FINAL DRAINAGE REPORT

For

1838 22ND STREET RESIDENTIAL DEVELOPMENT

1838 22nd Street
Lot 18 and the North One-Half of Lot 17, Block C, East Boulder
Boulder, Colorado

November 2013

Prepared For:
22nd St. Element, LLC
c/o Element Properties
1539 Pearl Street
Boulder, CO 80302

Contact: Scott Holton

Prepared By:

The Sanitas Group, LLC
801 Main Street, Suite 210
Louisville, CO 80027

Contact: Curtis C. Stevens, P.E.

DRAINAGE REPORT

For

1838 22ND STREET RESIDENTIAL DEVELOPMENT

1838 22nd Street
Lot 18 and the North One-Half of Lot 17, Block C, East Boulder
Boulder, Colorado

TABLE OF CONTENTS

1.0 Introduction 1
2.0 Existing Site Conditions 1
3.0 Proposed Developement 2
4.0 Design Criteria 2
5.0 Hydrology 2
Existing Conditions 2
Proposed Conditions 3
6.0 Permeable Pavers 4
7.0 Stormwater Quality and Erosion Control 6
8.0 Wetland Impacts 6
9.0 Conclusions 6
10.0 References 7

TECHNICAL APPENDICES

Hydrology Calculations and Supporting Documents ..... Appendix A
Permeable Pavement Sizing Calculations ..... Appendix B

EXHIBIT PLANS

Existing Conditions Drainage Plan [SHT DR1] ..... Back Pocket
Proposed Conditions Drainage Plan [SHT DR2] ..... Back Pocket

1.0 INTRODUCTION

This **Final Drainage Report** [Report] is prepared on behalf of 22nd Street Element, LLC for the proposed **1838 22nd Street Residential Development** project. The purpose of this report is to address the City of Boulder's [City] requirements for a "Final Storm Water Report and Plan" as outlined in Chapter 7 "Storm Water Design", "*Design and Construction Standards*" [1]. This Report documents the existing drainage conditions present at the site and provides an analysis of the drainage conditions and water quality measures proposed for the **1838 22nd Street Development**.

2.0 EXISTING SITE CONDITIONS

The proposed **1838 22nd Street Development** project site is located at 1838 22nd Street and is in the Southeast quarter of Section 30, Township 1 North, Range 70 West of the 6th P.M., County of Boulder, City of Boulder, State of Colorado.

The 12,284-sf property measures approximately 75-ft wide by 165-ft deep. The legal description is:

> Lot 18 and the North One-Half of Lot 17, Block C, Corrected and Enlarged Plat of East Boulder.

The property is located on the east side of 22nd Street between Canyon Blvd and Walnut Street. The adjacent lots north and south of the project site are developed with multi-family buildings.

As shown on the "*Existing Conditions Drainage Plan"* included in the back pocket of this report, the existing site is developed with a two-story house, detached garage, gravel driveway, concrete walk and patio and three storage sheds. The property has access from 22nd Street via a concrete drive ramp. The property generally slopes downward from the west property line to the southeast corner of the property. The terrain has an average 1.4% grade across the property from west to east. The property is fairly flat from north to south on the western portion of the property. The eastern portion of the property slopes downward at an average 1.8% grade from north to south.

USDA Natural Resources Conservation Services classified the soils on the property as Niwot Soils (Nh) having a Group C hydrological soil rating [2]. Group C soils are characterized by slow infiltration rates when saturated. A geotechnical investigation was performed in October, 2013 by Western Soils, Inc. [Western]. The Western investigation found the soils at the project site consist of

a layer of topsoil underlain by a stratum of clayey, sandy silt that extends to a depth of 2 to 2 ½ feet below grade. A stratum of sand and gravel was encountered below the clayey, sandy silt layer which continued to the bottom of the borings, approximately 15 feet below grade. Groundwater was encountered at a depth of approximately 5 feet below grade.

The property lies within flood hazard Zone X (areas determined to be outside the 0.2% annual chance floodplain) as delineated on FEMA Flood Insurance Rate Map 08013CO394J, effective date 18 December 2012 [3].

3.0 PROPOSED DEVELOPEMENT

The proposed **1838 22nd Street Development** project includes the construction of 3 multi-story residential buildings and replacing the existing gravel drive with a new asphalt drive with a vehicle parking area. A portion of the drive and the vehicle parking area will contain permeable pavers as described in Section 6.0 of this report. The proposed development layout and grading is shown on the "*Proposed Conditions Drainage Plan"* included in the back pocket of this report.

4.0 DESIGN CRITERIA

This Report was prepared using the criteria outlined in the City of Boulder "*Design and Construction Standards*", Chapter 7 "Storm Water Design" [Criteria] [1], the Urban Drainage and Flood Control District [UDFCD] "*Urban Storm Drainage Criteria Manual, Volumes 1 and 2"* [4], and the Urban Drainage and Flood Control District "*Urban Storm Drainage Criteria Manual, Volume 3 – Best Management Practices*" [5].

5.0 HYDROLOGY

The rational method was used to calculate runoff rates for the 2-year, 5-year, 10-year and 100-year storm events. The proposed project is a multi-family residential development and the 5-year and 100-year events are presented as the minor and major design storms, respectively.

Existing Conditions

The existing drainage basin is delineated on the "*Existing Conditions Drainage Plan*" provided in the back pocket of this report. Drainage basin delineations, storm flow directions and off-site drainage

conditions were determined visually during a site visit on 21 October, 2013. The property is not subject to any observable offsite tributary drainage.

The existing site is a single basin labeled Ax where the "x" denotes existing conditions. The property does not have a defined drainage outfall. The existing drainage sheet flows across the site from the west property line towards the southeast corner of the property where the runoff flows onto adjacent properties.

Existing conditions storm water runoff for the existing on-site basin is presented in Table 5.1. Basin description, imperviousness, weighted runoff coefficients, time of concentration and runoff values are provided for the existing drainage basin on a worksheet labeled "*Rational Method Calculations*" provided in Appendix A. For ease of reference, the existing conditions storm water flows are presented on the *"Existing Conditions Drainage Plan*" provided in the back pocket of this report.

Table 5.1: Storm Runoff by Basin – Existing Conditions

Basin I.D.	5-year Minor Design Storm Runoff [cfs]	100-year Major Design Storm Runoff [cfs]
Ax	0.37	1.43

Proposed Conditions

The proposed on-site drainage basins are delineated on the "*Proposed Conditions Drainage Plan*" provided in the back pocket of this report. With the development proposal, on-site Basin Ax splits into two developed basins: Basin A1 and Basin A2. Basin A1 is the north-central portion of the site and includes the existing house, concrete patio, vehicle parking area and most of the paved driveway. Runoff from this basin will drain to the permeable pavers located at the east end of the driveway.

Basin A2 is the western, eastern and southern portions of the site and will be developed with 3 residential buildings and the western portion of the paved driveway. Runoff on the western portion of the basin will sheet flow southeasterly to a proposed grass swale that will run along the south side of the proposed buildings. Two additional grass swales will be located between the

proposed buildings, directing runoff to the south. The roof drain piping from the proposed buildings will convey the runoff to the proposed swales where runoff will be directed to the southeast corner of the property, following existing drainage patterns.

Proposed conditions storm water runoff for each basin is presented in Table 5.2. Basin description, imperviousness, weighted runoff coefficients, time of concentration and runoff values are provided for the proposed drainage basin on a worksheet labeled "*Rational Method Calculations*" provided in Appendix B. For ease of reference, the proposed conditions storm water flows are presented on the *"Proposed Conditions Drainage Plan"* provided in the back pocket of this report. A comparison of Existing and Proposed Conditions runoff rates at Design Point 1 is presented in Table 5.3. Design Point 1 is located at the southeast corner of the property.

Table 5.2: Storm Runoff by Basin – Proposed Conditions

Basin I.D.	5-year Minor Design Storm Runoff [cfs]	100-year Major Design Storm Runoff [cfs]
A1	0.25	0.75
A2	0.25	0.84

Table 5.3: Storm Runoff Comparison

Design Point	5-year Minor Design Storm Runoff [cfs]			100-year Major Design Storm Runoff [cfs]		
	Existing Conditions	Proposed Conditions	Δ	Existing Conditions	Proposed Conditions	Δ
1	0.37	0.25	-0.12	1.43	1.20	-0.23

6.0 PERMEABLE PAVERS

The proposed improvements will increase the overall imperviousness of the property and, absent of mitigating measures, would also increase the peak runoff rates. Due to small size of the site, and resulting small change in flows from the site, the use of the typical detention pond design is not

recommended or very practical on a site such as this. This is due to the very small volume and release rates for the pond, resulting in a pond design in landscaping that tends to both not be maintained and often removed via future landscaping projects by owners that are unaware the area is a detention facility. Additionally, detention ponds result in a wet area and concentrated flow discharges, both issues you want to avoid on small, single owner residential sites such as this. The project team met with City engineering staff on 21 of October 2013 to discuss storm drainage and detention on the site, and concurred that a typical detention pond may not be appropriate for the property. The Sanitas Group reviewed various options for the site, and recommends the use of permeable pavers in the drive area to accomplish the same goals as a detention pond and control runoff from the subject property.

Permeable pavers will be used on a portion of the reconstructed driveway and parking area in order to decrease the impervious area and provide water quality and stormwater storage volume, resulting in a reduction in the runoff rates of Basin A1 and for the overall site. The storage volume available in the aggregate layer of the permeable pavers was calculated using UDFCD's UD-BMP_v3.02 spreadsheet. Percolation rates are not known at this time; therefore, the stormwater routing models were run with no infiltration occurring through the filter material. The proposed storage volume that will be provided by the permeable paver aggregate layer is sufficient to reduce the runoff from Basin A1 so that when combined with the Basin A2 runoff, the total site runoff will be less than the existing conditions runoff rates. Supporting calculations for the permeable pavement sizing are provided in Appendix B.

Due to existing topography constraints, Basin A2 will be released without detention. The storage volume provided by the permeable paver aggregate layer was sized to compensate for the undetained release from Basin A2. The *City of Boulder Design and Construction Standards, Section 7.12 (C)(4)* outlines criteria for undetained releases from project sites. Specifically, it states that the unreleased area shall not exceed 5%, and the unreleased rate from the unreleased area should not exceed 25% of the historic flow. The proposed site design exceeds both of these criteria, and we are requesting a variance for this project. It is our opinion that the proposed design meets the intend of the DCS to control developed flow rates while providing a solution that will be effective in the long term, have less impact on the property and any future owners, and provide an increased

water quality treatment component for the site. The developed flow from the unreleased basin (A2) is less than 1.0 cfs for the 100-year event.

The proposed permeable pavement is designed in accordance with the "Full Infiltration Section" shown in Figure PPS-1, included in Appendix B. The area receiving the permeable pavers will be over excavated to remove the 2 to 2 ½ foot layer of clayey, sandy silt. Class C filter material will be placed above the existing sand and gravel layer which was determined to be approximately 2 ½ to 3 feet above the ground water table. The ground water table will fluctuate throughout the year but it is not anticipated to affect the capacity or functionality of the proposed permeable pavement system.

7.0 STORMWATER QUALITY AND EROSION CONTROL

Permanent storm water quality Best Management Practices [BMPs] are not required for this project because the proposed grading disturbance on the 0.28-acre site will be well below the 1.0-acre requirement threshold established by the Criteria [1]; however, the proposed permeable pavers and grass swales will provide water quality enhancement.

