

February 11, 2021

Town of Bolton Conservation Commission
Attn: Ms. Rebecca Longvall, Conservation Agent
Bolton Town Hall
663 Main Street
Bolton, Massachusetts 01740

**RE: Isolated Land Subject to Flooding
Lands Subject to Flooding or Inundation by Ground Water or Surface Water
Century Mill Road, Bolton, Massachusetts**

Dear Conservation Commission Members and Ms. Longvall:

BSC Group (BSC) has completed its evaluation of two localized depressions at the proposed three lot residential development on Century Mill Road in Bolton, Massachusetts. In accordance with our contract with the Commission, BSC has evaluated the depressions to determine if they qualify as Isolated Land Subject to Flooding (ILSF) under the Massachusetts Wetlands Protection Act (the Act) and associated regulations (310 CMR 10.00) and/or as Lands Subject to Flooding or Inundation by Ground Water or Surface Water (LSF) under the Town of Bolton Wetlands Protection Bylaw (the Bylaw) and Wetlands Bylaw Regulations. This letter report summarizes the work performed and our findings and recommendations.

Summary of Work Performed

Using the proposed project documents readily available data, BSC performed calculations to determine if either of the depressions qualify as ILSF and/or LSF. Calculations were performed using HydroCAD v.10 software, which performs hydrologic calculations utilizing the Soil Conservation Service (SCS) methodologies set forth in SCS Technical Release (TR) 20 and TR-55. In support of our calculations, BSC utilized information from the following sources:

- A Notice of Intent (NOI) for 21 Century Mill LLC prepared by Goddard Consulting LLC, dated September 1, 2020, including “Stormwater Report and Calculations for A Proposed Common Driveway Serving 4 Lots” prepared by FORESITE Engineering Associates, Inc., dated September 20, 2018 and the plan “Common Driveway Plan & Profile, Lots 1-4 Century Mill Road” prepared by FORESITE Engineering Associates, Inc., dated August 11, 2020,
- United States Department of Agriculture Natural Resource Conservation Service (NRCS) Web Soil Survey data for the project area (included in Attachment D), and
- LiDAR contour data for the project area obtained from the Federal Emergency Management Agency (FEMA) from 2010 (shown on Subcatchment Area Plan included in Attachment A).

Using the information above, the subcatchment (or tributary drainage area) for each depression was determined. In addition, the surface description and hydrologic soil group (HSG) for the



subcatchments was determined to be “woods, good” and HSG A. These variables were used in the calculations with specific details of each outlined in the following sections.

Isolated Land Subject to Flooding

Per 310 CMR 10.57(2)(b)1., Isolated Land Subject to Flooding (ILSF) is defined as “an isolated depression or closed basin without an inlet or an outlet. It is an area which at least once a year confines standing water to a volume of at least 1/4 acre-feet and to an average depth of at least six inches.” Per 310 CMR 10.57(2)(b)3., “The boundary of Isolated Land Subject to Flooding is the perimeter of the largest observed or recorded volume of water confined in said area.” This section also provides a method to determine if an area is ILSF through calculations certified by a registered professional engineer “in accordance with the general requirements of 310 CMR 10.57(2)(a)3.a. through c., except that the maximum extent of said water shall be based upon the total volume (rather than peak rate) of run-off from the drainage area contributing to the Isolated Land Subject to Flooding and shall be further based upon the assumption that there is no infiltration of said run-off into the soil within the Isolated Land Subject to Flooding.” The calculation requirements in 310 CMR 10.57(2)(a)3.a. through c., are generally as follows:

- Calculations shall be performed per SCS TR-55 methodology and in accordance with Section 4 of the SCS “National Engineering Hydrology Handbook”,
- A design storm of 7-inches in 24-hours with a Type III rainfall distribution shall be used, and
- The calculations shall be performed by a registered professional engineer or other competent professional.

Using the variables determined above and the methodology of 310 CMR 10.57 with HydroCAD, BSC performed the calculations for each depression. The full calculations are included in Attachment B and are summarized in the table below.

Depression	Volume Stored	Full Volume Storage Depth
Lot 2	0.010 acre-feet	0.6 inches
Lot 4	0.010 acre-feet	0.5 inches

As shown above, neither depression holds a volume of water of at least 1/4 acre-feet or to an average depth of at least 6-inches in the prescribed design storm. As such, neither depression meets the definition in 310 CMR 10.57(2)(b)1. for ILSF.

Lands Subject to Flooding or Inundation by Ground Water or Surface Water

Section 1.05 of the Town of Bolton Conservation Commission Wetlands Bylaw Regulations defines Lands Subject to Flooding or Inundation by Ground Water or Surface Water (LSF) as “areas where there is a depression in topography, isolated depression, low lying land, or closed basin which floods periodically and/or serves as a ponding area of ground or surface water.” In addition, “Such areas shall be 1000 square feet or greater in surface area and hold an average depth of six inches.” Section 1.05 details two ways to determine the extent of LSF.

- The most recent FEMA flood profile for a 100-year flood or
- The elevation for a 7-inch, 24-hour storm event determined using the SCS TR-20 methodology.



Using the variables determined above and the methodology of 310 CMR 10.57 with HydroCAD, BSC performed the calculations for each depression. The full calculations are included in Attachment C and are summarized in the table below.

Depression	Area	Depth of Ponding
Lot 2	8,285 square feet	0.6 inches
Lot 4	11,591 square feet	0.5 inches

As shown above, while each depression is suitably large, neither depression holds a volume of water to an average depth of at least 6-inches in the prescribed design storm. As such, neither depression meets the definition for LSF from the Town of Bolton Conservation Commission Wetlands Bylaw Regulations.

Analysis

As detailed in the sections above, neither depression meets the definition for ILSF or LSF. In fact, neither depression is particularly close to meeting either definition. Based on anecdotal information provided to BSC including photographs of the area, these results do not seem to conform to what has been observed on site. As such, BSC analyzed the calculations in more detail to try and determine why this disconnect appears to exist. More detailed analysis of the results shows the primary reason for this disconnect is the minimal volume of runoff produced due to the small size of each depression's subcatchment area, the surface type of "woods, good", and the presence of HSG A soils. Based upon those inputs, it is unsurprising that the runoff volume, even from a large storm event, is so small. These inputs were used based upon the best, currently available data for the sites with specific details as follows.

Subcatchment Areas

Subcatchment areas are determined by topography. In order to determine the subcatchment areas, BSC utilized the plan "Common Driveway Plan & Profile, Lots 1-4 Century Mill Road" prepared by FORESITE Engineering Associates, Inc., dated August 11, 2020, supplemented with LiDAR data from FEMA. The LiDAR data generally matches what is shown on the plan. Additionally, publicly available aerial photography shows that no changes have been made to the site or the surrounding areas that would significantly alter the topography and, therefore, the subcatchment areas. As such, we are satisfied that the subcatchment area determinations are appropriate for the calculations of ILSF and LSF.

