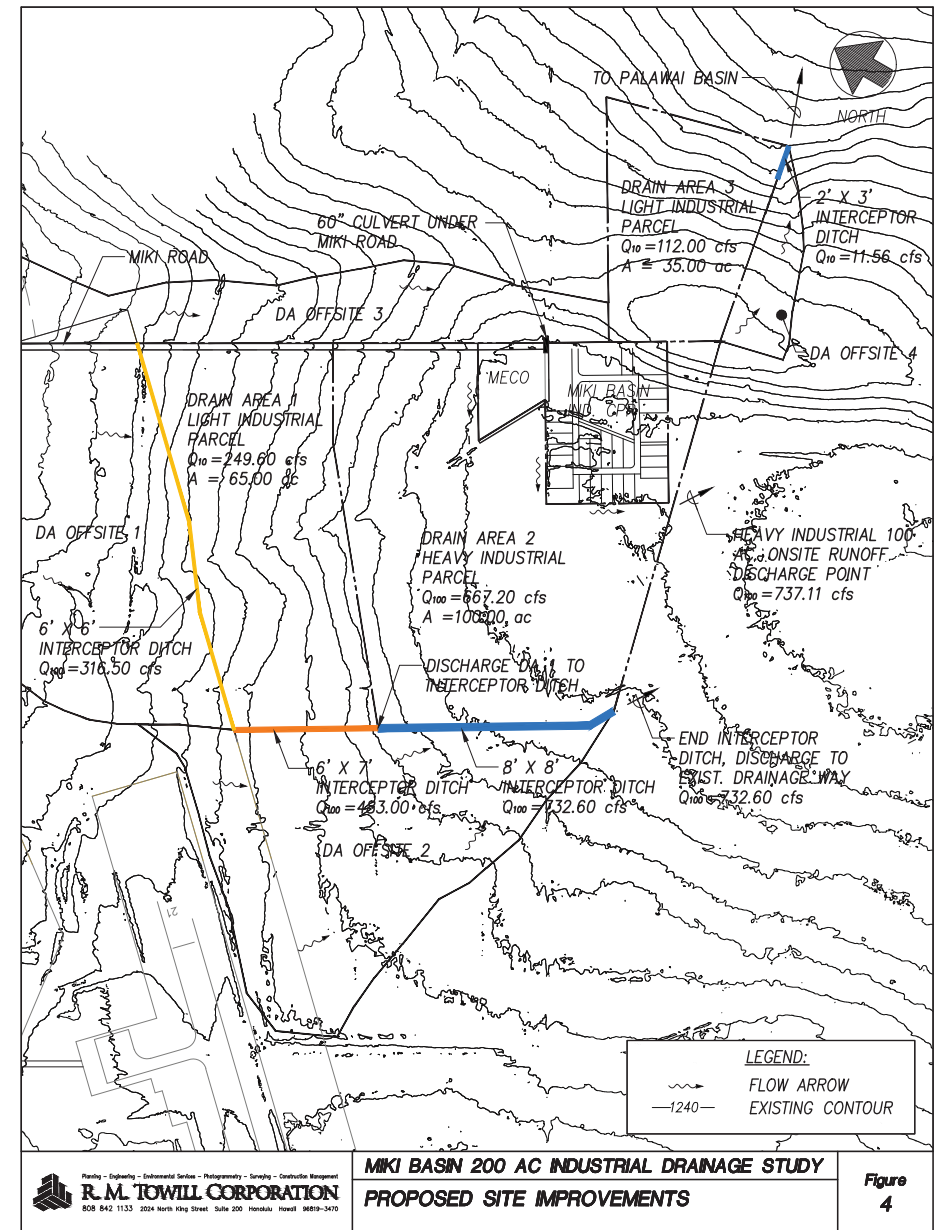
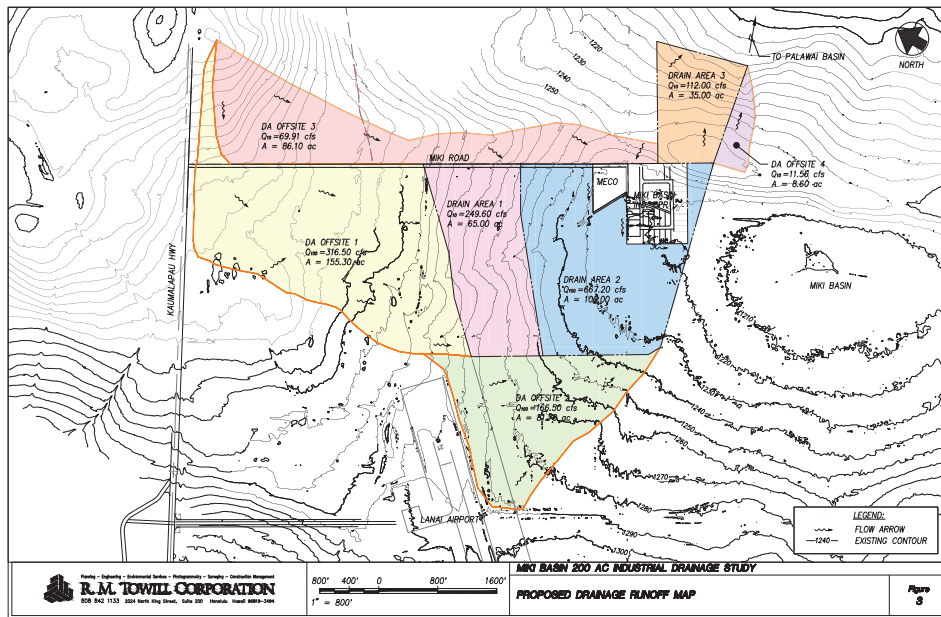






R. M. TOWILL CORPORATION

2024 N King Street, Suite 200, Honolulu, Hawaii 96819

Ph. (808) 842-1133 Fax (808) 842-1937

Project:	Miki Industrial	Job No.	
Location:	Lanai	Prepared By:	DAA
Item:	Runoff Calculations	Checked By:	GR
		Date:	11/5/2018
		Date:	11/5/2018

Purpose: Determine the existing runoff from project site.

Assumptions

Rational Method

Runoff Coefficient, C

RUNOFF COEFFICIENT FOR SMALL AGRICULTURAL AREAS

Watershed Characteristics	Description	Value
Infiltration	Medium	0.07
Relief	Rolling	0.03
Vegetal Cover	Good	0.03
Development Type	Agricultural	0.15
Sum		0.28

Small agricultural areas = 0.28

Light Industrial Areas = 0.8

Heavy Industrial Areas = 0.9

Rainfall Intensity, I (10 Year-1 hr)

I = 1.85 in /hr NOAA Data

See TC spreadsheet for adjusted rainfall intensities.

SCS Method

Curve No. (CN)

Existing Condition 91

Proposed Condition 79

RESULTS

Calculate Peak Runoff, Q

EXISTING CONDITION

Drainage Area Name	Area (Acres)	C	I (in/hr)	Q (cfs)
DA 1*	65.00	0.28	4.8	87.36
DA2**	100.00	-	-	576.00
DA 3*	32.6	0.28	2.8	25.56
DA OFFSITE 1**	155.3	-	-	316.5
DA OFFSITE 2**	81.7	-	-	166.5
DA OFFSITE 3*	88.5	0.28	2.9	71.86
DA OFFSITE 4*	8.6	0.28	4.8	11.56

APPENDIX

HYDROLOGIC AND HYDRAULIC CALCULATIONS



R. M. TOWILL CORPORATION

2024 N King Street, Suite 200, Honolulu, Hawaii 96819
Ph. (808) 842-1133 Fax (808) 842-1937

Project: Miki Industrial Job No. _____
Location: Lanai Prepared By: DAA Date: 11/5/2018
Item: Runoff Calculations Checked By: GR Date: 11/5/2018

Calculate Peak Runoff, Q PROPOSED CONDITION

Drainage Area Name	Area (Acres)	C	I (in/hr)	Q (cfs)
DA 1*	65.00	0.80	4.8	249.60
DA2**	100.00	-	-	667.20
DA 3*	35	0.80	4	112.00
DA OFFSITE 1**	155.3	-	-	316.5
DA OFFSITE 2**	81.7	-	-	166.5
DA OFFSITE 3*	86.1	0.28	2.9	69.91
DA OFFSITE 4*	8.6	0.28	4.8	11.56

*Calculated using Rational Method
**Calculated using SCS Method

Drainage Area Name	Existing Q	Proposed Q	Increase in Q
DA 1*	87.36	249.60	162.24
DA 2**	576.00	667.20	91.20
DA 3*	25.56	112.00	86.44

Miki Basin
Maui County Drainage Standards - Rational Method
11-05-18

	TRIBUTARY SUBAREAS	AREA (acres)	WEIGHTED RUNOFF COEFFICIENT "C"	MAXIMUM LENGTH OF TRAVEL (feet)	DIFFERENCE IN ELEVATION (feet)	Slope %	k-value	TIME OF CONCENTRATION "Tc" (minutes)	10-YEAR "I" (in/hr)
EXISTING	DA 1 (Light Industrial)	65.00	0.28	1140	56.0	4.91%	5143.6	5.6	4.80
	DA 3 (Light Industrial)	32.60	0.28	1600	100.0	6.25%	6400.0	26.0	2.80
	DA OFFSITE 3	88.50	0.28	7570	272.0	3.59%	39935.5	27.2	2.90
	DA OFFSITE 4	9.60	0.28	1330	85.0	6.39%	5261.0	5.7	4.8
PROPOSED	DA 1 (Light Industrial)	65.00	0.80	-	-	-	-	15.0	3.6
	DA 3 (Light Industrial)	35.00	0.80	-	-	-	-	10.0	4
	DA OFFSITE 3	86.10	0.28	7570.00	272.00	3.59%	39935.52	27.24	2.90
	DA OFFSITE 4	8.6	0.28	1330	85.0	6.39%	5261.0	5.7	4.8

