

Rational Method for Proposed Conditions

TYPE OF LAND SURFACE	NRCS CONVEYANCE FACTOR, K
HEAVY MEADOW	2.5
TILLAGE / FIELD	5
SHORT PASTURE AND LAWNS	7
NEARLY BARE GROUND	10
GRASSED WATERWAY	15
PAVED AREAS AND SHALLOW PAVED SWALES	20

Intensity-Duration-Frequency Table					
	STORM EVENT				
Duration Min	05 yr	10 yr	25 yr	50 yr	100 yr
5	6.61	8.00	10.00	11.70	13.40
10	4.90	5.93	7.43	8.65	9.97
15	4.11	4.97	6.22	7.24	8.34
30	2.89	3.50	4.37	5.10	5.87
60	1.90	2.30	2.88	3.35	3.86
120	1.30	1.57	1.96	2.28	2.62
From NOAA Atlas 14, Volume 4, Version 3 for HNL Airport in Honolulu, Hawaii, USA					

Composite C value Calculations

Project Name	H-1 Widening					Project No.	D3216600		
Revised Date	2/2/2021					Calculated by	MRD		
Pond Area	100%	Impervious	Roof Area	85%	Impervious				
Lawn Area	5%	Impervious	Gravel Area	40%	Impervious				
Paved Area	95%	Impervious	Walks	80%	Impervious				
Values of Runoff Coefficients, C, for use in the Rational Method									
Type of Surface					*Runoff Coefficient (C)				
Lawns: Heavy soil, steep, 7 percent					0.35				
Streets: Asphalt					0.70				
Roofs					0.75				
Basin Designation	A Pond (ft ²)	A Lawn (ft ²)	A Paved (ft ²)	A Roof (ft ²)	A Gravel (ft ²)	A Walks (ft ²)	A total (acres)	Impervious %	Weighted C
A01	0	0	23799	0	0	0	0.55	95%	0.70
A02A	0	0	11548	0	0	0	0.27	95%	0.70
A02B	0	5482	0	0	0	0	0.13	5%	0.35
A03	0	0	27302	0	0	0	0.63	95%	0.70
A04	0	0	26542	0	0	0	0.61	95%	0.70
A05	0	1998	16298	1621	0	0	0.46	85%	0.67
A06	0	375	10155	0	0	0	0.24	92%	0.69
A07	0	2695	14047	0	0	0	0.38	81%	0.64
A08	0	1630	17883	0	0	0	0.45	87%	0.67
A09	0	1943	17571	0	0	0	0.45	86%	0.67

Time of Concentration Calculations

Project Name **H-1 Widening**
Revised Date **2/2/2021**

City and County of Honolulu
Rules Relating to Storm Drainage Standards

Project No. **D3216600**
Calculated by **MRD**

$$T_{ti} = \frac{K_c}{I^{0.4}} \left(\frac{nL}{\sqrt{S}} \right)^{0.6}$$

T_{ti} = sheet flow travel time, minutes (min) I = rainfall intensity, in/hr $T_{ti} = \frac{L}{60V}$ $V = (3.28)kS_p^{0.5}$ V = velocity, ft/s
 n = roughness coefficient (see Table 2-2) S = surface slope, feet per foot (ft/ft) L = flow length for segment i, ft k = intercept coefficient (see Table 2-3)
 L = flow length, ft K_c = empirical coefficient equal to 0.933 V = velocity for segment i, ft/s S_p = slope, percent

