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KALANIANAOLE HIGHWAY IMPROVEMENTS PHASE 1
CWB-NOI CBMP Plan

Attachment A.2
Item 1.6a – Quantity of Storm Water

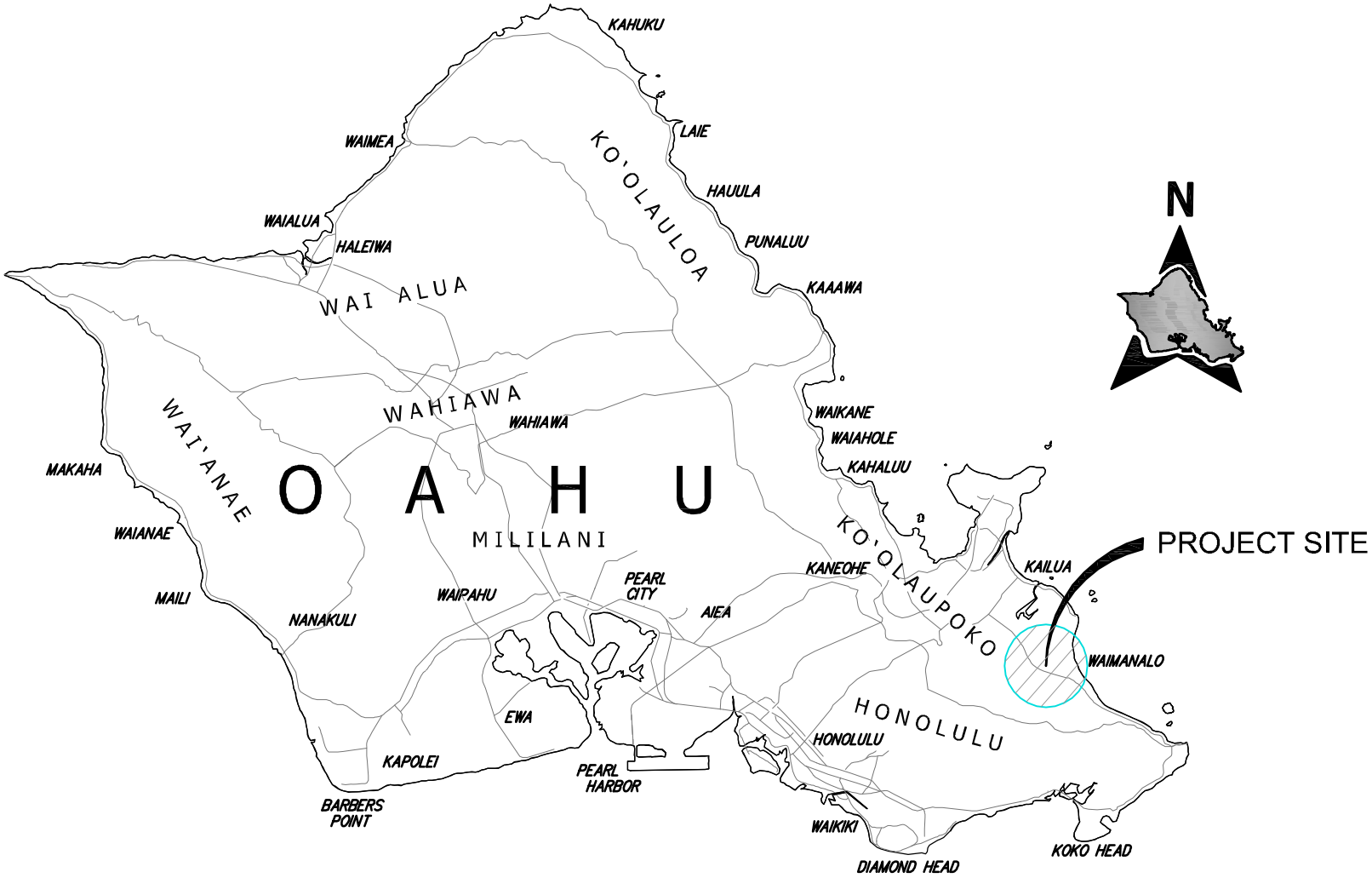

Figure 1: Project Vicinity Map

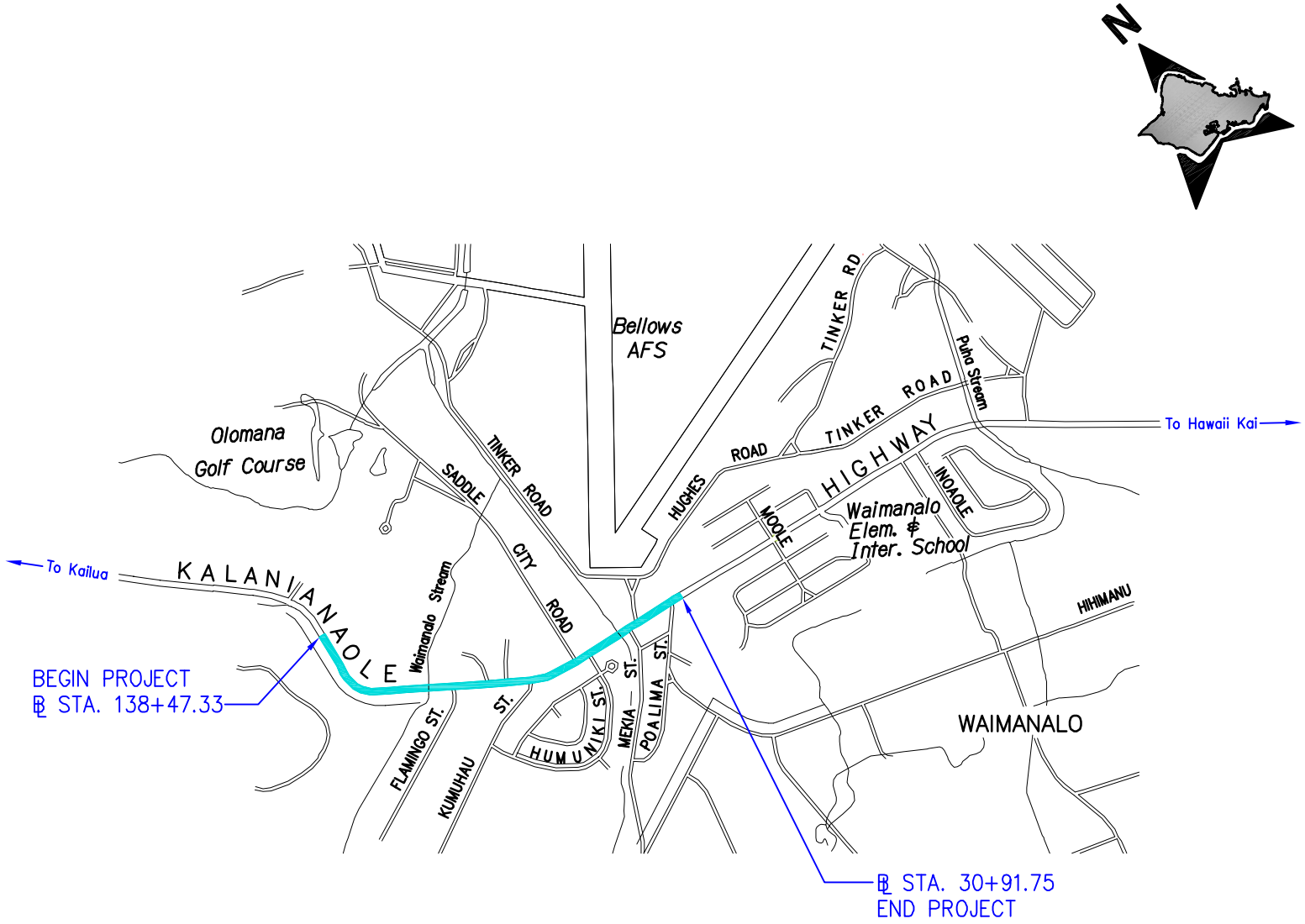

Figure 2: Project Location Map

NOAA Atlas 14, Volume 4, Version 3
Location name: Waimanalo, Hawaii, US*
Coordinates: 21.3476, -157.7221
Elevation: 23ft*
* 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/hour)[1]

Duration	Average recurrence interval(years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	5.08 (4.33–5.80)	6.35 (5.41–7.33)	8.27 (7.00–9.58)	9.78 (8.23–11.4)	11.8 (9.79–13.9)	13.4 (10.9–16.0)	15.1 (12.0–18.1)	16.8 (13.1–20.4)	19.1 (14.4–23.8)	20.9 (15.3–26.5)
10-min	3.76 (3.21–4.30)	4.71 (4.01–5.44)	6.13 (5.19–7.10)	7.25 (6.10–8.42)	8.77 (7.26–10.3)	9.96 (8.11–11.8)	11.2 (8.93–13.4)	12.4 (9.71–15.1)	14.1 (10.7–17.6)	15.5 (11.3–19.7)
15-min	3.15 (2.69–3.60)	3.94 (3.36–4.55)	5.13 (4.34–5.94)	6.07 (5.11–7.06)	7.35 (6.08–8.63)	8.34 (6.79–9.90)	9.35 (7.48–11.2)	10.4 (8.14–12.7)	11.8 (8.94–14.8)	12.9 (9.48–16.5)
30-min	2.21 (1.89–2.53)	2.77 (2.36–3.20)	3.61 (3.06–4.18)	4.27 (3.59–4.96)	5.17 (4.28–6.07)	5.87 (4.78–6.97)	6.58 (5.26–7.91)	7.32 (5.72–8.92)	8.33 (6.29–10.4)	9.11 (6.67–11.6)
60-min	1.46 (1.24–1.66)	1.83 (1.55–2.11)	2.38 (2.01–2.75)	2.81 (2.36–3.27)	3.40 (2.81–4.00)	3.86 (3.14–4.59)	4.33 (3.46–5.20)	4.82 (3.77–5.87)	5.48 (4.14–6.83)	5.99 (4.39–7.62)
2-hr	0.970 (0.828–1.10)	1.23 (1.05–1.42)	1.61 (1.37–1.86)	1.91 (1.61–2.21)	2.31 (1.91–2.71)	2.62 (2.14–3.11)	2.93 (2.35–3.53)	3.26 (2.55–3.98)	3.70 (2.80–4.62)	4.04 (2.96–5.14)
3-hr	0.739 (0.633–0.841)	0.956 (0.813–1.10)	1.26 (1.07–1.46)	1.49 (1.25–1.73)	1.81 (1.50–2.13)	2.06 (1.68–2.45)	2.31 (1.85–2.78)	2.57 (2.01–3.14)	2.93 (2.21–3.66)	3.20 (2.35–4.08)
6-hr	0.467 (0.398–0.531)	0.602 (0.513–0.693)	0.797 (0.676–0.920)	0.950 (0.799–1.10)	1.16 (0.961–1.36)	1.32 (1.08–1.57)	1.49 (1.19–1.79)	1.67 (1.30–2.04)	1.91 (1.44–2.39)	2.10 (1.54–2.68)
12-hr	0.280 (0.238–0.320)	0.365 (0.310–0.423)	0.485 (0.410–0.562)	0.577 (0.486–0.673)	0.701 (0.580–0.825)	0.794 (0.648–0.945)	0.889 (0.712–1.07)	0.985 (0.771–1.21)	1.11 (0.843–1.39)	1.21 (0.889–1.55)
24-hr	0.173 (0.149–0.196)	0.230 (0.198–0.261)	0.305 (0.262–0.348)	0.362 (0.309–0.414)	0.435 (0.369–0.503)	0.490 (0.412–0.572)	0.544 (0.453–0.643)	0.599 (0.491–0.716)	0.669 (0.539–0.817)	0.722 (0.571–0.896)
2-day	0.102 (0.090–0.112)	0.136 (0.120–0.151)	0.180 (0.158–0.200)	0.212 (0.185–0.237)	0.253 (0.219–0.286)	0.283 (0.243–0.324)	0.312 (0.265–0.361)	0.341 (0.286–0.400)	0.378 (0.311–0.452)	0.405 (0.327–0.492)
3-day	0.074 (0.065–0.082)	0.099 (0.087–0.110)	0.131 (0.115–0.146)	0.155 (0.135–0.174)	0.185 (0.161–0.210)	0.208 (0.178–0.237)	0.229 (0.195–0.265)	0.251 (0.210–0.294)	0.278 (0.229–0.332)	0.298 (0.241–0.362)
4-day	0.060 (0.053–0.066)	0.080 (0.071–0.089)	0.107 (0.094–0.119)	0.127 (0.111–0.142)	0.152 (0.131–0.171)	0.170 (0.146–0.194)	0.188 (0.160–0.217)	0.206 (0.172–0.241)	0.228 (0.187–0.272)	0.244 (0.197–0.297)
7-day	0.039 (0.035–0.043)	0.053 (0.047–0.058)	0.070 (0.062–0.078)	0.083 (0.073–0.093)	0.100 (0.087–0.113)	0.113 (0.097–0.129)	0.125 (0.106–0.144)	0.137 (0.115–0.161)	0.153 (0.126–0.183)	0.165 (0.133–0.200)
10-day	0.030 (0.027–0.034)	0.041 (0.036–0.045)	0.054 (0.047–0.060)	0.064 (0.056–0.072)	0.077 (0.067–0.087)	0.087 (0.075–0.099)	0.096 (0.082–0.111)	0.106 (0.089–0.124)	0.118 (0.097–0.141)	0.127 (0.103–0.154)
20-day	0.019 (0.016–0.021)	0.025 (0.022–0.027)	0.033 (0.029–0.036)	0.038 (0.034–0.043)	0.046 (0.040–0.052)	0.052 (0.045–0.060)	0.058 (0.049–0.067)	0.064 (0.054–0.075)	0.071 (0.059–0.085)	0.077 (0.062–0.094)
30-day	0.014 (0.013–0.016)	0.019 (0.017–0.021)	0.025 (0.022–0.028)	0.029 (0.026–0.033)	0.035 (0.030–0.040)	0.039 (0.034–0.045)	0.044 (0.037–0.050)	0.048 (0.040–0.056)	0.053 (0.044–0.064)	0.058 (0.047–0.070)
45-day	0.012 (0.010–0.013)	0.015 (0.013–0.017)	0.020 (0.017–0.022)	0.023 (0.020–0.026)	0.027 (0.024–0.031)	0.030 (0.026–0.035)	0.034 (0.029–0.039)	0.037 (0.031–0.043)	0.041 (0.033–0.049)	0.044 (0.035–0.053)
60-day	0.010 (0.009–0.011)	0.013 (0.012–0.014)	0.017 (0.015–0.019)	0.019 (0.017–0.022)	0.023 (0.020–0.026)	0.025 (0.022–0.029)	0.028 (0.024–0.032)	0.030 (0.026–0.036)	0.033 (0.028–0.040)	0.036 (0.029–0.044)

[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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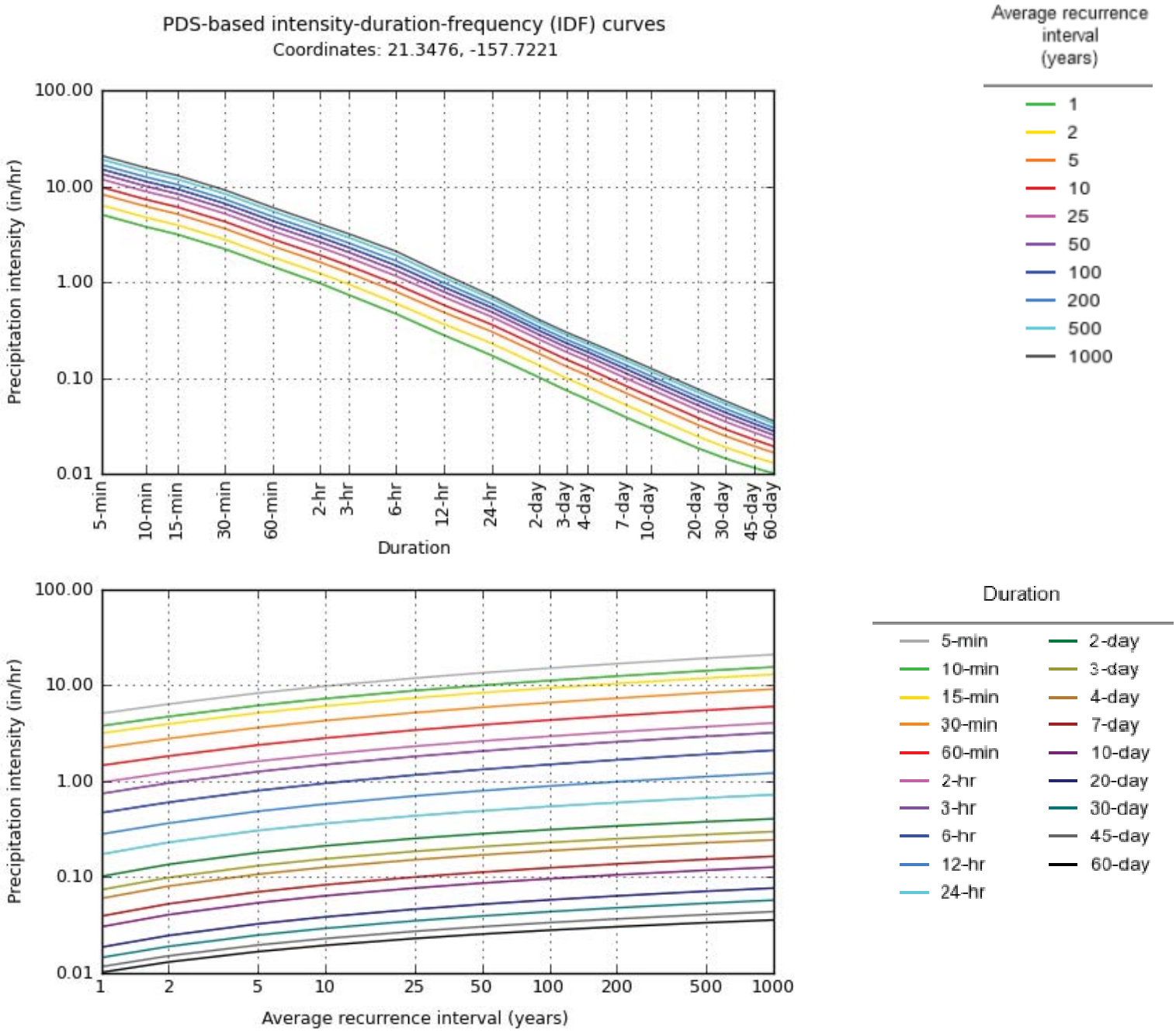
PF graphical

PF graphical



NOAA/NWS/OHD/HDSC

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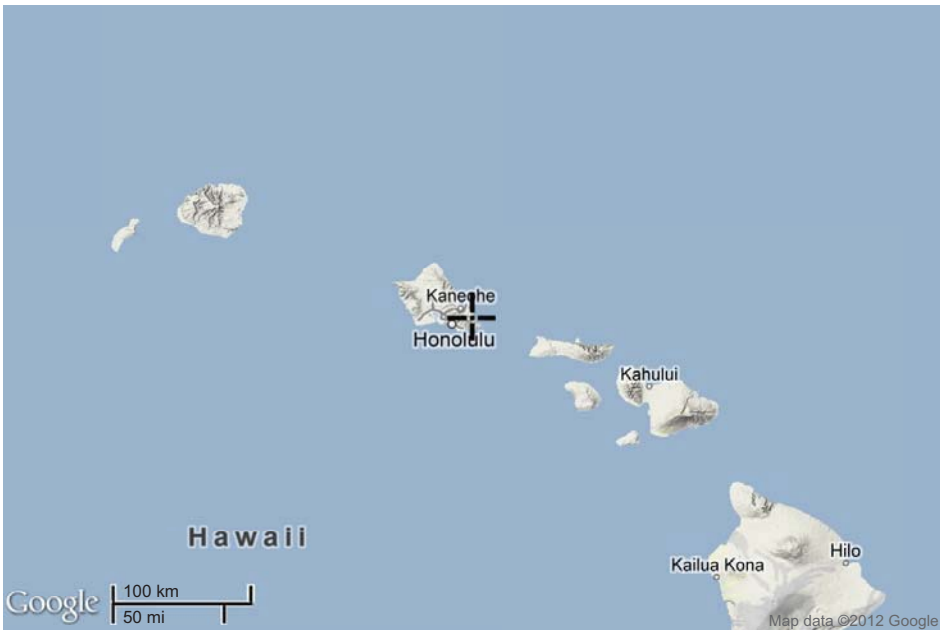

Large scale terrain

Large scale map

Large scale aerial

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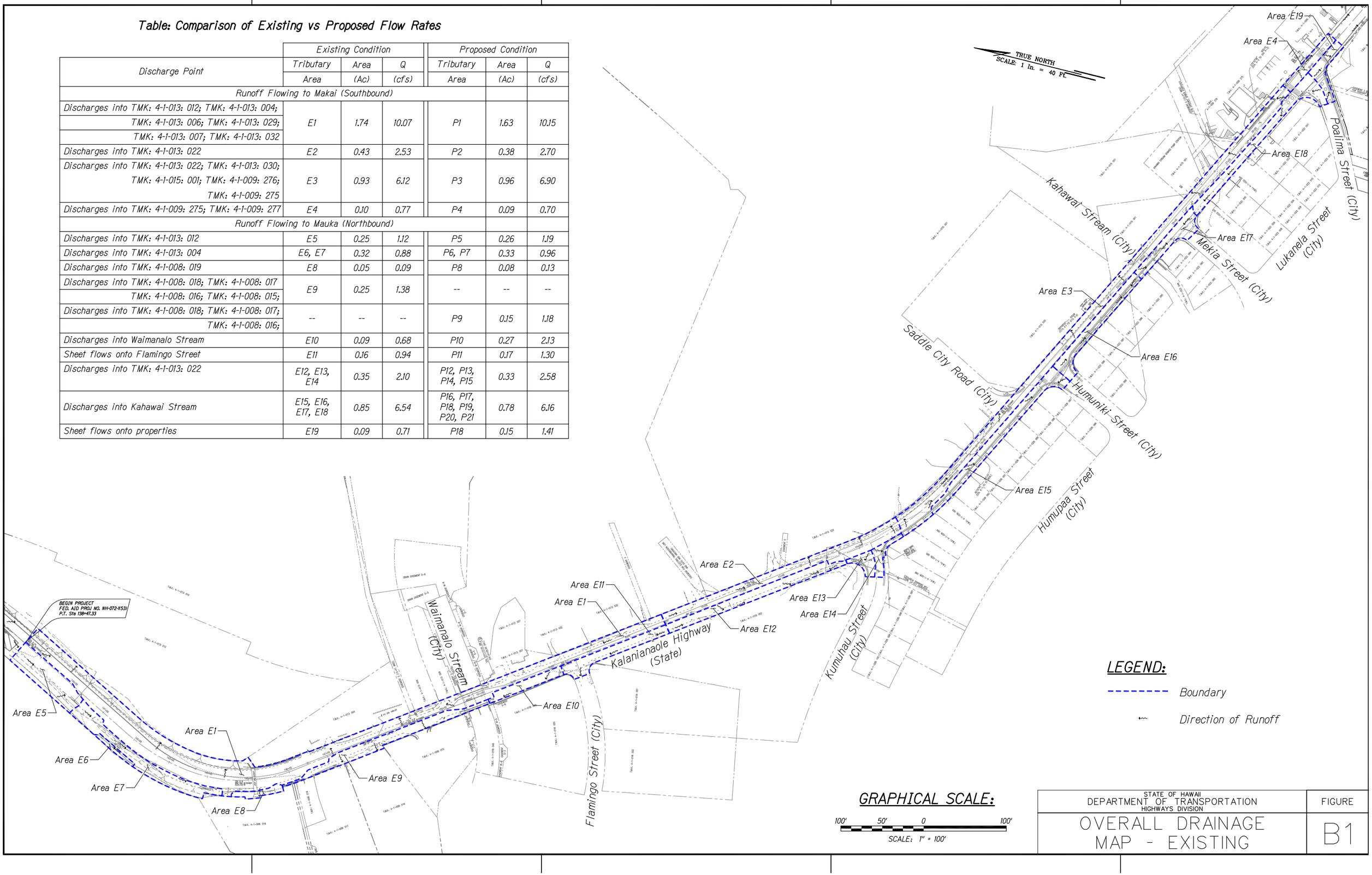
Disclaimer

Table: Comparison of Existing vs Proposed Flow Rates

Discharge Point	Existing Condition			Proposed Condition		
	Tributary Area	Area (Ac)	Q (cfs)	Tributary Area	Area (Ac)	Q (cfs)
Runoff Flowing to Makai (Southbound)						
Discharges into TMK: 4-1-013: 012; TMK: 4-1-013: 004; TMK: 4-1-013: 006; TMK: 4-1-013: 029; TMK: 4-1-013: 007; TMK: 4-1-013: 032	E1	1.74	10.07	P1	1.63	10.15
Discharges into TMK: 4-1-013: 022	E2	0.43	2.53	P2	0.38	2.70
Discharges into TMK: 4-1-013: 022; TMK: 4-1-013: 030; TMK: 4-1-015: 001; TMK: 4-1-009: 276; TMK: 4-1-009: 275	E3	0.93	6.12	P3	0.96	6.90
Discharges into TMK: 4-1-009: 275; TMK: 4-1-009: 277	E4	0.10	0.77	P4	0.09	0.70
Runoff Flowing to Mauka (Northbound)						
Discharges into TMK: 4-1-013: 012	E5	0.25	1.12	P5	0.26	1.19
Discharges into TMK: 4-1-013: 004	E6, E7	0.32	0.88	P6, P7	0.33	0.96
Discharges into TMK: 4-1-008: 019	E8	0.05	0.09	P8	0.08	0.13
Discharges into TMK: 4-1-008: 018; TMK: 4-1-008: 017 TMK: 4-1-008: 016; TMK: 4-1-008: 015;	E9	0.25	1.38	--	--	--
Discharges into TMK: 4-1-008: 018; TMK: 4-1-008: 017; TMK: 4-1-008: 016;	--	--	--	P9	0.15	1.18
Discharges into Waimanalo Stream	E10	0.09	0.68	P10	0.27	2.13
Sheet flows onto Flamingo Street	E11	0.16	0.94	P11	0.17	1.30
Discharges into TMK: 4-1-013: 022	E12, E13, E14	0.35	2.10	P12, P13, P14, P15	0.33	2.58
Discharges into Kahawai Stream	E15, E16, E17, E18	0.85	6.54	P16, P17, P18, P19, P20, P21	0.78	6.16
Sheet flows onto properties	E19	0.09	0.71	P18	0.15	1.41



STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION

OVERALL DRAINAGE MAP - EXISTING

FIGURE B1

BEGIN PROJECT
FED. AID PROJ NO. NH-072-1(53)
P.T. Sta 138+47.33

exist. 18" RCP

Area E5 (flows to existing catch basin)
A = 0.25 ac
C = 0.51
I_{25} = 8.77 in/hr
Q_{25} = 1.12 cfs

exist. catch basin

exist. drain box

Area E6 (flows to existing concrete swale to drain box)
A = 0.03 ac
C = 0.46
I_{25} = 8.77 in/hr
Q_{25} = 0.12 cfs

Area E7 (flows to existing catch basin)
A = 0.29 ac
C = 0.30
I_{25} = 8.77 in/hr
Q_{25} = 0.76 cfs

exist. 36" RCP

Area E8 (sheet flow)
A = 0.05 ac
C = 0.20
I_{25} = 8.77 in/hr
Q_{25} = 0.09 cfs

Area E1 (Dispersed Sheet Flow)
A = 1.74 ac
C = 0.66
I_{25} = 8.77 in/hr
Q_{25} = 10.07 cfs

Kalanianaole Highway (State)

exist. 8'x4' box culvert

exist. 42" RCP

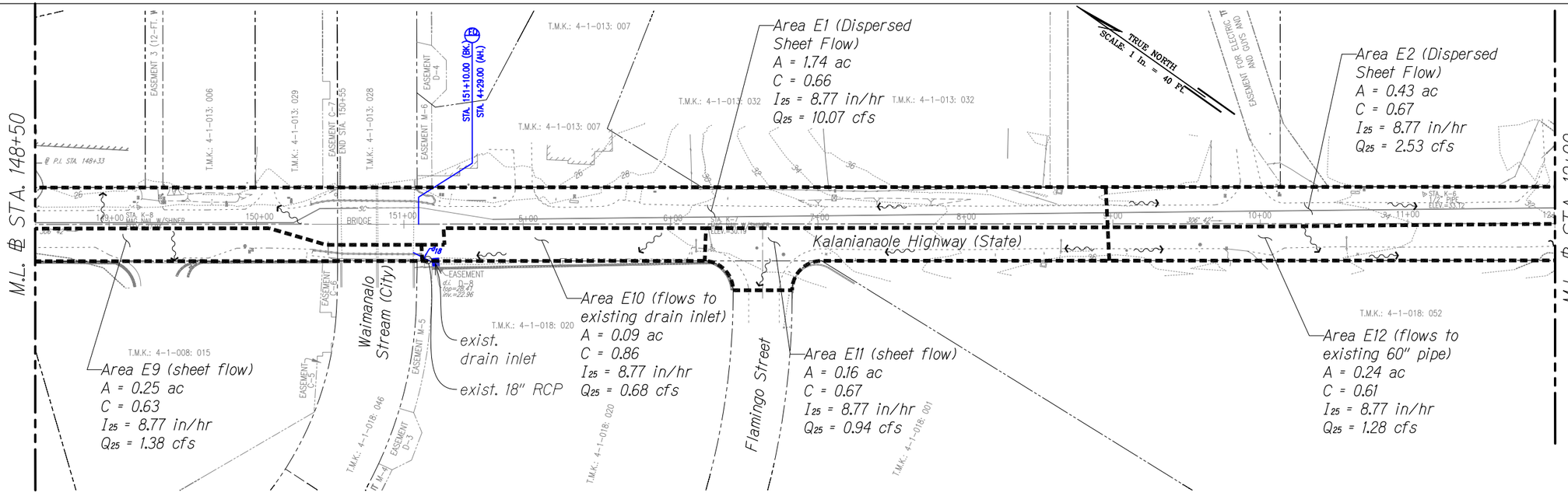
exist. catch basin

Area E9 (sheet flow)
A = 0.25 ac
C = 0.63
I_{25} = 8.77 in/hr
Q_{25} = 1.38 cfs

TRUE NORTH
SCALE: 1 in. = 40 FT.

M.L. ℄ STA. 148+50

T.M.K.: 4-1-013: 012
T.M.K.: 4-1-013: 004
T.M.K.: 4-1-008: 018
T.M.K.: 4-1-008: 017
T.M.K.: 4-1-008: 019



LEGEND:

Boundary

Direction of Runoff

GRAPHICAL SCALE:

80′ 40′ 0 80′
SCALE: 1" = 80′

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION

EXISTING DRAINAGE MAP

FIGURE B2

Area E13 (flows to existing catch basin)
A = 0.05 ac
C = 0.78
I_{25} = 8.77 in/hr
Q_{25} = 0.34 cfs

Area E2 (Dispersed Sheet Flow)
A = 0.43 ac
C = 0.67
I_{25} = 8.77 in/hr
Q_{25} = 2.53 cfs

Area E14 (flows to existing catch basin)
A = 0.06 ac
C = 0.90
I_{25} = 8.77 in/hr
Q_{25} = 0.47 cfs

Area E3 (Dispersed Sheet Flow)
A = 0.93 ac
C = 0.75
I_{25} = 8.77 in/hr
Q_{25} = 6.12 cfs

Area E16 (flows to existing catch basin)
A = 0.19 ac
C = 0.90
I_{25} = 8.77 in/hr
Q_{25} = 1.50 cfs

Area E12 (flows to existing 60" pipe)
A = 0.24 ac
C = 0.61
I_{25} = 8.77 in/hr
Q_{25} = 1.28 cfs

M.L. @ STA. 12+00

M.L. @ STA. 22+00

exist. 60" RCP

exist. catch basin

Kumuhau Street (City)

Kalanianaole Highway (State)

Saddle Street (City)

exist. catch basin

exist. 30" RCP

Humuniki Street

Area E15 (flows to existing catch basin)
A = 0.27 ac
C = 0.90
I_{25} = 8.77 in/hr
Q_{25} = 2.13 cfs

TRUE NORTH
SCALE: 1 In. = 40 Ft.

Area E3 (Dispersed Sheet Flow)
A = 0.93 ac
C = 0.75
I_{25} = 8.77 in/hr
Q_{25} = 6.12 cfs

Area E4 (Dispersed Sheet Flow)
A = 0.10 ac
C = 0.88
I_{25} = 8.77 in/hr
Q_{25} = 0.77 cfs

exist. 18" RCP

Hughes Road (Akebono Gate)

KAHAWAI STREAM SEWAGE PUMP STATION

Kalanianaole Highway (State)

exist. catch basin

exist. drain inlet

exist. 30" RCP

Kahawai Stream

Mekia Street (City)

exist. drain inlet

Area E17 (flows to existing drain inlet)
A = 0.14 ac
C = 0.87
I_{25} = 8.77 in/hr
Q_{25} = 1.07 cfs

Area E18 (flows to existing drain inlet)
A = 0.25 ac
C = 0.84
I_{25} = 8.77 in/hr
Q_{25} = 1.84 cfs

Poalima Street (City)

Area E19 (flows to existing catch basin)
A = 0.09 ac
C = 0.90
I_{25} = 8.77 in/hr
Q_{25} = 0.71 cfs

TRUE NORTH
SCALE: 1 In. = 40 Ft.

LEGEND:

Boundary

Direction Of Runoff

GRAPHICAL SCALE:

80′ 40′ 0 80′

SCALE: 1" = 80′

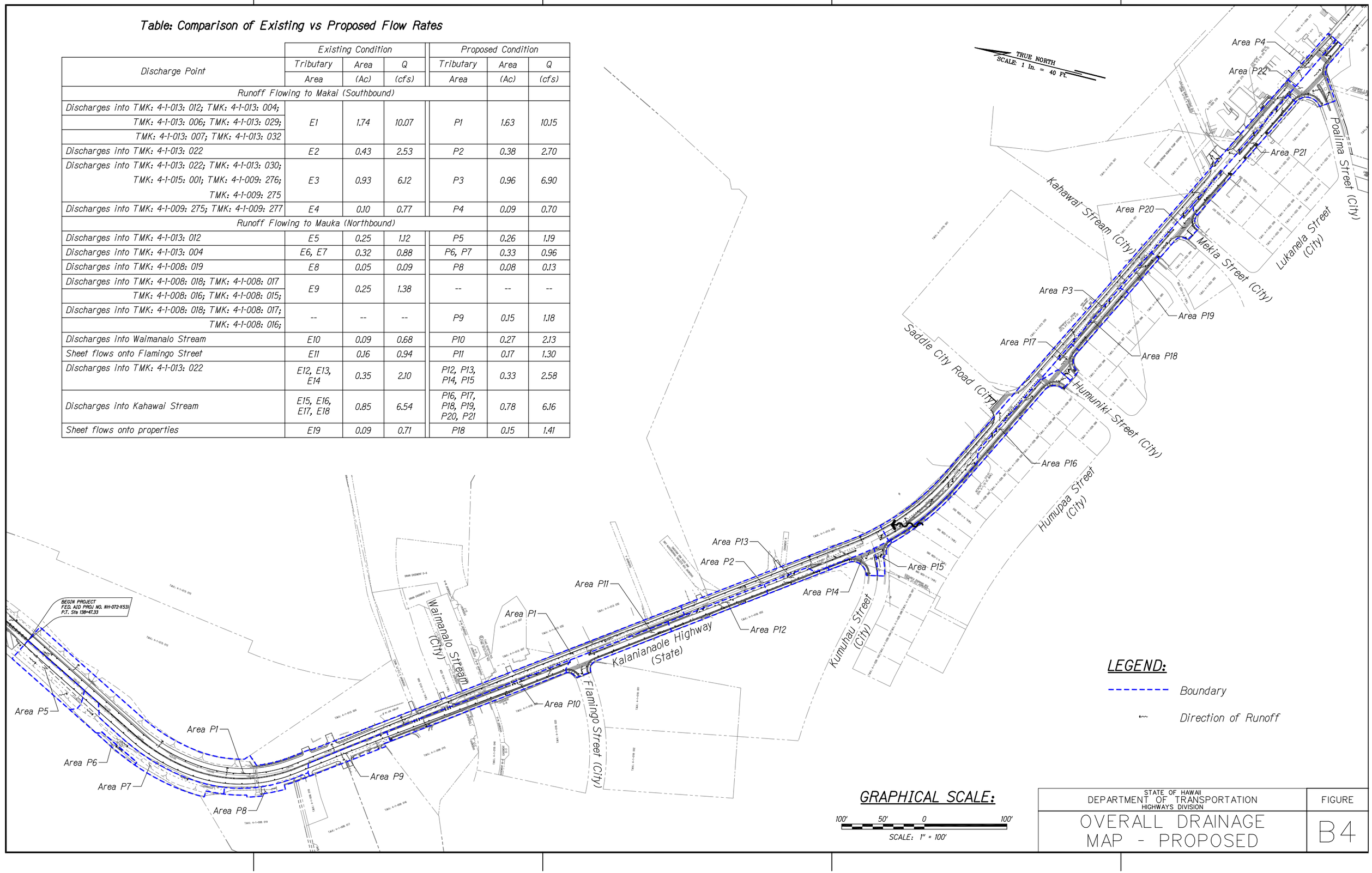
STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION

EXISTING DRAINAGE MAP

FIGURE B3

Table: Comparison of Existing vs Proposed Flow Rates

Discharge Point	Existing Condition			Proposed Condition		
	Tributary Area	Area (Ac)	Q (cfs)	Tributary Area	Area (Ac)	Q (cfs)
Runoff Flowing to Makai (Southbound)						
Discharges into TMK: 4-1-013: 012; TMK: 4-1-013: 004; TMK: 4-1-013: 006; TMK: 4-1-013: 029; TMK: 4-1-013: 007; TMK: 4-1-013: 032	E1	1.74	10.07	P1	1.63	10.15
Discharges into TMK: 4-1-013: 022	E2	0.43	2.53	P2	0.38	2.70
Discharges into TMK: 4-1-013: 022; TMK: 4-1-013: 030; TMK: 4-1-015: 001; TMK: 4-1-009: 276; TMK: 4-1-009: 275	E3	0.93	6.12	P3	0.96	6.90
Discharges into TMK: 4-1-009: 275; TMK: 4-1-009: 277	E4	0.10	0.77	P4	0.09	0.70
Runoff Flowing to Mauka (Northbound)						
Discharges into TMK: 4-1-013: 012	E5	0.25	1.12	P5	0.26	1.19
Discharges into TMK: 4-1-013: 004	E6, E7	0.32	0.88	P6, P7	0.33	0.96
Discharges into TMK: 4-1-008: 019	E8	0.05	0.09	P8	0.08	0.13
Discharges into TMK: 4-1-008: 018; TMK: 4-1-008: 017 TMK: 4-1-008: 016; TMK: 4-1-008: 015;	E9	0.25	1.38	--	--	--
Discharges into TMK: 4-1-008: 018; TMK: 4-1-008: 017; TMK: 4-1-008: 016;	--	--	--	P9	0.15	1.18
Discharges into Waimanalo Stream	E10	0.09	0.68	P10	0.27	2.13
Sheet flows onto Flamingo Street	E11	0.16	0.94	P11	0.17	1.30
Discharges into TMK: 4-1-013: 022	E12, E13, E14	0.35	2.10	P12, P13, P14, P15	0.33	2.58
Discharges into Kahawai Stream	E15, E16, E17, E18	0.85	6.54	P16, P17, P18, P19, P20, P21	0.78	6.16
Sheet flows onto properties	E19	0.09	0.71	P18	0.15	1.41



STATE OF HAWAII DEPARTMENT OF TRANSPORTATION HIGHWAYS DIVISION	FIGURE
OVERALL DRAINAGE MAP - PROPOSED	B4

BEGIN PROJECT
FED. AID PROJ NO. NH-072-1(53)
P.T. Sta 138+47.33

exist. 18" RCP

Area P5 (flows to exist. catch basin)
A = 0.26 ac
C = 0.52
I_{25} = 8.77 in/hr
Q_{25} = 1.19 cfs

exist. catch basin

exist. drain box

Area P6 (flows to exist. drain box)
A = 0.03 ac
C = 0.46
I_{25} = 8.77 in/hr
Q_{25} = 0.12 cfs

Kalanianaole Highway (State)

exist. 36" RCP

Area P1 (Dispersed Sheet Flow)
A = 1.63 ac
C = 0.71
I_{25} = 8.77 in/hr
Q_{25} = 10.15 cfs

Area P7 (flows to exist. catch basin)
A = 0.30 ac
C = 0.32
I_{25} = 8.77 in/hr
Q_{25} = 0.84 cfs

exist. 8'x4' box culvert

exist. 42" RCP

exist. catch basin

Area P8 (sheet flow)
A = 0.08 ac
C = 0.19
I_{25} = 8.77 in/hr
Q_{25} = 0.13 cfs

Area P9 (sheet flow)
A = 0.15 ac
C = 0.90
I_{25} = 8.77 in/hr
Q_{25} = 1.18 cfs

EXISTING BUS STOP TO REMAIN

TRUE NORTH
SCALE: 1 in. = 40 FT.

M.L. ℄ STA. 148+50

T.M.K.: 4-1-013: 012
T.M.K.: 4-1-013: 004
T.M.K.: 4-1-008: 018
T.M.K.: 4-1-008: 017

Proposed Catch Basin

Proposed D18

Regrade for Drainage

Area P10 (flows to Proposed Catch Basin)
A = 0.27 ac
C = 0.90
I_{25} = 8.77 in/hr
Q_{25} = 2.13 cfs

Waimanalo Stream (City)

existing drain inlet to be replaced

EXISTING BUS STOP TO REMAIN

Flamingo Road

Area P1 (Dispersed Sheet Flow)
A = 1.63 ac
C = 0.71
I_{25} = 8.77 in/hr
Q_{25} = 10.15 cfs

Area P2 (Dispersed Sheet Flow)
A = 0.38 ac
C = 0.81
I_{25} = 8.77 in/hr
Q_{25} = 2.70 cfs

Proposed D18

Proposed Catch Basin

Kalanianaole Highway (State)

Area P11 (sheet flow)
A = 0.17 ac
C = 0.87
I_{25} = 8.77 in/hr
Q_{25} = 1.30 cfs

Area P12 (flows to Proposed Catch Basin)
A = 0.14 ac
C = 0.88
I_{25} = 8.77 in/hr
Q_{25} = 1.08 cfs

TRUE NORTH
SCALE: 1 in. = 40 FT.

M.L. ℄ STA. 148+50

M.L. ℄ STA. 12+00

T.M.K.: 4-1-018: 001

LEGEND:

Boundary

Direction of Runoff

GRAPHICAL SCALE:

80' 40' 0 80'
SCALE: 1" = 80'

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION

PROPOSED DRAINAGE MAP

FIGURE B5

Area P13 (flows to Proposed Catch Basin)
A = 0.08 ac
C = 0.90
I_{25} = 8.77 in/hr
Q_{25} = 0.63 cfs

Proposed Catch Basin
exist. 18" RCP

Area P15 (flows to Proposed Catch Basin)
A = 0.04 ac
C = 0.90
I_{25} = 8.77 in/hr
Q_{25} = 0.32 cfs

Area P14 (flows to Proposed Catch Basin)
A = 0.07 ac
C = 0.90
I_{25} = 8.77 in/hr
Q_{25} = 0.55 cfs

Proposed Catch Basin (removed existing catch basin)

Proposed Catch Basin (removed existing catch basin)

Area P3 (Dispersed Sheet Flow)
A = 0.96 ac
C = 0.82
I_{25} = 8.77 in/hr
Q_{25} = 6.90 cfs

Area P18 (flows to Proposed Catch Basin)
A = 0.10 ac
C = 0.90
I_{25} = 8.77 in/hr
Q_{25} = 0.79 cfs

Proposed Catch Basin

Area P17 (flows to Proposed Catch Basin)
A = 0.07 ac
C = 0.90
I_{25} = 8.77 in/hr
Q_{25} = 0.55 cfs

Proposed Catch Basin (removed existing catch basin)

exist. 30" RCP

Area P16 (flows to Proposed Catch Basin)
A = 0.23 ac
C = 0.90
I_{25} = 8.77 in/hr
Q_{25} = 1.82 cfs

Area P19 (flows to Proposed Drain Inlet)
A = 0.06 ac
C = 0.90
I_{25} = 8.77 in/hr
Q_{25} = 0.47 cfs

exist. 30" RCP

Proposed Drain Inlet

exist. 18" RCP

Proposed Catch Basin (removed existing catch basin)

Proposed Drain Inlet (removed existing drain inlet)

Area P20 (flows to Proposed Drain Inlet)
A = 0.11 ac
C = 0.90
I_{25} = 8.77 in/hr
Q_{25} = 0.87 cfs

Proposed Catch Basin (removed existing drain inlet)

Area P21 (flows to Proposed Catch Basin)
A = 0.21 ac
C = 0.90
I_{25} = 8.77 in/hr
Q_{25} = 1.66 cfs

Area P4 (Dispersed Sheet Flow)
A = 0.09 ac
C = 0.89
I_{25} = 8.77 in/hr
Q_{25} = 0.70 cfs

Area P22 (Dispersed Sheet Flow)
A = 0.18 ac
C = 0.89
I_{25} = 8.77 in/hr
Q_{25} = 1.41 cfs

M.L. @ STA. 12+00

M.L. @ STA. 22+00

Kumuhau Street (City)

Kalanianaole Highway (State)

Saddle Street (City)

Humuniki Street

Kahawai Stream (City)

Mekia Street (City)

Poalima Street (City)

Hughes Road (Akebono Gate)

KAHAWAI STREAM SEWAGE PUMP STATION

EXISTING BUS STOP TO REMAIN

BENCH MARK STA. 1 BRASS CAP ELEV.=30.58

STA. K-1 MAG NAIL W/SHINER ELEV.=23.37

STA. K-3 MAG NAIL ELEV.=23.61

EASEMENT A FOR SANITARY SEWER

EASEMENT 2 (10 FT WIDE) FOR DRAINAGE PURPOSES

TRUE NORTH
SCALE: 1 In. = 40 Ft.

T.M.K.: 4-1-028: 100
T.M.K.: 4-1-028: 099
T.M.K.: 4-1-028: 098
T.M.K.: 4-1-028: 097
T.M.K.: 4-1-028: 096
T.M.K.: 4-1-028: 095
T.M.K.: 4-1-028: 094
T.M.K.: 4-1-028: 093
T.M.K.: 4-1-028: 092
T.M.K.: 4-1-028: 091
T.M.K.: 4-1-028: 090
T.M.K.: 4-1-028: 089
T.M.K.: 4-1-028: 088
T.M.K.: 4-1-028: 087
T.M.K.: 4-1-028: 086
T.M.K.: 4-1-022: 088
T.M.K.: 4-1-022: 089
T.M.K.: 4-1-022: 086
T.M.K.: 4-1-022: 085
T.M.K.: 4-1-022: 084
T.M.K.: 4-1-022: 083
T.M.K.: 4-1-022: 082
T.M.K.: 4-1-022: 007
T.M.K.: 4-1-022: 004
T.M.K.: 4-1-022: 005
T.M.K.: 4-1-022: 003
T.M.K.: 4-1-022: 001
T.M.K.: 4-1-022: 008
T.M.K.: 4-1-022: 009
T.M.K.: 4-1-022: 010
T.M.K.: 4-1-022: 011
T.M.K.: 4-1-009: 276
T.M.K.: 4-1-009: 275
T.M.K.: 4-1-009: 277
T.M.K.: 4-1-009: 278
T.M.K.: 4-1-009: 285
T.M.K.: 4-1-015: 001
T.M.K.: 4-1-013: 030
T.M.K.: 4-1-023: 048

LEGEND:

Boundary

Direction Of Runoff

GRAPHICAL SCALE:

80' 40' 0 80'

SCALE: 1" = 80'

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION

PROPOSED DRAINAGE MAP

FIGURE B6

RUNOFF CALCULATION *(Existing and Proposed Condition)*

Hydrologic Calculations

The Department of Transportation indicates to use the Rational Method to calculate runoff for drainage areas up to 200 acres.
The Rational Method of hydrologic analysis consists of an empirical equation used to compute peak runoff from a drainage basin.

The Rational Method equation is as follows: ***Q= C x I x A***

Where:
Q = Peak discharge, cubic feet per second (cfs)
C = weighted runoff coefficient for the drainage area
I = Average rainfall intensity, inches per hour (in/hr)
A = Drainage area (acre)

DESCRIPTION:

Drainage Area = Area of subbasin (acre)

Time of Concentration (Tc) = Based on the HDOT Design Criteria. Use 10minutes as the minimum Tc

Rainfall Intensity (I) = Based on the National Atmospheric Administration's (NOAA) precipitation Frequency data Server
= Based on the HDOT Design Criteria. Use 25 year recurrence interval

Runoff Coefficient (C) = based on the summation of watershed characteristics value on Table below

Discharge (Q) = Based on rational method (cfs)

Runoff Coefficient (C) = based on the summation of watershed characteristics value on Table below
= Based on surface type

Type of Surface	Runoff Coefficient	
Rural Area		
Concrete or Asphalt pavement	0.90 - 0.95	
Gravel Roadways or Shoulder	0.4 - 0.6	
Bare earth	0.2 - 0.9	
Steep grassed areas (2:1)	0.5 - 0.7	
turf meadows	0.1 - 0.4	
Forested areas	0.1 - 0.3	
Cultivated fields	0.2 - 0.4	
Grass/Lawn	0.15	*used to represent "pervious" area for existing and proposed condition*
Paved	0.90	*used to represent "impervious" area for existing and proposed condition*

Summary of Storm Water Runoff (Existing Condition)

Tributary Area	*Area*	*Rainfall Intensity (I_{25})*	*Weighted Coefficient*	*Q_{25}*	*Discharge Point*
	acre	in/hr	C	cfs	
Runoff flowing to Makai (Southbound)					
E1	1.74	8.77	0.66	10.07	*dispersed sheet flow*
E2	0.43	8.77	0.67	2.53	*dispersed sheet flow*
E3	0.93	8.77	0.75	6.12	*dispersed sheet flow*
E4	0.10	8.77	0.88	0.77	*dispersed sheet flow*
Runoff flowing to Mauka (Northbound)					
E5	0.25	8.77	0.51	1.12	*existing catch basin*
E6	0.03	8.77	0.46	0.12	*existing conc. swale to drain box*
E7	0.29	8.77	0.30	0.76	*existing catch basin*
E8	0.05	8.77	0.20	0.09	*sheet flow to properties*
E9	0.25	8.77	0.63	1.38	*sheet flow to properties*
E10	0.09	8.77	0.86	0.68	*existing drain inlet*
E11	0.16	8.77	0.67	0.94	*sheet flow to properties*
E12	0.24	8.77	0.61	1.28	*flows to existing 60" pipe*
E13	0.05	8.77	0.78	0.34	*existing catch basin*
E14	0.06	8.77	0.90	0.47	*existing catch basin*
E15	0.27	8.77	0.90	2.13	*existing catch basin*
E16	0.19	8.77	0.90	1.50	*existing catch basin*
E17	0.14	8.77	0.87	1.07	*existing drain inlet*
E18	0.25	8.77	0.84	1.84	*existing drain inlet*
E19	0.09	8.77	0.90	0.71	*sheet flow to properties*

Summary of Storm Water Runoff (Proposed Condition)

Tributary Area	*Area*	*Rainfall Intensity (I_{25})*	*Weighted Coefficient (C)*	*Q_{25}*	*Discharge Point*
	acre	in/hr		cfs	
Runoff flowing to Makai					
P1	1.63	8.77	0.71	10.15	*dispersed sheet flow*
P2	0.38	8.77	0.81	2.70	*dispersed sheet flow*
P3	0.96	8.77	0.82	6.90	*dispersed sheet flow*
P4	0.09	8.77	0.89	0.70	*dispersed sheet flow*
Runoff flowing to Mauka					
P5	0.26	8.77	0.52	1.19	*existing catch basin*
P6	0.03	8.77	0.46	0.12	*existing conc. swale to drain box*
P7	0.30	8.77	0.32	0.84	*existing catch basin*
P8	0.08	8.77	0.19	0.13	*sheet flow to properties*
P9	0.15	8.77	0.90	1.18	*sheet flow to properties*
P10	0.27	8.77	0.90	2.13	*proposed catch basin (sag)*
P11	0.17	8.77	0.87	1.30	*sheet flow*
P12	0.14	8.77	0.88	1.08	*proposed catch basin*
P13	0.08	8.77	0.90	0.63	*proposed catch basin*
P14	0.07	8.77	0.90	0.55	*proposed catch basin*
P15	0.04	8.77	0.90	0.32	*proposed catch basin*
P16	0.23	8.77	0.90	1.82	*proposed catch basin*
P17	0.07	8.77	0.90	0.55	*proposed catch basin*
P18	0.10	8.77	0.90	0.79	*proposed catch basin*
P19	0.06	8.77	0.90	0.47	*proposed drain inlet*
P20	0.11	8.77	0.90	0.87	*proposed drain inlet*
P21	0.21	8.77	0.90	1.66	*proposed catch basin*
P22	0.18	8.77	0.89	1.41	*sheet flow to properties*

WEIGHTED C (*EXISTING CONDITION*)

Land Use	Area (acres)	Runoff Coef.
Paved/Conc.	1.17	0.90
Lawn/Grass	0.57	0.15
Area E1 **Total**	***1.74***	***0.66***

Land Use	Area (acres)	Runoff Coef.
Paved/Conc.	0.11	0.90
Lawn/Grass	0.05	0.15
Area E11 **Total**	***0.16***	***0.67***

Land Use	Area (acres)	Runoff Coef.
Paved/Conc.	0.29	0.90
Lawn/Grass	0.13	0.15
Area E2 **Total**	***0.43***	***0.67***

Land Use	Area (acres)	Runoff Coef.
Paved/Conc.	0.15	0.90
Lawn/Grass	0.09	0.15
Area E12 **Total**	***0.24***	***0.61***

Land Use	Area (acres)	Runoff Coef.
Paved/Conc.	0.75	0.90
Lawn/Grass	0.19	0.15
Area E3 **Total**	***0.93***	***0.75***

Land Use	Area (acres)	Runoff Coef.
Paved/Conc.	0.05	0.90
Lawn/Grass	0.01	0.15
Area E13 **Total**	***0.05***	***0.78***

Land Use	Area (acres)	Runoff Coef.
Paved/Conc.	0.09	0.90
Lawn/Grass	0.00	0.15
Area E4 **Total**	***0.10***	***0.88***

Land Use	Area (acres)	Runoff Coef.
Paved/Conc.	0.06	0.90
Lawn/Grass	0.00	0.15
Area E14 **Total**	***0.06***	***0.90***

Land Use	Area (acres)	Runoff Coef.
Paved/Conc.	0.12	0.90
Lawn/Grass	0.13	0.15
Area E5 **Total**	***0.25***	***0.51***

Land Use	Area (acres)	Runoff Coef.
Paved/Conc.	0.27	0.90
Lawn/Grass	0.00	0.15
Area E15 **Total**	***0.27***	***0.90***

Land Use	Area (acres)	Runoff Coef.
Paved/Conc.	0.01	0.90
Lawn/Grass	0.02	0.15
Area E6 **Total**	***0.03***	***0.46***

Land Use	Area (acres)	Runoff Coef.
Paved/Conc.	0.19	0.90
Lawn/Grass	0.00	0.15
Area E16 **Total**	***0.19***	***0.90***

Land Use	Area (acres)	Runoff Coef.
Paved/Conc.	0.06	0.90
Lawn/Grass	0.23	0.15
Area E7 **Total**	***0.29***	***0.30***

Land Use	Area (acres)	Runoff Coef.
Paved/Conc.	0.13	0.90
Lawn/Grass	0.01	0.15
Area E17 **Total**	***0.14***	***0.87***

Land Use	Area (acres)	Runoff Coef.
Paved/Conc.	0.00	0.90
Lawn/Grass	0.04	0.15
Area E8 **Total**	***0.05***	***0.20***

Land Use	Area (acres)	Runoff Coef.
Paved/Conc.	0.23	0.90
Lawn/Grass	0.02	0.15
Area E18 **Total**	***0.25***	***0.84***

Land Use	Area (acres)	Runoff Coef.
Paved/Conc.	0.16	0.90
Lawn/Grass	0.09	0.15
Area E9 **Total**	***0.25***	***0.63***

Land Use	Area (acres)	Runoff Coef.
Paved/Conc.	0.09	0.90
Lawn/Grass	0.00	0.15
Area E19 **Total**	***0.09***	***0.90***

Land Use	Area (acres)	Runoff Coef.
Paved/Conc.	0.09	0.90
Lawn/Grass	0.00	0.15
Area E10 **Total**	***0.09***	***0.86***

WEIGHTED C (*PROPOSED CONDITION*)

Land Use	Area (acres)	Runoff Coef.
Paved/Conc.	1.22	0.90
Lawn/Grass	0.41	0.15
Area P1 **Total**	***1.63***	***0.71***

Land Use	Area (acres)	Runoff Coef.
Paved/Conc.	0.33	0.90
Lawn/Grass	0.05	0.15
Area P2 **Total**	***0.38***	***0.81***

Land Use	Area (acres)	Runoff Coef.
Paved/Conc.	0.86	0.90
Lawn/Grass	0.10	0.15
Area P3 **Total**	***0.96***	***0.82***

Land Use	Area (acres)	Runoff Coef.
Paved/Conc.	0.09	0.90
Lawn/Grass	0.00	0.15
Area P4 **Total**	***0.09***	***0.89***

Land Use	Area (acres)	Runoff Coef.
Paved/Conc.	0.13	0.90
Lawn/Grass	0.13	0.15
Area P5 **Total**	***0.26***	***0.52***

Land Use	Area (acres)	Runoff Coef.
Paved/Conc.	0.01	0.90
Lawn/Grass	0.02	0.15
Area P6 **Total**	***0.03***	***0.46***

Land Use	Area (acres)	Runoff Coef.
Paved/Conc.	0.07	0.90
Lawn/Grass	0.23	0.15
Area P7 **Total**	***0.30***	***0.32***

Land Use	Area (acres)	Runoff Coef.
Paved/Conc.	0.00	0.90
Lawn/Grass	0.07	0.15
Area P8 **Total**	***0.08***	***0.19***

Land Use	Area (acres)	Runoff Coef.
Paved/Conc.	0.15	0.90
Lawn/Grass	0.00	0.15
Area P9 **Total**	***0.15***	***0.90***

Land Use	Area (acres)	Runoff Coef.
Paved/Conc.	0.27	0.90
Lawn/Grass	0.00	0.15
Area P10 **Total**	***0.27***	***0.90***

Land Use	Area (acres)	Runoff Coef.
Paved/Conc.	0.17	0.90
Lawn/Grass	0.01	0.15
Area P11 **Total**	***0.17***	***0.87***

Land Use	Area (acres)	Runoff Coef.
Paved/Conc.	0.14	0.90
Lawn/Grass	0.00	0.15
Area P12 **Total**	***0.14***	***0.88***

Land Use	Area (acres)	Runoff Coef.
Paved/Conc.	0.08	0.90
Lawn/Grass	0.00	0.15
Area P13 **Total**	***0.08***	***0.90***

Land Use	Area (acres)	Runoff Coef.
Paved/Conc.	0.07	0.90
Lawn/Grass	0.00	0.15
Area P14 **Total**	***0.07***	***0.90***

Land Use	Area (acres)	Runoff Coef.
Paved/Conc.	0.04	0.90
Lawn/Grass	0.00	0.15
Area P15 **Total**	***0.04***	***0.90***

Land Use	Area (acres)	Runoff Coef.
Paved/Conc.	0.23	0.90
Lawn/Grass	0.00	0.15
Area P16 **Total**	***0.23***	***0.90***

WEIGHTED C (*PROPOSED CONDITION*)

Land Use	Area (acres)	Runoff Coef.
Paved/Conc.	0.07	0.90
Lawn/Grass	0.00	0.15
Area P17 **Total**	***0.07***	***0.90***

Land Use	Area (acres)	Runoff Coef.
Paved/Conc.	0.11	0.90
Lawn/Grass	0.00	0.15
Area P20 **Total**	***0.11***	***0.90***

Land Use	Area (acres)	Runoff Coef.
Paved/Conc.	0.10	0.90
Lawn/Grass	0.00	0.15
Area P18 **Total**	***0.10***	***0.90***

Land Use	Area (acres)	Runoff Coef.
Paved/Conc.	0.21	0.90
Lawn/Grass	0.00	0.15
Area P21 **Total**	***0.21***	***0.90***

Land Use	Area (acres)	Runoff Coef.
Paved/Conc.	0.06	0.90
Lawn/Grass	0.00	0.15
Area P19 **Total**	***0.06***	***0.90***

Land Use	Area (acres)	Runoff Coef.
Paved/Conc.	0.18	0.90
Lawn/Grass	0.00	0.15
Area P22 **Total**	***0.18***	***0.89***