Hydrograph Report

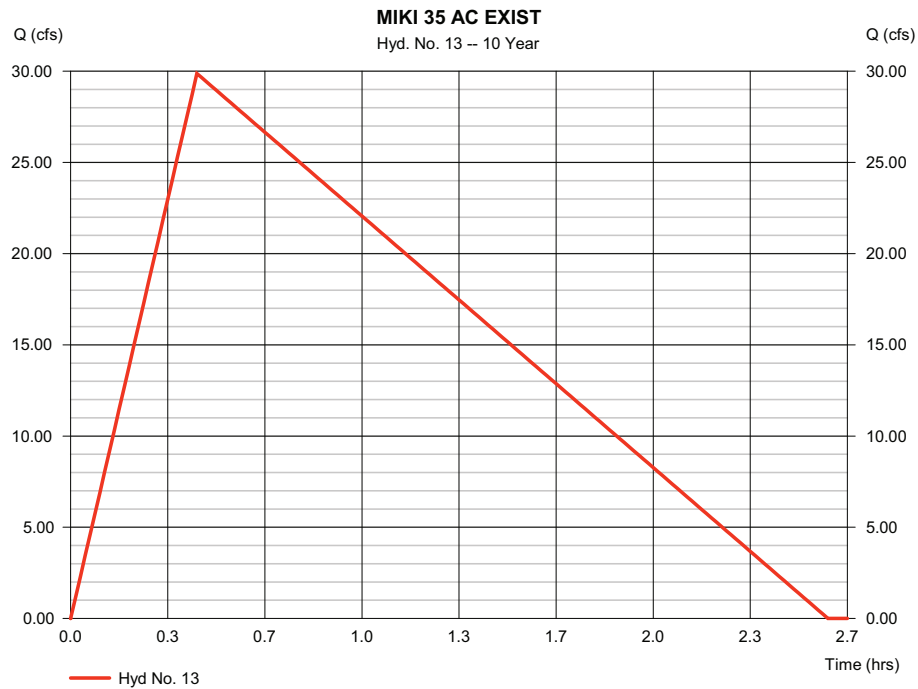
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2018 by Autodesk, Inc. v12

Monday, 11 / 5 / 2018

Hyd. No. 13

MIKI 35 AC EXIST

Hydrograph type	= Rational	Peak discharge	= 29.87 cfs
Storm frequency	= 10 yrs	Time to peak	= 0.43 hrs
Time interval	= 1 min	Hyd. volume	= 139,813 cuft
Drainage area	= 35.000 ac	Runoff coeff.	= 0.28
Intensity	= 3.048 in/hr	Tc by User	= 26.00 min
IDF Curve	= MIKI NOAA DATA.IDF	Asc/Rec limb fact	= 1/5



Hydrograph Report

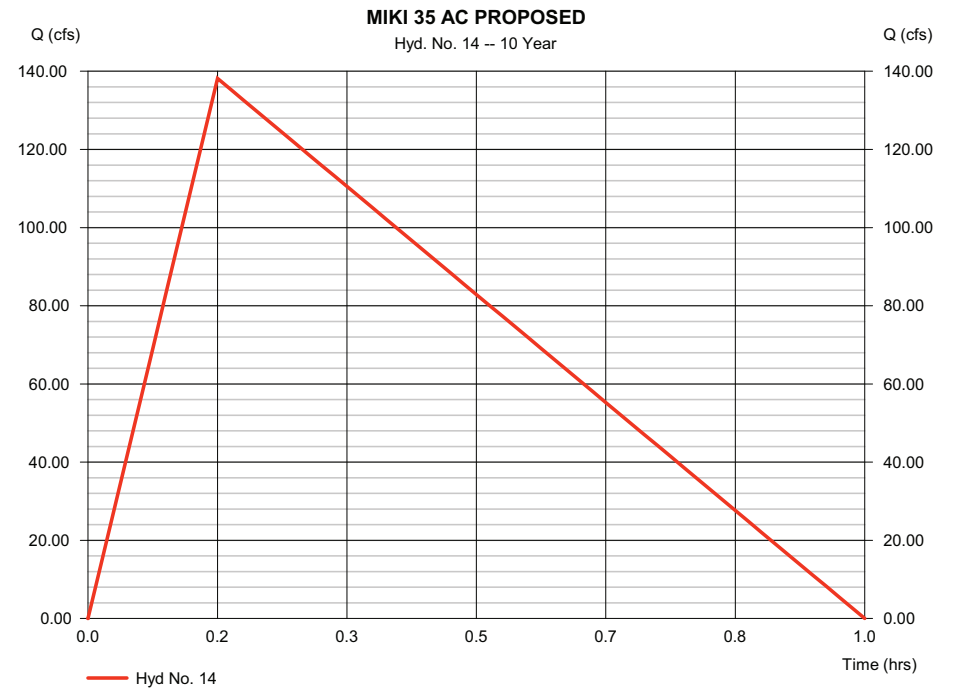
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2018 by Autodesk, Inc. v12

Monday, 11 / 5 / 2018

Hyd. No. 14

MIKI 35 AC PROPOSED

Hydrograph type	= Rational	Peak discharge	= 138.15 cfs
Storm frequency	= 10 yrs	Time to peak	= 0.17 hrs
Time interval	= 1 min	Hyd. volume	= 248,674 cuft
Drainage area	= 35.000 ac	Runoff coeff.	= 0.8
Intensity	= 4.934 in/hr	Tc by User	= 10.00 min
IDF Curve	= MIKI NOAA DATA.IDF	Asc/Rec limb fact	= 1/5



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2018 by Autodesk, Inc. v12

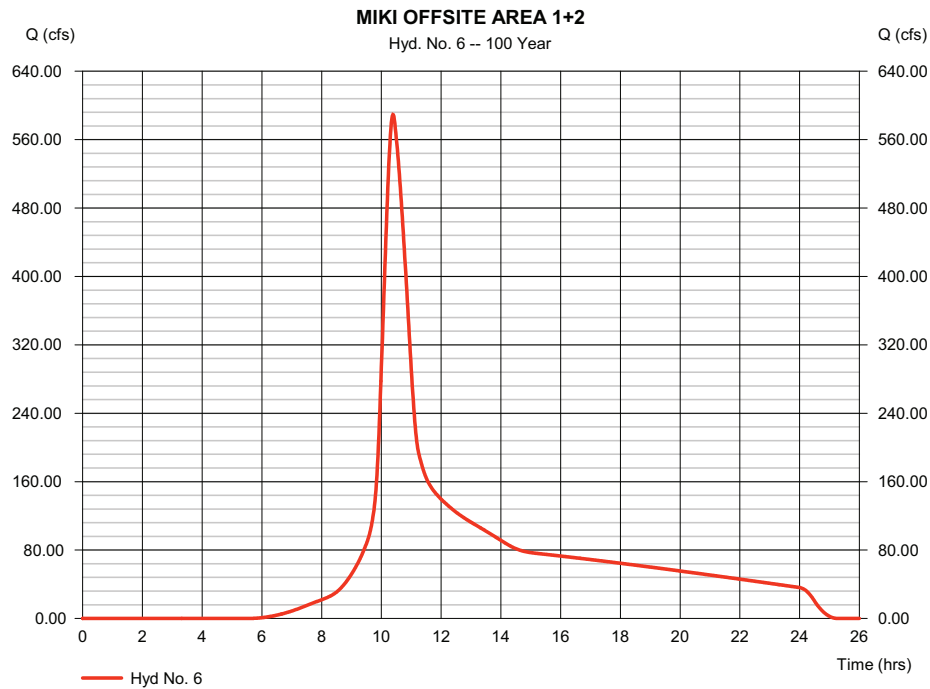
Monday, 11 / 5 / 2018

Hyd. No. 6

MIKI OFFSITE AREA 1+2

Hydrograph type	= SCS Runoff	Peak discharge	= 589.22 cfs
Storm frequency	= 100 yrs	Time to peak	= 10.38 hrs
Time interval	= 1 min	Hyd. volume	= 5,943,357 cuft
Drainage area	= 302.000 ac	Curve number	= 65*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 48.50 min
Total precip.	= 9.86 in	Distribution	= Type I
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1455.000 x 62)] / 302.000



Hydrograph Report

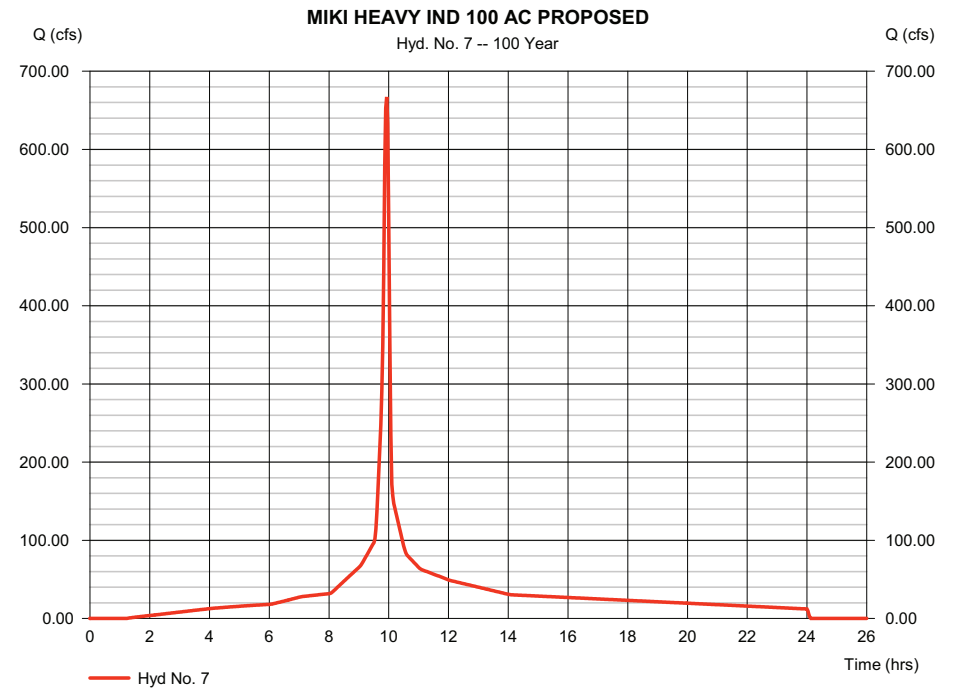
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2018 by Autodesk, Inc. v12

Monday, 11 / 5 / 2018

Hyd. No. 7

MIKI HEAVY IND 100 AC PROPOSED

Hydrograph type	= SCS Runoff	Peak discharge	= 667.18 cfs
Storm frequency	= 100 yrs	Time to peak	= 9.93 hrs
Time interval	= 2 min	Hyd. volume	= 2,982,844 cuft
Drainage area	= 100.000 ac	Curve number	= 91
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 4.00 min
Total precip.	= 9.86 in	Distribution	= Type I
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2018 by Autodesk, Inc. v12

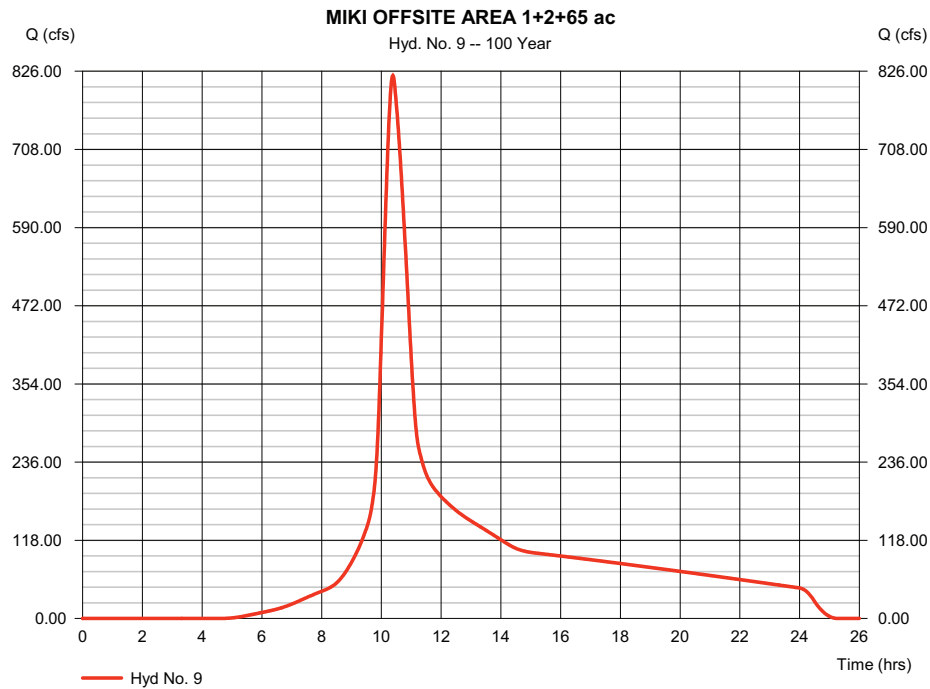
Monday, 11 / 5 / 2018

Hyd. No. 9

MIKI OFFSITE AREA 1+2+65 ac

Hydrograph type	= SCS Runoff	Peak discharge	= 819.67 cfs
Storm frequency	= 100 yrs	Time to peak	= 10.38 hrs
Time interval	= 1 min	Hyd. volume	= 8,090,571 cuft
Drainage area	= 367.000 ac	Curve number	= 70*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 48.50 min
Total precip.	= 9.86 in	Distribution	= Type I
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(302.000 x 65) + (65.000 x 91)] / 367.000



Hydrograph Report

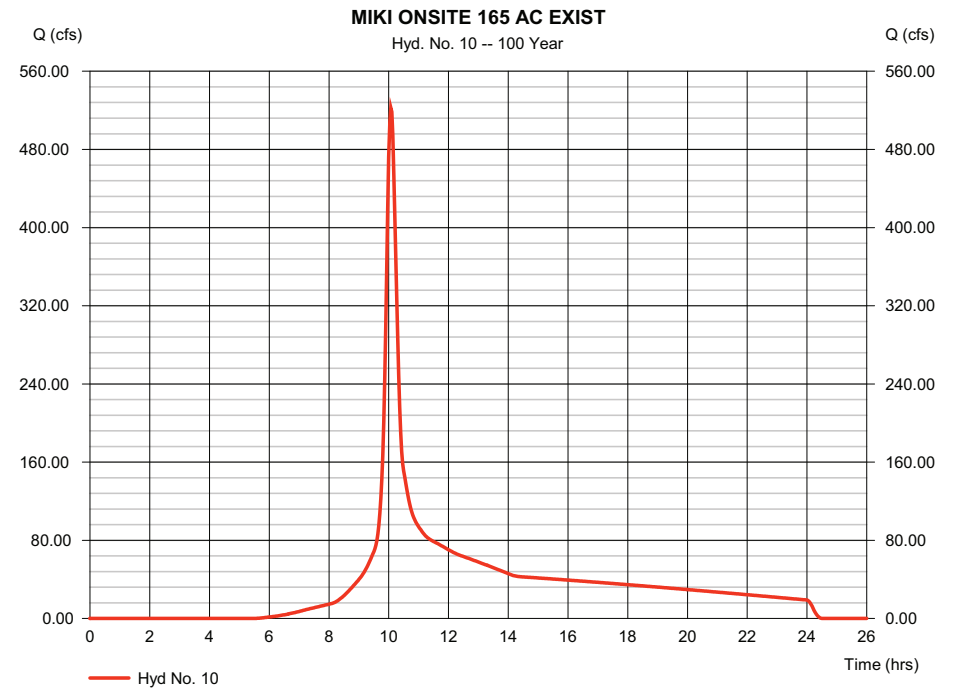
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2018 by Autodesk, Inc. v12

Monday, 11 / 5 / 2018

Hyd. No. 10

MIKI ONSITE 165 AC EXIST

Hydrograph type	= SCS Runoff	Peak discharge	= 522.53 cfs
Storm frequency	= 100 yrs	Time to peak	= 10.07 hrs
Time interval	= 2 min	Hyd. volume	= 3,261,255 cuft
Drainage area	= 165.000 ac	Curve number	= 65
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 17.00 min
Total precip.	= 9.86 in	Distribution	= Type I
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2018 by Autodesk, Inc. v12

Monday, 11 / 5 / 2018

Hyd. No. 11

MIKI ONSITE 165 AC PROPOSED

Hydrograph type	=	SCS Runoff	Peak discharge	=	1100.85 cfs
Storm frequency	=	100 yrs	Time to peak	=	9.93 hrs
Time interval	=	2 min	Hyd. volume	=	4,921,690 cuft
Drainage area	=	165.000 ac	Curve number	=	91
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	6.50 min
Total precip.	=	9.86 in	Distribution	=	Type I
Storm duration	=	24 hrs	Shape factor	=	484

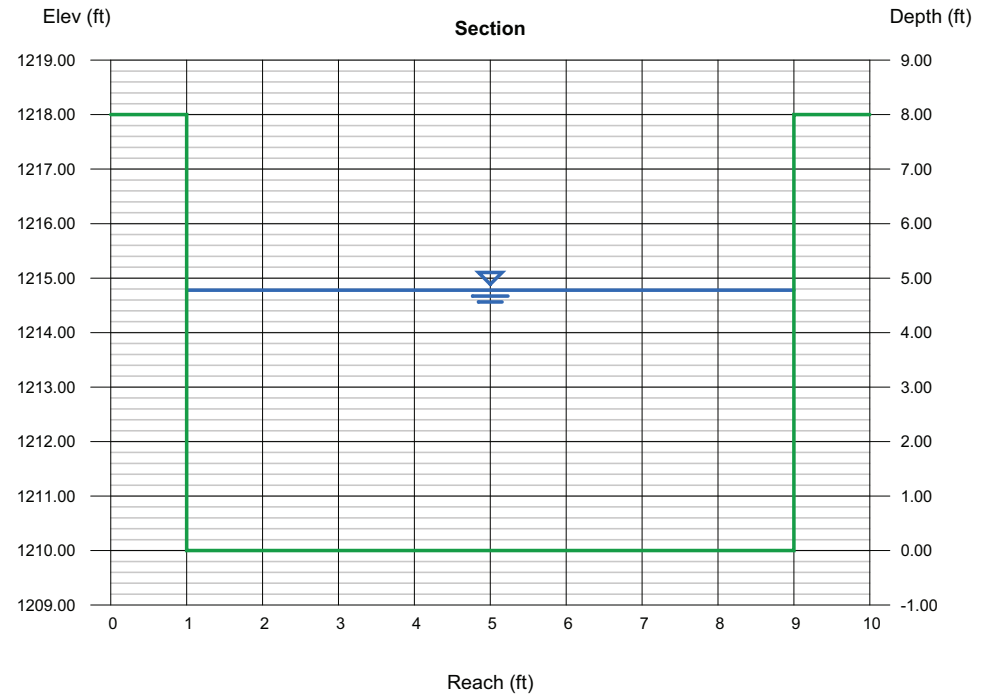
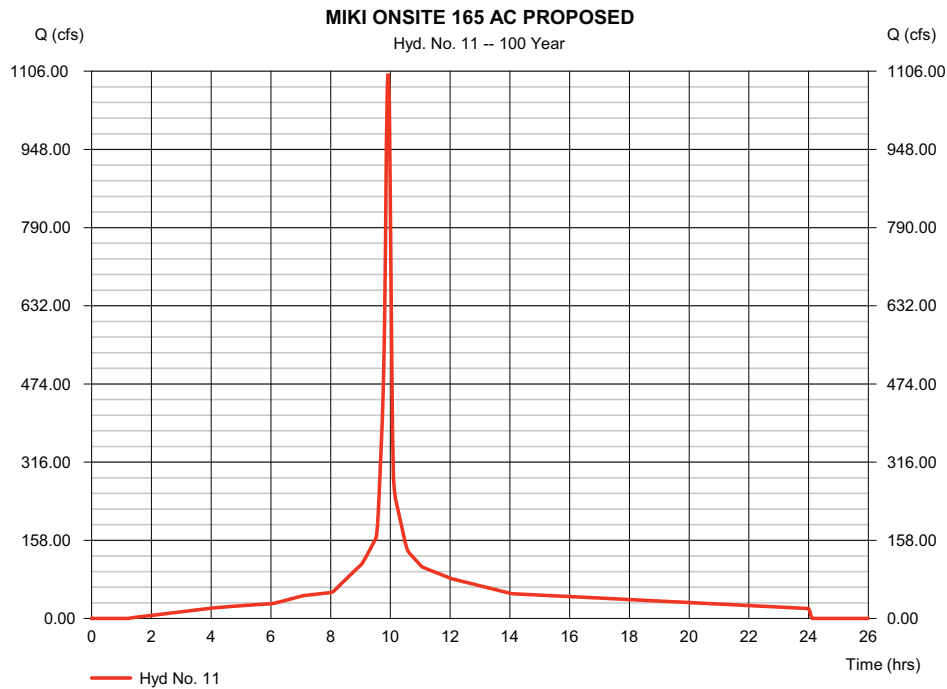
Channel Report

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

Monday, Nov 5 2018

8' X 8' Interceptor Ditch

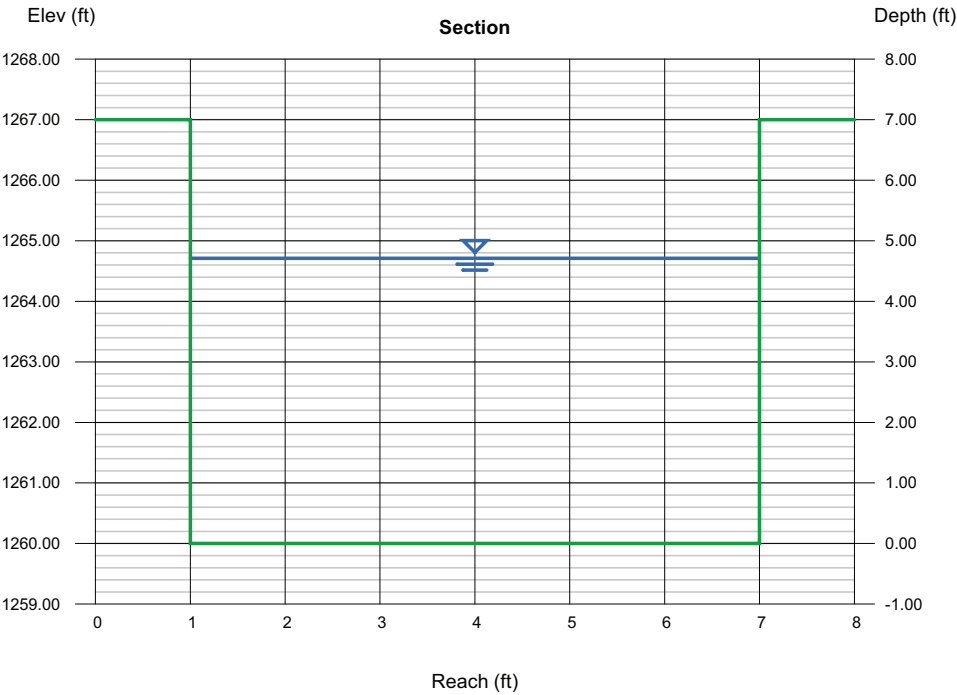
Rectangular			Highlighted		
Bottom Width (ft)	=	8.00	Depth (ft)	=	4.78
Total Depth (ft)	=	8.00	Q (cfs)	=	732.60
Invert Elev (ft)	=	1210.00	Area (sqft)	=	38.24
Slope (%)	=	1.00	Velocity (ft/s)	=	19.16
N-Value	=	0.013	Wetted Perim (ft)	=	17.56
Calculations			Crit Depth, Yc (ft)	=	6.39
Compute by:		Known Q	Top Width (ft)	=	8.00
Known Q (cfs)	=	732.60	EGL (ft)	=	10.49



Channel Report

6' X 7' Interceptor Ditch

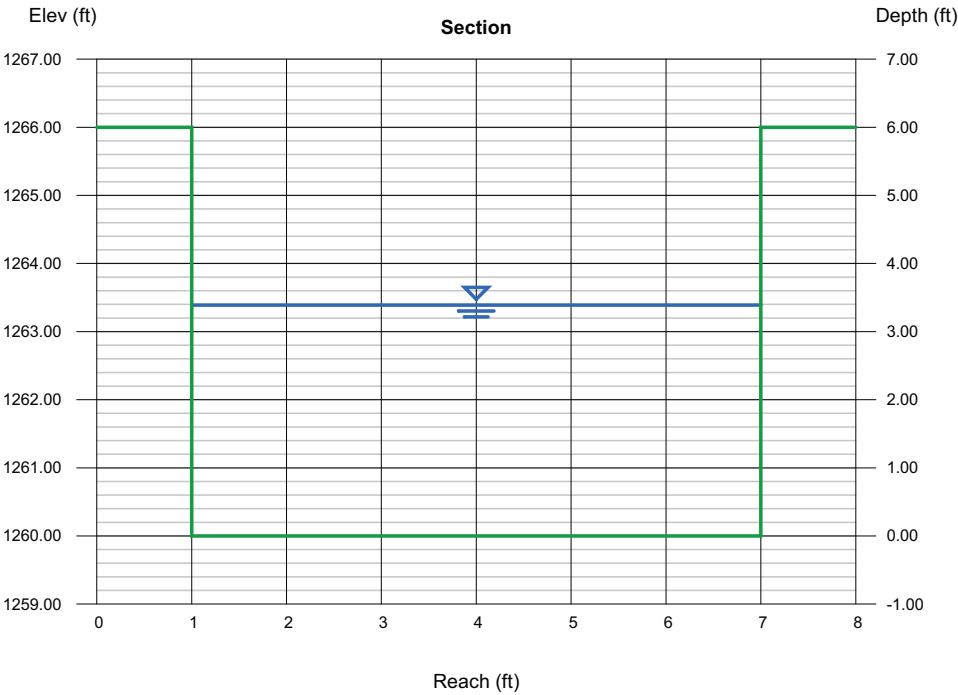
Rectangular		Highlighted	
Bottom Width (ft)	= 6.00	Depth (ft)	= 4.71
Total Depth (ft)	= 7.00	Q (cfs)	= 483.00
		Area (sqft)	= 28.26
Invert Elev (ft)	= 1260.00	Velocity (ft/s)	= 17.09
Slope (%)	= 1.00	Wetted Perim (ft)	= 15.42
N-Value	= 0.013	Crit Depth, Yc (ft)	= 5.87
		Top Width (ft)	= 6.00
		EGL (ft)	= 9.25
Calculations			
Compute by:	Known Q		
Known Q (cfs)	= 483.00		



Channel Report

6' X 6' Interceptor Ditch

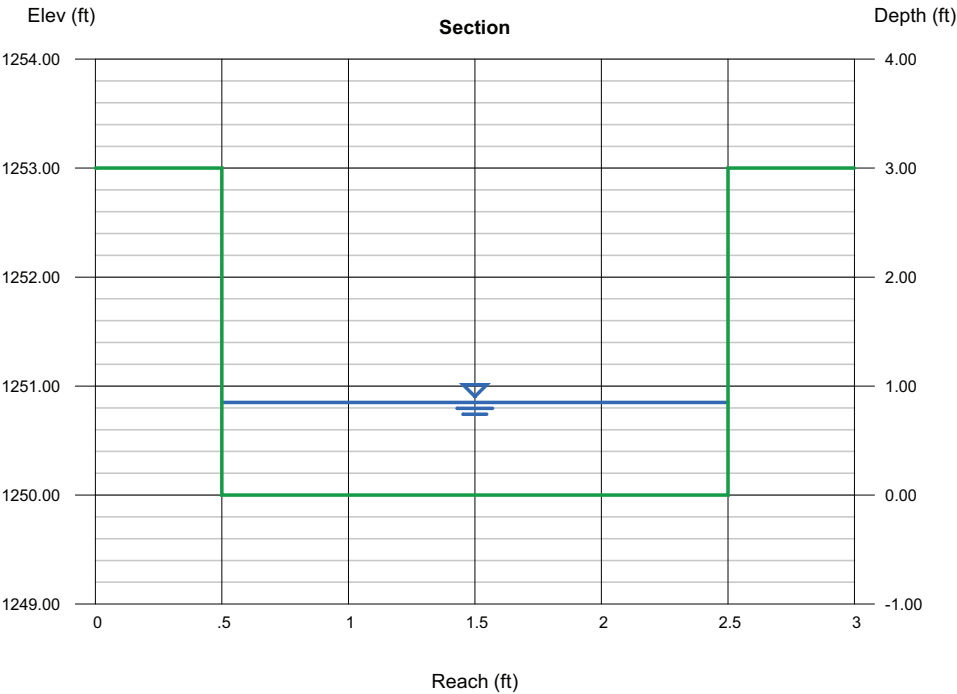
Rectangular		Highlighted	
Bottom Width (ft)	= 6.00	Depth (ft)	= 3.39
Total Depth (ft)	= 6.00	Q (cfs)	= 316.50
		Area (sqft)	= 20.34
Invert Elev (ft)	= 1260.00	Velocity (ft/s)	= 15.56
Slope (%)	= 1.00	Wetted Perim (ft)	= 12.78
N-Value	= 0.013	Crit Depth, Yc (ft)	= 4.43
		Top Width (ft)	= 6.00
		EGL (ft)	= 7.15
Calculations			
Compute by:	Known Q		
Known Q (cfs)	= 316.50		



Channel Report

2' X 3' Interceptor Ditch

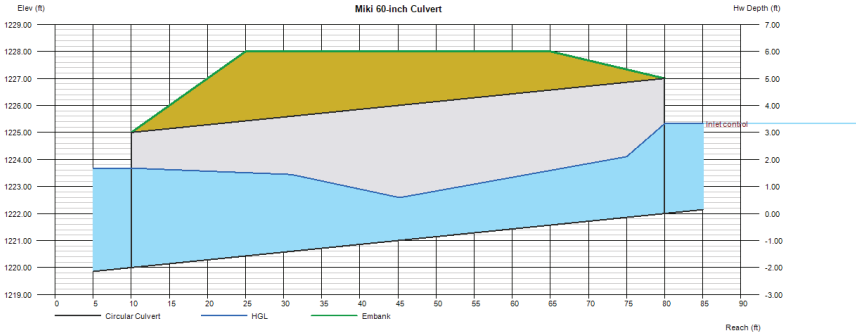
Rectangular		Highlighted	
Bottom Width (ft)	= 2.00	Depth (ft)	= 0.85
Total Depth (ft)	= 3.00	Q (cfs)	= 11.56
		Area (sqft)	= 1.70
Invert Elev (ft)	= 1250.00	Velocity (ft/s)	= 6.80
Slope (%)	= 1.00	Wetted Perim (ft)	= 3.70
N-Value	= 0.013	Crit Depth, Yc (ft)	= 1.02
		Top Width (ft)	= 2.00
		EGL (ft)	= 1.57
Calculations			
Compute by:	Known Q		
Known Q (cfs)	= 11.56		

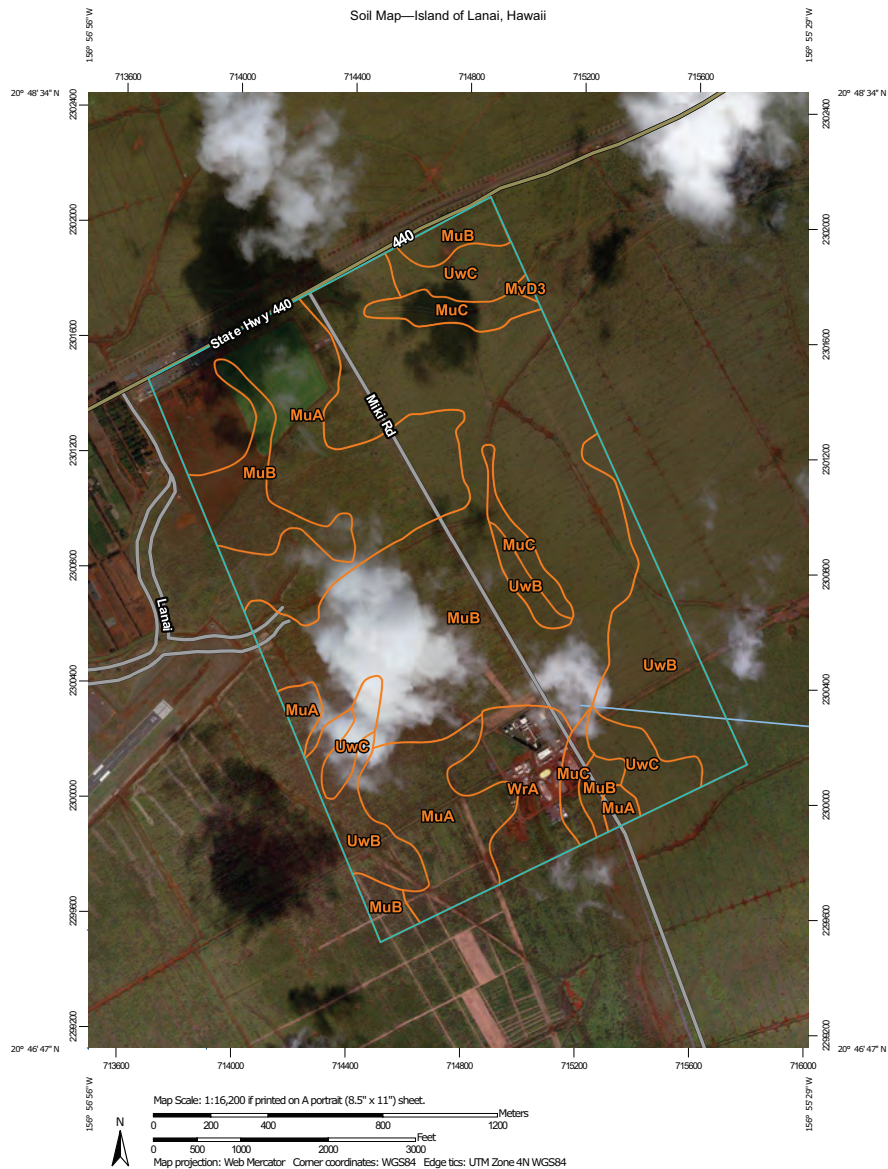


Culvert Report

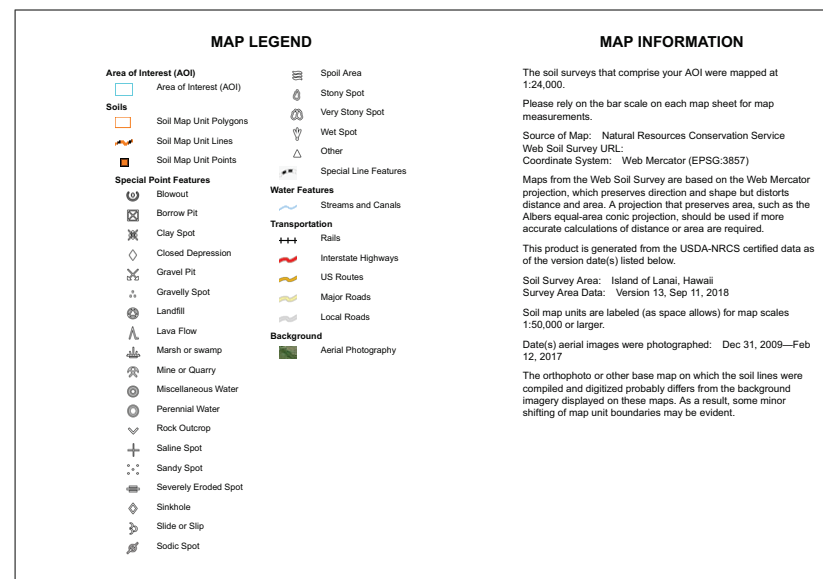
Miki 60-inch Culvert

Invert Elev Dn (ft)	= 1220.00	Calculations	
Pipe Length (ft)	= 70.00	Qmin (cfs)	= 69.91
Slope (%)	= 2.86	Qmax (cfs)	= 69.91
Invert Elev Up (ft)	= 1222.00	Tailwater Elev (ft)	= (dc+D)/2
Rise (in)	= 60.0		
Shape	= Circular	Highlighted	
Span (in)	= 60.0	Qtotal (cfs)	= 69.91
No. Barrels	= 1	Qpipe (cfs)	= 69.91
n-Value	= 0.012	Qovertop (cfs)	= 0.00
Culvert Type	= Circular Concrete	Veloc Dn (ft/s)	= 4.51
Culvert Entrance	= Square edge w/headwall (C)	Veloc Up (ft/s)	= 7.68
Coeff. K,M,c,Y,k	= 0.0098, 2, 0.0398, 0.67, 0.5	HGL Dn (ft)	= 1223.68
		HGL Up (ft)	= 1224.36
		Hw Elev (ft)	= 1225.33
Embankment		Hw/D (ft)	= 0.67
Top Elevation (ft)	= 1228.00	Flow Regime	= Inlet Control
Top Width (ft)	= 40.00		
Crest Width (ft)	= 80.00		





Soil Map—Island of Lanai, Hawaii



Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
MuA	Molokai silty clay loam, 0 to 3 percent slopes, MLRA 158	193.2	26.3%
MuB	Molokai silty clay loam, 3 to 7 percent slopes, MLRA 158	346.1	47.1%
MuC	Molokai silty clay loam, 7 to 15 percent slopes, MLRA 158	29.0	3.9%
MvD3	Lithic Eutrotorrox, 15 to 25 percent slopes, severely eroded, MLRA 158	1.0	0.1%
UwB	Uwala silty clay loam, 2 to 7 percent slopes	84.6	11.5%
UwC	Uwala silty clay loam, 7 to 15 percent slopes	42.3	5.8%
WrA	Waikapu silty clay loam, 0 to 3 percent slopes, MLRA 158	38.8	5.3%
Totals for Area of Interest		735.0	100.0%

PROPOSED CONDITION CN SOIL GROUP C

Chapter 2

Estimating Runoff

Technical Release 55
Urban Hydrology for Small Watersheds

Table 2-2a Runoff curve numbers for urban areas ^{1/}

Cover description	Curve numbers for hydrologic soil group				
Cover type and hydrologic condition	Average percent impervious area ^{2/}	A	B	C	D
<i>Fully developed urban areas (vegetation established)</i>					
Open space (lawns, parks, golf courses, cemeteries, etc.) ^{3/} :					
Poor condition (grass cover < 50%)		68	79	86	89
Fair condition (grass cover 50% to 75%)		49	69	79	84
Good condition (grass cover > 75%)		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	98	98	98
Streets and roads:					
Paved; curbs and storm sewers (excluding right-of-way)		98	98	98	98
Paved; open ditches (including right-of-way)		83	89	92	93
Gravel (including right-of-way)		76	85	89	91
Dirt (including right-of-way)		72	82	87	89
Western desert urban areas:					
Natural desert landscaping (pervious areas only) ^{4/}		63	77	85	88
Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders)		96	96	96	96
Urban districts:					
Commercial and business	85	89	92	94	95
Industrial	72	81	88	91	93
Residential districts by average lot size:					
1/8 acre or less (town houses)	65	77	85	90	92
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acres	12	46	65	77	82
<i>Developing urban areas</i>					
Newly graded areas (pervious areas only, no vegetation) ^{5/}					
		77	86	91	94

Idle lands (CN's are determined using cover types
similar to those in table 2-2c).

^{1/} Average runoff condition, and $I_a = 0.2S$.

^{2/} The average percent impervious area shown was used to develop the composite CN's. Other assumptions are as follows: impervious areas are directly connected to the drainage system, impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition. CN's for other combinations of conditions may be computed using figure 2-3 or 2-4.

^{3/} CN's shown are equivalent to those of pasture. Composite CN's may be computed for other combinations of open space cover type.

^{4/} Composite CN's for natural desert landscaping should be computed using figures 2-3 or 2-4 based on the impervious area percentage (CN = 98) and the pervious area CN. The pervious area CN's are assumed equivalent to desert shrub in poor hydrologic condition.

^{5/} Composite CN's to use for the design of temporary measures during grading and construction should be computed using figure 2-3 or 2-4 based on the degree of development (impervious area percentage) and the CN's for the newly graded pervious areas.

