DRAINAGE REPORT
HŌKŪLIʻA SHORELINE PARK PUBLIC ACCESS PARKING

North Kona, Hawaiʻi
Tax Map Key: 8-1-34: 27

Date: June 23, 2016

Prepared for:
1250 Oceanside, LLC
2260 Douglas Boulevard, Suite 240
Roseville, CA 95661

Prepared by:
BELT COLLINS HAWAII LLC
2153 North King Street, Suite 200
Honolulu, Hawaiʻi 96819

Job No. 2014.50.0300

ALAN M. KATO
LICENSED PROFESSIONAL ENGINEER
No. 7552-C
HAWAII, U.S.A.

This work was prepared by me or under my supervision.
Expiration date of the License: **April 30, 2018**

1 GENERAL PROJECT SITE DESCRIPTION

The Hōkūli'a Shoreline Park Public Access Parking project is located within the Hōkūli'a development, west of Hawai'i Loa Drive, at Tax Map Key (TMK) 8-1-34: 27. See Figure 1 – Project Location Map. The project site is owned by 1250 Oceanside, LLC. The mauka (south-east) half of the property has been partially graded. An archaeological preservation site is located on the makai (north-west) half of the property. The proposed project, located on the mauka (south-east) half of the site, includes public parking, a restroom facility with showers and signage.

2 STUDY METHODOLOGY

The County of Hawai'i, Department of Public Works' Storm Drainage Standards, hereinafter referred to as the Standards, dated October 1970 was used for the analysis of the storm drainage. Since the project area is less than 100 acres, the 10-year-recurrence-interval flows for the drainage are calculated by using the Rational Method, as outlined in the Standards.

A rainfall intensity of 1.8 inches per hour was selected for the design storm from Plate 1 of the Standards. Runoff coefficients of 0.32 and 0.66 were taken from Table 1 of the Standards for the existing and developed conditions, respectively.

3 EXISTING DRAINAGE

The existing property is approximately 1.494 acres. The mauka (south-east) half of the site was previously graded, and vegetation has naturally grown back on the site. The proposed project will be located on approximately 0.59 acres of the mauka (south-east) half of the site. The makai (north-west) portion of the site is an archaeological preservation area. The site slopes from mauka (south-east) to makai (north-west). Rainfall runoff sheet flows from mauka (south-east) to makai (north-west) until it gets to the preservation site, where the runoff sheet flows north and south around the archaeological preservation site and continues to flow in the makai (north-west) direction.

The project site is divided into two drainage areas designated as Basins 1 and 2, as shown in Figure 2 –Existing Drainage Plan. Basin 1 encompasses approximately 0.47 acres, generating approximately 0.50 cubic feet per second (cfs) of runoff with a runoff volume of approximately 451 cubic feet (cf). Basin 2 encompasses approximately 0.12 acres, generating approximately 0.15 cfs of runoff with a volume of approximately 81 cf. The total runoff is approximately 0.65 cfs with a total volume of approximately 531 cf. See Table 1: Existing Condition Runoff Calculations and Table 5: Runoff Volume at the end of this report.

4 DEVELOPED DRAINAGE

The proposed improvements located on the mauka (south-east) half of the site will include a new restroom facility building, asphaltic concrete paved driveway and parking lot, Portland cement concrete paved walkways, and signage. Areas around the parking lot and building will either be landscaped or renaturalized with lava. The developed area of the site is divided into two drainage areas designated as Basins 1 and 2. Rainfall runoff will generally follow the same drainage patterns as the existing conditions, as shown in Figure 3 – Developed Drainage Plan.

Drainage Basin 1 encompasses 0.41 acres, generating approximately 1.26 cfs of runoff with a volume of approximately 377 cf. Drainage Basin 2 encompasses 0.18 acres, generating approximately 0.54 cfs of runoff with a volume of approximately 179 cf. The total runoff is approximately 1.80 cfs with a volume of approximately 556 cf. See Table 3: Developed Condition Runoff Calculations at the end of this report.

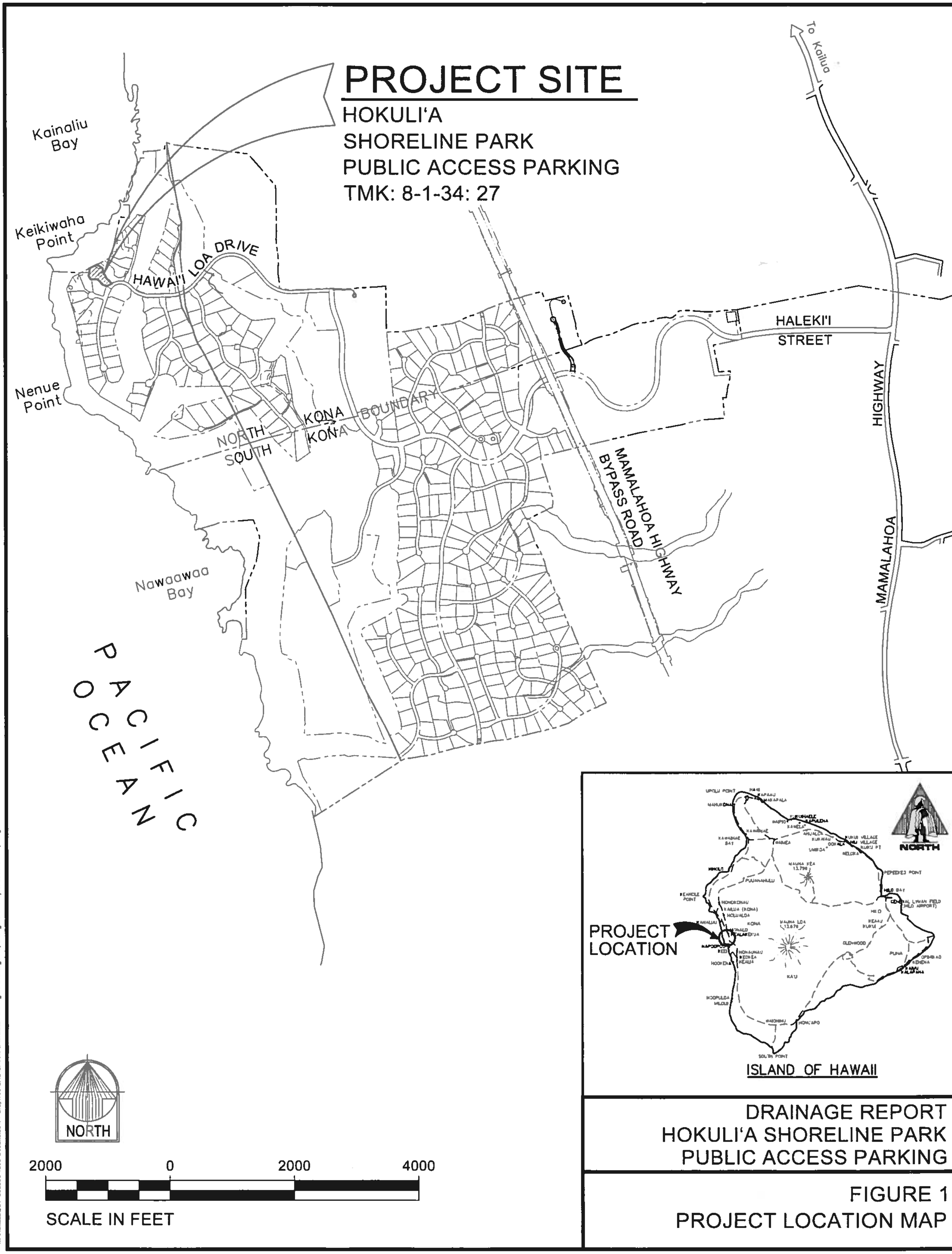
One (1) seepage well will be constructed in each Basin to capture and mitigate the increased discharge rate and volume of rainfall runoff. The seepage wells consist of 8-foot diameter perforated concrete rings with a total depth of approximately 7-feet, and a storage volume of approximately 301 cf each. The seepage well in Basin 1 will contain approximately 80% of the runoff, while the seepage well in Basin 2 has the capacity to store the entire volume of runoff from the design storm. Lava sumps, appropriately size, can also be used as an alternate to the seepage wells. The net effect will be a reduction in runoff from the project site.

5 SUMMARY

Under existing conditions, approximately 0.65 cfs of runoff flows from the project site, with a volume of approximately 531 cf. With the site improvements, approximately 1.80 cfs of runoff will be generated on the site, with a volume of approximately 556 cf. Two (2) proposed seepage wells with a total storage volume of 602 cf are designed to capture the majority of the storm runoff from the improvements. There should be no increase in runoff flow rate or volume discharging from the site.

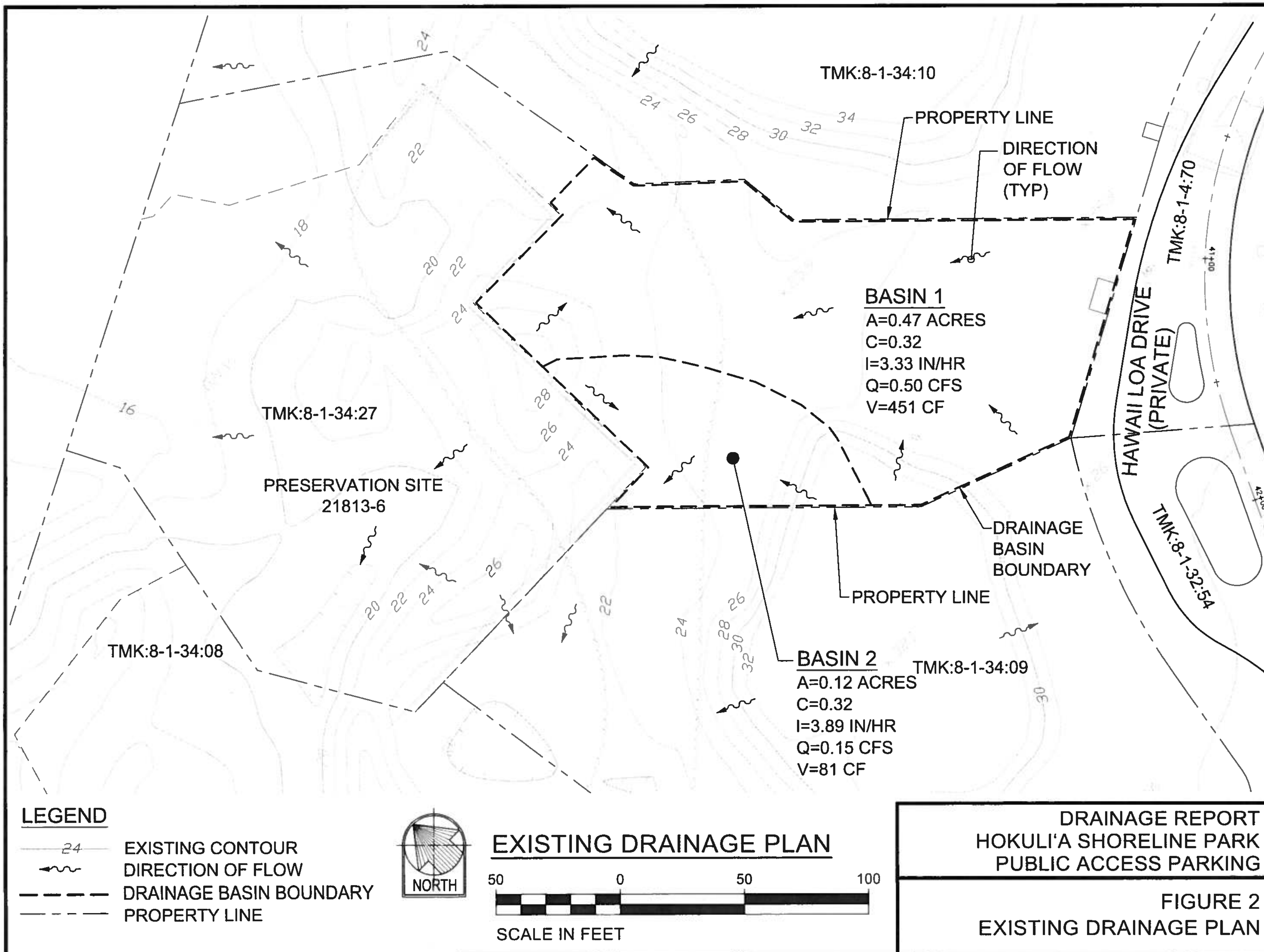
<u>REFERENCES:</u>

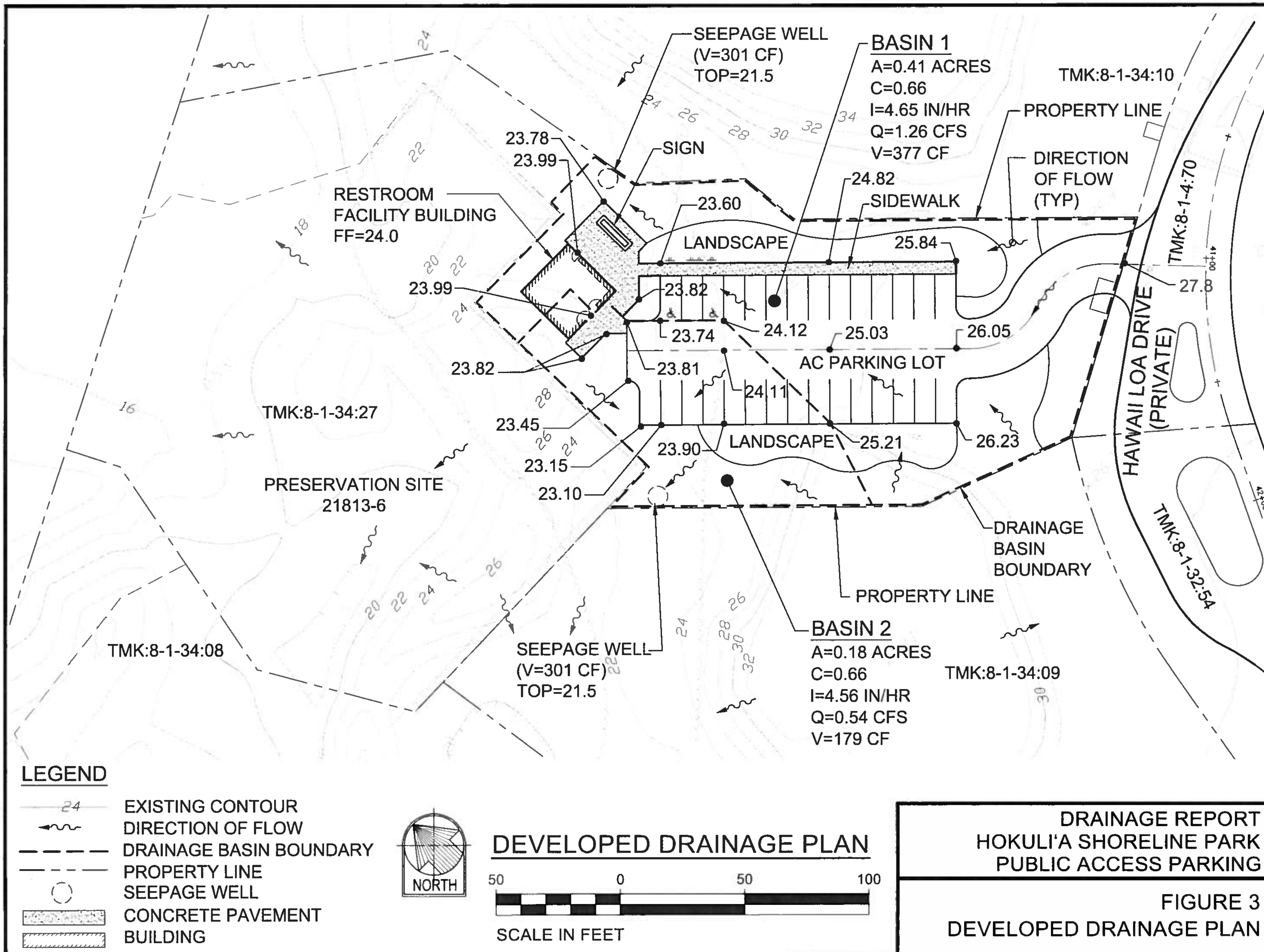
"Storm Drainage Standard", County of Hawaii, Department of Public Works, October 1970.



DRAINAGE REPORT
HOKULI'A SHORELINE PARK
PUBLIC ACCESS PARKING

FIGURE 1
PROJECT LOCATION MAP


TMK:8-1-34:10
PROPERTY LINE
DIRECTION OF FLOW (TYP)
TMK:8-1-4:70
HAWAII LOA DRIVE (PRIVATE)
TMK:8-1-32:54
BASIN 1
A=0.47 ACRES
C=0.32
I=3.33 IN/HR
Q=0.50 CFS
V=451 CF
TMK:8-1-34:27
PRESERVATION SITE 21813-6
DRAINAGE BASIN BOUNDARY
PROPERTY LINE
TMK:8-1-34:08
BASIN 2
A=0.12 ACRES
C=0.32
I=3.89 IN/HR
Q=0.15 CFS
V=81 CF
TMK:8-1-34:09
LEGEND
EXISTING CONTOUR
DIRECTION OF FLOW
DRAINAGE BASIN BOUNDARY
PROPERTY LINE
NORTH
EXISTING DRAINAGE PLAN
50
0
50
100
SCALE IN FEET
DRAINAGE REPORT
HOKULI'A SHORELINE PARK
PUBLIC ACCESS PARKING
FIGURE 2
EXISTING DRAINAGE PLAN



DRAINAGE REPORT
HOKULI'A SHORELINE PARK
PUBLIC ACCESS PARKING

FIGURE 3
DEVELOPED DRAINAGE PLAN

HOKULIA SHORELINE PARK PUBLIC ACCESS PARKING TABLE 1: EXISTING CONDITION RUNOFF CALCULATIONS					
Basin	Tributary Area (Acres)	Tc (Minutes)	Runoff Coefficient C	Rainfall Intensity (in/hr)	Discharge (cfs)
1	0.47	15.0	0.32	3.33	0.50
2	0.12	9.0	0.32	3.89	0.15
Total	0.59				0.65

NOTES:
1. The Time of Concentration (Tc) is determined from Plate 3 of the County of Hawaii Storm Drainage Standards.
2. The Runoff Coefficient is from Table 1 of the County of Hawaii Storm Drainage Standards.
3. The Rainfall Intensity is based on a 1.8 inch rainfall for a 10-year, 1-hour storm from Plate 1.

HOKULIA SHORELINE PARK PUBLIC ACCESS PARKING TABLE 2: EXISTING DRAINAGE TIME OF CONCENTRATION, Tc					
Basin	Length (ft)	Beg. Elev (ft)	End Elev (ft)	Slope (%)	Tc (min)
1	215	26.5	21.9	2.1%	15.0
2	87	26	22	4.6%	9.0

NOTES:
1. The Time of Concentration (Tc) is determined from Plate 3 of the County of Hawaii Storm Drainage Standards.
2. Ground surface is good vegetal cover.

HOKULIA SHORELINE PARK PUBLIC ACCESS PARKING TABLE 3: DEVELOPED CONDITION RUNOFF CALCULATIONS					
Basin	Tributary Area (Acres)	Tc (Minutes)	Runoff Coefficient C	Rainfall Intensity (in/hr)	Discharge (cfs)
1	0.41	5.0	0.66	4.65	1.26
2	0.18	5.5	0.66	4.56	0.54
Total	0.59				1.80

NOTES:
1. The Time of Concentration (Tc) is determined from Plate 3 of the County of Hawaii Storm Drainage Standards.
2. The Runoff Coefficient is from Table 1 of the County of Hawaii Storm Drainage Standards.
3. The Rainfall Intensity is based on a 1.8 inch rainfall for a 10-year, 1-hour storm from Plate 1.

HOKULIA GOLF MAINTENANCE FACILITY MASS GRADING TABLE 4: DEVELOPED DRAINAGE TIME OF CONCENTRATION, Tc						
Basin	Length (ft)	Ground Surface	Beg. Elev (ft)	End Elev (ft)	Slope (%)	Tc (min)
1	224	AC/Lava	26.5	21.9	2.1%	5.0
Total	**224**					**5.0**
2	75	Lava	26	22	5.3%	5.5
Total	**75**					**5.5**

NOTES:
1. The Time of Concentration (Tc) is determined from Plate 3 of the County of Hawaii Storm Drainage Standards.

BELT COLLINS

PROJECT:	Hōkūli'a Shoreline Park	JOB NO:	2014.50.0300
CLIENT:	1250 Oceanside, LLC	DATE:	23-Jun-16
SUBJECT:	Drainage Calculations	BY:	A. Kato
FILE:	M:\Hokulia\2014500300 1250 Oceanside\05 Basis of Design\Shoreline P:		

HOKULIA SHORELINE PARK PUBLIC ACCESS PARKING
TABLE 5: RUNOFF VOLUME

Basin	Discharge (cfs)	Tc (Minutes)	Runoff Volume (cf)	Volume Increase (cf)
Existing 1	0.50	15.0	451	
Existing 2	0.15	9.0	81	
Subtotal	0.65		531	
Developed 1	1.26	5.0	377	-73
Developed 2	0.54	5.5	179	98
Subtotal	1.80		556	

NOTES:
1. Volume of Runoff based on triangular unit hydrograph, where Peak Discharge occurs at Tc.
   Total Time of storm = 2 x Tc
   Volume = 1/2 (base) (height) = 1/2 (2 x Tc) (Discharge) = (Tc) x (Discharge)
2. 8' Diameter Seepage Wells , Ring heights H = 6'
   Storage Volume = [(pi x D**2)/4] x H = [(pi x 8**2)/4] x 6 = 301 cf

Seepage Wells to store the increase in runoff volume and mitigate increase in discharge rate.
Install One 8' Diameter Seepage Well in each Basin.

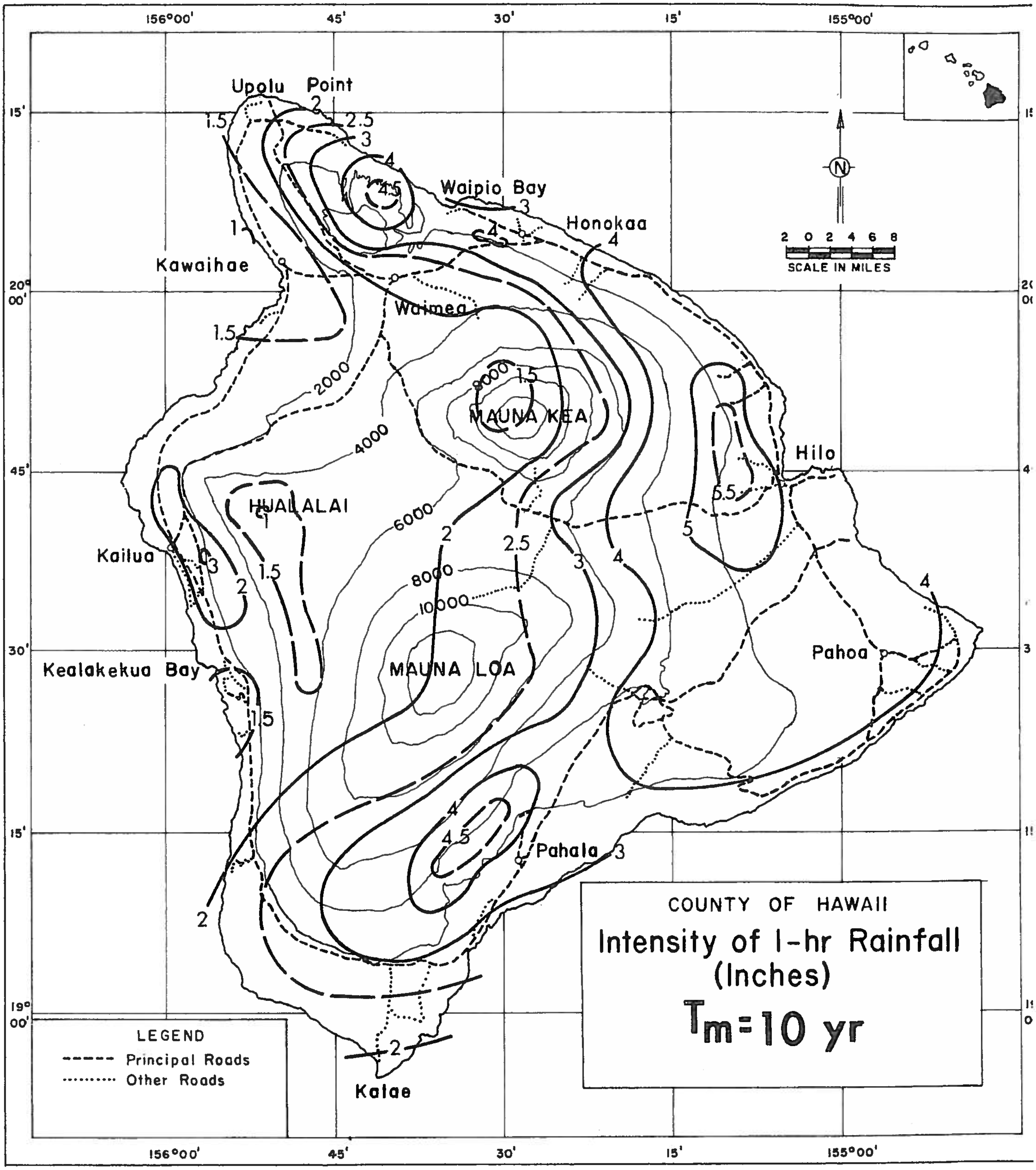

156°00'
45'
30'
15'
155°00'
Upolu Point
Waipio Bay
Honokaa
Kawaihae
Waimea
MAUNA KEA
Hilo
HUALALAI
Kailua
MAUNA LOA
Kealakekua Bay
Pahoa
Pahala
Kalae
2 0 2 4 6 8
SCALE IN MILES
LEGEND
Principal Roads
Other Roads
COUNTY OF HAWAII
Intensity of 1-hr Rainfall
(Inches)
Tm=10 yr

Plate 1

Table 1

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

c=0.95 for paved areas (per K. Emler - DEQ) 4/24/[illegible]

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

APPROXIMATE AVERAGE VELOCITIES OF RUNOFF FOR CALCULATING TIME OF CONCENTRATION

TYPE OF FLOW	VELOCITY IN FPS FOR SLOPES (in percent) INDICATED			
OVERLAND FLOW:	0–3%	4–7%	8–11%	12–15%
Woodlands	1.0	2.0	3.0	3.5
Pastures	1.5	3.0	4.0	4.5
Cultivated	2.0	4.0	5.0	6.0
Pavements	5.0	12.0	15.0	18.0
OPEN CHANNEL FLOW:				
Improved Channels	Determine Velocity by Manning's Formula			
Natural Channel* (not well defined)	1.0	3.0	5.0	8.0

**These values vary with the channel size and other conditions so that the ones given are the averages of a wide range. Whereever possible, more accurate determinations should be made for particular conditions by Manning's formula.*

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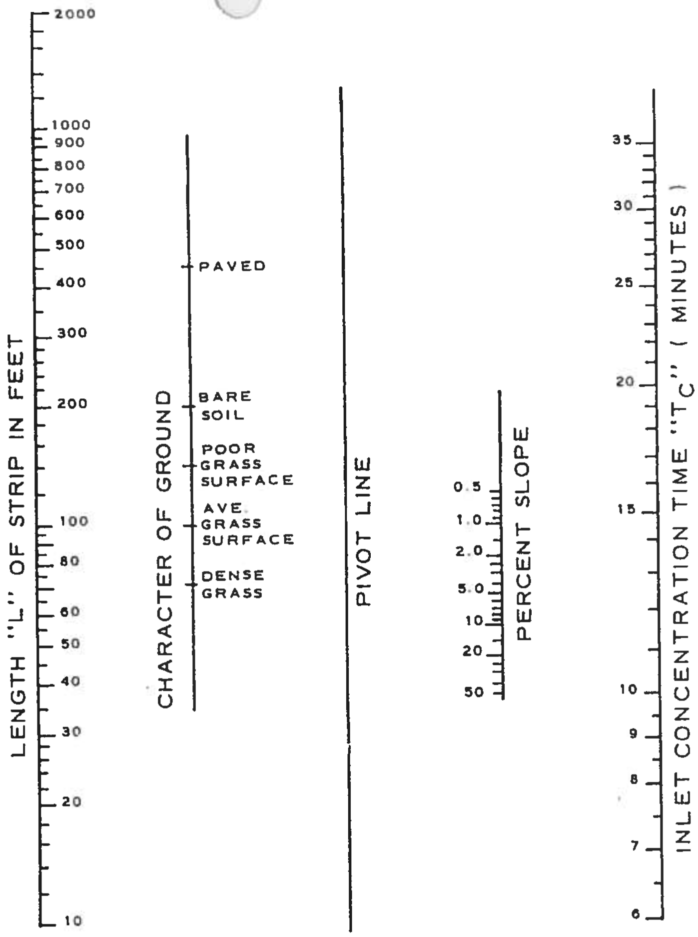

Plate 3

Overland Flow Chart

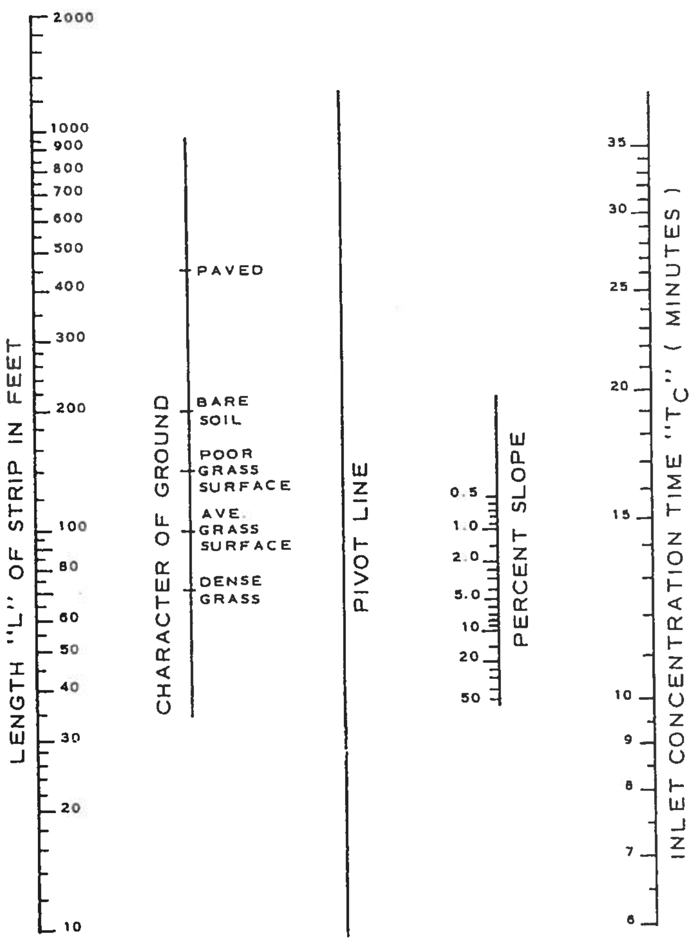

Plate 3

Overland Flow Chart

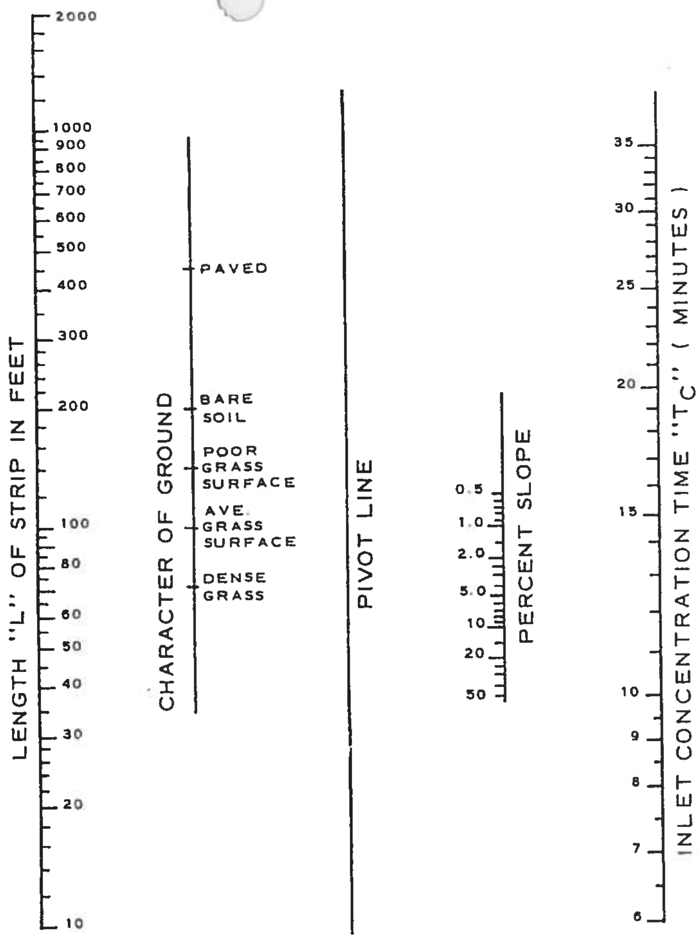

Plate 3

Overland Flow Chart

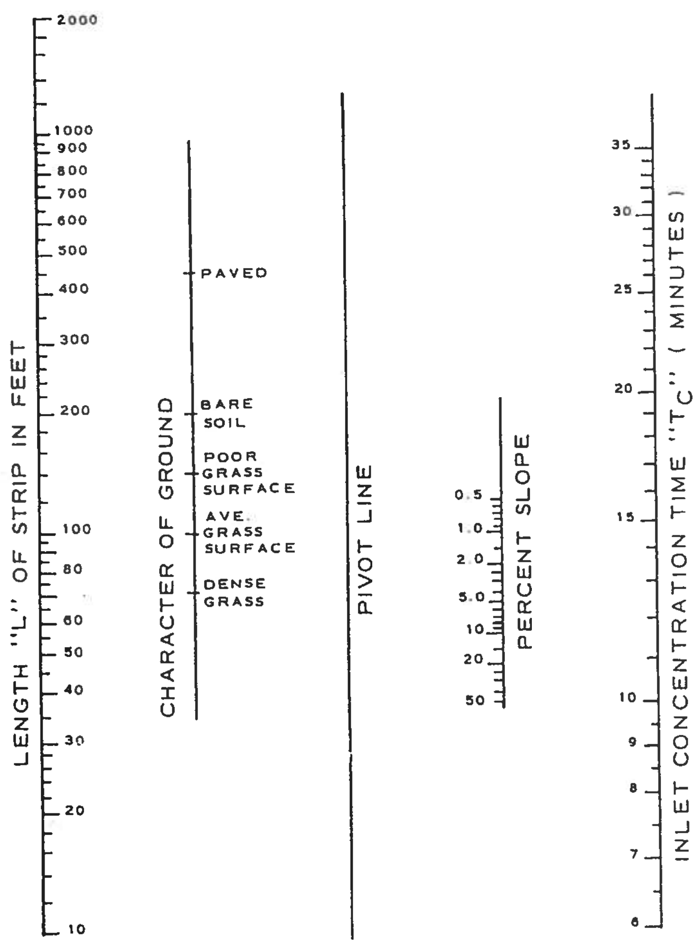

Plate 3

Overland Flow Chart

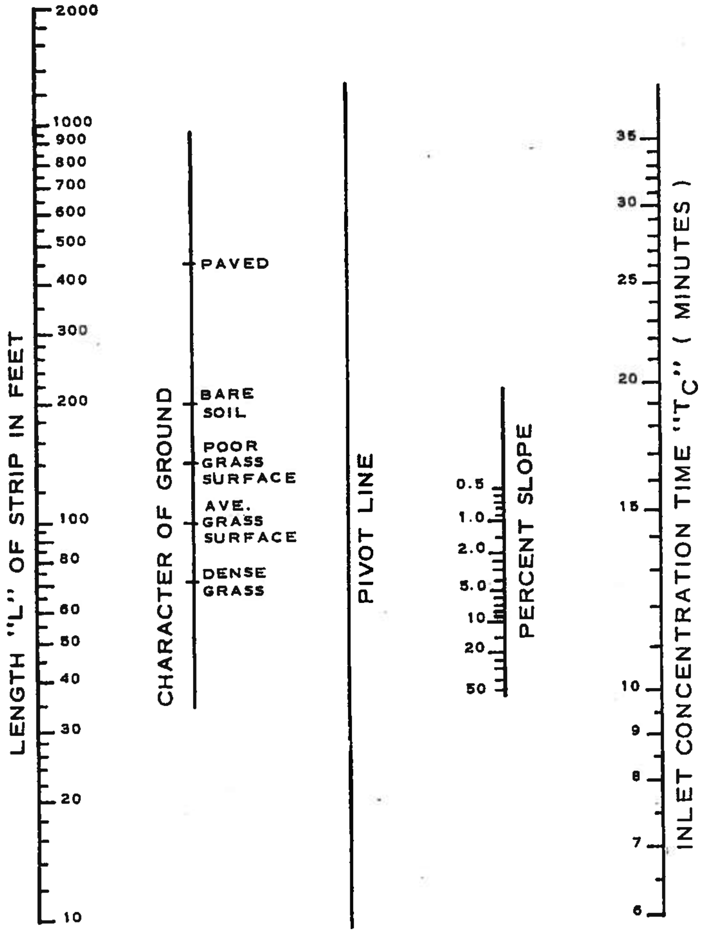

Plate 3

Overland Flow Chart

Plate 4

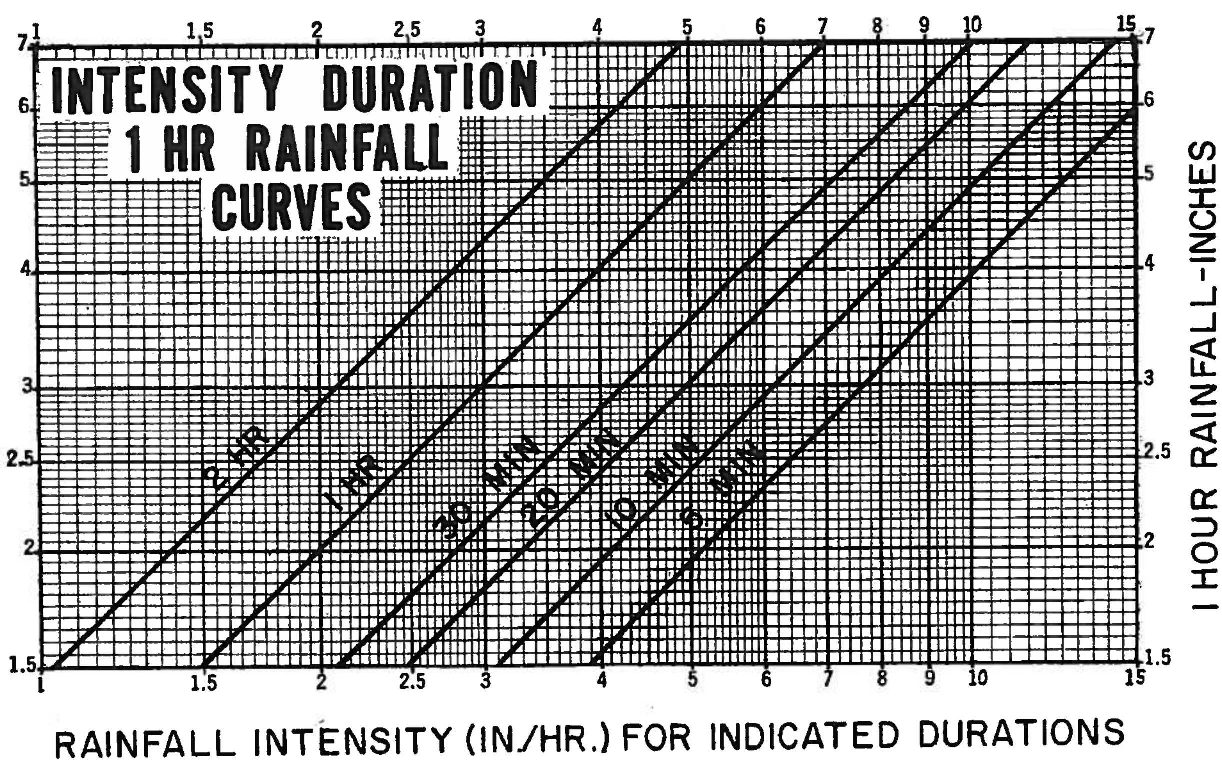

Table 1

Hōkūli'a Shoreline Park Public Access Parking
*Rainfall Intensity for Indicated Tc