Surface Condition

The surface condition is chosen from a list of surface conditions included in SCS TR-55. Based on the site, "woods, good" is the obvious surface condition to use. As such, we are satisfied this is appropriate for the calculations of ILSF and LSF.

Hydrologic Soils Group

Hydrologic Soils Group (HSG) determinations can be done in a variety of ways. NRCS soils mapping often provides information on the HSG of the soils in a given area. On-site test pits and/or sampling may be done to determine the specific soils on site and their subsequent HSG. Information available in this case included the NRCS mapping as well as soil test pits performed by the project applicant for household septic system leaching fields. Each of these sources showed the soils on site to sand or loamy sand falling into HSG A, having high



permeabilities and infiltration rates. As both the NRCS and test pit data matched, we believe it was appropriate to perform the calculations using HSG A soils.

However, soils are the variable in the calculations most likely to change over relatively short distances. As shown on the NRCS mapping (see Attachment D), while the locations of the depressions are mapped as HSG A, surrounding areas that are a relatively short distance away, include HSG A/D, B/D, and D soils. Soils with 2 HSG assignments indicate a drained and undrained condition having to do with groundwater depth (i.e. high groundwater results in the lower rating). While NRCS soils mapping is generally reasonably accurate, it is based upon limited field testing along with other visual and topographic factors. Therefore, it is not meant to be considered exact. It is possible that, while the soils toward the front of the lots where soil test pit were performed are sandy HSG A soils, soil conditions in the depression areas may be different. If that were the case, it would explain the apparent disconnect between the calculations performed and the anecdotal information of localized flooding in these depressions. Soils testing within the depressions could be performed in one day or less with a small excavator or backhoe. It must be noted that, depending on the exact soil information found in these depressions, they may or may not qualify as ILSF and/or LSF. Even if the soil found in the depressions differs from the mapping, it does not necessarily mean the depressions are ILSF and/or LSF. In addition, it should be noted that BSC has been made aware of excavation work that occurred in recent years around the depression on Lot 4 to removed various trash and debris from that area. Depending upon the extent of that excavation work and the restoration performed, the soils in and around this depression may have been significantly altered from their natural state which would affect any findings in this area as well as subsequent calculations for ILSF and LSF.

Conclusions

In accordance with our contract with the Bolton Conservation Commission, BSC Group has completed calculations for determining if two localized depressions at the proposed three lot residential development on Century Mill Road in Bolton, Massachusetts qualify as Isolated Land Subject to Flooding (ILSF) under the Massachusetts Wetlands Protection Act and associated regulations and/or as Lands Subject to Flooding or Inundation by Ground Water or Surface Water (LSF) under the Town of Bolton Wetlands Protection Bylaw and Wetlands Bylaw Regulations. Based on these calculations, using the information available to us, neither depression qualifies as either ILSF or LSF under the applicable regulations and bylaws. However, these calculation results do not appear to conform with anecdotal and photographic evidence of localized flooding in these areas. In addition, it may be that soils information currently available does not fully represent the soils in and around the depressions. Should additional soils data be obtained from the area in and around the depressions, BSC's calculations can be quickly updated based on that information to refine the ILSF and LSF determinations.



Town of Bolton Conservation Commission

Attn: Rebecca Longvall

February 11, 2021

Page 5

Please feel free to contact me at (617) 896-4386 or drinaldi@bscgroup.com should you have any questions on the information in this report and I look forward to discussing this information with you at a future meeting of the Commission.

Sincerely,
BSC GROUP, INC.

Dominic Rinaldi, P.E., LEED AP BD+C
Senior Associate

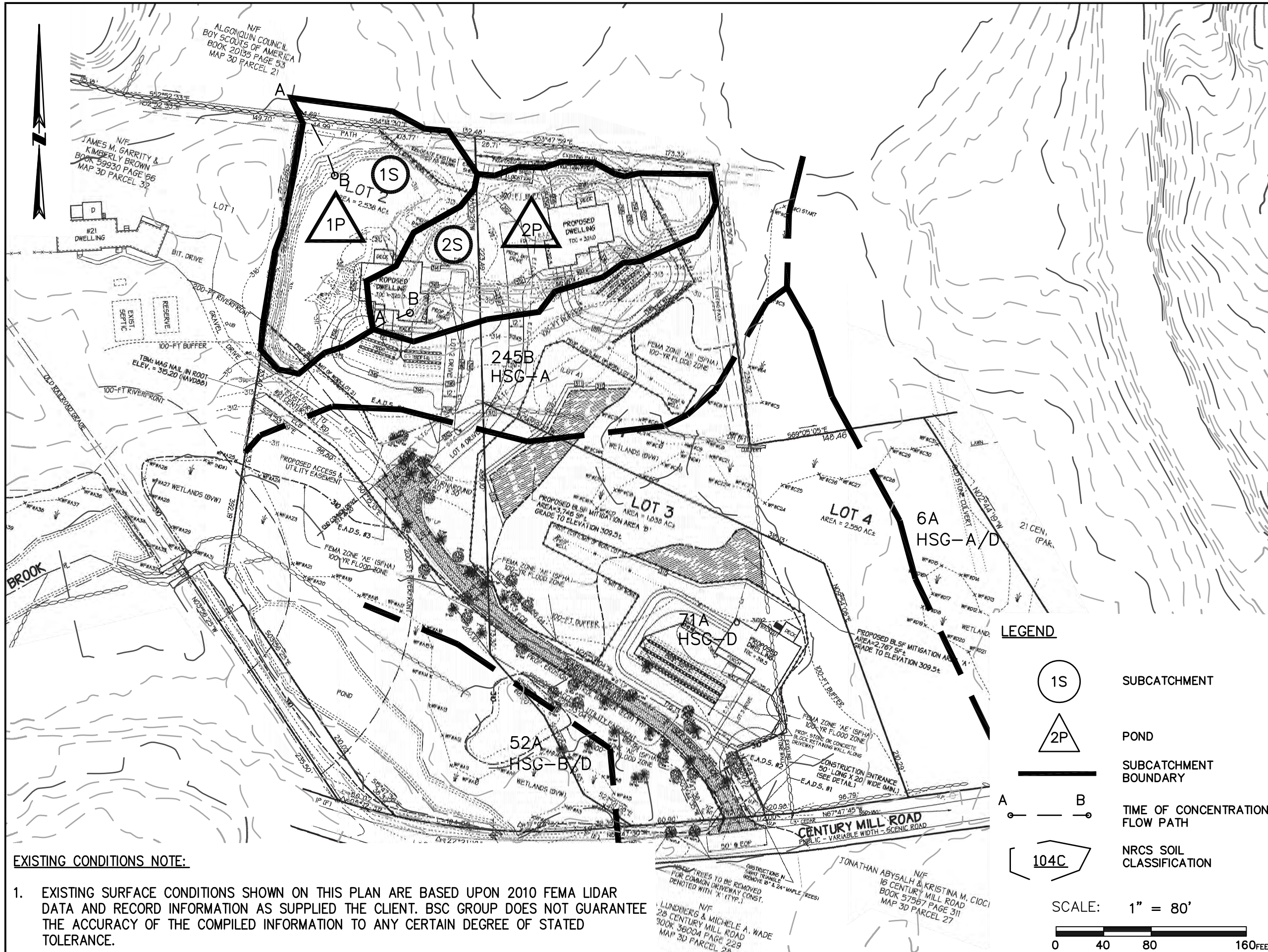
cc: C. Thomas, BSC
G. Davie, BSC

Attachments:

