



DRAINAGE ANALYSIS FOR
HOKUA PLACE
TMK (4) 4-3-003:001 (PORTION)

February 2021



EXECUTIVE SUMMARY

Hokua Place is a proposed subdivision located directly south of the Kapaʻa Middle School. The existing lot is currently vacant and covered in vegetation. The addition of single-family and multi-family residential units, roadways, parking lots, and a few commercial facilities will add impervious surfaces, and will therefore increase the amount of runoff generated from the property. The Hokua Place project is in the concept stages of planning, and the impervious surfaces used in this analysis are rough estimates. These will be revised in the design stages.

This report will describe the existing and proposed conditions of the site and estimate the quantities of runoff for the 2-year and 100-year frequency storms. The following table summarizes the estimated peak runoff rates given the estimated impervious surfaces in the proposed development. The values shown are the accumulated flow rates discharging offsite. Discharge points include Greenbelt 1/Unnamed Stream, Greenbelt 2, Greenbelt 3, Olohena Road, and Kapaʻa By-Pass Road.

Table A - Existing and Proposed Condition Summary			
Condition	Area (acres)	Q₂ (cfs)	Q₁₀₀ (cfs)
Existing	125.45	87.98	611.44
Proposed	91.49	267.53	961.07

To maintain the storm runoff rates for the 2-year and 100-year storms to the predevelopment rates, drainage systems that consist of catch basins, inlets, and drainlines will route storm water to detention basins proposed near the perimeters of the project site. These will detain storm water during rain events and slowly release it to the existing discharge points (existing streams and canal). They will also act in sediment control, allowing sediment in runoff to settle before being discharged offsite. The required sizes for the basins to maintain predevelopment runoff rates has been calculated in this report, but similar to the impervious surfaces, these are strictly estimates for planning purposes. The dimensions were determined due to anticipated site constraints and may be adjusted. Required basin sizes will be revised in the design stages. Estimated sizes from this analysis are shown in Table B.

Table B – Detention Basin Sizes		
Basin	Dimensions	Volume
Detention Basin 1	300' x 450' x 5'	675,000 cu ft
Detention Basin 2	100' x 500' x 12.5'	625,000 cu ft



PROJECT DESCRIPTION

Hokua Place (formerly known as Kapaa Highlands II) is a proposed subdivision in the Kawaihau District of Wailua, Kauai and will include a mixture of single-family and multi-family residential lots at market rate and affordable prices. The portion of the parcel designated for the subdivision is about 97 acres, with an anticipated 683 multi-family units and 86 single family lots. The project will also have open green spaces, a 3.1 acre park and community pool, and 1.4 acres for commercial use.

The following analysis will reference the “Preliminary Engineering Report, Drainage Improvements, Kapaa Highlands – Phase II” prepared by Honua Engineering, Inc. which was Exhibit F of the “HoKua Place Section 343-5e HRS Final Environmental Impact Statement (FEIS)” dated November 2019. This report will hereinafter be referred to as the *PER*. (Areas stated above were taken directly from the FEIS. Due to adjustments in layout and section boundaries since the finalization of the FEIS, areas used in this analysis will marginally differ.)

Existing Condition

The Hokua Place subdivision is bounded by Olohena Road to the north, Kapaa By-Pass Road to the south and east, and the Hokua Ag Lots to the west. The Hokua Ag Lots are another proposed project to be constructed prior to Hokua Place. The terrain generally slopes from Olohena Road at an approximate elevation of 114 ft MSL down to Kapaa By-Pass Road (~60 ft MSL) at about 5%. Some areas are steeper, with slopes up to 20%. The western greenbelt is approximately 120 ft MSL at its northernmost point and also slopes down towards Kapaa By-Pass Road.

An existing unnamed stream runs along the western greenbelt of the project. The unnamed stream merges with Kainahola Stream at the southwestern corner of the project. Kainahola Stream then discharges to Waika‘ea Canal, which discharges to the ocean. See Figure 1 for offsite flow paths.

Two existing gullies run from west to east on the eastern side of the project site. These gullies will remain as undeveloped greenbelts in the proposed condition.

Plotted: Tue, 22 Dec 2020 - 4:01pm By: MCHANG
File Name: H:\FY2020\20017.00 Hokuu Subdivision\10 Analysis & Permits\Drainage\Fig.1 - Hokuu Offsite Drainage Flow Path.dwg

LEGEND:

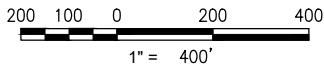
- PROPERTY LINE
- KAINAHOLA STREAM
- FLOW DIRECTION

NOTE:

STREAM LOCATION IS APPROXIMATE BASED ON LIDAR DATA AND AERIAL IMAGES.



GRAPHIC SCALE:



HOKUA PLACE OFFSITE DRAINAGE FLOW PATH

SCALE: 1" = 400'

Designed by: DY
Checked by: MF
Drawn by: DY
Approved by: WB
Date: DEC 2020
Scale: AS NOTED
T.M.K. 4-3-003-001

THIS WORK WAS PREPARED BY ME
OR UNDER MY SUPERVISION AND
CONSTRUCTION OF THIS PROJECT
WILL BE UNDER MY OBSERVATION.
4/20/22
EXPIRATION DATE OF THE LICENSE
SIGNATURE

HOKUA PLACE SUBDIVISION
Kapaa, Kaua'i, Hawai'i

OFFSITE DRAINAGE
FLOW PATH

Bow Engineering & Development, Inc.

CIVIL ENGINEERS



PLANNERS

1953 S. BERETANIA ST., SUITE PH-A
HONOLULU, HI 96826
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SYMBOL	DESCRIPTION	DATE

FIG. 1



Proposed Condition

To comply with the Department of Public Works, County of Kauai “Storm Water Runoff System Manual” dated July 2001 hereinafter referred to as the *County Drainage Standards*, a combination of catch basins, inlets, drainline systems, detention basins, and bioswales will be designed to capture runoff and maintain predevelopment flow rates and provide storm water quality control. See excerpts below from the County Drainage Standards:

“3.2.h. Where there are no downstream drainage systems and/or if the downstream drainage system does not have sufficient drainage capacity, the upstream owner shall install drainage facilities (such as detention basins) to maintain both the 2-year and 100-year storm flows at or below the predevelopment flow rates and conditions.”

3.3.f. Storm runoff detention is recommended to maintain storm runoff to peak predevelopment rates.”

The addition of roadways, homes, and commercial buildings will increase the impervious surface within Hokua Place and will therefore increase the runoff accumulating and discharging from the property. The PER provides locations for three detention basins to service the runoff of the subdivision.

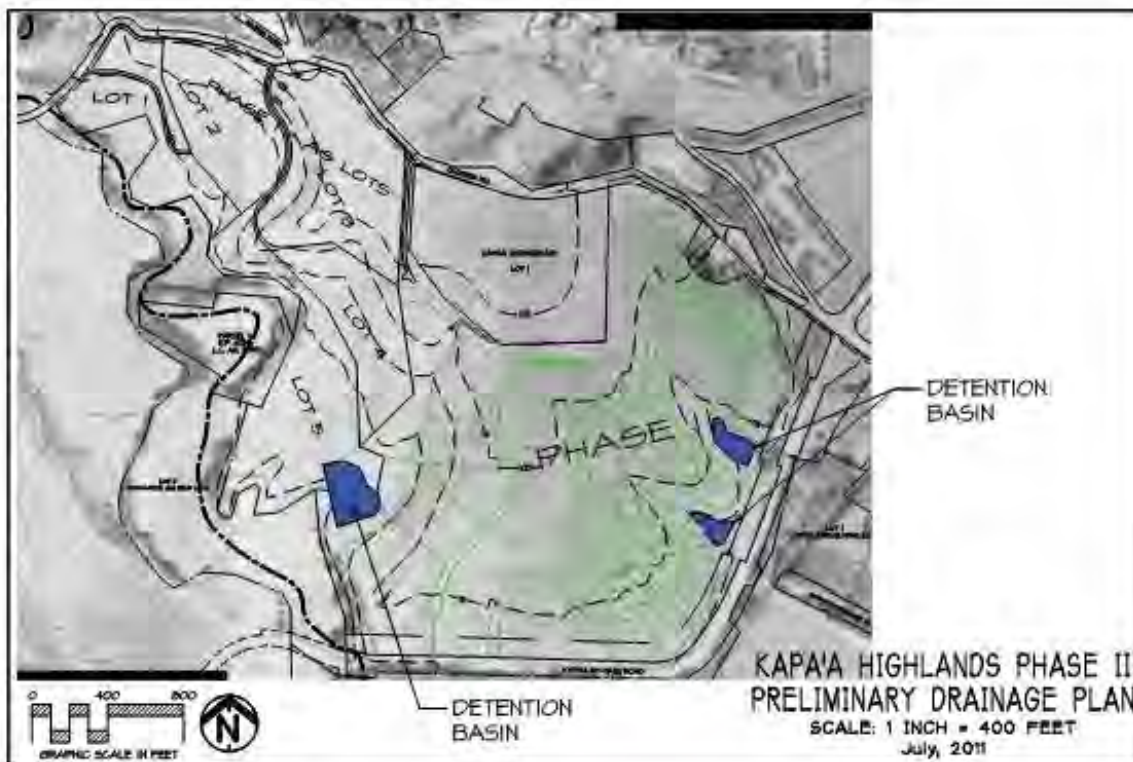


Figure 2 – Drainage Plan from PER

The lots shown in Figure 2 are outdated and were not used in the current drainage analysis.



HYDROLOGIC ANALYSIS

Existing Condition

The computer program HydroCAD® (by HydroCAD Software Solutions version 10.0) was used to model the storm water runoff quantities and discharge from the property for the existing and proposed conditions. HydroCAD utilizes the TR-20 method of calculating runoff. Since the lots and roadways have not yet been laid out in the proposed condition, this calculation will be a very rough estimate for planning purposes only.

Rainfall data was obtained from the National Ocean and Atmospheric Administration (NOAA) Atlas 14 Point Precipitation Frequency Estimates. See Attachment 1 for Rainfall Data. Table 1 summarizes the existing hydrologic calculations shown in Attachment 4. Per the County Drainage Standards, storms with 2-year and 100-year recurrence intervals were analyzed.

Basins were delineated based on their discharge points. Basin A discharges to the area labeled Greenbelt 1 in Figure 3, in which the unnamed stream mentioned previously flows. Basin B discharges to a gully in Greenbelt 3. Basin C sheet flows to the northern Olohena Road. Basin D discharges to a gully in Greenbelt 2. Basin E sheet flows south towards Kapaa By-Pass Road. Offsite areas, including Kapaa Middle School, were factored into these existing basins to analyze the capacities of the onsite unnamed stream and gullies. See Figure 3 for locations of existing basins and unnamed stream and gullies.

Table 1 – Existing Condition Hydrologic Summary				
Basin	Area (acres)	Q₂ (cfs)	Q₁₀₀ (cfs)	Discharge Point
A	27.28	36.46	213.29	Greenbelt 1/ Unnamed Stream
B	31.57	28.25	174.65	Greenbelt 3
C	11.47	7.97	51.60	Olohena Road
D	17.09	10.96	70.95	Greenbelt 2
E	38.04	4.34	100.95	Kapaa By-Pass Road
Total	125.45	87.98	611.44	

Proposed Condition

Figure 4 depicts the concept area designations for the single family, multi-family, commercial, park and greenbelt areas. Again, it is noted that the areas shown in the current figure are not the same as the areas shown in the EIS.

The greenbelt areas house the unnamed stream and two gullies. To determine the boundaries between the greenbelts and the residential areas (i.e. buildable area), sections were taken through



the unnamed stream and gullies and were analyzed using the existing flows in the corresponding basins (Basin A, Basin B and Basin D) for the 100-year storm. Sections to be analyzed were chosen based on which appeared to have the least capacity. The 100-year flood elevation was then determined. A four feet freeboard was also added as a safety measure. See Attachment 3 for analysis of sections through the unnamed stream and two gullies. See Table 2 for a summary of the section analysis.

Table 2 – Summary of Channel Sections					
Area	Q₁₀₀ (cfs)	Station	Longitudinal Slope (%)	Depth (ft)	Top Width of Flow (ft)
Greenbelt 1/ Unnamed Stream (Basin A)	213.29	2+00	5.6	1.62	27.78
		5+00	4.9	1.14	52.43
		6+00	4.9	1.77	29.45
		7+00	3.5	0.77	137.68
		9+00	6.8	1.46	84.46
		11+00	17.6	1.24	22.80
		14+00	22.3	0.38	81.16
Greenbelt 2/ Gully (Basin D)	70.95	1+00	4.9	0.64	45.72
		5+00	8.6	0.84	23.11
		8+00	5.9	0.63	48.82
		10+00	3.3	0.44	57.94
Greenbelt 3/ Gully (Basin B)	174.65	2+00	10.5	1.29	18.97
		4+00	7.3	1.32	22.91
		6+00	4.0	1.26	34.39
		8+00	3.0	1.45	46.91

It should be noted that Hokua Place will be split into two phases (Increment-I and Increment-II), but for master planning purposes, this drainage analysis was performed for the ultimate buildout of the development. Based on the current approximate boundaries for the single family and multi-family areas, the approximate areas in acres are shown in Table 3. The assumed impervious percentage of the areas was taken from Table 1 of the County Drainage Standards.

It is assumed that all runoff from each area (Single Family, Multi-Family, etc.) is routed to catch basins within its own area. Multiple areas may share a detention basin as their discharge points. It was also assumed that access roadways would take up 25% of the buildable area within the residential areas. These were considered to be 100% impervious in the table below.



Table 3 – Proposed Drainage Areas				
Type	Units	Total Area (acres)	Percent Impervious* (%)	Impervious Area (acres)
Multi-Family 1	683	29.31	50**	18.32
Multi-Family 2		17.09		10.68
Single Family 1	86	18.25	50**	11.41
Single Family 2		4.70		2.94
Greenbelt 1	N/A	6.14	0	0.00
Greenbelt 2		3.95		0.00
Greenbelt 3		4.04		0.00
Neighborhood Commercial	N/A	1.81	70	1.27
Park/Pool	N/A	2.46	7	0.17
Roadway 1	N/A	3.18	100	3.18
Roadway 2		0.56	100	0.56
Total		91.49***		48.53

*Refer to County Drainage Standards Table 1

**Only includes buildable area. Roadways are calculated as 100% impervious.

***Total Area does not include areas near the stream or adjacent roadways considered too steep to be buildable.

Table 4 – Proposed Condition Hydrologic Summary				
Basin	Area (acres)	Q ₂ (cfs)	Q ₁₀₀ (cfs)	Discharge Point
Multi-Family 1	29.31	94.65	311.96	Detention Basin 1
Multi-Family 2	17.09	55.19	181.90	Detention Basin 2
Single Family 1*	18.25	52.06	189.15	Detention Basin 2
Single Family 2	4.70	15.18	50.02	Detention Basin 2
Greenbelt 1	6.14	9.29	57.51	Unnamed Stream
Greenbelt 2	3.95	5.76	35.62	Detention Basin 2
Greenbelt 3	4.04	6.49	39.80	Detention Basin 2
Neighborhood Commercial	1.81	7.25	23.06	Roadway 2/ Detention Basin 2
Park/Pool	2.46	5.24	23.68	Roadway 1/ Detention Basin 1
Roadway 1	3.18	13.96	41.13	Detention Basin 1
Roadway 2	0.56	2.46	7.24	Detention Basin 2
Total	91.49	267.53	961.07	

*The area designated as Single Family 1 was analyzed using Soil Type B. All other areas are Soil Type C. See Attachment 2 for NRCS Web Soil Survey.



Values calculated in Table 4 are conservative. Due to the lack of lot and roadway layouts within the multi-family and single family areas at this time, the times of concentration used to calculate the discharge flows were conservative. Bioswales can be added during the design phase to lessen flow quantities.

Plotted: Wed, 23 Dec 2020 - 11:44am By: MCHANG
File Name: HNTY2020\20017.00 Hokuu Subdivision\0 Analysis & Permits\Drainage\Fig.3 - Hokuu Concept Existing Drainage Map.dwg

BASIN A
DISCHARGE TO GREENBELT 1
/UNNAMED STREAM
A=27.28 AC
Q₂=36.46 CFS
Q₁₀₀=213.29 CFS

BASIN B
DISCHARGE TO GREENBELT 3
A=31.57 AC
Q₂=28.25 CFS
Q₁₀₀=174.65 CFS

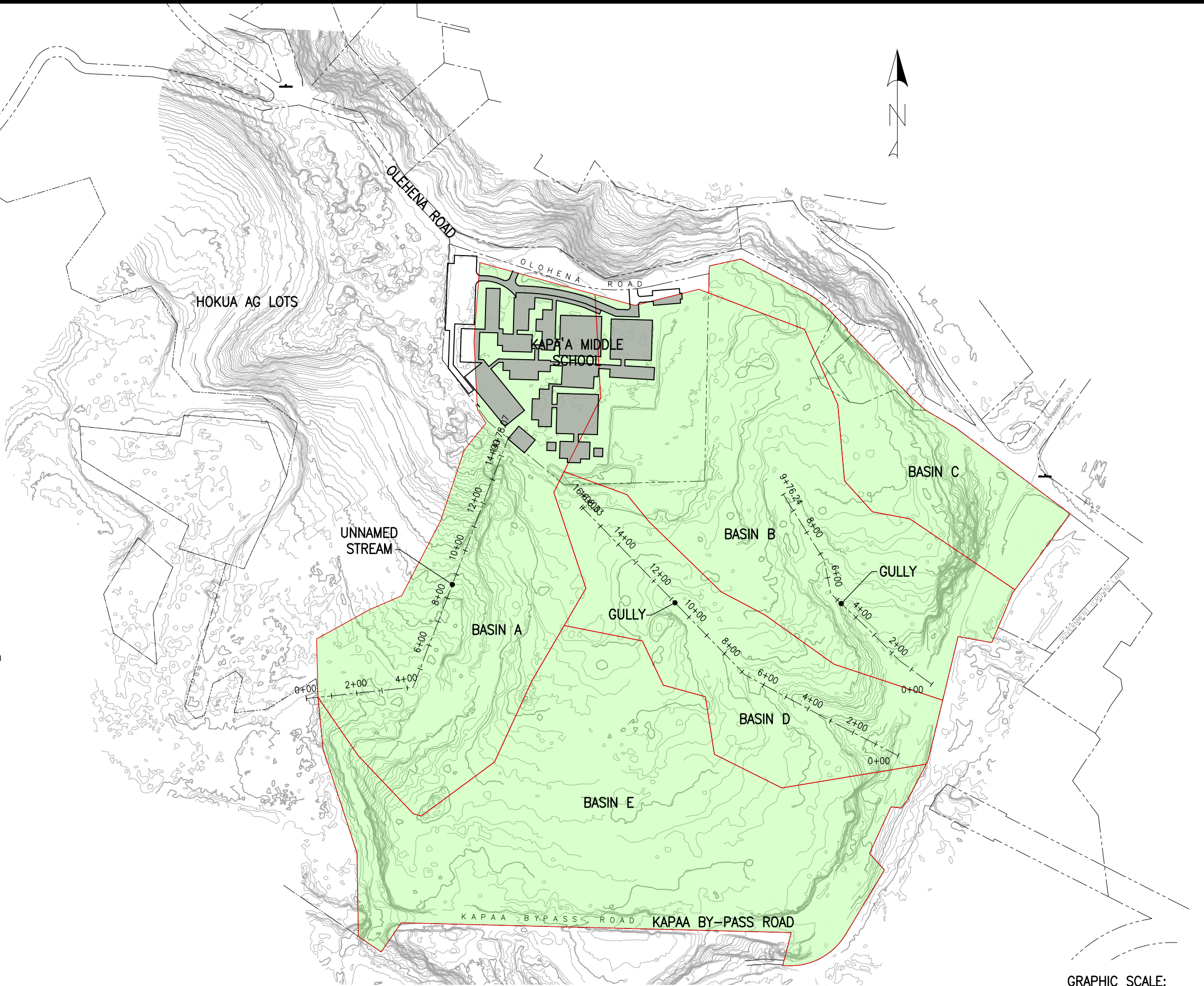
BASIN C
DISCHARGE TO OLOHENA ROAD
A=11.47 AC
Q₂=7.97 CFS
Q₁₀₀=51.60 CFS

BASIN D
DISCHARGE TO GREENBELT 2
A=17.09 AC
Q₂=10.96 CFS
Q₁₀₀=70.95 CFS

BASIN E
DISCHARGE TO KAPAA BYPASS-ROAD
A=38.04 AC
Q₂=4.34 CFS
Q₁₀₀=100.95 CFS

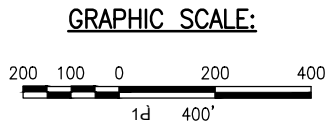
LEGEND:

- PROPERTY LINE
- PERVIOUS SURFACE
- IMPERVIOUS SURFACE



HOKUA PLACE CONCEPT EXISTING DRAINAGE MAP

SCALE: 1" = 400'



SYMBOL	DESCRIPTION	DATE

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HOKUA PLACE SUBDIVISION
Kapaa, Kaua'i, Hawai'i

CONCEPT EXISTING DRAINAGE MAP

Designed by: DY
Checked by: MF
Drawn by: DY
Approved by: WB
Date: DEC 2020
Scale: AS NOTED
T.M.K. 4-3-003-001

THIS WORK WAS PREPARED BY ME
OR UNDER MY SUPERVISION AND
CONSTRUCTION OF THIS PROJECT
WILL BE UNDER MY OBSERVATION.

4/29/22
EXPIRATION DATE OF THE LICENSE

SIGNATURE

FIG. 3



Detention Basins

To contain the generated runoff onsite to maintain the pre-development flow rates, detention basins are proposed. The locations of our proposed detention basins generally match that of the PER. However, we are proposing one large detention basin at the end of the two gullies and the detention basin serving Multi-family 1 is further south towards Kapaa By-Pass Road.

Table 5 – Detention Basin Summary			
Discharge Point	Contributing Basins	Q₂* (cfs)	Q₁₀₀* (cfs)
Unnamed Stream	Greenbelt 1	9.29	57.51
Detention Basin 1	Multi-Family 1 Park/Pool Roadway 1	105.79	353.57
Detention Basin 2	Multi-Family 2 Single Family 1 Single Family 2 Greenbelt 2 Greenbelt 3 Neighborhood Commercial Roadway 2	137.55	501.00

*Due to differences in times of concentration, the flows shown in Table 4 are not direct summations of the peak flows from each contributing basin, but were taken directly from HydroCAD.

The following analysis is not a direct comparison since the existing condition flows also include the offsite runoff from the middle school and the proposed condition flows do not. However, this is sufficient for concept planning purposes. In the existing condition, Basin B and D discharge to the bottom of the two gullies. The flows from these two existing basins will be compared to the proposed flows to Detention Basin 2. In the existing condition, Basin E discharges to Kapaa By-Pass Road. The flow from Basin E will be compared to the proposed flows to Detention Basin 1. The increase in flows between the existing and proposed conditions will then be used to determine the required size of the detention basins to maintain predevelopment flow rates. The 100-year storm was used for sizing.



Table 6 – Detention Basin Sizing					
Existing Condition		Proposed Condition		Net (cfs)	Required Basin Size
Basin	Q₁₀₀ (cfs)	Basin	Q₁₀₀ (cfs)		
E	100.95	Detention Basin 1	353.57	252.62	300'x450'x5' Volume = 675,000 cu ft
B, D	245.60	Detention Basin 2	501.00	255.40	100'x500'x12.5' Volume = 625,000 cu ft
Total	346.55	Total	854.57	508.02	1,300,000 cu ft

Based on the preliminary proposed flows shown in Table 5, Detention Basin 1 and 2 were sized. See Figure 4 for their proposed locations. The modeled discharge from Detention Basin 1 during a 100-year storm is 94.30 cfs and from Detention Basin 2 is 196.02 cfs, which are less than predevelopment flow rates.

The final sizes of the detention basins will be adjusted as the lots and roadway layouts and the drainage systems (i.e. catch basins, inlets, drainlines) are designed and finalized. The sizes shown in Table 6 are for planning purposes only. Detention Basin 1 and 2 were both modeled with a 100 ft long, 6-inch high weir and a 36-inch culvert outlet.

ATTACHMENTS

Attachment 1 – NOAA Point Precipitation Frequency Estimates

Attachment 2 – NRCS Web Soil Survey

Attachment 3 – Greenbelt Sections

Attachment 4 – HydroCAD Reports

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www.bowengineering.com



ATTACHMENT 1

NOAA POINT PRECIPITATION FREQUENCY ESTIMATES



NOAA Atlas 14, Volume 4, Version 3
Location name: Kapaa, Hawaii, USA*
Latitude: 22.0761°, Longitude: -159.3268°
Elevation: 104.78 ft**
* source: ESRI Maps
** source: USGS



POINT PRECIPITATION FREQUENCY ESTIMATES

S. Perica, D. Martin, B. Lin, T. Parzybok, D. Riley, M. Yekta, L. Hiner, L.-C. Chen, D. Brewer, F. Yan, K. Maitaria, C. Trypaluk, G. M. Bonnin

NOAA, National Weather Service, Silver Spring, Maryland

[PF_tabular](#) | [PF_graphical](#) | [Maps & aeriels](#)

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	0.409 (0.353-0.480)	0.538 (0.460-0.640)	0.726 (0.615-0.866)	0.878 (0.738-1.05)	1.09 (0.902-1.32)	1.26 (1.02-1.54)	1.45 (1.15-1.77)	1.65 (1.27-2.03)	1.92 (1.43-2.40)	2.15 (1.53-2.71)
10-min	0.607 (0.523-0.711)	0.798 (0.682-0.949)	1.08 (0.912-1.28)	1.30 (1.09-1.56)	1.62 (1.34-1.95)	1.88 (1.52-2.28)	2.15 (1.71-2.62)	2.44 (1.89-3.01)	2.85 (2.11-3.56)	3.19 (2.27-4.01)
15-min	0.762 (0.657-0.893)	1.00 (0.856-1.19)	1.35 (1.15-1.61)	1.64 (1.37-1.96)	2.03 (1.68-2.45)	2.36 (1.91-2.86)	2.70 (2.14-3.30)	3.06 (2.37-3.77)	3.58 (2.65-4.47)	4.00 (2.85-5.04)
30-min	1.07 (0.925-1.26)	1.41 (1.21-1.68)	1.90 (1.61-2.27)	2.30 (1.93-2.76)	2.86 (2.37-3.45)	3.32 (2.69-4.02)	3.80 (3.01-4.64)	4.31 (3.33-5.31)	5.04 (3.74-6.28)	5.63 (4.02-7.10)
60-min	1.41 (1.22-1.65)	1.86 (1.59-2.21)	2.51 (2.12-2.99)	3.03 (2.54-3.63)	3.77 (3.11-4.54)	4.36 (3.54-5.29)	4.99 (3.97-6.10)	5.67 (4.39-6.99)	6.63 (4.92-8.27)	7.41 (5.28-9.34)
2-hr	1.90 (1.63-2.22)	2.55 (2.18-3.02)	3.47 (2.94-4.14)	4.21 (3.54-5.04)	5.26 (4.34-6.34)	6.11 (4.95-7.41)	7.00 (5.56-8.55)	7.96 (6.15-9.80)	9.31 (6.89-11.6)	10.4 (7.43-13.1)
3-hr	2.19 (1.88-2.57)	2.97 (2.54-3.52)	4.07 (3.45-4.85)	4.96 (4.17-5.93)	6.23 (5.15-7.50)	7.26 (5.90-8.80)	8.35 (6.64-10.2)	9.53 (7.38-11.7)	11.2 (8.32-14.0)	12.6 (9.00-15.9)
6-hr	2.83 (2.40-3.34)	3.86 (3.30-4.59)	5.36 (4.54-6.39)	6.58 (5.53-7.88)	8.34 (6.89-10.1)	9.78 (7.94-11.9)	11.3 (8.99-13.8)	13.0 (10.0-16.0)	15.4 (11.4-19.2)	17.4 (12.4-21.9)
12-hr	3.43 (2.92-4.06)	4.70 (4.03-5.56)	6.53 (5.54-7.76)	8.03 (6.75-9.57)	10.2 (8.40-12.2)	11.9 (9.69-14.4)	13.8 (11.0-16.8)	15.8 (12.3-19.4)	18.7 (13.9-23.3)	21.1 (15.1-26.5)
24-hr	4.11 (3.51-4.82)	5.63 (4.83-6.63)	7.83 (6.69-9.25)	9.63 (8.20-11.4)	12.2 (10.3-14.5)	14.3 (12.0-17.1)	16.5 (13.8-19.9)	18.9 (15.6-22.9)	22.3 (18.2-27.3)	25.2 (20.3-31.0)
2-day	4.90 (4.26-5.66)	6.66 (5.79-7.71)	9.13 (7.90-10.6)	11.1 (9.57-12.9)	13.8 (11.8-16.1)	16.0 (13.6-18.8)	18.3 (15.4-21.5)	20.7 (17.3-24.5)	24.0 (19.7-28.8)	26.7 (21.6-32.2)
3-day	5.34 (4.66-6.15)	7.20 (6.28-8.29)	9.75 (8.48-11.3)	11.7 (10.2-13.6)	14.5 (12.5-16.8)	16.7 (14.2-19.4)	18.9 (16.0-22.2)	21.2 (17.8-25.0)	24.4 (20.1-29.1)	26.9 (21.9-32.3)
4-day	5.78 (5.07-6.63)	7.73 (6.77-8.88)	10.4 (9.05-11.9)	12.4 (10.8-14.3)	15.2 (13.1-17.6)	17.3 (14.9-20.1)	19.5 (16.6-22.8)	21.7 (18.3-25.5)	24.8 (20.5-29.4)	27.1 (22.2-32.4)
7-day	6.75 (5.92-7.74)	8.92 (7.81-10.2)	11.8 (10.3-13.6)	14.0 (12.2-16.1)	16.9 (14.6-19.5)	19.1 (16.4-22.2)	21.3 (18.1-24.9)	23.5 (19.8-27.6)	26.4 (21.8-31.2)	28.4 (23.2-33.9)
10-day	7.59 (6.65-8.70)	9.95 (8.71-11.4)	13.0 (11.4-15.0)	15.3 (13.3-17.7)	18.4 (15.9-21.2)	20.6 (17.7-23.9)	22.8 (19.4-26.6)	25.0 (21.0-29.4)	27.7 (23.0-32.9)	29.6 (24.2-35.4)
20-day	9.65 (8.46-11.1)	12.5 (10.9-14.3)	16.0 (14.0-18.5)	18.6 (16.2-21.5)	21.9 (19.0-25.4)	24.3 (20.9-28.3)	26.6 (22.6-31.1)	28.8 (24.3-33.9)	31.6 (26.2-37.4)	33.4 (27.4-39.9)
30-day	11.3 (9.89-13.0)	14.5 (12.6-16.6)	18.4 (16.1-21.2)	21.3 (18.5-24.5)	24.8 (21.4-28.7)	27.4 (23.5-31.8)	29.8 (25.3-34.8)	32.1 (27.0-37.7)	34.9 (29.0-41.4)	37.0 (30.3-44.2)
45-day	13.7 (12.0-15.7)	17.3 (15.2-19.9)	21.8 (19.1-25.1)	25.0 (21.8-28.9)	29.0 (25.0-33.5)	31.7 (27.2-36.9)	34.3 (29.2-40.1)	36.8 (31.0-43.2)	39.7 (33.0-47.1)	41.8 (34.2-50.0)
60-day	15.8 (13.8-18.1)	19.8 (17.3-22.7)	24.8 (21.7-28.5)	28.3 (24.6-32.6)	32.5 (28.1-37.6)	35.5 (30.5-41.3)	38.3 (32.6-44.7)	40.9 (34.4-48.0)	44.0 (36.5-52.2)	46.2 (37.8-55.2)
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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ATTACHMENT 2

NRCS WEB SOIL SURVEY



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 Island of Kauai, Hawaii



December 4, 2020

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://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/>) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (<https://offices.sc.egov.usda.gov/locator/app?agency=nrcs>) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

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 Web Soil Survey, the site for official soil survey information.