**EXISTING CONDITION CN
SOIL GROUP C**Table 2-2c Runoff curve numbers for other agricultural lands ^{1/}

Cover description	Hydrologic condition	Curve numbers for hydrologic soil group			
		A	B	C	D
Pasture, grassland, or range—continuous forage for grazing. ^{2/}	Poor	68	79	86	89
	Fair	49	69	79	84
	Good	39	61	74	80
Meadow—continuous grass, protected from grazing and generally mowed for hay.	—	30	58	71	78
	—	30	58	71	78
Brush—brush-weed-grass mixture with brush the major element. ^{3/}	Poor	48	67	77	83
	Fair	35	56	70	77
	Good	30 ^{4/}	48	65	73
Woods—grass combination (orchard or tree farm). ^{5/}	Poor	57	73	82	86
	Fair	43	65	76	82
	Good	32	58	72	79
Woods. ^{6/}	Poor	45	66	77	83
	Fair	36	60	73	79
	Good	30 ^{4/}	55	70	77
Farmsteads—buildings, lanes, driveways, and surrounding lots.	—	59	74	82	86
	—	59	74	82	86

^{1/} Average runoff condition, and $I_a = 0.2S$.^{2/} Poor: <50% ground cover or heavily grazed with no mulch.

Fair: 50 to 75% ground cover and not heavily grazed.

Good: > 75% ground cover and lightly or only occasionally grazed.

^{3/} Poor: <50% ground cover.

Fair: 50 to 75% ground cover.

Good: >75% ground cover.

^{4/} Actual curve number is less than 30; use CN = 30 for runoff computations.^{5/} CN's shown were computed for areas with 50% woods and 50% grass (pasture) cover. Other combinations of conditions may be computed from the CN's for woods and pasture.^{6/} Poor: Forest litter, small trees, and brush are destroyed by heavy grazing or regular burning.

Fair: Woods are grazed but not burned, and some forest litter covers the soil.

Good: Woods are protected from grazing, and litter and brush adequately cover the soil.

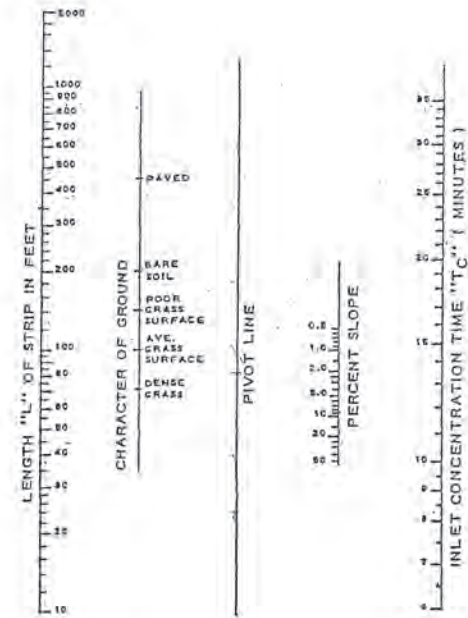
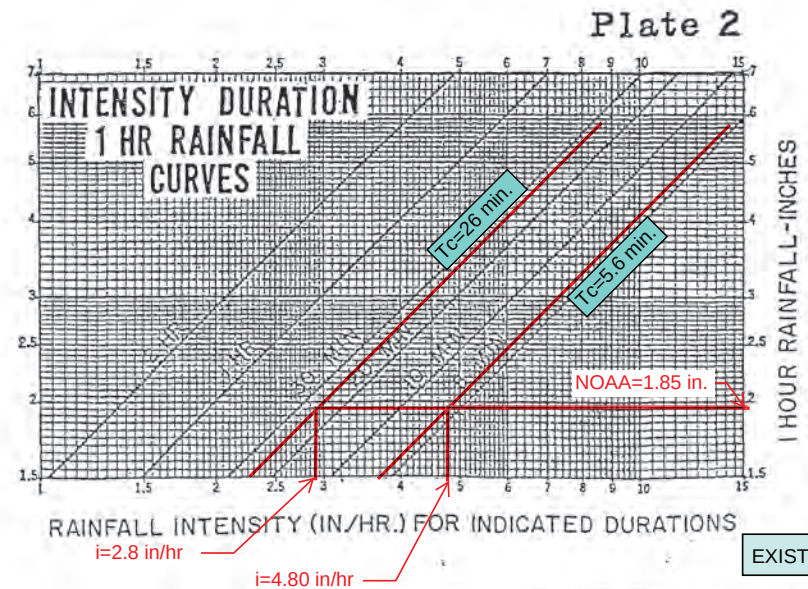


Plate 1

Overland
Flow
Chart

EXISTING

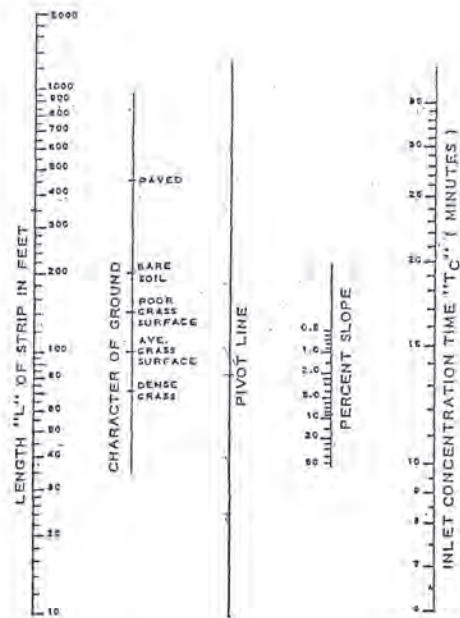
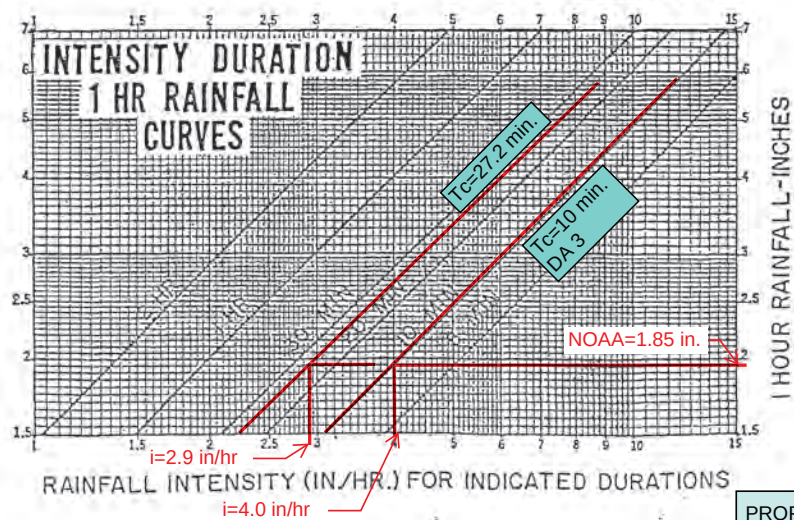


Plate 1

Overland Flow Chart

Plate 2



10/20/2018

Precipitation Frequency Data Server



NOAA Atlas 14, Volume 4, Version 3
Location name: Lanai City, Hawaii, USA*
Latitude: 20.7936°, Longitude: -156.9374°
Elevation: 1295.93 ft**
*source: ESRI Maps
**source: USGS



POINT PRECIPITATION FREQUENCY ESTIMATES

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

NOAA, National Weather Service, Silver Spring, Maryland

[PF_tabular](#) | [PF_graphical](#) | [Maps_&_aerials](#)

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches) ¹										
Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.235 (0.208-0.293)	0.320 (0.260-0.388)	0.440 (0.354-0.534)	0.536 (0.430-0.655)	0.679 (0.535-0.838)	0.794 (0.621-0.992)	0.918 (0.708-1.16)	1.05 (0.798-1.35)	1.25 (0.922-1.63)	1.41 (1.02-1.88)
10-min	0.349 (0.308-0.434)	0.474 (0.386-0.575)	0.652 (0.525-0.792)	0.794 (0.638-0.971)	1.01 (0.794-1.24)	1.18 (0.921-1.47)	1.36 (1.05-1.72)	1.56 (1.18-2.00)	1.85 (1.37-2.42)	2.09 (1.51-2.78)
15-min	0.438 (0.387-0.545)	0.595 (0.485-0.722)	0.819 (0.660-0.994)	0.997 (0.801-1.22)	1.26 (0.997-1.56)	1.48 (1.16-1.85)	1.71 (1.32-2.16)	1.96 (1.49-2.51)	2.33 (1.72-3.04)	2.63 (1.90-3.49)
30-min	0.616 (0.544-0.768)	0.838 (0.682-1.02)	1.15 (0.929-1.40)	1.40 (1.13-1.72)	1.78 (1.40-2.20)	2.08 (1.63-2.60)	2.41 (1.85-3.04)	2.76 (2.09-3.54)	3.27 (2.42-4.28)	3.70 (2.67-4.91)
60-min	0.811 (0.716-1.01)	1.10 (0.898-1.34)	1.52 (1.22-1.84)	1.85 (1.48-2.26)	2.34 (1.85-2.89)	2.74 (2.14-3.42)	3.17 (2.44-4.00)	3.63 (2.75-4.65)	4.31 (3.18-5.63)	4.87 (3.51-6.47)
2-hr	1.12 (0.952-1.33)	1.48 (1.21-1.80)	2.04 (1.64-2.48)	2.47 (1.98-3.01)	3.08 (2.44-3.80)	3.58 (2.80-4.45)	4.08 (3.15-5.14)	4.63 (3.51-5.91)	5.41 (3.99-7.04)	6.02 (4.35-7.98)
3-hr	1.25 (1.05-1.48)	1.67 (1.36-2.02)	2.29 (1.85-2.78)	2.77 (2.23-3.38)	3.47 (2.75-4.28)	4.02 (3.15-5.01)	4.59 (3.55-5.79)	5.20 (3.94-6.64)	6.04 (4.47-7.89)	6.72 (4.86-8.92)
6-hr	1.58 (1.31-1.88)	2.09 (1.70-2.52)	2.88 (2.32-3.49)	3.50 (2.81-4.27)	4.38 (3.48-5.41)	5.08 (3.99-6.33)	5.82 (4.49-7.34)	6.59 (5.00-8.42)	7.67 (5.66-10.0)	8.53 (6.14-11.3)
12-hr	1.96 (1.62-2.36)	2.66 (2.16-3.22)	3.68 (2.97-4.47)	4.51 (3.62-5.51)	5.69 (4.52-7.03)	6.66 (5.22-8.29)	7.67 (5.92-9.66)	8.76 (6.64-11.2)	10.3 (7.60-13.4)	11.5 (8.30-15.3)
24-hr	2.37 (1.98-2.82)	3.26 (2.72-3.90)	4.57 (3.80-5.47)	5.64 (4.67-6.77)	7.20 (5.90-8.69)	8.48 (6.90-10.3)	9.86 (7.92-12.0)	11.4 (9.00-14.0)	13.6 (10.5-16.8)	15.4 (11.7-19.2)
2-day	2.75 (2.32-3.27)	3.82 (3.22-4.55)	5.36 (4.50-6.41)	6.65 (5.54-7.97)	8.50 (7.01-10.2)	10.0 (8.21-12.2)	11.7 (9.43-14.3)	13.5 (10.7-16.6)	16.1 (12.5-20.0)	18.2 (13.9-22.9)
3-day	2.93	4.07	5.71	7.06	8.99	10.6	12.3	14.2	16.8	19.0

https://hdsc.nws.noaa.gov/hdsc/pfds/pfds_printpage.html?lat=20.7936&lon=-156.9374&data=depth&units=english&series=pds