- Attachment A: Subcatchment Area Plan
- Attachment B: ILSF Calculations
- Attachment C: LSF Calculations
- Attachment D: NRCS Soils Mapping and Report



ATTACHMENT A
SUBCATCHMENT AREA PLAN



**LOCALIZED
DEPRESSIONS**
21 CENTURY MILL ROAD

**BOLTON
MASSACHUSETTS**

EXISTING WATERSHED

FEBRUARY 12, 2021

LEGEND

- 1S SUBCATCHMENT
- 2P POND
- SUBCATCHMENT BOUNDARY
- TIME OF CONCENTRATION FLOW PATH
- 104C NRCS SOIL CLASSIFICATION

EXISTING CONDITIONS NOTE:

1. EXISTING SURFACE CONDITIONS SHOWN ON THIS PLAN ARE BASED UPON 2010 FEMA LIDAR DATA AND RECORD INFORMATION AS SUPPLIED THE CLIENT. BSC GROUP DOES NOT GUARANTEE THE ACCURACY OF THE COMPILED INFORMATION TO ANY CERTAIN DEGREE OF STATED TOLERANCE.

PREPARED FOR:
BOLTON CONSERVATION
663 MAIN STREET
BOLTON, MA 01740

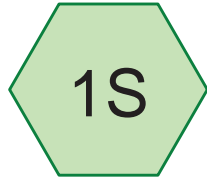
BSC GROUP
803 Summer Street
Boston, Massachusetts
02127
617 896 4300

SCALE: 1" = 80'
0 40 80 160 FEET

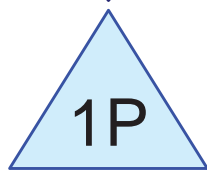
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Scale: **AS SHOWN** Revised: _____
Dwg No: **1 OF 1**



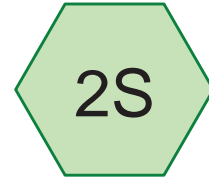
ATTACHMENT B
ISOLATED LAND SUBJECT TO FLOODING
CALCULATIONS



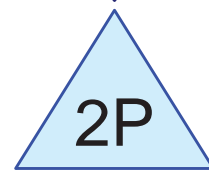
Lot 2 Isolated
Depression



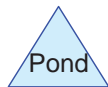
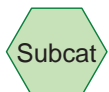
Lot 2 Depression



Lot 4 Isolated
Depression



Lot 4 Depression



HydroCAD for A Soil

Prepared by BSC Group

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Century Mill Road ILSF Calculations
Type III 24-hr 100-YR Rainfall=7.00"

Printed 2/12/2021

Page 2

Summary for Subcatchment 1S: Lot 2 Isolated Depression

Runoff = 0.02 cfs @ 13.83 hrs, Volume= 0.010 af, Depth> 0.21"

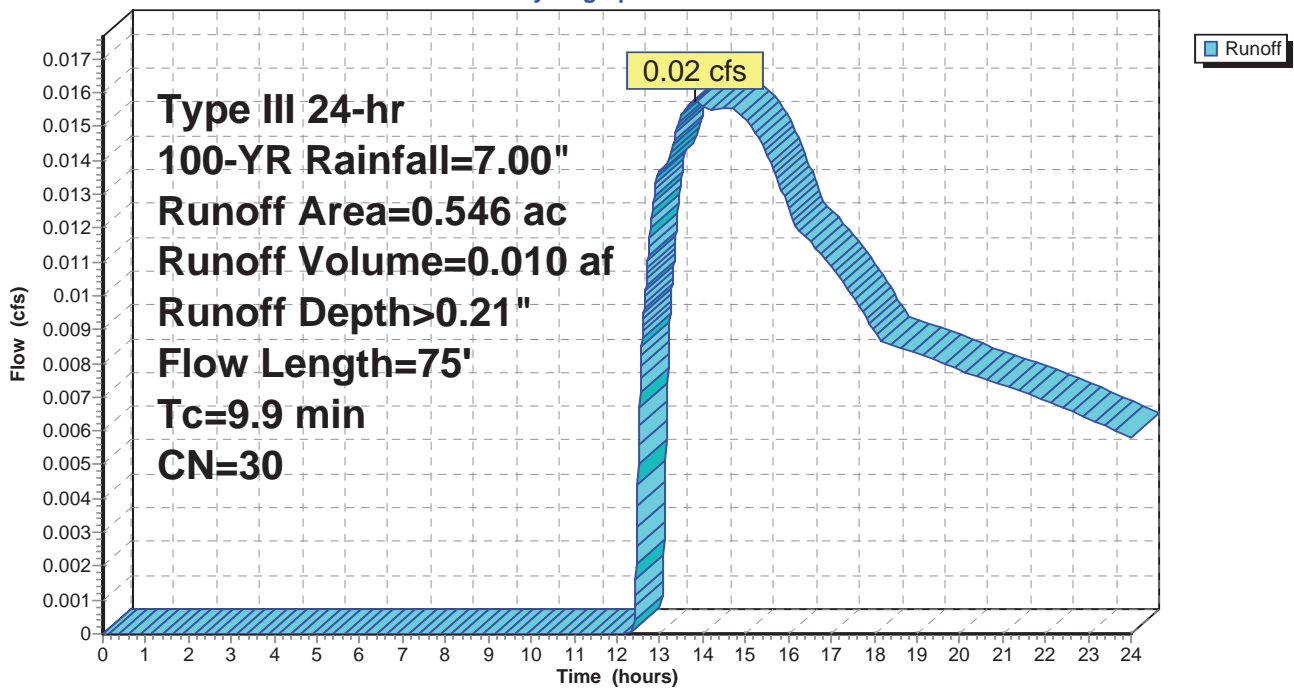
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-YR Rainfall=7.00"

Area (ac)	CN	Description
0.546	30	Woods, Good, HSG A
0.546		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.9	50	0.0350	0.08		Sheet Flow, Sheet Flow Woods: Light underbrush n= 0.400 P2= 3.20"
0.0	25	0.3000	8.82		Shallow Concentrated Flow, Shallow Concentrated Unpaved Kv= 16.1 fps
9.9	75	Total			

Subcatchment 1S: Lot 2 Isolated Depression

Hydrograph



HydroCAD for A Soil

Prepared by BSC Group

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Century Mill Road ILSF Calculations
Type III 24-hr 100-YR Rainfall=7.00"

Printed 2/12/2021

Page 3

Summary for Subcatchment 2S: Lot 4 Isolated Depression

Runoff = 0.02 cfs @ 13.78 hrs, Volume= 0.010 af, Depth> 0.21"