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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

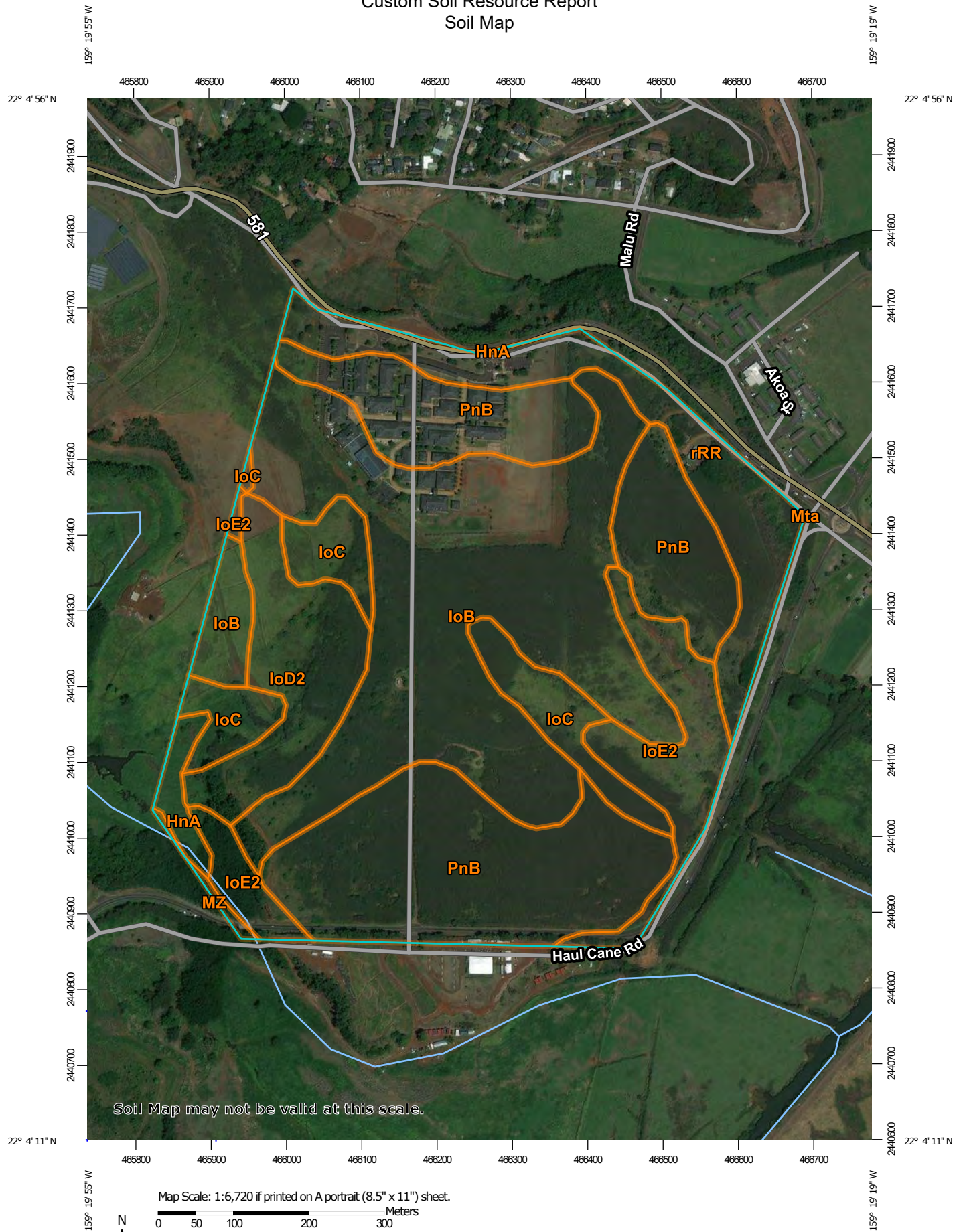
Custom Soil Resource Report

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



Soil Map may not be valid at this scale.

MAP LEGEND

Area of Interest (AOI)

 Area of Interest (AOI)

Soils

 Soil Map Unit Polygons

 Soil Map Unit Lines

 Soil Map Unit Points

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

Water Features

 Streams and Canals

Transportation

 Rails

 Interstate Highways

 US Routes

 Major Roads

 Local Roads

Background

 Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: Island of Kauai, Hawaii
Survey Area Data: Version 15, Jun 8, 2020

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

Date(s) aerial images were photographed: Dec 31, 2009—Mar 5, 2017

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

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
HnA	Hanalei silty clay, 0 to 2 percent slopes, MLRA 167	1.8	1.3%
IoB	Ioleau silty clay loam, 2 to 6 percent slopes	47.8	35.2%
IoC	Ioleau silty clay loam, 6 to 12 percent slopes	10.0	7.4%
IoD2	Ioleau silty clay loam, 12 to 20 percent slopes, eroded	11.0	8.1%
IoE2	Ioleau silty clay loam, 20 to 30 percent slopes, eroded	11.1	8.2%
Mta	Mokuleia clay loam, poorly drained variant	0.0	0.0%
MZ	Marsh	0.4	0.3%
PnB	Puhi silty clay loam, 3 to 8 percent slopes	40.1	29.5%
rRR	Rough broken land	13.7	10.1%
Totals for Area of Interest		135.9	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.

Island of Kauai, Hawaii

HnA—Hanalei silty clay, 0 to 2 percent slopes, MLRA 167

Map Unit Setting

National map unit symbol: 2w02x

Elevation: 0 to 300 feet

Mean annual precipitation: 20 to 120 inches

Mean annual air temperature: 72 to 73 degrees F

Frost-free period: 365 days

Farmland classification: Prime farmland if protected from flooding or not frequently flooded during the growing season

Map Unit Composition

Hanalei and similar soils: 85 percent

Minor components: 15 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Hanalei

Setting

Landform: Flood plains on valley floors

Landform position (two-dimensional): Toeslope

Landform position (three-dimensional): Tread, dip

Down-slope shape: Linear

Across-slope shape: Concave, linear

Parent material: Alluvium derived from basalt

Typical profile

Apg - 0 to 6 inches: silty clay

Ag1 - 6 to 10 inches: silty clay

Ag2 - 10 to 13 inches: silty clay

Bg1 - 13 to 18 inches: silty clay loam

Bg2 - 18 to 26 inches: silty clay loam

Cg - 26 to 36 inches: silty clay loam

Properties and qualities

Slope: 0 to 2 percent

Depth to restrictive feature: More than 80 inches

Drainage class: Poorly drained

Runoff class: Negligible

Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high
(0.20 to 1.98 in/hr)

Depth to water table: About 24 to 60 inches

Frequency of flooding: Frequent

Frequency of ponding: Occasional

Sodium adsorption ratio, maximum: 5.0

Available water capacity: Moderate (about 6.7 inches)

Interpretive groups

Land capability classification (irrigated): 2w

Land capability classification (nonirrigated): 2w

Hydrologic Soil Group: B

Ecological site: F164XY500HI - Volcanic Ash Forest

Hydric soil rating: No

Minor Components

Hanalei, ponded

Percent of map unit: 15 percent
Landform: Flood plains on valley floors
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread, dip
Down-slope shape: Linear
Across-slope shape: Concave, linear
Ecological site: F164XY500HI - Volcanic Ash Forest
Hydric soil rating: Yes

loB—loleau silty clay loam, 2 to 6 percent slopes

Map Unit Setting

National map unit symbol: hpt0
Elevation: 100 to 750 feet
Mean annual precipitation: 40 to 70 inches
Mean annual air temperature: 72 to 73 degrees F
Frost-free period: 365 days
Farmland classification: All areas are prime farmland

Map Unit Composition

loleau and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of loleau

Setting

Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Basic igneous rock

Typical profile

H1 - 0 to 15 inches: silty clay loam
H2 - 15 to 61 inches: silty clay

Properties and qualities

Slope: 2 to 6 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Moderate (about 7.8 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C
Hydric soil rating: No

loC—loleau silty clay loam, 6 to 12 percent slopes

Map Unit Setting

National map unit symbol: hpt1
Elevation: 100 to 750 feet
Mean annual precipitation: 40 to 70 inches
Mean annual air temperature: 72 to 73 degrees F
Frost-free period: 365 days
Farmland classification: All areas are prime farmland

Map Unit Composition

loleau and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of loleau

Setting

Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Basic igneous rock

Typical profile

H1 - 0 to 15 inches: silty clay loam
H2 - 15 to 61 inches: silty clay

Properties and qualities

Slope: 6 to 12 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Moderate (about 7.8 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Hydric soil rating: No

loD2—loleau silty clay loam, 12 to 20 percent slopes, eroded

Map Unit Setting

National map unit symbol: hpt2

Elevation: 100 to 750 feet

Mean annual precipitation: 40 to 70 inches

Mean annual air temperature: 72 to 73 degrees F

Frost-free period: 365 days

Farmland classification: Not prime farmland

Map Unit Composition

loleau and similar soils: 100 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of loleau

Setting

Landform position (two-dimensional): Shoulder

Landform position (three-dimensional): Interfluve

Down-slope shape: Linear

Across-slope shape: Convex

Parent material: Basic igneous rock

Typical profile

H1 - 0 to 3 inches: silty clay loam

H2 - 3 to 60 inches: silty clay

Properties and qualities

Slope: 12 to 20 percent

Depth to restrictive feature: More than 80 inches

Drainage class: Well drained

Runoff class: Medium

Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.60 in/hr)

Depth to water table: More than 80 inches

Frequency of flooding: None

Frequency of ponding: None

Available water capacity: Moderate (about 7.8 inches)

Interpretive groups

Land capability classification (irrigated): 4e

Land capability classification (nonirrigated): 4e

Hydrologic Soil Group: C

Hydric soil rating: No

loE2—loleau silty clay loam, 20 to 30 percent slopes, eroded

Map Unit Setting

National map unit symbol: hpt3

Elevation: 100 to 750 feet

Mean annual precipitation: 40 to 70 inches

Mean annual air temperature: 72 to 73 degrees F

Frost-free period: 365 days

Farmland classification: Not prime farmland

Map Unit Composition

loleau and similar soils: 100 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of loleau

Setting

Landform position (two-dimensional): Shoulder

Landform position (three-dimensional): Interfluve

Down-slope shape: Linear

Across-slope shape: Convex

Parent material: Basic igneous rock

Typical profile

H1 - 0 to 3 inches: silty clay loam

H2 - 3 to 60 inches: silty clay

Properties and qualities

Slope: 20 to 30 percent

Depth to restrictive feature: More than 80 inches

Drainage class: Well drained

Runoff class: High

Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.60 in/hr)

Depth to water table: More than 80 inches

Frequency of flooding: None

Frequency of ponding: None

Available water capacity: Moderate (about 7.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 6e

Hydrologic Soil Group: C

Hydric soil rating: No

Mta—Mokuleia clay loam, poorly drained variant

Map Unit Setting

National map unit symbol: hpw3

Elevation: 0 to 20 feet

Mean annual precipitation: 40 to 80 inches

Mean annual air temperature: 72 to 75 degrees F

Frost-free period: 365 days

Farmland classification: Not prime farmland

Map Unit Composition

Mokuleia variant and similar soils: 85 percent

Minor components: 15 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Mokuleia Variant

Setting

Landform: Coastal plains

Landform position (three-dimensional): Tread, rise

Down-slope shape: Linear

Across-slope shape: Concave

Parent material: Alluvium

Typical profile

H1 - 0 to 16 inches: clay loam

H2 - 16 to 50 inches: loamy sand

Properties and qualities

Slope: 0 to 2 percent

Depth to restrictive feature: More than 80 inches

Drainage class: Poorly drained

Runoff class: Negligible

Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high
(0.60 to 1.98 in/hr)

Depth to water table: About 36 to 60 inches

Frequency of flooding: RareOccasional

Frequency of ponding: Occasional

Calcium carbonate, maximum content: 99 percent

Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)

Available water capacity: Low (about 4.6 inches)

Interpretive groups

Land capability classification (irrigated): 3w

Land capability classification (nonirrigated): 3w

Hydrologic Soil Group: B

Hydric soil rating: No

Minor Components

Inclusion

Percent of map unit: 15 percent

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Landform: Coastal plains
Landform position (three-dimensional): Tread, rise
Down-slope shape: Linear
Across-slope shape: Concave
Hydric soil rating: Yes

MZ—Marsh

Map Unit Setting

National map unit symbol: hpvg
Elevation: 0 to 800 feet
Mean annual precipitation: 12 to 150 inches
Mean annual air temperature: 72 to 75 degrees F
Frost-free period: 365 days
Farmland classification: Not prime farmland

Map Unit Composition

Marsh and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Marsh

Setting

Landform: Marshes
Landform position (three-dimensional): Talf
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Organic

Typical profile

Oe1 - 0 to 10 inches: mucky peat
Oe2 - 10 to 60 inches: mucky peat

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high
(0.06 to 5.95 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: Frequent
Frequency of ponding: Frequent
Maximum salinity: Nonsaline to strongly saline (0.0 to 16.0 mmhos/cm)
Available water capacity: Very high (about 16.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8w
Hydrologic Soil Group: A/D
Hydric soil rating: Yes

PnB—Puhi silty clay loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: hpww
Elevation: 170 to 500 feet
Mean annual precipitation: 60 to 80 inches
Mean annual air temperature: 72 to 73 degrees F
Frost-free period: 365 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Puhi and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Puhi

Setting

Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Interfluve, rise
Down-slope shape: Linear
Across-slope shape: Concave
Parent material: Basic igneous rock

Typical profile

H1 - 0 to 12 inches: silty clay loam
H2 - 12 to 60 inches: silty clay loam

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high
(0.20 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Sodium adsorption ratio, maximum: 5.0
Available water capacity: Moderate (about 6.6 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: B
Hydric soil rating: No

rRR—Rough broken land

Map Unit Setting

National map unit symbol: hpxd
Elevation: 0 to 4,000 feet
Mean annual precipitation: 20 to 200 inches
Mean annual air temperature: 61 to 73 degrees F
Frost-free period: 365 days
Farmland classification: Not prime farmland

Map Unit Composition

Rough broken land and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Rough Broken Land

Setting

Landform: Gulches
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Mountainflank, side slope, rise
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Alluvium and colluvium

Typical profile

H1 - 0 to 8 inches: silty clay loam
H2 - 8 to 30 inches: silty clay
H3 - 30 to 60 inches: bedrock

Properties and qualities

Slope: 40 to 70 percent
Depth to restrictive feature: 20 to 55 inches to paralithic bedrock
Drainage class: Well drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Low to moderately low
(0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 4.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: C
Hydric soil rating: No

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ATTACHMENT 3

GREENBELT SECTIONS

Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc.

Thursday, Dec 17 2020

Greenbelt 1, Sta. 2+00, 100 yr

User-defined

Invert Elev (ft) = 26.00
Slope (%) = 5.60
N-Value = 0.050

Calculations

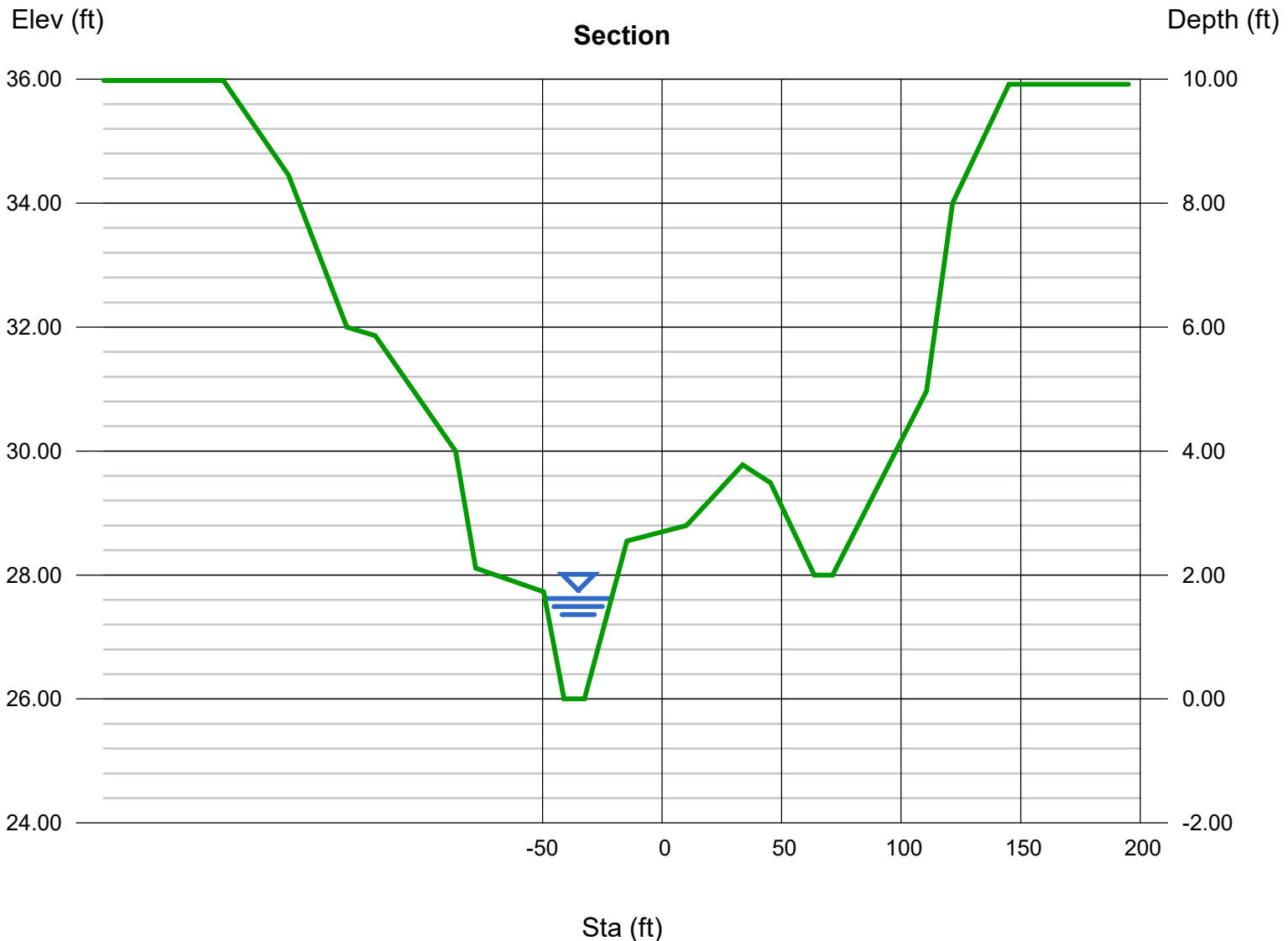
Compute by: Known Q
Known Q (cfs) = 213.29

Highlighted

Depth (ft) = 1.62
Q (cfs) = 213.29
Area (sqft) = 29.42
Velocity (ft/s) = 7.25
Wetted Perim (ft) = 28.06
Crit Depth, Yc (ft) = 1.94
Top Width (ft) = 27.78
EGL (ft) = 2.44

(Sta, El, n)-(Sta, El, n)...

(-183.48, 35.98)-(10.25, 28.80, 0.050)-(33.65, 29.78, 0.050)-(45.38, 29.49, 0.050)-(63.71, 28.00, 0.050)-(71.35, 28.00, 0.050)-(110.67, 30.97, 0.050)
-(121.56, 34.00, 0.050)-(145.11, 35.92, 0.050)



Channel Report

Greenbelt 1, Sta. 5+00, 100 yr

User-defined

Invert Elev (ft) = 38.49
Slope (%) = 4.90
N-Value = 0.050

Calculations

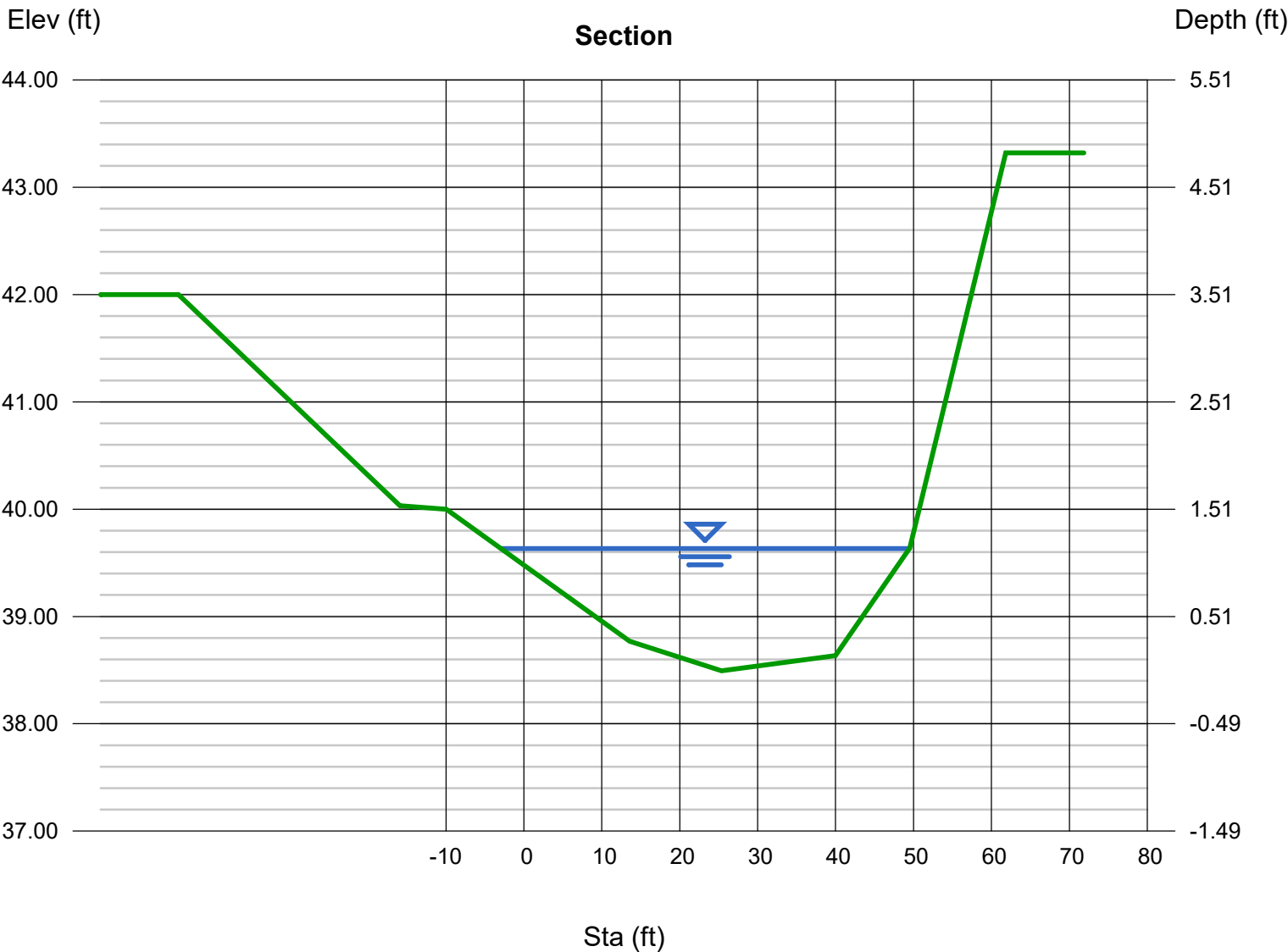
Compute by: Known Q
Known Q (cfs) = 213.29

Highlighted

Depth (ft) = 1.14
Q (cfs) = 213.29
Area (sqft) = 39.36
Velocity (ft/s) = 5.42
Wetted Perim (ft) = 52.51
Crit Depth, Yc (ft) = 1.20
Top Width (ft) = 52.43
EGL (ft) = 1.60

(Sta, El, n)-(Sta, El, n)...

(-44.32, 42.00)-(13.59, 38.77, 0.050)-(25.38, 38.49, 0.050)-(40.00, 38.64, 0.050)-(49.52, 39.64, 0.050)-(61.85, 43.32, 0.050)



Channel Report

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Thursday, Dec 17 2020

Greenbelt 1, Sta. 6+00, 100 yr

User-defined

Invert Elev (ft) = 40.00
Slope (%) = 4.90
N-Value = 0.050

Calculations

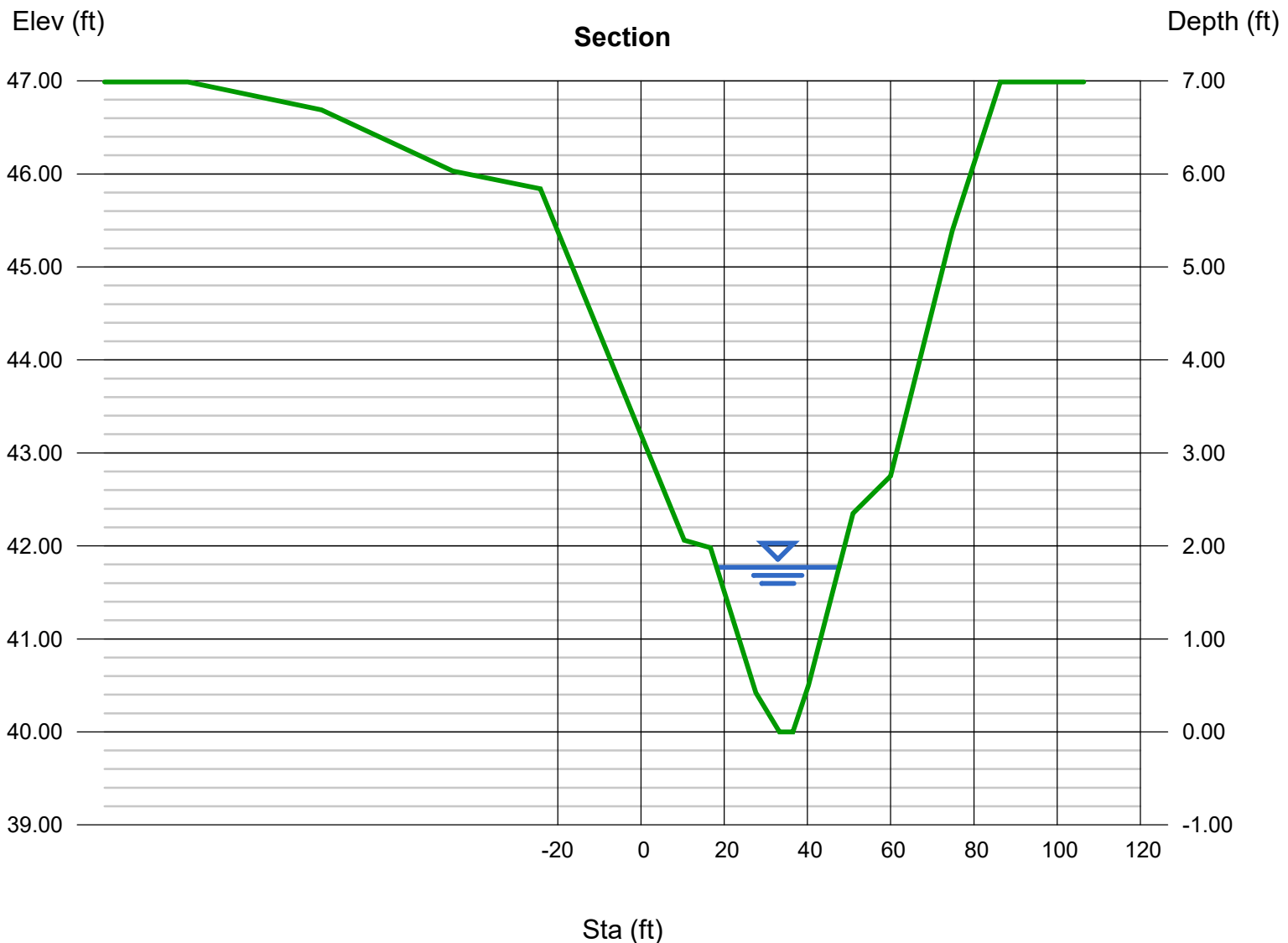
Compute by: Known Q
Known Q (cfs) = 213.29

Highlighted

Depth (ft) = 1.77
Q (cfs) = 213.29
Area (sqft) = 31.34
Velocity (ft/s) = 6.80
Wetted Perim (ft) = 29.70
Crit Depth, Yc (ft) = 1.91
Top Width (ft) = 29.45
EGL (ft) = 2.49

(Sta, El, n)-(Sta, El, n)...

(-108.88, 46.99)-(10.40, 42.06, 0.050)-(16.70, 41.98, 0.050)-(27.58, 40.42, 0.050)-(33.26, 40.00, 0.050)-(36.49, 40.00, 0.050)-(40.27, 40.50, 0.050)
-(50.97, 42.35, 0.050)-(60.00, 42.75, 0.050)-(74.82, 45.39, 0.050)-(86.37, 46.99, 0.050)



Channel Report

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Thursday, Dec 17 2020

Greenbelt 1, Sta. 7+00, 100 yr

User-defined

Invert Elev (ft) = 49.47
Slope (%) = 3.50
N-Value = 0.050

Calculations

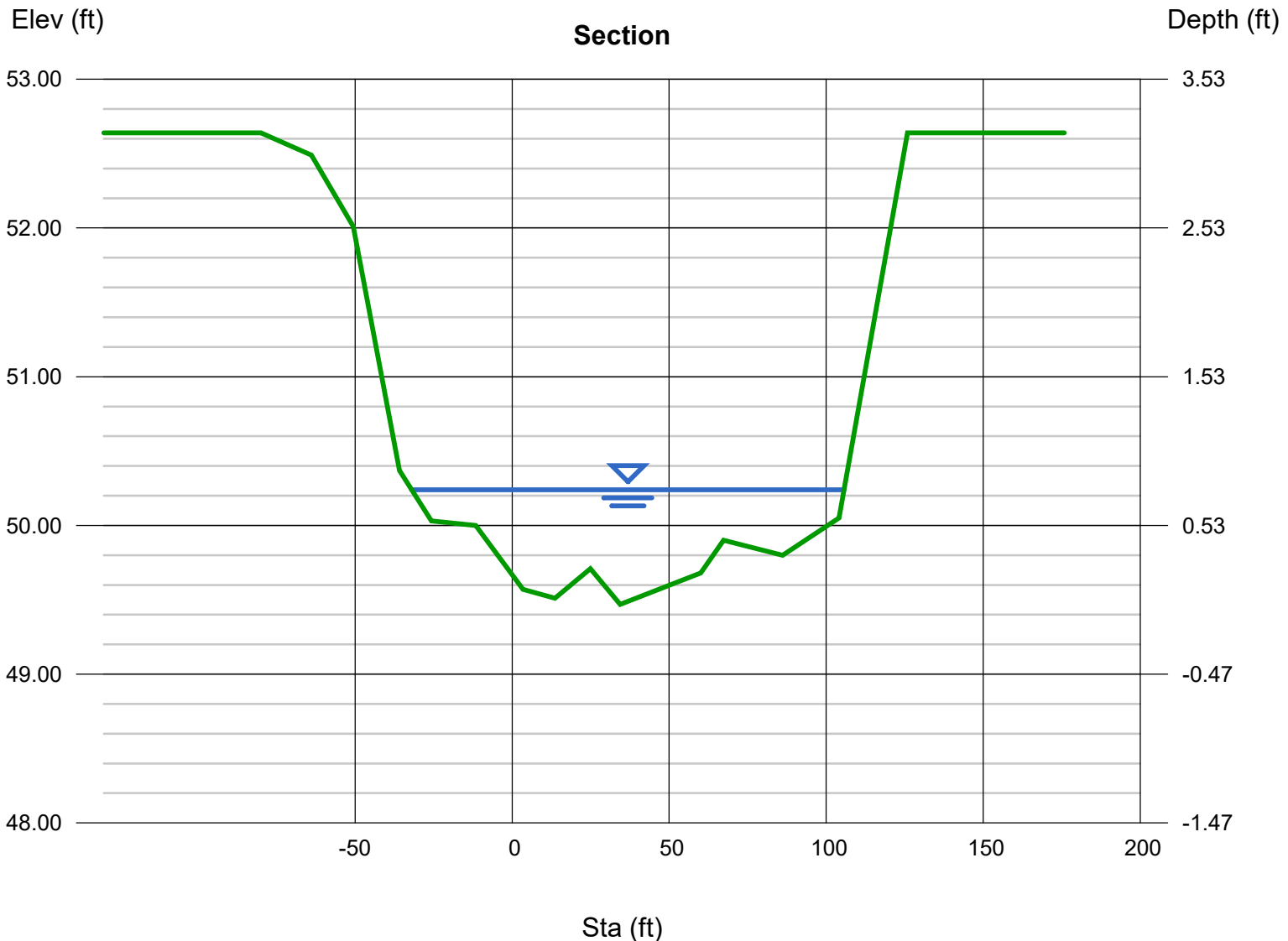
Compute by: Known Q
Known Q (cfs) = 213.29

Highlighted

Depth (ft) = 0.77
Q (cfs) = 213.29
Area (sqft) = 64.55
Velocity (ft/s) = 3.30
Wetted Perim (ft) = 137.71
Crit Depth, Yc (ft) = 0.72
Top Width (ft) = 137.68
EGL (ft) = 0.94

(Sta, El, n)-(Sta, El, n)...

(-80.00, 52.64)-(3.46, 49.57, 0.050)-(13.65, 49.51, 0.050)-(24.91, 49.71, 0.050)-(34.43, 49.47, 0.050)-(60.03, 49.68, 0.050)-(67.31, 49.90, 0.050)
-(86.13, 49.80, 0.050)-(104.09, 50.05, 0.050)-(125.85, 52.64, 0.050)



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc.

Thursday, Dec 17 2020

Greenbelt 1, Sta. 9+00, 100 yr

User-defined

Invert Elev (ft) = 59.10
Slope (%) = 6.80
N-Value = 0.050

Calculations

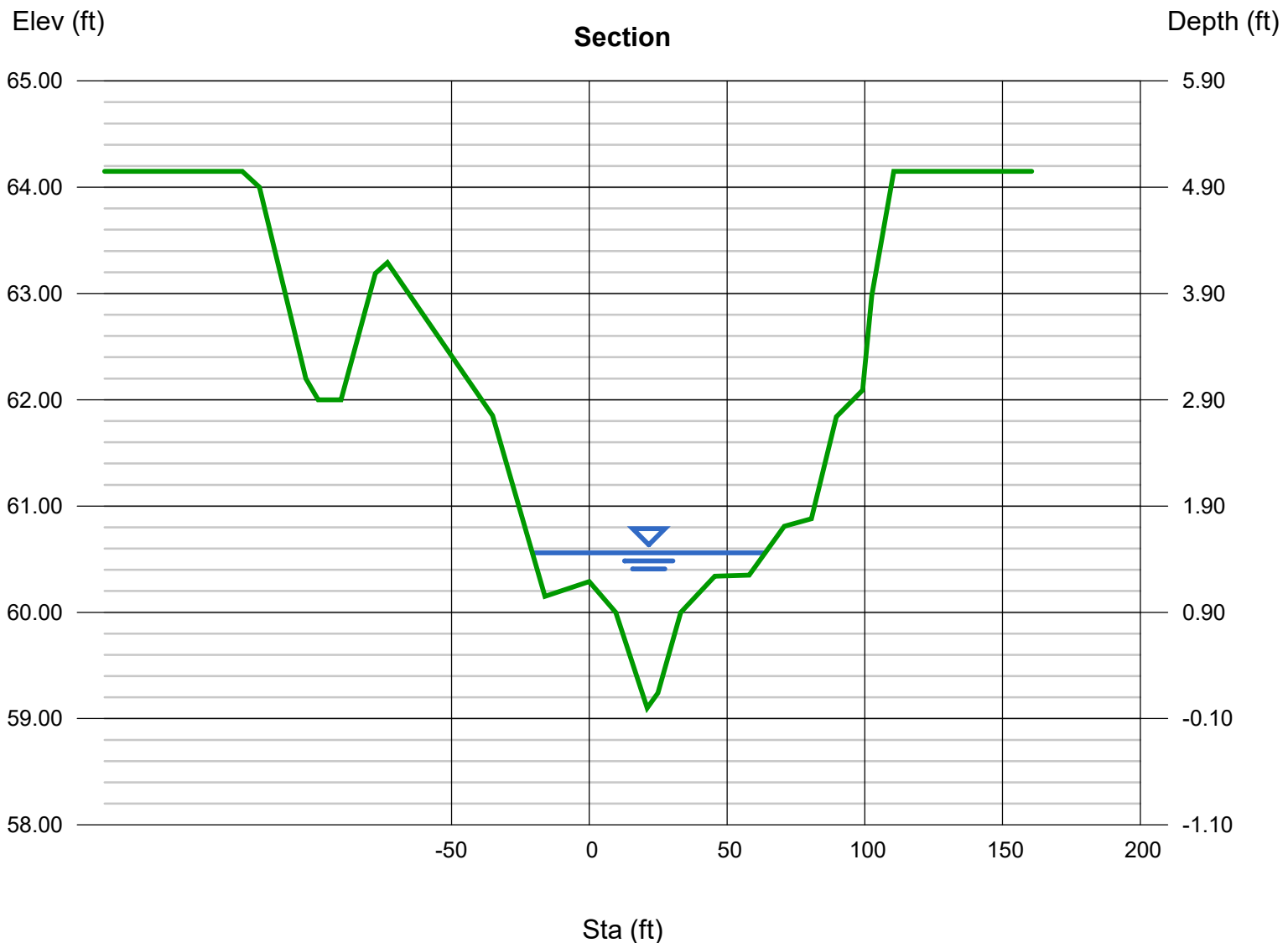
Compute by: Known Q
Known Q (cfs) = 213.29

Highlighted

Depth (ft) = 1.46
Q (cfs) = 213.29
Area (sqft) = 43.18
Velocity (ft/s) = 4.94
Wetted Perim (ft) = 84.56
Crit Depth, Yc (ft) = 1.54
Top Width (ft) = 84.46
EGL (ft) = 1.84

(Sta, El, n)-(Sta, El, n)...

