STANDARD SPECIFICATIONS.
5. THE LOCATION OF THE ABOVE GROUND UTILITIES SHOWN HEREON ARE BASED ON THE TOPOGRAPHIC SURVEY BY SCOTT, COX & ASSOCIATES, INC. ON 10/15/2014. THE LOCATIONS OF THE UNDERGROUND UTILITIES SHOWN HEREON ARE BASED ON SAID SURVEY AND INFORMATION PROVIDED BY OTHERS (WHICH MAY INCLUDE THE UTILITY OWNER OR UTILITY LOCATING SERVICES). SCOTT, COX & ASSOCIATES, INC. IS NOT RESPONSIBLE FOR UTILITY INFORMATION PROVIDED BY OTHERS. SCOTT, COX & ASSOCIATES, INC. RECOMMENDS THAT THE LOCATION OF THE UTILITIES BE FIELD VERIFIED PRIOR TO ANY DIGGING ON, OR ADJACENT TO THE SUBJECT PROPERTY.
6. BENCH MARK: CITY OF LAFAYETTE B.M. 21, CHISELED SQUARE, N.W. CORNER WEST HEADWALL, W. SIDE 120TH ST., CONCRETE CULVERT ON ROCK CREEK. ELEVATION = 5152.04' (NGVD29). SITE BENCHMARK AS SHOWN.

LEGEND

- 25' PROPOSED CONTOUR
ADD 5500 TO ALL CONTOURS
- 25' EXISTING CONTOUR
- POINT WHERE PROPOSED GRADE MEETS EXISTING GRADE
- 25.8 PROPOSED SPOT ELEVATION
ADD 5500 TO ALL SPOT ELEVATIONS
- 25.8 EXISTING SPOT ELEVATION
- HISTORIC SHEET FLOW
- PROPOSED FLOW DIRECTION
- DRAINAGE BASIN BOUNDARY (HISTORIC)
- PROPOSED BASIN BOUNDARY
- SUB-BASIN DESIGNATION (HISTORIC)
- AREA IN ACRES
- PROPOSED SUB-BASIN DESIGNATION
- AREA IN ACRES
- PROPOSED DETENTION POND
- EXISTING STORM SEWER W/MANHOLE
- PROPOSED STORM SEWER W/MANHOLE
- VEHICLE TRACKING CONTROL
PROPOSED STORM SEWER W/INLET
- CATCH FENCE (CF)
- SILT FENCE (SF)
- STRAW BALE BARRIER (SB)
- VEHICLE TRACKING CONTROL (VTC)
- INLET PROTECTION (IP)
- INLET PROTECTION (IP)
- CONCRETE WASHOUT AREA (CWA)
- ROCK SOCK INLET PROTECTION (RS)



**PRELIMINARY GRADING, DRAINAGE
AND EROSION CONTROL PLAN
LOT 29 VISTA BUSINESS PARK
LAFAYETTE, COLORADO**

SCOTT, COX & ASSOCIATES, INC.
consulting engineers • surveyors
1530 55th Street • Boulder, Colorado 80303
(303) 444 - 3051

Designed by	DMS	Date	12/01/16	Scale	1"=20'	Drawing no.	16536A-2	Sheet	C1.02
Drawn by	GCW	Revision		Description		Date		Project no.	16536A
Checked by	DPA								

DRAFT
12/29/16