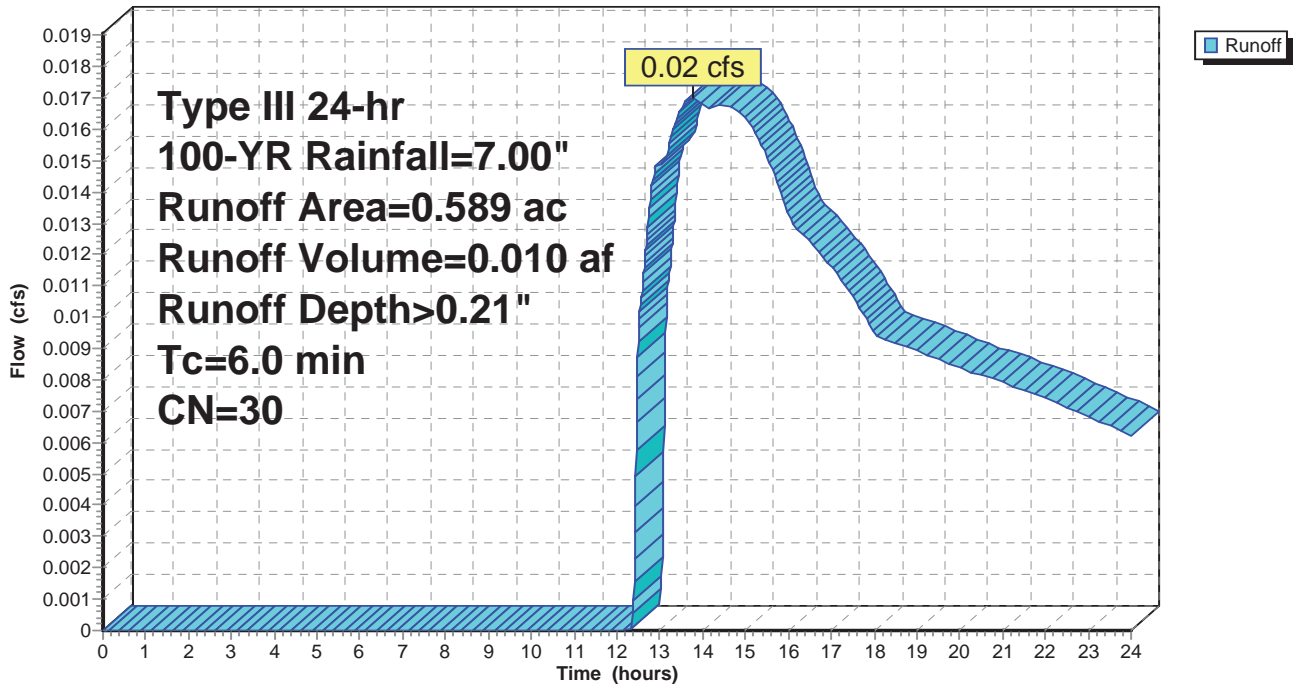
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-YR Rainfall=7.00"

Area (ac)	CN	Description
0.589	30	Woods, Good, HSG A
0.589		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					Direct Entry,

Subcatchment 2S: Lot 4 Isolated Depression

Hydrograph



HydroCAD for A Soil

Prepared by BSC Group

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Century Mill Road ILSF Calculations
Type III 24-hr 100-YR Rainfall=7.00"

Printed 2/12/2021

Page 4

Summary for Pond 1P: Lot 2 Depression

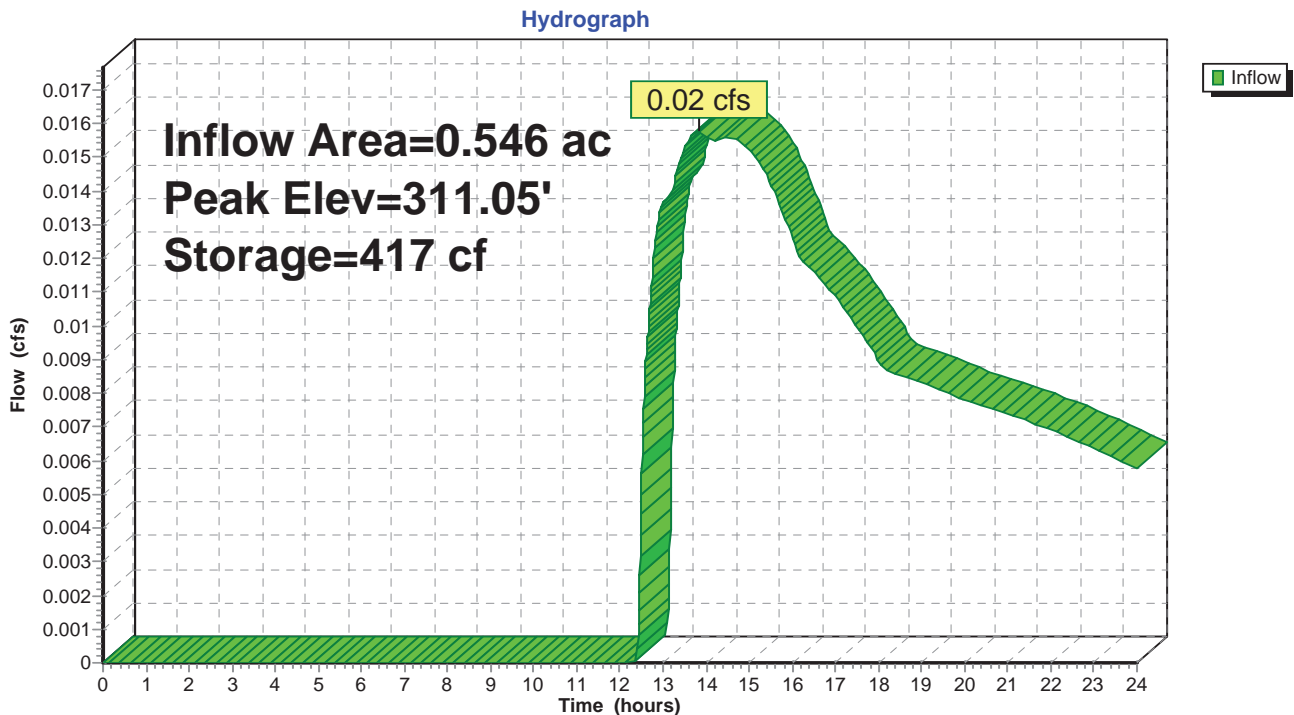
Inflow Area = 0.546 ac, 0.00% Impervious, Inflow Depth > 0.21" for 100-YR event
Inflow = 0.02 cfs @ 13.83 hrs, Volume= 0.010 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 311.05' @ 24.00 hrs Surf.Area= 8,386 sf Storage= 417 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description		
#1	311.00'	9,332 cf	Custom Stage Data (Irregular) Listed below (Recalc)		
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
311.00	8,285	585.0	0	0	8,285
312.00	10,419	620.0	9,332	9,332	11,695

Pond 1P: Lot 2 Depression



HydroCAD for A Soil

Prepared by BSC Group

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Century Mill Road ILSF Calculations
Type III 24-hr 100-YR Rainfall=7.00"

Printed 2/12/2021

Page 5

Summary for Pond 2P: Lot 4 Depression

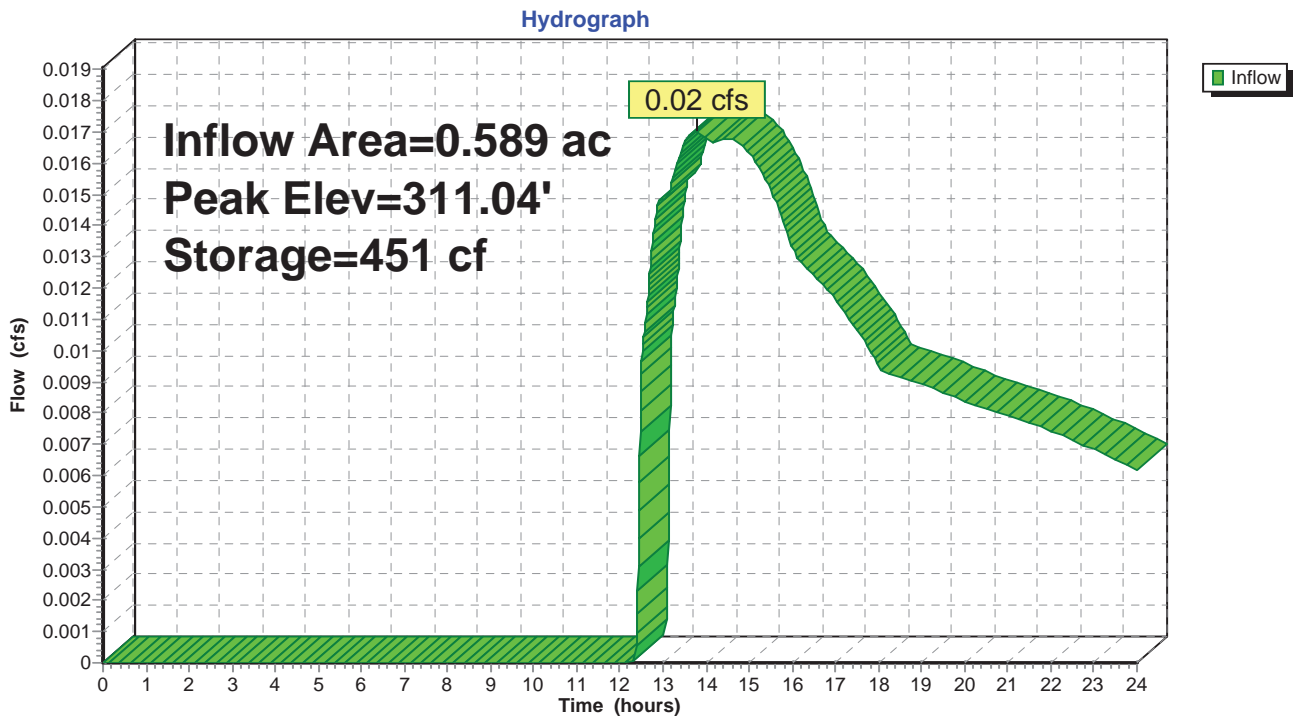
Inflow Area = 0.589 ac, 0.00% Impervious, Inflow Depth > 0.21" for 100-YR event
Inflow = 0.02 cfs @ 13.78 hrs, Volume= 0.010 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 311.04' @ 24.00 hrs Surf.Area= 11,710 sf Storage= 451 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description		
#1	311.00'	13,189 cf	Custom Stage Data (Irregular) Listed below (Recalc)		
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
311.00	11,591	634.0	0	0	11,591
312.00	14,855	690.0	13,189	13,189	17,528

Pond 2P: Lot 4 Depression



HydroCAD for A Soil

Prepared by BSC Group

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Type III 24-hr 100-YR Rainfall=7.00"

Printed 2/12/2021

Stage-Area-Storage for Pond 1P: Lot 2 Depression

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
311.00	8,285	0	311.53	9,386	4,680
311.01	8,305	83	311.54	9,407	4,774
311.02	8,325	166	311.55	9,428	4,868
311.03	8,345	249	311.56	9,450	4,962
311.04	8,366	333	311.57	9,471	5,057
311.05	8,386	417	311.58	9,493	5,152
311.06	8,406	501	311.59	9,515	5,247
311.07	8,426	585	311.60	9,536	5,342
311.08	8,447	669	311.61	9,558	5,437
311.09	8,467	754	311.62	9,579	5,533
311.10	8,487	839	311.63	9,601	5,629
311.11	8,508	924	311.64	9,623	5,725
311.12	8,528	1,009	311.65	9,644	5,821
311.13	8,549	1,094	311.66	9,666	5,918
311.14	8,569	1,180	311.67	9,688	6,015
311.15	8,590	1,266	311.68	9,710	6,112
311.16	8,610	1,352	311.69	9,731	6,209
311.17	8,631	1,438	311.70	9,753	6,306
311.18	8,651	1,524	311.71	9,775	6,404
311.19	8,672	1,611	311.72	9,797	6,502
311.20	8,692	1,698	311.73	9,819	6,600
311.21	8,713	1,785	311.74	9,841	6,698
311.22	8,734	1,872	311.75	9,863	6,797
311.23	8,754	1,959	311.76	9,885	6,895
311.24	8,775	2,047	311.77	9,907	6,994
311.25	8,796	2,135	311.78	9,929	7,094
311.26	8,816	2,223	311.79	9,951	7,193
311.27	8,837	2,311	311.80	9,973	7,293
311.28	8,858	2,400	311.81	9,995	7,392
311.29	8,879	2,488	311.82	10,017	7,493
311.30	8,900	2,577	311.83	10,039	7,593
311.31	8,920	2,666	311.84	10,061	7,693
311.32	8,941	2,756	311.85	10,083	7,794
311.33	8,962	2,845	311.86	10,106	7,895
311.34	8,983	2,935	311.87	10,128	7,996
311.35	9,004	3,025	311.88	10,150	8,098
311.36	9,025	3,115	311.89	10,172	8,199
311.37	9,046	3,205	311.90	10,195	8,301
311.38	9,067	3,296	311.91	10,217	8,403
311.39	9,088	3,387	311.92	10,239	8,505
311.40	9,109	3,478	311.93	10,262	8,608
311.41	9,130	3,569	311.94	10,284	8,711
311.42	9,152	3,660	311.95	10,306	8,814
311.43	9,173	3,752	311.96	10,329	8,917
311.44	9,194	3,844	311.97	10,351	9,020
311.45	9,215	3,936	311.98	10,374	9,124
311.46	9,236	4,028	311.99	10,396	9,228
311.47	9,258	4,120	312.00	10,419	9,332
311.48	9,279	4,213			
311.49	9,300	4,306			
311.50	9,321	4,399			
311.51	9,343	4,492			
311.52	9,364	4,586			

Total volume:
0.010 acft = 435.6 cft
Depth:
Approx. 0.05' = 0.6"

HydroCAD for A Soil

Prepared by BSC Group

HydroCAD® 10.00-22 s/n 00904 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 100-YR Rainfall=7.00"

Printed 2/12/2021

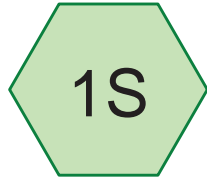
Stage-Area-Storage for Pond 2P: Lot 4 Depression

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
311.00	11,591	0	311.53	13,271	6,583
311.01	11,622	116	311.54	13,303	6,716
311.02	11,652	232	311.55	13,336	6,849
311.03	11,683	349	311.56	13,369	6,983
311.04	11,714	466	311.57	13,402	7,117
311.05	11,745	583	311.58	13,435	7,251
311.06	11,775	701	311.59	13,468	7,385
311.07	11,806	819	311.60	13,501	7,520
311.08	11,837	937	311.61	13,534	7,655
311.09	11,868	1,056	311.62	13,567	7,791
311.10	11,899	1,174	311.63	13,600	7,927
311.11	11,930	1,294	311.64	13,633	8,063
311.12	11,961	1,413	311.65	13,667	8,199
311.13	11,992	1,533	311.66	13,700	8,336
311.14	12,024	1,653	311.67	13,733	8,473
311.15	12,055	1,773	311.68	13,767	8,611
311.16	12,086	1,894	311.69	13,800	8,749
311.17	12,117	2,015	311.70	13,833	8,887
311.18	12,149	2,136	311.71	13,867	9,025
311.19	12,180	2,258	311.72	13,900	9,164
311.20	12,211	2,380	311.73	13,934	9,303
311.21	12,243	2,502	311.74	13,967	9,443
311.22	12,274	2,625	311.75	14,001	9,583
311.23	12,306	2,748	311.76	14,035	9,723
311.24	12,337	2,871	311.77	14,068	9,864
311.25	12,369	2,994	311.78	14,102	10,004
311.26	12,401	3,118	311.79	14,136	10,146
311.27	12,432	3,242	311.80	14,170	10,287
311.28	12,464	3,367	311.81	14,204	10,429
311.29	12,496	3,492	311.82	14,238	10,571
311.30	12,528	3,617	311.83	14,272	10,714
311.31	12,560	3,742	311.84	14,306	10,857
311.32	12,591	3,868	311.85	14,340	11,000
311.33	12,623	3,994	311.86	14,374	11,143
311.34	12,655	4,121	311.87	14,408	11,287
311.35	12,687	4,247	311.88	14,442	11,432
311.36	12,719	4,374	311.89	14,476	11,576
311.37	12,752	4,502	311.90	14,510	11,721
311.38	12,784	4,629	311.91	14,545	11,866
311.39	12,816	4,757	311.92	14,579	12,012
311.40	12,848	4,886	311.93	14,613	12,158
311.41	12,880	5,014	311.94	14,648	12,304
311.42	12,913	5,143	311.95	14,682	12,451
311.43	12,945	5,273	311.96	14,717	12,598
311.44	12,977	5,402	311.97	14,751	12,745
311.45	13,010	5,532	311.98	14,786	12,893
311.46	13,042	5,662	311.99	14,820	13,041
311.47	13,075	5,793	312.00	14,855	13,189
311.48	13,107	5,924			
311.49	13,140	6,055			
311.50	13,172	6,187			
311.51	13,205	6,319			
311.52	13,238	6,451			

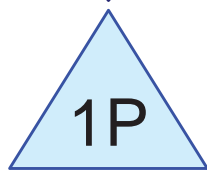
Total volume:
0.010 acft = 435.6 cft
Depth:
Approx. 0.04' = 0.5"



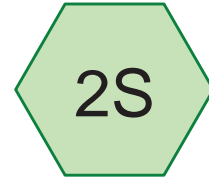
ATTACHMENT C
LANDS SUBJECT TO FLOODING OR INUNDATION BY
GROUND WATER OR SURFACE WATER
CALCULATIONS



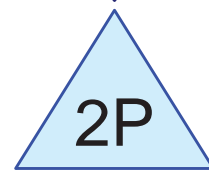
Lot 2 Isolated
Depression



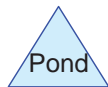
Lot 2 Depression



Lot 4 Isolated
Depression



Lot 4 Depression



HydroCAD for A Soil

Prepared by BSC Group

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Century Mill Road LSF Calculations
Type III 24-hr 100-YR Rainfall=7.00"

Printed 2/12/2021

Page 2

Summary for Subcatchment 1S: Lot 2 Isolated Depression

Runoff = 0.02 cfs @ 13.83 hrs, Volume= 0.010 af, Depth> 0.21"

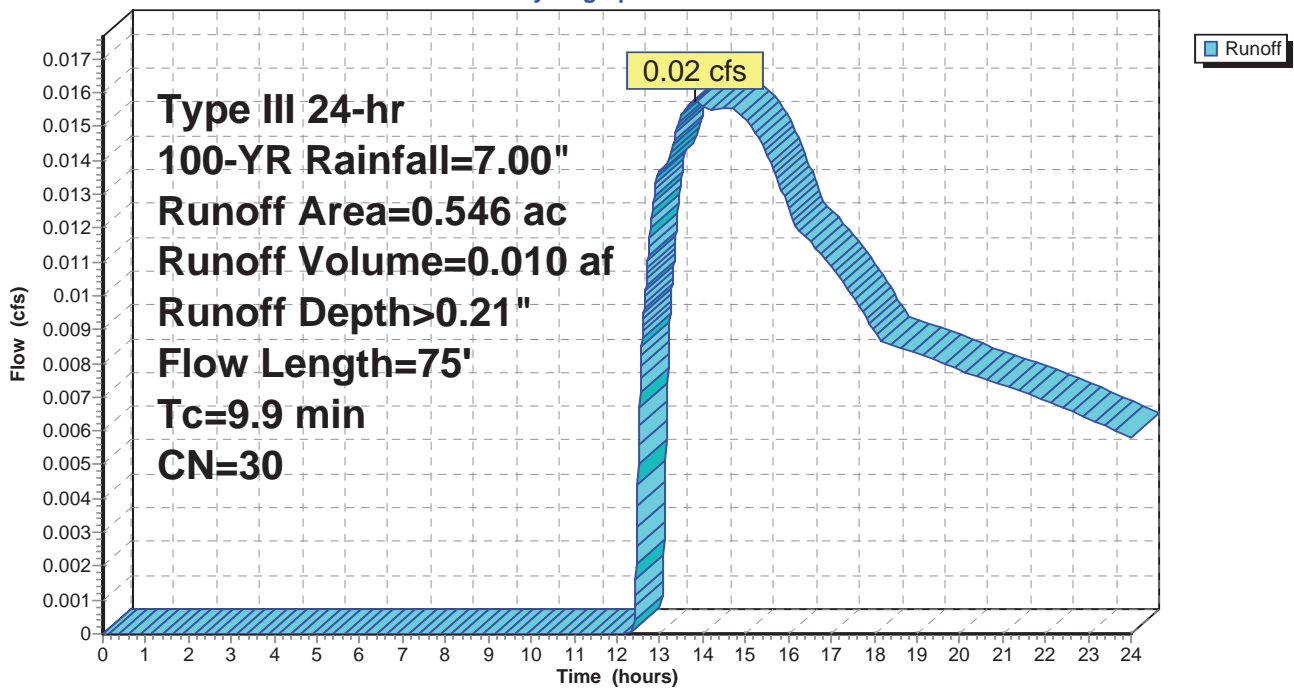
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-YR Rainfall=7.00"

Area (ac)	CN	Description
0.546	30	Woods, Good, HSG A
0.546		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.9	50	0.0350	0.08		Sheet Flow, Sheet Flow Woods: Light underbrush n= 0.400 P2= 3.20"
0.0	25	0.3000	8.82		Shallow Concentrated Flow, Shallow Concentrated Unpaved Kv= 16.1 fps
9.9	75	Total			

Subcatchment 1S: Lot 2 Isolated Depression

Hydrograph



HydroCAD for A Soil

Prepared by BSC Group

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Century Mill Road LSF Calculations
Type III 24-hr 100-YR Rainfall=7.00"

Printed 2/12/2021

Page 3

Summary for Subcatchment 2S: Lot 4 Isolated Depression

Runoff = 0.02 cfs @ 13.78 hrs, Volume= 0.010 af, Depth> 0.21"

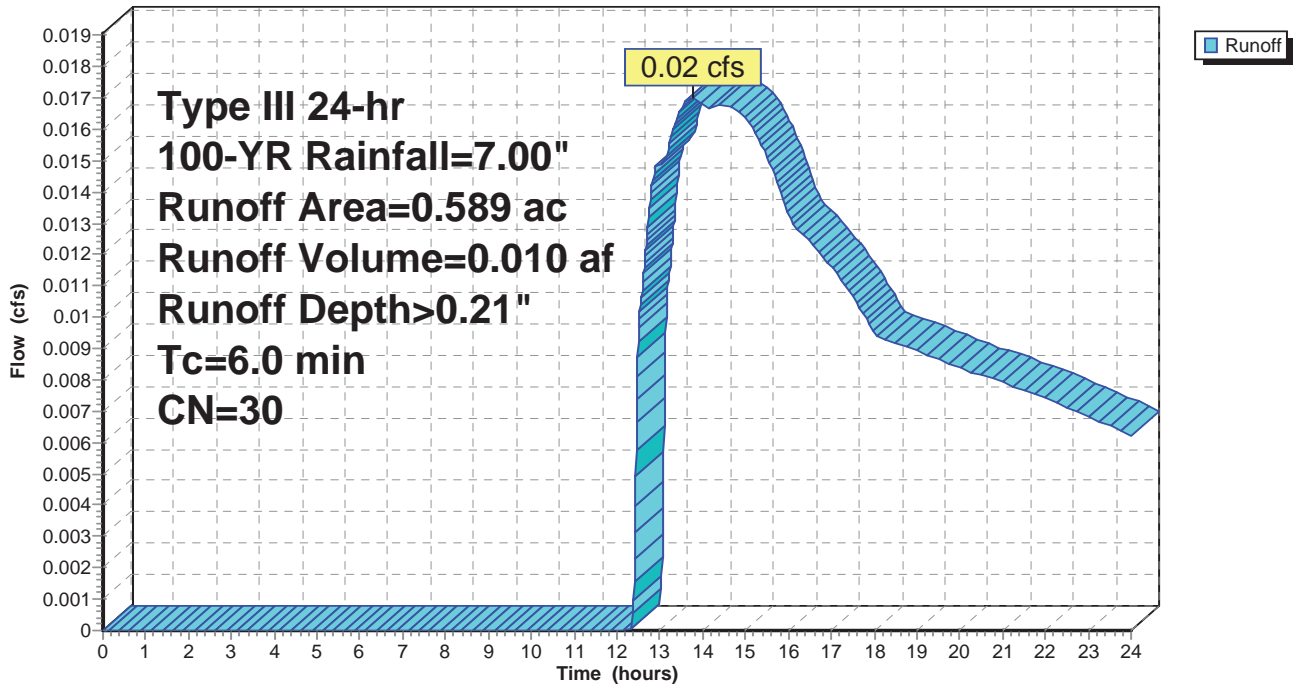
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-YR Rainfall=7.00"

Area (ac)	CN	Description
0.589	30	Woods, Good, HSG A
0.589		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					Direct Entry,

Subcatchment 2S: Lot 4 Isolated Depression

Hydrograph



HydroCAD for A Soil

Prepared by BSC Group

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Summary for Pond 1P: Lot 2 Depression

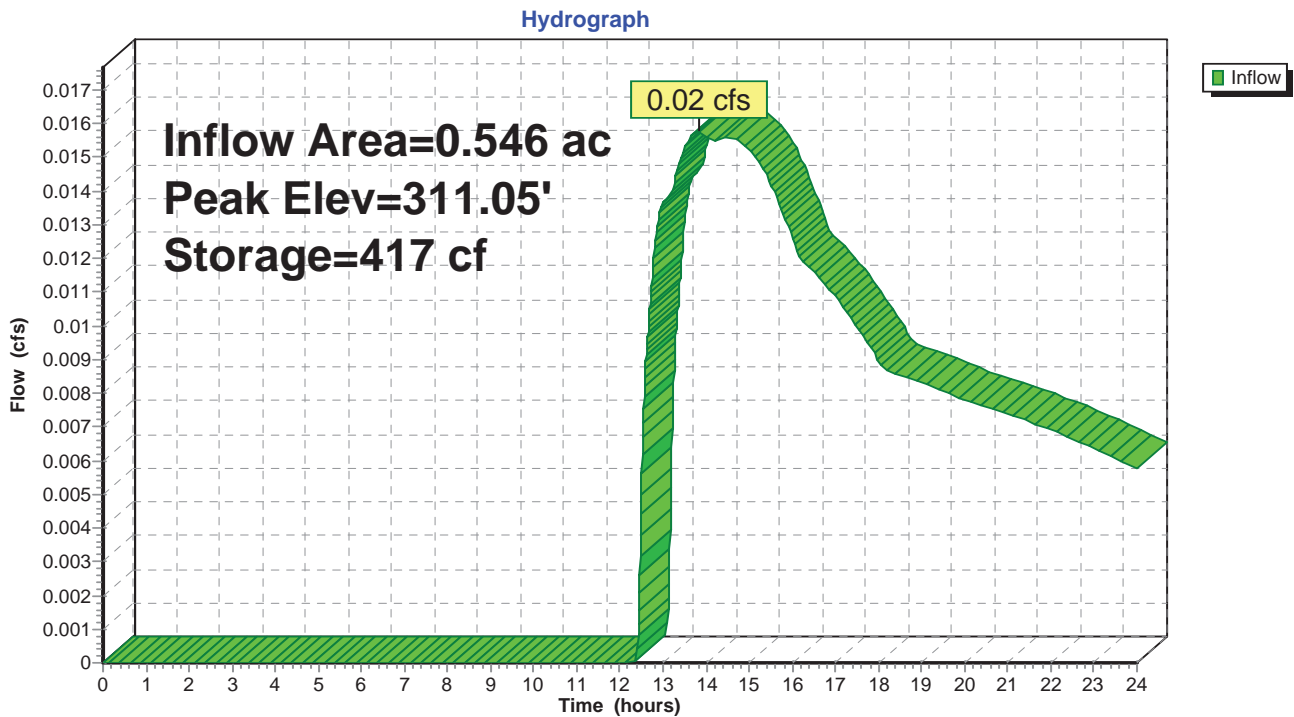
Inflow Area = 0.546 ac, 0.00% Impervious, Inflow Depth > 0.21" for 100-YR event
Inflow = 0.02 cfs @ 13.83 hrs, Volume= 0.010 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 311.05' @ 24.00 hrs Surf.Area= 8,386 sf Storage= 417 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description			
#1	311.00'	9,332 cf	Custom Stage Data (Irregular) Listed below (Recalc)			
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)	
311.00	8,285	585.0	0	0	8,285	
312.00	10,419	620.0	9,332	9,332	11,695	

Pond 1P: Lot 2 Depression



HydroCAD for A Soil

Prepared by BSC Group

HydroCAD® 10.00-22 s/n 00904 © 2018 HydroCAD Software Solutions LLC

Summary for Pond 2P: Lot 4 Depression

Inflow Area = 0.589 ac, 0.00% Impervious, Inflow Depth > 0.21" for 100-YR event
 Inflow = 0.02 cfs @ 13.78 hrs, Volume= 0.010 af
 Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min

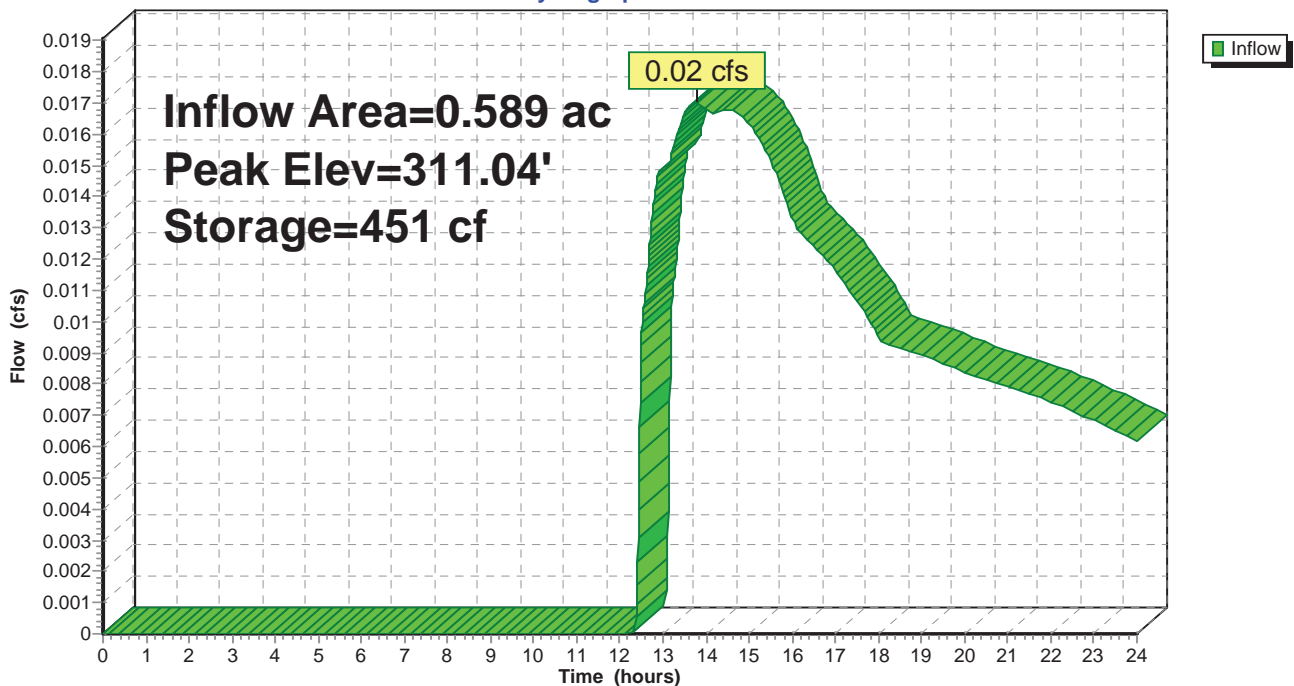
Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 311.04' @ 24.00 hrs Surf.Area= 11,710 sf Storage= 451 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
 Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description			
#1	311.00'	13,189 cf	Custom Stage Data (Irregular) Listed below (Recalc)			
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)	
311.00	11,591	634.0	0	0	11,591	
312.00	14,855	690.0	13,189	13,189	17,528	

Pond 2P: Lot 4 Depression

Hydrograph



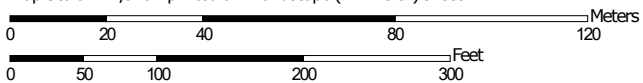


ATTACHMENT D
NRCS SOIL SURVEY MAP AND REPORT

Hydrologic Soil Group—Worcester County, Massachusetts, Northeastern Part
(Century Mill Road)



Map Scale: 1:1,570 if printed on A landscape (11" x 8.5") sheet.



Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 19N WGS84

MAP LEGEND

Area of Interest (AOI)









 Area of Interest (AOI)

Soils

Soil Rating Polygons





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

Soil Rating Lines


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

Soil Rating Points

 A
 A/D
 B
 B/D

 C
 C/D
 D
 Not rated or not available


Water Features

 Streams and Canals

Transportation

 Rails
 Interstate Highways
 US Routes
 Major Roads
 Local Roads

Background

 Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

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

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

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

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

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

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

Soil Survey Area: Worcester County, Massachusetts, Northeastern Part
 Survey Area Data: Version 15, Jun 10, 2020

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

Date(s) aerial images were photographed: Aug 12, 2019—Sep 29, 2019

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

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
6A	Scarboro mucky fine sandy loam, 0 to 3 percent slopes	A/D	1.3	16.8%
51A	Swansea muck, 0 to 1 percent slopes	B/D	0.0	0.0%
52A	Freetown muck, 0 to 1 percent slopes	B/D	0.3	3.6%
71A	Ridgebury fine sandy loam, 0 to 3 percent slopes, extremely stony	D	3.5	44.2%
102D	Chatfield-Hollis-Rock outcrop complex, 15 to 35 percent slopes	D	0.4	4.7%
245B	Hinckley loamy sand, 3 to 8 percent slopes	A	2.4	30.7%
Totals for Area of Interest			8.0	100.0%

Description

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

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

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

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

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

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

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

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher