Rational(50)

R. M. TOWILL CORPORATION
File:
2024 N King Street, Suite 200, Honolulu, Hawaii 96819
Ph. (808) 842-1133 Fax (808) 842-1937

Project:
Location: H-1 Freeway Kapiolani to Ainakoa
Prepared by: RSY
Date: 8/26/2016
Page
Job No.:
Checked by:
Date:

ITEM: RATIONAL METHOD, EXISTING CONDITIONS, 50-YEAR RECURRENCE INTERVAL

1. INTRODUCTION

The purpose of this work sheet is to determine the runoff quantities for drainage areas of 100 acres or less under existing conditions.

2. REFERENCES

2.1 "Erosion and Sediment Control Guide for Hawaii," U.S. Dept. of Agriculture, Soil Conservation Service, 3/1981 updated table 14 and 15 - Pages 54-58, 7/1993
2.2 "Soil Survey of Kauai, Oahu, Maui, Molokai, and Lanai, State of Hawaii," U.S. Dept.of Agriculture, Soil Conservation Service, 8/1972
2.3 "Rules Relating to Storm Drainage Standards
2.4 "NOAA Atlas 14 Vol 4", NOAA Precipitation Frequency Data Server website, 2011

3. COMPUTATIONS

Per Ref 2.3, 50-yr, 1-hr storm is used for design to account for potential sump and tailwater conditions.
This will apply to all the following calculations in determing rainfall intensity.

Minimum value for time of concentration, Tc, is 5 minutes

Rational Formula: Q = C I A

Runoff Coefficient:

Characteristic	Type	C
concrete		1.00

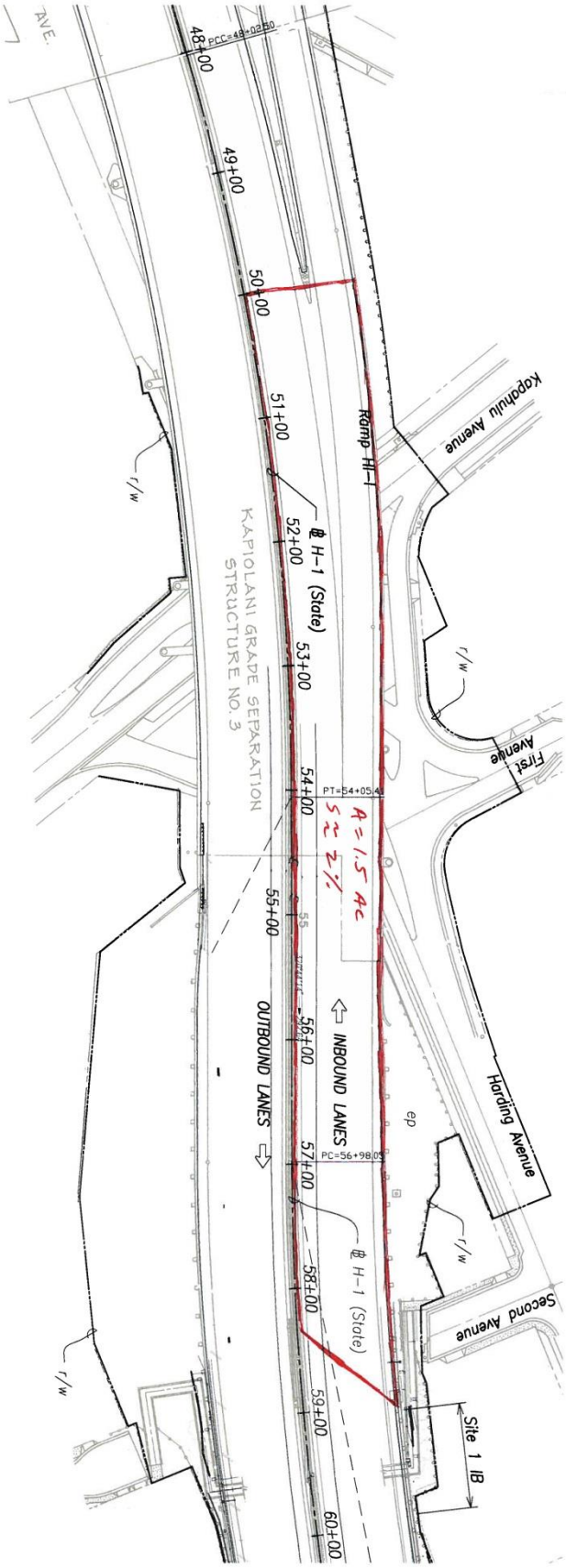
Rainfall Intensity: 50-yr, 1-hr rainfall depth = 3.01" (Ref. 2.4)

Time of Concentration =	9.5	minutes
Rainfall Intensity, I =	3.5	in/hr
correction factor=	2.3	

Drainage Area: A = 1.5 acres

Peak Flow: Q = 12.075 cfs

Page 1


PCC=48+02.50
48+00
49+00
50+00
51+00
52+00
53+00
54+00
55+00
56+00
57+00
58+00
59+00
60+00
Ramp H1
Kapahulu Avenue
First Avenue
Harding Avenue
Second Avenue
H-1 (State)
KAPIOLANI GRADE SEPARATION STRUCTURE NO. 3
PT=54+05.43
PC=56+98.05
INBOUND LANES
OUTBOUND LANES
A = 1.5 ac
Site 1 IB
r/w
ep

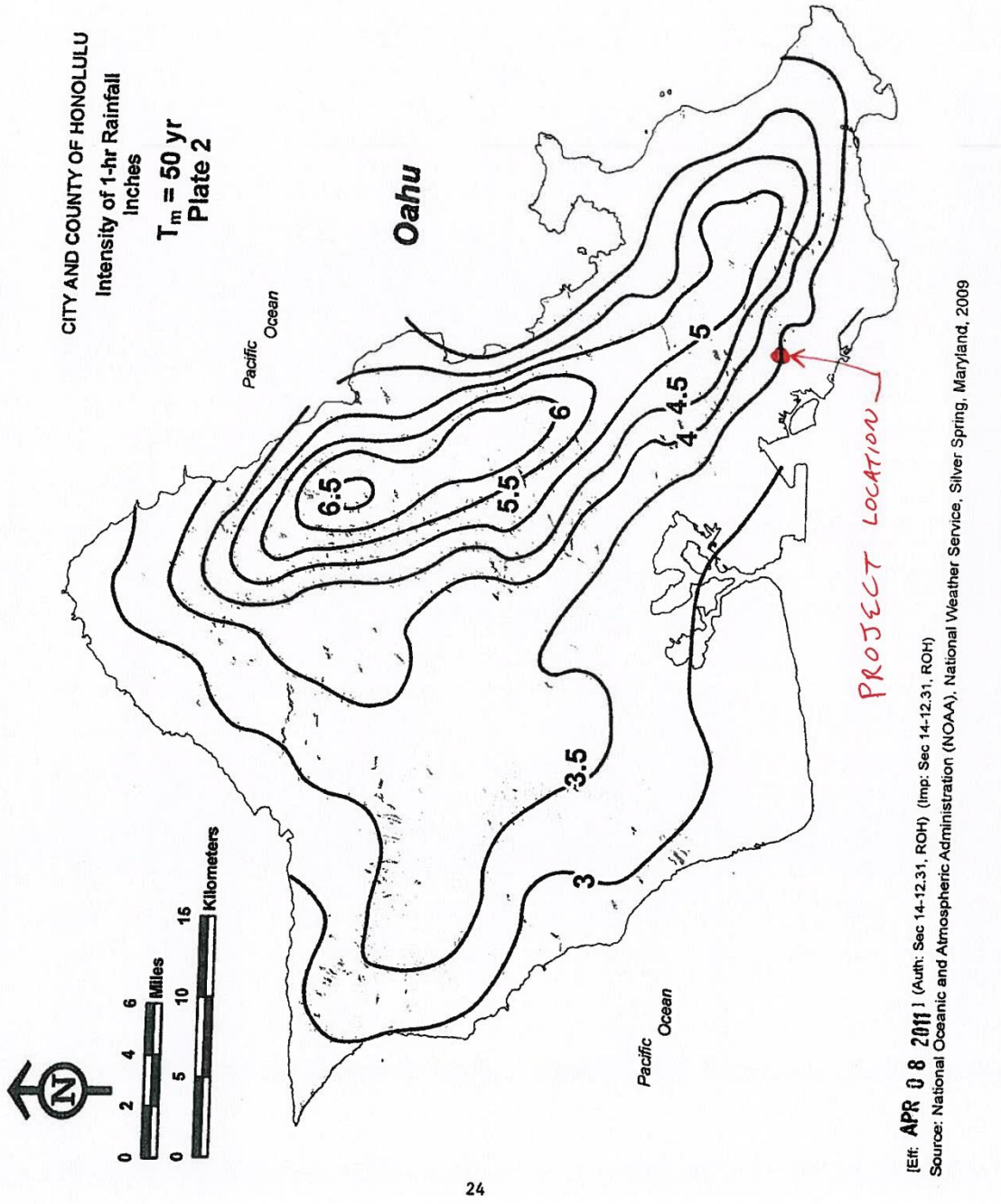
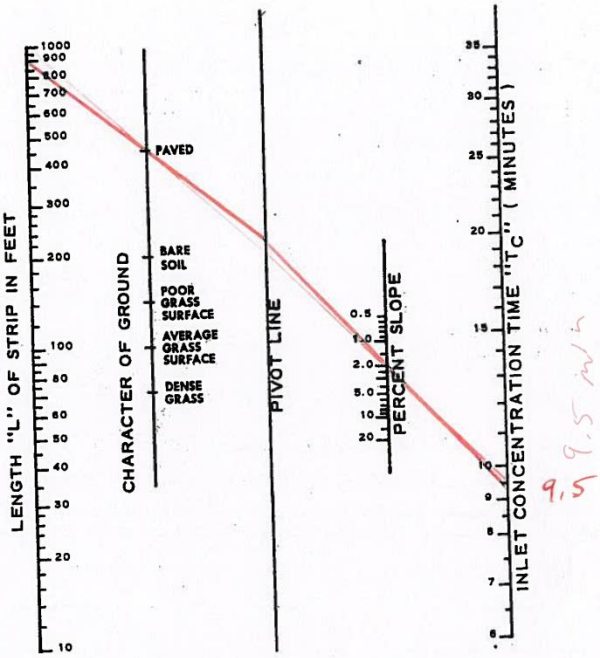

