

Attachment 1

Drainage Calculations

Attachment 1 Drainage Calculations
Mamalahoa Highway Drainage Improvements
By Okahara and Associates, Inc.
Friday, March 28, 2014

The maximum area of disturbance will occur during construction of the new swale and Tie Back Retaining Walls No. 1 and No. 2. During this construction, traffic will be diverted around the work area per details shown in the Traffic Control Plans – see next page. The maximum area of disturbance also includes the contractor's staging and material storage area located on the makai side of the road in the immediate vicinity of new Drywell No. 1. Using the Rational Method for the maximum disturbance area of 0.76 acre, the peak runoff was calculated to be 0.3 cfs. The County of Hawaii Dept. of Public Works Storm Drainage Standard, October 1970 was used as a guide for these drainage calculations. In addition, NOAA's National Weather Service Hydrometeorological Design Studies Center Precipitation Frequency Data Server (PFDS) was used to determine the rainfall intensity for the appropriate recurrence interval. See the following pages for the NOAA printouts and the peak runoff calculations.

LEGEND

 *Work Area*

Flagger/Police Officer



Vehicle Traffic Flow



Cones/Barricades (Typ.)



Sign



Lighting



Temporary Traffic Signal



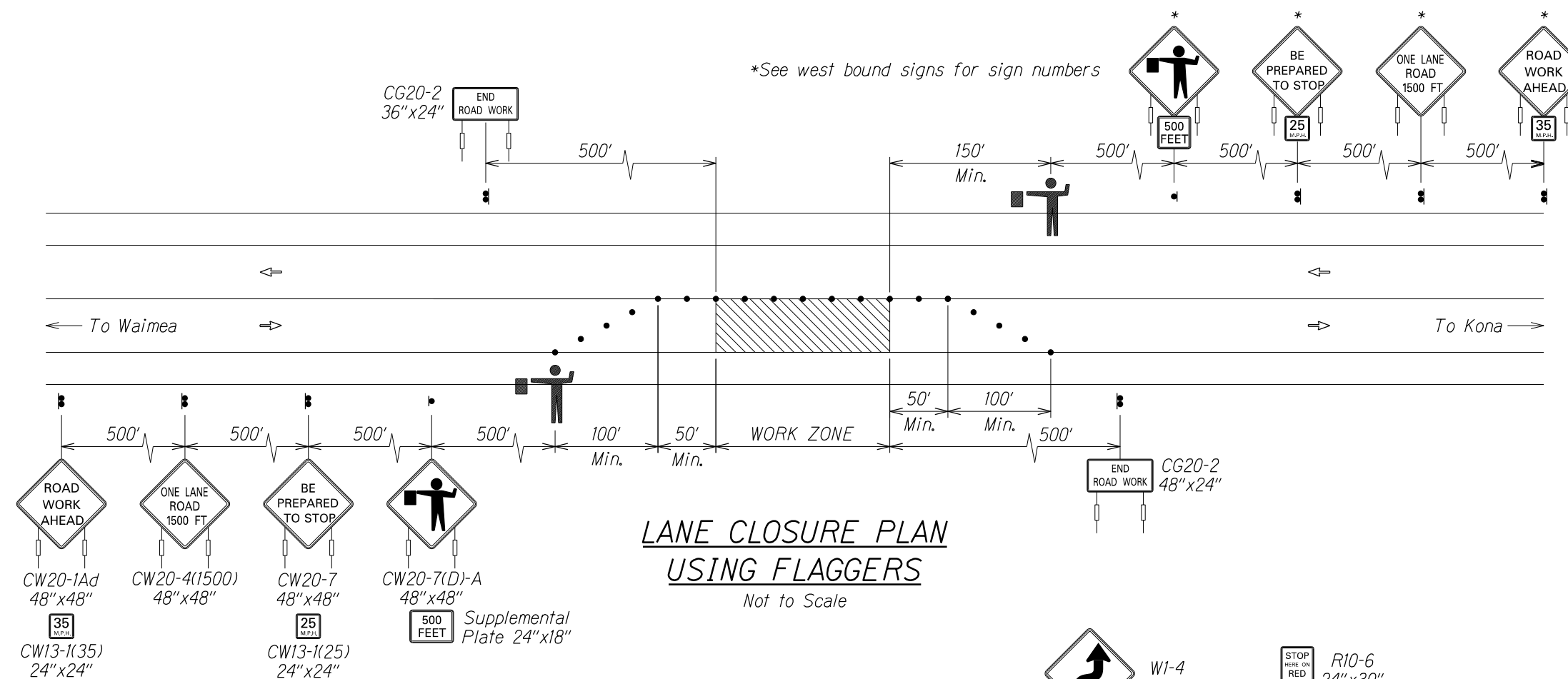
Warning Lights



■ *Portable Concrete Barriers
(w/ NCHRP 350 End Treatment
and Steady Burn Lamps @ 20' O.C.)*

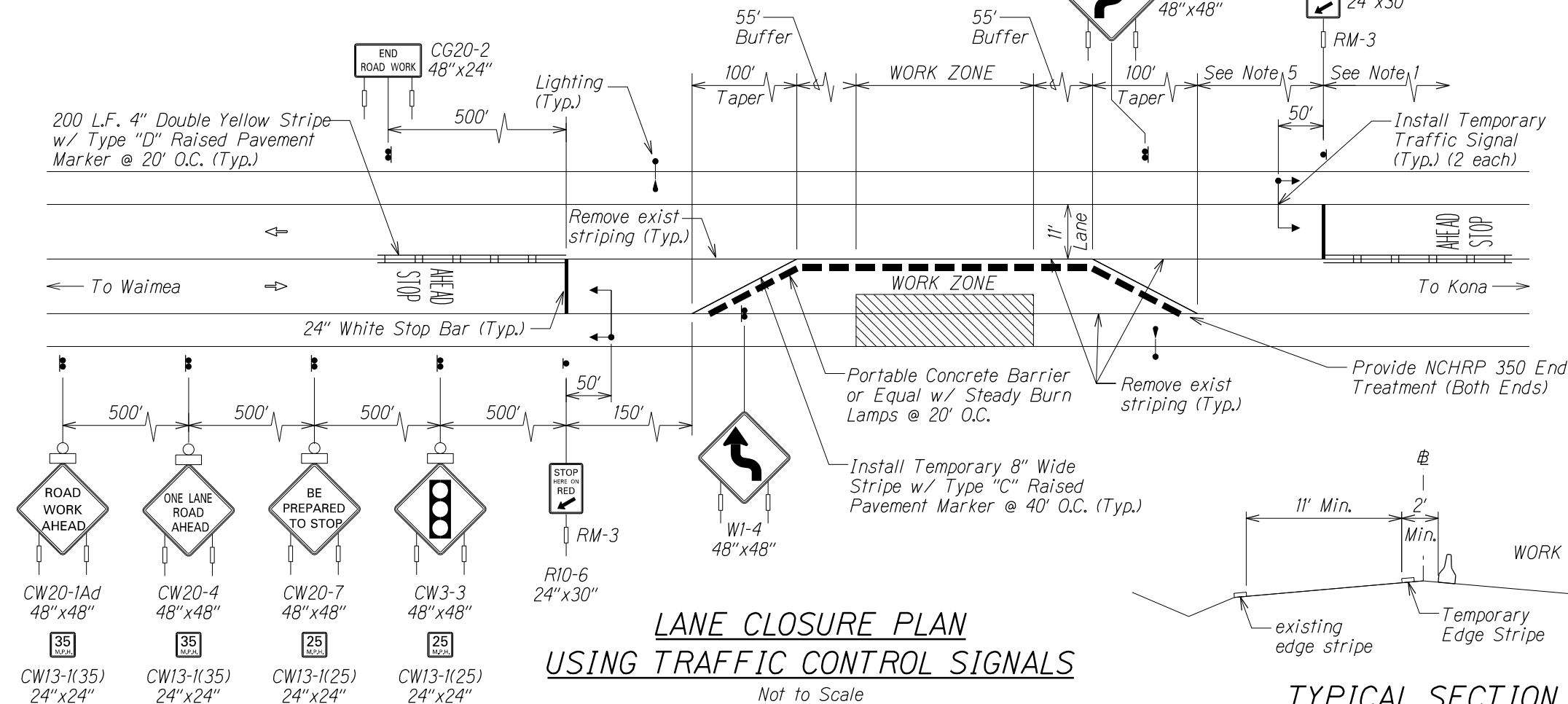
NOTES:

1. *For lane closure using traffic control signals, signage and distances shall be the same on both sides of the work area. The Contractor shall reverse layout for second phase of construction along the opposite side of the road.*
2. *End treatments for Portable Concrete Barriers shall be considered incidental to item No. 645.2000 - Additional Police Officers, Additional Traffic Control Devices, and Advertisement.*
3. *The Contractor shall consider the cost for removal and reinstallation of Portable Concrete Barriers, traffic control signs, etc. For construction phasing as included in the price of the various items, and will not be paid for separately.*
4. *The Contractor shall restore permanent pavement markings and signage to the pre-existing configuration upon completion of construction.*
5. *The Engineer will determine the location of this signal.*

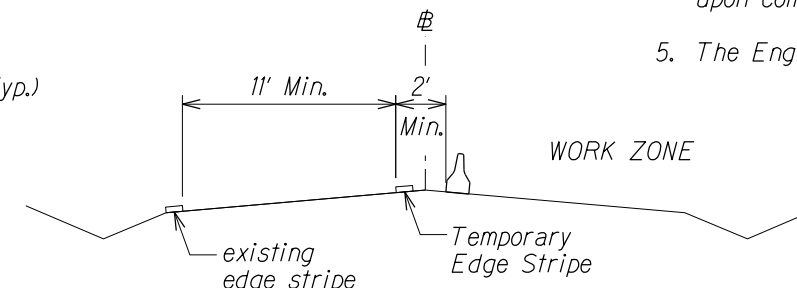


LANE CLOSURE PLAN
USING TRAFFIC CONTROL SIGNALS

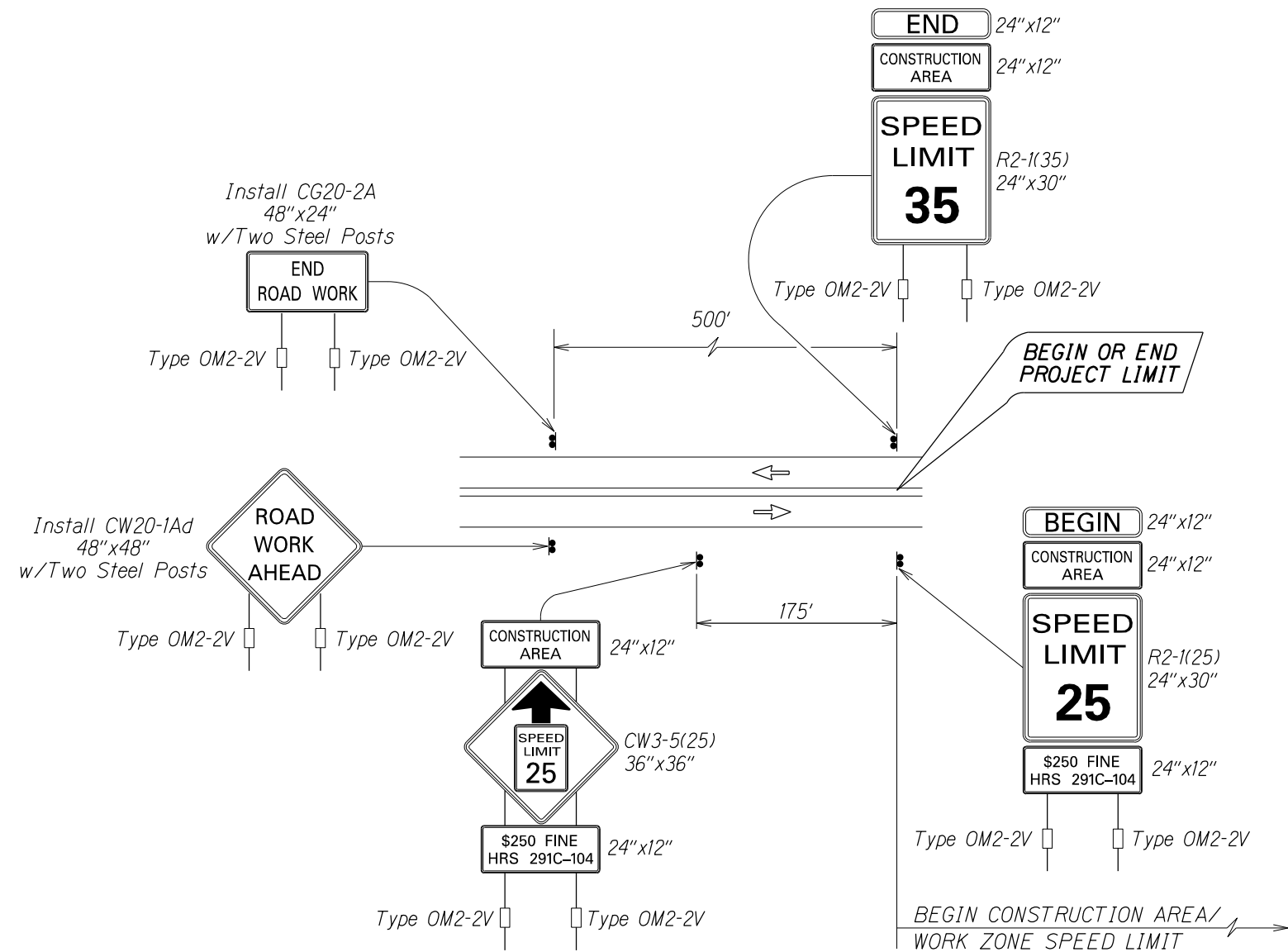
Not to Scale



TYPICAL SECTION



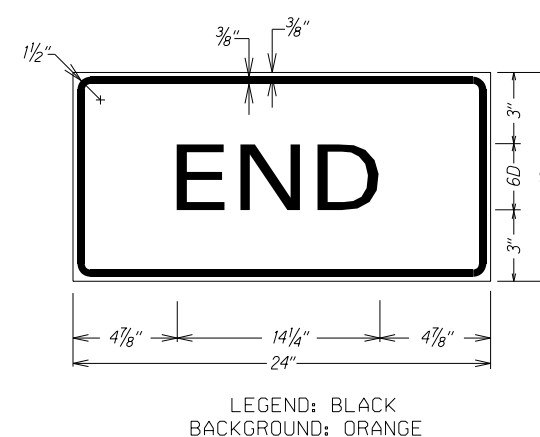
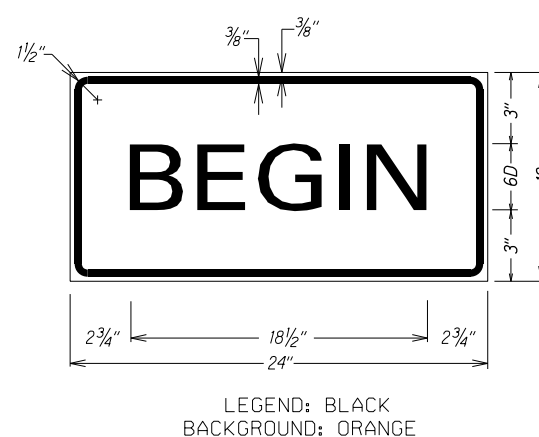
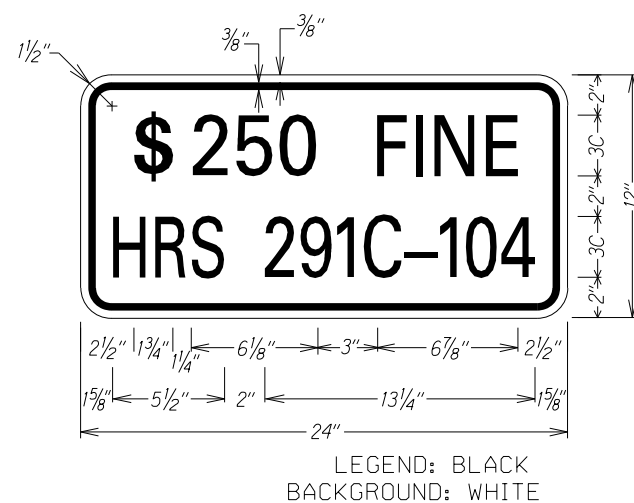
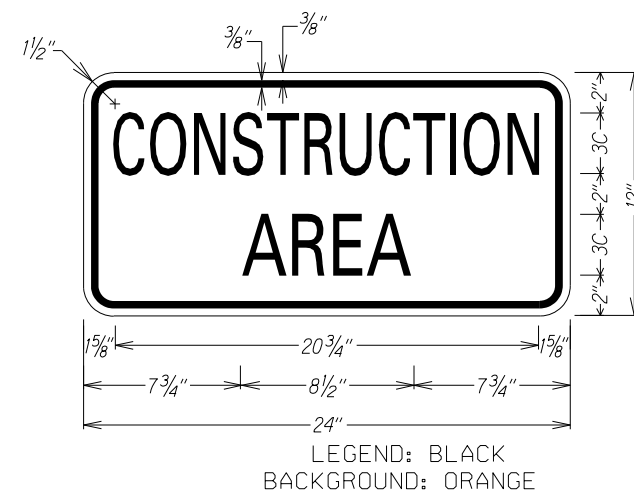
FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
HAWAII	HAW.	STP-0190(016)	2014	22	35



TYPICAL DETAIL FOR WORK ZONE SIGNS
ON TWO LANE LOW SPEED HIGHWAY

Work Zone Notes:

1. This Work Zone Sign Plan is intended for use on long-term stationary work zones/construction phases (3 days or more).
2. All existing regulatory speed limit signs within the work zone/project limits shall be temporarily replaced with applicable signs. Work zone speed limit sign assemblies and supplemental signs shall be temporarily installed within work zone/project limits.
3. Work Zone sign assemblies shall be installed on both the approaching and trailing ends of each work zone as shown on this plan.
4. Each construction warning sign and work zone speed limit assembly shall have a minimum of two (2) Type OM2-2V. Installation of each Type OM2-2V shall be considered incidental to Item No. 645.1000 - Traffic Control.
5. Upon the completion of all physical work or as directed by the Engineer, all construction signs and work zone speed limit assemblies shall be removed. All speed limit signs and posts that were existing at the start of the project within the work zone/project limits shall be replaced.
6. Placement of Work Zone signs shall not obstruct the path of pedestrians and bicyclists.
7. Maintenance and removal of work zone speed limit sign assemblies shall be considered incidental to Item No. 645.1000 - Traffic Control.



STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION

WORK ZONE SIGNING PLAN, NOTES & DETAILS

MAMALAHOA HIGHWAY
DRAINAGE IMPROVEMENTS
Vicinity of Puuwaawaa Ranch Road
Federal-Aid Project No. STP-0190(016)

Scale: Not to Scale Date: April 2014

SHEET No. 1 OF 2 SHEETS

OKAHARA & ASSOCIATES, INC.677 Ala Moana Blvd. Suite 703
HONOLULU, HAWAII 96813
(808) 524-1224JOB 211-044SHEET NO. 1OF 1CALCULATED BY DATE CHECKED BY DATE SCALE

Attachment 1

$$C: C_{ROAD} = 0.95 \text{ (A.C. Pavement)}$$

$$C_{VEGETATED} = \begin{array}{cccc} 0.07 & + & 0.08 & + & 0.0 & + & 0.15 \\ / & & / & & / & & / \\ \text{Medium} & & \text{Steep} & & \text{High} & & \text{Ag} \\ \text{Infiltration} & & \text{Relief} & & \text{Vegetal} & & \text{De-} \\ & & & & \text{Cover} & & \text{velop-} \\ & & & & & & \text{ment} \\ & & & & & & \text{Type} \end{array}$$

$$= 0.30$$

$$C_{WEIGHTED} = \frac{0.95(0.27 \text{ ac}) + 0.30(0.49 \text{ ac})}{0.76 \text{ ac}}$$

$$= 0.53$$

$$i: T_m = 10 \text{ yr}$$

$$\text{Use } T_c, \min = 10 \text{ min}$$

Per NOAA Point Precipitation Frequency
Estimates, $i = 0.833 \text{ in}$

$$A: A_{\text{Max Disturbance}} = 0.76 \text{ ac}$$

$$Q: Q = C i A = 0.53(0.833)(0.76) \\ = 0.3 \text{ cfs}$$



NOAA Atlas 14, Volume 4, Version 3
Location name: Kailua-Kona, Hawaii, US*
Latitude: 19.8082°, Longitude: -155.8408°
Elevation: 2075 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. Bonnlin

NOAA, National Weather Service, Silver Spring, Maryland

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

PF tabular

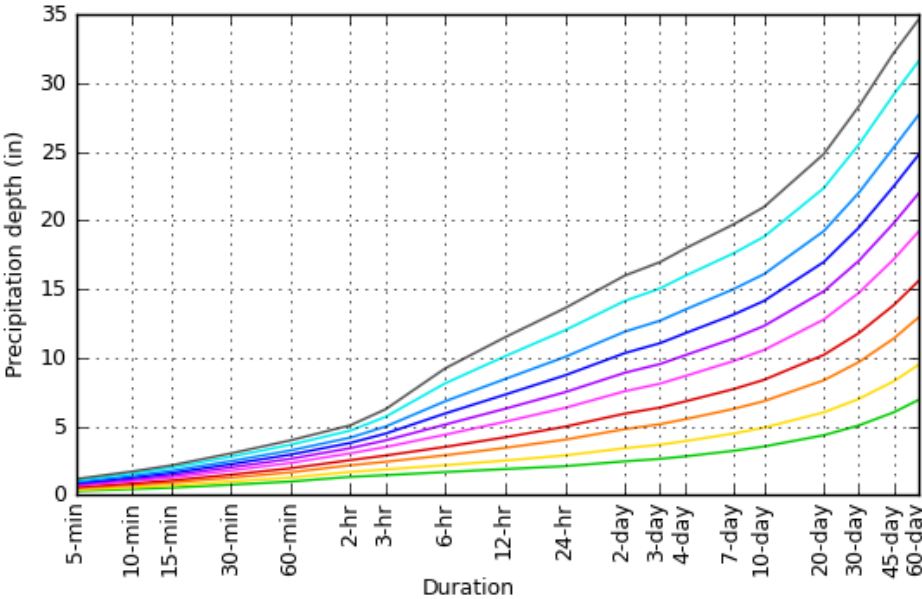
PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches) ¹										
Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.282 (0.247-0.321)	0.366 (0.318-0.418)	0.476 (0.411-0.545)	0.562 (0.481-0.648)	0.675 (0.573-0.789)	0.762 (0.641-0.900)	0.851 (0.708-1.02)	0.939 (0.768-1.14)	1.06 (0.846-1.31)	1.15 (0.901-1.45)
10-min	0.418 (0.366-0.476)	0.543 (0.472-0.619)	0.706 (0.609-0.809)	0.833 (0.713-0.961)	1.00 (0.850-1.17)	1.13 (0.950-1.33)	1.26 (1.05-1.51)	1.39 (1.14-1.69)	1.57 (1.25-1.95)	1.71 (1.34-2.15)
15-min	0.524 (0.460-0.598)	0.682 (0.592-0.778)	0.887 (0.765-1.02)	1.05 (0.895-1.21)	1.26 (1.07-1.47)	1.42 (1.19-1.68)	1.58 (1.31-1.89)	1.75 (1.43-2.12)	1.97 (1.57-2.44)	2.14 (1.68-2.70)
30-min	0.738 (0.647-0.842)	0.960 (0.834-1.09)	1.25 (1.08-1.43)	1.47 (1.26-1.70)	1.77 (1.50-2.07)	2.00 (1.68-2.36)	2.23 (1.85-2.66)	2.46 (2.01-2.98)	2.78 (2.22-3.44)	3.02 (2.36-3.81)
60-min	0.971 (0.851-1.11)	1.26 (1.10-1.44)	1.64 (1.42-1.88)	1.94 (1.66-2.23)	2.33 (1.98-2.72)	2.63 (2.21-3.10)	2.93 (2.43-3.50)	3.24 (2.65-3.93)	3.65 (2.92-4.52)	3.97 (3.11-5.01)
2-hr	1.31 (1.15-1.50)	1.67 (1.45-1.91)	2.16 (1.86-2.48)	2.53 (2.17-2.92)	3.03 (2.57-3.54)	3.40 (2.87-4.02)	3.79 (3.15-4.52)	4.17 (3.42-5.06)	4.68 (3.75-5.81)	5.07 (3.97-6.41)
3-hr	1.44 (1.25-1.64)	1.85 (1.60-2.12)	2.41 (2.07-2.78)	2.86 (2.44-3.32)	3.48 (2.94-4.08)	3.96 (3.31-4.70)	4.46 (3.67-5.35)	4.97 (4.04-6.05)	5.68 (4.51-7.07)	6.23 (4.84-7.89)
6-hr	1.66 (1.44-1.92)	2.16 (1.87-2.48)	2.89 (2.48-3.33)	3.50 (2.98-4.06)	4.39 (3.70-5.15)	5.12 (4.27-6.09)	5.93 (4.89-7.14)	6.82 (5.54-8.33)	8.13 (6.45-10.2)	9.22 (7.16-11.7)
12-hr	1.88 (1.62-2.18)	2.50 (2.15-2.87)	3.42 (2.93-3.96)	4.19 (3.57-4.87)	5.33 (4.49-6.27)	6.27 (5.23-7.46)	7.30 (6.02-8.80)	8.44 (6.85-10.3)	10.1 (8.01-12.6)	11.5 (8.91-14.6)
24-hr	2.09 (1.79-2.47)	2.87 (2.46-3.39)	4.02 (3.43-4.76)	4.97 (4.21-5.90)	6.34 (5.30-7.58)	7.48 (6.18-9.01)	8.71 (7.08-10.6)	10.0 (8.03-12.3)	12.0 (9.31-15.0)	13.6 (10.3-17.2)
2-day	2.44 (2.17-2.77)	3.40 (3.02-3.87)	4.79 (4.22-5.46)	5.92 (5.19-6.78)	7.55 (6.54-8.71)	8.89 (7.61-10.3)	10.3 (8.71-12.1)	11.9 (9.84-14.1)	14.1 (11.4-17.0)	16.0 (12.5-19.5)
3-day	2.62 (2.33-2.98)	3.65 (3.25-4.16)	5.14 (4.55-5.87)	6.36 (5.58-7.29)	8.10 (7.02-9.35)	9.53 (8.16-11.1)	11.0 (9.32-13.0)	12.7 (10.5-15.0)	15.0 (12.1-18.1)	16.9 (13.3-20.7)
4-day	2.80 (2.50-3.19)	3.91 (3.48-4.45)	5.50 (4.87-6.29)	6.80 (5.98-7.80)	8.64 (7.51-9.99)	10.2 (8.71-11.8)	11.8 (9.94-13.8)	13.5 (11.2-16.0)	15.9 (12.9-19.2)	17.9 (14.1-21.9)
7-day	3.20 (2.86-3.64)	4.46 (3.97-5.08)	6.25 (5.54-7.13)	7.69 (6.77-8.81)	9.73 (8.46-11.2)	11.4 (9.77-13.2)	13.1 (11.1-15.4)	15.0 (12.4-17.8)	17.6 (14.2-21.2)	19.7 (15.5-24.0)
10-day	3.52 (3.14-4.00)	4.89 (4.34-5.56)	6.82 (6.03-7.77)	8.38 (7.35-9.59)	10.5 (9.14-12.2)	12.3 (10.5-14.3)	14.1 (11.9-16.6)	16.1 (13.3-19.0)	18.8 (15.1-22.6)	21.0 (16.4-25.6)
20-day	4.34 (3.88-4.93)	6.01 (5.34-6.83)	8.34 (7.38-9.52)	10.2 (8.95-11.7)	12.8 (11.1-14.7)	14.8 (12.7-17.2)	17.0 (14.3-19.9)	19.2 (15.9-22.8)	22.3 (18.0-26.9)	24.8 (19.5-30.3)
30-day	5.06 (4.51-5.74)	6.99 (6.22-7.94)	9.66 (8.56-11.0)	11.8 (10.4-13.5)	14.7 (12.8-17.0)	17.0 (14.6-19.8)	19.4 (16.4-22.8)	22.0 (18.2-26.1)	25.5 (20.6-30.7)	28.3 (22.2-34.5)
45-day	6.01 (5.37-6.83)	8.27 (7.38-9.41)	11.4 (10.1-13.0)	13.8 (12.2-15.8)	17.2 (14.9-19.8)	19.8 (17.0-23.0)	22.5 (19.0-26.4)	25.3 (21.0-30.0)	29.2 (23.6-35.1)	32.2 (25.4-39.3)
60-day	6.92 (6.18-7.86)	9.47 (8.44-10.8)	12.9 (11.5-14.7)	15.6 (13.7-17.8)	19.2 (16.7-22.1)	22.0 (18.9-25.5)	24.8 (20.9-29.0)	27.7 (23.0-32.8)	31.6 (25.5-38.0)	34.6 (27.2-42.2)
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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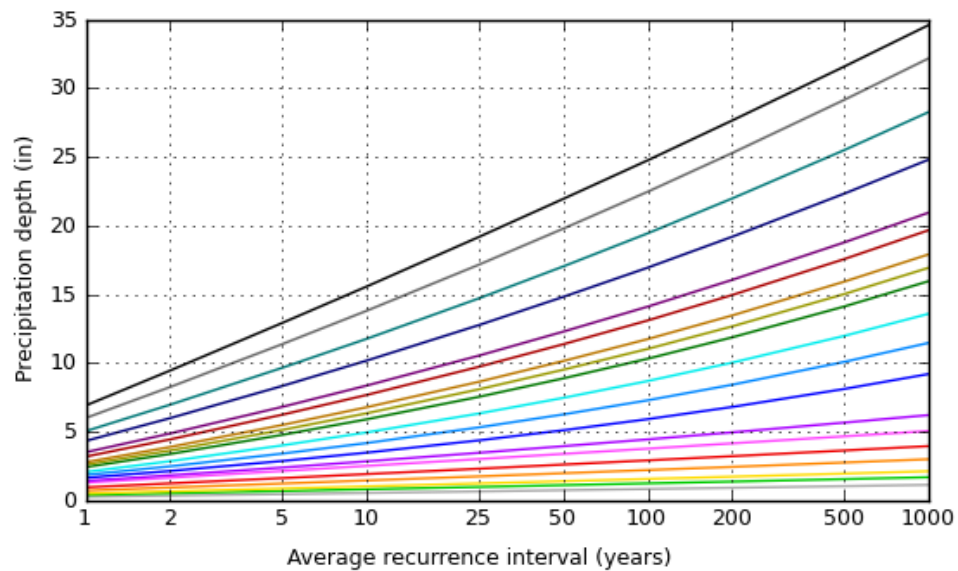
PF graphical

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

PDS-based depth-duration-frequency (DDF) curves
Latitude: 19.8082°, Longitude: -155.8408°



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



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Created (GMT): Wed Apr 16 19:51:33 2014

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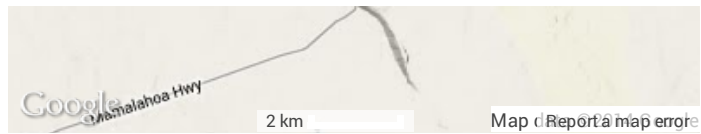
Maps & aerials

Small scale terrain



Large scale terrain





Large scale map



Large scale aerial



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