SUB-BASIN DATA		OVERLAND (INITIAL) FLOW TIME (t _i)					CHANNELIZED (TRAVEL) FLOW TIME (t _i)							t _i + t _c	FINAL t _c USED
Basin Designation	Area	Overland Flow Length, Li	U/S Elevation (Optional)	D/S Elevation (Optional)	Overland Flow Slope, Si	Overland Flow Time, ti	Channelized Flow Length, Lt	U/S Elevation (Optional)	D/S Elevation (Optional)	Channelized Flow Slope, St	Type of Land Surface	Channelized Flow Time, ti	Computed tc	tc	
	(acres)	(ft)	(ft)	(ft)	(ft/ft)	(min)	(ft)	(ft)	(ft)	(ft/ft)		(min)	(min)		(min)
A01	0.55	2	58.7	58.5	0.090	0.16	938	58.5	37.6	0.022	Paved areas and shallow paved swales	6.99	7.15	10.0	
A02A	0.27	86	52.4	49.7	0.032	1.92	252	49.7	44.9	0.019	Paved areas and shallow paved swales	2.03	3.95	10.0	
A02B	0.13	4	56.0	53.8	0.600	0.12	244	53.8	45.1	0.036	Heavy Meadow	1.43	1.55	10.0	
A03	0.63	66	58.8	56.8	0.030	1.66	439	56.8	49.7	0.016	Paved areas and shallow paved swales	3.84	5.50	10.0	
A04	0.61	66	58.8	56.8	0.030	1.66	408	56.8	53.6	0.008	Paved areas and shallow paved swales	5.13	6.79	10.0	
A05	0.46	79	55.3	52.8	0.031	1.84	225	52.8	50.3	0.011	Paved areas and shallow paved swales	2.35	4.19	10.0	
A06	0.24	72	52.2	50.2	0.028	1.79	41	50.2	50.1	0.002	Paved areas and shallow paved swales	1.11	2.90	10.0	
A07	0.38	106	55.2	51.7	0.033	2.14	175	51.7	50.2	0.009	Paved areas and shallow paved swales	2.09	4.24	10.0	
A08	0.45	71	59.9	57.1	0.039	1.60	264	57.1	52.4	0.018	Paved areas and shallow paved swales	2.20	3.81	10.0	
A09	0.45	65	62.6	60.0	0.040	1.52	296	60.0	57.1	0.010	Paved areas and shallow paved swales	3.33	4.85	10.0	

Runoff Calculations

Project Name H-1 Widening Revised Date 2/2/2021					Project No. D3216600 Calculated by MRD		
Basin	Area (ac.)	'c'	cA	t _c (min)	intensity (in/hr)	Q (cfs)	Storm Event
A01	0.55	0.70	0.38	10.0	4.90	1.87	05 YR
					5.93	2.27	10 YR
					7.43	2.84	25 YR
					8.65	3.31	50 YR
					9.97	3.81	100 YR
A02A	0.27	0.70	0.19	10.0	4.90	0.91	05 YR
					5.93	1.10	10 YR
					7.43	1.38	25 YR
					8.65	1.61	50 YR
					9.97	1.85	100 YR
A02B	0.13	0.35	0.04	10.0	4.90	0.22	05 YR
					5.93	0.26	10 YR
					7.43	0.33	25 YR
					8.65	0.38	50 YR
					9.97	0.44	100 YR
A03	0.63	0.70	0.44	10.0	4.90	2.15	05 YR
					5.93	2.60	10 YR
					7.43	3.26	25 YR
					8.65	3.80	50 YR
					9.97	4.37	100 YR
A04	0.61	0.70	0.43	10.0	4.90	2.09	05 YR
					5.93	2.53	10 YR
					7.43	3.17	25 YR
					8.65	3.69	50 YR
					9.97	4.25	100 YR
A05	0.46	0.67	0.31	10.0	4.90	1.50	05 YR
					5.93	1.81	10 YR
					7.43	2.27	25 YR
					8.65	2.65	50 YR
					9.97	3.05	100 YR
A06	0.24	0.69	0.17	10.0	4.90	0.81	05 YR
					5.93	0.99	10 YR
					7.43	1.23	25 YR
					8.65	1.44	50 YR
					9.97	1.66	100 YR
A07	0.38	0.64	0.25	10.0	4.90	1.21	05 YR
					5.93	1.47	10 YR
					7.43	1.84	25 YR
					8.65	2.14	50 YR
					9.97	2.47	100 YR
A08	0.45	0.67	0.30	10.0	4.90	1.47	05 YR
					5.93	1.78	10 YR
					7.43	2.23	25 YR
					8.65	2.60	50 YR
					9.97	3.00	100 YR
A09	0.45	0.67	0.30	10.0	4.90	1.46	05 YR
					5.93	1.77	10 YR
					7.43	2.21	25 YR
					8.65	2.58	50 YR
					9.97	2.97	100 YR