Tc	I	Tc	I	Tc	I	Tc	I	Tc	I	Tc	I
5.0	4.65	10.0	3.70	15.0	3.33	20.0	2.96	25.0	2.74	30.0	2.51
5.1	4.63	10.1	3.69	15.1	3.32	20.1	2.96	25.1	2.73	40.0	2.27
5.2	4.61	10.2	3.69	15.2	3.32	20.2	2.95	25.2	2.73	60.0	1.79
5.3	4.59	10.3	3.68	15.3	3.31	20.3	2.95	25.3	2.72		
5.4	4.57	10.4	3.67	15.4	3.30	20.4	2.94	25.4	2.72		
5.5	4.56	10.5	3.66	15.5	3.29	20.5	2.94	25.5	2.71		
5.6	4.54	10.6	3.66	15.6	3.29	20.6	2.93	25.6	2.71		
5.7	4.52	10.7	3.65	15.7	3.28	20.7	2.93	25.7	2.70		
5.8	4.50	10.8	3.64	15.8	3.27	20.8	2.92	25.8	2.70		
5.9	4.48	10.9	3.63	15.9	3.26	20.9	2.92	25.9	2.69		
6.0	4.46	11.0	3.63	16.0	3.26	21.0	2.92	26.0	2.69		
6.1	4.44	11.1	3.62	16.1	3.25	21.1	2.91	26.1	2.69		
6.2	4.42	11.2	3.61	16.2	3.24	21.2	2.91	26.2	2.68		
6.3	4.40	11.3	3.60	16.3	3.23	21.3	2.90	26.3	2.68		
6.4	4.38	11.4	3.60	16.4	3.23	21.4	2.90	26.4	2.67		
6.5	4.37	11.5	3.59	16.5	3.22	21.5	2.89	26.5	2.67		
6.6	4.35	11.6	3.58	16.6	3.21	21.6	2.89	26.6	2.66		
6.7	4.33	11.7	3.57	16.7	3.20	21.7	2.88	26.7	2.66		
6.8	4.31	11.8	3.57	16.8	3.20	21.8	2.88	26.8	2.65		
6.9	4.29	11.9	3.56	16.9	3.19	21.9	2.87	26.9	2.65		
7.0	4.27	12.0	3.55	17.0	3.18	22.0	2.87	27.0	2.65		
7.1	4.25	12.1	3.54	17.1	3.17	22.1	2.87	27.1	2.64		
7.2	4.23	12.2	3.54	17.2	3.17	22.2	2.86	27.2	2.64		
7.3	4.21	12.3	3.53	17.3	3.16	22.3	2.86	27.3	2.63		
7.4	4.19	12.4	3.52	17.4	3.15	22.4	2.85	27.4	2.63		
7.5	4.18	12.5	3.52	17.5	3.15	22.5	2.85	27.5	2.62		
7.6	4.16	12.6	3.51	17.6	3.14	22.6	2.84	27.6	2.62		
7.7	4.14	12.7	3.50	17.7	3.13	22.7	2.84	27.7	2.61		
7.8	4.12	12.8	3.49	17.8	3.12	22.8	2.83	27.8	2.61		
7.9	4.10	12.9	3.49	17.9	3.12	22.9	2.83	27.9	2.60		
8.0	4.08	13.0	3.48	18.0	3.11	23.0	2.83	28.0	2.60		
8.1	4.06	13.1	3.47	18.1	3.10	23.1	2.82	28.1	2.60		
8.2	4.04	13.2	3.46	18.2	3.09	23.2	2.82	28.2	2.59		
8.3	4.02	13.3	3.46	18.3	3.09	23.3	2.81	28.3	2.59		
8.4	4.00	13.4	3.45	18.4	3.08	23.4	2.81	28.4	2.58		
8.5	3.99	13.5	3.44	18.5	3.07	23.5	2.80	28.5	2.58		
8.6	3.97	13.6	3.43	18.6	3.06	23.6	2.80	28.6	2.57		
8.7	3.95	13.7	3.43	18.7	3.06	23.7	2.79	28.7	2.57		
8.8	3.93	13.8	3.42	18.8	3.05	23.8	2.79	28.8	2.56		
8.9	3.91	13.9	3.41	18.9	3.04	23.9	2.78	28.9	2.56		
9.0	3.89	14.0	3.40	19.0	3.03	24.0	2.78	29.0	2.56		
9.1	3.87	14.1	3.40	19.1	3.03	24.1	2.78	29.1	2.55		
9.2	3.85	14.2	3.39	19.2	3.02	24.2	2.77	29.2	2.55		
9.3	3.83	14.3	3.38	19.3	3.01	24.3	2.77	29.3	2.54		
9.4	3.81	14.4	3.37	19.4	3.00	24.4	2.76	29.4	2.54		
9.5	3.79	14.5	3.37	19.5	3.00	24.5	2.76	29.5	2.53		
9.6	3.78	14.6	3.36	19.6	2.99	24.6	2.75	29.6	2.53		
9.7	3.76	14.7	3.35	19.7	2.98	24.7	2.75	29.7	2.52		
9.8	3.74	14.8	3.34	19.8	2.97	24.8	2.74	29.8	2.52		
9.9	3.72	14.9	3.34	19.9	2.97	24.9	2.74	29.9	2.51		

** Interpolate from Plate 4 graph, i = 1.8*