(-125.90, 64.15)-(9.61, 60.00, 0.050)-(21.04, 59.10, 0.050)-(24.88, 59.24, 0.050)-(33.16, 60.00, 0.050)-(45.59, 60.34, 0.050)-(57.98, 60.35, 0.050)
-(70.76, 60.81, 0.050)-(80.58, 60.88, 0.050)-(89.66, 61.84, 0.050)-(99.20, 62.09, 0.050)-(102.53, 62.98, 0.050)-(110.54, 64.15, 0.050)



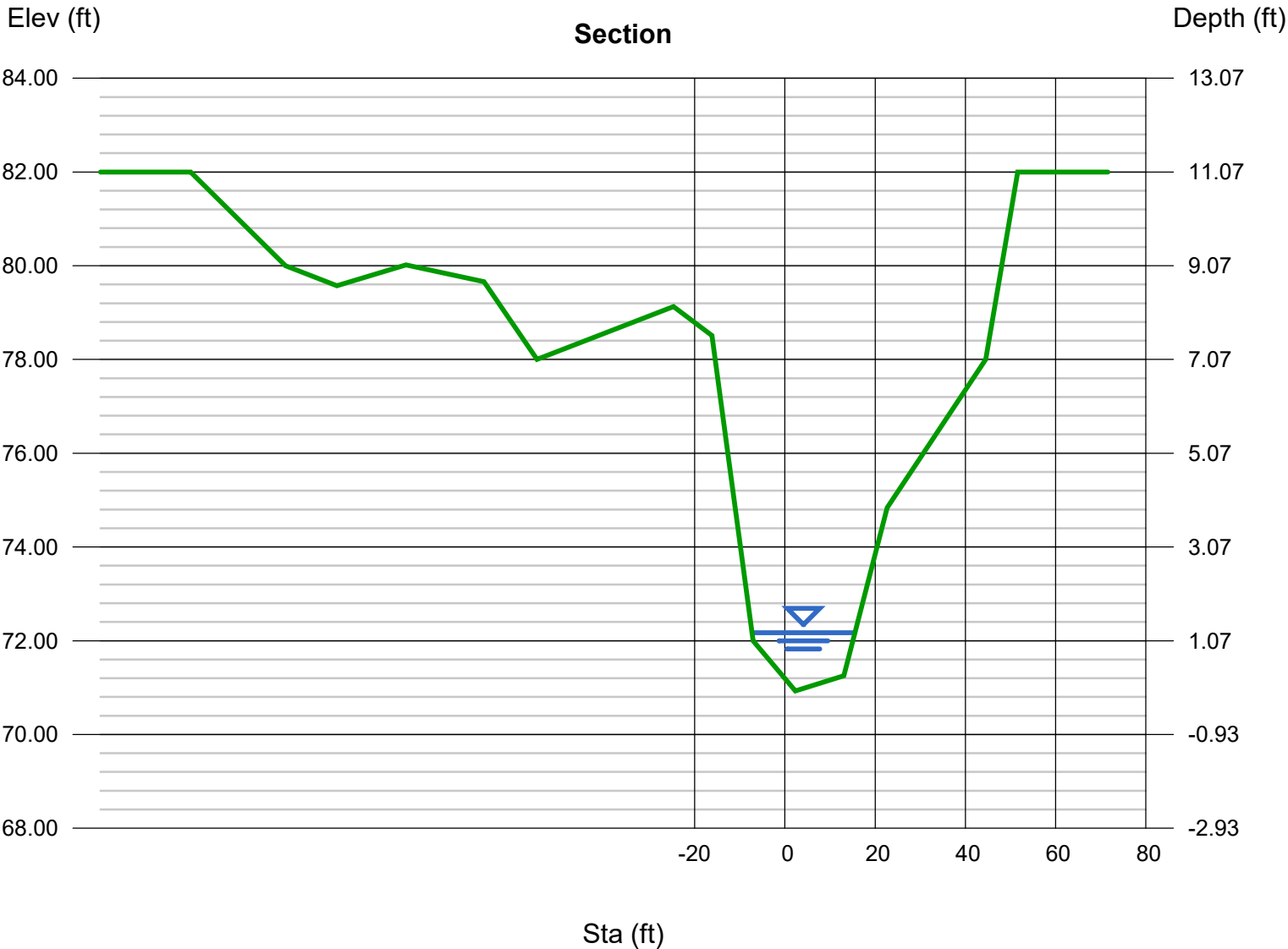
Channel Report

Greenbelt 1, Sta. 11+00, 100 yr

User-defined		Highlighted	
Invert Elev (ft)	= 70.93	Depth (ft)	= 1.24
Slope (%)	= 17.60	Q (cfs)	= 213.29
N-Value	= 0.050	Area (sqft)	= 19.36
		Velocity (ft/s)	= 11.02
		Wetted Perim (ft)	= 23.09
		Crit Depth, Yc (ft)	= 1.81
		Top Width (ft)	= 22.80
		EGL (ft)	= 3.13

(Sta, El, n)-(Sta, El, n)...

(-131.75, 82.00)-(2.29, 70.93, 0.050)-(13.05, 71.25, 0.050)-(22.64, 74.84, 0.050)-(44.54, 78.00, 0.050)-(51.62, 82.00, 0.050)



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc.

Thursday, Dec 17 2020

Greenbelt 1, Sta. 14+00, 100 yr

User-defined

Invert Elev (ft) = 110.00
Slope (%) = 22.30
N-Value = 0.050

Calculations

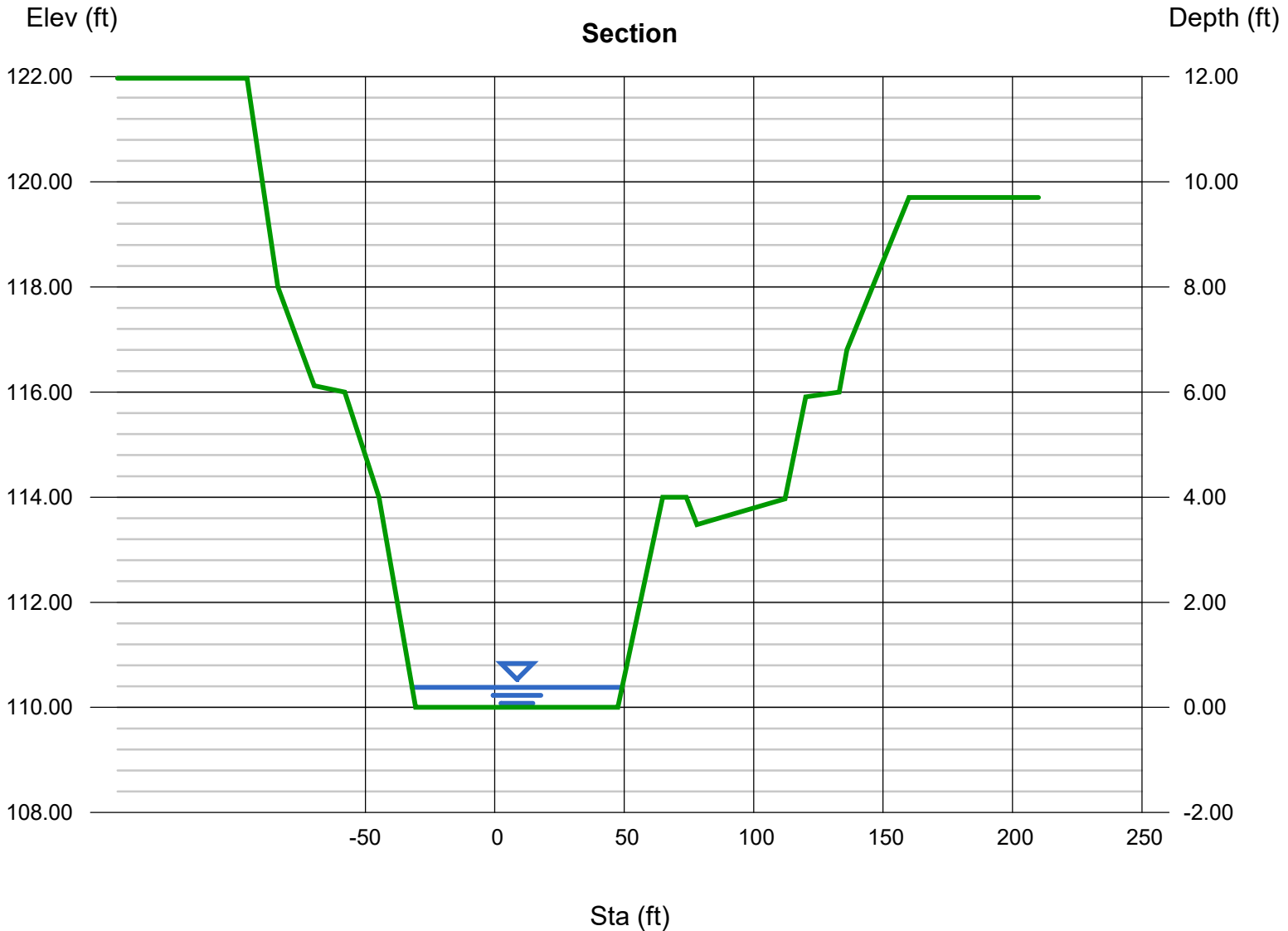
Compute by: Known Q
Known Q (cfs) = 213.29

Highlighted

Depth (ft) = 0.38
Q (cfs) = 213.29
Area (sqft) = 30.27
Velocity (ft/s) = 7.05
Wetted Perim (ft) = 81.26
Crit Depth, Yc (ft) = 0.61
Top Width (ft) = 81.16
EGL (ft) = 1.15

(Sta, El, n)-(Sta, El, n)...

(-95.71, 121.97)-(47.54, 110.00, 0.050)-(64.90, 114.00, 0.050)-(74.02, 114.00, 0.050)-(78.10, 113.48, 0.050)-(112.15, 113.97, 0.050)-(120.07, 115.91, 0.050)
-(133.06, 116.00, 0.050)-(136.00, 116.80, 0.050)-(160.00, 119.70, 0.050)



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc.

Wednesday, Dec 9 2020

Greenbelt 2, Sta. 1+00, 100 yr

User-defined

Invert Elev (ft) = 37.64
Slope (%) = 4.90
N-Value = 0.050

Calculations

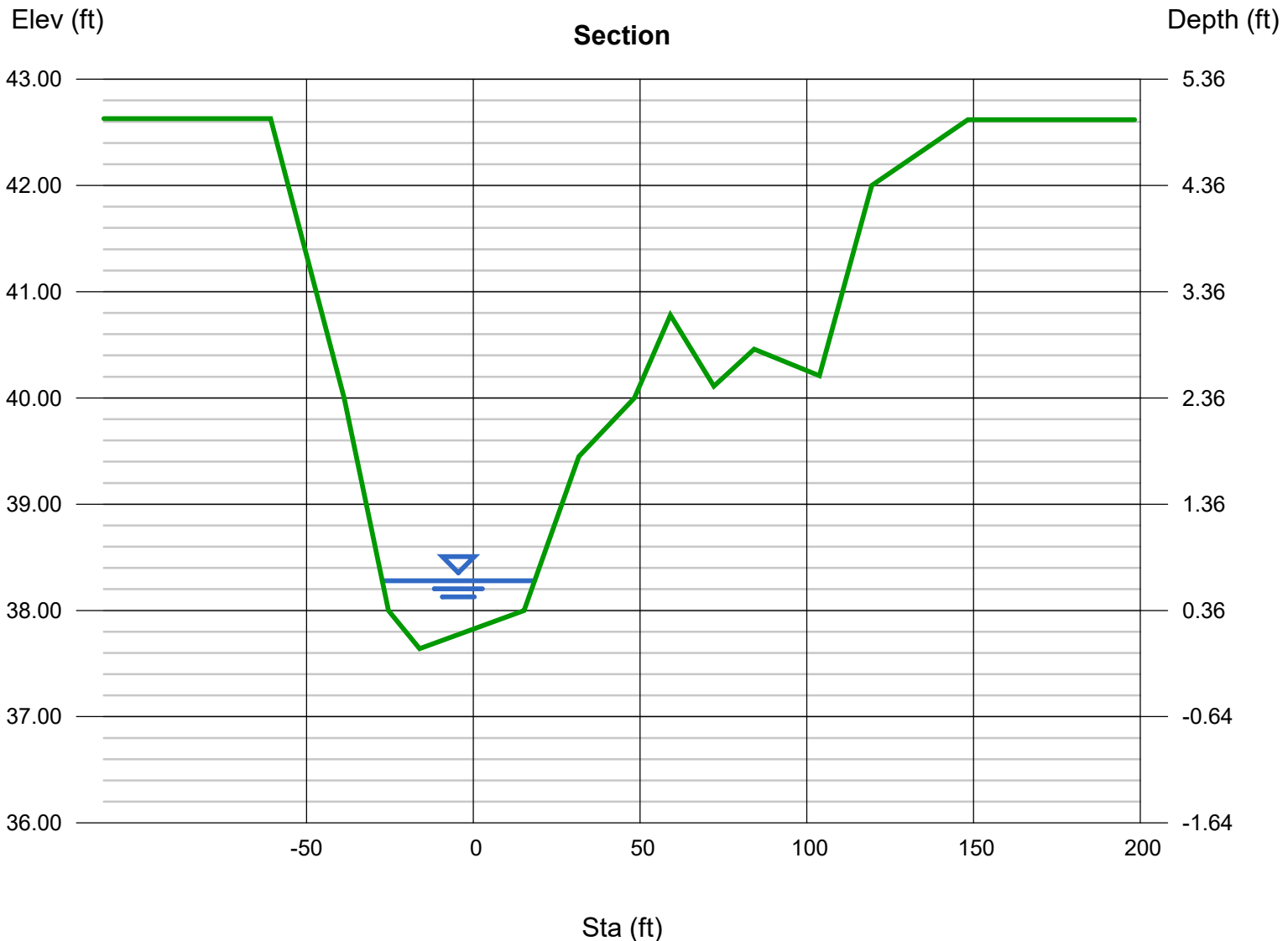
Compute by: Known Q
Known Q (cfs) = 70.95

Highlighted

Depth (ft) = 0.64
Q (cfs) = 70.95
Area (sqft) = 19.42
Velocity (ft/s) = 3.65
Wetted Perim (ft) = 45.76
Crit Depth, Yc (ft) = 0.64
Top Width (ft) = 45.72
EGL (ft) = 0.85

(Sta, El, n)-(Sta, El, n)...

(-60.82, 42.63)-(-15.19, 38.00, 0.050)-(31.66, 39.45, 0.050)-(48.28, 40.00, 0.050)-(59.07, 40.78, 0.050)-(72.12, 40.11, 0.050)-(84.22, 40.46, 0.050)
-(103.81, 40.21, 0.050)-(119.51, 42.00, 0.050)-(148.29, 42.62, 0.050)



Channel Report

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Wednesday, Dec 9 2020

Greenbelt 2, Sta. 5+00, 100 yr

User-defined

Invert Elev (ft) = 62.00
Slope (%) = 8.60
N-Value = 0.050

Calculations

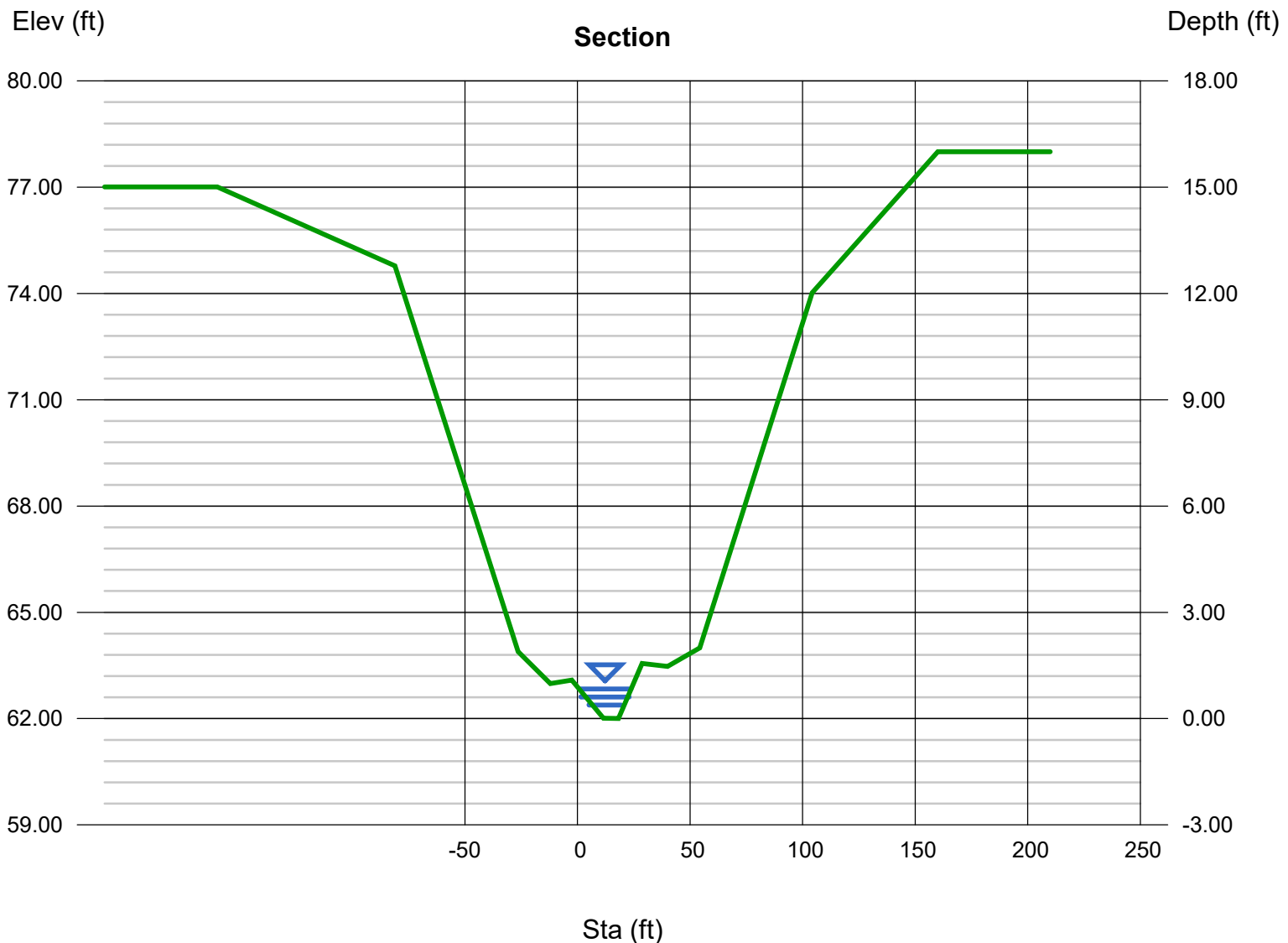
Compute by: Known Q
Known Q (cfs) = 70.95

Highlighted

Depth (ft) = 0.84
Q (cfs) = 70.95
Area (sqft) = 12.43
Velocity (ft/s) = 5.71
Wetted Perim (ft) = 23.21
Crit Depth, Yc (ft) = 0.99
Top Width (ft) = 23.11
EGL (ft) = 1.35

(Sta, El, n)-(Sta, El, n)...

(-160.00, 77.01)-(11.55, 62.01, 0.050)-(18.25, 62.00, 0.050)-(28.69, 63.56, 0.050)-(40.00, 63.47, 0.050)-(54.31, 64.00, 0.050)-(104.24, 74.02, 0.050)
-(-160.00, 78.00, 0.050)



Channel Report

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Wednesday, Dec 9 2020

Greenbelt 2, Sta. 8+00, 100 yr

User-defined

Invert Elev (ft) = 79.85
Slope (%) = 5.90
N-Value = 0.050

Calculations

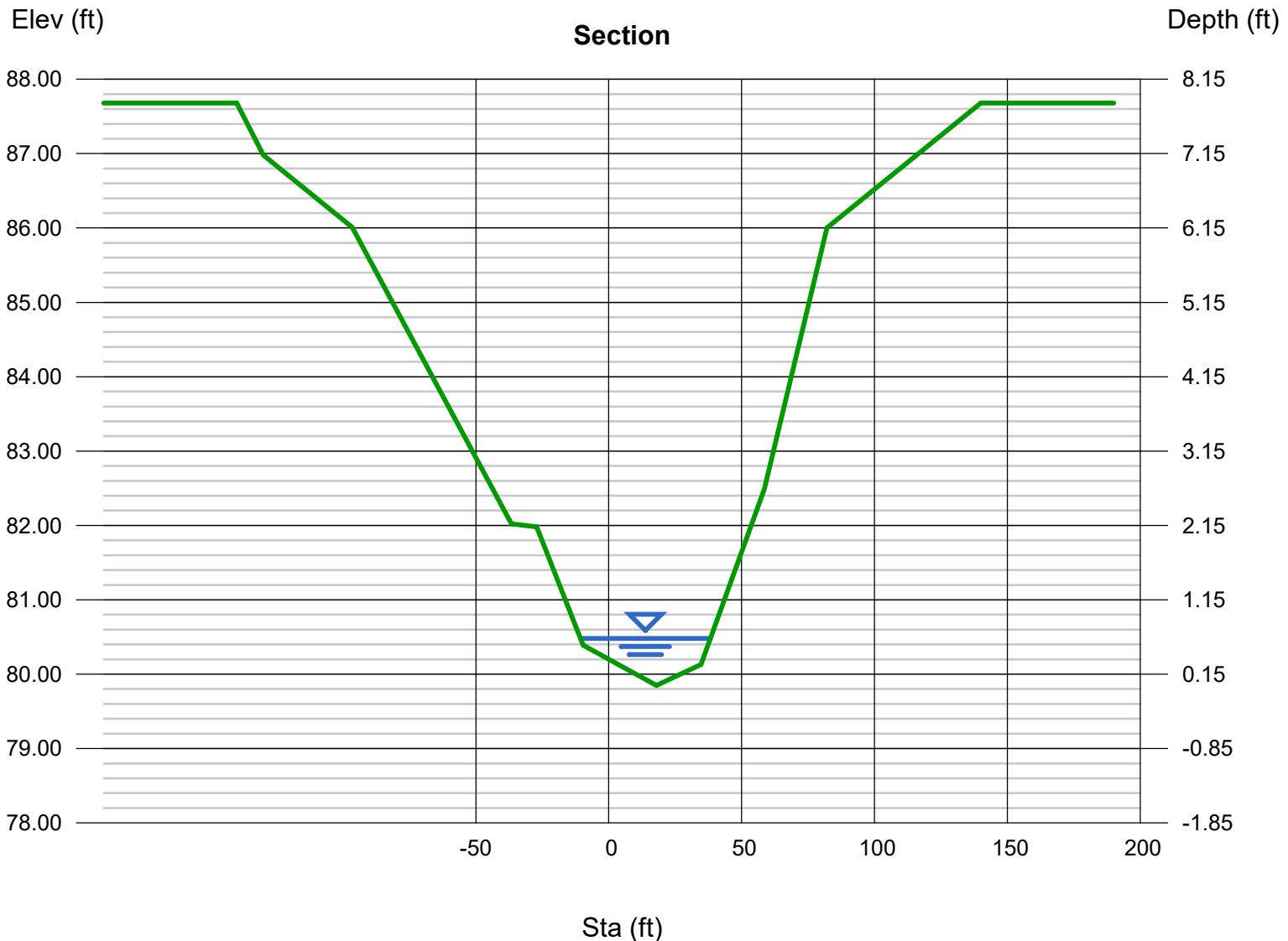
Compute by: Known Q
Known Q (cfs) = 70.95

Highlighted

Depth (ft) = 0.63
Q (cfs) = 70.95
Area (sqft) = 18.79
Velocity (ft/s) = 3.78
Wetted Perim (ft) = 48.85
Crit Depth, Yc (ft) = 0.65
Top Width (ft) = 48.82
EGL (ft) = 0.85

(Sta, El, n)-(Sta, El, n)...

(-140.00, 87.68)-(17.91, 79.85, 0.050)-(34.69, 80.13, 0.050)-(58.56, 82.49, 0.050)-(82.06, 86.00, 0.050)-(140.00, 87.68, 0.050)



Channel Report

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Wednesday, Dec 9 2020

Greenbelt 2, Sta. 10+00, 100 yr

User-defined

Invert Elev (ft) = 88.00
Slope (%) = 3.30
N-Value = 0.050

Calculations

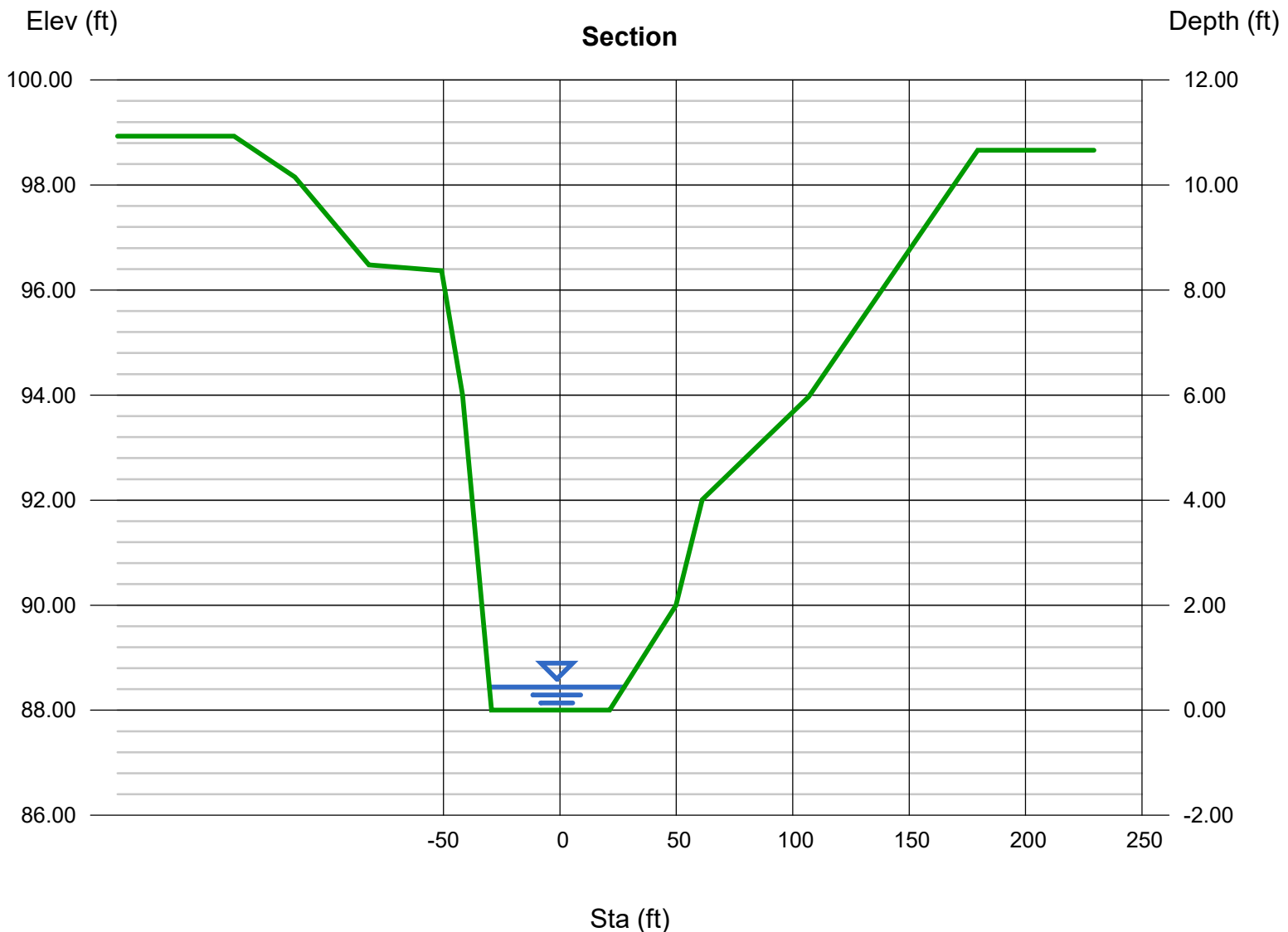
Compute by: Known Q
Known Q (cfs) = 70.95

Highlighted

Depth (ft) = 0.44
Q (cfs) = 70.95
Area (sqft) = 23.92
Velocity (ft/s) = 2.97
Wetted Perim (ft) = 58.05
Crit Depth, Yc (ft) = 0.39
Top Width (ft) = 57.94
EGL (ft) = 0.58

(Sta, El, n)-(Sta, El, n)...

(-140.00, 98.93)-(21.37, 88.00, 0.050)-(49.81, 90.00, 0.050)-(61.12, 92.01, 0.050)-(106.78, 93.97, 0.050)-(179.43, 98.66, 0.050)



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc.

Wednesday, Dec 9 2020

Greenbelt 3, Sta. 2+00, 100 yr

User-defined

Invert Elev (ft) = 44.00
Slope (%) = 10.50
N-Value = 0.050

Calculations

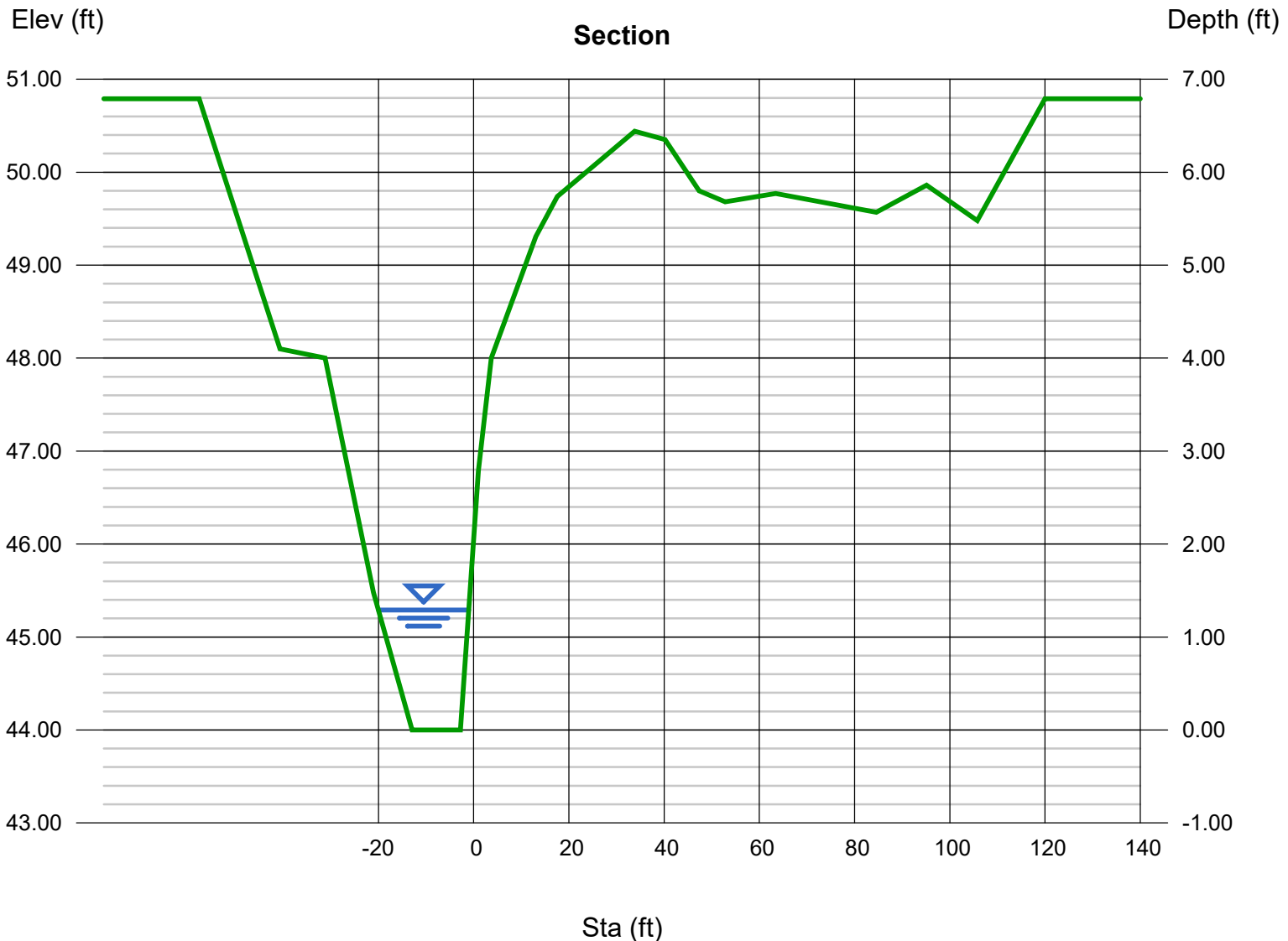
Compute by: Known Q
Known Q (cfs) = 174.65

Highlighted

Depth (ft) = 1.29
Q (cfs) = 174.65
Area (sqft) = 18.79
Velocity (ft/s) = 9.29
Wetted Perim (ft) = 19.51
Crit Depth, Yc (ft) = 1.71
Top Width (ft) = 18.97
EGL (ft) = 2.63

(Sta, El, n)-(Sta, El, n)...

