Cuyahoga County Public Library
South Euclid/Lyndhurst Branch

1876 South Green Road
South Euclid, OH

PROJECT NO. 2012154.00
January, 2013

PRELIMINARY STORMWATER REPORT

Prepared For
The City of South Euclid

Prepared by:

GPD GROUP®
Glaus, Pyle, Schomer, Burns & DeHaven, Inc.

520 South Main Street, Suite 2531
Akron, Ohio 44311-1010
Phone: 330-572-2100
Fax: 330-572-2101
(JLR)

Darrin Kotecki, P.E. NO. 57418 _____ Date _____

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SECTION 1:

Project Description

Background

The project site encompasses approximately 5.405 acres of land and is located at 1876 South Green Road in South Euclid, OH. The existing site consists of several parcels and contains numerous buildings and paved areas. In addition, the western portion of the site contains numerous trees and is steeply sloped to the west. The site in its current condition appears to naturally drain to the west, however, some of the existing facilities may have storm sewer that is piped east to the storm sewer in South Green Road. The soils on the proposed site primarily consist of Allis – Urban Land Complex and Brecksville Silt Loam. Both soil types have a Hydrologic Soil Group Classification of "D". The proposed site is bounded by South Green Road to the east, Langerdale Boulevard to the west, residential and commercial to the south, and residential to the north.

Methods of Stormwater Management Design

The Method of Stormwater Management for the above referenced project is governed by the City of South Euclid. City of South Euclid Regulation utilizes the Critical Storm Method to determine the amount of stormwater detention required for new sites. All storm flows up to the Critical Storm must be held to the 1-year, 24-hour storm flow and all storm flows above the Critical Storm must be less than or equal to their pre-developed equivalent. The proposed stormwater management system was sized using the SCS Method in the Computer Program PondPack V8i. The rainfall values used for the calculations can be found in Section 4 of this report. It should be noted that the City of South Euclid Regulations indicate that the current edition of the Ohio Rainwater and Land Development Manual should be utilized.

The proposed development is greater than 1 acre and therefore the Water Quality Volume will have to be treated. The proposed development will utilize bio-retention cells to treat the water quality volume. Parking lot run-off shall be collected via inlets and piped to a bio-retention cell. It is expected that at least half the run-off from the proposed library roof will be able to be directed to a bio-retention cell as well. From the bio-retention cells, the run-off will be directed to the proposed above ground detention basin.

The following table contains pre and post-developed runoff rates for the proposed site:

	PRE-DEV. (ft^3)	POST-DEV. (ft^3)
1-yr	5.04	3.16
2-yr	7.26	3.97
5-yr	10.79	4.92
10-yr	13.76	9.28
25-yr	18.23	13.37
50-yr	22.01	15.57
100-yr	26.14	16.05

Pipe sizing for conveyance was not completed for this preliminary engineering package. It is not expected that it will difficult to properly size the proposed storm sewer piping as there is significant fall from the southeast corner of the site to the northwest corner of the site; where the site outfall is located.

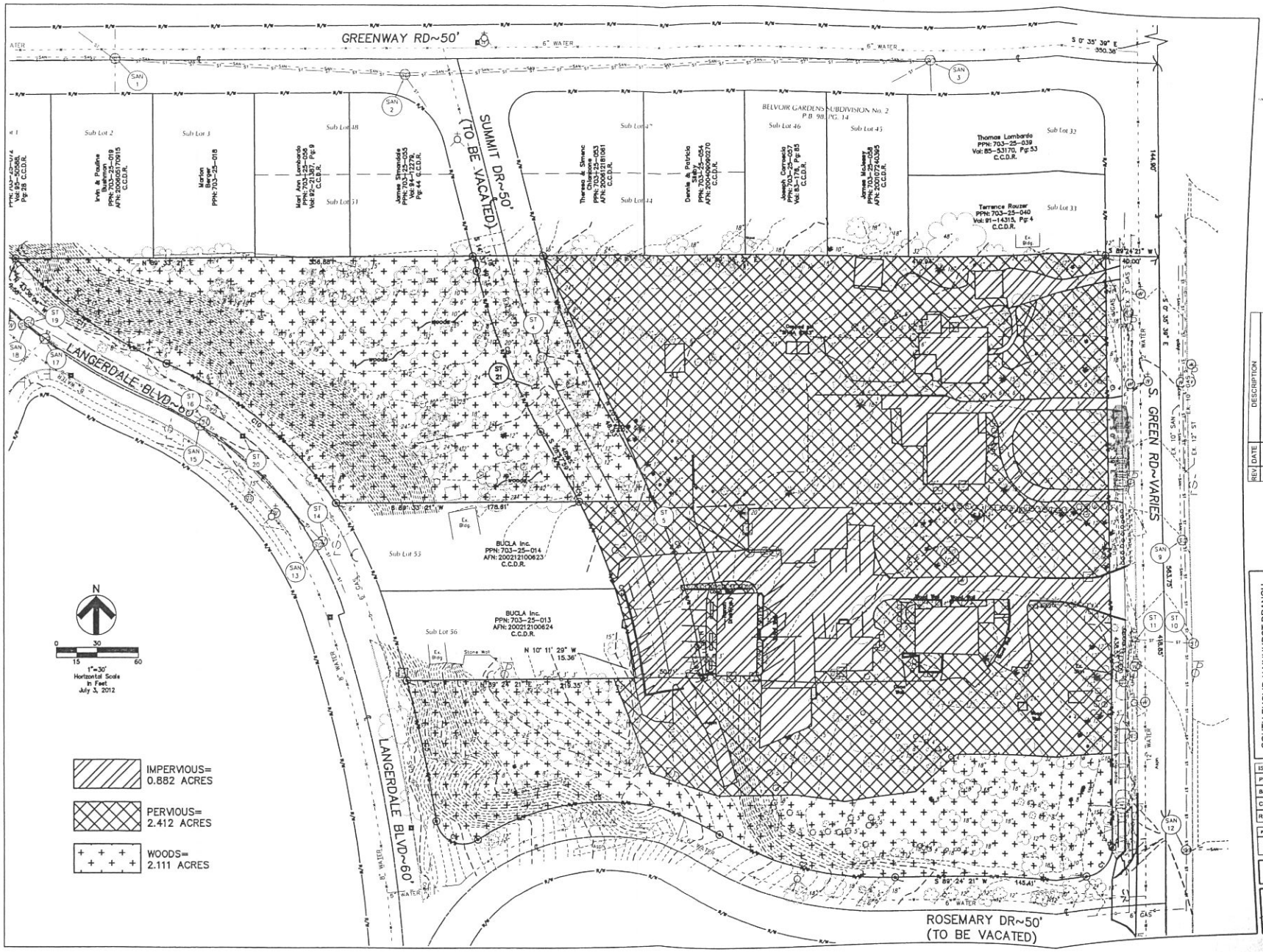
SECTION 2:
Section 2 contains the Pre-Developed Drainage Area Map and the Post-Developed Drainage Area Map.

SECTION 3:
Section 3 contains the Critical Storm Calculations and the Stormwater Management Calculations that were done in the computer program PondPack. The proposed stormwater management system utilizes a combination of an orifice and an overflow riser to control the flows leaving the proposed detention basin. From the detention basin, the run-off will be piped to the 48" storm sewer that runs under Langerdale Boulevard.

Also included in this section are the water quality calculations for the proposed site. Water quality for a majority of the site is obtained by directing runoff through two proposed bio-retention cells. There is a Water Quality Volume calculation sheet and a Bio-retention Cell sizing calculation sheet included in this section. The Water Quality Volume required to be treated is 5382 ft^3. The bio-retention cells as shown should be able to adequately treat the Water Quality Volume.

SECTION 4:
Section 4 contains the rainfall data that was used to compute the stormwater management storage (in inches) and the NRCS Soil Survey to determine CN values.

Section 2



GPD GROUP

REV	DATE	DESCRIPTION

SOUTH EUCLID / LYNHURST BRANCH
1876 SOUTH GREEN ROAD
SOUTH EUCLID, OHIO 44121

PRE-DEVELOPED DRAINAGE MAP

ISSUED FOR:	
PERMIT	-
BID	-
CONSTRUCTION	-
RECORD	-

PROJECT MANAGER	DESIGNER
MM	DLS

JOB NO.
2012154.00

PRE

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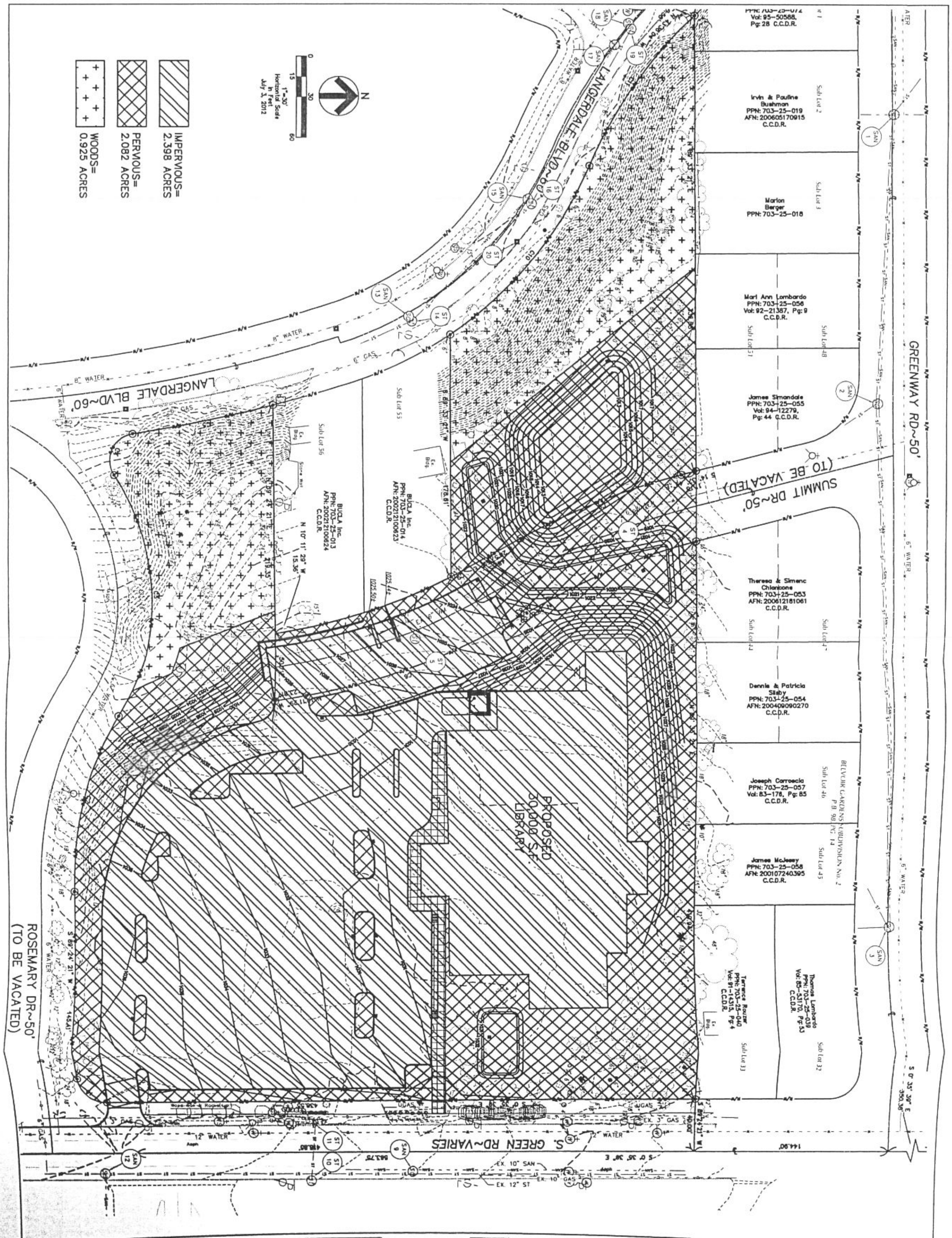


REV.	DATE	DESCRIPTION

GPD GROUP.

SOUTH EUCLID / LYNHURST BRANCH
1876 SOUTH GREEN ROAD
SOUTH EUCLID, OHIO 44121

POST-DEVELOPED
DRAINAGE MAP

JOB NO.
2012154.00

POST

Section 3

Critical Storm Calculations

Project Name:	SOUTH EUCLID LIBRARY
Project #:	2012154.00
Project Location:	SOUTH GREEN ROAD
Date:	1/21/2013

SITE OUTFALL

Conditions: Pre-Developed

SCS Method

HSG	Cover Type	Hydrologic Condition	CN	Area	Product
D	Open Space (Lawns, parks, etc.)	Good condition, grass cover >75%	80	2.41	192.96
D	Woods-grass combination	Good....Woods/grass combination	79	2.11	166.77
D	Impervious Areas	Paved parking lots, roofs, driveways, streets and roads	98	0.88	86.44
			Total=	5.41	446.17
			Composite CN=		83

Conditions: Post-Developed

SCS Method

HSG	Cover Type	Hydrologic Condition	CN	Area	Product
D	Open Space (Lawns, parks, etc.)	Good condition, grass cover >75%	80	2.08	166.56
D	Woods-grass combination	Good....Woods/grass combination	79	0.93	73.08
D	Impervious Areas	Paved parking lots, roofs, driveways, streets and roads	98	2.40	235.00
			Total=	5.41	474.64
			Composite CN=		88

Critical Storm Determination

1- Year PRE

CN	*P (in)	S	$Q=(P-0.2S)^2 / (P+0.8S)$	A (acres)	V (cf)
83	2.03	2.11	0.69	5.41	13617

1- Year Post

CN	*P (in)	S	$Q=(P-0.2S)^2 / (P+0.8S)$	A (acres)	V (cf)
88	2.03	1.39	0.98	5.41	19190

*(Enter Reference used for 24 hour P values) utilized for 24-hour rainfall value (P).

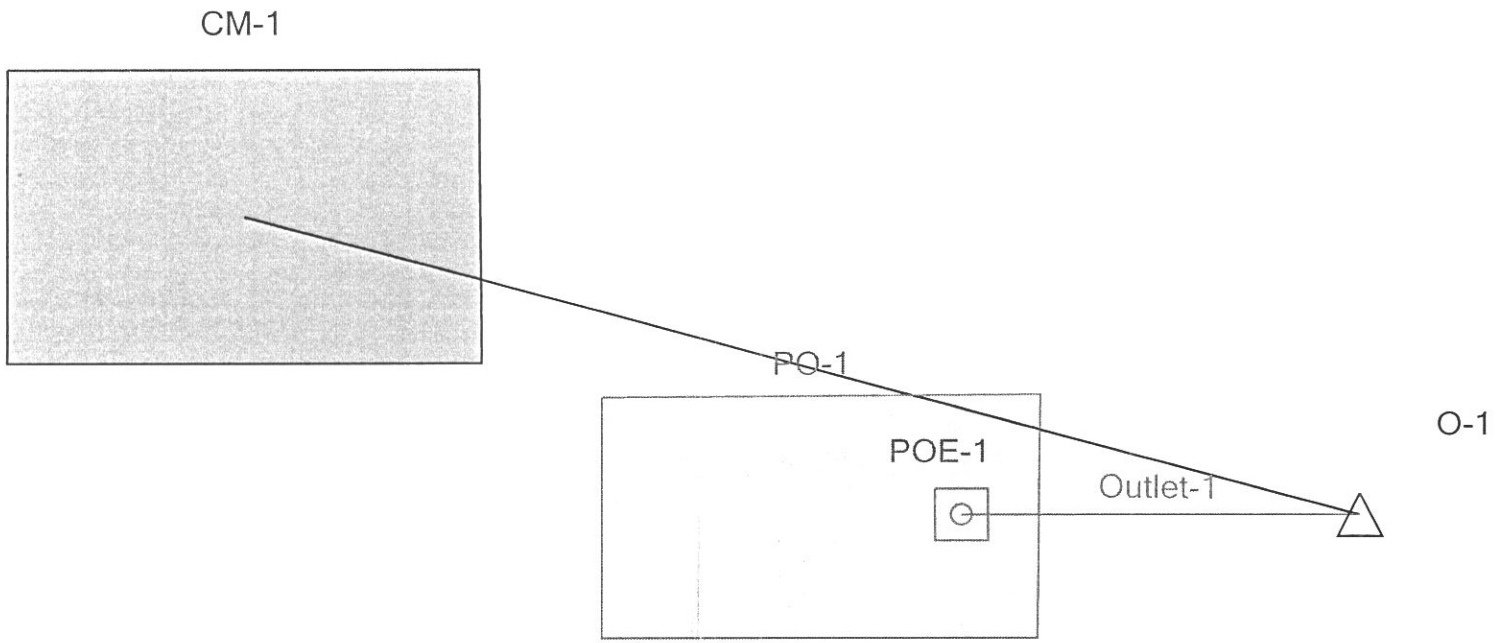
Increase in Runoff Volume (%) =	41

Determining Storm Control for Which Control is Needed (TYP.)
Percent Increase in Runoff Volume

Equal to or Greater Than (%)		Less Than (%)	Storm Frequency (yr)
-		10	1
10		20	2
20		50	5
50		100	10
100		250	25
250		500	50
500		-	100

Critical Storm Frequency =	5 YR

Scenario: Pre-Development 1 YR



SOUTH EUCLID LIBRARY

Project Summary	
Title	SOUTH EUCLID LIBRARY
Engineer	J. Rufener
Company	GPD Group
Date	1/17/2013

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SOUTH EUCLID LIBRARY

Subsection: Master Network Summary

Catchments Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft^3/s)
CM-1	Pre-Development 1 YR	1	0.312	12.000	5.04
CM-1	Pre-Development 2 YR	2	0.442	12.000	7.26
CM-1	Pre-Development 5 YR	5	0.654	12.000	10.79
CM-1	Pre-Development 10 YR	10	0.835	12.000	13.76
CM-1	Pre-Development 25 YR	25	1.112	12.000	18.23
CM-1	Pre-Development 50 YR	50	1.351	12.000	22.01
CM-1	Pre-Development 100 YR	100	1.615	12.000	26.14

Node Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft^3/s)
O-1	Pre-Development 1 YR	1	0.312	12.000	5.04
O-1	Pre-Development 2 YR	2	0.442	12.000	7.26
O-1	Pre-Development 5 YR	5	0.654	12.000	10.79
O-1	Pre-Development 10 YR	10	0.835	12.000	13.76
O-1	Pre-Development 25 YR	25	1.112	12.000	18.23
O-1	Pre-Development 50 YR	50	1.351	12.000	22.01
O-1	Pre-Development 100 YR	100	1.615	12.000	26.14

SOUTH EUCLID LIBRARY

Subsection: Unit Hydrograph Summary
Label: CM-1

Return Event: 1 years
Storm Event: 1 YR

Storm Event	1 YR
Return Event	1 years
Duration	24.000 hours
Depth	2.0 in
Time of Concentration (Composite)	0.167 hours
Area (User Defined)	5.405 acres

Computational Time Increment	0.022 hours
Time to Peak (Computed)	12.000 hours
Flow (Peak, Computed)	5.04 ft^3/s
Output Increment	0.050 hours
Time to Flow (Peak Interpolated Output)	12.000 hours
Flow (Peak Interpolated Output)	5.04 ft^3/s

Drainage Area	
SCS CN (Composite)	82.547
Area (User Defined)	5.405 acres
Maximum Retention (Pervious)	2.1 in
Maximum Retention (Pervious, 20 percent)	0.4 in

Cumulative Runoff	
Cumulative Runoff Depth (Pervious)	0.7 in
Runoff Volume (Pervious)	0.313 ac-ft

Hydrograph Volume (Area under Hydrograph curve)	
Volume	0.312 ac-ft

SCS Unit Hydrograph Parameters	
Time of Concentration (Composite)	0.167 hours
Computational Time Increment	0.022 hours
Unit Hydrograph Shape Factor	483.432
K Factor	0.749
Receding/Rising, Tr/Tp	1.670

SOUTH EUCLID LIBRARY

Subsection: Unit Hydrograph Summary
Label: CM-1

Return Event: 1 years
Storm Event: 1 YR

SCS Unit Hydrograph Parameters	
Unit peak, qp	36.74 ft^3/s
Unit peak time, Tp	0.111 hours
Unit receding limb, Tr	0.444 hours
Total unit time, Tb	0.556 hours

SOUTH EUCLID LIBRARY

Subsection: Unit Hydrograph Summary
Label: CM-1

Return Event: 2 years
Storm Event: 2 YR

Storm Event	2 YR
Return Event	2 years
Duration	24.000 hours
Depth	2.4 in
Time of Concentration (Composite)	0.167 hours
Area (User Defined)	5.405 acres

Computational Time Increment	0.022 hours
Time to Peak (Computed)	12.000 hours
Flow (Peak, Computed)	7.26 ft^3/s
Output Increment	0.050 hours
Time to Flow (Peak Interpolated Output)	12.000 hours
Flow (Peak Interpolated Output)	7.26 ft^3/s

Drainage Area	
SCS CN (Composite)	82.547
Area (User Defined)	5.405 acres
Maximum Retention (Pervious)	2.1 in
Maximum Retention (Pervious, 20 percent)	0.4 in

Cumulative Runoff	
Cumulative Runoff Depth (Pervious)	1.0 in
Runoff Volume (Pervious)	0.444 ac-ft

Hydrograph Volume (Area under Hydrograph curve)	
Volume	0.442 ac-ft

SCS Unit Hydrograph Parameters	
Time of Concentration (Composite)	0.167 hours
Computational Time Increment	0.022 hours
Unit Hydrograph Shape Factor	483.432
K Factor	0.749
Receding/Rising, Tr/Tp	1.670

SOUTH EUCLID LIBRARY

Subsection: Unit Hydrograph Summary
Label: CM-1

Return Event: 2 years
Storm Event: 2 YR

SCS Unit Hydrograph Parameters	
Unit peak, qp	36.74 ft^3/s
Unit peak time, Tp	0.111 hours
Unit receding limb, Tr	0.444 hours
Total unit time, Tb	0.556 hours

SOUTH EUCLID LIBRARY

Subsection: Unit Hydrograph Summary
Label: CM-1

Return Event: 5 years
Storm Event: 5 YR

Storm Event	5 YR
Return Event	5 years
Duration	24.000 hours
Depth	3.1 in
Time of Concentration (Composite)	0.167 hours
Area (User Defined)	5.405 acres

Computational Time Increment	0.022 hours
Time to Peak (Computed)	12.000 hours
Flow (Peak, Computed)	10.79 ft³/s
Output Increment	0.050 hours
Time to Flow (Peak Interpolated Output)	12.000 hours
Flow (Peak Interpolated Output)	10.79 ft³/s

Drainage Area	
SCS CN (Composite)	82.547
Area (User Defined)	5.405 acres
Maximum Retention (Pervious)	2.1 in
Maximum Retention (Pervious, 20 percent)	0.4 in

Cumulative Runoff	
Cumulative Runoff Depth (Pervious)	1.5 in
Runoff Volume (Pervious)	0.656 ac-ft

Hydrograph Volume (Area under Hydrograph curve)	
Volume	0.654 ac-ft

SCS Unit Hydrograph Parameters	
Time of Concentration (Composite)	0.167 hours
Computational Time Increment	0.022 hours
Unit Hydrograph Shape Factor	483.432
K Factor	0.749
Receding/Rising, Tr/Tp	1.670

SOUTH EUCLID LIBRARY

Subsection: Unit Hydrograph Summary
Label: CM-1

Return Event: 5 years
Storm Event: 5 YR

SCS Unit Hydrograph Parameters	
Unit peak, qp	36.74 ft^3/s
Unit peak time, Tp	0.111 hours
Unit receding limb, Tr	0.444 hours
Total unit time, Tb	0.556 hours

SOUTH EUCLID LIBRARY

Subsection: Unit Hydrograph Summary
Label: CM-1

Return Event: 10 years
Storm Event: 10 YR

Storm Event	10 YR
Return Event	10 years
Duration	24.000 hours
Depth	3.5 in
Time of Concentration (Composite)	0.167 hours
Area (User Defined)	5.405 acres

Computational Time Increment	0.022 hours
Time to Peak (Computed)	12.000 hours
Flow (Peak, Computed)	13.76 ft³/s
Output Increment	0.050 hours
Time to Flow (Peak Interpolated Output)	12.000 hours
Flow (Peak Interpolated Output)	13.76 ft³/s

Drainage Area	
SCS CN (Composite)	82.547
Area (User Defined)	5.405 acres
Maximum Retention (Pervious)	2.1 in
Maximum Retention (Pervious, 20 percent)	0.4 in

Cumulative Runoff	
Cumulative Runoff Depth (Pervious)	1.9 in
Runoff Volume (Pervious)	0.837 ac-ft

Hydrograph Volume (Area under Hydrograph curve)	
Volume	0.835 ac-ft

SCS Unit Hydrograph Parameters	
Time of Concentration (Composite)	0.167 hours
Computational Time Increment	0.022 hours
Unit Hydrograph Shape Factor	483.432
K Factor	0.749
Receding/Rising, Tr/Tp	1.670

SOUTH EUCLID LIBRARY

Subsection: Unit Hydrograph Summary
Label: CM-1

Return Event: 10 years
Storm Event: 10 YR

SCS Unit Hydrograph Parameters	
Unit peak, qp	36.74 ft^3/s
Unit peak time, Tp	0.111 hours
Unit receding limb, Tr	0.444 hours
Total unit time, Tb	0.556 hours

SOUTH EUCLID LIBRARY

Subsection: Unit Hydrograph Summary
Label: CM-1

Return Event: 25 years
Storm Event: 25 YR

Storm Event	25 YR
Return Event	25 years
Duration	24.000 hours
Depth	4.3 in
Time of Concentration (Composite)	0.167 hours
Area (User Defined)	5.405 acres

Computational Time Increment	0.022 hours
Time to Peak (Computed)	12.000 hours
Flow (Peak, Computed)	18.23 ft^3/s
Output Increment	0.050 hours
Time to Flow (Peak Interpolated Output)	12.000 hours
Flow (Peak Interpolated Output)	18.23 ft^3/s

Drainage Area	
SCS CN (Composite)	82.547
Area (User Defined)	5.405 acres
Maximum Retention (Pervious)	2.1 in
Maximum Retention (Pervious, 20 percent)	0.4 in

Cumulative Runoff	
Cumulative Runoff Depth (Pervious)	2.5 in
Runoff Volume (Pervious)	1.114 ac-ft

Hydrograph Volume (Area under Hydrograph curve)	
Volume	1.112 ac-ft

SCS Unit Hydrograph Parameters	
Time of Concentration (Composite)	0.167 hours
Computational Time Increment	0.022 hours
Unit Hydrograph Shape Factor	483.432
K Factor	0.749
Receding/Rising, Tr/Tp	1.670

SOUTH EUCLID LIBRARY

Subsection: Unit Hydrograph Summary
Label: CM-1

Return Event: 25 years
Storm Event: 25 YR

SCS Unit Hydrograph Parameters	
Unit peak, qp	36.74 ft^3/s
Unit peak time, Tp	0.111 hours
Unit receding limb, Tr	0.444 hours
Total unit time, Tb	0.556 hours

SOUTH EUCLID LIBRARY

Subsection: Unit Hydrograph Summary
Label: CM-1

Return Event: 50 years
Storm Event: 50 YR

Storm Event	50 YR
Return Event	50 years
Duration	24.000 hours
Depth	4.9 in
Time of Concentration (Composite)	0.167 hours
Area (User Defined)	5.405 acres

Computational Time Increment	0.022 hours
Time to Peak (Computed)	11.978 hours
Flow (Peak, Computed)	22.07 ft^3/s
Output Increment	0.050 hours
Time to Flow (Peak Interpolated Output)	12.000 hours
Flow (Peak Interpolated Output)	22.01 ft^3/s

Drainage Area	
SCS CN (Composite)	82.547
Area (User Defined)	5.405 acres
Maximum Retention (Pervious)	2.1 in
Maximum Retention (Pervious, 20 percent)	0.4 in

Cumulative Runoff	
Cumulative Runoff Depth (Pervious)	3.0 in
Runoff Volume (Pervious)	1.354 ac-ft

Hydrograph Volume (Area under Hydrograph curve)	
Volume	1.351 ac-ft

SCS Unit Hydrograph Parameters	
Time of Concentration (Composite)	0.167 hours
Computational Time Increment	0.022 hours
Unit Hydrograph Shape Factor	483.432
K Factor	0.749
Receding/Rising, Tr/Tp	1.670

SOUTH EUCLID LIBRARY

Subsection: Unit Hydrograph Summary
Label: CM-1

Return Event: 50 years
Storm Event: 50 YR

SCS Unit Hydrograph Parameters	
Unit peak, qp	36.74 ft^3/s
Unit peak time, Tp	0.111 hours
Unit receding limb, Tr	0.444 hours
Total unit time, Tb	0.556 hours

SOUTH EUCLID LIBRARY

Subsection: Unit Hydrograph Summary
Label: CM-1

Return Event: 100 years
Storm Event: 100 YR

Storm Event	100 YR
Return Event	100 years
Duration	24.000 hours
Depth	5.5 in
Time of Concentration (Composite)	0.167 hours
Area (User Defined)	5.405 acres

Computational Time Increment	0.022 hours
Time to Peak (Computed)	11.978 hours
Flow (Peak, Computed)	26.27 ft^3/s
Output Increment	0.050 hours
Time to Flow (Peak Interpolated Output)	12.000 hours
Flow (Peak Interpolated Output)	26.14 ft^3/s

Drainage Area	
SCS CN (Composite)	82.547
Area (User Defined)	5.405 acres
Maximum Retention (Pervious)	2.1 in
Maximum Retention (Pervious, 20 percent)	0.4 in

Cumulative Runoff	
Cumulative Runoff Depth (Pervious)	3.6 in
Runoff Volume (Pervious)	1.619 ac-ft

Hydrograph Volume (Area under Hydrograph curve)	
Volume	1.615 ac-ft

SCS Unit Hydrograph Parameters	
Time of Concentration (Composite)	0.167 hours
Computational Time Increment	0.022 hours
Unit Hydrograph Shape Factor	483.432
K Factor	0.749
Receding/Rising, Tr/Tp	1.670

SOUTH EUCLID LIBRARY

Subsection: Unit Hydrograph Summary
Label: CM-1

Return Event: 100 years
Storm Event: 100 YR

SCS Unit Hydrograph Parameters	
Unit peak, qp	36.74 ft^3/s
Unit peak time, Tp	0.111 hours
Unit receding limb, Tr	0.444 hours
Total unit time, Tb	0.556 hours

SOUTH EUCLID LIBRARY

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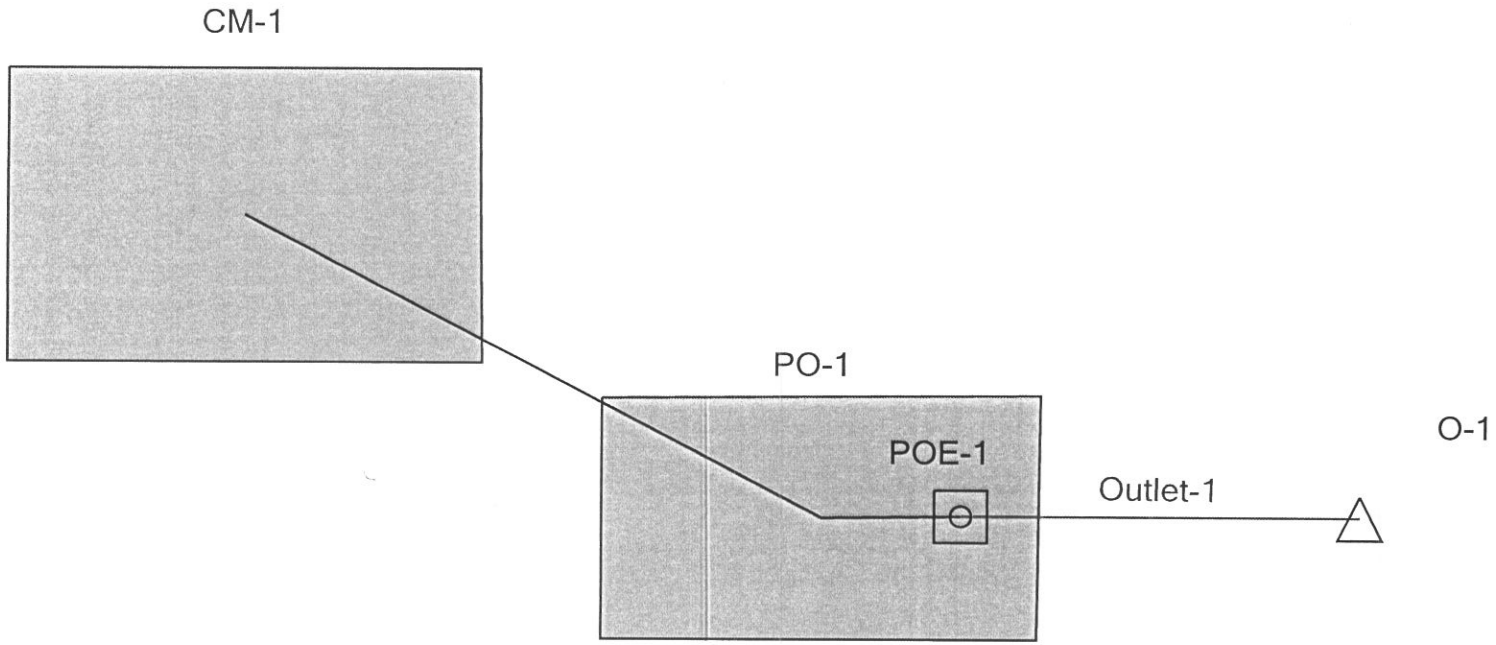
Scenario: Post-Development 1 YR



SOUTH EUCLID LIBRARY

Project Summary	
Title	SOUTH EUCLID LIBRARY
Engineer	J. Rufener
Company	GPD Group
Date	1/17/2013

Notes

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SOUTH EUCLID LIBRARY

Subsection: Master Network Summary

Catchments Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft^3/s)
CM-1	Post-Development 1 YR	1	0.437	12.000	7.20
CM-1	Post-Development 2 YR	2	0.589	12.000	9.69
CM-1	Post-Development 5 YR	5	0.827	12.000	13.50
CM-1	Post-Development 10 YR	10	1.025	12.000	16.61
CM-1	Post-Development 25 YR	25	1.323	12.000	21.21
CM-1	Post-Development 50 YR	50	1.576	12.000	25.04
CM-1	Post-Development 100 YR	100	1.854	12.000	29.19

Node Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft^3/s)
O-1	Post-Development 1 YR	1	0.430	12.150	3.16
O-1	Post-Development 2 YR	2	0.581	12.150	3.97
O-1	Post-Development 5 YR	5	0.816	12.200	4.92
O-1	Post-Development 10 YR	10	1.012	12.100	9.28
O-1	Post-Development 25 YR	25	1.308	12.100	13.37
O-1	Post-Development 50 YR	50	1.559	12.100	15.57
O-1	Post-Development 100 YR	100	1.834	12.100	16.05

Pond Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft^3/s)	Maximum Water Surface Elevation (ft)	Maximum Pond Storage (ac-ft)
PO-1 (IN)	Post-Development 1 YR	1	0.437	12.000	7.20	(N/A)	(N/A)

SOUTH EUCLID LIBRARY

Subsection: Master Network Summary

Pond Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft^3/s)	Maximum Water Surface Elevation (ft)	Maximum Pond Storage (ac-ft)
PO-1 (OUT)	Post-Development 1 YR	1	0.430	12.150	3.16	1,014.22	0.126
PO-1 (IN)	Post-Development 2 YR	2	0.589	12.000	9.69	(N/A)	(N/A)
PO-1 (OUT)	Post-Development 2 YR	2	0.581	12.150	3.97	1,014.61	0.175
PO-1 (IN)	Post-Development 5 YR	5	0.827	12.000	13.50	(N/A)	(N/A)
PO-1 (OUT)	Post-Development 5 YR	5	0.816	12.200	4.92	1,015.20	0.257
PO-1 (IN)	Post-Development 10 YR	10	1.025	12.000	16.61	(N/A)	(N/A)
PO-1 (OUT)	Post-Development 10 YR	10	1.012	12.100	9.28	1,015.47	0.299
PO-1 (IN)	Post-Development 25 YR	25	1.323	12.000	21.21	(N/A)	(N/A)
PO-1 (OUT)	Post-Development 25 YR	25	1.308	12.100	13.37	1,015.82	0.354
PO-1 (IN)	Post-Development 50 YR	50	1.576	12.000	25.04	(N/A)	(N/A)
PO-1 (OUT)	Post-Development 50 YR	50	1.559	12.100	15.57	1,016.11	0.404
PO-1 (IN)	Post-Development 100 YR	100	1.854	12.000	29.19	(N/A)	(N/A)
PO-1 (OUT)	Post-Development 100 YR	100	1.834	12.100	16.05	1,016.51	0.477

SOUTH EUCLID LIBRARY

Subsection: Unit Hydrograph Summary
Label: CM-1

Return Event: 1 years
Storm Event: 1 YR

Storm Event	1 YR
Return Event	1 years
Duration	24.000 hours
Depth	2.0 in
Time of Concentration (Composite)	0.167 hours
Area (User Defined)	5.405 acres

Computational Time Increment	0.022 hours
Time to Peak (Computed)	12.000 hours
Flow (Peak, Computed)	7.20 ft^3/s
Output Increment	0.050 hours
Time to Flow (Peak Interpolated Output)	12.000 hours
Flow (Peak Interpolated Output)	7.20 ft^3/s

Drainage Area	
SCS CN (Composite)	87.707
Area (User Defined)	5.405 acres
Maximum Retention (Pervious)	1.4 in
Maximum Retention (Pervious, 20 percent)	0.3 in

Cumulative Runoff	
Cumulative Runoff Depth (Pervious)	1.0 in
Runoff Volume (Pervious)	0.438 ac-ft

Hydrograph Volume (Area under Hydrograph curve)	
Volume	0.437 ac-ft

SCS Unit Hydrograph Parameters	
Time of Concentration (Composite)	0.167 hours
Computational Time Increment	0.022 hours
Unit Hydrograph Shape Factor	483.432
K Factor	0.749
Receding/Rising, Tr/Tp	1.670

SOUTH EUCLID LIBRARY

Subsection: Unit Hydrograph Summary
Label: CM-1

Return Event: 1 years
Storm Event: 1 YR

SCS Unit Hydrograph Parameters	
Unit peak, qp	36.74 ft³/s
Unit peak time, Tp	0.111 hours
Unit receding limb, Tr	0.444 hours
Total unit time, Tb	0.556 hours

SOUTH EUCLID LIBRARY

Subsection: Unit Hydrograph Summary
Label: CM-1

Return Event: 2 years
Storm Event: 2 YR

Storm Event	2 YR
Return Event	2 years
Duration	24.000 hours
Depth	2.4 in
Time of Concentration (Composite)	0.167 hours
Area (User Defined)	5.405 acres

Computational Time Increment	0.022 hours
Time to Peak (Computed)	12.000 hours
Flow (Peak, Computed)	9.69 ft³/s
Output Increment	0.050 hours
Time to Flow (Peak Interpolated Output)	12.000 hours
Flow (Peak Interpolated Output)	9.69 ft³/s

Drainage Area	
SCS CN (Composite)	87.707
Area (User Defined)	5.405 acres
Maximum Retention (Pervious)	1.4 in
Maximum Retention (Pervious, 20 percent)	0.3 in

Cumulative Runoff	
Cumulative Runoff Depth (Pervious)	1.3 in
Runoff Volume (Pervious)	0.590 ac-ft

Hydrograph Volume (Area under Hydrograph curve)	
Volume	0.589 ac-ft

SCS Unit Hydrograph Parameters	
Time of Concentration (Composite)	0.167 hours
Computational Time Increment	0.022 hours
Unit Hydrograph Shape Factor	483.432
K Factor	0.749
Receding/Rising, Tr/Tp	1.670

SOUTH EUCLID LIBRARY

Subsection: Unit Hydrograph Summary
Label: CM-1

Return Event: 2 years
Storm Event: 2 YR

SCS Unit Hydrograph Parameters	
Unit peak, qp	36.74 ft^3/s
Unit peak time, Tp	0.111 hours
Unit receding limb, Tr	0.444 hours
Total unit time, Tb	0.556 hours

SOUTH EUCLID LIBRARY

Subsection: Unit Hydrograph Summary
Label: CM-1

Return Event: 5 years
Storm Event: 5 YR

Storm Event	5 YR
Return Event	5 years
Duration	24.000 hours
Depth	3.1 in
Time of Concentration (Composite)	0.167 hours
Area (User Defined)	5.405 acres

Computational Time Increment	0.022 hours
Time to Peak (Computed)	11.978 hours
Flow (Peak, Computed)	13.52 ft^3/s
Output Increment	0.050 hours
Time to Flow (Peak Interpolated Output)	12.000 hours
Flow (Peak Interpolated Output)	13.50 ft^3/s

Drainage Area	
SCS CN (Composite)	87.707
Area (User Defined)	5.405 acres
Maximum Retention (Pervious)	1.4 in
Maximum Retention (Pervious, 20 percent)	0.3 in

Cumulative Runoff	
Cumulative Runoff Depth (Pervious)	1.8 in
Runoff Volume (Pervious)	0.828 ac-ft

Hydrograph Volume (Area under Hydrograph curve)	
Volume	0.827 ac-ft

SCS Unit Hydrograph Parameters	
Time of Concentration (Composite)	0.167 hours
Computational Time Increment	0.022 hours
Unit Hydrograph Shape Factor	483.432
K Factor	0.749
Receding/Rising, Tr/Tp	1.670

SOUTH EUCLID LIBRARY

Subsection: Unit Hydrograph Summary
Label: CM-1

Return Event: 5 years
Storm Event: 5 YR

SCS Unit Hydrograph Parameters	
Unit peak, qp	36.74 ft³/s
Unit peak time, Tp	0.111 hours
Unit receding limb, Tr	0.444 hours
Total unit time, Tb	0.556 hours

SOUTH EUCLID LIBRARY

Subsection: Unit Hydrograph Summary
Label: CM-1

Return Event: 10 years
Storm Event: 10 YR

Storm Event	10 YR
Return Event	10 years
Duration	24.000 hours
Depth	3.5 in
Time of Concentration (Composite)	0.167 hours
Area (User Defined)	5.405 acres

Computational Time Increment	0.022 hours
Time to Peak (Computed)	11.978 hours
Flow (Peak, Computed)	16.68 ft^3/s
Output Increment	0.050 hours
Time to Flow (Peak Interpolated Output)	12.000 hours
Flow (Peak Interpolated Output)	16.61 ft^3/s

Drainage Area	
SCS CN (Composite)	87.707
Area (User Defined)	5.405 acres
Maximum Retention (Pervious)	1.4 in
Maximum Retention (Pervious, 20 percent)	0.3 in

Cumulative Runoff	
Cumulative Runoff Depth (Pervious)	2.3 in
Runoff Volume (Pervious)	1.027 ac-ft

Hydrograph Volume (Area under Hydrograph curve)	
Volume	1.025 ac-ft

SCS Unit Hydrograph Parameters	
Time of Concentration (Composite)	0.167 hours
Computational Time Increment	0.022 hours
Unit Hydrograph Shape Factor	483.432
K Factor	0.749
Receding/Rising, Tr/Tp	1.670

SOUTH EUCLID LIBRARY

Subsection: Unit Hydrograph Summary
Label: CM-1

Return Event: 10 years
Storm Event: 10 YR

SCS Unit Hydrograph Parameters	
Unit peak, qp	36.74 ft^3/s
Unit peak time, Tp	0.111 hours
Unit receding limb, Tr	0.444 hours
Total unit time, Tb	0.556 hours

SOUTH EUCLID LIBRARY

Subsection: Unit Hydrograph Summary
Label: CM-1

Return Event: 25 years
Storm Event: 25 YR

Storm Event	25 YR
Return Event	25 years
Duration	24.000 hours
Depth	4.3 in
Time of Concentration (Composite)	0.167 hours
Area (User Defined)	5.405 acres

Computational Time Increment	0.022 hours
Time to Peak (Computed)	11.978 hours
Flow (Peak, Computed)	21.36 ft^3/s
Output Increment	0.050 hours
Time to Flow (Peak Interpolated Output)	12.000 hours
Flow (Peak Interpolated Output)	21.21 ft^3/s

Drainage Area	
SCS CN (Composite)	87.707
Area (User Defined)	5.405 acres
Maximum Retention (Pervious)	1.4 in
Maximum Retention (Pervious, 20 percent)	0.3 in

Cumulative Runoff	
Cumulative Runoff Depth (Pervious)	2.9 in
Runoff Volume (Pervious)	1.326 ac-ft

Hydrograph Volume (Area under Hydrograph curve)	
Volume	1.323 ac-ft

SCS Unit Hydrograph Parameters	
Time of Concentration (Composite)	0.167 hours
Computational Time Increment	0.022 hours
Unit Hydrograph Shape Factor	483.432
K Factor	0.749
Receding/Rising, Tr/Tp	1.670

SOUTH EUCLID LIBRARY

Subsection: Unit Hydrograph Summary
Label: CM-1

Return Event: 25 years
Storm Event: 25 YR

SCS Unit Hydrograph Parameters	
Unit peak, qp	36.74 ft^3/s
Unit peak time, Tp	0.111 hours
Unit receding limb, Tr	0.444 hours
Total unit time, Tb	0.556 hours

SOUTH EUCLID LIBRARY

Subsection: Unit Hydrograph Summary
Label: CM-1

Return Event: 50 years
Storm Event: 50 YR

Storm Event	50 YR
Return Event	50 years
Duration	24.000 hours
Depth	4.9 in
Time of Concentration (Composite)	0.167 hours
Area (User Defined)	5.405 acres

Computational Time Increment	0.022 hours
Time to Peak (Computed)	11.978 hours
Flow (Peak, Computed)	25.26 ft^3/s
Output Increment	0.050 hours
Time to Flow (Peak Interpolated Output)	12.000 hours
Flow (Peak Interpolated Output)	25.04 ft^3/s

Drainage Area	
SCS CN (Composite)	87.707
Area (User Defined)	5.405 acres
Maximum Retention (Pervious)	1.4 in
Maximum Retention (Pervious, 20 percent)	0.3 in

Cumulative Runoff	
Cumulative Runoff Depth (Pervious)	3.5 in
Runoff Volume (Pervious)	1.579 ac-ft

Hydrograph Volume (Area under Hydrograph curve)	
Volume	1.576 ac-ft

SCS Unit Hydrograph Parameters	
Time of Concentration (Composite)	0.167 hours
Computational Time Increment	0.022 hours
Unit Hydrograph Shape Factor	483.432
K Factor	0.749
Receding/Rising, Tr/Tp	1.670

SOUTH EUCLID LIBRARY

Subsection: Unit Hydrograph Summary
Label: CM-1

Return Event: 50 years
Storm Event: 50 YR

SCS Unit Hydrograph Parameters	
Unit peak, qp	36.74 ft³/s
Unit peak time, Tp	0.111 hours
Unit receding limb, Tr	0.444 hours
Total unit time, Tb	0.556 hours

Storm Event	100 YR
Return Event	100 years
Duration	24.000 hours
Depth	5.5 in
Time of Concentration (Composite)	0.167 hours
Area (User Defined)	5.405 acres

Computational Time Increment	0.022 hours
Time to Peak (Computed)	11.978 hours
Flow (Peak, Computed)	29.49 ft^3/s
Output Increment	0.050 hours
Time to Flow (Peak Interpolated Output)	12.000 hours
Flow (Peak Interpolated Output)	29.19 ft^3/s

Drainage Area	
SCS CN (Composite)	87.707
Area (User Defined)	5.405 acres
Maximum Retention (Pervious)	1.4 in
Maximum Retention (Pervious, 20 percent)	0.3 in

Cumulative Runoff	
Cumulative Runoff Depth (Pervious)	4.1 in
Runoff Volume (Pervious)	1.858 ac-ft

Hydrograph Volume (Area under Hydrograph curve)	
Volume	1.854 ac-ft

SCS Unit Hydrograph Parameters	
Time of Concentration (Composite)	0.167 hours
Computational Time Increment	0.022 hours
Unit Hydrograph Shape Factor	483.432
K Factor	0.749
Receding/Rising, Tr/Tp	1.670

SOUTH EUCLID LIBRARY

Subsection: Unit Hydrograph Summary
Label: CM-1

Return Event: 100 years
Storm Event: 100 YR

SCS Unit Hydrograph Parameters	
Unit peak, qp	36.74 ft^3/s
Unit peak time, Tp	0.111 hours
Unit receding limb, Tr	0.444 hours
Total unit time, Tb	0.556 hours

Requested Pond Water Surface Elevations	
Minimum (Headwater)	1,013.00 ft
Increment (Headwater)	0.50 ft
Maximum (Headwater)	1,017.00 ft

Outlet Connectivity

Structure Type	Outlet ID	Direction	Outfall	E1 (ft)	E2 (ft)
Inlet Box	Riser - 1	Forward	Culvert - 1	1,015.25	1,017.00
Orifice-Circular	Orifice - 1	Forward	Culvert - 1	1,013.00	1,017.00
Culvert-Circular	Culvert - 1	Forward	Culvert - 2	1,009.00	1,017.00
Culvert-Circular	Culvert - 2	Forward	TW	984.55	1,017.00
Tailwater Settings	Tailwater			(N/A)	(N/A)

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Subsection: Outlet Input Data
Label: Composite Outlet Structure - 1

Return Event: 100 years
Storm Event: 100 YR

Structure ID: Culvert - 1 Structure Type: Culvert-Circular	
Number of Barrels	1
Diameter	15.0 in
Length	107.00 ft
Length (Computed Barrel)	109.54 ft
Slope (Computed)	0.219 ft/ft

Outlet Control Data	
Manning's n	0.013
Ke	0.500
Kb	0.023
Kr	0.500
Convergence Tolerance	0.00 ft

Inlet Control Data	
Equation Form	Form 1
K	0.0098
M	2.0000
C	0.0398
Y	0.6700
T1 ratio (HW/D)	1.051
T2 ratio (HW/D)	1.197
Slope Correction Factor	-0.500

Use unsubmerged inlet control 0 equation below T1 elevation.
Use submerged inlet control 0 equation above T2 elevation

In transition zone between unsubmerged and submerged inlet control,
interpolate between flows at T1 & T2...

T1 Elevation	1,010.31 ft	T1 Flow	4.80 ft^3/s
T2 Elevation	1,010.50 ft	T2 Flow	5.49 ft^3/s

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Subsection: Outlet Input Data
Label: Composite Outlet Structure - 1

Return Event: 100 years
Storm Event: 100 YR

Structure ID: Orifice - 1 Structure Type: Orifice-Circular	
Number of Openings	1
Elevation	1,013.00 ft
Orifice Diameter	12.0 in
Orifice Coefficient	0.600

Structure ID: Riser - 1 Structure Type: Inlet Box	
Number of Openings	1
Elevation	1,015.25 ft
Orifice Area	5.0 ft²
Orifice Coefficient	0.600
Weir Length	12.00 ft
Weir Coefficient	3.00 (ft^0.5)/s
K Reverse	1.000
Manning's n	0.000
Kev, Charged Riser	0.000
Weir Submergence	False
Orifice H to crest	False

Structure ID: Culvert - 2 Structure Type: Culvert-Circular	
Number of Barrels	1
Diameter	24.0 in
Length	22.00 ft
Length (Computed Barrel)	22.01 ft
Slope (Computed)	0.022 ft/ft

Outlet Control Data	
Manning's n	0.013
Ke	0.500
Kb	0.012
Kr	0.500
Convergence Tolerance	0.00 ft

Inlet Control Data	
Equation Form	Form 1
K	0.0098
M	2.0000
C	0.0398
Y	0.6700

SOUTH EUCLID LIBRARY

Subsection: Outlet Input Data
Label: Composite Outlet Structure - 1

Return Event: 100 years
Storm Event: 100 YR

Inlet Control Data	
T1 ratio (HW/D)	1.149
T2 ratio (HW/D)	1.296
Slope Correction Factor	-0.500

Use unsubmerged inlet control 0 equation below T1 elevation.
Use submerged inlet control 0 equation above T2 elevation

In transition zone between unsubmerged and submerged inlet control,
interpolate between flows at T1 & T2...

T1 Elevation	986.85 ft	T1 Flow	15.55 ft³/s
T2 Elevation	987.14 ft	T2 Flow	17.77 ft³/s

Subsection: Outlet Input Data
Label: Composite Outlet Structure - 1

Return Event: 100 years
Storm Event: 100 YR

Structure ID: TW
Structure Type: TW Setup, DS Channel

Tailwater Type	Free Outfall
Convergence Tolerances	
Maximum Iterations	30
Tailwater Tolerance (Minimum)	0.01 ft
Tailwater Tolerance (Maximum)	0.50 ft
Headwater Tolerance (Minimum)	0.01 ft
Headwater Tolerance (Maximum)	0.50 ft
Flow Tolerance (Minimum)	0.001 ft^3/s
Flow Tolerance (Maximum)	10.000 ft^3/s

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Subsection: Composite Rating Curve
Label: Composite Outlet Structure - 1

Return Event: 100 years
Storm Event: 100 YR

Composite Outflow Summary

Water Surface Elevation (ft)	Flow (ft^3/s)	Tailwater Elevation (ft)	Convergence Error (ft)
1,013.00	0.00	(N/A)	0.00
1,013.50	0.76	(N/A)	0.00
1,014.00	2.67	(N/A)	0.00
1,014.50	3.78	(N/A)	0.00
1,015.00	4.63	(N/A)	0.00
1,015.25	5.00	(N/A)	0.00
1,015.50	9.85	(N/A)	0.00
1,016.00	15.44	(N/A)	0.00
1,016.50	16.04	(N/A)	0.00
1,017.00	16.62	(N/A)	0.00

Contributing Structures

(no Q: Riser - 1,Orifice - 1,Culvert - 1,Culvert - 2)
Orifice - 1,Culvert - 1,Culvert - 2 (no Q: Riser - 1)
Orifice - 1,Culvert - 1,Culvert - 2 (no Q: Riser - 1)
Orifice - 1,Culvert - 1,Culvert - 2 (no Q: Riser - 1)
Orifice - 1,Culvert - 1,Culvert - 2 (no Q: Riser - 1)
Orifice - 1,Culvert - 1,Culvert - 2 (no Q: Riser - 1)
Riser - 1,Orifice - 1,Culvert - 1,Culvert - 2
Riser - 1,Culvert - 1,Culvert - 2 (no Q: Orifice - 1)
Riser - 1,Culvert - 1,Culvert - 2 (no Q: Orifice - 1)
Riser - 1,Culvert - 1,Culvert - 2 (no Q: Orifice - 1)

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Subsection: Elevation-Volume-Flow Table (Pond)
Label: PO-1

Return Event: 1 years
Storm Event: 1 YR

Infiltration	
Infiltration Method (Computed)	No Infiltration

Initial Conditions	
Elevation (Water Surface, Initial)	1,013.00 ft
Volume (Initial)	0.000 ac-ft
Flow (Initial Outlet)	0.00 ft³/s
Flow (Initial Infiltration)	0.00 ft³/s
Flow (Initial, Total)	0.00 ft³/s
Time Increment	0.050 hours

Elevation (ft)	Outflow (ft³/s)	Storage (ac-ft)	Area (acres)	Infiltration (ft³/s)	Flow (Total) (ft³/s)	2S/t + O (ft³/s)
1,013.00	0.00	0.000	0.088	0.00	0.00	0.00
1,013.50	0.76	0.047	0.101	0.00	0.76	23.56
1,014.00	2.67	0.101	0.114	0.00	2.67	51.42
1,014.50	3.78	0.161	0.128	0.00	3.78	81.75
1,015.00	4.63	0.228	0.142	0.00	4.63	115.21
1,015.25	5.00	0.265	0.149	0.00	5.00	133.19
1,015.50	9.85	0.303	0.157	0.00	9.85	156.54
1,016.00	15.44	0.385	0.172	0.00	15.44	201.89
1,016.50	16.04	0.475	0.188	0.00	16.04	245.99
1,017.00	16.62	0.573	0.204	0.00	16.62	293.95

SOUTH EUCLID LIBRARY

Index

Ohio EPA Water Quality Volume Calculations

Project Name:	SOUTH EUCLID LIBRARY
Project #:	2012154.00
Project Location:	SOUTH GREEN ROAD
Date:	1/21/13

Water Quality Volume Sizing (Based on Ohio NPDES requirements)

Total Area **At** (acres)	Impervious Area **Ai** (acres)	Time of Concentration **Tc** (minutes)	**i**=Ai/At	*Composite **C**	Depth of Rainfall **P** (in)
5.41	2.40	10	0.44	0.30	0.75

Water Quality Volume, **WQv**	=	P	*	C	*	A/12	
	=	0.75	*	0.30	*	0.450	
	=	0.10					Ac-ft
	=	4485					ft^3
	=	**5382**					ft^3 (with 20% Additional WQv Storage per EPA Requirements)

**Ohio EPA will allow the use of the ASCE "mixed-use" formula to calculate a weighted C-coefficient. $C=0.858i^3-0.78i^2+0.774i+0.04$*

Ohio EPA Bioretention Cell Calculations

Project Name:	SOUTH EUCLID LIBRARY
Project #:	2012154.00
Project Location:	SOUTH GREEN ROAD
Date:	1/21/2013

Bioretention Cell Sizing (Based on Ohio NPDES requirements)

Filter Bed Depth d_f (ft)	Infiltration Rate **k** (ft/day)	Ave. Ponding Depth Above Filter Bed h_f (in)	Drawdown Time t_f (hours)	Water Quality Volume **WQv** (ft^3)
2.50	0.50	6	40.00	5382

*Area of Filter, A_f	=	$(WQv*d_f)$	/	$k*t_f*(h_f+d_f)$	
	=	13455	/	2.50	
	=	**5382**			ft^2

**Area of Filter calculated utilizing Darcy's Law, Af=(WQv*df)/(k*tf*(hf+df))*

Section 4

NOAA Atlas 14, Volume 2, Version 3
Location name: Cleveland, Ohio, US*
Coordinates: 41.5051, -81.5217
Elevation: 1039ft*
* source: Google Maps

POINT PRECIPITATION FREQUENCY ESTIMATES

G.M. Bonnin, D. Martin, B. Lin, T. Parzybok, M.Yekta, and D. Riley

NOAA, National Weather Service, Silver Spring, Maryland

PF tabular | PF graphical | Maps & aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval(years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.324 (0.293-0.359)	0.388 (0.351-0.430)	0.466 (0.421-0.517)	0.528 (0.475-0.585)	0.607 (0.542-0.674)	0.668 (0.593-0.743)	0.728 (0.643-0.811)	0.789 (0.691-0.884)	0.873 (0.754-0.984)	0.934 (0.798-1.06)
10-min	0.503 (0.456-0.558)	0.605 (0.548-0.671)	0.725 (0.654-0.803)	0.815 (0.734-0.903)	0.928 (0.829-1.03)	1.01 (0.900-1.13)	1.10 (0.968-1.22)	1.18 (1.03-1.32)	1.28 (1.11-1.45)	1.36 (1.16-1.54)
15-min	0.617 (0.558-0.683)	0.740 (0.670-0.821)	0.890 (0.803-0.986)	1.00 (0.903-1.11)	1.15 (1.02-1.27)	1.25 (1.11-1.39)	1.36 (1.20-1.52)	1.47 (1.28-1.64)	1.60 (1.38-1.81)	1.70 (1.45-1.93)
30-min	0.817 (0.739-0.904)	0.990 (0.897-1.10)	1.22 (1.10-1.35)	1.39 (1.25-1.54)	1.62 (1.45-1.80)	1.79 (1.59-1.99)	1.97 (1.74-2.19)	2.14 (1.87-2.40)	2.37 (2.05-2.67)	2.55 (2.18-2.89)
60-min	0.997 (0.902-1.10)	1.22 (1.10-1.35)	1.53 (1.38-1.70)	1.77 (1.60-1.96)	2.10 (1.88-2.33)	2.36 (2.10-2.62)	2.63 (2.32-2.93)	2.90 (2.54-3.25)	3.28 (2.84-3.70)	3.58 (3.06-4.06)
2-hr	1.16 (1.05-1.29)	1.41 (1.28-1.57)	1.79 (1.62-1.98)	2.09 (1.88-2.31)	2.51 (2.24-2.78)	2.85 (2.53-3.16)	3.21 (2.82-3.57)	3.59 (3.13-4.01)	4.13 (3.53-4.64)	4.57 (3.85-5.17)
3-hr	1.25 (1.13-1.39)	1.53 (1.38-1.70)	1.93 (1.74-2.15)	2.26 (2.03-2.51)	2.72 (2.42-3.04)	3.11 (2.74-3.48)	3.51 (3.07-3.95)	3.94 (3.40-4.45)	4.56 (3.87-5.19)	5.08 (4.24-5.81)
6-hr	1.51 (1.37-1.66)	1.82 (1.65-2.00)	2.29 (2.08-2.52)	2.69 (2.43-2.95)	3.27 (2.93-3.60)	3.76 (3.33-4.15)	4.30 (3.76-4.76)	4.88 (4.21-5.45)	5.75 (4.86-6.49)	6.49 (5.38-7.41)
12-hr	1.74 (1.59-1.92)	2.10 (1.92-2.31)	2.62 (2.39-2.88)	3.07 (2.79-3.37)	3.72 (3.34-4.08)	4.28 (3.81-4.71)	4.89 (4.29-5.40)	5.56 (4.82-6.19)	6.56 (5.56-7.38)	7.42 (6.17-8.44)
24-hr	2.03 (1.88-2.20)	2.44 (2.26-2.64)	3.05 (2.81-3.30)	3.54 (3.26-3.84)	4.26 (3.89-4.61)	4.86 (4.40-5.28)	5.51 (4.94-6.01)	6.20 (5.50-6.81)	7.22 (6.28-8.00)	8.07 (6.91-9.02)
2-day	2.34 (2.17-2.54)	2.81 (2.60-3.04)	3.47 (3.21-3.75)	4.01 (3.69-4.34)	4.80 (4.38-5.20)	5.45 (4.94-5.92)	6.14 (5.51-6.71)	6.89 (6.12-7.59)	7.96 (6.93-8.88)	8.86 (7.59-10.0)
3-day	2.52 (2.34-2.71)	3.01 (2.80-3.25)	3.70 (3.44-3.99)	4.27 (3.95-4.60)	5.06 (4.66-5.47)	5.72 (5.22-6.19)	6.40 (5.80-6.97)	7.14 (6.40-7.82)	8.17 (7.22-9.04)	9.03 (7.86-10.1)
4-day	2.70 (2.51-2.89)	3.22 (3.00-3.45)	3.94 (3.67-4.23)	4.52 (4.20-4.86)	5.33 (4.93-5.74)	5.99 (5.51-6.46)	6.67 (6.09-7.22)	7.38 (6.69-8.04)	8.38 (7.50-9.20)	9.20 (8.14-10.2)
7-day	3.27 (3.06-3.49)	3.89 (3.64-4.16)	4.71 (4.40-5.04)	5.36 (5.00-5.73)	6.25 (5.81-6.70)	6.96 (6.43-7.47)	7.69 (7.07-8.28)	8.44 (7.70-9.13)	9.47 (8.54-10.3)	10.3 (9.17-11.3)
10-day	3.76 (3.54-4.01)	4.47 (4.20-4.76)	5.35 (5.01-5.70)	6.05 (5.66-6.44)	6.99 (6.52-7.44)	7.74 (7.18-8.25)	8.49 (7.84-9.08)	9.26 (8.49-9.95)	10.3 (9.35-11.2)	11.1 (10.0-12.1)
20-day	5.19 (4.91-5.50)	6.13 (5.80-6.50)	7.21 (6.82-7.65)	8.05 (7.60-8.54)	9.16 (8.62-9.73)	10.0 (9.39-10.7)	10.9 (10.1-11.6)	11.7 (10.8-12.5)	12.8 (11.7-13.8)	13.6 (12.4-14.8)
30-day	6.56 (6.22-6.93)	7.73 (7.33-8.16)	8.98 (8.52-9.49)	9.93 (9.41-10.5)	11.2 (10.5-11.8)	12.1 (11.4-12.8)	13.0 (12.2-13.8)	13.9 (12.9-14.8)	15.0 (13.9-16.0)	15.8 (14.5-17.0)
45-day	8.44 (8.04-8.88)	9.91 (9.44-10.4)	11.4 (10.8-12.0)	12.5 (11.9-13.1)	13.9 (13.2-14.6)	14.9 (14.1-15.7)	15.9 (15.0-16.8)	16.8 (15.8-17.8)	18.0 (16.9-19.2)	18.9 (17.6-20.2)
60-day	10.2 (9.73-10.7)	11.9 (11.4-12.5)	13.6 (12.9-14.2)	14.8 (14.1-15.5)	16.3 (15.6-17.2)	17.5 (16.6-18.4)	18.5 (17.6-19.5)	19.5 (18.4-20.7)	20.7 (19.5-22.0)	21.6 (20.2-23.1)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Cuyahoga County, Ohio

SOUTH EUCLID LIBRARY

January 17, 2013

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://soils.usda.gov/sqi/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (http://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://soils.usda.gov/contact/state_offices/).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Soil Data Mart Web site or the NRCS Web Soil Survey. The Soil Data Mart is the data storage site for the official soil survey information.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means

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Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the

individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

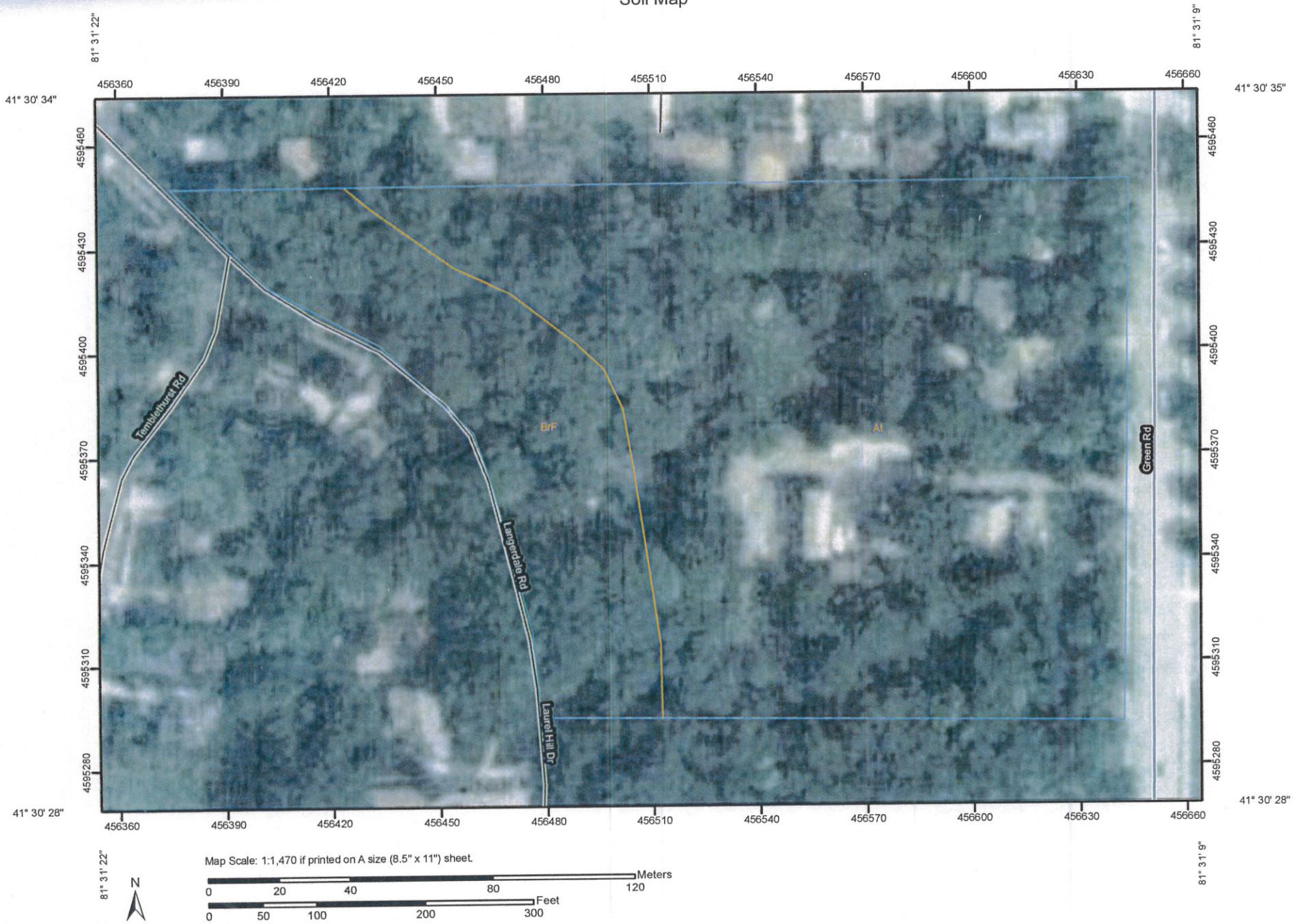
Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map



MAP LEGEND

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

Soils
- Soil Map Units

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

Special Line Features
- Gully
- Short Steep Slope
- Other

Political Features
- Cities

Water Features
- Streams and Canals

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

MAP INFORMATION

Map Scale: 1:1,470 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:15,840.

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 accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 17N NAD83

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

Soil Survey Area: Cuyahoga County, Ohio
Survey Area Data: Version 11, Jan 27, 2010

Date(s) aerial images were photographed: 6/30/2004

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

Map Unit Legend

Cuyahoga County, Ohio (OH035)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
At	Allis-Urban land complex	5.8	77.1%
BrF	Brecksville silt loam, 25 to 70 percent slopes	1.7	22.9%
Totals for Area of Interest		**7.5**	**100.0%**

Map Unit Descriptions

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

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

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

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

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

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

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

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

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

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

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

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

Cuyahoga County, Ohio

At—Allis-Urban land complex

Map Unit Setting

Landscape: Uplands
Mean annual precipitation: 32 to 42 inches
Mean annual air temperature: 48 to 54 degrees F
Frost-free period: 140 to 195 days

Map Unit Composition

Allis and similar soils: 55 percent
Urban land: 30 percent
Minor components: 15 percent

Description of Allis

Setting

Landform: Lake plains
Parent material: Till derived from shale

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 0.20 in/hr)
Depth to water table: About 0 to 12 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 3.9 inches)

Typical profile

0 to 7 inches: Silt loam
7 to 35 inches: Silty clay
35 to 39 inches: Weathered bedrock

Minor Components

Hornell

Percent of map unit: 15 percent
Landform: Till plains

BrF—Brecksville silt loam, 25 to 70 percent slopes

Map Unit Setting

Landscape: Uplands
Elevation: 690 to 1,110 feet
Mean annual precipitation: 30 to 44 inches
Mean annual air temperature: 46 to 55 degrees F

Frost-free period: 130 to 195 days

Map Unit Composition

Brecksville and similar soils: 85 percent
Minor components: 15 percent

Description of Brecksville

Setting

Landform: Drainageways
Parent material: Residuum weathered from shale

Properties and qualities

Slope: 25 to 70 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 5.2 inches)

Interpretive groups

Farmland classification: Not prime farmland
Land capability (nonirrigated): 7e
Hydrologic Soil Group: D

Typical profile

0 to 14 inches: Silt loam
14 to 30 inches: Silty clay loam
30 to 35 inches: Weathered bedrock

Minor Components

Ellsworth

Percent of map unit: 5 percent
Landform: Till plains

Glenford

Percent of map unit: 5 percent
Landform: Lake plains, terraces

Holly

Percent of map unit: 5 percent
Landform: Flood plains

Soil Information for All Uses

Soil Properties and Qualities

The Soil Properties and Qualities section includes various soil properties and qualities displayed as thematic maps with a summary table for the soil map units in the selected area of interest. A single value or rating for each map unit is generated by aggregating the interpretive ratings of individual map unit components. This aggregation process is defined for each property or quality.

Soil Qualities and Features

Soil qualities are behavior and performance attributes that are not directly measured, but are inferred from observations of dynamic conditions and from soil properties. Example soil qualities include natural drainage, and frost action. Soil features are attributes that are not directly part of the soil. Example soil features include slope and depth to restrictive layer. These features can greatly impact the use and management of the soil.

Hydrologic Soil Group (SOUTH EUCLID LIBRARY)

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.

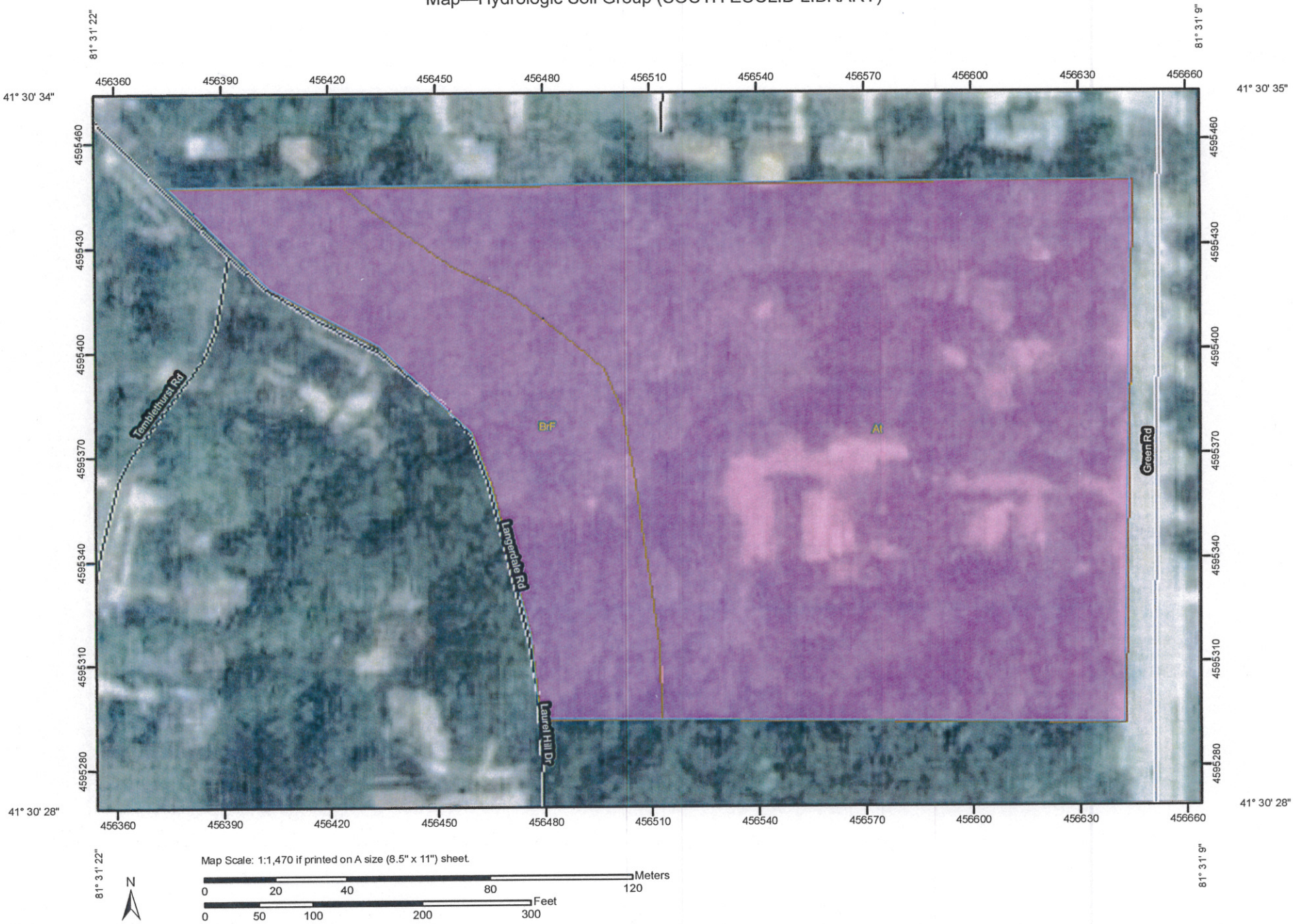
Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

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.

Custom Soil Resource Report
Map—Hydrologic Soil Group (SOUTH EUCLID LIBRARY)



MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Units

Soil Ratings

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Political Features

- Cities

Water Features

- Streams and Canals

Transportation

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

MAP INFORMATION

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