Construction Best Management Practices [BMPs] will be installed prior to and during construction, to restrict the amount of sediment transported offsite by either wind or water. Construction BMPs include vehicle tracking control at the construction entrance, silt fencing, temporary seeding, concrete washouts and dust control. An "*Overall Grading and Erosion Control Plan*" is provided with the Construction Plans submitted separately for Technical Document Review.

8.0 WETLAND IMPACTS

There are no known wetlands located on the project site.

9.0 CONCLUSIONS

This Report meets the City's requirements for Final Drainage Report information as outlined in the Criteria. The Report documents the existing drainage conditions present at the site and provides an analysis of the drainage conditions and water quality measures proposed for the **1838 22nd Street Residential Development** project. The proposed development will not adversely affect downstream drainage facilities or properties.

10.0 REFERENCES

[1] "*Design and Construction Standards*", City of Boulder.

[2] Soils Map, "*Web Soil Survey 2.0*" , USDA Natural Resources Conservation Service, October 2013.

[3] "Flood Insurance Rate Map", Federal Emergency Management Agency, Map Number 08013CO394J, effective date 18 December 2012.

[4] "*Storm Drainage Criteria Manual, Volumes 1 and 2*", Urban Drainage and Flood Control District", April 2008.

[5] "*Urban Storm Drainage Criteria Manual, Volume 3 – Best Management Practices*" Urban Drainage and Flood Control District", November 2010.

APPENDIX A

Hydrology Calculations and Supporting Documents

Rational Method Calculations

Basin Ax

Existing Conditions

Project: 1838 22nd Street
SG Project I.D.: B1064

Prepared By: MLM
Reviewed By: CCS
Date: 10/21/13
Revised Date: -

Basin Description: Entire Onsite Basin

NRCS Soil Type: Nh - Niwot Soils

NRCS Hydrologic Soil Rating: C

Basin Area= 0.28 [acres] = 12,284 [sf]

Surface Characteristics[1]	Sub-Area [acres]	Imp [%]	Runoff Coefficients[1]			
			C_2	C_5	C_{10}	C_{100}
Asphalt: Parking	0.000	100	0.87	0.88	0.90	0.93
Concrete: Patio and Walks	0.007	96	0.85	0.87	0.90	0.92
Roofs	0.047	90	0.80	0.85	0.90	0.90
Gravel: Driveway	0.040	7	0.15	0.25	0.35	0.65
Lawns, clayey	0.186	0	0.10	0.20	0.30	0.60

[1] *City of Boulder"Design and Construction Standards", Table 7-2*

Weighted Percent Imperviousness : I [%] = 18.51 A_I = 2,273.42 [sf]

Weighted Runoff Coefficients:

C_2 = 0.24 C_5 = 0.33 C_{10} = 0.42 C_{100} = 0.67

Time of Concentration:

Sheet Flow:

L_i [ft] = 195
S_i [%] = 1.50
t_i [min] = 16.84

Concentrated Flow:

L_{t1} [FT] =	0	L_{t2} [FT] =	0
S_{t1} [%] =	1.50	S_{t2} [%] =	0.00
C_{V1}[3] =	7.00	C_{V2}[3] =	7.00
V_{t1} [fps][4] =	0.86	V_{t2} [fps][4] =	0.00
t_{t1} [min] =	0.00	t_{t2} [min] =	0.00

[3] *UDFCD, Table RO-2*
[4] *UDFCD, Eqn RO-4*

t_t [min] = 0.00

Time of Concentration:

$t_c=t_i+t_t$ [min] = 16.84
t_c(minimum)= 5 min
Check for Urbanized Basins:
$t_c=(L_i+L_{t1}+L_{t2})/180+10$ [min] = 11.08

t_c [min] = 11.08

Rainfall Intensity[5]

I_2 [in/hr]= 2.68 I_5 [in/hr]= 3.96 I_{10} [in/hr]= 5.20 I_{100} [in/hr]= 7.65

[5] *City of Boulder "Design and Construction Standards", Figure 7-1*

Runoff - Rational Method Equation[6]

Q_2 [cfs]= 0.18 **Q_5 [cfs]= 0.37** **Q_{10} [cfs]= 0.62** **Q_{100} [cfs]= 1.43**

[6] *UDFCD "Drainage Criteria Manual, Vol 1", Eqn RO-1*

Rational Method Calculations
Basin A1
Proposed Conditions

Prepared By: MLM
Project: 1838 22nd Street
Reviewed By: CCS
SG Project I.D.: B1064
Date: 10/21/13
Revised Date: -

Basin Description: North-central portion of the lot.

NRCS Soil Type: Nh - Niwot Soils
NRCS Hydrologic Soil Rating: C

Basin Area= 0.13 [acres] = 5,481 [sf]

Surface Characteristics[1]	Sub-Area [acres]	Imp [%]	Runoff Coefficients[1]			
			C_2	C_5	C_{10}	C_{100}
Asphalt: Parking	0.020	100	0.87	0.88	0.90	0.93
Concrete: Patio and Walks	0.005	96	0.85	0.87	0.90	0.92
Roofs	0.024	90	0.80	0.85	0.90	0.90
Permeable Pavement	0.046	7	0.15	0.25	0.35	0.65
Lawns, clayey	0.035	0	0.10	0.20	0.30	0.60

[1] *City of Boulder"Design and Construction Standards", Table 7-2*

Weighted Percent Imperviousness : I [%] = 38.17 A_I = 2,092.06 [sf]

Weighted Runoff Coefficients:

C_2 = 0.39 C_5 = 0.47 C_{10} = 0.54 C_{100} = 0.74

Time of Concentration:

Sheet Flow:

L_i [ft] = 90
S_i [%] = 0.50
t_i [min] = 13.60

Concentrated Flow:

L_{t1} [FT] =	0	L_{t2} [FT] =	0
S_{t1} [%] =	1.50	S_{t2} [%] =	0.00
C_{V1}[3]=	7.00	C_{V2}[3]=	7.00
V_{t1} [fps][4]=	0.86	V_{t2} [fps][4]=	0.00
t_{t1} [min] =	0.00	t_{t2} [min] =	0.00

[3] *UDFCD, Table RO-2*
[4] *UDFCD, Eqn RO-4*

t_t [min] = 0.00

Time of Concentration:

$t_c=t_i+t_t$ [min] = 13.60
t_c(minimum)= 5 min
Check for Urbanized Basins:
$t_c=(L_i+L_{t1}+L_{t2})/180+10$ [min] = 10.50

t_c [min] = 10.50

Rainfall Intensity[5]

I_2 [in/hr]= 2.75 I_5 [in/hr]= 4.06 I_{10} [in/hr]= 5.33 I_{100} [in/hr]= 7.82

[5] *City of Boulder "Design and Construction Standards", Figure 7-1*

Runoff - Rational Method Equation[6]

Q_2 [cfs]= 0.14 **Q_5 [cfs]= 0.25** **Q_{10} [cfs]= 0.38** **Q_{100} [cfs]= 0.75**

[6] *UDFCD "Drainage Criteria Manual, Vol 1", Eqn RO-1*

Rational Method Calculations
Basin A2
Proposed Conditions

Prepared By: MLM
Project: 1838 22nd Street
Reviewed By: CCS
SG Project I.D.: B1064
Date: 10/21/13
Revised Date: -

Basin Description: West, east and south portions of the lot.

NRCS Soil Type: Nh - Niwot Soils
NRCS Hydrologic Soil Rating: C

Basin Area= 0.16 [acres] = 6,803 [sf]

Surface Characteristics[1]	Sub-Area [acres]	Imp [%]	Runoff Coefficients[1]			
			C_2	C_5	C_{10}	C_{100}
Asphalt: Parking	0.008	100	0.87	0.88	0.90	0.93
Concrete: Patio and Walks	0.002	96	0.85	0.87	0.90	0.92
Roofs	0.037	90	0.80	0.85	0.90	0.90
Permeable Pavement	0.000	7	0.15	0.25	0.35	0.65
Lawns, clayey	0.113	0	0.10	0.20	0.30	0.60

[1] *City of Boulder"Design and Construction Standards", Table 7-2*

Weighted Percent Imperviousness : I [%] = 27.01 A_I = 1,837.66 [sf]

Weighted Runoff Coefficients:

C_2 = 0.31 C_5 = 0.39 C_{10} = 0.48 C_{100} = 0.69

Time of Concentration:

Sheet Flow:

L_i [ft] = 198
S_i [%] = 1.50
t_i [min] = 15.65

Concentrated Flow:

L_{t1} [FT] =	0	L_{t2} [FT] =	0
S_{t1} [%] =	1.50	S_{t2} [%] =	0.00
C_{V1}[3]=	7.00	C_{V2}[3]=	7.00
V_{t1} [fps][4]=	0.86	V_{t2} [fps][4]=	0.00
t_{t1} [min] =	0.00	t_{t2} [min] =	0.00

[3] *UDFCD, Table RO-2*
[4] *UDFCD, Eqn RO-4*

t_t [min] = 0.00

Time of Concentration:

$t_c=t_i+t_t$ [min] = 15.65
t_c(minimum)= 5 min
Check for Urbanized Basins:
$t_c=(L_i+L_{t1}+L_{t2})/180+10$ [min] = 11.10

t_c [min] = 11.10

Rainfall Intensity[5]

I_2 [in/hr]= 2.68 I_5 [in/hr]= 3.96 I_{10} [in/hr]= 5.20 I_{100} [in/hr]= 7.64

[5] *City of Boulder "Design and Construction Standards", Figure 7-1*

Runoff - Rational Method Equation[6]

Q_2 [cfs]= 0.13 **Q_5 [cfs]= 0.25** **Q_{10} [cfs]= 0.40** **Q_{100} [cfs]= 0.84**

[6] *UDFCD "Drainage Criteria Manual, Vol 1", Eqn RO-1*

Project Description

File Name	1064-HYD-5YR.SPF
Description	
	1838 22nd Street, Boulder, CO

Project Options

Flow Units	CFS
Elevation Type	Elevation
Hydrology Method	Rational
Time of Concentration (TOC) Method	User-Defined
Link Routing Method	Kinematic Wave
Enable Overflow Ponding at Nodes	YES
Skip Steady State Analysis Time Periods	YES

Analysis Options

Start Analysis On	Aug 01, 2013	00:00:00
End Analysis On	Aug 01, 2013	01:00:00
Start Reporting On	Aug 01, 2013	00:00:00
Antecedent Dry Days	0	days
Runoff (Dry Weather) Time Step	0 01:00:00	days hh:mm:ss
Runoff (Wet Weather) Time Step	0 00:05:00	days hh:mm:ss
Reporting Time Step	0 00:05:00	days hh:mm:ss
Routing Time Step	30	seconds

Number of Elements

	Qty
Rain Gages	0
Subbasins	3
Nodes	3
Junctions	0
Outfalls	2
Flow Diversions	0
Inlets	0
Storage Nodes	1
Links	1
Channels	0
Pipes	0
Pumps	0
Orifices	0
Weirs	1
Outlets	0
Pollutants	0
Land Uses	0

Rainfall Details

Return Period	5 year(s)

Subbasin Summary

SN	Subbasin ID	Area (ac)	Weighted Runoff Coefficient	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1	A1	0.13	0.4700	0.71	0.33	0.04	0.25	0 00:10:30
2	A2	0.16	0.3900	0.74	0.29	0.05	0.25	0 00:11:06
3	Ax	0.28	0.3300	0.73	0.24	0.07	0.37	0 00:11:04

Node Summary

SN	Element ID	Element Type	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Initial Water Elevation (ft)	Surcharge Elevation (ft)	Ponded Area (ft²)	Peak Inflow (cfs)	Max HGL Elevation Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	DP1p	Outfall	99.00					0.25	99.00					
2	DP1x	Outfall	99.00					0.37	99.00					
3	DET01	Storage Node	100.00	101.00	100.00		0.00	0.25	100.27				0.00	0.00

Link Summary

SN	Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length	Inlet Invert Elevation	Outlet Invert Elevation	Average Slope	Diameter or Height	Manning's Roughness	Peak Flow	Design Flow Capacity	Peak Flow/ Design Flow Ratio	Peak Flow Velocity	Peak Flow Depth	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged	Reported Condition
					(ft)	(ft)	(ft)	(%)	(in)		(cfs)	(cfs)		(ft/sec)	(ft)		(min)	
1	DET01-OVERFLOW	Weir	DET01	DP1p		100.00	99.00				0.00							

Subbasin Hydrology

Subbasin : A1

Input Data

Area (ac) 0.13
Weighted Runoff Coefficient 0.4700

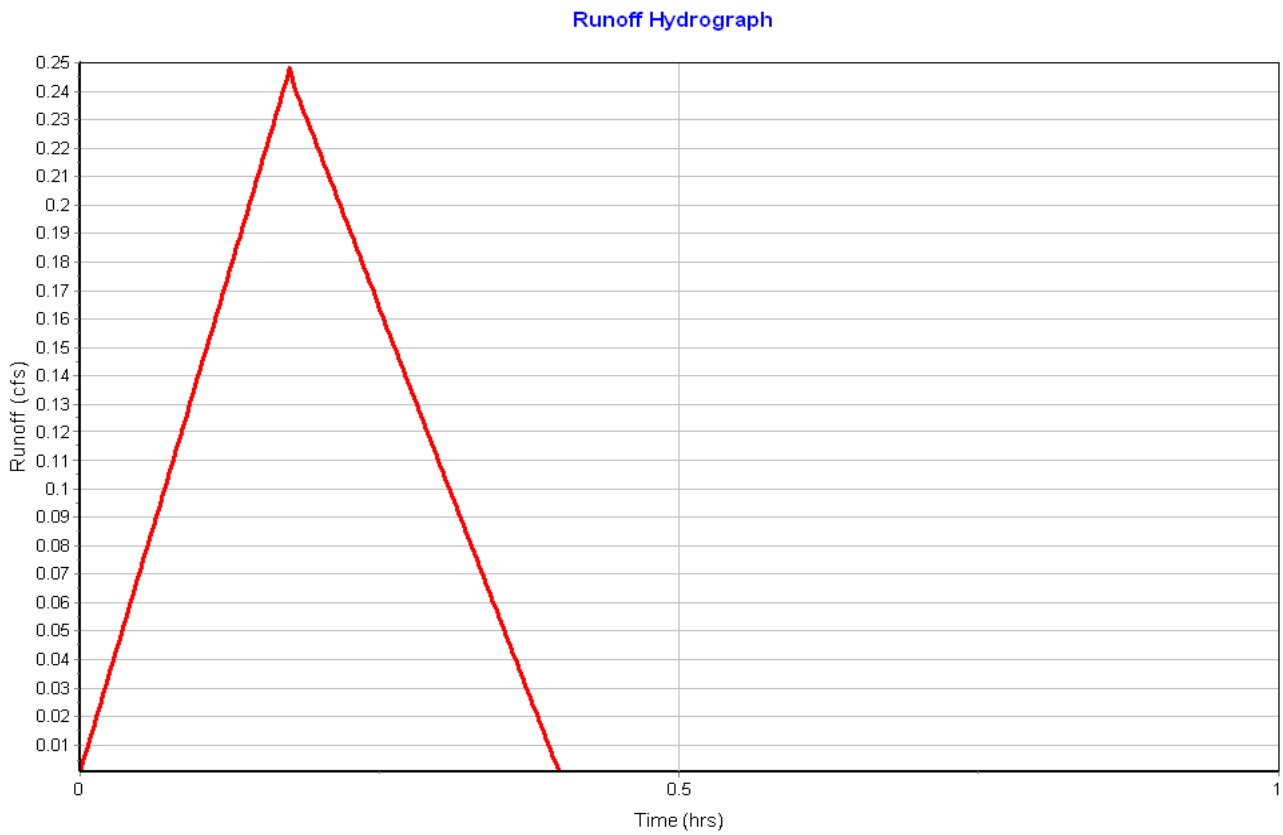
Runoff Coefficient

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	0.13	-	0.47
Composite Area & Weighted Runoff Coeff.	0.13		0.47

Subbasin Runoff Results

Total Rainfall (in) 0.71
Total Runoff (in) 0.33
Peak Runoff (cfs) 0.25
Rainfall Intensity 4.061
Weighted Runoff Coefficient 0.4700
Time of Concentration (days hh:mm:ss) 0 00:10:30

Subbasin : A1


Runoff Hydrograph
Runoff (cfs)
0.25
0.24
0.23
0.22
0.21
0.2
0.19
0.18
0.17
0.16
0.15
0.14
0.13
0.12
0.11
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
0.5
1
Time (hrs)

Subbasin : A2

Input Data

Area (ac) 0.16
Weighted Runoff Coefficient 0.3900

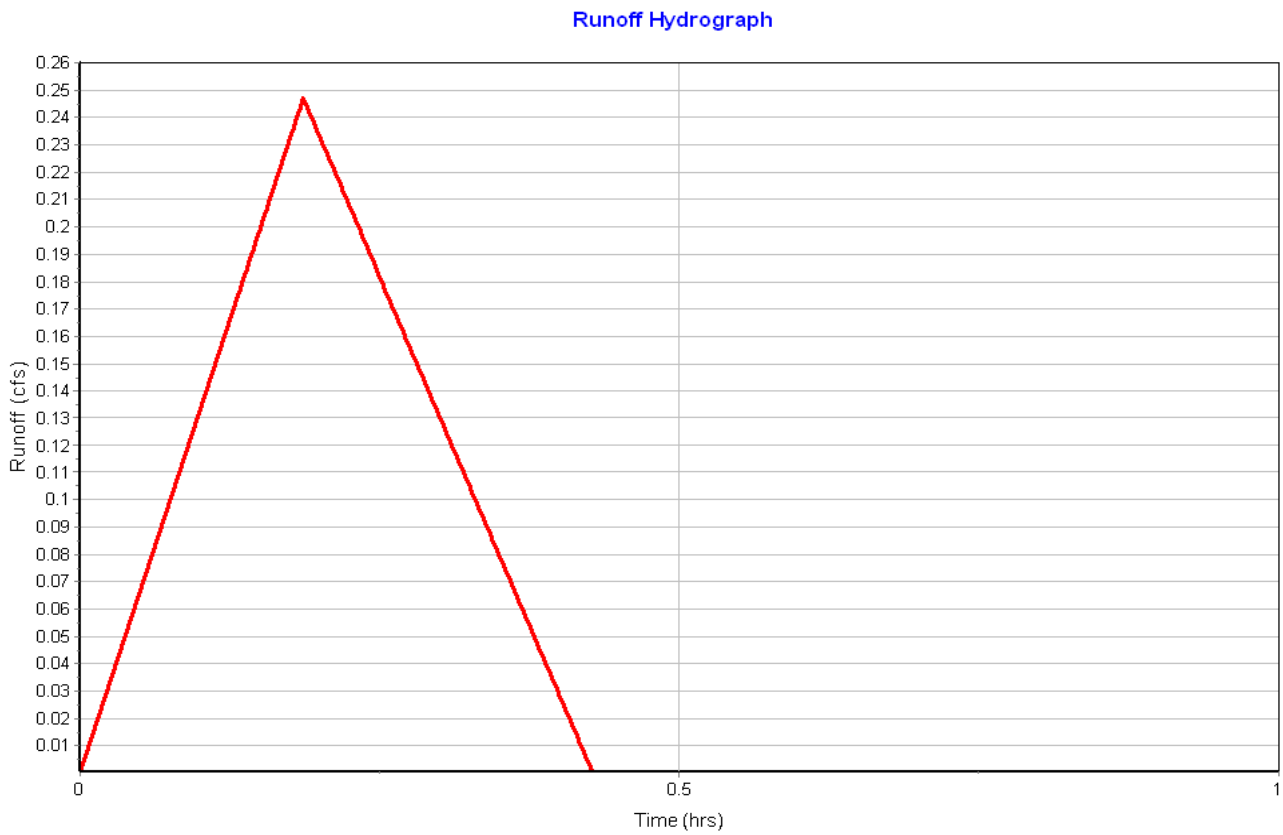
Runoff Coefficient

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	0.16	-	0.39
Composite Area & Weighted Runoff Coeff.	0.16		0.39

Subbasin Runoff Results

Total Rainfall (in) 0.74
Total Runoff (in) 0.29
Peak Runoff (cfs) 0.25
Rainfall Intensity 3.959
Weighted Runoff Coefficient 0.3900
Time of Concentration (days hh:mm:ss) 0 00:11:06

Subbasin : A2


Runoff Hydrograph
Runoff (cfs)
0.26
0.25
0.24
0.23
0.22
0.21
0.2
0.19
0.18
0.17
0.16
0.15
0.14
0.13
0.12
0.11
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
0.5
1
Time (hrs)

Subbasin : Ax

Input Data

Area (ac) 0.28
Weighted Runoff Coefficient 0.3300

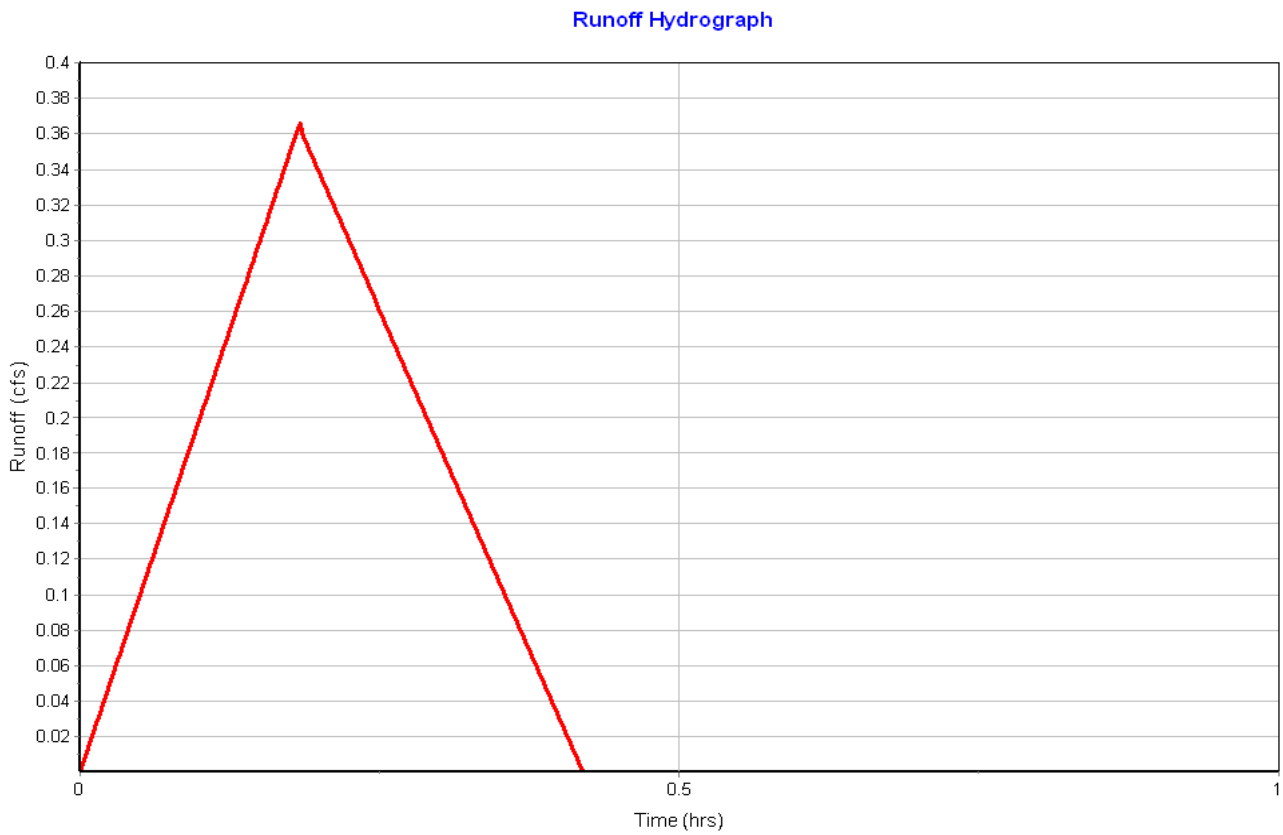
Runoff Coefficient

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	0.28	-	0.33
Composite Area & Weighted Runoff Coeff.	0.28		0.33

Subbasin Runoff Results

Total Rainfall (in) 0.73
Total Runoff (in) 0.24
Peak Runoff (cfs) 0.37
Rainfall Intensity 3.962
Weighted Runoff Coefficient 0.3300
Time of Concentration (days hh:mm:ss) 0 00:11:05

Subbasin : Ax


Runoff Hydrograph
Runoff (cfs)
0.4
0.38
0.36
0.34
0.32
0.3
0.28
0.26
0.24
0.22
0.2
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
0.5
1
Time (hrs)

Storage Nodes

Storage Node : DET01

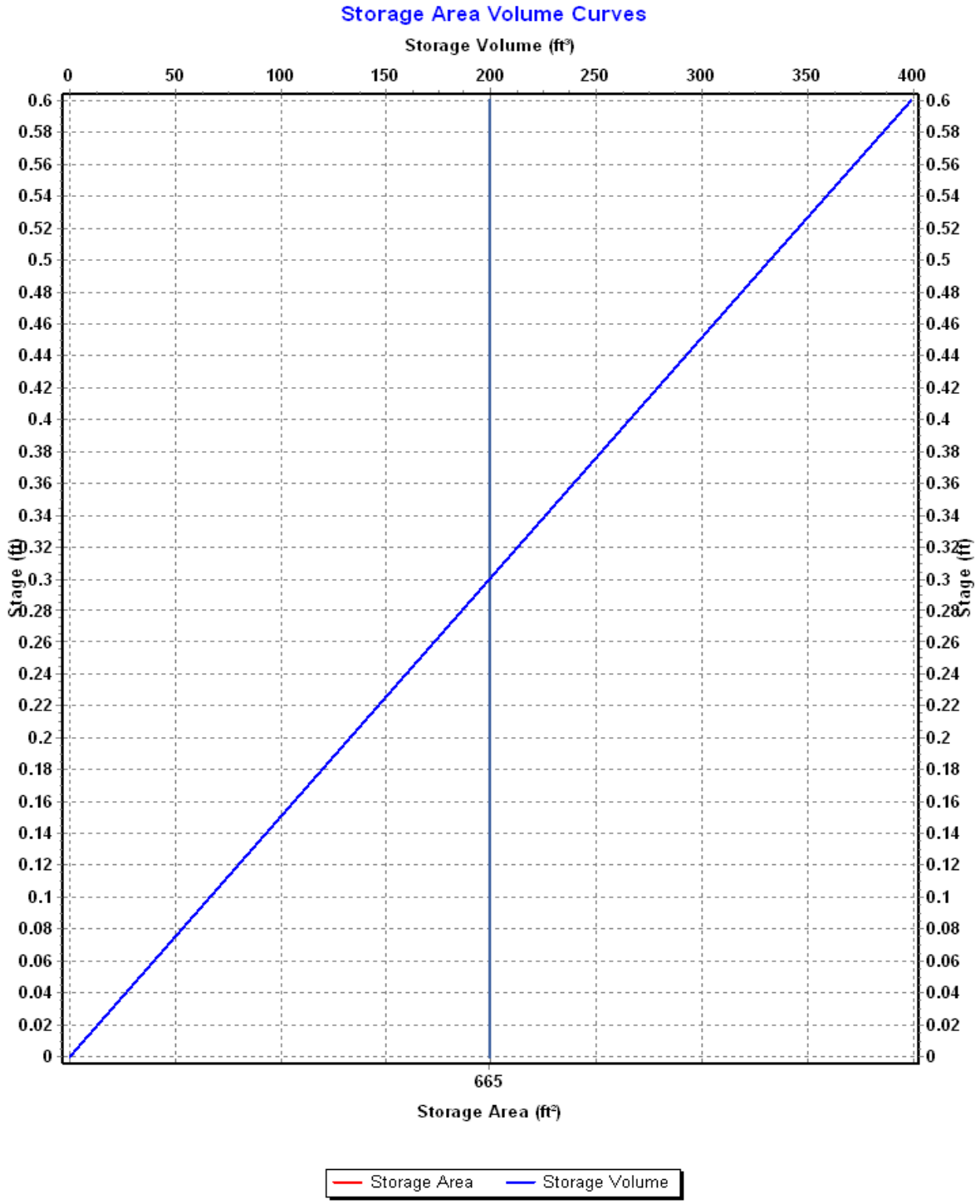
Input Data

Invert Elevation (ft) 100.00
Max (Rim) Elevation (ft) 101.00
Max (Rim) Offset (ft) 1.00
Initial Water Elevation (ft) 100.00
Initial Water Depth (ft) 0.00
Ponded Area (ft²) 0.00
Evaporation Loss 0.00

Storage Area Volume Curves

Storage Curve : DET01

Stage (ft)	Storage Area (ft²)	Storage Volume (ft³)
0	665	0.000
0.5	665	332.50
0.6	665	399.00


Storage Area Volume Curves
Storage Volume (ft³)
0
50
100
150
200
250
300
350
400
0.6
0.58
0.56
0.54
0.52
0.5
0.48
0.46
0.44
0.42
0.4
0.38
0.36
0.34
0.32
0.3
0.28
0.26
0.24
0.22
0.2
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
Stage (ft)
665
Storage Area (ft²)
Storage Area
Storage Volume

Storage Node : DET01 (continued)

Outflow Weirs

SN	Element ID	Weir Type	Flap Gate	Crest Elevation (ft)	Crest Offset (ft)	Length (ft)	Weir Total Height (ft)	Discharge Coefficient
1	DET01-OVERFLOW	Trapezoidal	No	100.50	0.50	30.00	0.25	2.75

Output Summary Results

Peak Inflow (cfs) 0.25
Peak Lateral Inflow (cfs) 0.25
Peak Outflow (cfs) 0.00
Peak Exfiltration Flow Rate (cfm) 0.00
Max HGL Elevation Attained (ft) 100.27
Max HGL Depth Attained (ft) 0.27
Average HGL Elevation Attained (ft) 100.22
Average HGL Depth Attained (ft) 0.22
Time of Max HGL Occurrence (days hh:mm) 0 00:30
Total Exfiltration Volume (1000-ft³) 0.000
Total Flooded Volume (ac-in) 0
Total Time Flooded (min) 0
Total Retention Time (sec) 0.00

Project Description

File Name	1064-HYD-100YR.SPF
Description	
	1838 22nd Street, Boulder, CO

Project Options

Flow Units	CFS
Elevation Type	Elevation
Hydrology Method	Rational
Time of Concentration (TOC) Method	User-Defined
Link Routing Method	Kinematic Wave
Enable Overflow Ponding at Nodes	YES
Skip Steady State Analysis Time Periods	YES

Analysis Options

Start Analysis On	Aug 01, 2013	00:00:00
End Analysis On	Aug 01, 2013	01:00:00
Start Reporting On	Aug 01, 2013	00:00:00
Antecedent Dry Days	0	days
Runoff (Dry Weather) Time Step	0 01:00:00	days hh:mm:ss
Runoff (Wet Weather) Time Step	0 00:05:00	days hh:mm:ss
Reporting Time Step	0 00:05:00	days hh:mm:ss
Routing Time Step	30	seconds

Number of Elements

	Qty
Rain Gages	0
Subbasins	3
Nodes	3
Junctions	0
Outfalls	2
Flow Diversions	0
Inlets	0
Storage Nodes	1
Links	1
Channels	0
Pipes	0
Pumps	0
Orifices	0
Weirs	1
Outlets	0
Pollutants	0
Land Uses	0

Rainfall Details

Return Period	100 year(s)

Subbasin Summary

SN	Subbasin ID	Area (ac)	Weighted Runoff Coefficient	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1	A1	0.13	0.7400	1.37	1.01	0.13	0.75	0 00:10:30
2	A2	0.16	0.6900	1.42	0.98	0.16	0.84	0 00:11:06
3	Ax	0.28	0.6700	1.40	0.94	0.26	1.43	0 00:11:04

Node Summary

SN	Element ID	Element Type	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Initial Water Elevation (ft)	Surcharge Elevation (ft)	Ponded Area (ft²)	Peak Inflow (cfs)	Max HGL Elevation Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	DP1p	Outfall	99.00					1.20	99.00					
2	DP1x	Outfall	99.00					1.43	99.00					
3	DET01	Storage Node	100.00	101.00	100.00		0.00	0.75	100.54				0.00	0.00

Link Summary

SN	Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length (ft)	Inlet Invert Elevation (ft)	Outlet Invert Elevation (ft)	Average Slope (%)	Diameter or Height (in)	Manning's Roughness	Peak Flow (cfs)	Design Flow Capacity (cfs)	Peak Flow/ Design Flow Ratio	Peak Flow Velocity (ft/sec)	Peak Flow Depth (ft)	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged (min)	Reported Condition
1	DET01-OVERFLOW	Weir	DET01	DP1p		100.00	99.00				0.55							

Subbasin Hydrology

Subbasin : A1

Input Data

Area (ac) 0.13
Weighted Runoff Coefficient 0.7400

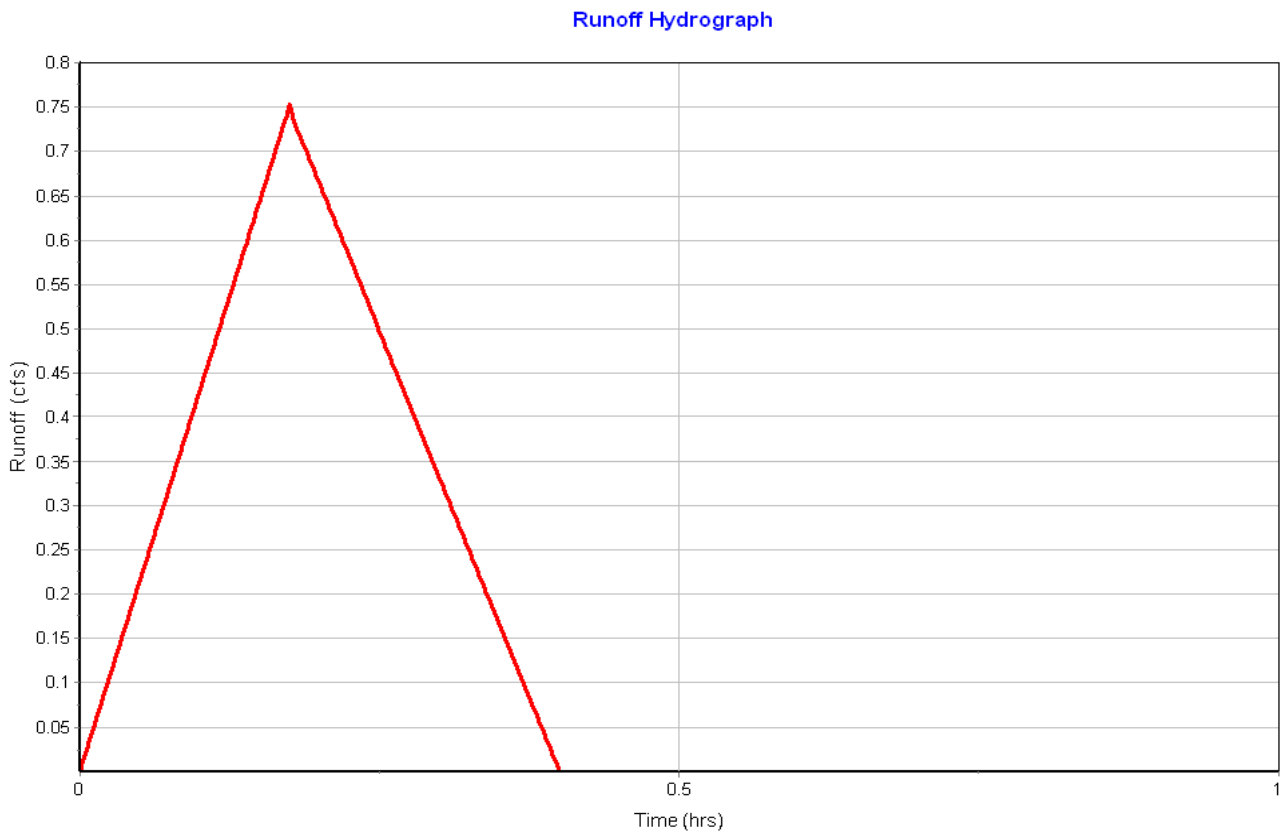
Runoff Coefficient

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	0.13	-	0.74
Composite Area & Weighted Runoff Coeff.	0.13		0.74

Subbasin Runoff Results

Total Rainfall (in) 1.37
Total Runoff (in) 1.01
Peak Runoff (cfs) 0.75
Rainfall Intensity 7.823
Weighted Runoff Coefficient 0.7400
Time of Concentration (days hh:mm:ss) 0 00:10:30

Subbasin : A1


Runoff Hydrograph
Runoff (cfs)
0.8
0.75
0.7
0.65
0.6
0.55
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
0.5
1
Time (hrs)

Subbasin : A2

Input Data

Area (ac) 0.16
Weighted Runoff Coefficient 0.6900

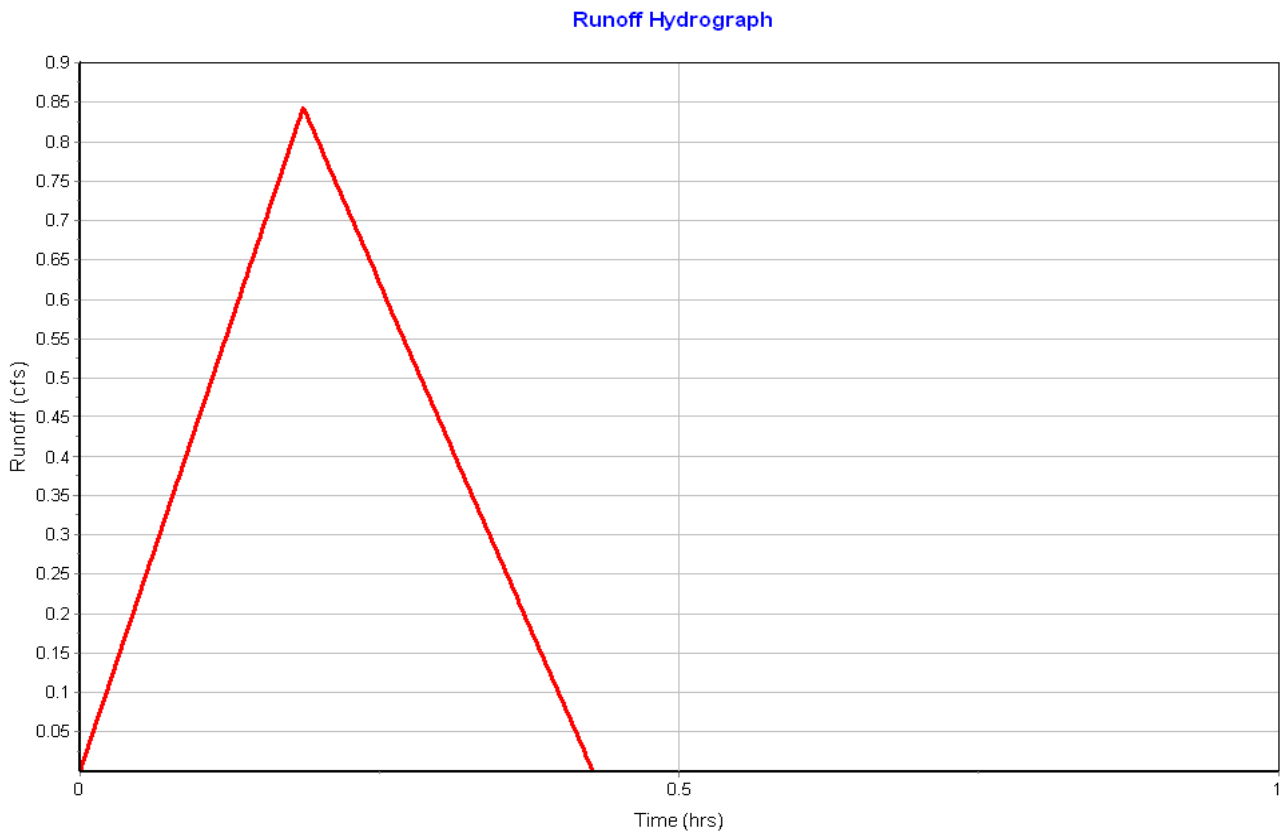
Runoff Coefficient

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	0.16	-	0.69
Composite Area & Weighted Runoff Coeff.	0.16		0.69

Subbasin Runoff Results

Total Rainfall (in) 1.42
Total Runoff (in) 0.98
Peak Runoff (cfs) 0.84
Rainfall Intensity 7.637
Weighted Runoff Coefficient 0.6900
Time of Concentration (days hh:mm:ss) 0 00:11:06

Subbasin : A2


Runoff Hydrograph
Runoff (cfs)
0.9
0.85
0.8
0.75
0.7
0.65
0.6
0.55
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
0.5
1
Time (hrs)

Subbasin : Ax

Input Data

Area (ac) 0.28
Weighted Runoff Coefficient 0.6700

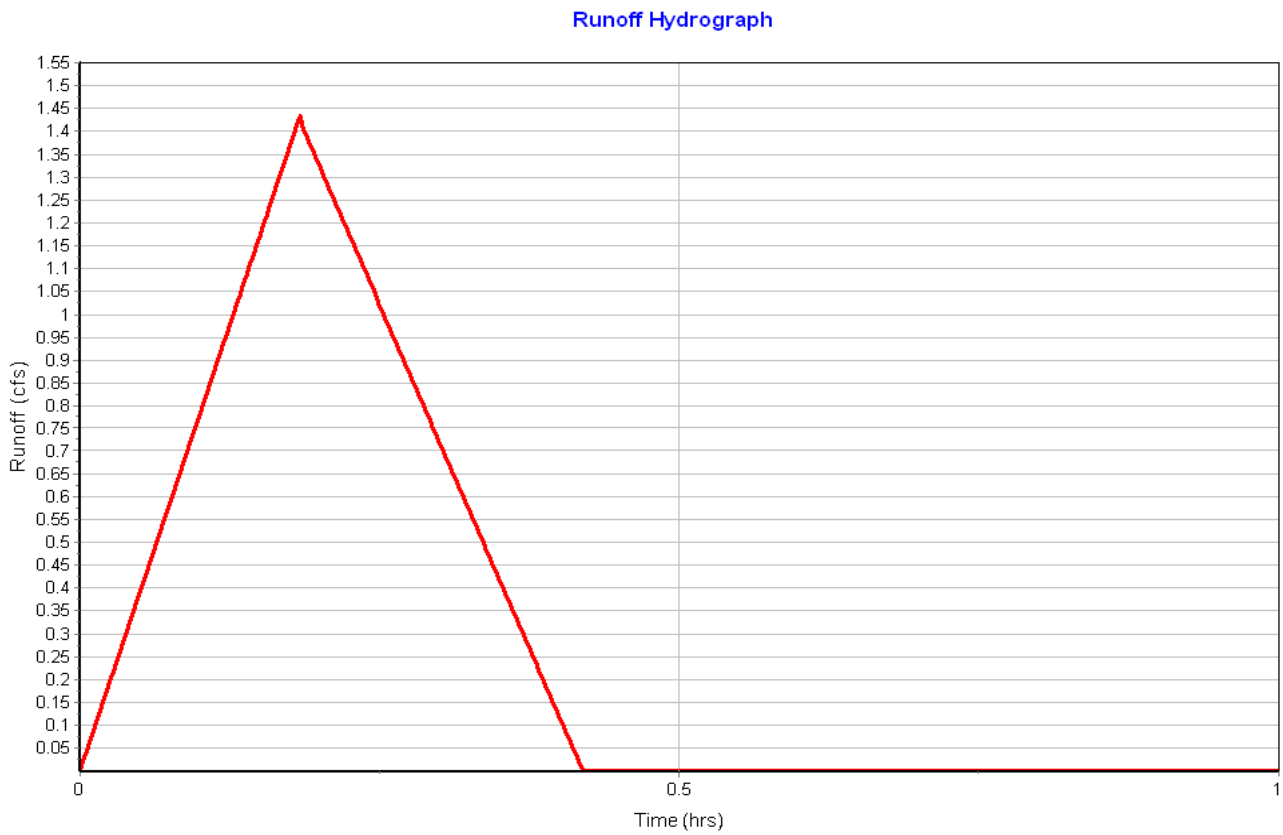
Runoff Coefficient

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	0.28	-	0.67
Composite Area & Weighted Runoff Coeff.	0.28		0.67

Subbasin Runoff Results

Total Rainfall (in) 1.40
Total Runoff (in) 0.94
Peak Runoff (cfs) 1.43
Rainfall Intensity 7.643
Weighted Runoff Coefficient 0.6700
Time of Concentration (days hh:mm:ss) 0 00:11:05

Subbasin : Ax


Runoff Hydrograph
Runoff (cfs)
1.55
1.5
1.45
1.4
1.35
1.3
1.25
1.2
1.15
1.1
1.05
1
0.95
0.9
0.85
0.8
0.75
0.7
0.65
0.6
0.55
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
0.5
1
Time (hrs)

Storage Nodes

Storage Node : DET01

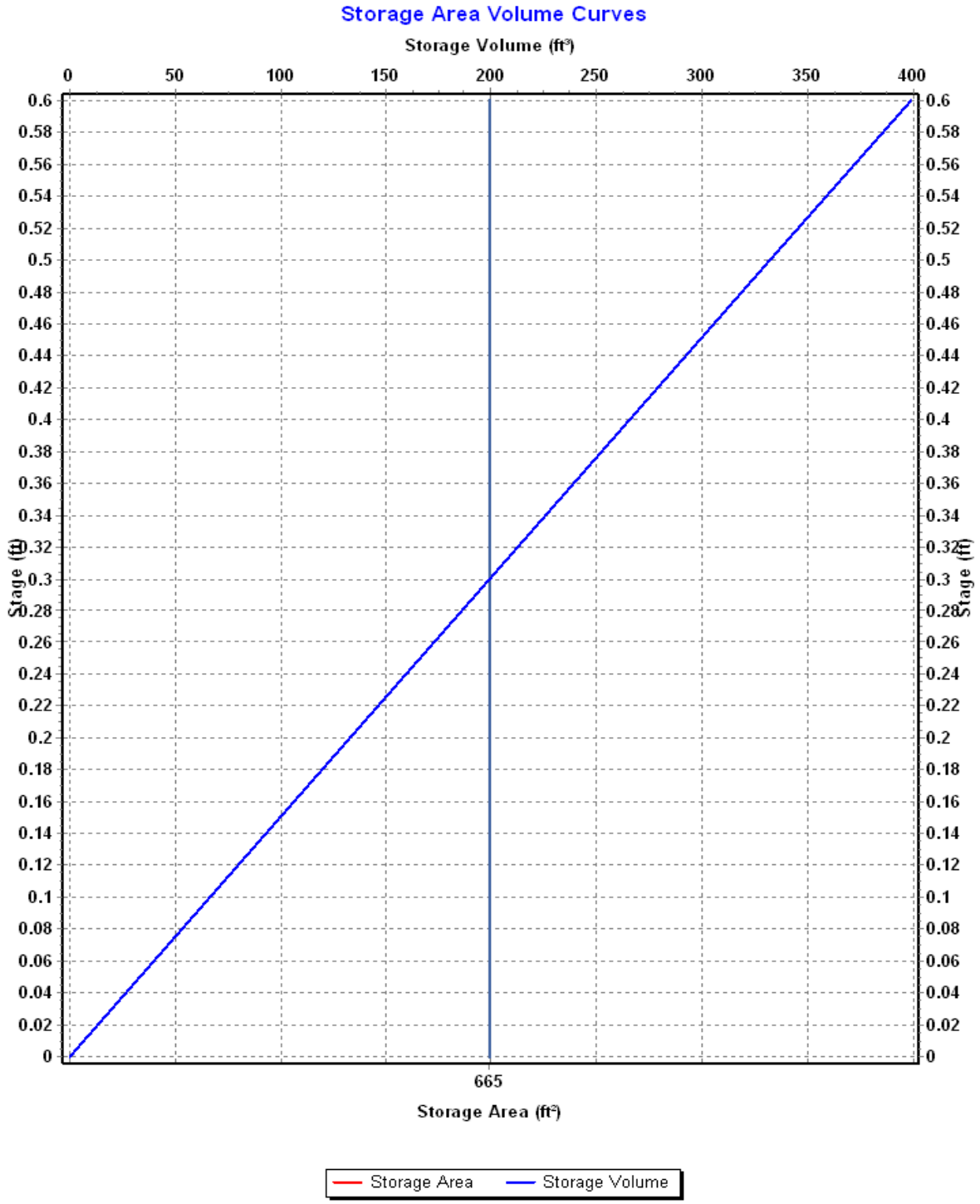
Input Data

Invert Elevation (ft) 100.00
Max (Rim) Elevation (ft) 101.00
Max (Rim) Offset (ft) 1.00
Initial Water Elevation (ft) 100.00
Initial Water Depth (ft) 0.00
Ponded Area (ft²) 0.00
Evaporation Loss 0.00

Storage Area Volume Curves

Storage Curve : DET01

Stage (ft)	Storage Area (ft²)	Storage Volume (ft³)
0	665	0.000
0.5	665	332.50
0.6	665	399.00


Storage Area Volume Curves
Storage Volume (ft³)
0
50
100
150
200
250
300
350
400
0.6
0.58
0.56
0.54
0.52
0.5
0.48
0.46
0.44
0.42
0.4
0.38
0.36
0.34
0.32
0.3
0.28
0.26
0.24
0.22
0.2
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
Stage (ft)
665
Storage Area (ft²)
Storage Area
Storage Volume

Storage Node : DET01 (continued)

Outflow Weirs

SN	Element ID	Weir Type	Flap Gate	Crest Elevation (ft)	Crest Offset (ft)	Length (ft)	Weir Total Height (ft)	Discharge Coefficient
1	DET01-OVERFLOW	Trapezoidal	No	100.50	0.50	30.00	0.25	2.75

Output Summary Results

Peak Inflow (cfs)	0.75
Peak Lateral Inflow (cfs)	0.75
Peak Outflow (cfs)	0.55
Peak Exfiltration Flow Rate (cfm)	0.00
Max HGL Elevation Attained (ft)	100.54
Max HGL Depth Attained (ft)	0.54
Average HGL Elevation Attained (ft)	100.43
Average HGL Depth Attained (ft)	0.43
Time of Max HGL Occurrence (days hh:mm)	0 00:14
Total Exfiltration Volume (1000-ft³)	0.000
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0.00

APPENDIX B

Permeable Pavement Sizing Calculations

Design Procedure Form: Permeable Pavement Systems (PPS)

Designer: MLM
Company: The Sanitas Group
Date: November 2, 2013
Project: 1838 22nd Street
Location: Boulder, CO

1. Type of Permeable Pavement Section

A) What type of section of permeable pavement is used?
(Based on the land use and activities, proximity to adjacent structures and soil characteristics.)

Choose One
- ○ No Infiltration
- ○ Partial Infiltration Section
- ● Full Infiltration Section

B) What type of wearing course?

Choose One
- ● PICP
- ○ Concrete Grid Pavement
- ○ Pervious Concrete
- ○ Porous Gravel

2. Required Storage Volume

A) Effective Imperviousness of Area Tributary to Permeable Pavement, I_a — I_a = 49.6 %

B) Tributary Area's Imperviousness Ratio ($I = I_a / 100$) — i = 0.496

C) Tributary Watershed Area (including area of permeable pavement system) — A_{Total} = 5,481 sq ft

D) Area of Permeable Pavement System (Minimum recommended permeable pavement area = 1090 sq ft) — A_{PPS} = 1,997 sq ft

E) Impervious Tributary Ratio (Contributing Imperviuos Area / Permeable Pavement Ratio) — R_T = 0.9

F) Water Quality Capture Volume (WQCV) Based on 12-hour Drain Time
($WQCV = (0.8 * (0.91 * i^3 - 1.19 * i^2 + 0.78 * i) / 12) * Area$) — WQCV = 75 cu ft

G) Is flood control volume being added?

Choose One
- ● YES
- ○ NO

Provide overflow to carry runoff directly into the reservoir layer to ensure use of flood control volume regardless of infiltration rates.

H) Total Volume Needed — V_{Total} = 333 cu ft

3. Depth of Reservoir

A) Minimum Depth of Reservoir (Minimum recommended depth is 6 inches) — D_{min} = 6.0 inches

B) Is the slope of the reservoir/subgrade interface equal to 0%?

Choose One
- ● YES- Flat or Stepped Installation
- ○ NO- Sloped Installation

C) Porosity (Porous Gravel Pavement $\leq$ 0.3, Others $\leq$ 0.40) — P = 0.40

D) Slope of the Base Course/Subgrade Interface — S = _____ ft / ft

E) Length Between Lateral Flow Barriers — L = _____ ft

F) Volume Provided Based on Depth of Base Course
Flat or Stepped: $V = P * ((D_{min-1})/12) * Area$
Sloped: $V = P * [(D_{min} - (D_{min} - 6*SL-1)) / 12] * Area$ — V = 333 cu ft

4. Lateral Flow Barriers

A) Type of Lateral Flow Barriers

Choose One
- ○ Concrete Walls
- ○ PVC geomembrane installed normal to flow
- ● N/A- Flat installation
- ○ Other (Describe):

B) Number of Permeable Pavement Cells — Cells = _____

5. Perimeter Barrier

A) Is a perimeter barrier provided on all sides of the pavement system?
(Recommeded for PICP, concrete grid pavement, or for any no-infiltration section.)

Choose One
- ○ YES
- ● NO

Design Procedure Form: Permeable Pavement Systems (PPS)

Designer: MLM
Company: The Sanitas Group
Date: November 2, 2013
Project: 1838 22nd Street
Location: Boulder, CO

6. Filter Material and Underdrain System	
A) Is the underdrain placed below a 6-inch thick layer of CDOT Class C filter material?	Choose One ○ YES ○ NO ◉ N/A
B) Diameter of Slotted Pipe (slot dimensions per Table PPs-2)	Choose One ○ 4-inch ○ 6-inch
C) Distance from the Lowest Elevation of the Storage Volume (i.e. the bottom of the base course to the center of the orifice)	y = _____ ft
7. Impermeable Geomembrane Liner and Geotextile Separator Fabric	
A) Is there a minimum 30 mil thick impermeable PVC geomembrane liner on the bottom and sides of the basin, extending up to the top of the base course?	Choose One ○ YES ◉ NO
B) CDOT Class B Separator Fabric	Choose One ○ Placed above the liner ○ Placed above and below the liner
8. Outlet (Assumes each cell has similar area, subgrade slope, and length between lateral barriers (unless subgrade is flat). Calculate cells individually where this varies.)	
A) Depth of WQCV in the Reservoir (Elevation of the Flood Control Outlet)	D_{WQCV} = _____ inches
B) Diameter of Orifice for 12-hour Drain Time (Use a minimum orifice diameter of 3/8-inches)	$D_{Orifice}$ = _____ inches