1/6

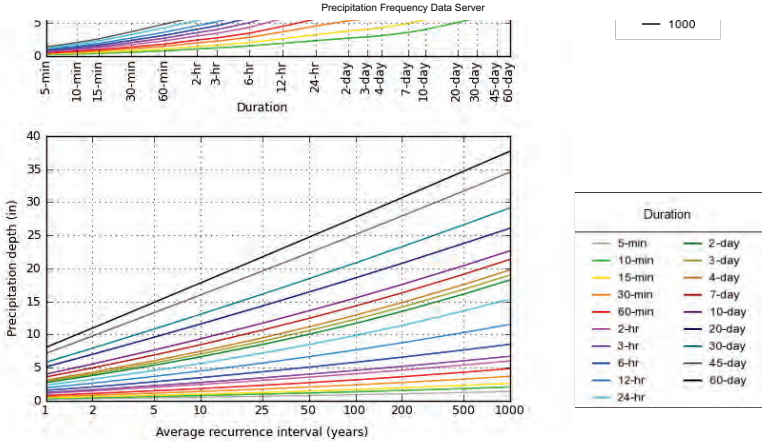
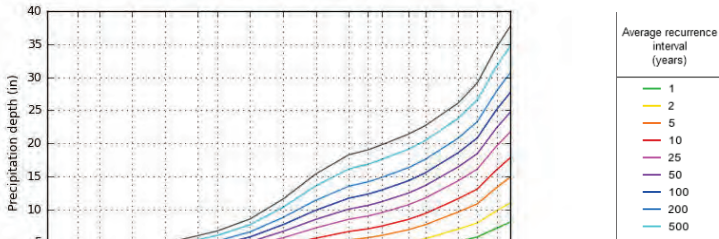
Precipitation Frequency Data Server										
	(2.48-3.49)	(3.43-4.85)	(4.79-6.83)	(5.89-8.47)	(7.43-10.8)	(8.67-12.8)	(9.94-15.0)	(11.3-17.4)	(13.1-20.9)	(14.5-23.8)
4-day	3.12 (2.64-3.71)	4.32 (3.65-5.15)	6.06 (5.09-7.24)	7.47 (6.24-8.96)	9.49 (7.86-11.5)	11.2 (9.14-13.5)	12.9 (10.5-15.8)	14.8 (11.8-18.2)	17.5 (13.7-21.8)	19.8 (15.1-24.8)
7-day	3.60 (3.03-4.28)	4.96 (4.17-5.92)	6.91 (5.78-8.24)	8.47 (7.04-10.1)	10.7 (8.78-12.8)	12.4 (10.1-15.1)	14.3 (11.5-17.4)	16.3 (12.9-20.0)	19.1 (14.8-23.6)	21.4 (16.2-26.7)
10-day	4.03 (3.43-4.74)	5.55 (4.71-6.54)	7.67 (6.48-9.06)	9.36 (7.87-11.1)	11.7 (9.74-13.9)	13.6 (11.2-16.2)	15.5 (12.6-18.7)	17.6 (14.1-21.3)	20.4 (16.0-25.0)	22.7 (17.4-28.0)
20-day	5.12 (4.36-6.04)	7.01 (5.94-8.27)	9.59 (8.09-11.3)	11.6 (9.72-13.7)	14.3 (11.9-17.1)	16.4 (13.5-19.7)	18.5 (15.1-22.4)	20.8 (16.6-25.2)	23.8 (18.6-29.2)	26.1 (20.0-32.3)
30-day	5.82 (4.94-6.85)	7.94 (6.73-9.37)	10.8 (9.14-12.8)	13.1 (11.0-15.5)	16.1 (13.4-19.2)	18.4 (15.2-22.1)	20.8 (16.9-25.1)	23.3 (18.6-28.3)	26.6 (20.8-32.6)	29.1 (22.4-36.1)
45-day	7.16 (6.08-8.42)	9.77 (8.28-11.5)	13.3 (11.2-15.7)	16.0 (13.4-19.0)	19.6 (16.3-23.4)	22.3 (18.3-26.8)	25.1 (20.4-30.3)	27.9 (22.3-33.9)	31.7 (24.8-38.9)	34.5 (26.5-42.8)
60-day	8.07 (6.85-9.50)	11.0 (9.30-13.0)	14.9 (12.5-17.6)	17.8 (14.9-21.1)	21.7 (18.0-25.9)	24.7 (20.3-29.6)	27.7 (22.5-33.4)	30.7 (24.8-37.3)	34.7 (27.1-42.6)	37.7 (28.9-46.7)

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.

[Back to Top](#)

PF graphical

PDS-based depth-duration-frequency (DDF) curves
Latitude: 20.7936°, Longitude: -156.9374°



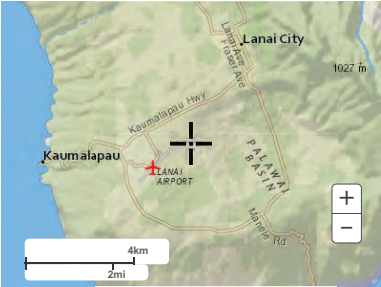
[Back to Top](#)

Maps & aeriels

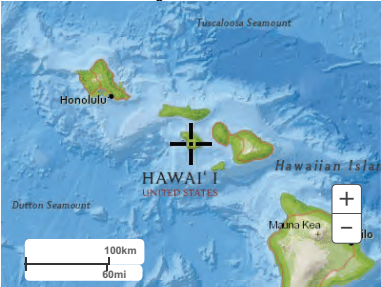
Small scale terrain

10/20/2018

Precipitation Frequency Data Server



Large scale terrain



Large scale map

10/20/2018

Precipitation Frequency Data Server



Large scale aerial



[Back to Top](#)



NOAA Atlas 14, Volume 4, Version 3
Location name: Lanai City, Hawaii, USA*
Latitude: 20.7907°, Longitude: -156.9376°
Elevation: 1246.73 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. Maitani, C. Trypaluk, G. M. Bonnin

NOAA, National Weather Service, Silver Spring, Maryland

[PF tabular](#) | [PF graphical](#) | [Maps & aerials](#)

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National Weather Service
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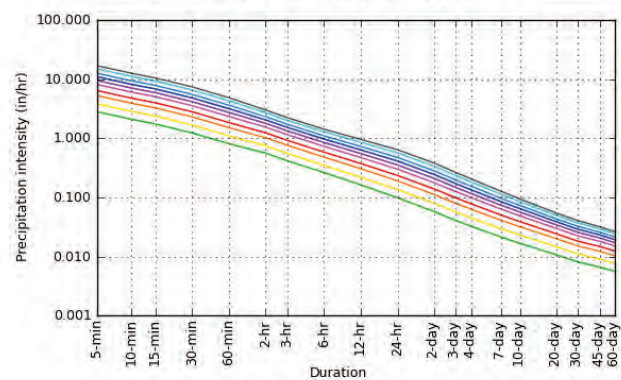
PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches/hour) ¹										
Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	2.82 (2.50-3.52)	3.84 (3.12-4.66)	5.28 (4.25-6.41)	6.43 (5.16-7.86)	8.15 (6.42-10.1)	9.53 (7.45-11.9)	11.0 (8.50-13.9)	12.6 (9.58-16.2)	15.0 (11.1-19.6)	16.9 (12.2-22.5)
10-min	2.09 (1.85-2.60)	2.84 (2.32-3.45)	3.91 (3.15-4.75)	4.76 (3.83-5.83)	6.04 (4.76-7.45)	7.06 (5.53-8.83)	8.17 (6.29-10.3)	9.37 (7.10-12.0)	11.1 (8.20-14.5)	12.6 (9.05-16.7)
15-min	1.75 (1.55-2.18)	2.38 (1.94-2.89)	3.28 (2.64-3.98)	3.99 (3.20-4.88)	5.06 (3.99-6.24)	5.91 (4.63-7.39)	6.84 (5.27-8.63)	7.85 (5.94-10.0)	9.30 (6.87-12.2)	10.5 (7.58-14.0)
30-min	1.23 (1.09-1.54)	1.68 (1.36-2.03)	2.30 (1.86-2.80)	2.81 (2.25-3.43)	3.56 (2.81-4.39)	4.16 (3.26-5.20)	4.81 (3.71-6.08)	5.52 (4.18-7.07)	6.55 (4.83-8.56)	7.39 (5.33-9.83)
60-min	0.811 (0.716-1.01)	1.10 (0.898-1.34)	1.52 (1.22-1.84)	1.85 (1.48-2.26)	2.34 (1.85-2.89)	2.74 (2.14-3.42)	3.17 (2.44-4.00)	3.63 (2.75-4.65)	4.31 (3.18-5.63)	4.87 (3.51-6.47)
2-hr	0.561 (0.476-0.666)	0.742 (0.604-0.898)	1.02 (0.822-1.24)	1.24 (0.989-1.51)	1.54 (1.22-1.90)	1.79 (1.40-2.22)	2.04 (1.58-2.57)	2.31 (1.76-2.96)	2.70 (1.99-3.52)	3.01 (2.17-3.99)
3-hr	0.417 (0.350-0.494)	0.554 (0.452-0.671)	0.763 (0.615-0.925)	0.923 (0.742-1.13)	1.15 (0.915-1.43)	1.34 (1.05-1.67)	1.53 (1.18-1.93)	1.73 (1.31-2.21)	2.01 (1.49-2.63)	2.24 (1.62-2.97)
6-hr	0.263 (0.219-0.315)	0.349 (0.283-0.421)	0.480 (0.388-0.583)	0.584 (0.469-0.713)	0.731 (0.581-0.903)	0.849 (0.665-1.06)	0.971 (0.750-1.23)	1.10 (0.835-1.41)	1.28 (0.946-1.67)	1.43 (1.03-1.89)
12-hr	0.163 (0.134-0.196)	0.220 (0.179-0.267)	0.306 (0.247-0.371)	0.374 (0.301-0.457)	0.473 (0.375-0.584)	0.553 (0.433-0.688)	0.637 (0.491-0.802)	0.727 (0.551-0.928)	0.855 (0.631-1.11)	0.958 (0.689-1.27)
24-hr	0.099 (0.082-0.118)	0.136 (0.114-0.163)	0.190 (0.158-0.228)	0.235 (0.195-0.282)	0.300 (0.246-0.362)	0.353 (0.287-0.429)	0.411 (0.330-0.502)	0.474 (0.375-0.582)	0.565 (0.438-0.702)	0.640 (0.486-0.802)
2-day	0.057 (0.048-0.068)	0.080 (0.067-0.095)	0.112 (0.094-0.133)	0.138 (0.115-0.166)	0.177 (0.146-0.213)	0.209 (0.171-0.253)	0.243 (0.197-0.297)	0.281 (0.224-0.345)	0.335 (0.261-0.416)	0.380 (0.290-0.476)
3-day	0.041 (0.034-0.048)	0.057 (0.048-0.067)	0.079 (0.067-0.095)	0.098 (0.082-0.118)	0.125 (0.103-0.151)	0.147 (0.120-0.178)	0.171 (0.138-0.208)	0.197 (0.157-0.242)	0.234 (0.182-0.290)	0.264 (0.202-0.331)
4-day	0.032 (0.027-0.039)	0.045 (0.038-0.054)	0.063 (0.053-0.075)	0.078 (0.065-0.093)	0.099 (0.082-0.119)	0.116 (0.095-0.141)	0.135 (0.109-0.164)	0.154 (0.123-0.190)	0.183 (0.143-0.227)	0.206 (0.157-0.258)
7-day	0.021 (0.018-0.025)	0.030 (0.025-0.035)	0.041 (0.034-0.049)	0.050 (0.042-0.060)	0.064 (0.052-0.076)	0.074 (0.060-0.090)	0.085 (0.069-0.104)	0.097 (0.077-0.119)	0.114 (0.088-0.141)	0.127 (0.097-0.159)
10-day	0.017 (0.014-0.020)	0.023 (0.020-0.027)	0.032 (0.027-0.038)	0.039 (0.033-0.046)	0.049 (0.041-0.058)	0.057 (0.047-0.068)	0.065 (0.053-0.078)	0.073 (0.059-0.089)	0.085 (0.067-0.104)	0.094 (0.073-0.117)
20-day	0.011 (0.009-0.013)	0.015 (0.012-0.017)	0.020 (0.017-0.024)	0.024 (0.020-0.029)	0.030 (0.025-0.036)	0.034 (0.028-0.041)	0.039 (0.031-0.047)	0.043 (0.035-0.053)	0.049 (0.039-0.061)	0.054 (0.042-0.067)
30-day	0.008 (0.007-0.010)	0.011 (0.009-0.013)	0.015 (0.013-0.018)	0.018 (0.015-0.022)	0.022 (0.019-0.027)	0.026 (0.021-0.031)	0.029 (0.023-0.035)	0.032 (0.026-0.039)	0.037 (0.029-0.045)	0.040 (0.031-0.050)
45-day	0.007 (0.006-0.008)	0.009 (0.008-0.011)	0.012 (0.010-0.015)	0.015 (0.012-0.018)	0.018 (0.015-0.022)	0.021 (0.017-0.025)	0.023 (0.019-0.028)	0.026 (0.021-0.031)	0.029 (0.023-0.036)	0.032 (0.025-0.040)
60-day	0.006 (0.005-0.007)	0.008 (0.006-0.009)	0.010 (0.009-0.012)	0.012 (0.010-0.015)	0.015 (0.013-0.018)	0.017 (0.014-0.021)	0.019 (0.016-0.023)	0.021 (0.017-0.026)	0.024 (0.019-0.030)	0.026 (0.020-0.032)
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.										

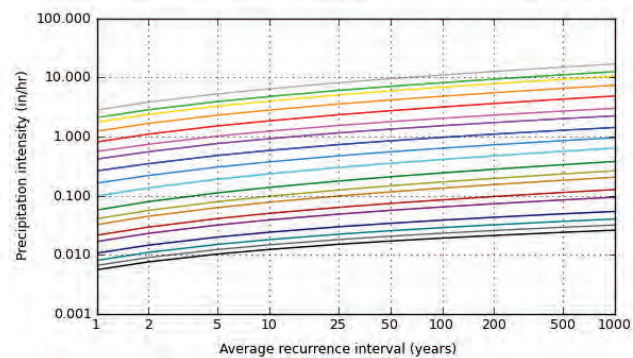
[Back to Top](#)

PF graphical

PDS-based intensity-duration-frequency (IDF) curves
Latitude: 20.7907°, Longitude: -156.9376°



Average recurrence interval (years)
1
2
5
10
25
50
100
200
500
1000



Duration
5-min
10-min
15-min
30-min
60-min
2-hr
3-hr
6-hr
12-hr
24-hr
2-day
3-day
4-day
7-day
10-day
20-day
30-day
45-day
60-day

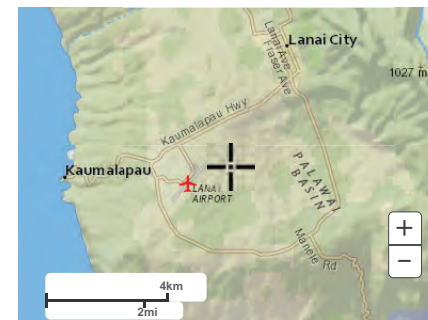
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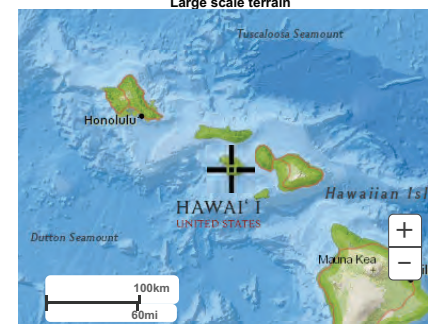
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Maps & aeriels

Small scale terrain



Large scale terrain



Large scale map



Large scale aerial


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Table 1

GUIDE FOR THE DETERMINATION OF RUNOFF COEFFICIENTS FOR BUILT-UP AREAS*

WATERSHED CHARACTERISTICS	EXTREME	HIGH	MODERATE	LOW
INFILTRATION	NEGLIGIBLE 0.20	SLOW 0.14	MEDIUM 0.07	HIGH 0.0
RELIEF	STEEP (> 25%) 0.08	HILLY (15 - 25%) 0.06	ROLLING (5 - 15%) 0.03	FLAT (0 - 5%) 0.0
VEGETAL COVER	NONE 0.07	POOR (< 10%) 0.05	GOOD (10 - 50%) 0.03	HIGH (50 - 90%) 0.0
DEVELOPMENT TYPE	INDUSTRIAL & BUSINESS 0.55	HOTEL - APARTMENT 0.45	RESIDENTIAL 0.40	AGRICULTURAL 0.15

*NOTE: The design coefficient "C" must result from a total of the values for all four watershed characteristics of the site.

Table 2

RUNOFF COEFFICIENTS

Type of Drainage Area	Runoff Coefficient C
Business:	
Downtown areas	0.95
Neighborhood areas	0.70
Residential:	
Single-family areas	0.50
Multi-units, detached	0.60
Multi-units, attached	0.75
Suburban	0.40
Apartment dwelling areas	0.70
Industrial:	
Light areas	0.80
Heavy areas	0.90
Parks, cemeteries	0.25
Playgrounds	0.33
Railroad-yard areas	0.40
Unimproved areas	0.30
Streets:	
Asphaltic	0.95
Concrete	0.95
Brick	0.85
Drive and walks	0.85
Roads	0.95
Lawns:	
Sandy, soil, flat, 2%	0.10
Sandy, soil, avg., 2-7%	0.15
Sandy, soil, steep, 7%	0.20
Heavy soil, flat, 2%	0.17
Heavy soil, avg., 2-7%	0.22
Heavy soil, steep, 7%	0.35

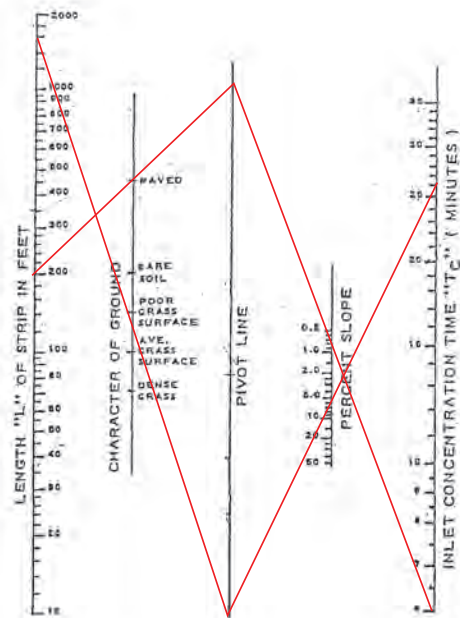


Plate 1

Overland
Flow
Chart