(-57.67, 50.79)-(1.01, 46.79, 0.050)-(3.69, 48.00, 0.050)-(13.09, 49.31, 0.050)-(17.60, 49.74, 0.050)-(33.79, 50.44, 0.050)-(40.17, 50.35, 0.050)
-(47.35, 49.80, 0.050)-(52.84, 49.68, 0.050)-(63.45, 49.77, 0.050)-(84.57, 49.57, 0.050)-(95.09, 49.86, 0.050)-(105.80, 49.48, 0.050)-(120.00, 50.79, 0.050)



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc.

Wednesday, Dec 9 2020

Greenbelt 3, Sta. 4+00, 100 yr

User-defined

Invert Elev (ft) = 52.00
Slope (%) = 7.30
N-Value = 0.050

Calculations

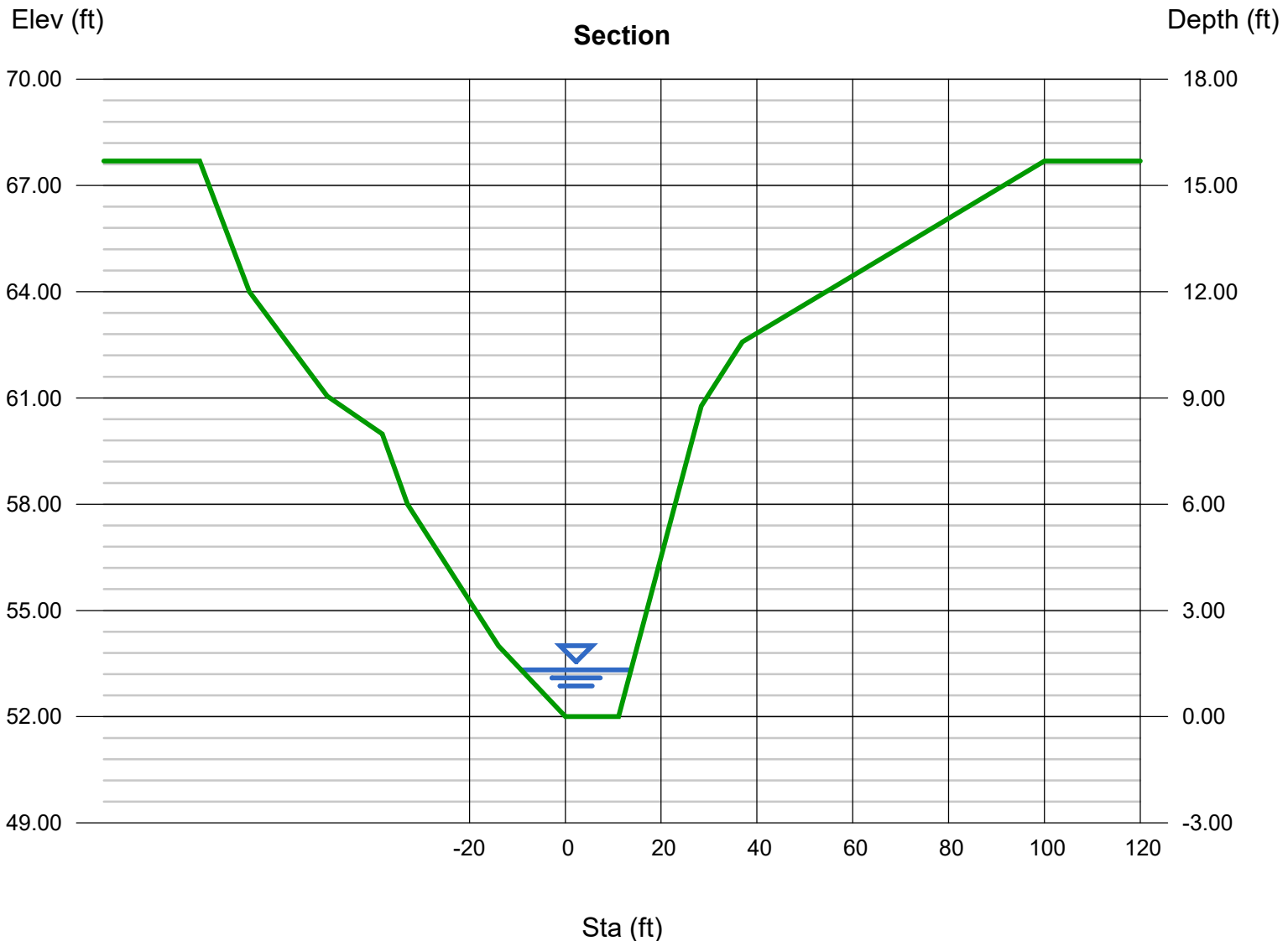
Compute by: Known Q
Known Q (cfs) = 174.65

Highlighted

Depth (ft) = 1.32
Q (cfs) = 174.65
Area (sqft) = 22.46
Velocity (ft/s) = 7.78
Wetted Perim (ft) = 23.32
Crit Depth, Yc (ft) = 1.59
Top Width (ft) = 22.91
EGL (ft) = 2.26

(Sta, El, n)-(Sta, El, n)...

(-76.30, 67.69)-(11.12, 52.00, 0.050)-(28.36, 60.77, 0.050)-(36.94, 62.58, 0.050)-(100.00, 67.69, 0.050)



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc.

Wednesday, Dec 9 2020

Greenbelt 3, Sta. 6+00, 100 yr

User-defined

Invert Elev (ft) = 65.83
Slope (%) = 4.00
N-Value = 0.050

Calculations

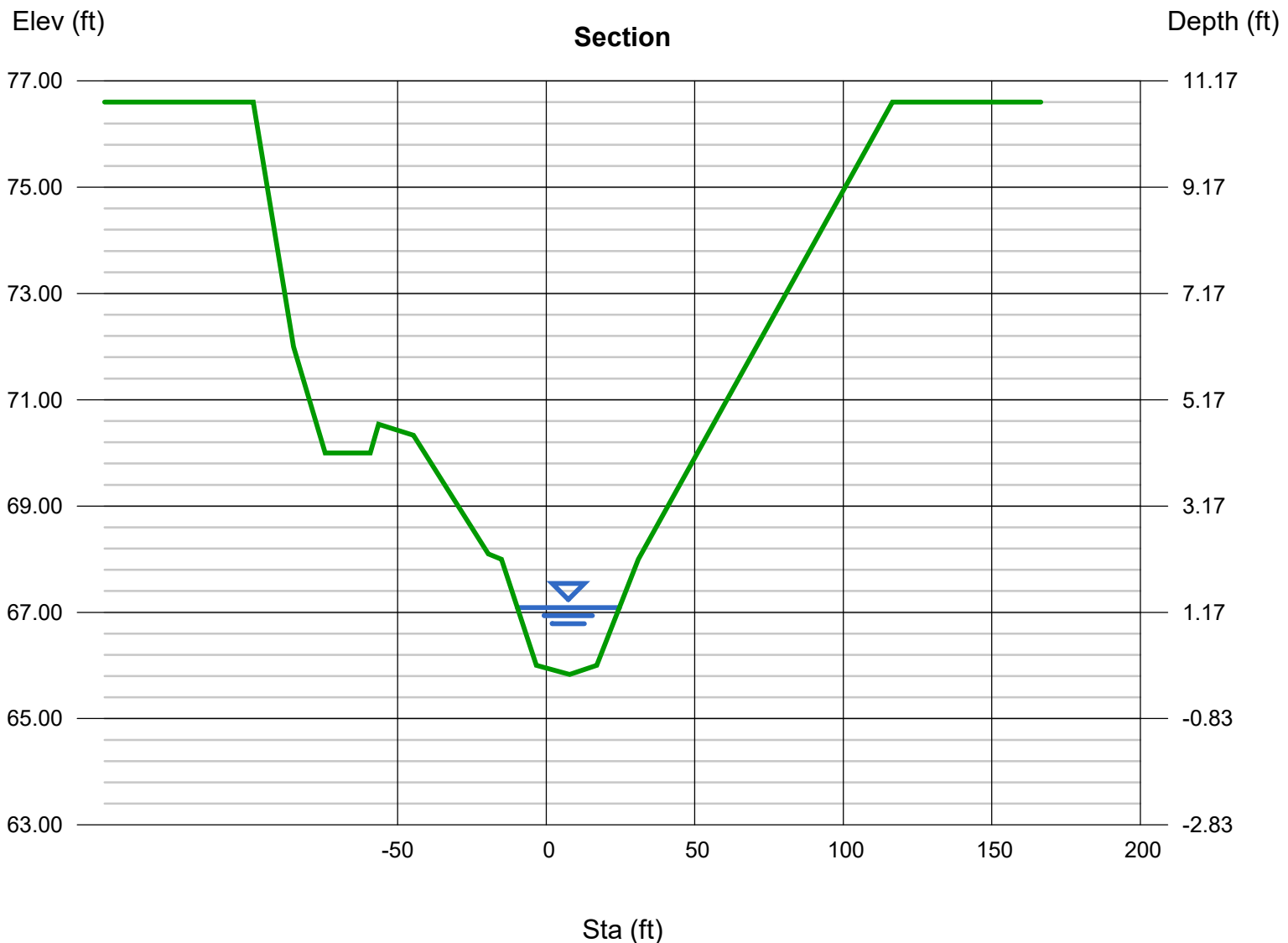
Compute by: Known Q
Known Q (cfs) = 174.65

Highlighted

Depth (ft) = 1.26
Q (cfs) = 174.65
Area (sqft) = 31.57
Velocity (ft/s) = 5.53
Wetted Perim (ft) = 34.56
Crit Depth, Yc (ft) = 1.28
Top Width (ft) = 34.39
EGL (ft) = 1.74

(Sta, El, n)-(Sta, El, n)...

(-98.67, 76.60)-(7.91, 65.83, 0.050)-(17.01, 66.00, 0.050)-(31.03, 68.00, 0.050)-(116.50, 76.60, 0.050)



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc.

Wednesday, Dec 9 2020

Greenbelt 3, Sta. 8+00, 100 yr

User-defined

Invert Elev (ft) = 76.60
Slope (%) = 3.00
N-Value = 0.050

Calculations

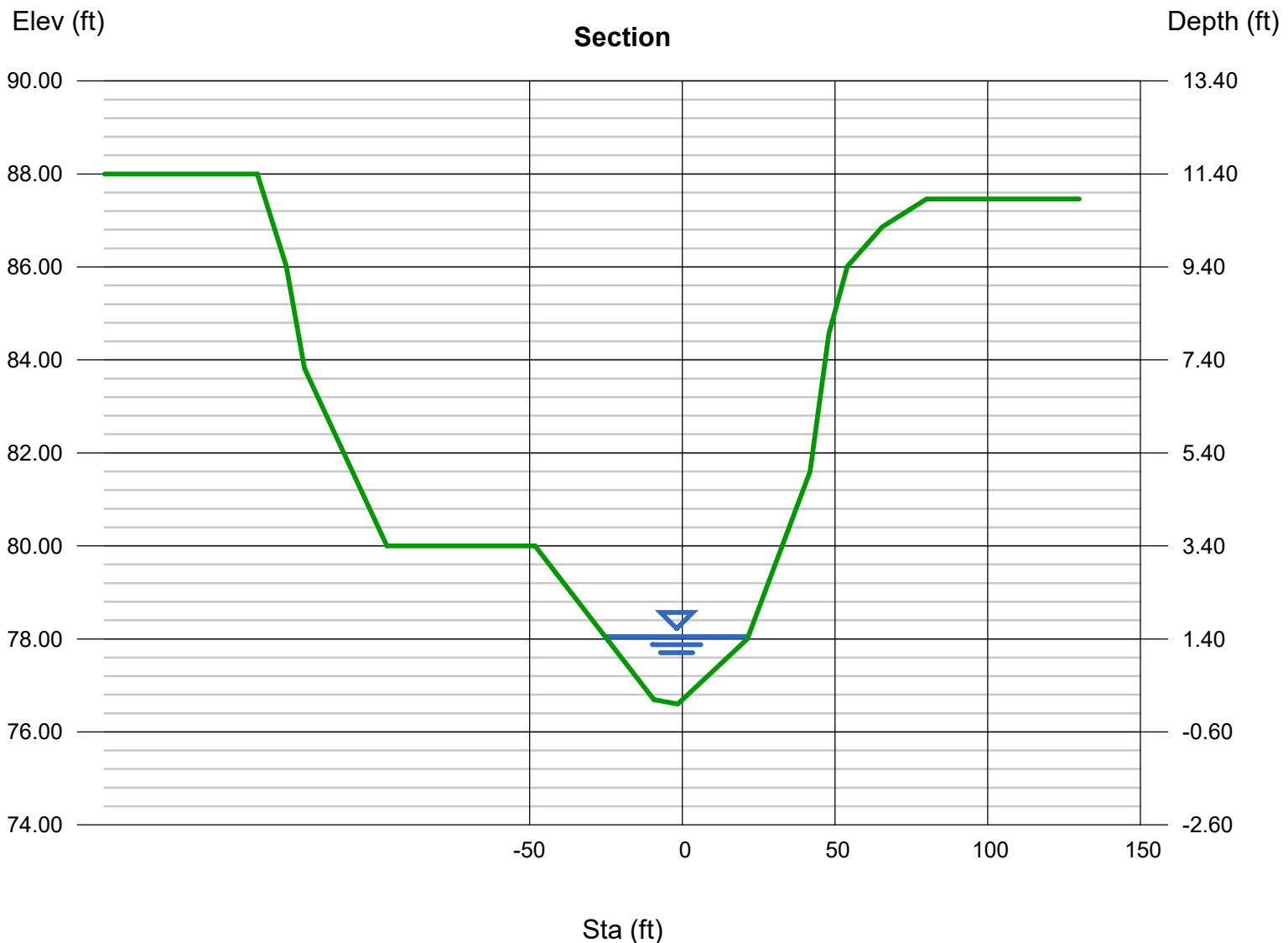
Compute by: Known Q
Known Q (cfs) = 174.65

Highlighted

Depth (ft) = 1.45
Q (cfs) = 174.65
Area (sqft) = 39.02
Velocity (ft/s) = 4.48
Wetted Perim (ft) = 47.02
Crit Depth, Yc (ft) = 1.37
Top Width (ft) = 46.91
EGL (ft) = 1.76

(Sta, El, n)-(Sta, El, n)...

(-139.19, 88.00)-(21.30, 78.00, 0.050)-(41.80, 81.60, 0.050)-(47.98, 84.56, 0.050)-(54.09, 86.01, 0.050)-(65.51, 86.86, 0.050)-(80.00, 87.46, 0.050)



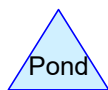
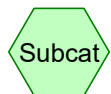
Bow Engineering & Development, Inc.
1953 S. Beretania Street, PH-A
Honolulu, Hawaii 96826-1342

Telephone: (808) 941-8853
Fax: (808) 945-9299
www.bowengineering.com



ATTACHMENT 4

HYDROCAD REPORTS



Routing Diagram for Hokua Concept Existing Condition
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Hokua Concept Existing Condition

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Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
38.038	48	Brush, Good, HSG B (E)
82.021	65	Brush, Good, HSG C (A, B, C, D)
5.386	98	Unconnected pavement, HSG C (A, B)
125.444	61	TOTAL AREA

Hokua Concept Existing Condition

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Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	38.038	82.021	0.000	0.000	120.059	Brush, Good	A, B, C, D, E
0.000	0.000	5.386	0.000	0.000	5.386	Unconnected pavement	A, B
0.000	38.038	87.407	0.000	0.000	125.444	TOTAL AREA	

Hokua Concept Existing Condition

Type I 24-hr 2 yr storm Rainfall=5.63"

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Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

SubcatchmentA: Basin A Runoff Area=1,188,218 sf 15.03% Impervious Runoff Depth>1.96"
Flow Length=2,065' Tc=14.4 min UI Adjusted CN=67 Runoff=36.46 cfs 4.456 af

SubcatchmentB: Basin B Runoff Area=1,375,103 sf 4.07% Impervious Runoff Depth>1.86"
Flow Length=2,071' Tc=28.9 min CN=66 Runoff=28.25 cfs 4.900 af

SubcatchmentC: Basin C Runoff Area=499,774 sf 0.00% Impervious Runoff Depth>1.77"
Flow Length=844' Tc=40.6 min CN=65 Runoff=7.97 cfs 1.692 af

SubcatchmentD: Basin D Runoff Area=744,339 sf 0.00% Impervious Runoff Depth>1.76"
Flow Length=1,871' Tc=46.5 min CN=65 Runoff=10.96 cfs 2.509 af

SubcatchmentE: Basin E Runoff Area=1,656,916 sf 0.00% Impervious Runoff Depth>0.65"
Flow Length=1,397' Tc=50.3 min CN=48 Runoff=4.34 cfs 2.047 af

Total Runoff Area = 125.444 ac Runoff Volume = 15.605 af Average Runoff Depth = 1.49"
95.71% Pervious = 120.059 ac 4.29% Impervious = 5.386 ac

Hokua Concept Existing Condition

Type I 24-hr 2 yr storm Rainfall=5.63"

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Summary for Subcatchment A: Basin A

Runoff = 36.46 cfs @ 10.07 hrs, Volume= 4.456 af, Depth> 1.96"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type I 24-hr 2 yr storm Rainfall=5.63"

Area (sf)	CN	Adj	Description
1,009,639	65		Brush, Good, HSG C
178,579	98		Unconnected pavement, HSG C
1,188,218	70	67	Weighted Average, UI Adjusted
1,009,639			84.97% Pervious Area
178,579			15.03% Impervious Area
178,579			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.6	295	0.0130	1.91		Sheet Flow, Smooth surfaces n= 0.011 P2= 5.63"
5.1	198	0.0010	0.64		Shallow Concentrated Flow, Paved Kv= 20.3 fps
1.3	158	0.0880	2.08		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
0.2	100	0.2000	10.70	79.15	Trap/Vee/Rect Channel Flow, Bot.W=5.00' D=1.00' Z= 3.3 & 1.5 '/' Top.W=9.80' n= 0.050 Scattered brush, heavy weeds
0.9	385	0.0740	6.86	72.34	Trap/Vee/Rect Channel Flow, Bot.W=8.00' D=1.00' Z= 1.8 & 3.3 '/' Top.W=13.10' n= 0.050 Scattered brush, heavy weeds
1.8	552	0.0500	5.13	155.05	Trap/Vee/Rect Channel Flow, Bot.W=16.00' D=1.00' Z= 10.7 & 17.7 '/' Top.W=44.40' n= 0.050
2.5	377	0.0150	2.51	48.13	Trap/Vee/Rect Channel Flow, Bot.W=5.00' D=1.00' Z= 12.5 & 15.8 '/' Top.W=33.30' n= 0.050
14.4	2,065	Total			

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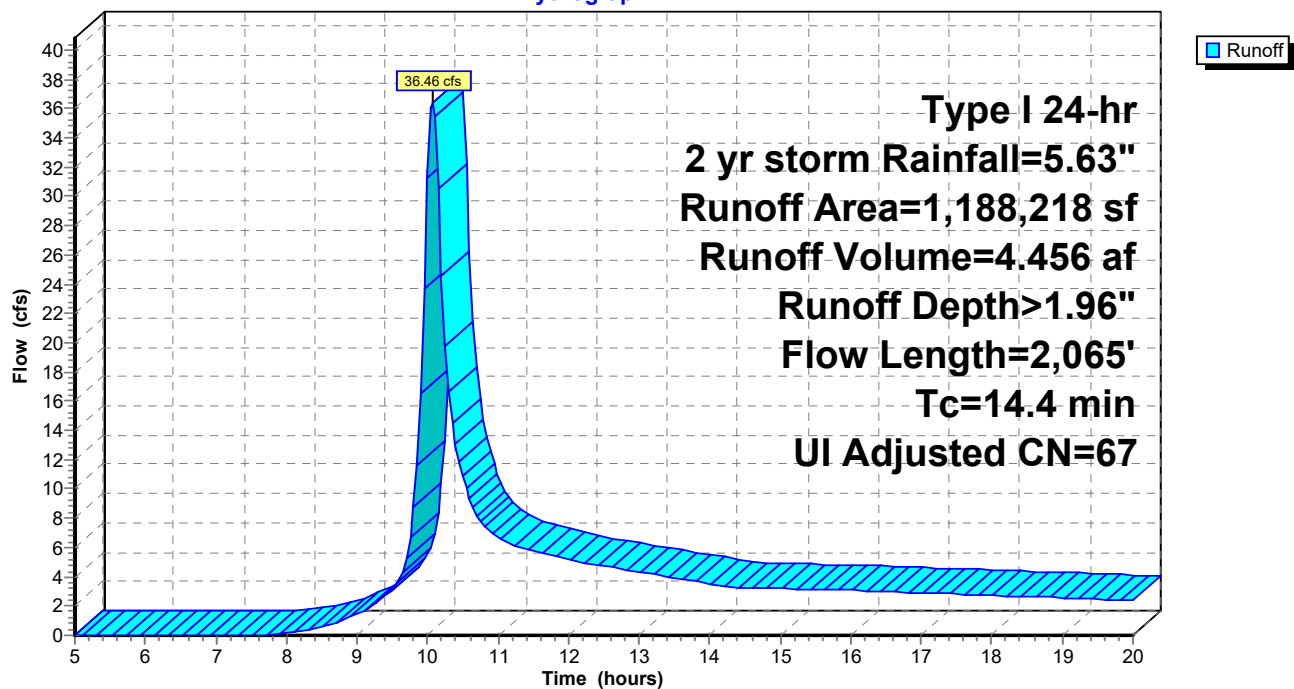
Type I 24-hr 2 yr storm Rainfall=5.63"

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Subcatchment A: Basin A

Hydrograph



Hokua Concept Existing Condition

Type I 24-hr 2 yr storm Rainfall=5.63"

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Summary for Subcatchment B: Basin B

Runoff = 28.25 cfs @ 10.25 hrs, Volume= 4.900 af, Depth> 1.86"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type I 24-hr 2 yr storm Rainfall=5.63"

Area (sf)	CN	Description
1,319,082	65	Brush, Good, HSG C
56,021	98	Unconnected pavement, HSG C
1,375,103	66	Weighted Average
1,319,082		95.93% Pervious Area
56,021		4.07% Impervious Area
56,021		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.0	225	0.0370	0.34		Sheet Flow, Grass: Short n= 0.150 P2= 5.63"
3.1	133	0.0210	0.72		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
3.1	161	0.0300	0.87		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
3.1	151	0.0270	0.82		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
4.5	277	0.0430	1.04		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
1.1	326	0.0310	4.93	488.00	Trap/Vee/Rect Channel Flow, Bot.W=90.00' D=1.00' Z= 15.0 & 2.8 ' Top.W=107.80' n= 0.050
0.7	256	0.0620	6.30	215.55	Trap/Vee/Rect Channel Flow, Bot.W=25.00' D=1.00' Z= 7.4 & 11.0 ' Top.W=43.40' n= 0.050
0.7	271	0.0470	6.09	210.72	Trap/Vee/Rect Channel Flow, Bot.W=32.00' D=1.00' Z= 3.8 & 1.4 ' Top.W=37.20' n= 0.050
0.2	126	0.1300	10.25	547.15	Trap/Vee/Rect Channel Flow, Bot.W=50.00' D=1.00' Z= 4.4 & 2.4 ' Top.W=56.80' n= 0.050
1.4	145	0.1140	1.69		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
28.9	2,071	Total			

Hokua Concept Existing Condition

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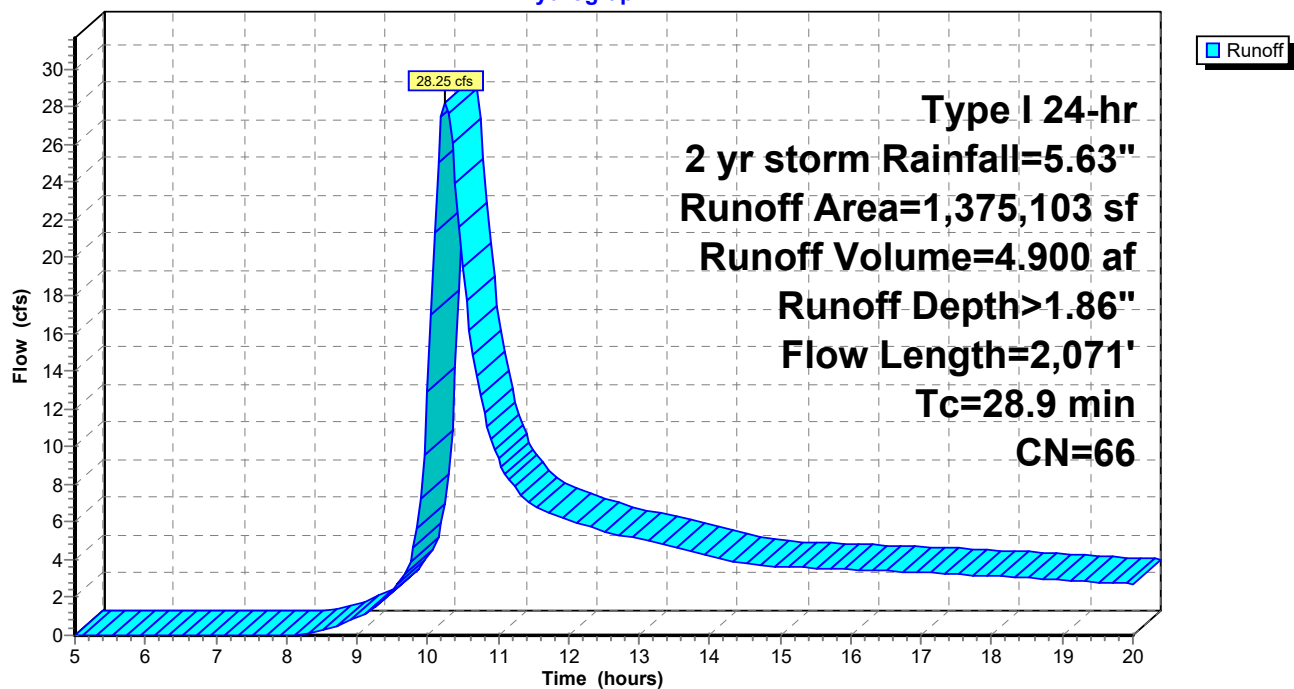
Type I 24-hr 2 yr storm Rainfall=5.63"

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Subcatchment B: Basin B

Hydrograph



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Type I 24-hr 2 yr storm Rainfall=5.63"

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Summary for Subcatchment C: Basin C

Runoff = 7.97 cfs @ 10.42 hrs, Volume= 1.692 af, Depth> 1.77"

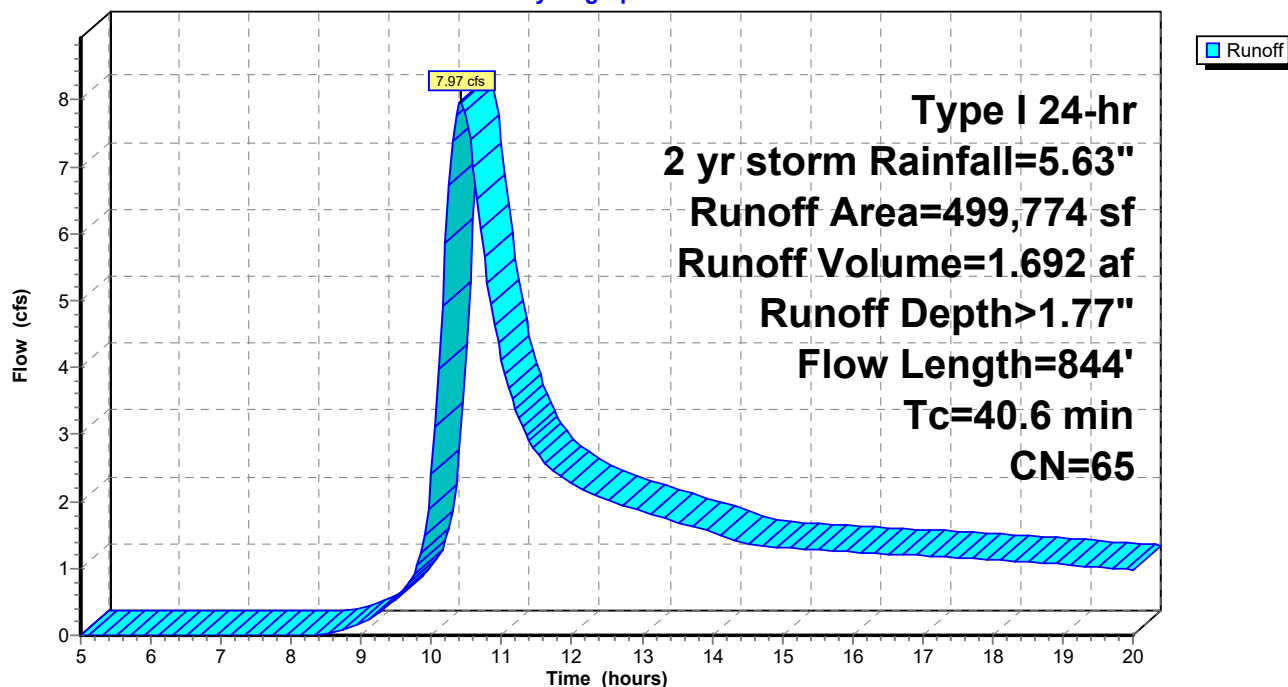
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type I 24-hr 2 yr storm Rainfall=5.63"

Area (sf)	CN	Description
499,774	65	Brush, Good, HSG C
499,774		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
26.8	188	0.0200	0.12		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 5.63"
7.4	112	0.1780	0.25		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 5.63"
1.9	238	0.1780	2.11		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
4.5	306	0.0520	1.14		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
40.6	844	Total			

Subcatchment C: Basin C

Hydrograph



Hokua Concept Existing Condition

Type I 24-hr 2 yr storm Rainfall=5.63"

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Summary for Subcatchment D: Basin D

Runoff = 10.96 cfs @ 10.50 hrs, Volume= 2.509 af, Depth> 1.76"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type I 24-hr 2 yr storm Rainfall=5.63"

Area (sf)	CN	Description
744,339	65	Brush, Good, HSG C
744,339		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
31.9	300	0.0330	0.16		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 5.63"
3.0	163	0.0330	0.91		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
9.6	607	0.0440	1.05		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
0.9	393	0.0700	6.97	101.02	Trap/Vee/Rect Channel Flow, Bot.W=12.00' D=1.00' Z= 2.4 & 2.6 '/' Top.W=17.00' n= 0.050
0.6	172	0.0370	5.14	279.11	Trap/Vee/Rect Channel Flow, Bot.W=45.00' D=1.00' Z= 5.0 & 13.7 '/' Top.W=63.70' n= 0.050
0.5	236	0.0830	8.18	701.40	Trap/Vee/Rect Channel Flow, Bot.W=80.00' D=1.00' Z= 9.9 & 1.6 '/' Top.W=91.50' n= 0.050
46.5	1,871	Total			

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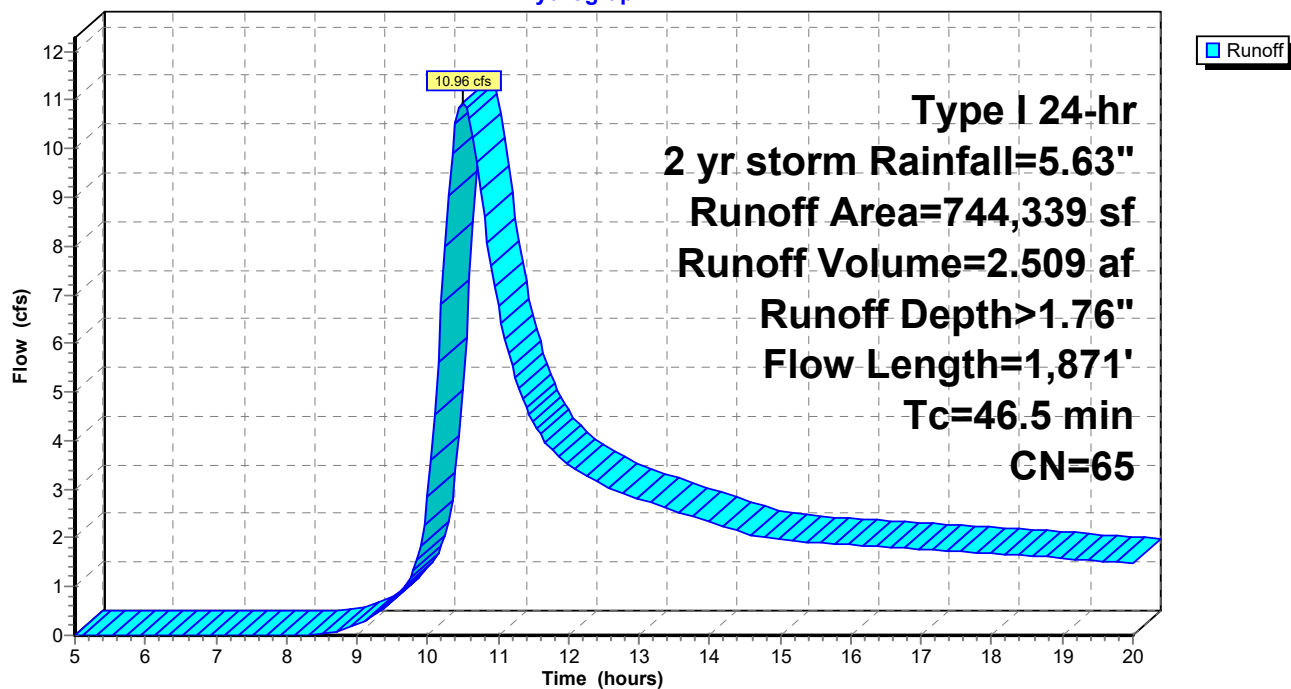
Type I 24-hr 2 yr storm Rainfall=5.63"

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Subcatchment D: Basin D

Hydrograph



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Summary for Subcatchment E: Basin E

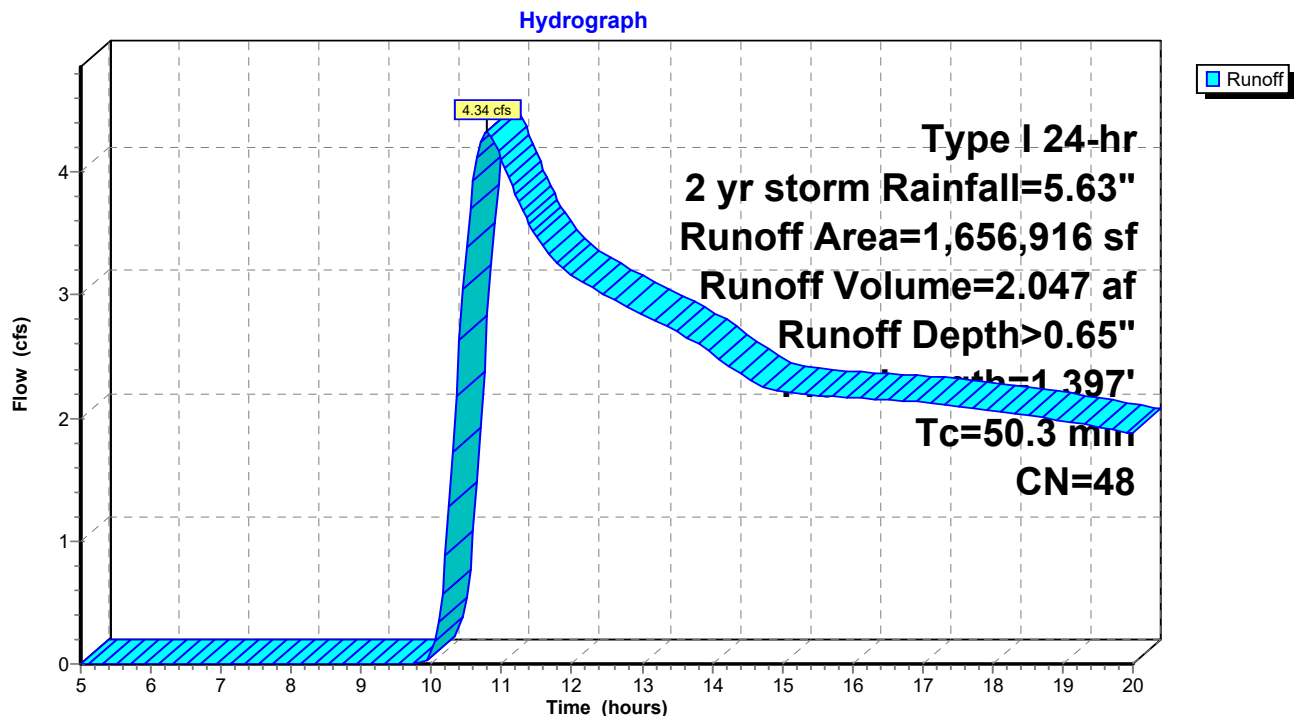
Runoff = 4.34 cfs @ 10.79 hrs, Volume= 2.047 af, Depth> 0.65"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type I 24-hr 2 yr storm Rainfall=5.63"

Area (sf)	CN	Description
1,656,916	48	Brush, Good, HSG B
1,656,916		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
34.1	300	0.0280	0.15		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 5.63"
1.2	60	0.0280	0.84		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
7.8	423	0.0330	0.91		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
2.9	166	0.0370	0.96		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
4.3	448	0.1230	1.75		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
50.3	1,397	Total			

Subcatchment E: Basin E



Hokua Concept Existing Condition

Type I 24-hr 100 yr storm Rainfall=16.50"

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Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

SubcatchmentA: Basin A Runoff Area=1,188,218 sf 15.03% Impervious Runoff Depth>10.60"
Flow Length=2,065' Tc=14.4 min UI Adjusted CN=67 Runoff=213.29 cfs 24.096 af

SubcatchmentB: Basin B Runoff Area=1,375,103 sf 4.07% Impervious Runoff Depth>10.38"
Flow Length=2,071' Tc=28.9 min CN=66 Runoff=174.65 cfs 27.316 af

SubcatchmentC: Basin C Runoff Area=499,774 sf 0.00% Impervious Runoff Depth>10.17"
Flow Length=844' Tc=40.6 min CN=65 Runoff=51.60 cfs 9.724 af

SubcatchmentD: Basin D Runoff Area=744,339 sf 0.00% Impervious Runoff Depth>10.14"
Flow Length=1,871' Tc=46.5 min CN=65 Runoff=70.95 cfs 14.442 af

SubcatchmentE: Basin E Runoff Area=1,656,916 sf 0.00% Impervious Runoff Depth>7.04"
Flow Length=1,397' Tc=50.3 min CN=48 Runoff=100.95 cfs 22.324 af

Total Runoff Area = 125.444 ac Runoff Volume = 97.901 af Average Runoff Depth = 9.37"
95.71% Pervious = 120.059 ac 4.29% Impervious = 5.386 ac

Hokua Concept Existing Condition

Type I 24-hr 100 yr storm Rainfall=16.50"

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Summary for Subcatchment A: Basin A

Runoff = 213.29 cfs @ 10.06 hrs, Volume= 24.096 af, Depth>10.60"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type I 24-hr 100 yr storm Rainfall=16.50"

Area (sf)	CN	Adj	Description
1,009,639	65		Brush, Good, HSG C
178,579	98		Unconnected pavement, HSG C
1,188,218	70	67	Weighted Average, UI Adjusted
1,009,639			84.97% Pervious Area
178,579			15.03% Impervious Area
178,579			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.6	295	0.0130	1.91		Sheet Flow, Smooth surfaces n= 0.011 P2= 5.63"
5.1	198	0.0010	0.64		Shallow Concentrated Flow, Paved Kv= 20.3 fps
1.3	158	0.0880	2.08		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
0.2	100	0.2000	10.70	79.15	Trap/Vee/Rect Channel Flow, Bot.W=5.00' D=1.00' Z= 3.3 & 1.5 '/' Top.W=9.80' n= 0.050 Scattered brush, heavy weeds
0.9	385	0.0740	6.86	72.34	Trap/Vee/Rect Channel Flow, Bot.W=8.00' D=1.00' Z= 1.8 & 3.3 '/' Top.W=13.10' n= 0.050 Scattered brush, heavy weeds
1.8	552	0.0500	5.13	155.05	Trap/Vee/Rect Channel Flow, Bot.W=16.00' D=1.00' Z= 10.7 & 17.7 '/' Top.W=44.40' n= 0.050
2.5	377	0.0150	2.51	48.13	Trap/Vee/Rect Channel Flow, Bot.W=5.00' D=1.00' Z= 12.5 & 15.8 '/' Top.W=33.30' n= 0.050
14.4	2,065	Total			

Hokua Concept Existing Condition

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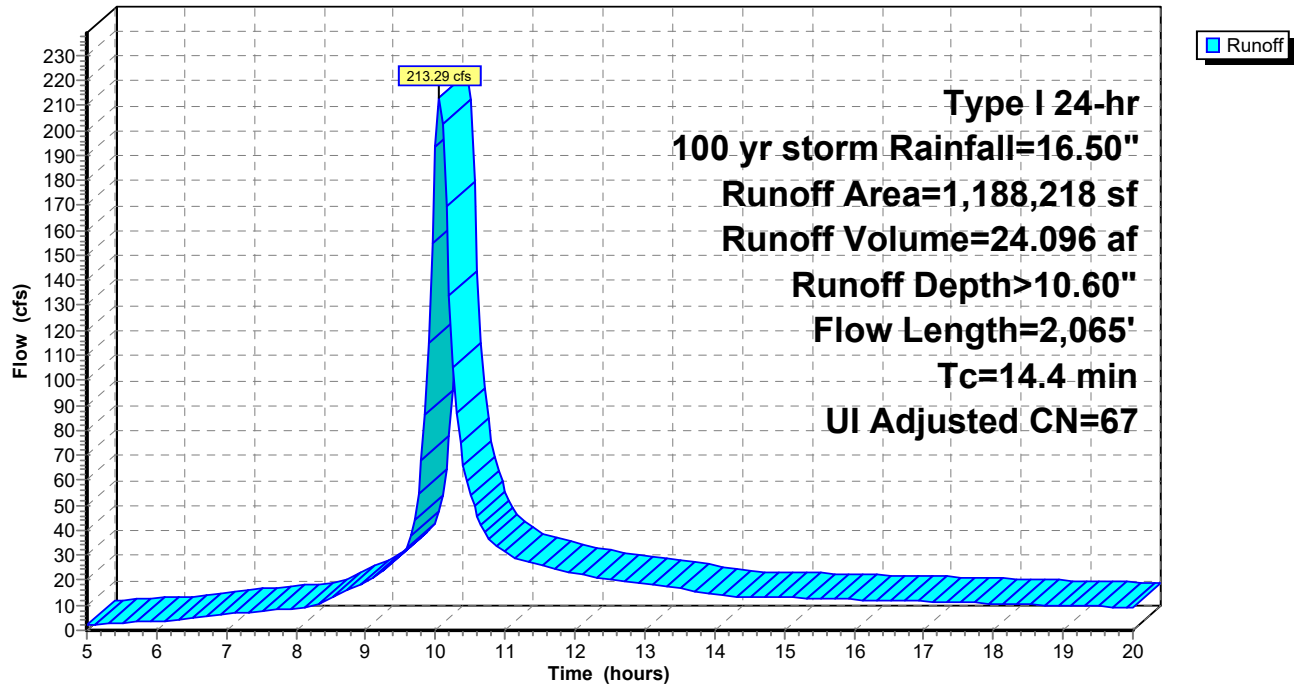
Type I 24-hr 100 yr storm Rainfall=16.50"

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Subcatchment A: Basin A

Hydrograph



Hokua Concept Existing Condition

Type I 24-hr 100 yr storm Rainfall=16.50"

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Summary for Subcatchment B: Basin B

Runoff = 174.65 cfs @ 10.23 hrs, Volume= 27.316 af, Depth>10.38"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type I 24-hr 100 yr storm Rainfall=16.50"

Area (sf)	CN	Description
1,319,082	65	Brush, Good, HSG C
56,021	98	Unconnected pavement, HSG C
1,375,103	66	Weighted Average
1,319,082		95.93% Pervious Area
56,021		4.07% Impervious Area
56,021		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.0	225	0.0370	0.34		Sheet Flow, Grass: Short n= 0.150 P2= 5.63"
3.1	133	0.0210	0.72		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
3.1	161	0.0300	0.87		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
3.1	151	0.0270	0.82		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
4.5	277	0.0430	1.04		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
1.1	326	0.0310	4.93	488.00	Trap/Vee/Rect Channel Flow, Bot.W=90.00' D=1.00' Z= 15.0 & 2.8 ' Top.W=107.80' n= 0.050
0.7	256	0.0620	6.30	215.55	Trap/Vee/Rect Channel Flow, Bot.W=25.00' D=1.00' Z= 7.4 & 11.0 ' Top.W=43.40' n= 0.050
0.7	271	0.0470	6.09	210.72	Trap/Vee/Rect Channel Flow, Bot.W=32.00' D=1.00' Z= 3.8 & 1.4 ' Top.W=37.20' n= 0.050
0.2	126	0.1300	10.25	547.15	Trap/Vee/Rect Channel Flow, Bot.W=50.00' D=1.00' Z= 4.4 & 2.4 ' Top.W=56.80' n= 0.050
1.4	145	0.1140	1.69		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
28.9	2,071	Total			

Hokua Concept Existing Condition

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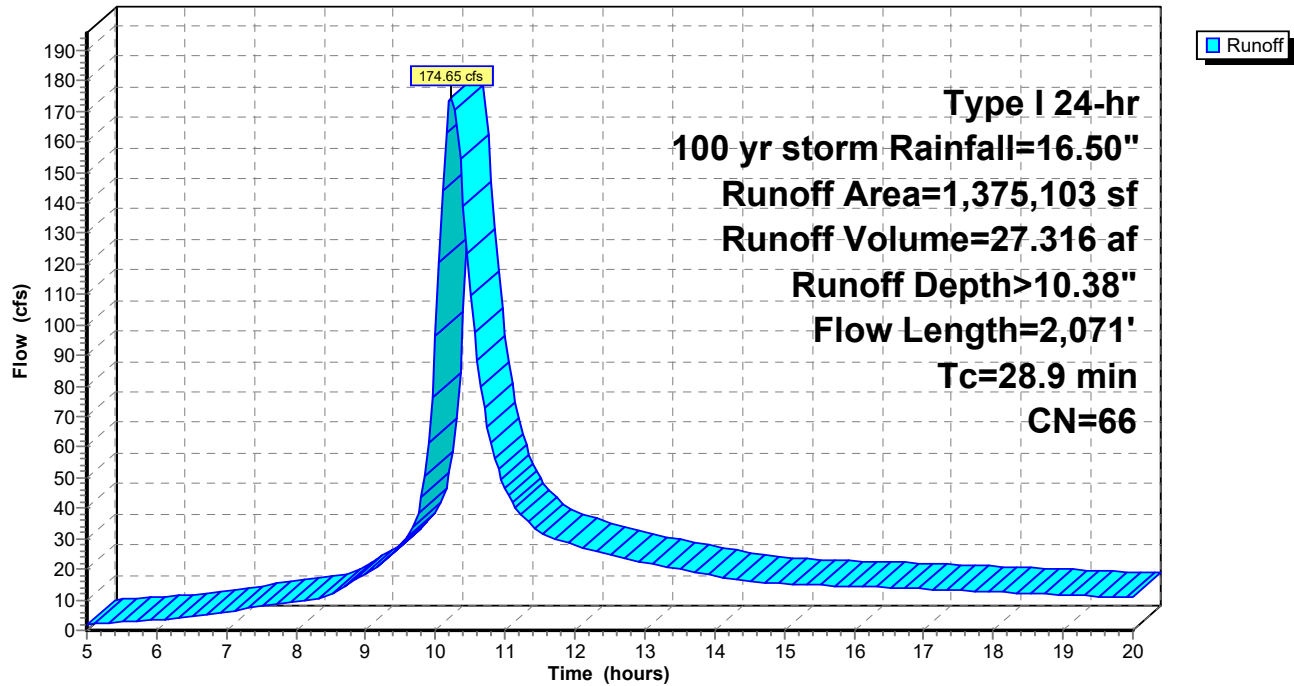
Type I 24-hr 100 yr storm Rainfall=16.50"

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Subcatchment B: Basin B

Hydrograph



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Type I 24-hr 100 yr storm Rainfall=16.50"

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Summary for Subcatchment C: Basin C

Runoff = 51.60 cfs @ 10.38 hrs, Volume= 9.724 af, Depth>10.17"

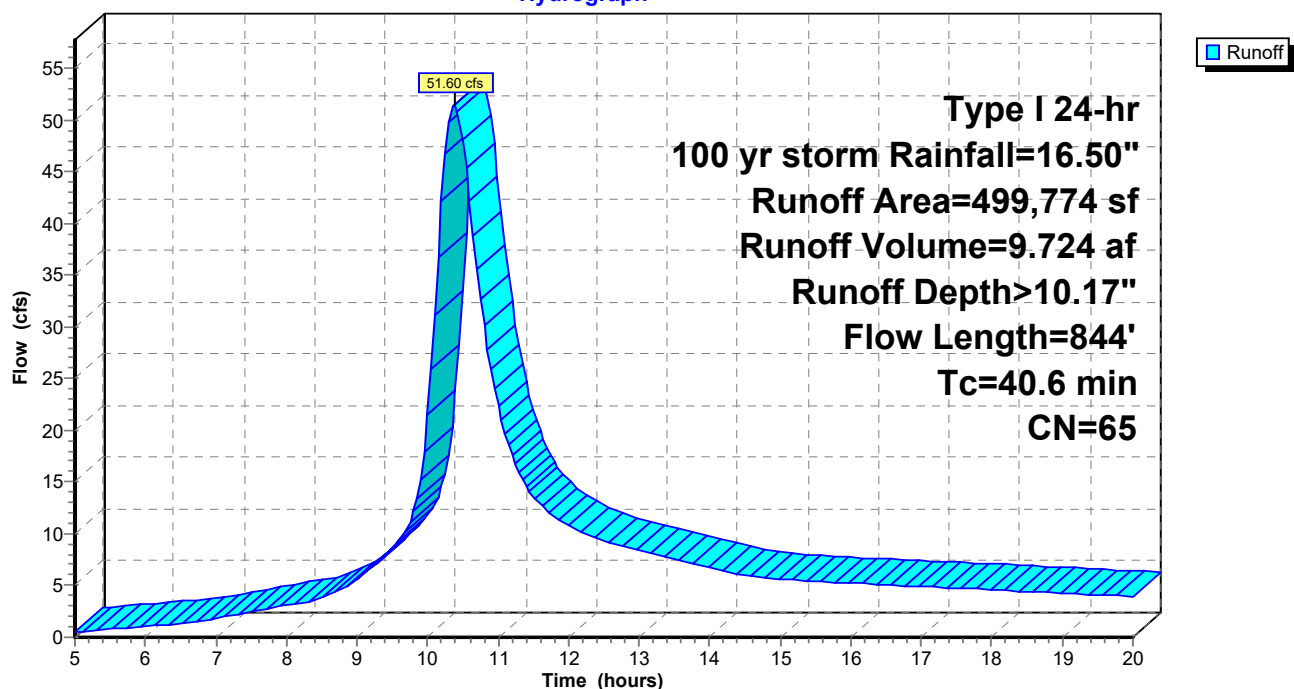
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type I 24-hr 100 yr storm Rainfall=16.50"

Area (sf)	CN	Description
499,774	65	Brush, Good, HSG C
499,774		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
26.8	188	0.0200	0.12		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 5.63"
7.4	112	0.1780	0.25		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 5.63"
1.9	238	0.1780	2.11		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
4.5	306	0.0520	1.14		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
40.6	844	Total			

Subcatchment C: Basin C

Hydrograph



Hokua Concept Existing Condition

Type I 24-hr 100 yr storm Rainfall=16.50"

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Summary for Subcatchment D: Basin D

Runoff = 70.95 cfs @ 10.46 hrs, Volume= 14.442 af, Depth>10.14"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type I 24-hr 100 yr storm Rainfall=16.50"

Area (sf)	CN	Description
744,339	65	Brush, Good, HSG C
744,339		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
31.9	300	0.0330	0.16		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 5.63"
3.0	163	0.0330	0.91		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
9.6	607	0.0440	1.05		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
0.9	393	0.0700	6.97	101.02	Trap/Vee/Rect Channel Flow, Bot.W=12.00' D=1.00' Z= 2.4 & 2.6 '/' Top.W=17.00' n= 0.050
0.6	172	0.0370	5.14	279.11	Trap/Vee/Rect Channel Flow, Bot.W=45.00' D=1.00' Z= 5.0 & 13.7 '/' Top.W=63.70' n= 0.050
0.5	236	0.0830	8.18	701.40	Trap/Vee/Rect Channel Flow, Bot.W=80.00' D=1.00' Z= 9.9 & 1.6 '/' Top.W=91.50' n= 0.050
46.5	1,871	Total			

Hokua Concept Existing Condition

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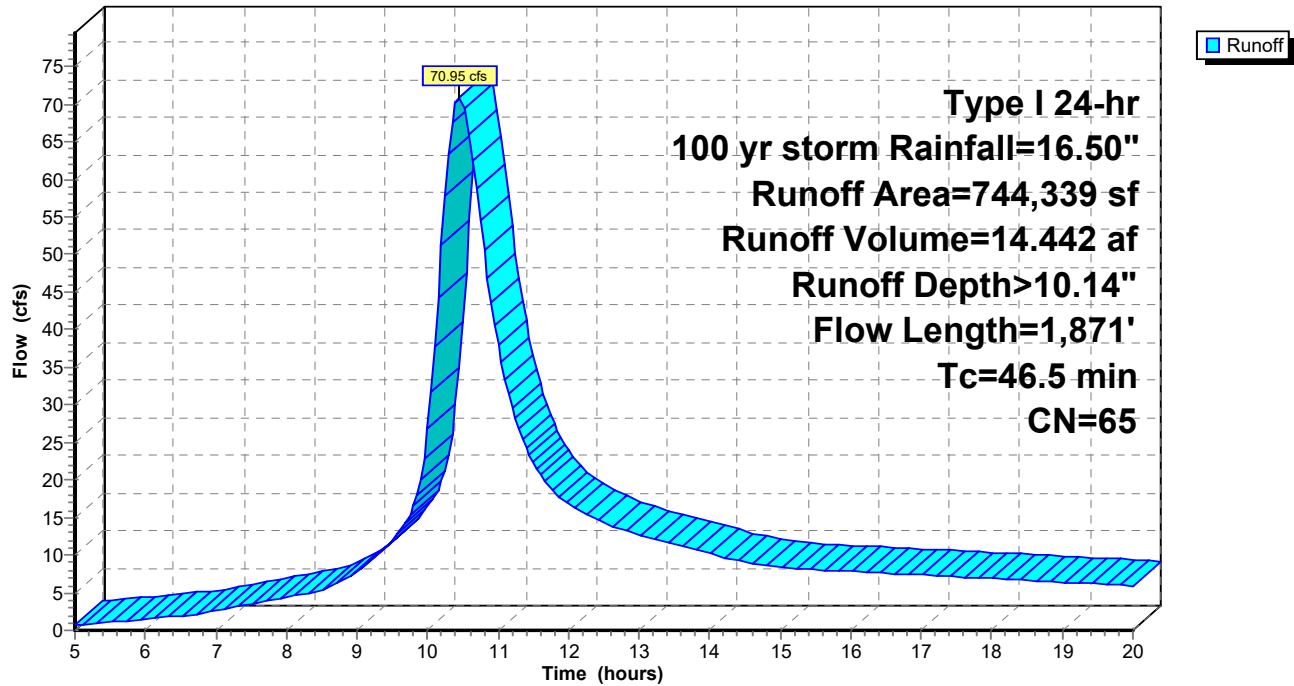
Type I 24-hr 100 yr storm Rainfall=16.50"

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Subcatchment D: Basin D

Hydrograph



Hokua Concept Existing Condition

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Type I 24-hr 100 yr storm Rainfall=16.50"

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Summary for Subcatchment E: Basin E

Runoff = 100.95 cfs @ 10.53 hrs, Volume= 22.324 af, Depth> 7.04"

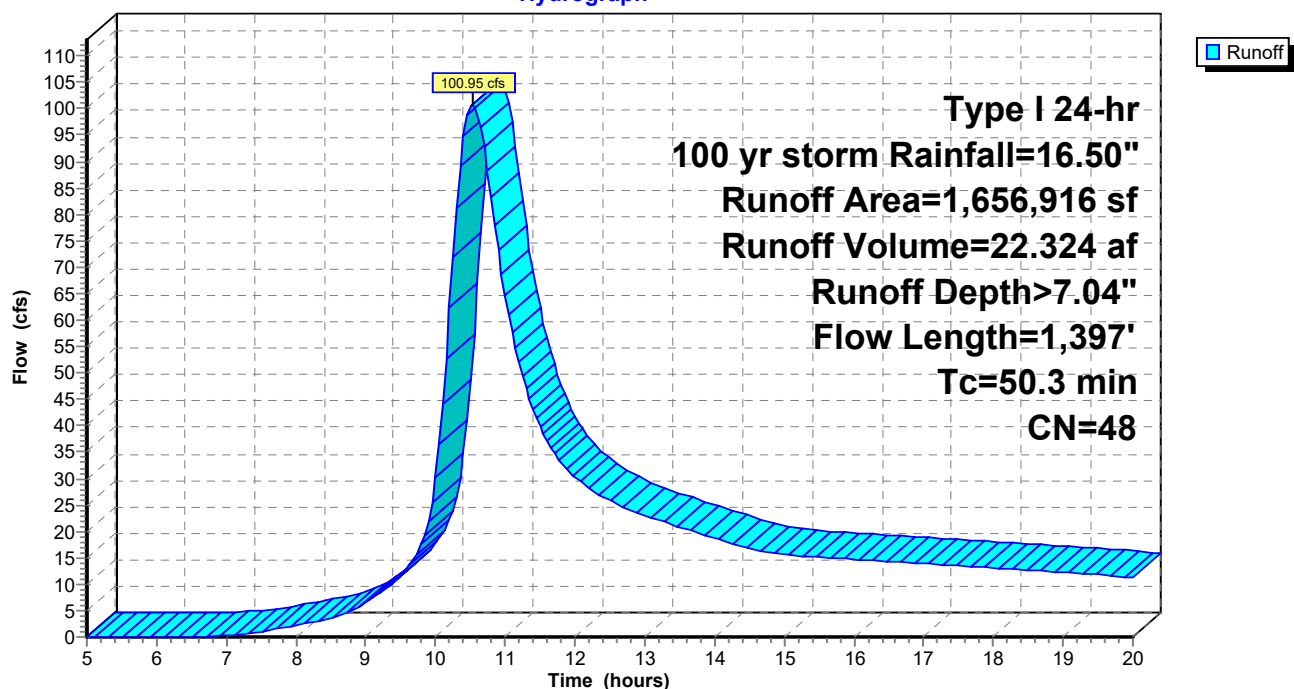
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type I 24-hr 100 yr storm Rainfall=16.50"

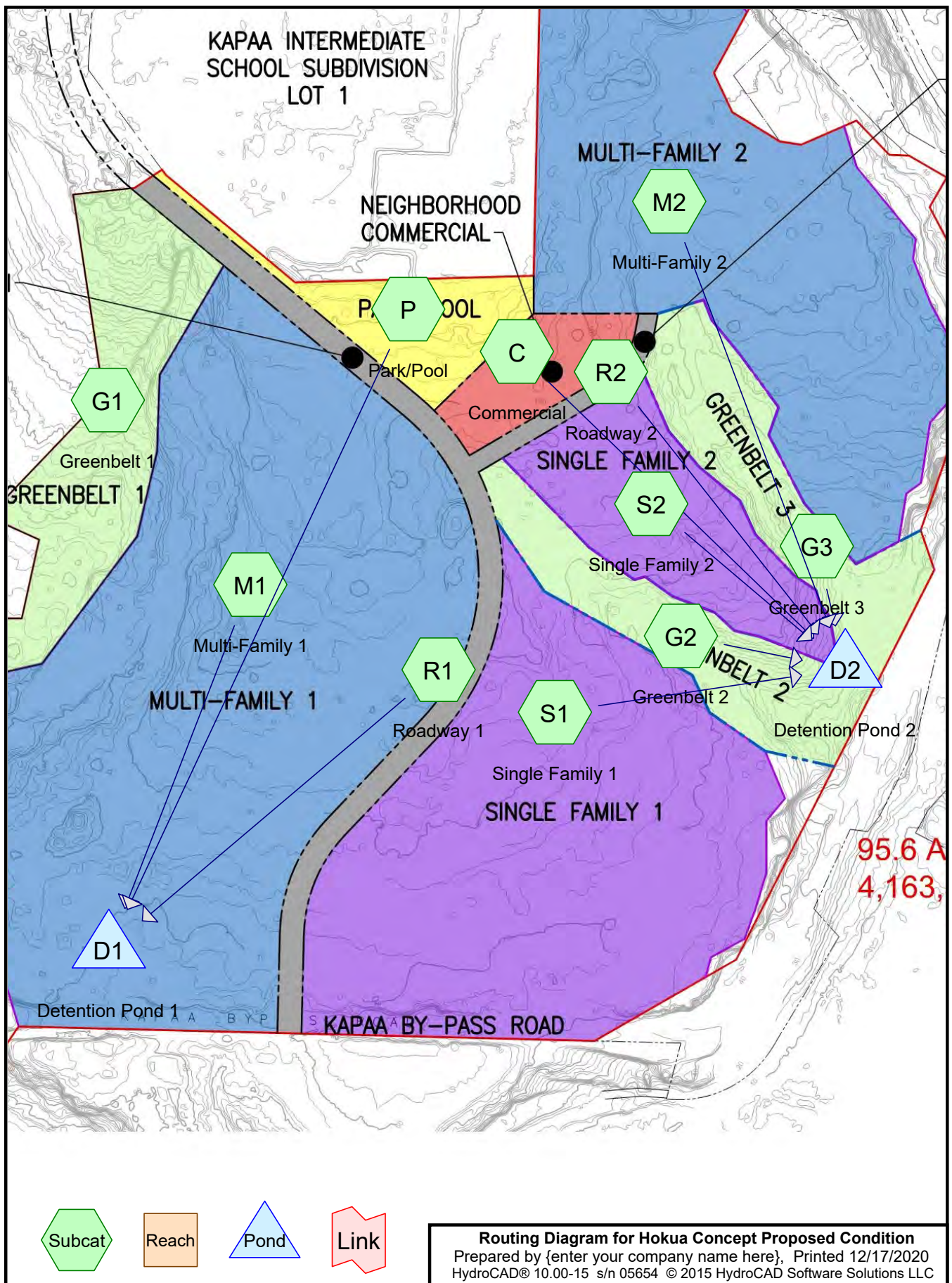
Area (sf)	CN	Description
1,656,916	48	Brush, Good, HSG B
1,656,916		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
34.1	300	0.0280	0.15		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 5.63"
1.2	60	0.0280	0.84		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
7.8	423	0.0330	0.91		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
2.9	166	0.0370	0.96		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
4.3	448	0.1230	1.75		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
50.3	1,397	Total			

Subcatchment E: Basin E

Hydrograph





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Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
6.840	61	>75% Grass cover, Good, HSG B (S1)
21.990	74	>75% Grass cover, Good, HSG C (C, M1, M2, P, S2)
14.130	65	Brush, Good, HSG C (G1, G2, G3)
11.410	98	Unconnected pavement, HSG B (S1)
37.120	98	Unconnected pavement, HSG C (C, M1, M2, P, R1, R2, S2)
91.490	84	TOTAL AREA

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Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	6.840	21.990	0.000	0.000	28.830	>75% Grass cover, Good	C, M1, M2, P, S1, S2
0.000	0.000	14.130	0.000	0.000	14.130	Brush, Good	G1, G2, G3
0.000	11.410	37.120	0.000	0.000	48.530	Unconnected pavement	C, M1, M2, P, R1, R2, S1, S2
0.000	18.250	73.240	0.000	0.000	91.490	TOTAL AREA	

Hokua Concept Proposed Condition

Type I 24-hr 2 yr storm Rainfall=5.63"

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Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

SubcatchmentC: Commercial Runoff Area=1.810 ac 70.17% Impervious Runoff Depth>4.13"
Flow Length=150' Slope=0.0200 '/' Tc=1.3 min CN=91 Runoff=7.25 cfs 0.623 af

SubcatchmentG1: Greenbelt 1 Runoff Area=6.140 ac 0.00% Impervious Runoff Depth>1.81"
Flow Length=1,502' Tc=6.1 min CN=65 Runoff=9.29 cfs 0.928 af

SubcatchmentG2: Greenbelt 2 Runoff Area=3.950 ac 0.00% Impervious Runoff Depth>1.81"
Flow Length=1,185' Tc=7.8 min CN=65 Runoff=5.76 cfs 0.597 af

SubcatchmentG3: Greenbelt 3 Runoff Area=4.040 ac 0.00% Impervious Runoff Depth>1.82"
Flow Length=1,016' Tc=3.7 min CN=65 Runoff=6.49 cfs 0.612 af

SubcatchmentM1: Multi-Family 1 Runoff Area=29.310 ac 62.50% Impervious Runoff Depth>3.94"
Flow Length=150' Slope=0.0200 '/' Tc=10.2 min CN=89 Runoff=94.65 cfs 9.620 af

SubcatchmentM2: Multi-Family 2 Runoff Area=17.090 ac 62.49% Impervious Runoff Depth>3.94"
Flow Length=150' Slope=0.0200 '/' Tc=10.2 min CN=89 Runoff=55.19 cfs 5.609 af

SubcatchmentP: Park/Pool Runoff Area=2.460 ac 6.91% Impervious Runoff Depth>2.64"
Flow Length=150' Slope=0.0200 '/' Tc=10.2 min UI Adjusted CN=75 Runoff=5.24 cfs 0.541 af

SubcatchmentR1: Roadway 1 Runoff Area=3.180 ac 100.00% Impervious Runoff Depth>4.64"
Flow Length=150' Slope=0.0100 '/' Tc=1.2 min CN=98 Runoff=13.96 cfs 1.230 af

SubcatchmentR2: Roadway 2 Runoff Area=0.560 ac 100.00% Impervious Runoff Depth>4.64"
Flow Length=150' Slope=0.0100 '/' Tc=1.2 min CN=98 Runoff=2.46 cfs 0.217 af

SubcatchmentS1: Single Family 1 Runoff Area=18.250 ac 62.52% Impervious Runoff Depth>3.47"
Flow Length=150' Slope=0.0200 '/' Tc=10.2 min CN=84 Runoff=52.06 cfs 5.278 af

SubcatchmentS2: Single Family 2 Runoff Area=4.700 ac 62.55% Impervious Runoff Depth>3.94"
Flow Length=150' Slope=0.0200 '/' Tc=10.2 min CN=89 Runoff=15.18 cfs 1.543 af

Pond D1: Detention Pond 1 Peak Elev=51.59' Storage=4.941 af Inflow=105.79 cfs 11.390 af
Outflow=16.41 cfs 8.673 af

Pond D2: Detention Pond 2 Peak Elev=23.43' Storage=3.941 af Inflow=137.55 cfs 14.478 af
Outflow=47.32 cfs 13.421 af

Total Runoff Area = 91.490 ac Runoff Volume = 26.797 af Average Runoff Depth = 3.51"
46.96% Pervious = 42.960 ac 53.04% Impervious = 48.530 ac

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Type I 24-hr 2 yr storm Rainfall=5.63"

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Summary for Subcatchment C: Commercial

[49] Hint: $T_c < 2dt$ may require smaller dt

Runoff = 7.25 cfs @ 9.89 hrs, Volume= 0.623 af, Depth> 4.13"

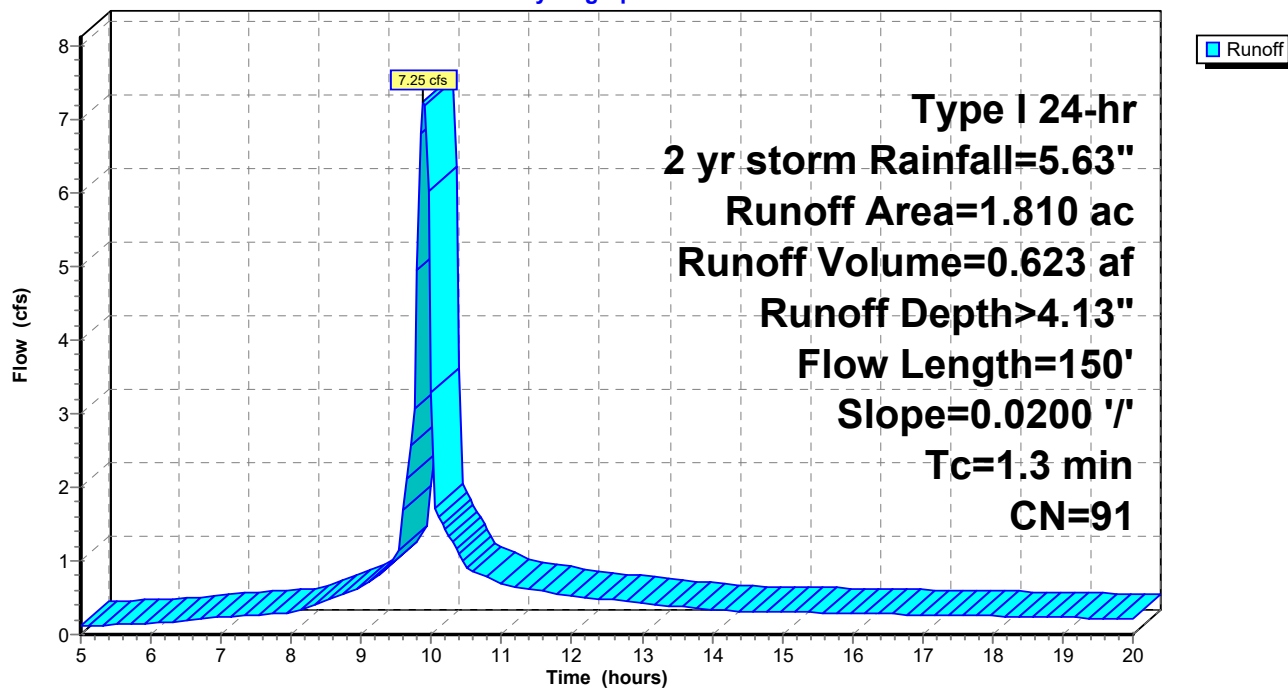
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, $dt=0.05$ hrs
Type I 24-hr 2 yr storm Rainfall=5.63"

Area (ac)	CN	Description
0.540	74	>75% Grass cover, Good, HSG C
1.270	98	Unconnected pavement, HSG C
1.810	91	Weighted Average
0.540		29.83% Pervious Area
1.270		70.17% Impervious Area
1.270		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.3	150	0.0200	1.98		Sheet Flow, Smooth surfaces $n=0.011$ $P2=5.63"$

Subcatchment C: Commercial

Hydrograph



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Type I 24-hr 2 yr storm Rainfall=5.63"

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Summary for Subcatchment G1: Greenbelt 1

Runoff = 9.29 cfs @ 9.97 hrs, Volume= 0.928 af, Depth> 1.81"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type I 24-hr 2 yr storm Rainfall=5.63"

Area (ac)	CN	Description
6.140	65	Brush, Good, HSG C
6.140		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	88	0.0880	2.08		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
0.2	100	0.2000	10.70	79.15	Trap/Vee/Rect Channel Flow, Bot.W=5.00' D=1.00' Z= 3.3 & 1.5 '/' Top.W=9.80' n= 0.050 Scattered brush, heavy weeds
0.9	385	0.0740	6.86	72.34	Trap/Vee/Rect Channel Flow, Bot.W=8.00' D=1.00' Z= 1.8 & 3.3 '/' Top.W=13.10' n= 0.050 Scattered brush, heavy weeds
1.8	552	0.0500	5.13	155.05	Trap/Vee/Rect Channel Flow, Bot.W=16.00' D=1.00' Z= 10.7 & 17.7 '/' Top.W=44.40' n= 0.050
2.5	377	0.0150	2.51	48.13	Trap/Vee/Rect Channel Flow, Bot.W=5.00' D=1.00' Z= 12.5 & 15.8 '/' Top.W=33.30' n= 0.050
6.1	1,502	Total			

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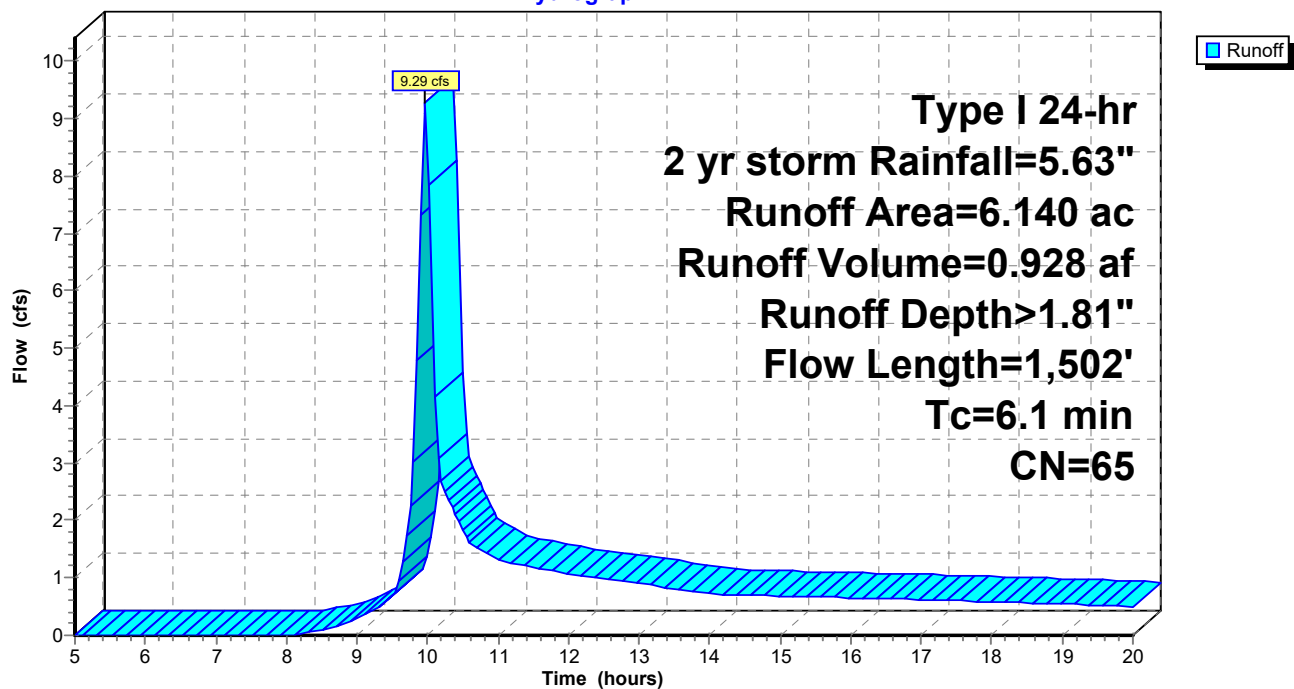
Type I 24-hr 2 yr storm Rainfall=5.63"

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Subcatchment G1: Greenbelt 1

Hydrograph



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Type I 24-hr 2 yr storm Rainfall=5.63"

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Summary for Subcatchment G2: Greenbelt 2

Runoff = 5.76 cfs @ 9.99 hrs, Volume= 0.597 af, Depth> 1.81"

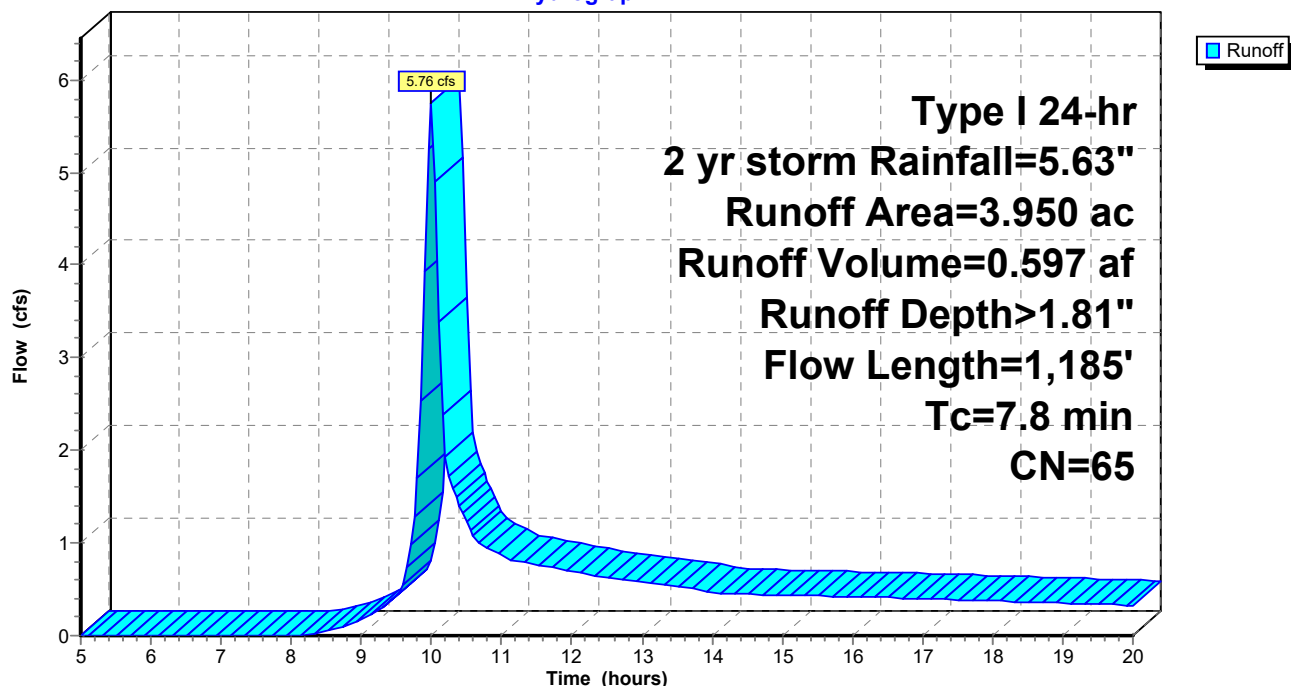
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type I 24-hr 2 yr storm Rainfall=5.63"

Area (ac)	CN	Description
3.950	65	Brush, Good, HSG C
3.950		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.8	384	0.0480	1.10		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
0.9	393	0.0700	6.97	101.02	Trap/Vee/Rect Channel Flow, Bot.W=12.00' D=1.00' Z= 2.4 & 2.6 '/' Top.W=17.00' n= 0.050
0.6	172	0.0370	5.14	279.11	Trap/Vee/Rect Channel Flow, Bot.W=45.00' D=1.00' Z= 5.0 & 13.7 '/' Top.W=63.70' n= 0.050
0.5	236	0.0830	8.18	701.40	Trap/Vee/Rect Channel Flow, Bot.W=80.00' D=1.00' Z= 9.9 & 1.6 '/' Top.W=91.50' n= 0.050
7.8	1,185	Total			

Subcatchment G2: Greenbelt 2

Hydrograph



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Type I 24-hr 2 yr storm Rainfall=5.63"

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Summary for Subcatchment G3: Greenbelt 3

[49] Hint: Tc<2dt may require smaller dt

Runoff = 6.49 cfs @ 9.94 hrs, Volume= 0.612 af, Depth> 1.82"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type I 24-hr 2 yr storm Rainfall=5.63"

Area (ac)	CN	Description
4.040	65	Brush, Good, HSG C
4.040		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	218	0.0380	5.46	540.30	Trap/Vee/Rect Channel Flow, Bot.W=90.00' D=1.00' Z= 15.0 & 2.8 '/' Top.W=107.80' n= 0.050
0.7	256	0.0620	6.30	215.55	Trap/Vee/Rect Channel Flow, Bot.W=25.00' D=1.00' Z= 7.4 & 11.0 '/' Top.W=43.40' n= 0.050
0.7	271	0.0470	6.09	210.72	Trap/Vee/Rect Channel Flow, Bot.W=32.00' D=1.00' Z= 3.8 & 1.4 '/' Top.W=37.20' n= 0.050
0.2	126	0.1300	10.25	547.15	Trap/Vee/Rect Channel Flow, Bot.W=50.00' D=1.00' Z= 4.4 & 2.4 '/' Top.W=56.80' n= 0.050
1.4	145	0.1140	1.69		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
3.7	1,016	Total			

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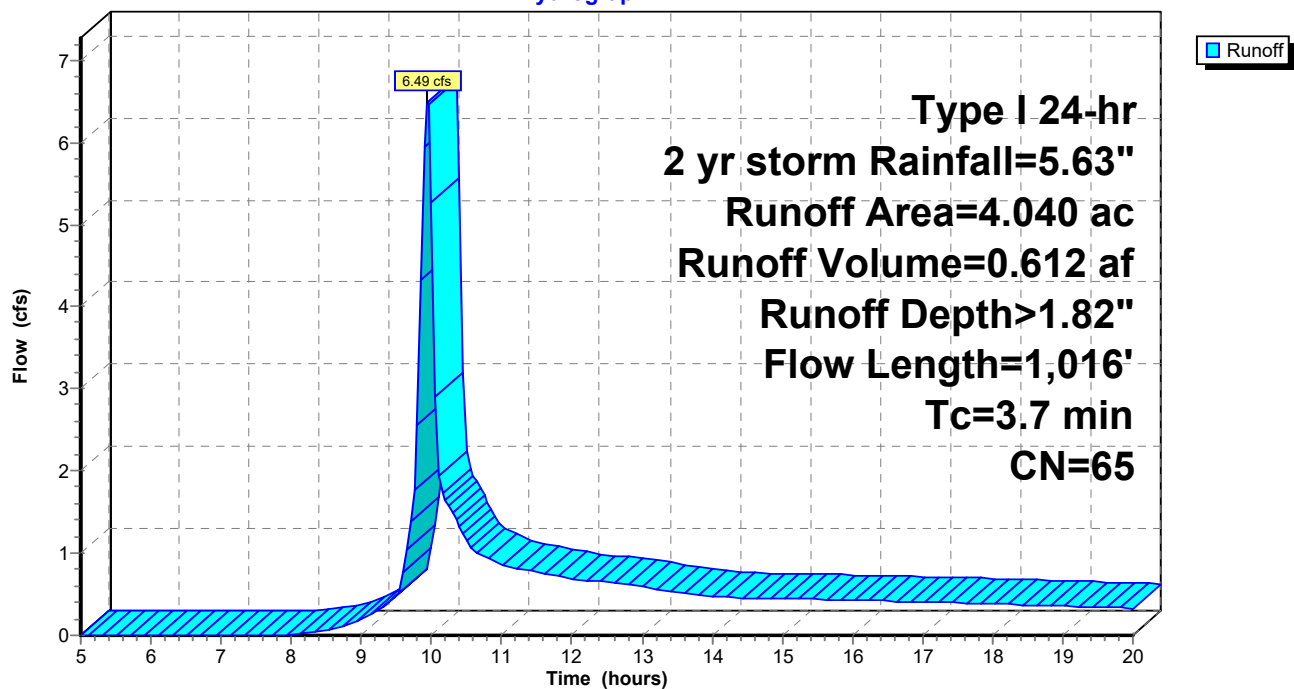
Type I 24-hr 2 yr storm Rainfall=5.63"

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Subcatchment G3: Greenbelt 3

Hydrograph



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Type I 24-hr 2 yr storm Rainfall=5.63"

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Summary for Subcatchment M1: Multi-Family 1

Runoff = 94.65 cfs @ 10.01 hrs, Volume= 9.620 af, Depth> 3.94"

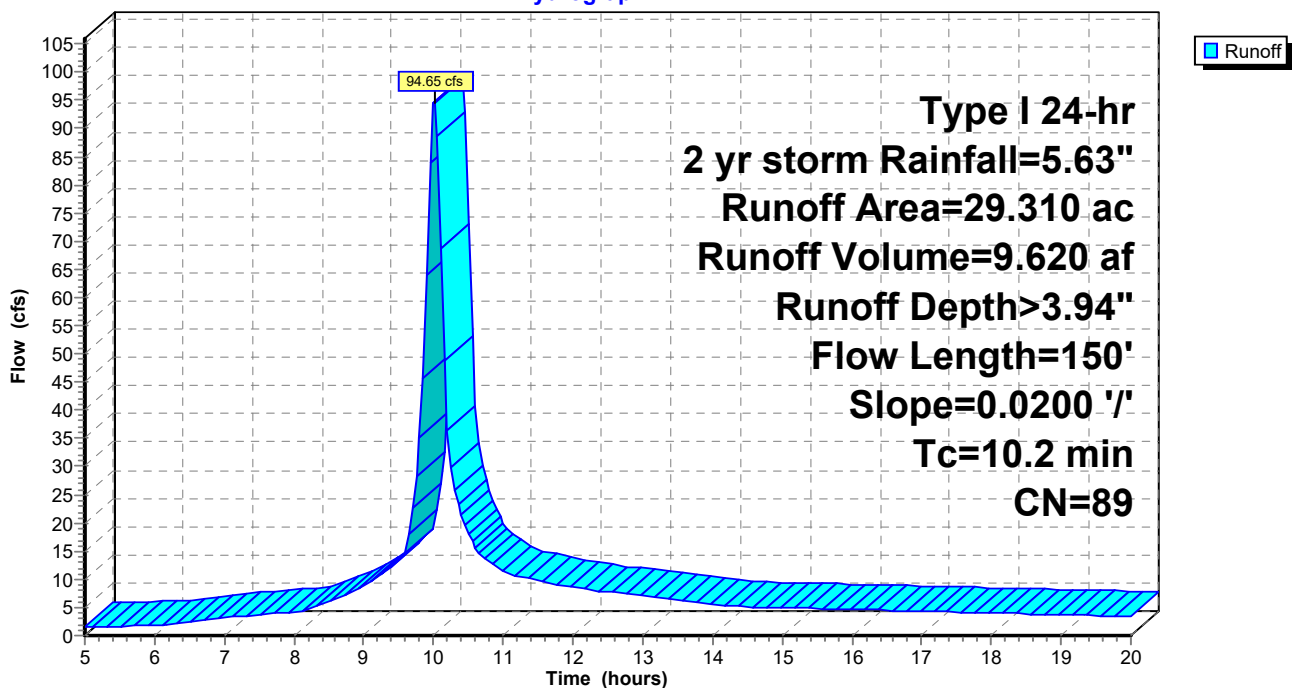
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type I 24-hr 2 yr storm Rainfall=5.63"

Area (ac)	CN	Description
10.990	74	>75% Grass cover, Good, HSG C
18.320	98	Unconnected pavement, HSG C
29.310	89	Weighted Average
10.990		37.50% Pervious Area
18.320		62.50% Impervious Area
18.320		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.2	150	0.0200	0.24		Sheet Flow, Grass: Short n= 0.150 P2= 5.63"

Subcatchment M1: Multi-Family 1

Hydrograph



Hokua Concept Proposed Condition

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Type I 24-hr 2 yr storm Rainfall=5.63"

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Summary for Subcatchment M2: Multi-Family 2

Runoff = 55.19 cfs @ 10.01 hrs, Volume= 5.609 af, Depth> 3.94"

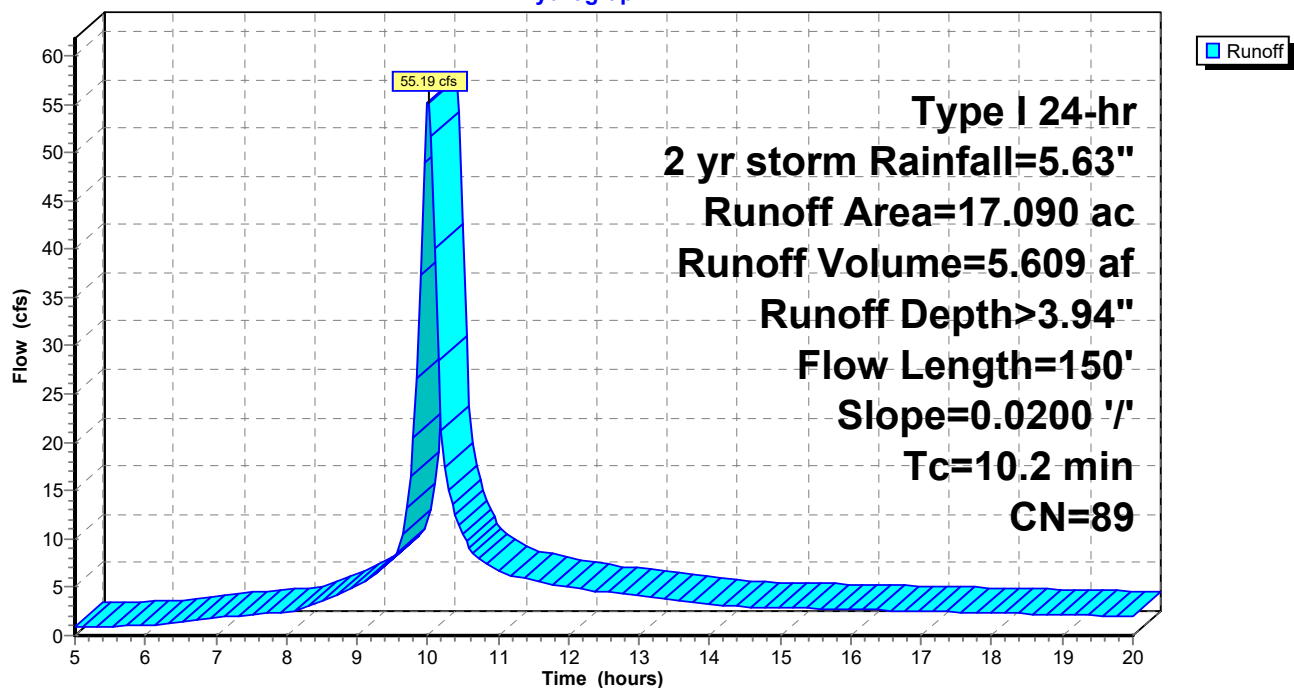
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type I 24-hr 2 yr storm Rainfall=5.63"

Area (ac)	CN	Description
6.410	74	>75% Grass cover, Good, HSG C
10.680	98	Unconnected pavement, HSG C
17.090	89	Weighted Average
6.410		37.51% Pervious Area
10.680		62.49% Impervious Area
10.680		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.2	150	0.0200	0.24		Sheet Flow, Grass: Short n= 0.150 P2= 5.63"

Subcatchment M2: Multi-Family 2

Hydrograph



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Type I 24-hr 2 yr storm Rainfall=5.63"

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Summary for Subcatchment P: Park/Pool

Runoff = 5.24 cfs @ 10.01 hrs, Volume= 0.541 af, Depth> 2.64"

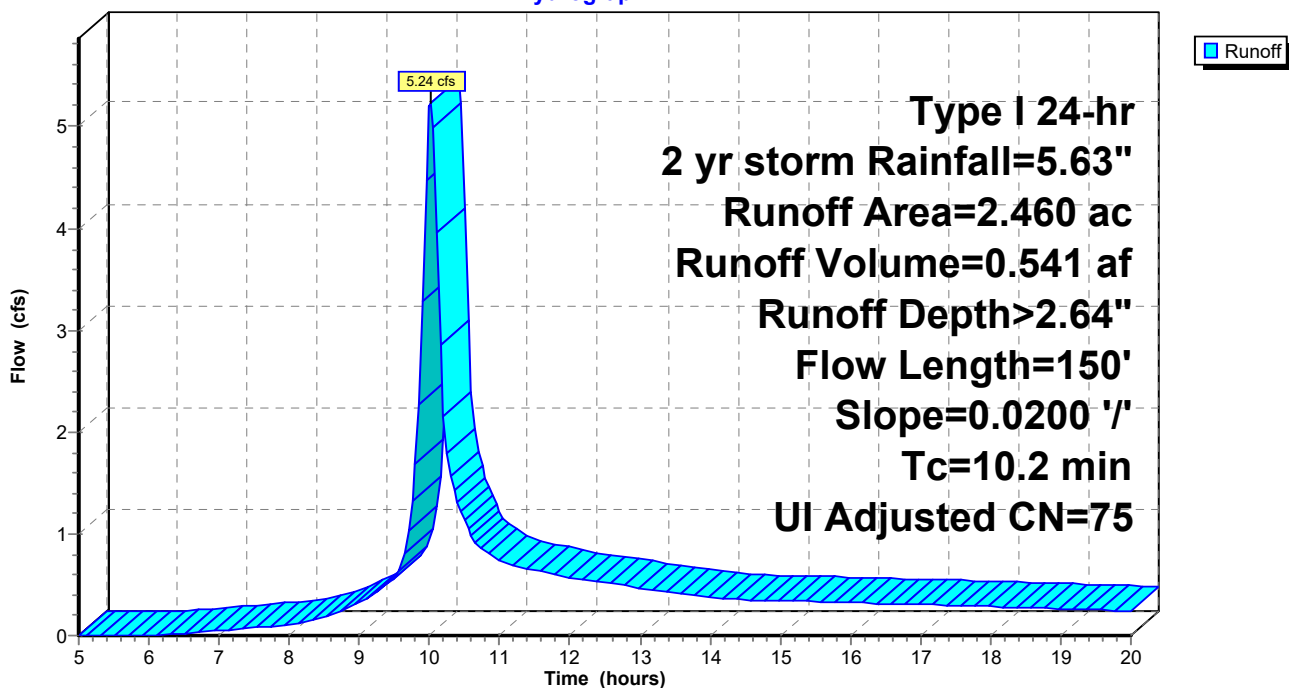
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type I 24-hr 2 yr storm Rainfall=5.63"

Area (ac)	CN	Adj	Description
2.290	74		>75% Grass cover, Good, HSG C
0.170	98		Unconnected pavement, HSG C
2.460	76	75	Weighted Average, UI Adjusted
2.290			93.09% Pervious Area
0.170			6.91% Impervious Area
0.170			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.2	150	0.0200	0.24		Sheet Flow, Grass: Short n= 0.150 P2= 5.63"

Subcatchment P: Park/Pool

Hydrograph



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Type I 24-hr 2 yr storm Rainfall=5.63"

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Summary for Subcatchment R1: Roadway 1

[49] Hint: $T_c < 2dt$ may require smaller dt

Runoff = 13.96 cfs @ 9.88 hrs, Volume= 1.230 af, Depth> 4.64"

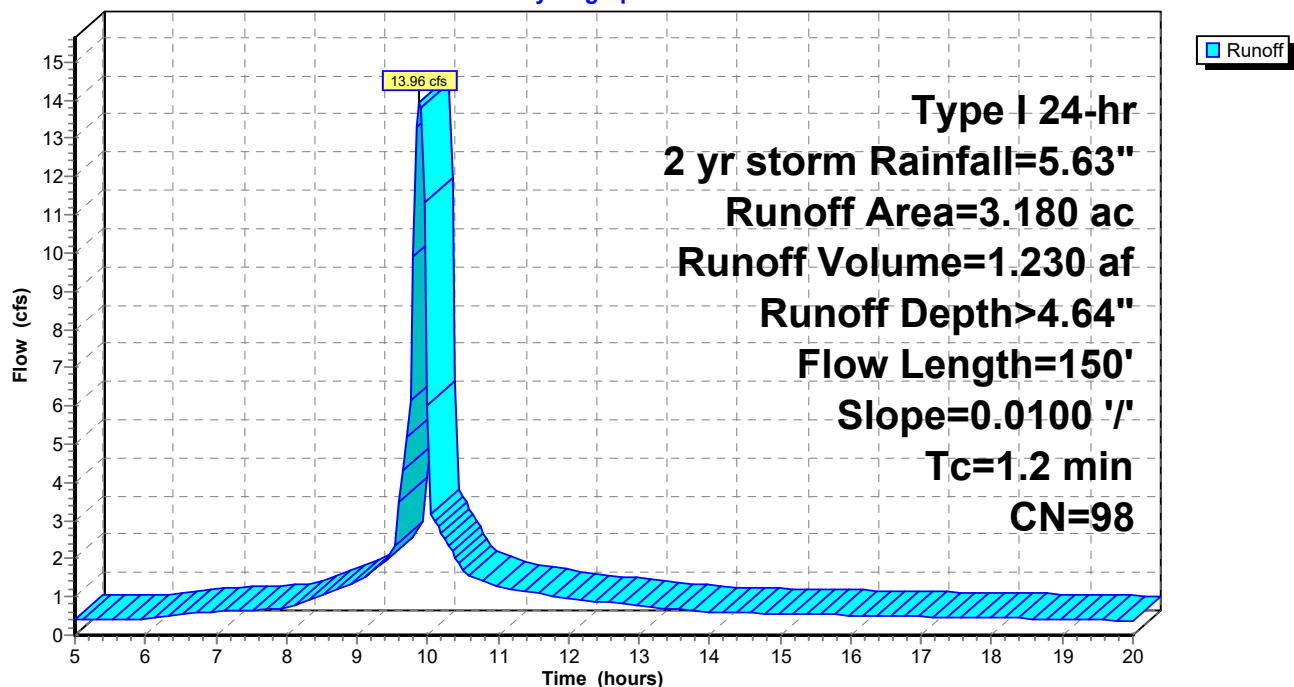
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, $dt=0.05$ hrs
Type I 24-hr 2 yr storm Rainfall=5.63"

Area (ac)	CN	Description
3.180	98	Unconnected pavement, HSG C
3.180		100.00% Impervious Area
3.180		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	150	0.0100	2.03		Shallow Concentrated Flow, Paved Kv= 20.3 fps

Subcatchment R1: Roadway 1

Hydrograph



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Type I 24-hr 2 yr storm Rainfall=5.63"

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Summary for Subcatchment R2: Roadway 2

[49] Hint: $T_c < 2dt$ may require smaller dt

Runoff = 2.46 cfs @ 9.88 hrs, Volume= 0.217 af, Depth> 4.64"

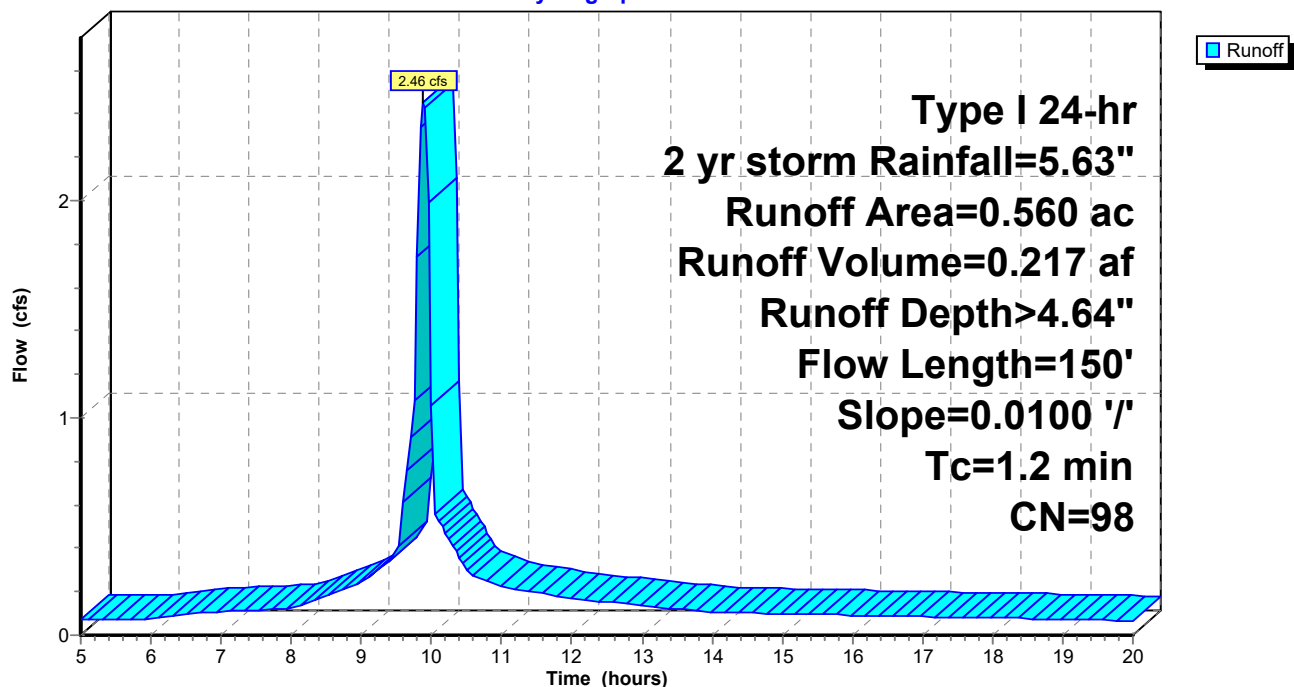
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, $dt=0.05$ hrs
Type I 24-hr 2 yr storm Rainfall=5.63"

Area (ac)	CN	Description
0.560	98	Unconnected pavement, HSG C
0.560		100.00% Impervious Area
0.560		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	150	0.0100	2.03		Shallow Concentrated Flow, Paved Kv= 20.3 fps

Subcatchment R2: Roadway 2

Hydrograph



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Type I 24-hr 2 yr storm Rainfall=5.63"

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Summary for Subcatchment S1: Single Family 1

Runoff = 52.06 cfs @ 10.01 hrs, Volume= 5.278 af, Depth> 3.47"

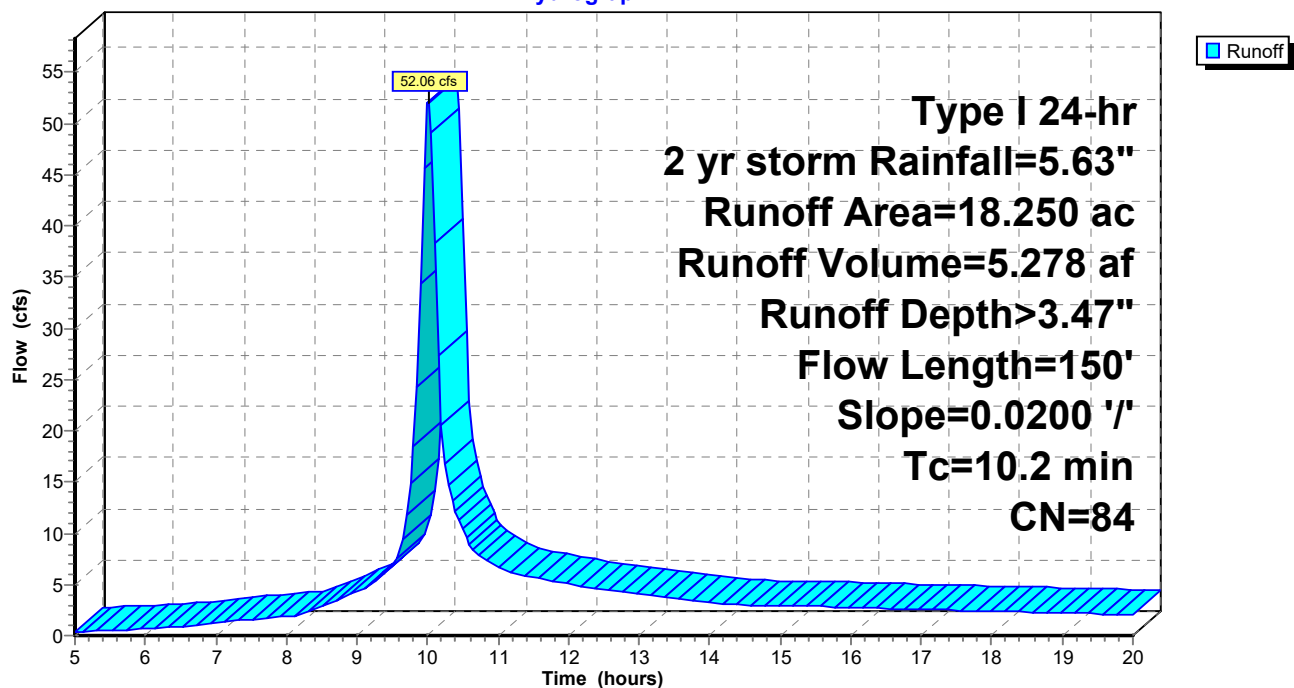
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type I 24-hr 2 yr storm Rainfall=5.63"

Area (ac)	CN	Description
6.840	61	>75% Grass cover, Good, HSG B
11.410	98	Unconnected pavement, HSG B
18.250	84	Weighted Average
6.840		37.48% Pervious Area
11.410		62.52% Impervious Area
11.410		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.2	150	0.0200	0.24		Sheet Flow, Grass: Short n= 0.150 P2= 5.63"

Subcatchment S1: Single Family 1

Hydrograph



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Type I 24-hr 2 yr storm Rainfall=5.63"

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Summary for Subcatchment S2: Single Family 2

Runoff = 15.18 cfs @ 10.01 hrs, Volume= 1.543 af, Depth> 3.94"

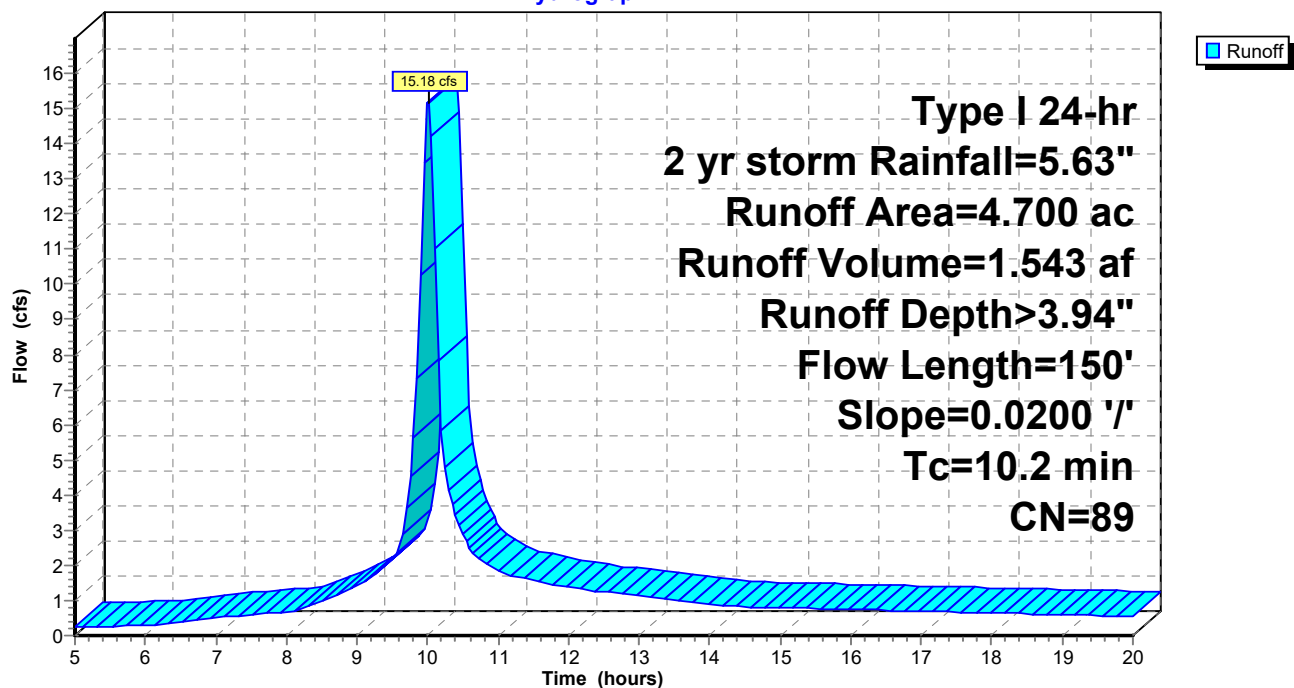
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type I 24-hr 2 yr storm Rainfall=5.63"

Area (ac)	CN	Description
1.760	74	>75% Grass cover, Good, HSG C
2.940	98	Unconnected pavement, HSG C
4.700	89	Weighted Average
1.760		37.45% Pervious Area
2.940		62.55% Impervious Area
2.940		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.2	150	0.0200	0.24		Sheet Flow, Grass: Short n= 0.150 P2= 5.63"

Subcatchment S2: Single Family 2

Hydrograph



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Type I 24-hr 2 yr storm Rainfall=5.63"

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Summary for Pond D1: Detention Pond 1

[82] Warning: Early inflow requires earlier time span

Inflow Area = 34.950 ac, 62.00% Impervious, Inflow Depth > 3.91" for 2 yr storm event
Inflow = 105.79 cfs @ 9.99 hrs, Volume= 11.390 af
Outflow = 16.41 cfs @ 10.69 hrs, Volume= 8.673 af, Atten= 84%, Lag= 42.0 min
Primary = 16.41 cfs @ 10.69 hrs, Volume= 8.673 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 51.59' @ 10.69 hrs Surf.Area= 3.099 ac Storage= 4.941 af

Plug-Flow detention time= 220.5 min calculated for 8.670 af (76% of inflow)
Center-of-Mass det. time= 127.9 min (830.2 - 702.3)

Volume	Invert	Avail.Storage	Storage Description
#1	50.00'	15.496 af	300.00'W x 450.00'L x 5.00'H Prismatic

Device	Routing	Invert	Outlet Devices
#1	Primary	54.50'	100.0' long Sharp-Crested Rectangular Weir 2 End Contraction(s)
#2	Primary	50.00'	36.0" Round Culvert L= 50.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 50.00' / 49.00' S= 0.0200'/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 7.07 sf

Primary OutFlow Max=16.41 cfs @ 10.69 hrs HW=51.59' (Free Discharge)

1=Sharp-Crested Rectangular Weir(Controls 0.00 cfs)
2=Culvert (Inlet Controls 16.41 cfs @ 4.30 fps)

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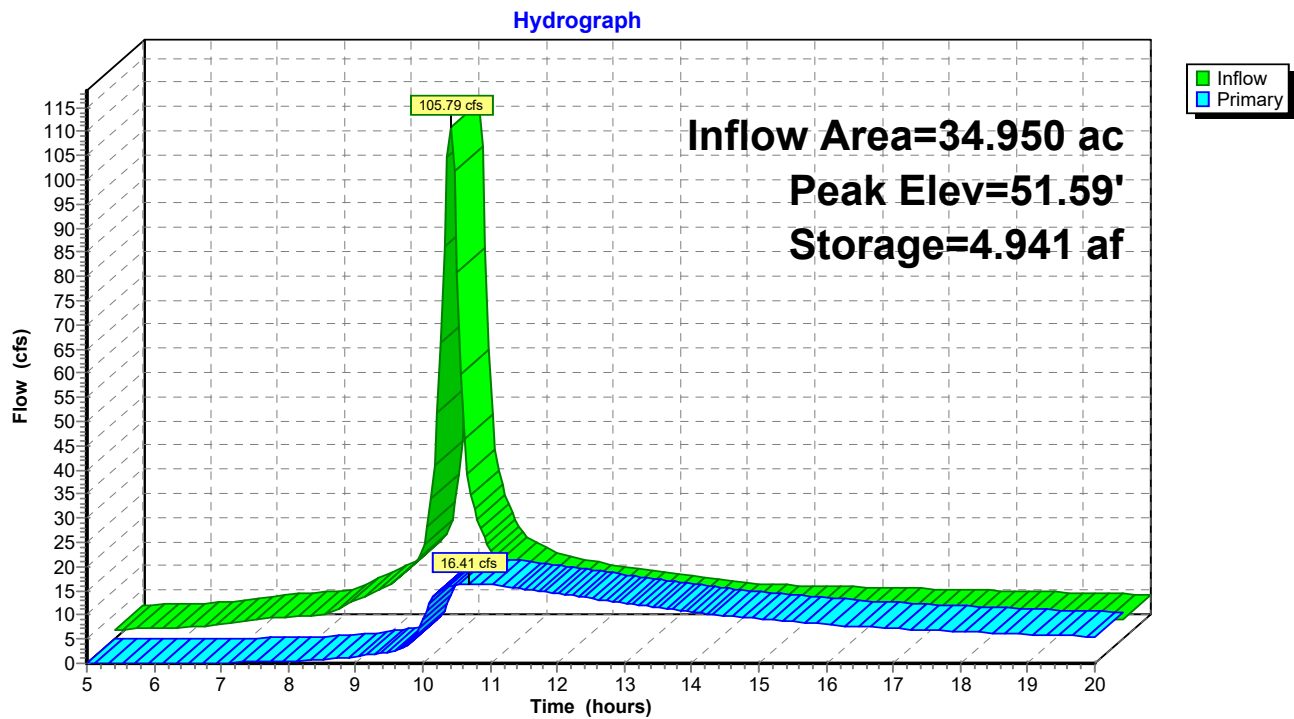
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Type I 24-hr 2 yr storm Rainfall=5.63"

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Pond D1: Detention Pond 1



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Type I 24-hr 2 yr storm Rainfall=5.63"

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Summary for Pond D2: Detention Pond 2

[82] Warning: Early inflow requires earlier time span

Inflow Area = 50.400 ac, 53.29% Impervious, Inflow Depth > 3.45" for 2 yr storm event
Inflow = 137.55 cfs @ 10.00 hrs, Volume= 14.478 af
Outflow = 47.32 cfs @ 10.23 hrs, Volume= 13.421 af, Atten= 66%, Lag= 14.3 min
Primary = 47.32 cfs @ 10.23 hrs, Volume= 13.421 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 23.43' @ 10.23 hrs Surf.Area= 1.148 ac Storage= 3.941 af

Plug-Flow detention time= 83.3 min calculated for 13.373 af (92% of inflow)
Center-of-Mass det. time= 50.0 min (763.6 - 713.6)

Volume	Invert	Avail.Storage	Storage Description
#1	20.00'	14.348 af	100.00'W x 500.00'L x 12.50'H Prisma

Device	Routing	Invert	Outlet Devices
#1	Primary	32.00'	100.0' long Sharp-Crested Rectangular Weir 2 End Contraction(s)
#2	Primary	20.00'	36.0" Round Culvert L= 50.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 20.00' / 19.00' S= 0.0200'/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 7.07 sf

Primary OutFlow Max=47.30 cfs @ 10.23 hrs HW=23.43' (Free Discharge)

1=Sharp-Crested Rectangular Weir(Controls 0.00 cfs)
2=Culvert (Inlet Controls 47.30 cfs @ 6.69 fps)

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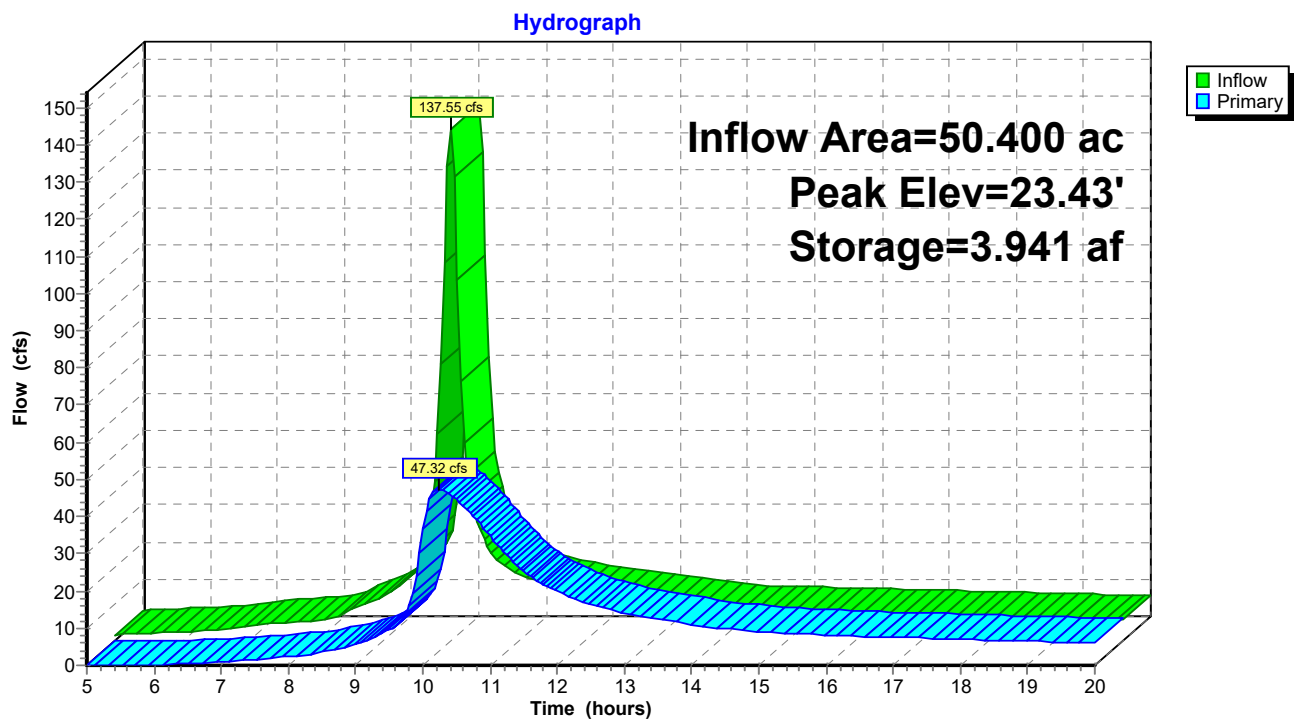
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Type I 24-hr 2 yr storm Rainfall=5.63"

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Pond D2: Detention Pond 2



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Type I 24-hr 100 yr storm Rainfall=16.50"

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Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

SubcatchmentC: Commercial Runoff Area=1.810 ac 70.17% Impervious Runoff Depth>13.41"
Flow Length=150' Slope=0.0200 '/' Tc=1.3 min CN=91 Runoff=23.06 cfs 2.022 af

SubcatchmentG1: Greenbelt 1 Runoff Area=6.140 ac 0.00% Impervious Runoff Depth>10.32"
Flow Length=1,502' Tc=6.1 min CN=65 Runoff=57.51 cfs 5.281 af

SubcatchmentG2: Greenbelt 2 Runoff Area=3.950 ac 0.00% Impervious Runoff Depth>10.31"
Flow Length=1,185' Tc=7.8 min CN=65 Runoff=35.62 cfs 3.395 af

SubcatchmentG3: Greenbelt 3 Runoff Area=4.040 ac 0.00% Impervious Runoff Depth>10.33"
Flow Length=1,016' Tc=3.7 min CN=65 Runoff=39.80 cfs 3.478 af

SubcatchmentM1: Multi-Family 1 Runoff Area=29.310 ac 62.50% Impervious Runoff Depth>13.25"
Flow Length=150' Slope=0.0200 '/' Tc=10.2 min CN=89 Runoff=311.96 cfs 32.372 af

SubcatchmentM2: Multi-Family 2 Runoff Area=17.090 ac 62.49% Impervious Runoff Depth>13.25"
Flow Length=150' Slope=0.0200 '/' Tc=10.2 min CN=89 Runoff=181.90 cfs 18.876 af

SubcatchmentP: Park/Pool Runoff Area=2.460 ac 6.91% Impervious Runoff Depth>11.75"
Flow Length=150' Slope=0.0200 '/' Tc=10.2 min UI Adjusted CN=75 Runoff=23.68 cfs 2.410 af

SubcatchmentR1: Roadway 1 Runoff Area=3.180 ac 100.00% Impervious Runoff Depth>13.73"
Flow Length=150' Slope=0.0100 '/' Tc=1.2 min CN=98 Runoff=41.13 cfs 3.638 af

SubcatchmentR2: Roadway 2 Runoff Area=0.560 ac 100.00% Impervious Runoff Depth>13.73"
Flow Length=150' Slope=0.0100 '/' Tc=1.2 min CN=98 Runoff=7.24 cfs 0.641 af

SubcatchmentS1: Single Family 1 Runoff Area=18.250 ac 62.52% Impervious Runoff Depth>12.80"
Flow Length=150' Slope=0.0200 '/' Tc=10.2 min CN=84 Runoff=189.15 cfs 19.467 af

SubcatchmentS2: Single Family 2 Runoff Area=4.700 ac 62.55% Impervious Runoff Depth>13.25"
Flow Length=150' Slope=0.0200 '/' Tc=10.2 min CN=89 Runoff=50.02 cfs 5.191 af

Pond D1: Detention Pond 1 Peak Elev=54.72' Storage=14.620 af Inflow=353.57 cfs 38.420 af
Outflow=94.30 cfs 33.642 af

Pond D2: Detention Pond 2 Peak Elev=32.40' Storage=14.236 af Inflow=501.00 cfs 53.069 af
Outflow=196.02 cfs 51.099 af

Total Runoff Area = 91.490 ac Runoff Volume = 96.770 af Average Runoff Depth = 12.69"
46.96% Pervious = 42.960 ac 53.04% Impervious = 48.530 ac

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Summary for Subcatchment C: Commercial

[49] Hint: $T_c < 2dt$ may require smaller dt

Runoff = 23.06 cfs @ 9.89 hrs, Volume= 2.022 af, Depth>13.41"

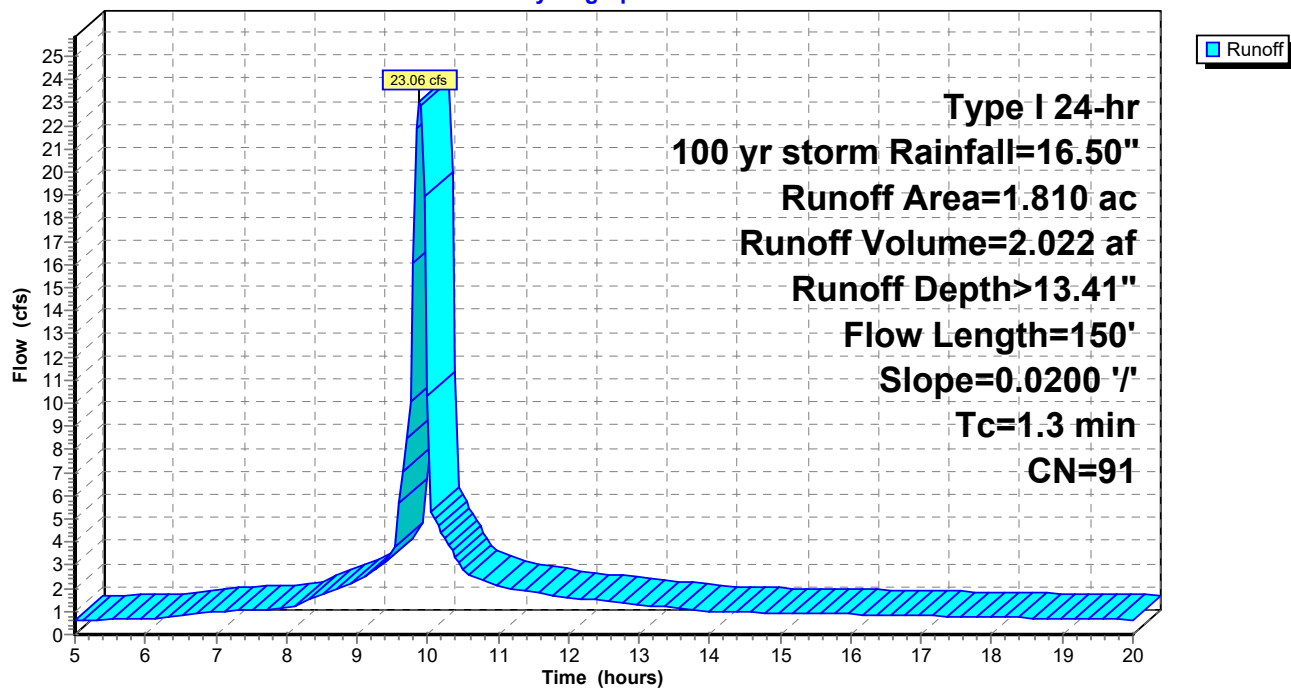
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, $dt=0.05$ hrs
Type I 24-hr 100 yr storm Rainfall=16.50"

Area (ac)	CN	Description
0.540	74	>75% Grass cover, Good, HSG C
1.270	98	Unconnected pavement, HSG C
1.810	91	Weighted Average
0.540		29.83% Pervious Area
1.270		70.17% Impervious Area
1.270		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.3	150	0.0200	1.98		Sheet Flow, Smooth surfaces $n=0.011$ $P2=5.63"$

Subcatchment C: Commercial

Hydrograph



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Type I 24-hr 100 yr storm Rainfall=16.50"

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Summary for Subcatchment G1: Greenbelt 1

Runoff = 57.51 cfs @ 9.96 hrs, Volume= 5.281 af, Depth>10.32"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type I 24-hr 100 yr storm Rainfall=16.50"

Area (ac)	CN	Description			
6.140	65	Brush, Good, HSG C			
6.140		100.00% Pervious Area			
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	88	0.0880	2.08		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
0.2	100	0.2000	10.70	79.15	Trap/Vee/Rect Channel Flow, Bot.W=5.00' D=1.00' Z= 3.3 & 1.5 ' Top.W=9.80' n= 0.050 Scattered brush, heavy weeds
0.9	385	0.0740	6.86	72.34	Trap/Vee/Rect Channel Flow, Bot.W=8.00' D=1.00' Z= 1.8 & 3.3 ' Top.W=13.10' n= 0.050 Scattered brush, heavy weeds
1.8	552	0.0500	5.13	155.05	Trap/Vee/Rect Channel Flow, Bot.W=16.00' D=1.00' Z= 10.7 & 17.7 ' Top.W=44.40' n= 0.050
2.5	377	0.0150	2.51	48.13	Trap/Vee/Rect Channel Flow, Bot.W=5.00' D=1.00' Z= 12.5 & 15.8 ' Top.W=33.30' n= 0.050
6.1	1,502	Total			

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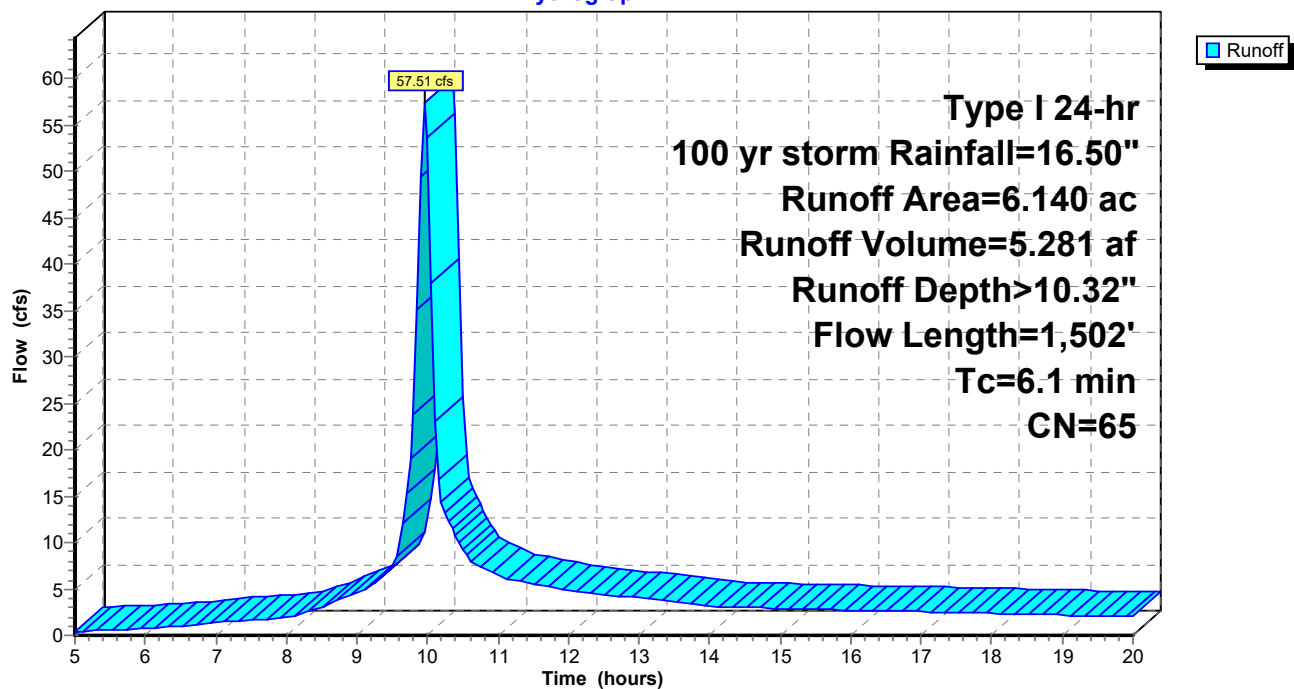
Type I 24-hr 100 yr storm Rainfall=16.50"

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Subcatchment G1: Greenbelt 1

Hydrograph



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Summary for Subcatchment G2: Greenbelt 2

Runoff = 35.62 cfs @ 9.98 hrs, Volume= 3.395 af, Depth>10.31"

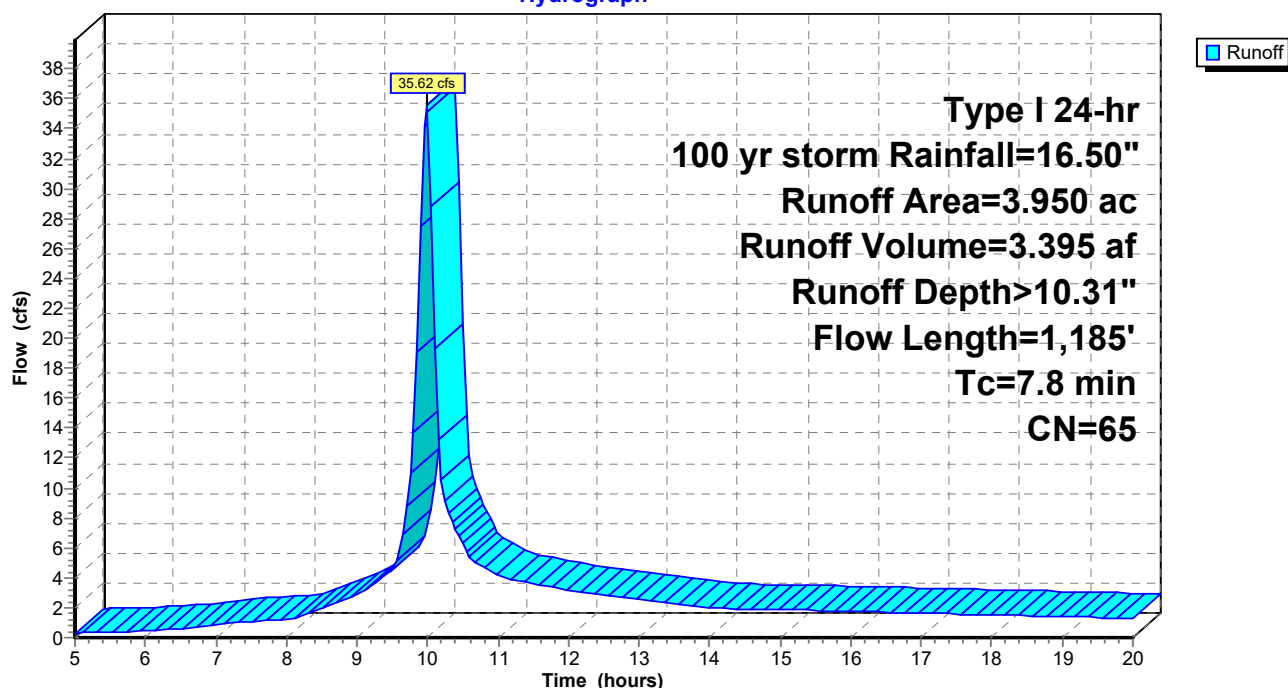
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type I 24-hr 100 yr storm Rainfall=16.50"

Area (ac)	CN	Description
3.950	65	Brush, Good, HSG C
3.950		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.8	384	0.0480	1.10		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
0.9	393	0.0700	6.97	101.02	Trap/Vee/Rect Channel Flow, Bot.W=12.00' D=1.00' Z= 2.4 & 2.6 '/' Top.W=17.00' n= 0.050
0.6	172	0.0370	5.14	279.11	Trap/Vee/Rect Channel Flow, Bot.W=45.00' D=1.00' Z= 5.0 & 13.7 '/' Top.W=63.70' n= 0.050
0.5	236	0.0830	8.18	701.40	Trap/Vee/Rect Channel Flow, Bot.W=80.00' D=1.00' Z= 9.9 & 1.6 '/' Top.W=91.50' n= 0.050
7.8	1,185	Total			

Subcatchment G2: Greenbelt 2

Hydrograph



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Type I 24-hr 100 yr storm Rainfall=16.50"

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Summary for Subcatchment G3: Greenbelt 3

[49] Hint: Tc<2dt may require smaller dt

Runoff = 39.80 cfs @ 9.93 hrs, Volume= 3.478 af, Depth>10.33"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type I 24-hr 100 yr storm Rainfall=16.50"

Area (ac)	CN	Description
4.040	65	Brush, Good, HSG C
4.040		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	218	0.0380	5.46	540.30	Trap/Vee/Rect Channel Flow, Bot.W=90.00' D=1.00' Z= 15.0 & 2.8 '/' Top.W=107.80' n= 0.050
0.7	256	0.0620	6.30	215.55	Trap/Vee/Rect Channel Flow, Bot.W=25.00' D=1.00' Z= 7.4 & 11.0 '/' Top.W=43.40' n= 0.050
0.7	271	0.0470	6.09	210.72	Trap/Vee/Rect Channel Flow, Bot.W=32.00' D=1.00' Z= 3.8 & 1.4 '/' Top.W=37.20' n= 0.050
0.2	126	0.1300	10.25	547.15	Trap/Vee/Rect Channel Flow, Bot.W=50.00' D=1.00' Z= 4.4 & 2.4 '/' Top.W=56.80' n= 0.050
1.4	145	0.1140	1.69		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
3.7	1,016	Total			

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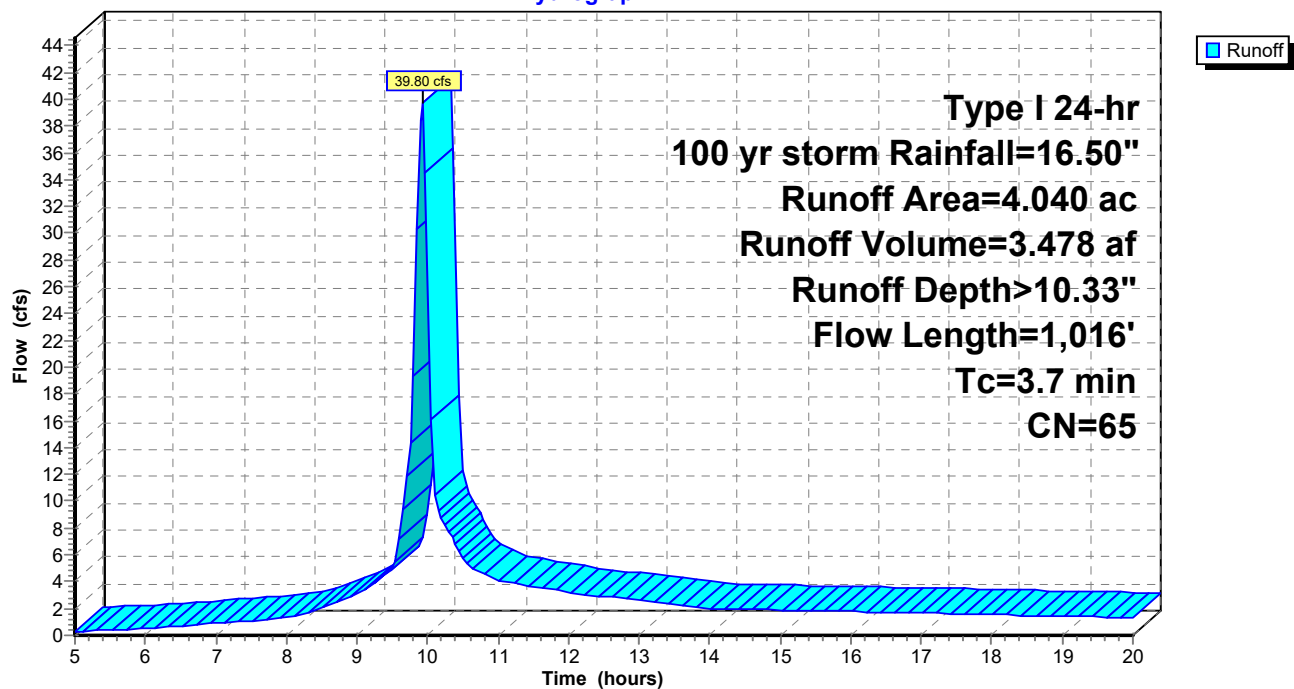
Type I 24-hr 100 yr storm Rainfall=16.50"

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Subcatchment G3: Greenbelt 3

Hydrograph



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Summary for Subcatchment M1: Multi-Family 1

Runoff = 311.96 cfs @ 10.00 hrs, Volume= 32.372 af, Depth>13.25"

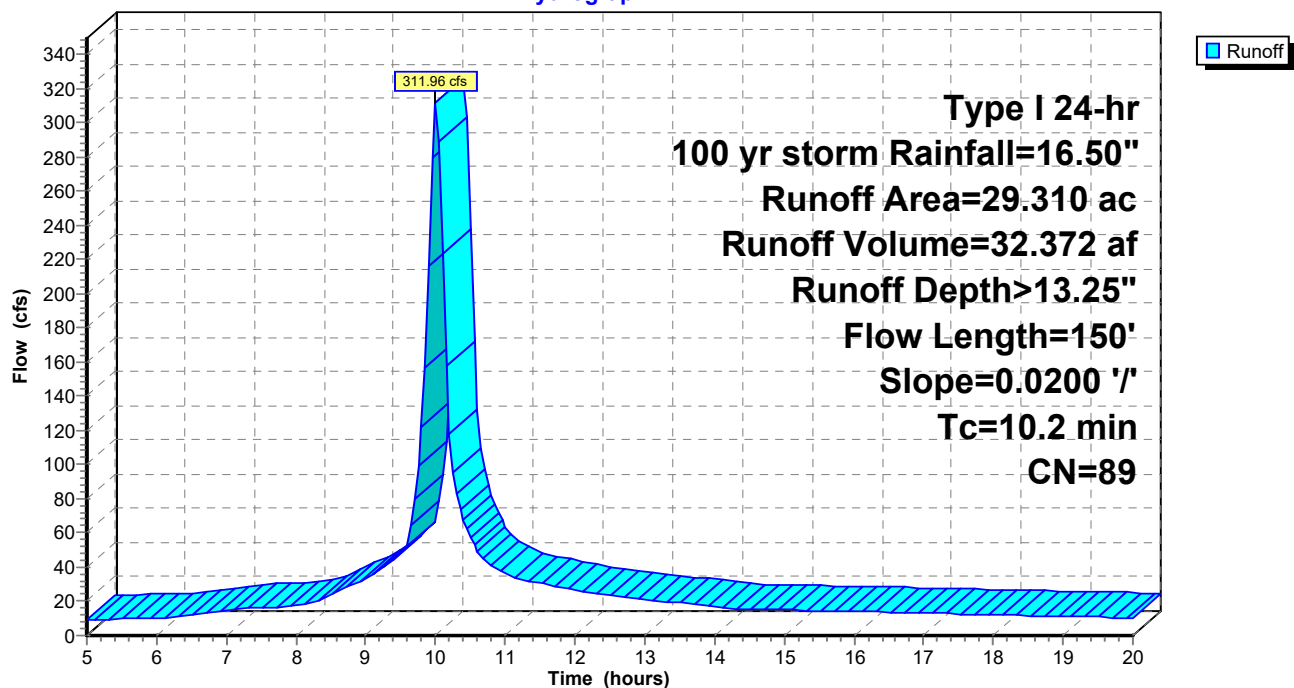
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type I 24-hr 100 yr storm Rainfall=16.50"

Area (ac)	CN	Description
10.990	74	>75% Grass cover, Good, HSG C
18.320	98	Unconnected pavement, HSG C
29.310	89	Weighted Average
10.990		37.50% Pervious Area
18.320		62.50% Impervious Area
18.320		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.2	150	0.0200	0.24		Sheet Flow, Grass: Short n= 0.150 P2= 5.63"

Subcatchment M1: Multi-Family 1

Hydrograph



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Type I 24-hr 100 yr storm Rainfall=16.50"

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Summary for Subcatchment M2: Multi-Family 2

Runoff = 181.90 cfs @ 10.00 hrs, Volume= 18.876 af, Depth>13.25"

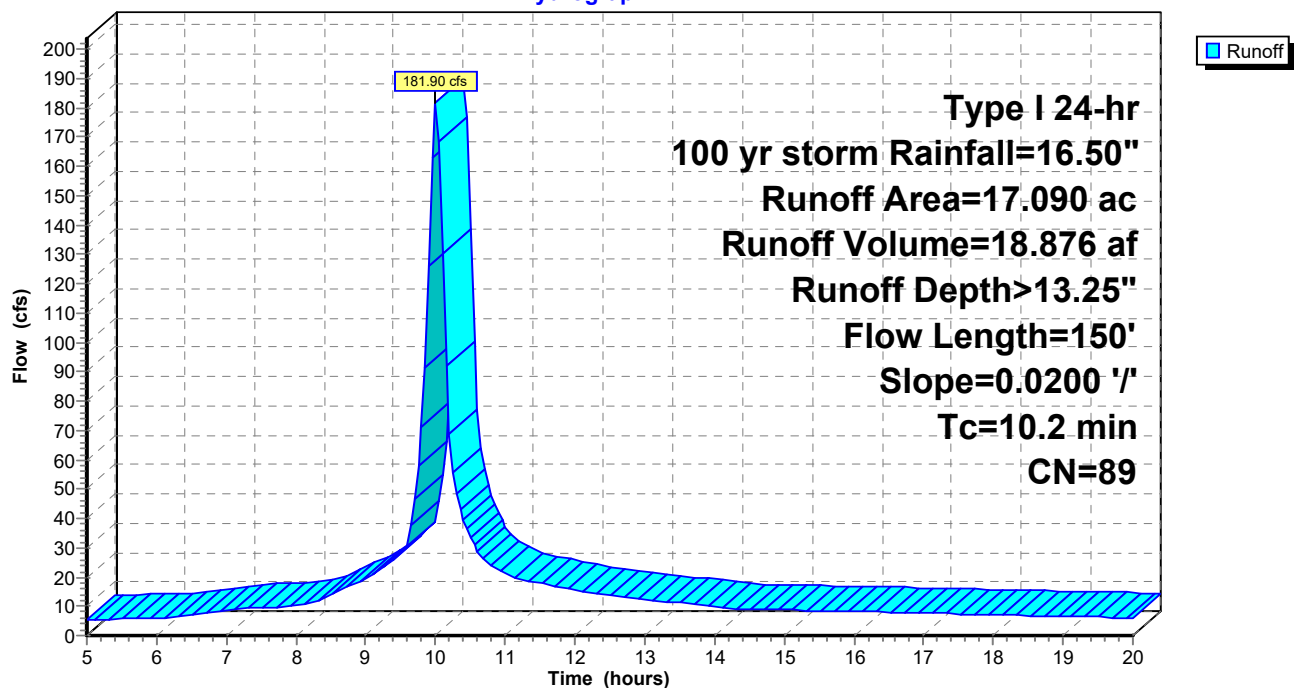
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type I 24-hr 100 yr storm Rainfall=16.50"

Area (ac)	CN	Description
6.410	74	>75% Grass cover, Good, HSG C
10.680	98	Unconnected pavement, HSG C
17.090	89	Weighted Average
6.410		37.51% Pervious Area
10.680		62.49% Impervious Area
10.680		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.2	150	0.0200	0.24		Sheet Flow, Grass: Short n= 0.150 P2= 5.63"

Subcatchment M2: Multi-Family 2

Hydrograph



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Summary for Subcatchment P: Park/Pool

Runoff = 23.68 cfs @ 10.01 hrs, Volume= 2.410 af, Depth>11.75"

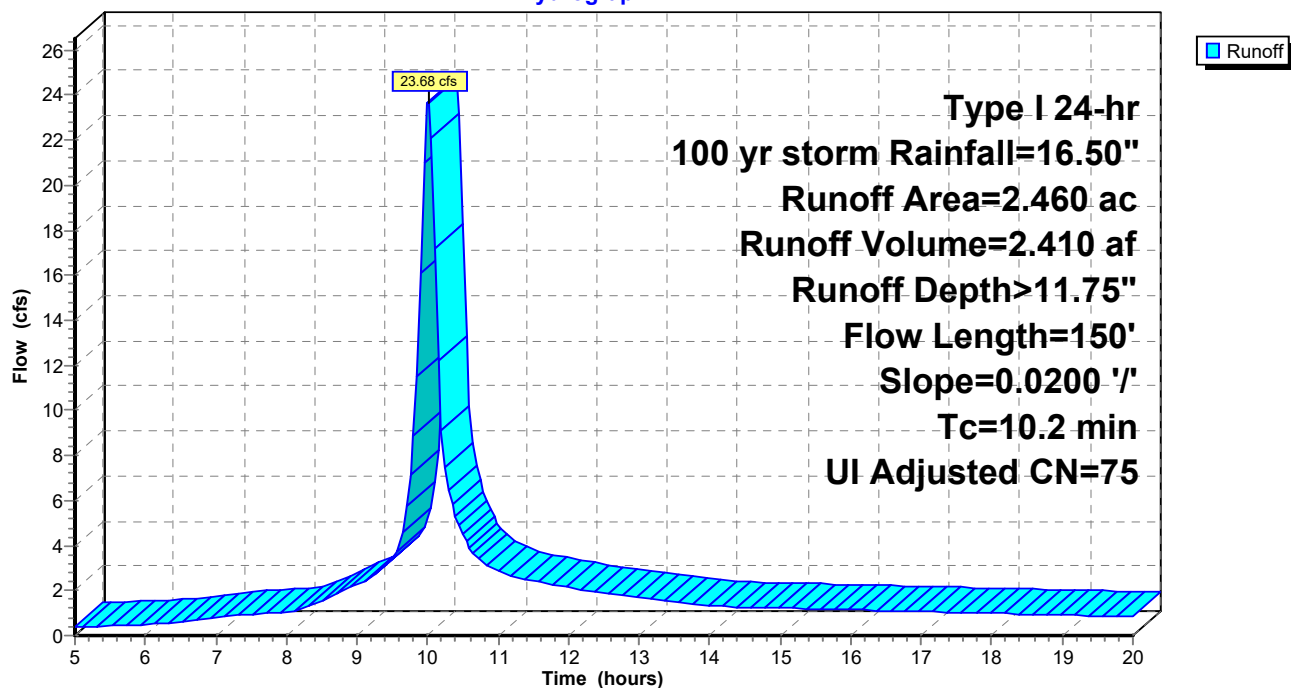
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type I 24-hr 100 yr storm Rainfall=16.50"

Area (ac)	CN	Adj	Description
2.290	74		>75% Grass cover, Good, HSG C
0.170	98		Unconnected pavement, HSG C
2.460	76	75	Weighted Average, UI Adjusted
2.290			93.09% Pervious Area
0.170			6.91% Impervious Area
0.170			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.2	150	0.0200	0.24		Sheet Flow, Grass: Short n= 0.150 P2= 5.63"

Subcatchment P: Park/Pool

Hydrograph



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Type I 24-hr 100 yr storm Rainfall=16.50"

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Summary for Subcatchment R1: Roadway 1

[49] Hint: $T_c < 2dt$ may require smaller dt

Runoff = 41.13 cfs @ 9.88 hrs, Volume= 3.638 af, Depth>13.73"

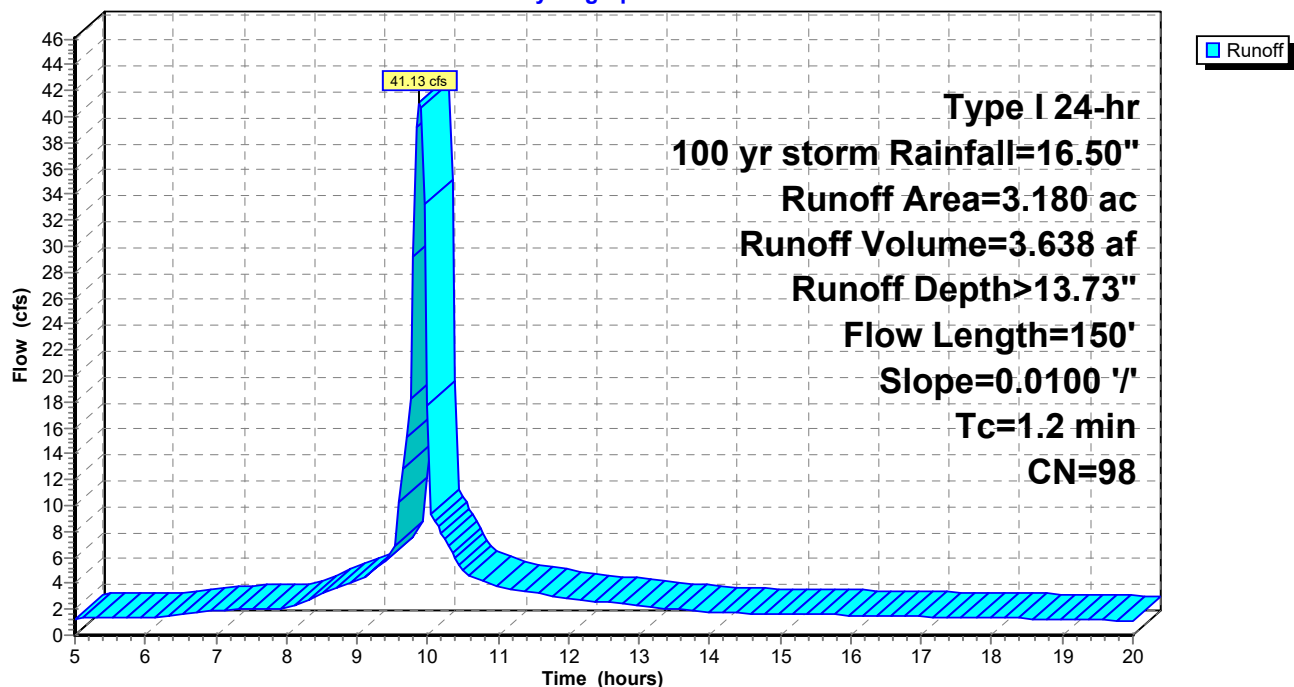
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, $dt=0.05$ hrs
Type I 24-hr 100 yr storm Rainfall=16.50"

Area (ac)	CN	Description
3.180	98	Unconnected pavement, HSG C
3.180		100.00% Impervious Area
3.180		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	150	0.0100	2.03		Shallow Concentrated Flow, Paved Kv= 20.3 fps

Subcatchment R1: Roadway 1

Hydrograph



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Type I 24-hr 100 yr storm Rainfall=16.50"

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Summary for Subcatchment R2: Roadway 2

[49] Hint: $T_c < 2dt$ may require smaller dt

Runoff = 7.24 cfs @ 9.88 hrs, Volume= 0.641 af, Depth>13.73"

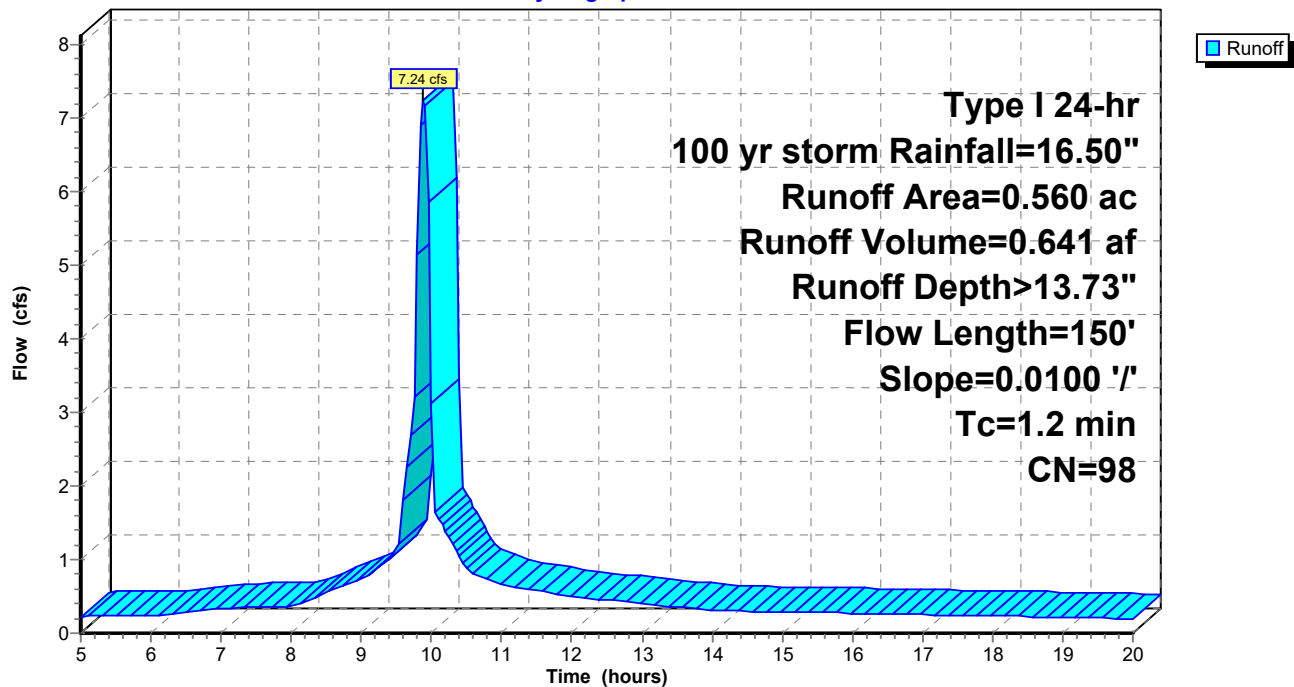
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, $dt=0.05$ hrs
Type I 24-hr 100 yr storm Rainfall=16.50"

Area (ac)	CN	Description
0.560	98	Unconnected pavement, HSG C
0.560		100.00% Impervious Area
0.560		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	150	0.0100	2.03		Shallow Concentrated Flow, Paved Kv= 20.3 fps

Subcatchment R2: Roadway 2

Hydrograph



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Type I 24-hr 100 yr storm Rainfall=16.50"

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Summary for Subcatchment S1: Single Family 1

Runoff = 189.15 cfs @ 10.00 hrs, Volume= 19.467 af, Depth>12.80"

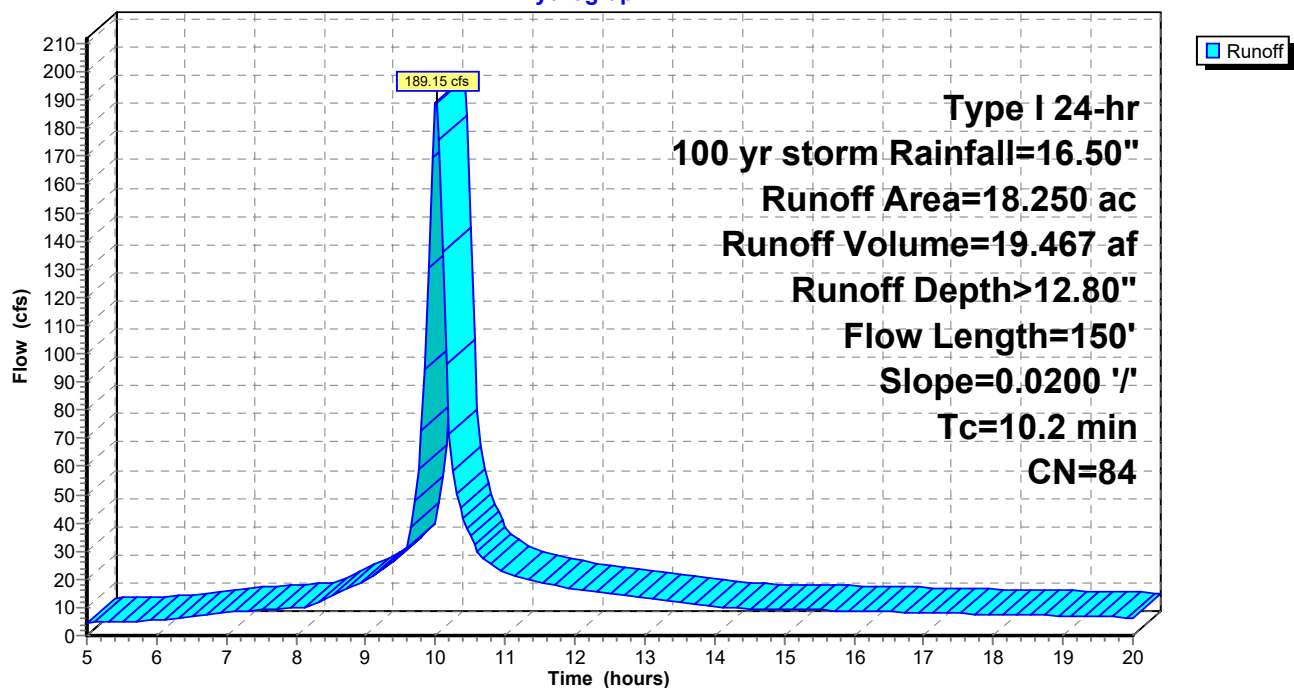
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type I 24-hr 100 yr storm Rainfall=16.50"

Area (ac)	CN	Description
6.840	61	>75% Grass cover, Good, HSG B
11.410	98	Unconnected pavement, HSG B
18.250	84	Weighted Average
6.840		37.48% Pervious Area
11.410		62.52% Impervious Area
11.410		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.2	150	0.0200	0.24		Sheet Flow, Grass: Short n= 0.150 P2= 5.63"

Subcatchment S1: Single Family 1

Hydrograph



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Type I 24-hr 100 yr storm Rainfall=16.50"

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Summary for Subcatchment S2: Single Family 2

Runoff = 50.02 cfs @ 10.00 hrs, Volume= 5.191 af, Depth>13.25"

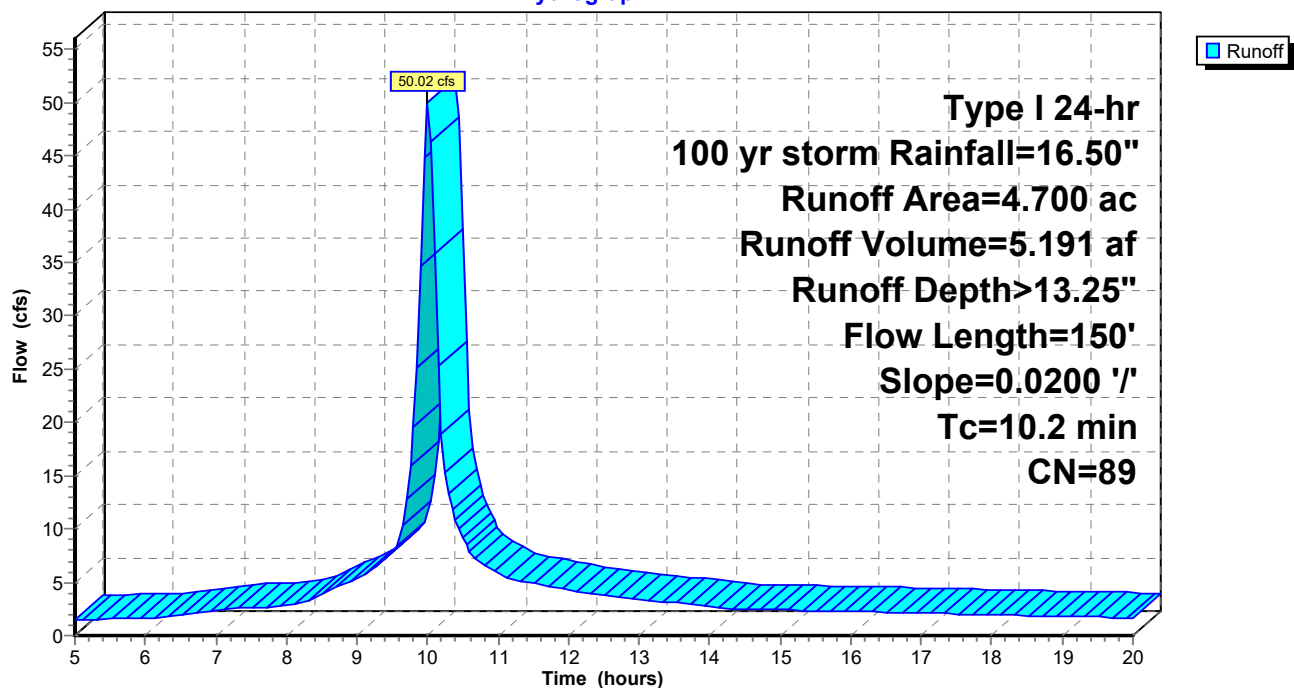
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type I 24-hr 100 yr storm Rainfall=16.50"

Area (ac)	CN	Description
1.760	74	>75% Grass cover, Good, HSG C
2.940	98	Unconnected pavement, HSG C
4.700	89	Weighted Average
1.760		37.45% Pervious Area
2.940		62.55% Impervious Area
2.940		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.2	150	0.0200	0.24		Sheet Flow, Grass: Short n= 0.150 P2= 5.63"

Subcatchment S2: Single Family 2

Hydrograph



Hokua Concept Proposed Condition

Type I 24-hr 100 yr storm Rainfall=16.50"

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Summary for Pond D1: Detention Pond 1

[82] Warning: Early inflow requires earlier time span

Inflow Area = 34.950 ac, 62.00% Impervious, Inflow Depth > 13.19" for 100 yr storm event
Inflow = 353.57 cfs @ 9.99 hrs, Volume= 38.420 af
Outflow = 94.30 cfs @ 10.32 hrs, Volume= 33.642 af, Atten= 73%, Lag= 19.4 min
Primary = 94.30 cfs @ 10.32 hrs, Volume= 33.642 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 54.72' @ 10.32 hrs Surf.Area= 3.099 ac Storage= 14.620 af

Plug-Flow detention time= 160.8 min calculated for 33.620 af (88% of inflow)
Center-of-Mass det. time= 104.7 min (789.2 - 684.5)

Volume	Invert	Avail.Storage	Storage Description
#1	50.00'	15.496 af	300.00'W x 450.00'L x 5.00'H Prismatic

Device	Routing	Invert	Outlet Devices
#1	Primary	54.50'	100.0' long Sharp-Crested Rectangular Weir 2 End Contraction(s)
#2	Primary	50.00'	36.0" Round Culvert L= 50.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 50.00' / 49.00' S= 0.0200'/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 7.07 sf

Primary OutFlow Max=93.69 cfs @ 10.32 hrs HW=54.72' (Free Discharge)

↑ **1=Sharp-Crested Rectangular Weir** (Weir Controls 32.66 cfs @ 1.52 fps)
└ **2=Culvert** (Inlet Controls 61.03 cfs @ 8.63 fps)

Hokua Concept Proposed Condition

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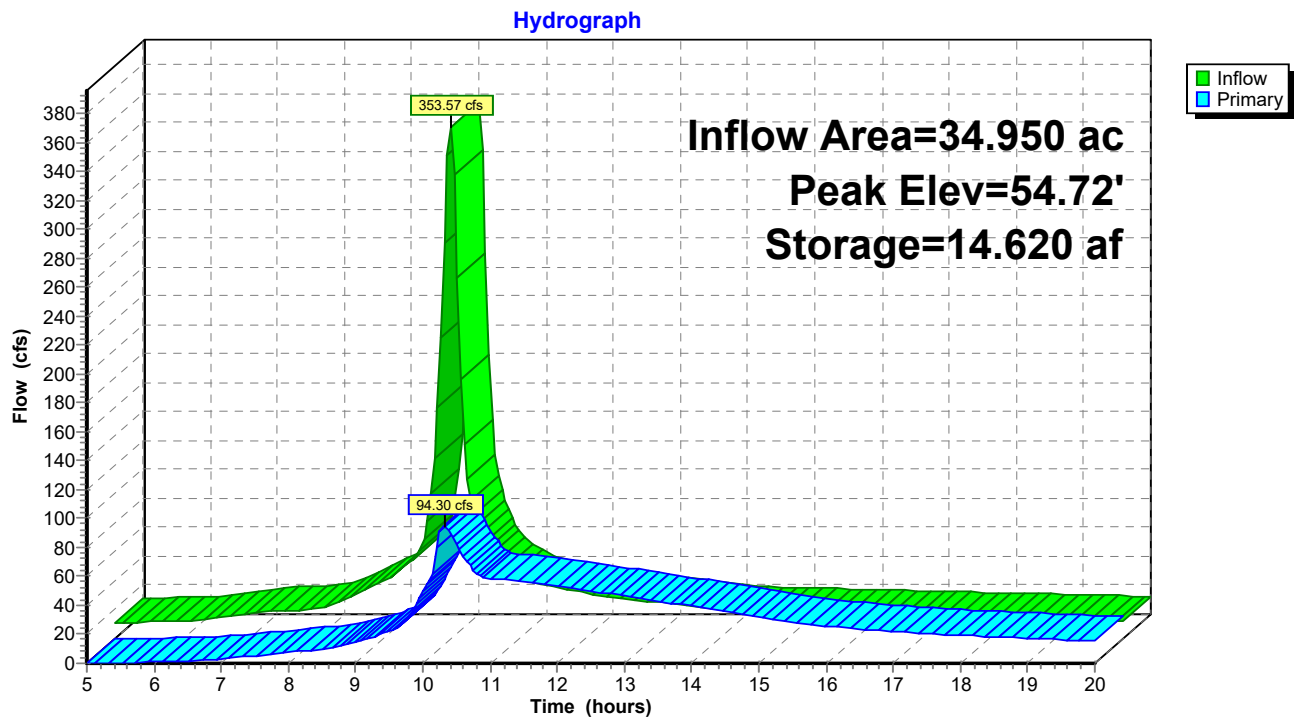
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Type I 24-hr 100 yr storm Rainfall=16.50"

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Pond D1: Detention Pond 1



Hokua Concept Proposed Condition

Type I 24-hr 100 yr storm Rainfall=16.50"

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Summary for Pond D2: Detention Pond 2

[82] Warning: Early inflow requires earlier time span

Inflow Area = 50.400 ac, 53.29% Impervious, Inflow Depth > 12.64" for 100 yr storm event
Inflow = 501.00 cfs @ 9.99 hrs, Volume= 53.069 af
Outflow = 196.02 cfs @ 10.21 hrs, Volume= 51.099 af, Atten= 61%, Lag= 13.1 min
Primary = 196.02 cfs @ 10.21 hrs, Volume= 51.099 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 32.40' @ 10.21 hrs Surf.Area= 1.148 ac Storage= 14.236 af

Plug-Flow detention time= 71.6 min calculated for 50.903 af (96% of inflow)
Center-of-Mass det. time= 53.0 min (742.8 - 689.8)

Volume	Invert	Avail.Storage	Storage Description
#1	20.00'	14.348 af	100.00'W x 500.00'L x 12.50'H Prisma

Device	Routing	Invert	Outlet Devices
#1	Primary	32.00'	100.0' long Sharp-Crested Rectangular Weir 2 End Contraction(s)
#2	Primary	20.00'	36.0" Round Culvert L= 50.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 20.00' / 19.00' S= 0.0200'/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 7.07 sf

Primary OutFlow Max=191.17 cfs @ 10.21 hrs HW=32.39' (Free Discharge)

1=Sharp-Crested Rectangular Weir (Weir Controls 78.87 cfs @ 2.04 fps)

2=Culvert (Inlet Controls 112.30 cfs @ 15.89 fps)

Hokua Concept Proposed Condition

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Type I 24-hr 100 yr storm Rainfall=16.50"

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Pond D2: Detention Pond 2