Notes: _____

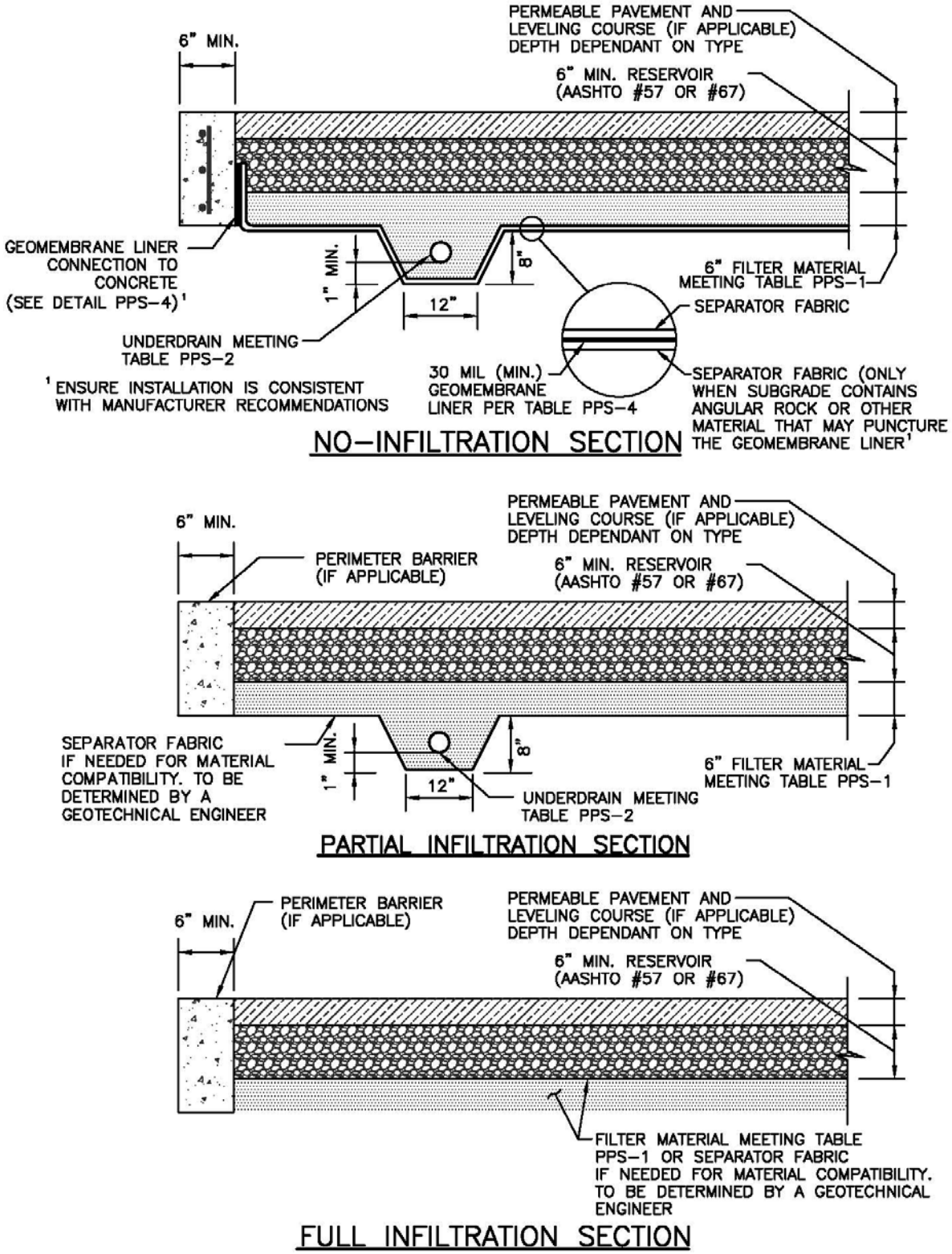
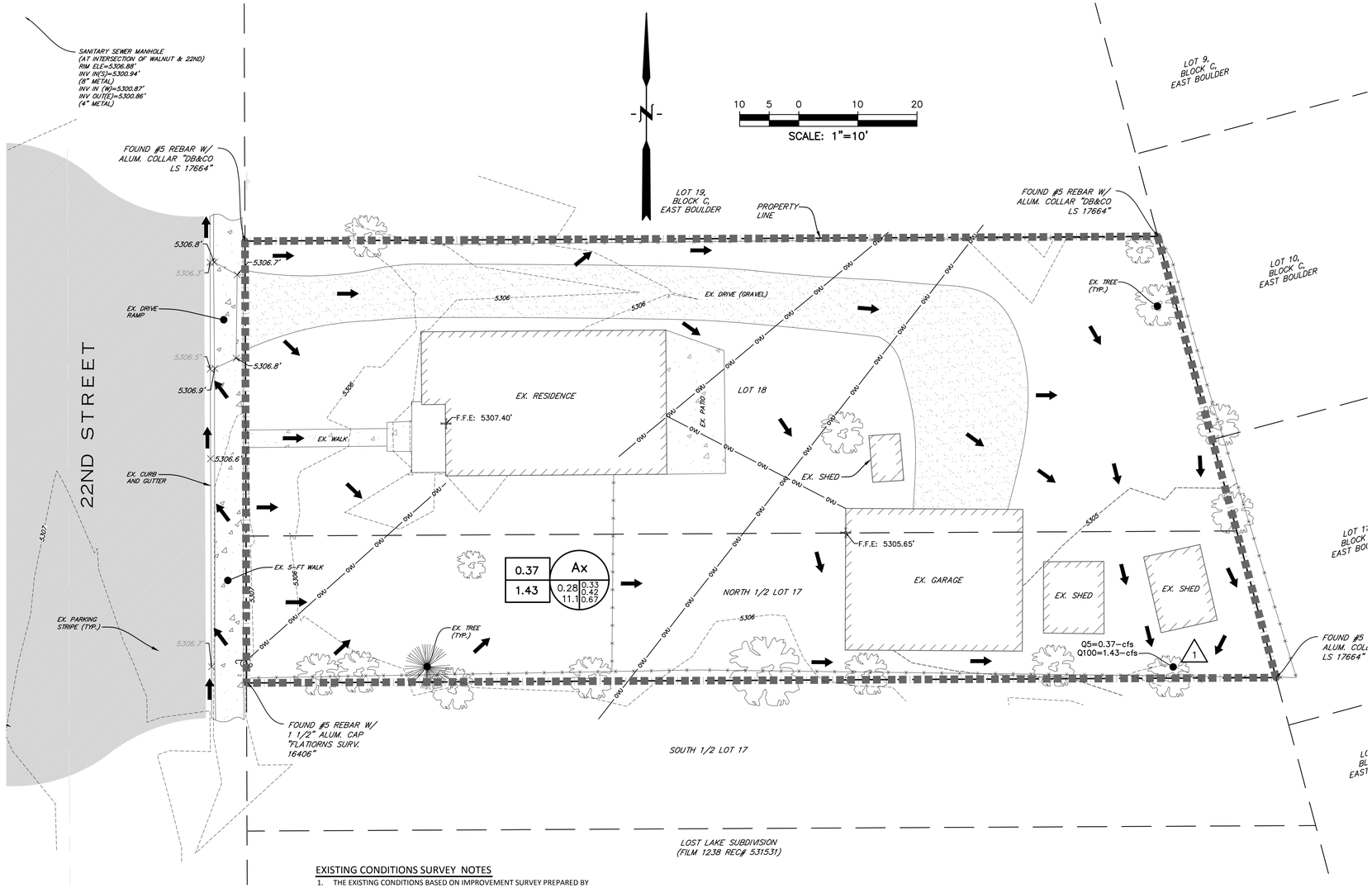


Figure PPS-1. Permeable Pavement Sections



LEGEND

- PROPERTY BOUNDARY
- ADJACENT PROPERTY BOUNDARY
- EX. LOT LINE
- EX. FENCE
- EX. MAJOR CONTOUR (5305)
- EX. MINOR CONTOUR (5306)
- EX. SPOT ELEVATION (57.62)
- EX. OVERHEAD UTILITIES (OVU)
- EX. UTILITY POLE
- EX. ASPHALT PAVEMENT
- EX. CONCRETE
- EX. GRAVEL
- DRAINAGE BASIN BOUNDARY
- DRAINAGE BASIN ID (ID)
- DRAINAGE BASIN DESIGNATOR (AREA / Tc / C5 C10 C100)
- BASIN AREA [AC]
- TIME OF CONCENTRATION [MIN]
- RUNOFF COEFFICIENT
- MINOR STORM RUNOFF (Q5)
- DRAINAGE BASIN STORM RUNOFF [CFS]
- MAJOR STORM RUNOFF (Q100)
- STORM WATER FLOW DIRECTION

EXISTING CONDITIONS SURVEY NOTES

1. THE EXISTING CONDITIONS BASED ON IMPROVEMENT SURVEY PREPARED BY FLATIRONS, INC. ISSUED 10/25/13.
2. THE LOCATION OF THE UTILITIES SHOWN HEREON ARE BASED ON THE FIELD SURVEY BY FLATIRONS, INC. 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). THE SANITAS GROUP, LLC IS NOT RESPONSIBLE FOR UTILITY INFORMATION PROVIDED BY OTHERS. THE SANITAS GROUP, LLC RECOMMENDS THAT THE LOCATION OF THE UTILITIES BE FIELD VERIFIED PRIOR TO ANY DIGGING ON, OR ADJACENT TO THE SUBJECT PROPERTY.
3. EXISTING TREE LOCATIONS ARE BASED ON THE FIELD SURVEY BY FLATIRONS, INC.
4. BASIS OF BEARINGS: ASSUMED NORTH 15°00'15" WEST, ALONG THE EAST LINE OF THE SUBJECT PROPERTY.
5. THE SUBJECT PROPERTY CONTAINS A GROSS AREA OF 12,284 SQUARE FEET (0.28 ACRES), MORE OR LESS.
6. BENCHMARK: #5 REBAR WITH 1½" ALUMINUM CAP "FLATIRONS SURV. 16406" AT THE SOUTHWEST CORNER OF THE SUBJECT PROPERTY, ELEVATION = 5306.82 FEET, NAVD 88 DATUM.

FLOOD PLAIN NOTES

1. THE SUBJECT PROPERTY IS LOCATED WITHIN FLOOD HAZARD ZONE X (AREAS DETERMINED TO BE OUTSIDE THE 0.2% ANNUAL CHANCE FLOODPLAIN) ACCORDING TO THE CURRENT FEMA FLOOD INSURANCE RATE MAP, MAP NUMBER 08013C0394J, DATED DECEMBER 18, 2012.

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

1064DR-X

PREPARED BY:

The Sanitas Group
801 MAIN ST, SUITE 210
LOUISVILLE, CO 80027
720.346.1656
PROJECT CONTACT:
CURTIS C. STEVENS, P.E.

PREPARED FOR:

22ND ST.
ELEMENT, LLC
C/O ELEMENT PROPERTIES
1539 PEARL STREET
BOULDER, CO 80302

CONTACT:
SCOTT HOLTON

TECHNICAL DOCUMENTS FOR:

1838 22ND STREET RESIDENTIAL DEVELOPMENT

1838 22ND STREET
CITY OF BOULDER, STATE OF COLORADO

COLORADO REGISTERED PROFESSIONAL ENGINEER
CURTIS CHARLES STEVENS
40337

NOT VALID WITHOUT ORIGINAL SIGNATURE AND DATE

ISSUE	DATE
TECH DOC	11/4/13

DESIGNED BY:	MLM
DRAWN BY:	MLM
CHECKED BY:	CCS

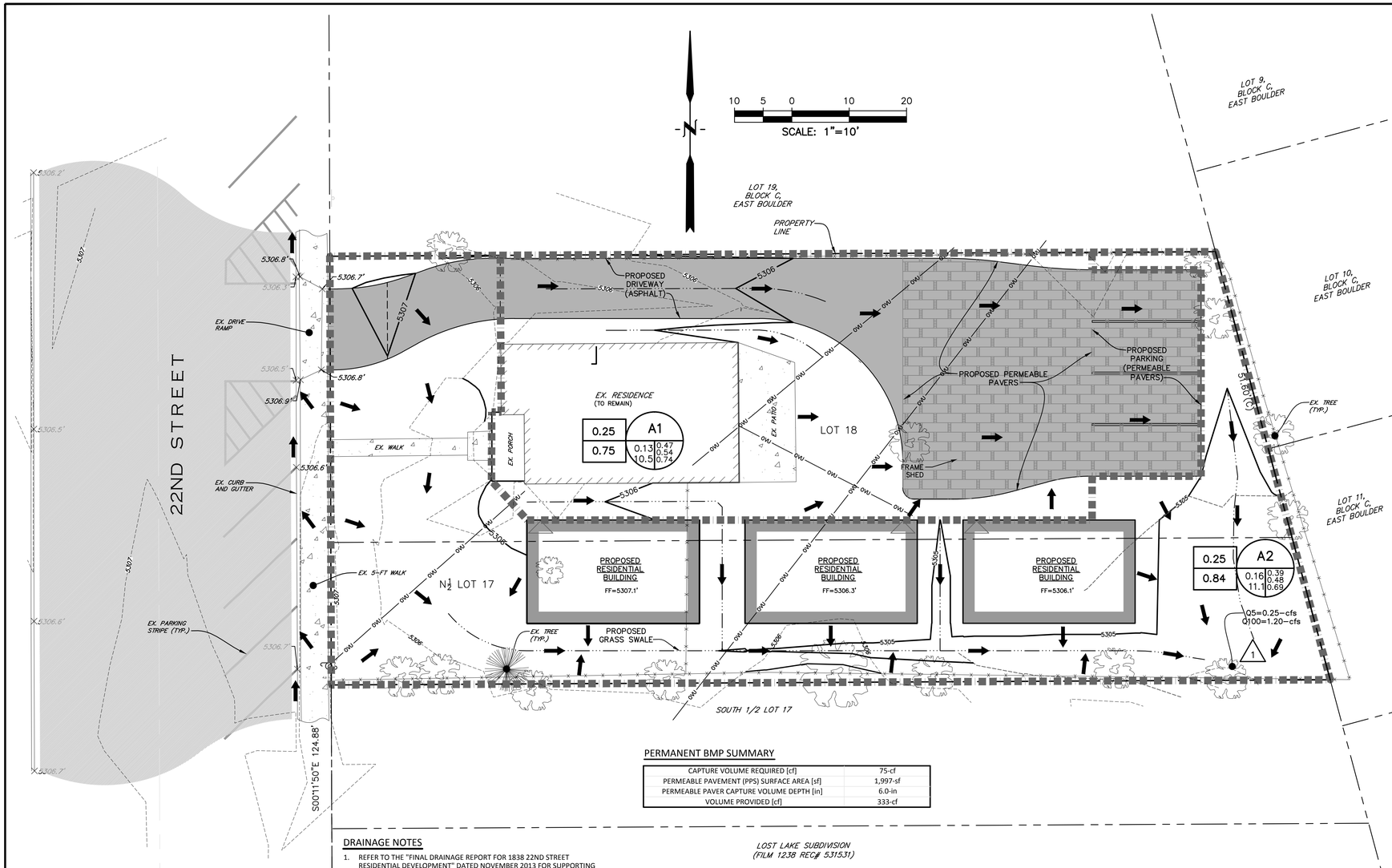
DRAWING SCALE:
HORIZONTAL: 1" = 10'
VERTICAL: NONE

EXISTING CONDITIONS DRAINAGE PLAN

PROJECT NO. B1064

DR1

SHEET: 1 OF 2



LEGEND

- PROPERTY BOUNDARY
- ADJACENT PROPERTY BOUNDARY
- EX. LOT LINE
- EX. FENCE
- EX. MAJOR CONTOUR
- EX. MINOR CONTOUR
- PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- EX. SPOT ELEVATION
- EX. OVERHEAD UTILITIES
- EX. UTILITY POLE
- EX. ASPHALT PAVEMENT
- EX. CONCRETE
- PROPOSED ASPHALT PAVEMENT
- PROPOSED PERMEABLE PAVEMENT
- DRAINAGE BASIN BOUNDARY
- DRAINAGE BASIN ID / DRAINAGE BASIN DESIGNATOR / BASIN AREA [AC] / TIME OF CONCENTRATION [MIN] / RUNOFF COEFFICIEN
- MINOR STORM RUNOFF / DRAINAGE BASIN STORM RUNOFF [CFS] / MAJOR STORM RUNOFF
- STORM WATER FLOW DIRECTION

PERMANENT BMP SUMMARY

CAPTURE VOLUME REQUIRED [cf]	75-cf
PERMEABLE PAVEMENT (PPS) SURFACE AREA [sf]	1,997-sf
PERMEABLE PAVER CAPTURE VOLUME DEPTH [in]	6.0-in
VOLUME PROVIDED [cf]	333-cf

EXISTING CONDITIONS SURVEY NOTES

1. THE EXISTING CONDITIONS BASED ON IMPROVEMENT SURVEY PREPARED BY FLATIRONS, INC. ISSUED 10/25/13.
2. THE LOCATION OF THE UTILITIES SHOWN HEREON ARE BASED ON THE FIELD SURVEY BY FLATIRONS, INC. 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). THE SANITAS GROUP, LLC IS NOT RESPONSIBLE FOR UTILITY INFORMATION PROVIDED BY OTHERS. THE SANITAS GROUP, LLC RECOMMENDS THAT THE LOCATION OF THE UTILITIES BE FIELD VERIFIED PRIOR TO ANY DIGGING ON, OR ADJACENT TO THE SUBJECT PROPERTY.
3. EXISTING TREE LOCATIONS ARE BASED ON THE FIELD SURVEY BY FLATIRONS, INC.
4. BASIS OF BEARINGS: ASSUMED NORTH 15°00'15" WEST, ALONG THE EAST LINE OF THE SUBJECT PROPERTY.
5. THE SUBJECT PROPERTY CONTAINS A GROSS AREA OF 12,284 SQUARE FEET (0.28 ACRES), MORE OR LESS.
6. BENCHMARK: #5 REBAR WITH 1¾" ALUMINUM CAP "FLATIRONS SURV. 16406" AT THE SOUTHWEST CORNER OF THE SUBJECT PROPERTY, ELEVATION = 5306.82 FEET, NAVD 88 DATUM.

FLOOD PLAIN NOTES

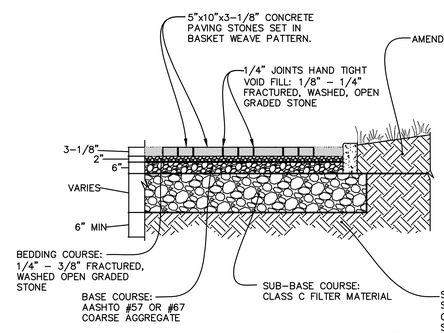
1. THE SUBJECT PROPERTY IS LOCATED WITHIN FLOOD HAZARD ZONE X (AREAS DETERMINED TO BE OUTSIDE THE 0.2% ANNUAL CHANCE FLOODPLAIN) ACCORDING TO THE CURRENT FEMA FLOOD INSURANCE RATE MAP, MAP NUMBER 08013C0394J, DATED DECEMBER 18, 2012.

DRAINAGE NOTES

1. REFER TO THE "FINAL DRAINAGE REPORT FOR 1838 22ND STREET RESIDENTIAL DEVELOPMENT" DATED NOVEMBER 2013 FOR SUPPORTING CALCULATIONS.
2. REFER TO SHEET DR1 FOR EXISTING CONDITIONS.

GRADING NOTES

1. ALL WORK SHALL COMPLY WITH THE CITY OF BOULDER DESIGN AND CONSTRUCTION STANDARDS, LATEST EDITION, AS WELL AS ALL APPLICABLE FEDERAL, STATE AND LOCAL CODES.
2. CONTRACTOR SHALL BE RESPONSIBLE FOR REPAIR TO ANY EXISTING IMPROVEMENTS DISTURBED OR DAMAGED BY CONSTRUCTION ACTIVITIES.
3. CONTRACTOR SHALL MAINTAIN AND PROTECT VEHICULAR AND PEDESTRIAN TRAFFIC IN PROXIMITY OF THE WORK.
4. COORDINATES REFER TO CENTERLINE OF UTILITY, UNLESS OTHERWISE NOTED ON THE PLANS.
5. ALL SPOT ELEVATIONS ARE FLOWLINE OF CURB AND GUTTER OR TOP OF PAVING UNLESS OTHERWISE NOTED.
6. ALL PROPOSED CONTOURS ARE TO TOP OF FINISHED PAVING AND LANDSCAPED AREAS UNLESS OTHERWISE NOTED.
7. ADD 5300 TO ALL PROPOSED SPOT ELEVATIONS AND CONTOUR ELEVATIONS TO REACH PROJECT VERTICAL DATUM.
8. IT SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR TO MAINTAIN AND PROVIDE FOR ADEQUATE DRAINAGE THROUGH THE SITE DURING THE PROCESS OF EXCAVATION, GRADING AND EMBANKMENT. THE GRADE SHALL BE MAINTAINED IN SUCH CONDITION THAT IT IS WELL DRAINED AT ALL TIMES.
9. LANDSCAPE SLOPES SHALL NOT EXCEED 4:1 (H:V) UNLESS OTHERWISE APPROVED BY THE CITY INSPECTOR/ENGINEER.
10. MATCH EXISTING GRADES AT LIMITS OF CONSTRUCTION.



PERMEABLE PAVEMENT DETAIL

NO SCALE

PERMEABLE PAVER NOTES

1. PERMEABLE CONCRETE PAVING STONE SYSTEM SHALL BE AQUA-BRIC BIO-AQUIFER STORM SYSTEM (BASS) BY BORGERT PRODUCTS OR APPROVED EQUAL.
2. CONCRETE PAVING STONES SHALL BE AQUA-BRIC COLOR "PEWTER". CONTRACTOR SHALL COORDINATE PAVING STONE COLOR SELECTION WITH OWNER PRIOR TO ORDERING STONE.
3. PERMEABLE CONCRETE PAVING STONE SYSTEM SHALL BE INSTALLED IN ACCORDANCE WITH THE MANUFACTURER'S RECOMMENDATIONS AND PRODUCT SPECIFICATIONS.
4. PERMEABLE PAVEMENT SUB-BASE COURSE SHALL EXTEND TO EXISTING SAND AND GRAVEL LAYER LOCATED APPROXIMATELY 2 FEET BELOW EXISTING GRADE PER GEOTECHNICAL INVESTIGATION PREPARED BY WESTERN SOILS, INC. DATED OCTOBER 21, 2013.

CITY OF BOULDER
DEPARTMENT OF PUBLIC WORKS
ENGINEERING CONSTRUCTION DRAWING
ENGINEERING REVIEW MANAGER DATE
APPROVAL EXPIRES ONE YEAR AFTER DATE ABOVE

CITY OF BOULDER
PUBLIC WORKS DEPARTMENT
RECOMMENDATION FOR APPROVAL
WATER/SEWER
TRANSPORTATION
DRAINAGE

Know what's below. Call before you dig.

1064DR-P

PREPARED BY:
The Sanitas Group
801 MAIN ST, SUITE 210
LOUISVILLE, CO 80027
720.346.1656
PROJECT CONTACT:
CURTIS C. STEVENS, P.E.

PREPARED FOR:
22ND ST. ELEMENT, LLC
C/O ELEMENT PROPERTIES
1539 PEARL STREET
BOULDER, CO 80302
CONTACT:
SCOTT HOLTON

TECHNICAL DOCUMENTS FOR:
1838 22ND STREET RESIDENTIAL DEVELOPMENT
1838 22ND STREET
CITY OF BOULDER, STATE OF COLORADO

COLORADO REGISTERED PROFESSIONAL ENGINEER CURTIS CHARLES STEVENS 40337
NOT VALID WITHOUT ORIGINAL SIGNATURE AND DATE

ISSUE	DATE
TECH DOC	11/4/13

DESIGNED BY:	MLM
DRAWN BY:	MLM
CHECKED BY:	CCS

DRAWING SCALE:
HORIZONTAL: 1" = 10'
VERTICAL: NONE

PROPOSED CONDITIONS DRAINAGE PLAN

PROJECT NO. B1064

DR2

SHEET: 2 OF 2