CITY AND COUNTY OF HONOLULU
Intensity of 1-hr Rainfall
Inches
T_m = 50 yr
Plate 2
Oahu
Pacific Ocean
Pacific Ocean
6.5
6
5.5
5
4.5
4
3.5
3
PROJECT LOCATION
N
0 2 4 6
Miles
0 5 10 15
Kilometers
[Eff: APR 0 8 2011] (Auth: Sec 14-12.31, ROH) (Imp: Sec 14-12.31, ROH)
Source: National Oceanic and Atmospheric Administration (NOAA), National Weather Service, Silver Spring, Maryland, 2009
24

Plate 3

Overland Flow Chart



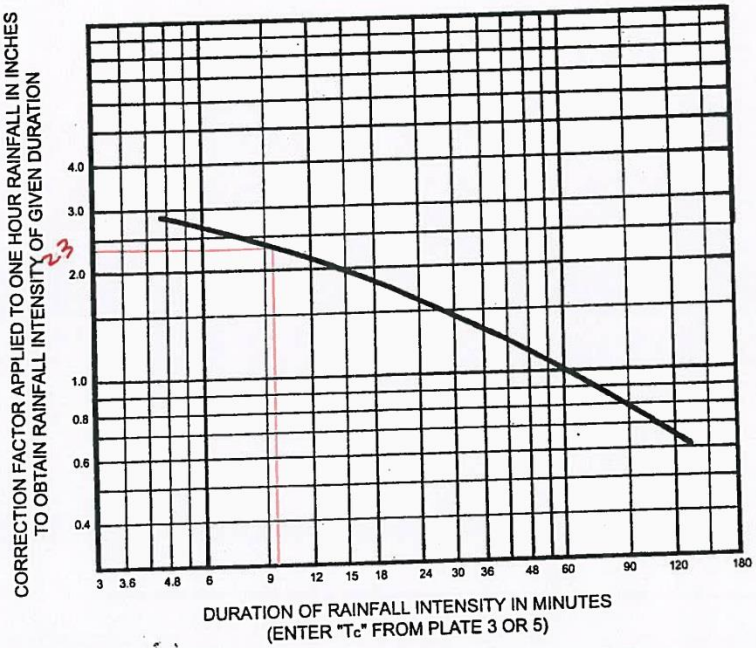


Plate 4

CORRECTION FACTOR
FOR CONVERTING 1 HR. RAINFALL
TO RAINFALL INTENSITY
OF VARIOUS DURATIONS

TO BE USED FOR AREA
LESS THAN 100 ACRES

(See Plate 6 for area
more than 100 acres)

A = 1.5 Ac

25

NOAA Atlas 14, Volume 4, Version 3
Location name: Honolulu, Hawaii, US*
Latitude: 21.2852°, Longitude: -157.8116°
Elevation: 43 ft*
* source: Google Maps

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_&_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	0.288 (0.246-0.329)	0.365 (0.313-0.425)	0.489 (0.416-0.574)	0.594 (0.502-0.697)	0.746 (0.619-0.880)	0.874 (0.713-1.03)	1.01 (0.807-1.20)	1.16 (0.903-1.39)	1.37 (1.03-1.66)	1.55 (1.13-1.89)
10-min	0.427 (0.366-0.488)	0.541 (0.464-0.631)	0.725 (0.617-0.851)	0.881 (0.744-1.03)	1.11 (0.918-1.30)	1.30 (1.06-1.53)	1.50 (1.20-1.78)	1.72 (1.34-2.06)	2.03 (1.53-2.46)	2.30 (1.67-2.81)
15-min	0.537 (0.459-0.613)	0.680 (0.583-0.792)	0.911 (0.775-1.07)	1.11 (0.934-1.30)	1.39 (1.15-1.64)	1.63 (1.33-1.93)	1.88 (1.50-2.24)	2.16 (1.68-2.58)	2.56 (1.92-3.09)	2.89 (2.10-3.52)
30-min	0.755 (0.646-0.863)	0.957 (0.821-1.11)	1.28 (1.09-1.50)	1.56 (1.31-1.83)	1.96 (1.62-2.31)	2.29 (1.87-2.71)	2.65 (2.12-3.15)	3.04 (2.37-3.64)	3.60 (2.70-4.35)	4.06 (2.96-4.96)
60-min	0.994 (0.850-1.14)	1.26 (1.08-1.47)	1.69 (1.44-1.98)	2.05 (1.73-2.40)	2.57 (2.14-3.04)	3.01 (2.46-3.57)	3.48 (2.78-4.14)	3.99 (3.12-4.79)	4.73 (3.56-5.72)	5.35 (3.89-6.52)
2-hr	1.33 (1.14-1.51)	1.72 (1.47-2.00)	2.31 (1.97-2.71)	2.80 (2.37-3.29)	3.52 (2.92-4.16)	4.11 (3.36-4.88)	4.74 (3.80-5.66)	5.43 (4.25-6.52)	6.41 (4.83-7.79)	7.23 (5.28-8.86)
3-hr	1.51 (1.29-1.70)	2.00 (1.72-2.33)	2.70 (2.30-3.16)	3.28 (2.77-3.85)	4.11 (3.41-4.85)	4.80 (3.92-5.70)	5.53 (4.43-6.60)	6.32 (4.94-7.60)	7.46 (5.62-9.05)	8.40 (6.12-10.3)
6-hr	1.94 (1.65-2.21)	2.56 (2.19-2.98)	3.48 (2.96-4.07)	4.23 (3.57-4.97)	5.31 (4.41-6.27)	6.20 (5.06-7.35)	7.14 (5.71-8.51)	8.16 (6.38-9.80)	9.62 (7.24-11.7)	10.8 (7.88-13.2)
12-hr	2.36 (2.01-2.69)	3.14 (2.69-3.66)	4.29 (3.65-5.03)	5.24 (4.42-6.16)	6.59 (5.46-7.78)	7.70 (6.28-9.13)	8.87 (7.08-10.6)	10.1 (7.91-12.1)	11.9 (8.96-14.4)	13.4 (9.72-16.3)
24-hr	2.79 (2.40-3.25)	3.81 (3.27-4.44)	5.28 (4.53-6.16)	6.49 (5.54-7.59)	8.23 (6.97-9.67)	9.66 (8.11-11.4)	11.2 (9.30-13.3)	12.9 (10.6-15.3)	15.2 (12.3-18.4)	17.2 (13.6-20.9)
2-day	3.31 (2.86-3.85)	4.52 (3.90-5.26)	6.24 (5.36-7.26)	7.62 (6.52-8.90)	9.58 (8.12-11.2)	11.2 (9.37-13.1)	12.8 (10.7-15.2)	14.6 (12.0-17.4)	17.1 (13.8-20.6)	19.1 (15.1-23.2)
3-day	3.66 (3.17-4.25)	5.00 (4.33-5.80)	6.88 (5.93-8.01)	8.38 (7.20-9.78)	10.5 (8.92-12.3)	12.2 (10.3-14.3)	13.9 (11.6-16.5)	15.8 (13.0-18.8)	18.4 (14.8-22.1)	20.4 (16.2-24.8)
4-day	4.00 (3.48-4.64)	5.48 (4.75-6.36)	7.52 (6.50-8.75)	9.15 (7.87-10.7)	11.4 (9.72-13.4)	13.2 (11.2-15.5)	15.1 (12.6-17.8)	17.0 (14.0-20.2)	19.7 (15.9-23.6)	21.8 (17.3-26.3)
7-day	4.45 (3.87-5.15)	6.05 (5.26-7.02)	8.29 (7.17-9.64)	10.1 (8.67-11.7)	12.5 (10.7-14.7)	14.5 (12.2-17.0)	16.5 (13.8-19.5)	18.6 (15.4-22.1)	21.5 (17.4-25.8)	23.7 (19.0-28.8)
10-day	4.98 (4.33-5.75)	6.74 (5.86-7.82)	9.20 (7.95-10.7)	11.1 (9.57-13.0)	13.8 (11.7-16.1)	15.8 (13.4-18.6)	18.0 (15.0-21.3)	20.2 (16.7-24.0)	23.2 (18.8-27.9)	25.6 (20.4-31.0)
20-day	6.14 (5.34-7.10)	8.26 (7.18-9.55)	11.1 (9.64-12.9)	13.3 (11.5-15.5)	16.3 (14.0-19.0)	18.6 (15.8-21.8)	20.9 (17.5-24.6)	23.2 (19.2-27.6)	26.4 (21.4-31.6)	28.7 (23.0-34.7)
30-day	7.11 (6.19-8.23)	9.50 (8.25-11.0)	12.7 (11.0-14.7)	15.1 (13.0-17.6)	18.3 (15.6-21.4)	20.7 (17.5-24.3)	23.1 (19.4-27.3)	25.6 (21.1-30.3)	28.7 (23.3-34.4)	31.1 (24.8-37.5)
45-day	8.40 (7.32-9.72)	11.2 (9.70-12.9)	14.8 (12.8-17.1)	17.5 (15.1-20.3)	21.0 (18.0-24.5)	23.7 (20.0-27.7)	26.3 (22.0-30.9)	28.8 (23.8-34.2)	32.1 (26.0-38.5)	34.5 (27.5-41.7)
60-day	9.51 (8.29-11.0)	12.6 (10.9-14.5)	16.5 (14.3-19.1)	19.5 (16.8-22.6)	23.3 (19.9-27.2)	26.1 (22.1-30.6)	28.9 (24.2-34.1)	31.6 (26.1-37.5)	35.1 (28.5-42.1)	37.6 (30.0-45.5)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

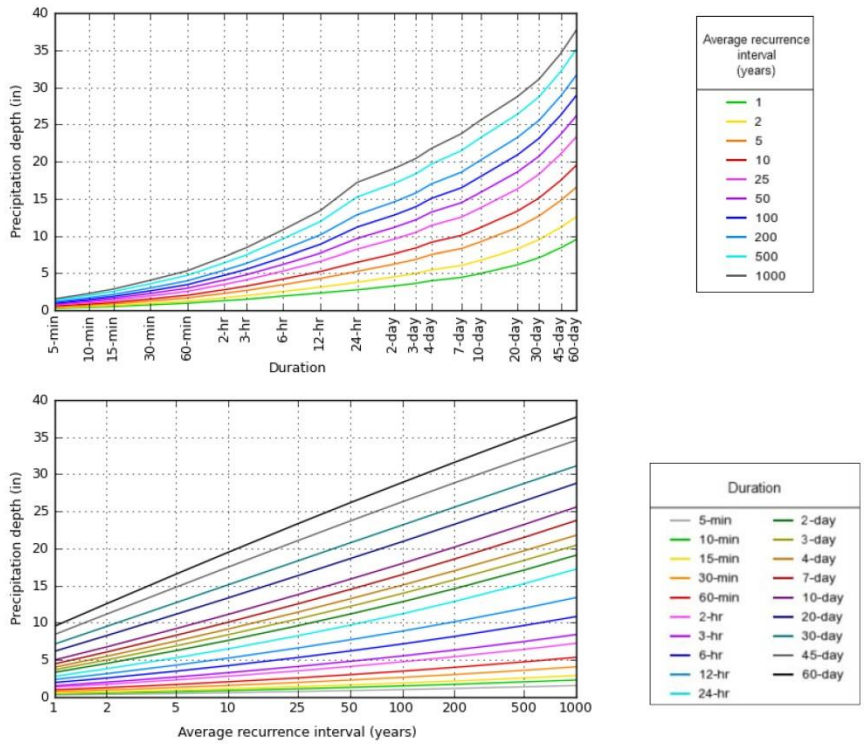
Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper 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: 21.2852°, Longitude: -157.8116°



NOAA Atlas 14, Volume 4, Version 3

Created (GMT): Fri Aug 26 23:18:59 2016

Back to Top

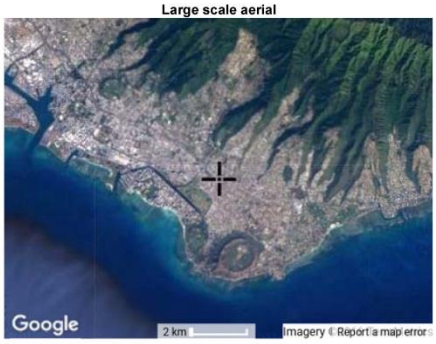
Maps & aerials

Small scale terrain

Large scale terrain

Large scale map

Large scale aerial



Back to Top

US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Disclaimer

site 2 Rational(50)

R. M. TOWILL CORPORATION
2024 N King Street, Suite 200, Honolulu, Hawaii 96819
File:
Ph. (808) 842-1133 Fax (808) 842-1937

Project:		Page	
Location:	H-1 Freeway Kapiolani to Ainakoa	Job No.:	
Prepared by:	RSY	Checked by:	
Date:	10/24/2016	Date:	

ITEM: RATIONAL METHOD, EXISTING CONDITIONS, 50-YEAR RECURRENCE INTERVAL

1. INTRODUCTION

The purpose of this work sheet is to determine the runoff quantities for drainage areas of 100 acres or less under existing conditions.

2. REFERENCES

2.1 "Erosion and Sediment Control Guide for Hawaii," U.S. Dept. of Agriculture, Soil Conservation Service, 3/1981 updated table 14 and 15 - Pages 54-58, 7/1993
2.2 "Soil Survey of Kauai, Oahu, Maui, Molokai, and Lanai, State of Hawaii," U.S. Dept.of Agriculture, Soil Conservation Service, 8/1972
2.3 "Rules Relating to Storm Drainage Standards
2.4 "NOAA Atlas 14 Vol 4", NOAA Precipitation Frequency Data Server website, 2011

3. COMPUTATIONS

Per Ref 2.3, 50-yr, 1-hr storm is used for design to account for potential sump and tailwater conditions.
This will apply to all the following calculations in determing rainfall intensity.

Minimum value for time of concentration, Tc, is 5 minutes

Rational Formula: Q = C I A

Runoff Coefficient:

Characteristic	Type	C
	concrete	1.00

Rainfall Intensity: 50-yr, 1-hr rainfall depth = 3.01" (Ref. 2.4)

Time of Concentration =	10.0	minutes
Rainfall Intensity, I =	3.5	in/hr
correction factor=	2.4	

Drainage Area: A = 9.9 acres

Peak Flow: Q = 83.16 cfs

Page 1

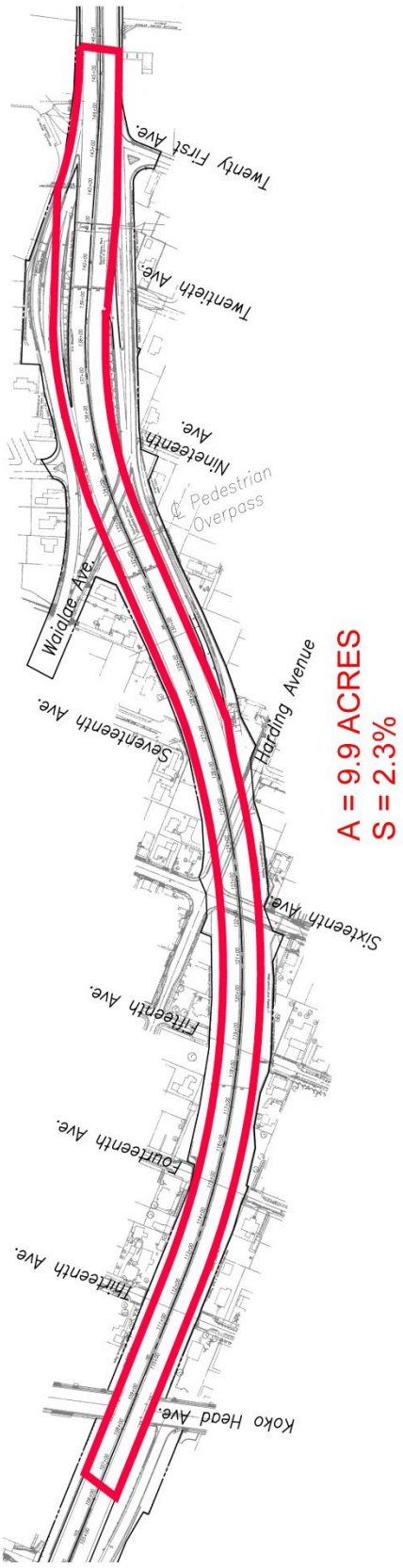
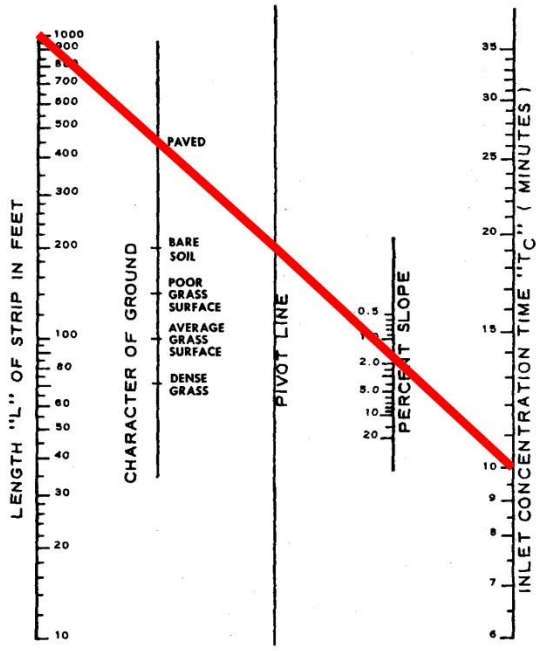

Twenty First Ave.
Twentieth Ave.
Nineteenth Ave.
℄ Pedestrian Overpass
Waiolae Ave.
Harding Avenue
Seventeenth Ave.
Sixteenth Ave.
Fifteenth Ave.
Fourteenth Ave.
Thirteenth Ave.
Koko Head Ave.
A = 9.9 ACRES
S = 2.3%

Plate 3

Overland Flow Chart



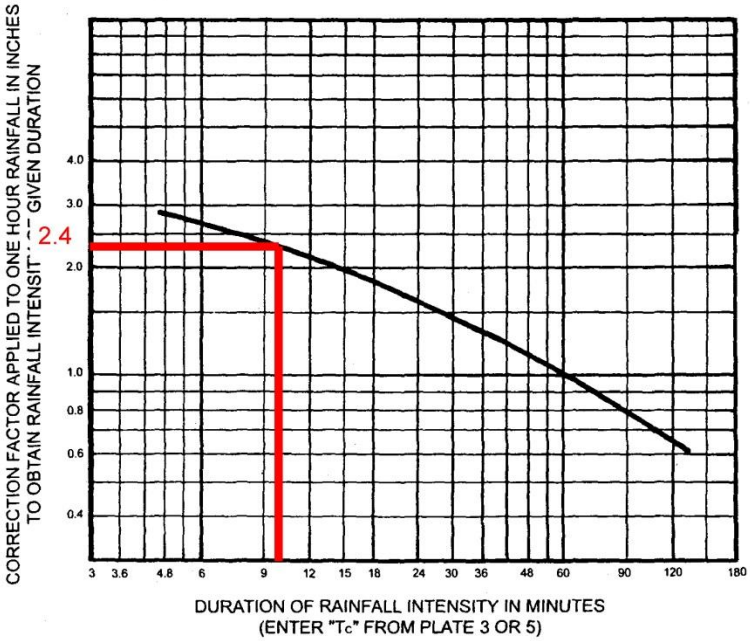


Plate 4

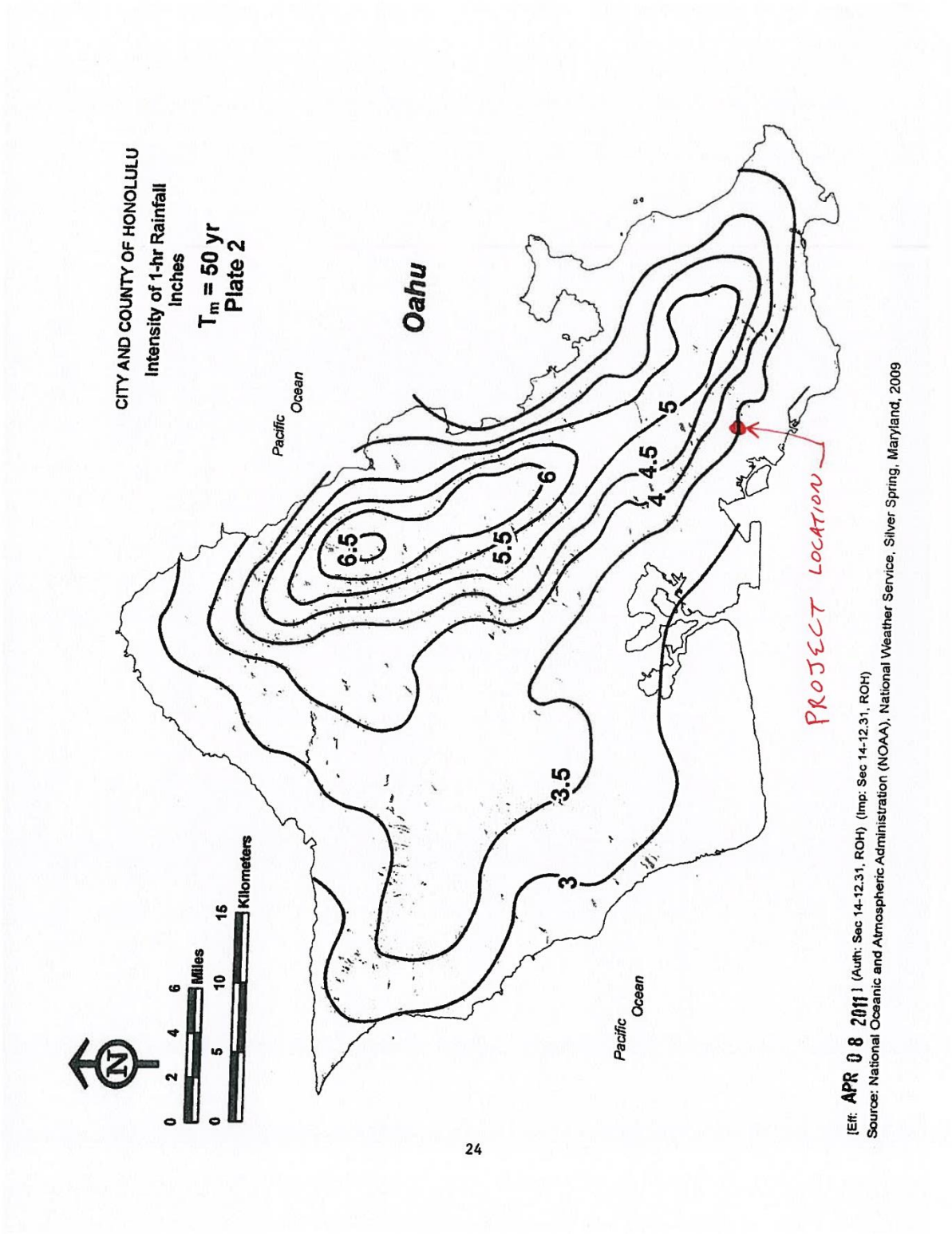
CORRECTION FACTOR

FOR CONVERTING 1 HR. RAINFALL TO RAINFALL INTENSITY OF VARIOUS DURATIONS

TO BE USED FOR AREA LESS THAN 100 ACRES

(See Plate 6 for area more than 100 acres)

25


CITY AND COUNTY OF HONOLULU
Intensity of 1-hr Rainfall
Inches
T_m = 50 yr
Plate 2
Oahu
Pacific Ocean
Pacific Ocean
6.5
6
5.5
5
4.5
4
3.5
3
PROJECT LOCATION
0 2 4 6 Miles
0 5 10 15 Kilometers
N
[Eff: APR 0 8 2011] (Auth: Sec 14-12.31, ROH) (Imp: Sec 14-12.31, ROH)
Source: National Oceanic and Atmospheric Administration (NOAA), National Weather Service, Silver Spring, Maryland, 2009
24

NOAA Atlas 14, Volume 4, Version 3
Location name: Honolulu, Hawaii, US*
Latitude: 21.2852°, Longitude: -157.8116°
Elevation: 43 ft*
* source: Google Maps

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_&_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	0.288 (0.246-0.329)	0.365 (0.313-0.425)	0.489 (0.416-0.574)	0.594 (0.502-0.697)	0.746 (0.619-0.880)	0.874 (0.713-1.03)	1.01 (0.807-1.20)	1.16 (0.903-1.39)	1.37 (1.03-1.66)	1.55 (1.13-1.89)
10-min	0.427 (0.366-0.488)	0.541 (0.464-0.631)	0.725 (0.617-0.851)	0.881 (0.744-1.03)	1.11 (0.918-1.30)	1.30 (1.06-1.53)	1.50 (1.20-1.78)	1.72 (1.34-2.06)	2.03 (1.53-2.46)	2.30 (1.67-2.81)
15-min	0.537 (0.459-0.613)	0.680 (0.583-0.792)	0.911 (0.775-1.07)	1.11 (0.934-1.30)	1.39 (1.15-1.64)	1.63 (1.33-1.93)	1.88 (1.50-2.24)	2.16 (1.68-2.58)	2.56 (1.92-3.09)	2.89 (2.10-3.52)
30-min	0.755 (0.646-0.863)	0.957 (0.821-1.11)	1.28 (1.09-1.50)	1.56 (1.31-1.83)	1.96 (1.62-2.31)	2.29 (1.87-2.71)	2.65 (2.12-3.15)	3.04 (2.37-3.64)	3.60 (2.70-4.35)	4.06 (2.96-4.96)
60-min	0.994 (0.850-1.14)	1.26 (1.08-1.47)	1.69 (1.44-1.98)	2.05 (1.73-2.40)	2.57 (2.14-3.04)	3.01 (2.46-3.57)	3.48 (2.78-4.14)	3.99 (3.12-4.79)	4.73 (3.56-5.72)	5.35 (3.89-6.52)
2-hr	1.33 (1.14-1.51)	1.72 (1.47-2.00)	2.31 (1.97-2.71)	2.80 (2.37-3.29)	3.52 (2.92-4.16)	4.11 (3.36-4.88)	4.74 (3.80-5.66)	5.43 (4.25-6.52)	6.41 (4.83-7.79)	7.23 (5.28-8.86)
3-hr	1.51 (1.29-1.70)	2.00 (1.72-2.33)	2.70 (2.30-3.16)	3.28 (2.77-3.85)	4.11 (3.41-4.85)	4.80 (3.92-5.70)	5.53 (4.43-6.60)	6.32 (4.94-7.60)	7.46 (5.62-9.05)	8.40 (6.12-10.3)
6-hr	1.94 (1.65-2.21)	2.56 (2.19-2.98)	3.48 (2.96-4.07)	4.23 (3.57-4.97)	5.31 (4.41-6.27)	6.20 (5.06-7.35)	7.14 (5.71-8.51)	8.16 (6.38-9.80)	9.62 (7.24-11.7)	10.8 (7.88-13.2)
12-hr	2.36 (2.01-2.69)	3.14 (2.69-3.66)	4.29 (3.65-5.03)	5.24 (4.42-6.16)	6.59 (5.46-7.78)	7.70 (6.28-9.13)	8.87 (7.08-10.6)	10.1 (7.91-12.1)	11.9 (8.96-14.4)	13.4 (9.72-16.3)
24-hr	2.79 (2.40-3.25)	3.81 (3.27-4.44)	5.28 (4.53-6.16)	6.49 (5.54-7.59)	8.23 (6.97-9.67)	9.66 (8.11-11.4)	11.2 (9.30-13.3)	12.9 (10.6-15.3)	15.2 (12.3-18.4)	17.2 (13.6-20.9)
2-day	3.31 (2.86-3.85)	4.52 (3.90-5.26)	6.24 (5.36-7.26)	7.62 (6.52-8.90)	9.58 (8.12-11.2)	11.2 (9.37-13.1)	12.8 (10.7-15.2)	14.6 (12.0-17.4)	17.1 (13.8-20.6)	19.1 (15.1-23.2)
3-day	3.66 (3.17-4.25)	5.00 (4.33-5.80)	6.88 (5.93-8.01)	8.38 (7.20-9.78)	10.5 (8.92-12.3)	12.2 (10.3-14.3)	13.9 (11.6-16.5)	15.8 (13.0-18.8)	18.4 (14.8-22.1)	20.4 (16.2-24.8)
4-day	4.00 (3.48-4.64)	5.48 (4.75-6.36)	7.52 (6.50-8.75)	9.15 (7.87-10.7)	11.4 (9.72-13.4)	13.2 (11.2-15.5)	15.1 (12.6-17.8)	17.0 (14.0-20.2)	19.7 (15.9-23.6)	21.8 (17.3-26.3)
7-day	4.45 (3.87-5.15)	6.05 (5.26-7.02)	8.29 (7.17-9.64)	10.1 (8.67-11.7)	12.5 (10.7-14.7)	14.5 (12.2-17.0)	16.5 (13.8-19.5)	18.6 (15.4-22.1)	21.5 (17.4-25.8)	23.7 (19.0-28.8)
10-day	4.98 (4.33-5.75)	6.74 (5.86-7.82)	9.20 (7.95-10.7)	11.1 (9.57-13.0)	13.8 (11.7-16.1)	15.8 (13.4-18.6)	18.0 (15.0-21.3)	20.2 (16.7-24.0)	23.2 (18.8-27.9)	25.6 (20.4-31.0)
20-day	6.14 (5.34-7.10)	8.26 (7.18-9.55)	11.1 (9.64-12.9)	13.3 (11.5-15.5)	16.3 (14.0-19.0)	18.6 (15.8-21.8)	20.9 (17.5-24.6)	23.2 (19.2-27.6)	26.4 (21.4-31.6)	28.7 (23.0-34.7)
30-day	7.11 (6.19-8.23)	9.50 (8.25-11.0)	12.7 (11.0-14.7)	15.1 (13.0-17.6)	18.3 (15.6-21.4)	20.7 (17.5-24.3)	23.1 (19.4-27.3)	25.6 (21.1-30.3)	28.7 (23.3-34.4)	31.1 (24.8-37.5)
45-day	8.40 (7.32-9.72)	11.2 (9.70-12.9)	14.8 (12.8-17.1)	17.5 (15.1-20.3)	21.0 (18.0-24.5)	23.7 (20.0-27.7)	26.3 (22.0-30.9)	28.8 (23.8-34.2)	32.1 (26.0-38.5)	34.5 (27.5-41.7)
60-day	9.51 (8.29-11.0)	12.6 (10.9-14.5)	16.5 (14.3-19.1)	19.5 (16.8-22.6)	23.3 (19.9-27.2)	26.1 (22.1-30.6)	28.9 (24.2-34.1)	31.6 (26.1-37.5)	35.1 (28.5-42.1)	37.6 (30.0-45.5)

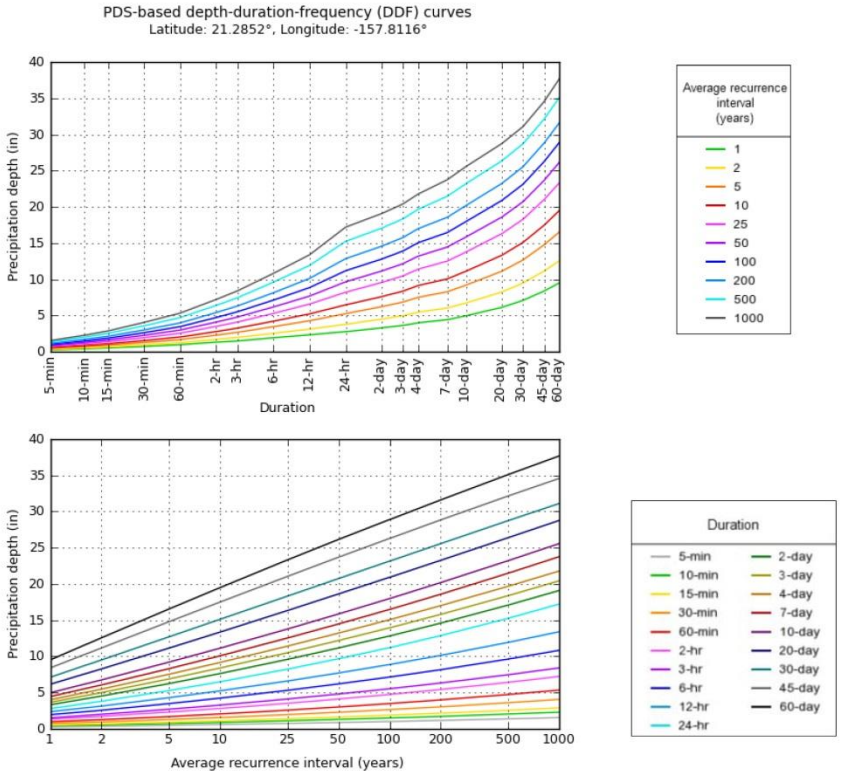
[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

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



NOAA Atlas 14, Volume 4, Version 3 Created (GMT): Fri Aug 26 23:18:59 2016

Back to Top

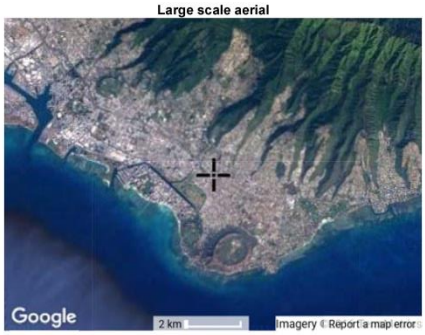
Maps & aerials

Small scale terrain

Large scale terrain

Large scale map

Large scale aerial



Back to Top

US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

site 3 Rational(50)

R. M. TOWILL CORPORATION
2024 N King Street, Suite 200, Honolulu, Hawaii 96819
File:
Ph. (808) 842-1133 Fax (808) 842-1937

Project:		Page	
Location:	H-1 Freeway Kapiolani to Ainakoa	Job No.:	
Prepared by:	RSY	Checked by:	
Date:	10/24/2016	Date:	

ITEM: RATIONAL METHOD, EXISTING CONDITIONS, 50-YEAR RECURRENCE INTERVAL

1. INTRODUCTION

The purpose of this work sheet is to determine the runoff quantities for drainage areas of 100 acres or less under existing conditions.

2. REFERENCES

2.1 "Erosion and Sediment Control Guide for Hawaii," U.S. Dept. of Agriculture, Soil Conservation Service, 3/1981 updated table 14 and 15 - Pages 54-58, 7/1993
2.2 "Soil Survey of Kauai, Oahu, Maui, Molokai, and Lanai, State of Hawaii," U.S. Dept.of Agriculture, Soil Conservation Service, 8/1972
2.3 "Rules Relating to Storm Drainage Standards
2.4 "NOAA Atlas 14 Vol 4", NOAA Precipitation Frequency Data Server website, 2011

3. COMPUTATIONS

Per Ref 2.3, 50-yr, 1-hr storm is used for design to account for potential sump and tailwater conditions.
This will apply to all the following calculations in determing rainfall intensity.

Minimum value for time of concentration, Tc, is 5 minutes

Rational Formula: Q = C I A

Runoff Coefficient:

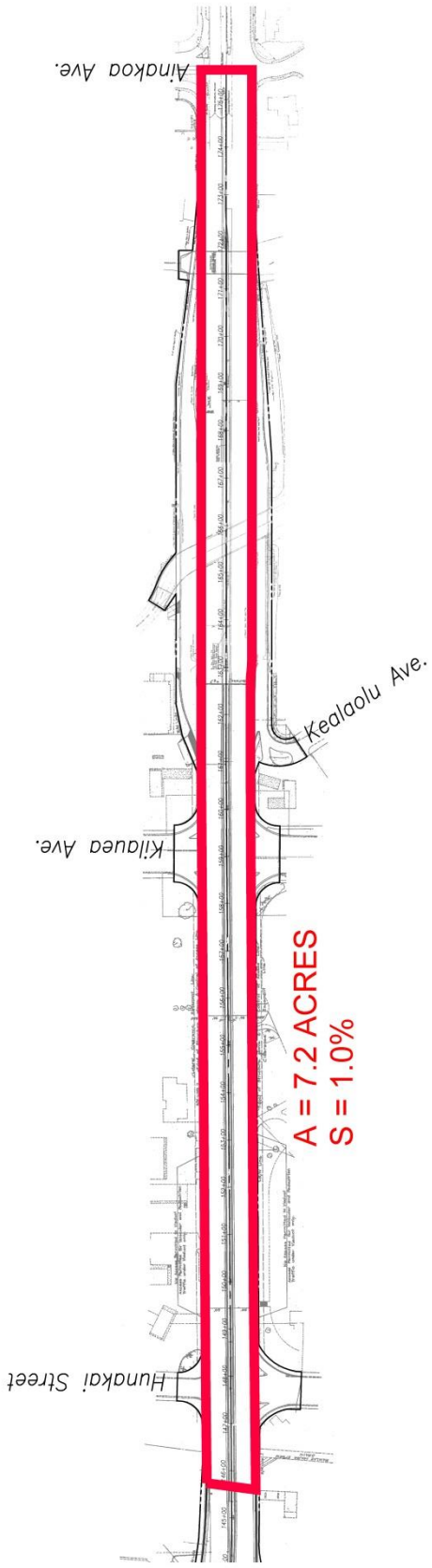
Characteristic	Type	C
	concrete	1.00

Rainfall Intensity: 50-yr, 1-hr rainfall depth = 3.01" (Ref. 2.4)

Time of Concentration =	11.0	minutes
Rainfall Intensity, I =	3.5	in/hr
correction factor=	2.3	

Drainage Area: A = 7.2 acres

Peak Flow: Q = 57.96 cfs


Ainakoa Ave.
Kealaolu Ave.
Kilauea Ave.
A = 7.2 ACRES
S = 1.0%
Hunakai Street

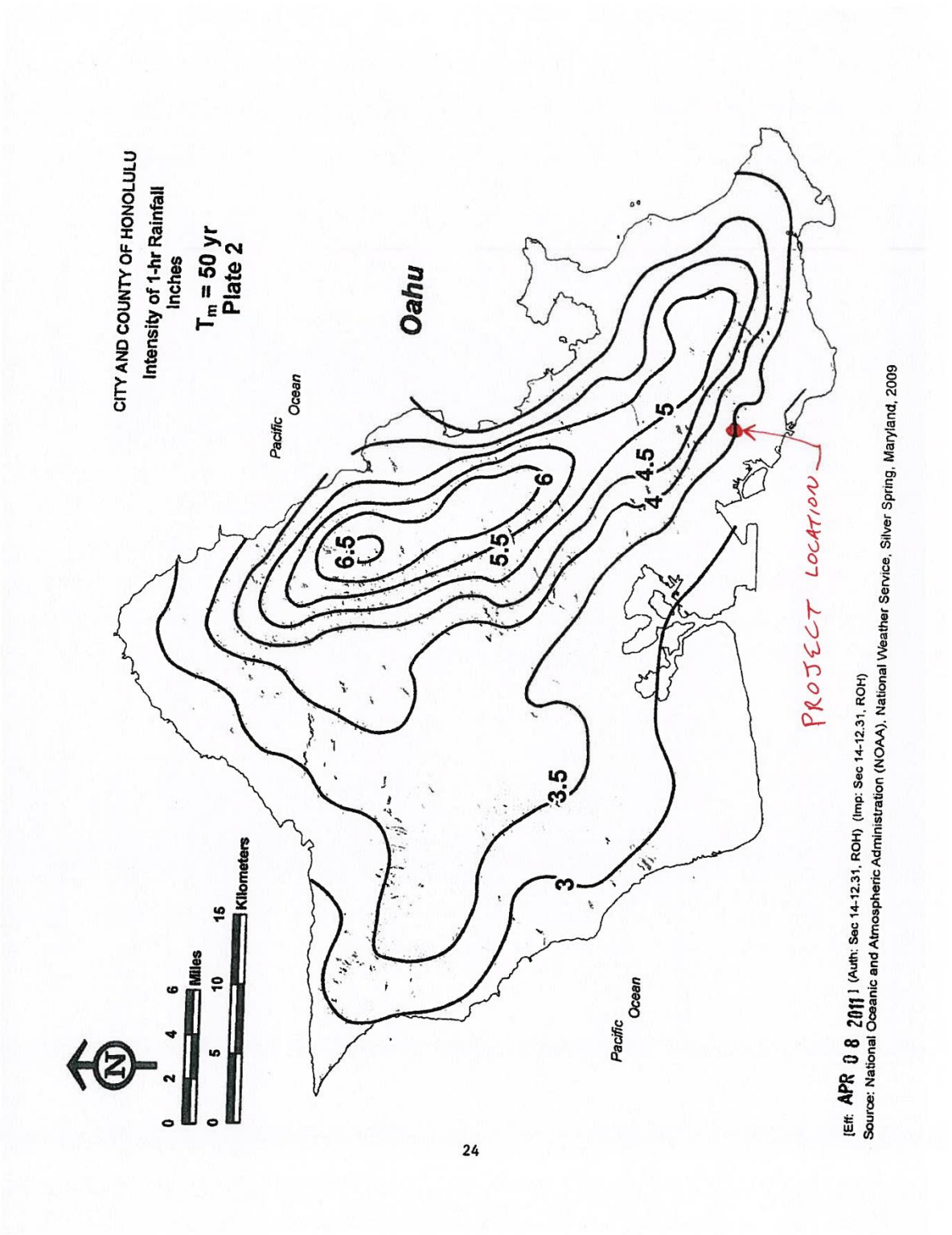
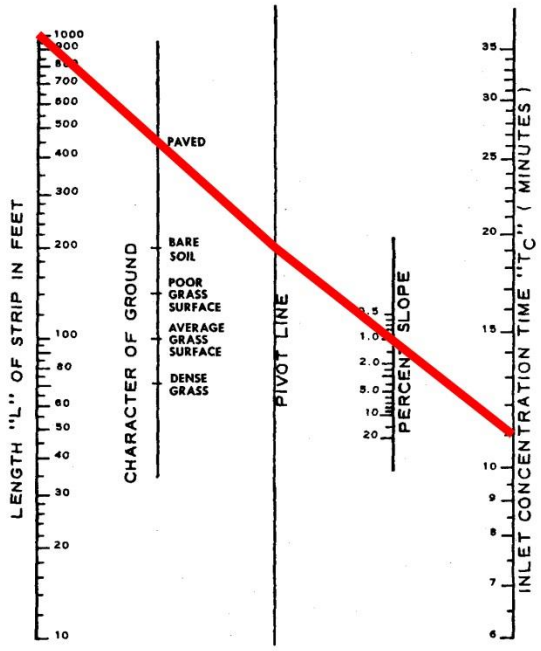

CITY AND COUNTY OF HONOLULU
Intensity of 1-hr Rainfall
Inches
T_m = 50 yr
Plate 2
Oahu
Pacific Ocean
Pacific Ocean
6.5
6
5.5
5
4.5
4
3.5
3
PROJECT LOCATION
N
0 2 4 6 Miles
0 5 10 15 Kilometers
[Eff: APR 0 8 2011] (Auth: Sec 14-12.31, ROH) (Imp: Sec 14-12.31, ROH)
Source: National Oceanic and Atmospheric Administration (NOAA), National Weather Service, Silver Spring, Maryland, 2009
24

Plate 3

Overland Flow Chart



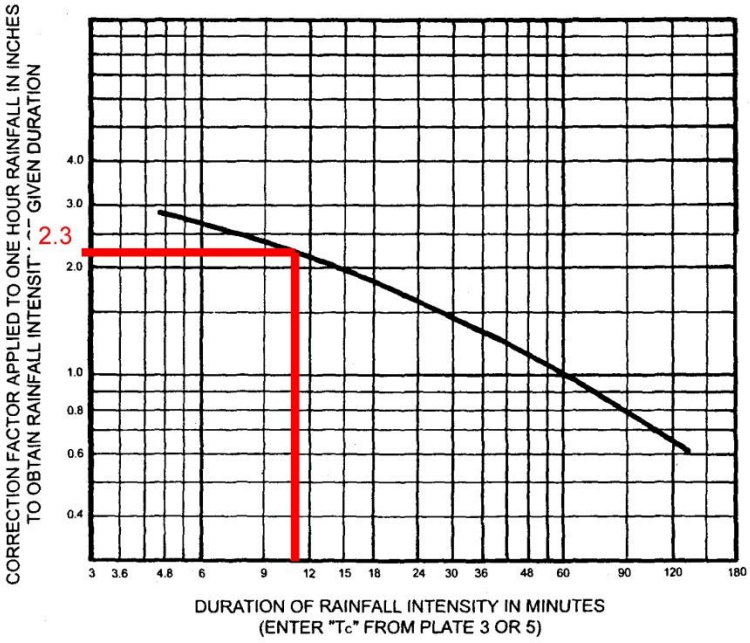


Plate 4

CORRECTION FACTOR

FOR CONVERTING 1 HR. RAINFALL TO RAINFALL INTENSITY OF VARIOUS DURATIONS

TO BE USED FOR AREA LESS THAN 100 ACRES

(See Plate 6 for area more than 100 acres)

25

NOAA Atlas 14, Volume 4, Version 3
Location name: Honolulu, Hawaii, US*
Latitude: 21.2852°, Longitude: -157.8116°
Elevation: 43 ft*
* source: Google Maps

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_&_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	0.288 (0.246-0.329)	0.365 (0.313-0.425)	0.489 (0.416-0.574)	0.594 (0.502-0.697)	0.746 (0.619-0.880)	0.874 (0.713-1.03)	1.01 (0.807-1.20)	1.16 (0.903-1.39)	1.37 (1.03-1.66)	1.55 (1.13-1.89)
10-min	0.427 (0.366-0.488)	0.541 (0.464-0.631)	0.725 (0.617-0.851)	0.881 (0.744-1.03)	1.11 (0.918-1.30)	1.30 (1.06-1.53)	1.50 (1.20-1.78)	1.72 (1.34-2.06)	2.03 (1.53-2.46)	2.30 (1.67-2.81)
15-min	0.537 (0.459-0.613)	0.680 (0.583-0.792)	0.911 (0.775-1.07)	1.11 (0.934-1.30)	1.39 (1.15-1.64)	1.63 (1.33-1.93)	1.88 (1.50-2.24)	2.16 (1.68-2.58)	2.56 (1.92-3.09)	2.89 (2.10-3.52)
30-min	0.755 (0.646-0.863)	0.957 (0.821-1.11)	1.28 (1.09-1.50)	1.56 (1.31-1.83)	1.96 (1.62-2.31)	2.29 (1.87-2.71)	2.65 (2.12-3.15)	3.04 (2.37-3.64)	3.60 (2.70-4.35)	4.06 (2.96-4.96)
60-min	0.994 (0.850-1.14)	1.26 (1.08-1.47)	1.69 (1.44-1.98)	2.05 (1.73-2.40)	2.57 (2.14-3.04)	3.01 (2.46-3.57)	3.48 (2.78-4.14)	3.99 (3.12-4.79)	4.73 (3.56-5.72)	5.35 (3.89-6.52)
2-hr	1.33 (1.14-1.51)	1.72 (1.47-2.00)	2.31 (1.97-2.71)	2.80 (2.37-3.29)	3.52 (2.92-4.16)	4.11 (3.36-4.88)	4.74 (3.80-5.66)	5.43 (4.25-6.52)	6.41 (4.83-7.79)	7.23 (5.28-8.86)
3-hr	1.51 (1.29-1.70)	2.00 (1.72-2.33)	2.70 (2.30-3.16)	3.28 (2.77-3.85)	4.11 (3.41-4.85)	4.80 (3.92-5.70)	5.53 (4.43-6.60)	6.32 (4.94-7.60)	7.46 (5.62-9.05)	8.40 (6.12-10.3)
6-hr	1.94 (1.65-2.21)	2.56 (2.19-2.98)	3.48 (2.96-4.07)	4.23 (3.57-4.97)	5.31 (4.41-6.27)	6.20 (5.06-7.35)	7.14 (5.71-8.51)	8.16 (6.38-9.80)	9.62 (7.24-11.7)	10.8 (7.88-13.2)
12-hr	2.36 (2.01-2.69)	3.14 (2.69-3.66)	4.29 (3.65-5.03)	5.24 (4.42-6.16)	6.59 (5.46-7.78)	7.70 (6.28-9.13)	8.87 (7.08-10.6)	10.1 (7.91-12.1)	11.9 (8.96-14.4)	13.4 (9.72-16.3)
24-hr	2.79 (2.40-3.25)	3.81 (3.27-4.44)	5.28 (4.53-6.16)	6.49 (5.54-7.59)	8.23 (6.97-9.67)	9.66 (8.11-11.4)	11.2 (9.30-13.3)	12.9 (10.6-15.3)	15.2 (12.3-18.4)	17.2 (13.6-20.9)
2-day	3.31 (2.86-3.85)	4.52 (3.90-5.26)	6.24 (5.36-7.26)	7.62 (6.52-8.90)	9.58 (8.12-11.2)	11.2 (9.37-13.1)	12.8 (10.7-15.2)	14.6 (12.0-17.4)	17.1 (13.8-20.6)	19.1 (15.1-23.2)
3-day	3.66 (3.17-4.25)	5.00 (4.33-5.80)	6.88 (5.93-8.01)	8.38 (7.20-9.78)	10.5 (8.92-12.3)	12.2 (10.3-14.3)	13.9 (11.6-16.5)	15.8 (13.0-18.8)	18.4 (14.8-22.1)	20.4 (16.2-24.8)
4-day	4.00 (3.48-4.64)	5.48 (4.75-6.36)	7.52 (6.50-8.75)	9.15 (7.87-10.7)	11.4 (9.72-13.4)	13.2 (11.2-15.5)	15.1 (12.6-17.8)	17.0 (14.0-20.2)	19.7 (15.9-23.6)	21.8 (17.3-26.3)
7-day	4.45 (3.87-5.15)	6.05 (5.26-7.02)	8.29 (7.17-9.64)	10.1 (8.67-11.7)	12.5 (10.7-14.7)	14.5 (12.2-17.0)	16.5 (13.8-19.5)	18.6 (15.4-22.1)	21.5 (17.4-25.8)	23.7 (19.0-28.8)
10-day	4.98 (4.33-5.75)	6.74 (5.86-7.82)	9.20 (7.95-10.7)	11.1 (9.57-13.0)	13.8 (11.7-16.1)	15.8 (13.4-18.6)	18.0 (15.0-21.3)	20.2 (16.7-24.0)	23.2 (18.8-27.9)	25.6 (20.4-31.0)
20-day	6.14 (5.34-7.10)	8.26 (7.18-9.55)	11.1 (9.64-12.9)	13.3 (11.5-15.5)	16.3 (14.0-19.0)	18.6 (15.8-21.8)	20.9 (17.5-24.6)	23.2 (19.2-27.6)	26.4 (21.4-31.6)	28.7 (23.0-34.7)
30-day	7.11 (6.19-8.23)	9.50 (8.25-11.0)	12.7 (11.0-14.7)	15.1 (13.0-17.6)	18.3 (15.6-21.4)	20.7 (17.5-24.3)	23.1 (19.4-27.3)	25.6 (21.1-30.3)	28.7 (23.3-34.4)	31.1 (24.8-37.5)
45-day	8.40 (7.32-9.72)	11.2 (9.70-12.9)	14.8 (12.8-17.1)	17.5 (15.1-20.3)	21.0 (18.0-24.5)	23.7 (20.0-27.7)	26.3 (22.0-30.9)	28.8 (23.8-34.2)	32.1 (26.0-38.5)	34.5 (27.5-41.7)
60-day	9.51 (8.29-11.0)	12.6 (10.9-14.5)	16.5 (14.3-19.1)	19.5 (16.8-22.6)	23.3 (19.9-27.2)	26.1 (22.1-30.6)	28.9 (24.2-34.1)	31.6 (26.1-37.5)	35.1 (28.5-42.1)	37.6 (30.0-45.5)

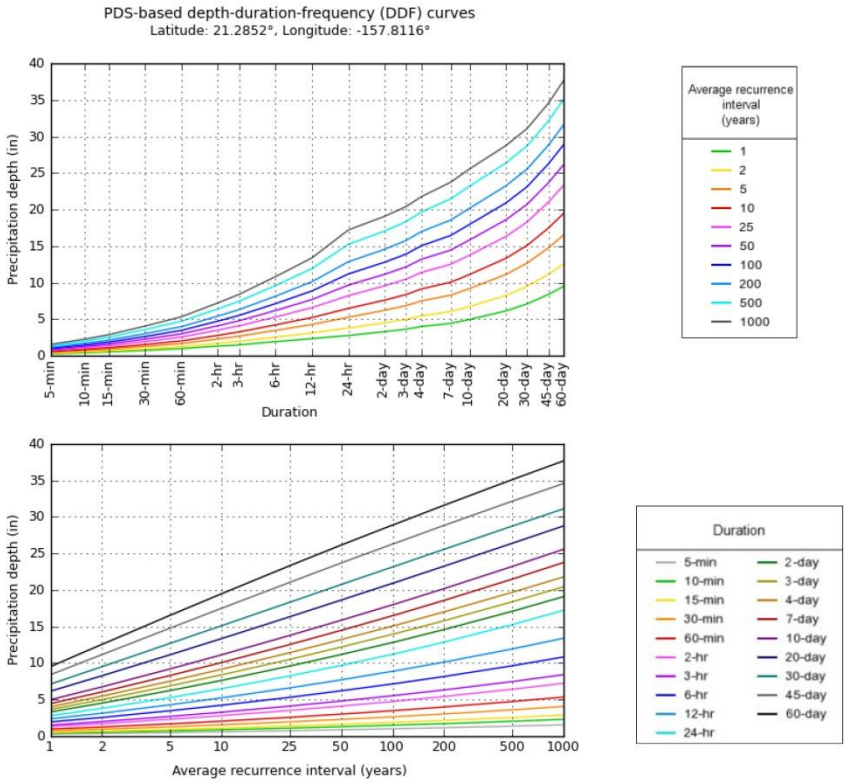
[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

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



NOAA Atlas 14, Volume 4, Version 3 Created (GMT): Fri Aug 26 23:18:59 2016

Back to Top

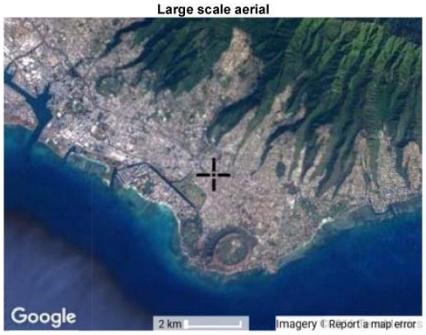
Maps & aerials

Small scale terrain

Large scale terrain

Large scale map

Large scale aerial



Back to Top

US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov