APPENDIX A

Wastewater Demand / Flow Calculations

MAUI RESEARCH AND TECHNOLOGY PARK MASTER PLAN
WASTEWATER FLOW PROJECTIONS

TOTAL PROJECT

1. Average Wastewater Flow:
   = 0.50 MGD (Obtained from Wastewater Flow Tabulation)

2. Maximum Wastewater Flow:
   = 0.50 MGD x 3.60 (Babbitt Peaking Factor)
   = 1.80 MGD

3. Dry Weather Infiltration/Inflow:
   =5 gpcd x 10,354 (Obtained from Per Capita Tabulation)
   =0.05 MGD

4. Design Average Flow:
   =0.50 MGD + 0.05 MGD
   =0.55 MGD

5. Design Maximum Flow:
   = 1.80 MGD + 0.05 MGD
   = 1.85 MGD

6. Wet Weather Infiltration/Inflow:
   = 1,250 gpad x 364 acres
   = 0.46 MGD

7. Design Peak Flow:
   =1.85 MGD + 0.46 MGD
   = 2.31 MGD

PHASE 1

1. Average Wastewater Flow:
   = 0.26 MGD (Obtained from Table A-1: Wastewater Flow Tabulation)

2. Maximum Wastewater Flow:
   = 0.26 MGD x 4.2 (Babbitt Peaking Factor)
   = 1.09 MGD

3. Dry Weather Infiltration/Inflow:
   =5 gpcd x 5,548 (Obtained from Table A-2: Per Capita Tabulation)
   =0.03 MGD

4. Design Average Flow:
   =0.26 MGD + 0.03 MGD
   =0.29 MGD

5. Design Maximum Flow:
   = 1.09 MGD + 0.03 MGD
   = 1.12 MGD

6. Wet Weather Infiltration/Inflow:
   = 1,250 gpad x 212 acres
   = 0.26 MGD

7. Design Peak Flow:
   =1.12 MGD + 0.26 MGD
   = 1.38 MGD

PHASE 2

1. Average Wastewater Flow:
   = 0.24 MGD (Obtained from Table A-1: Wastewater Flow Tabulation)

2. Maximum Wastewater Flow:
   = 0.24 MGD x 4.3 (Babbitt Peaking Factor)
   = 1.03 MGD

3. Dry Weather Infiltration/Inflow:
   =5 gpcd x 4,806 (Obtained from Table A-2: Per Capita Tabulation)
   =0.02 MGD

4. Design Average Flow:
   =0.24 MGD + 0.02 MGD
   =0.26 MGD

5. Design Maximum Flow:
   = 1.03 MGD + 0.02 MGD
   = 1.05 MGD

6. Wet Weather Infiltration/Inflow:
   = 1,250 gpad x 152 acres
   = 0.19 MGD

7. Design Peak Flow:
   =1.05 MGD + 0.19 MGD
   = 1.24 MGD

TABLE A-1
MAUI RESEARCH AND TECHNOLOGY PARK MASTER PLAN
WASTEWATER FLOW TABULATION

	Parcel Area (Acres)	Unit Area (Sq. Ft.)	Dwelling Units	Employees	Contribution (gal/unit/day)	Avg. Daily Flow (gpd)	Comments
A. EMPLOYMENT CORE							
1 to 5 Existing Buildings				400	20	8,000	
6 Future USPS Sorting Facility	2.2			100	20	2,000	
7 Employment	2.9			130	20	2,600	
8 Employment	2.7			120	20	1,340	
9 Employment	2.3			100	20	1,660	
10 Employment	5.0			200	20	1,040	
11 Employment	1.2			50	20	1,000	
12 Employment	1.2			50	20	1,000	
13 Employment	1.4			60	20	1,200	
14 Employment	1.4			60	20	1,200	
15 Employment	2.8			120	20	2,400	
16 Employment	2.3			100	20	2,000	
17 Employment	2.3			100	20	2,000	
18 Employment	2.3			100	20	2,000	
19 Employment	0.9			40	20	800	
20 Employment	1.2			50	20	1,000	
21 Employment	1.0			50	20	1,000	
22 Employment	1.0			50	20	1,000	
23 Employment	1.6			70	20	1,400	
24 Employment	1.5			60	20	1,200	
25a Employment	2.0			90	20	1,800	
25b Employment	1.9			80	20	1,600	
26 Employment	6.8			270	20	5,400	
					Subtotal:	**44,640**	

TABLE A-1
MAUI RESEARCH AND TECHNOLOGY PARK MASTER PLAN
WASTEWATER FLOW TABULATION

		Parcel Area (Acres)	Unit Area (Sq. Ft.)	Dwelling Units	Employees	Contribution (gal/unit/day)	Avg. Daily Flow (gpd)	Comments
B. KNOWLEDGE INDUSTRY EXPANSION/CAMPUS								
1A	Employment	4.4			190	20	3,800	
1B	Employment	0.9			40	20	800	
2	Employment	2.3			100	20	2,000	
3	Employment/Campus	9.9			370	20	7,400	
3b	Employment/Campus-Reserve	11.4						No Development
4	Employment	3.8			170	20	3,400	
5	Mixed Use/Flex	0.9			40	30	1,200	
6	Mixed Use/Flex	1.3			50	30	1,500	
7	Employment	4.0			170	20	3,400	
8	Employment	4.2			180	30	5,400	
9	Employment/Campus	11.4			430	20	8,600	
C. VILLAGE CENTER						**Subtotal:**	**37,500**	
1	Hotel	22.1	60,000	150		300	45,000	Assume 150 rooms
2	Mixed Use	3.1			80	30	2,400	
3	Mixed Use	2.5			50	30	1,500	
4	Mixed Use	2.5			50	30	1,500	
5	Residential	2.6		80		255	20,400	
6	Restaurant	0.8	8,000		100	80	4,160	Assume 100 seats
7	Residential	1.4		23		350	8,050	
8	Residential	2.4		42		350	14,700	
9	Residential	2.1		10		350	3,500	
10	Residential	0.9		10		350	3,500	
11	Residential	1.0		9		350	3,150	
12	Residential	0.9		7		350	2,450	
13	Residential	0.7		4		350	1,400	
14	Residential	0.9		7		350	2,450	

TABLE A-1
MAUI RESEARCH AND TECHNOLOGY PARK MASTER PLAN
WASTEWATER FLOW TABULATION

		Parcel Area (Acres)	Unit Area (Sq. Ft.)	Dwelling Units	Employees	Contribution (gal/unit/day)	Avg. Daily Flow (gpd)	Comments
15	Residential	0.1		1		350	350	
17	Civic	3.9						Open Space
18	Civic	6.2	100,000		500	15	7,500	
D. MAKAI RESIDENTIAL						**Subtotal:**	**122,010**	
1	Residential	3.1		52		255	13,260	
2	Residential	3.9		64		255	16,320	
3	Residential	3.2		53		255	13,515	
4	Residential	1.9		31		255	7,905	
5	Residential	2.5		42		255	10,710	
6	Residential	3.0		50		255	12,750	
7	Residential	3.5		58		255	14,790	
E. RESIDENTIAL AND KNOWLEDGE INDUSTRY EXPANSION						**Subtotal:**	**89,250**	
1	Residential	1.3		18		350	6,300	
2	Residential	2.1		30		350	10,500	
3	Residential	1.4		19		350	6,650	
4	Residential	1.7		24		350	8,400	
5	Residential	1.7		23		350	8,050	
6	Residential	1.8		25		350	8,750	
7	Residential	1.5		20		350	7,000	
9	Residential	1.1		15		350	5,250	
10	Residential	2.9		41		350	14,350	
11	Residential	1.9		27		350	9,450	
12	Residential	3.4		47		350	16,450	
14	Residential	2.5		35		350	12,250	

TABLE A-1
MAUI RESEARCH AND TECHNOLOGY PARK MASTER PLAN
WASTEWATER FLOW TABULATION

		Parcel Area (Acres)	Unit Area (Sq. Ft.)	Dwelling Units	Employees	Contribution (gal/unit/day)	Avg. Daily Flow (gpd)	Comments
15	Residential	1.9		27		350	9,450	
17	Residential	1.7		24		350	8,400	
18	Residential	2.5		34		350	11,900	
19	Residential	1.6		23		350	8,050	
20	Residential	1.8		25		350	8,750	
21	Residential	1.7		22		350	7,700	
22	Employment	4.1			180	30	5,400	
22b	Employment - Reserve	2.2						No Development
23	Employment	4.6			200	30	6,000	
23b	Employment - Reserve							No Development
24	Employment	6.0			260	30	7,800	
24b	Employment - Reserve							No Development
25	Employment	11.8			510	30	15,300	
						Subtotal:	**202,150**	
						Average Daily Wastewater Flow (gpd):	**495,550**	
						Average Daily Wastewater Flow (gpd) for Phase 1:	**255,900**	
						Average Daily Wastewater Flow (gpd) for Phase 2:	**239,650**	

NOTES:
1. PHASE 1 INCLUDES A-EMPLOYMENT CORE, C-VILLAGE CENTER, AND D-MAKAI RESIDENTIAL
2. PHASE 2 INCLUDES B-KNOWLEDGE INDUSTRY EXPANSION/CAMPUS AND E-OPTION LAND

TABLE A-2
MAUI RESEARCH AND TECHNOLOGY PARK MASTER PLAN
TOTAL PER CAPITA TABULATION

		Parcel Area (Acres)	Unit Area (Sq. Ft.)	Dwelling Units	Employees
A. EMPLOYMENT CORE					
1 to 5	Existing Buildings				400
6	Future USPS Sorting Facility	2.2			100
7	Employment	2.9			130
8	Employment	2.7			120
9	Employment	2.3			100
10	Employment	5.0			200
11	Employment	1.2			50
12	Employment	1.2			50
13	Employment	1.4			60
14	Employment	1.4			60
15	Employment	2.8			120
16	Employment	2.3			100
17	Employment	2.3			100
18	Employment	2.3			100
19	Employment	0.9			40
20	Employment	1.2			50
21	Employment	1.0			50
22	Employment	1.0			50
23	Employment	1.6			70
24	Employment	1.5			60
25a	Employment	2.0			90
25b	Employment	1.9			80
26	Employment	6.8			270
B. KNOWLEDGE INDUSTRY EXPANSION/CAMPUS				**Subtotal:**	**2,450**
1A	Employment	4.4			190
1B	Employment	0.9			40
2	Employment	2.3			100
3	Employment/Campus	9.9			370
3B	Employment - Reserve	11.4			0
4	Employment	3.8			170
5	Mixed Use/Flex	0.9			40
6	Mixed Use/Flex	1.3			50
7	Employment	4.0			170
8	Employment	4.2			180
7	Employment/Campus	11.4			430
				Subtotal:	**1,740**

TABLE A-2
MAUI RESEARCH AND TECHNOLOGY PARK MASTER PLAN
TOTAL PER CAPITA TABULATION

		Parcel Area (Acres)	Unit Area (Sq. Ft.)	Dwelling Units	Employees
C. VILLAGE CENTER					
1	Hotel	2.1	60,000	150	150
2	Mixed Use	3.1		80	80
3	Mixed Use	2.5		65	50
4	Mixed Use	2.5		63	50
5	Residential	2.6		80	320
6	Restaurant	0.8	8,000		100
7	Residential	1.4		23	92
8	Residential	2.4		42	168
9	Residential	2.1		10	40
10	Residential	0.9		10	40
11	Residential	1.0		9	36
12	Residential	0.9		7	28
13	Residential	0.7		4	16
14	Residential	0.9		7	28
15	Residential	0.1			
17	Civic	3.9			
18	Civic	6.2	100,000		500
D. MAKAI RESIDENTIAL				**Subtotal:**	**1,698**
1	Residential	3.1		52	208
2	Residential	3.9		64	256
3	Residential	3.2		53	212
4	Residential	1.9		31	124
5	Residential	2.5		42	168
6	Residential	3.0		50	200
7	Residential	3.5		58	232
				Subtotal:	**1,400**

TABLE A-2
MAUI RESEARCH AND TECHNOLOGY PARK MASTER PLAN
TOTAL PER CAPITA TABULATION

		Parcel Area (Acres)	Unit Area (Sq. Ft.)	Dwelling Units	Employees
E. RESIDENTIAL AND KNOWLEDGE INDUSTRY EXPANSION					
1	Residential	1.3		18	72
2	Residential	2.1		30	120
3	Residential	1.4		19	76
4	Residential	1.7		24	96
5	Residential	1.7		23	92
6	Residential	1.8		25	100
7	Residential	1.5		20	80
9	Residential	1.1		15	60
10	Residential	2.9		41	164
11	Residential	1.9		27	108
12	Residential	3.4		47	188
14	Residential	2.5		35	140
15	Residential	1.9		27	108
17	Residential	1.7		24	96
18	Residential	2.5		34	136
19	Residential	1.6		23	92
20	Residential	1.8		25	100
21	Residential	1.7		22	88
22	Employment	4.1			180
22b	Employment -Reserve	2.2			0
23	Employment	4.6			200
23b	Employment - Reserve	2.5			0
24	Employment	6.0			260
24b	Employment - Reserve	3.3			0
27	Employment	11.8			510
				Subtotal:	**3,066**
				Total Per Capita:	**10,354**
				Total Per Capita for Phase I:	**5,548**
				Total Per Capita for Phase 2:	**4,806**

NOTES:
1. PHASE 1 INCLUDES A-EMPLOYMENT CORE, C-VILLAGE CENTER, AND D-MAKAI RESIDENTIAL
2. PHASE 2 INCLUDES B-KNOWLEDGE INDUSTRY EXPANSION/CAMPUS AND E-OPTION LAND

APPENDIX B

Water Demand Calculations

APPENDIX B-1

Honolulu Board of Water Supply Dual System
Water Use Criteria

Table 2

Summary of Water System Design Criteria

WATER USE CRITERIA

Land Use	Unit	All Potable System	Dual System			
			Average Water Use		Average Daily Demand	
			Potable	Non-Potable	Potable	Non-Potable
Residential						
Single Family	GPD/Unit	500	345	155	414	186
Multi-Family Low Rise	GPD/Unit	400	276	124	331	149
Multi-Family High Rise	GPD/Unit	300	207	93	248	112
Commercial	GPD/Acre	3,000	1,800	1,200	2,160	1,440
Resort	GPD/Unit	350	203	147	244	176
	GPD/Acre	4,000	2,320	1,680	2,784	2,016
Golf Course and Parks	GPD/Acre	4,000	600	3,400	720	4,080
School	GPD/Student	60	35	25	42	30
Industrial	GPD/Acre	4,000	1,184	2,816	1,421	3,379
Commercial/Industrial	GPD/1,000 Ft^2	100	60	40	72	48
Commercial/Residential	GPD/1,000 Ft^2	120	83	37	100	44

PIPELINE, STORAGE, AND WELL PUMP SIZING CRITERIA

1. Demand Factors

   a. AVERAGE DAY DEMAND. For land uses to be served by a dual system, a 1.2 factor is applied to the AVERAGE WATER USE rates to derive the AVERAGE DAY DEMAND. For land uses served only by the potable system, AVERAGE WATER USE and AVERAGE DAY DEMAND are identical.

   b. MAXIMUM DAY DEMAND = (1.5) AVERAGE DAY DEMAND.

   c. PEAK HOUR RATE = (3.0) AVERAGE DAY DEMAND

2. Fire protection can be met in either the potable or non-potable system subject to meeting all present fire protection standards.

3. Reservoir Size

   a. The potable reservoir volume shall be equivalent to MAXIMUM DAY DEMAND.

   b. The non-potable reservoir volume shall be equivalent to AVERAGE DAY DEMAND.

4. Potable and non-potable pipelines shall be sized for PEAK HOUR flowrates with a minimum residual pressure of 40 psi and maximum velocity in the main of 6 feet per second. Hydraulic analyses will utilize tank spillway elevations as the initial hydraulic grade line elevations. Pipelines providing fire protection shall also be sized for MAXIMUM DAY flow plus fire flow with a residual of 20 psi at the critical fire hydrant. Hydraulic analyses will use three-quarters full tank water surface elevations as initial hydraulic grade line elevations.

5. Well pumps for potable and non-potable systems shall provide MAXIMUM DAY in an operating time of 16 hours.

Source: Honolulu Board of Water Supply, 1984.

APPENDIX B-2

Potable and Non-Potable Water Demand Calculations

Table 1

Projections of Required Potable and Irrigation Supply for
Phase 1 of the Expansion of the Maui Research and Technology Park

Development Area	Land Use	Area		Number of Units	Potable		Non-Potable	
		Acres	Ft^2		Unit Use Rate (GPD / Unit)	Amount (GPD)	Unit Use Rate (GPD / Unit)	Amount (GPD)
Employment Core (Portion Not Supplied by DWS)	Employment	15.7	224,730	--	84 / 1000 Ft^2	18,877	56 / 1000 Ft^2	12,585
	Open Space (PI)	3.2	--	--	--	--	1700 / Ac.	5,440
	Roads	1.8	--	--	--	--	880 / Ac.	1,584
	Totals	20.7	224,730	0	--	18,877	--	19,609
Village Center	Hotel	2.1	60,000	150	203 / Unit	30,450	147 / Unit	22,050
	Mixed Use	8.9	109,200	--	84 / 1000 Ft^2	9,173	56 / 1000 Ft^2	6,115
	SF Residential	11.1	--	100	6000 / Unit	60,000	--	--
	MF Residential	9.9	--	300	386 / Unit	115,800	174 / Unit	52,200
	Civic	10.1	100,000	--	84 / 1000 Ft^2	8,400	56 / 1000 Ft^2	5,600
	Park	3.2	--	--	600 / Acre	1,920	3400 / Ac.	10,880
	Open Space (FI)	0.4	--	--	--	--	3400 / Ac.	1,360
	Open Space (PI)	0.75	--	--	--	--	1700 / Ac.	1,275
	Retention (PI)	1.9	--	--	--	--	1700 / Ac.	3,230
	Roads	13.8	--	--	--	--	880 / Ac.	12,144
	Totals	62.15	269,200	550	--	225,743	--	114,854
Makai Residential	SF Residential	21.0	--	350	600 / Unit	210,000	--	--
	Park	2.1	--	--	600 / Acre	1,260	3400 / Ac.	7,140
	Open Space (FI)	0.2	--	--	--	--	3400 / Ac.	680
	Open Space (PI)	4.8	--	--	--	--	1700 / Ac.	8,160
	Roads	11.0	--	--	--	--	880 / Ac.	9,680
	Totals	39.1	0	350	--	211,260	--	25,660
Drainage Retention	Open Space (PI)	5.5	--	--	--	--	1700 / Ac.	9,350
	Roads	0.32	--	--	--	--	880 / Ac.	282
	Totals	5.82	0	0				9,632
Totals for Phase 1		127.8	493,930	900		455,880		169,755

Source:
Tom Nance Water Resource Engineering, "Evaluation of Source Supply Alternatives for the Planned Expansion of the Maui Research and Technology Park," March 1, 2012.

Table 2

Projections of Required Potable and Irrigation Supply for
Phase 2 of the Expansion of the Maui Research and Technology Park

Development Area	Land Use	Area		Number of Units	Potable		Non-Potable	
		Acres	Ft^2		Unit Use Rate (GPD / Unit)	Amount (GPD)	Unit Use Rate (GPD / Unit)	Amount (GPD)
Knowledge Industry Expansion Campus	Employment	40.9	188,272	--	84 / 1000 Ft^2	15,815	56 / 1000 Ft^2	10,543
	Mixed Use / Flex	2.2	33,200	--	84 / 1000 Ft^2	2,789	56 / 1000 Ft^2	1,859
	Employment (Reserve)	11.4	--	--	1800 / Ac.	20,520	1200 / Ac.	13,680
	Park	1.6	--	--	600 / Ac.	960	3400 / Ac.	5,440
	Traffic Circle (FI)	0.2	--	--	--	--	3400 / Ac.	680
	Open Space (PI)	12.1	--	--	--	--	1700 / Ac.	20,570
	Roads	7.6	--	--	--	--	880 / Ac.	6,688
	Totals	76.0	221,472	0	--	40,084	--	59,460
Option Land	SF Residential	28.6	--	300	600 / Unit	180,000	--	--
	MF Residential	5.9	--	179	386 / Unit	69,094	174 / Unit	31,146
	Employment	26.5	403,718	--	84 / 1000 Ft^2	33,867	56 / 1000 Ft^2	22,578
	Employment (Reserve)	8.0	--	--	1800 / Ac.	14,400	1200 / Ac.	9,600
	Parks	7.9	--	--	600 / Ac.	4,740	3400 / Ac.	26,860
	Traffic Circle (FI)	0.2	--	--	--	--	3400 / Ac.	680
	Open Space (PI)	18.9	--	--	--	--	1700 / Ac.	32,130
	Roads	24.0	--	--	--	--	880 / Ac.	21,120
	Totals	120.0	403,718	479	--	302,101	--	144,114
Totals for Phase 2		196.0	625,190	479		342,185		203,574

Source:
Tom Nance Water Resource Engineering, "Evaluation of Source Supply Alternatives for the Planned Expansion of the Maui Research and Technology Park," March 1, 2012.

APPENDIX C
Drainage Calculations

Hydrologic Calculations

Offsite:

The hydrologic calculations for drainage areas larger than 100 acres are based on the hydrograph method developed by the U.S. Department of Agriculture Natural Resources Conservation Service (NRCS)[1] and described in the "SCS National Engineering Handbook, Section 4, Hydrology (NEH-4)". Calculations were carried out using the "SCS Computer Program for Project Formulation, Hydrology (TR-20)", which utilizes the computational procedure described in NEH-4.

The curve numbers (CN) used in the hydrologic calculations were derived from USDA soil series and hydrologic group information and existing and proposed land uses for the relevant study area as recommended by USDA-NRCS in its publications entitled "Erosion and Sediment Control Guide for Hawaii"[2] and "Urban Hydrology for Small Watersheds"[3]. Weighted curve numbers were computed whenever a study area possessed a non-homogeneous mix of characteristics.

Concentration times used in hydrologic calculations were derived using the Curve Number (Lag) Method described in NEH-4.

100 yr.-24 hr. rainfall was obtained from Figure 56 in the Rainfall Frequency Atlas of the

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[1]Formerly known as the USDA Soil Conservation Service (SCS)

[2]United States Department of Agriculture, Soil Conservation Service, Erosion and Sediment Control, March 1981.

[3]United States Department of Agriculture, Soil Conservation Service, Urban Hydrology for Small Watersheds, June 1986.

Hawaiian Islands.[4] A 100 yr.-24 hr. rainfall of 10 inches was used for offsite drainage area computations.

Onsite:

According to the "Rules for the Design of Storm Drainage Facilities in the County of Maui,"[5] the runoff quantity for drainage areas of 100 acres or less is calculated using the Rational Method. The design storm is a 50-year recurrence interval, 1-hour duration storm and the precipitation is 2.3 inches.

Rational Formula:

$$Q = C \cdot I \cdot A$$

where, Q = *rate of flow* (cubic feet per second)

C = *runoff coefficient*

I = *rainfall intensity* (inches per hour)

A = *area* (acres)

[4]U.S. Weather Bureau, U.S. Department of Commerce, Rainfall Frequency Atlas of the Hawaiian Islands, Washington D.C.: U.S. Government Printing Office, 1962.

[5]County of Maui, Department of Public Works and Waste Management, "Rules for the Design of Storm Drainage Facilities in the County of Maui," November 2, 1995.

APPENDIX C-1

Offsite Surface Runoff (100-yr./24-hr.)

MASTER DESIGN STORM SUMMARY

Network Storm Collection: MyCounty

Return Event	Total Depth in	Rainfall Type	RNF ID
Pre100	10.0000	Synthetic Curve	TypeI 24hr

MASTER NETWORK SUMMARY
SCS Unit Hydrograph Method

(*Node=Outfall; +Node=Diversion;)
(Trun= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left&Rt)

Node ID	Type	Return Event	HYG Vol ac-ft	Trun	Qpeak hrs	Qpeak cfs	Max WSEL ft	Max Pond Storage ac-ft
10A-RB	AREA	100	61.349		10.3500	266.45		
11RB	AREA	100	35.822		10.0500	243.20		
13RB	AREA	100	16.194		10.0000	127.48		
14RB	AREA	100	131.396		10.5500	459.94		
14RC	AREA	100	7.232		10.0000	59.88		
15RB	AREA	100	79.150		10.3500	332.73		
15RC	AREA	100	1.679		9.9500	15.01		
16RB	AREA	100	31.091		10.0500	227.22		
17-R	AREA	100	3.720		10.0000	30.59		
*OUT 10	JCT	100	367.633		10.1000	1317.53		
POND 10 IN	POND	100	367.633		10.1000	1317.53		

MASTER NETWORK SUMMARY
SCS Unit Hydrograph Method

(*Node=Outfall; +Node=Diversion;)
(Trun= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left&Rt)

Node ID	Type	Return Event	HYG Vol ac-ft	Trun	Qpeak hrs	Qpeak cfs	Max WSEL ft	Max Pond Storage ac-ft
POND 10	OUT	POND	100	367.633	--	10.1000	1317.53	

APPENDIX C-2

Pre-Development Onsite Surface Runoff (50-yr./1-hr.)

Warren S. Unemori Engineering, Inc.
Civil & Structural Engineers · Land Surveyors
Wells Street Professional Center
2145 Wells Street, Suite 403
Wailuku, Maui, HI 96793

HYDROLOGIC CALCULATIONS - Surface Runoff

Project Name: Maui Research & Technology Park
Project No.: 08028
Engineer: Derek T. Ono
Date: 3/29/11

Area

Description: Pre-development onsite discharge [1]

Area (A):	30.52	acres
Impervious Area:	0.00	acres

Runoff Coefficient

Infiltration:	[Medium]	→	0.07
Relief:	[Flat]	→	0
Vegetal Cover:	[Good]	→	0.03
Development:	[Agricultural]	→	0.15
		Composite Runoff Coefficient:	0.25
		Impervious Runoff Coefficient:	0.95
		Weighted Runoff Coefficient (C):	0.25

Time of Concentration

Runoff Length:	880	ft.
Average Slope:	4.1	%
Time of Concentration (T_c):	20	minutes

Intensity

Project Location:	Kihei, Maui, Hawaii
Design Storm:	50-year recurrence interval, 1-hour duration
Rainfall Depth:	2.3 in.
Intensity (I):	3.80 in./hr.

Flow Rate

$Q = C \cdot I \cdot A$

$= 29.0$ $ft.^3/sec.$

Warren S. Unemori Engineering, Inc.
Civil & Structural Engineers · Land Surveyors
Wells Street Professional Center
2145 Wells Street, Suite 403
Wailuku, Maui, HI 96793

HYDROLOGIC CALCULATIONS - Surface Runoff

Project Name: Maui Research & Technology Park
Project No.: 08028
Engineer: Derek T. Ono
Date: 3/29/11

Area

Description: Pre-development onsite discharge [2]

Area (A):	85.22	acres
Impervious Area:	0.00	acres

Runoff Coefficient

Infiltration:	[Medium]	→	0.07
Relief:	[Flat]	→	0
Vegetal Cover:	[Good]	→	0.03
Development:	[Agricultural]	→	0.15
	Composite Runoff Coefficient:		0.25
	Impervious Runoff Coefficient:		0.95
	Weighted Runoff Coefficient (C):		0.25

Time of Concentration

Runoff Length:	2000	ft.
Average Slope:	3.0	%
Time of Concentration (T_c):	29	minutes

Intensity

Project Location:	Kihei, Maui, Hawaii
Design Storm:	50-year recurrence interval, 1-hour duration
Rainfall Depth:	2.3 in.
Intensity (I):	3.31 in./hr.

Flow Rate

$Q = C \cdot I \cdot A$

$= 70.5$ $ft.^3/sec.$

Warren S. Unemori Engineering, Inc.
Civil & Structural Engineers · Land Surveyors
Wells Street Professional Center
2145 Wells Street, Suite 403
Wailuku, Maui, HI 96793

HYDROLOGIC CALCULATIONS - Surface Runoff

Project Name: Maui Research & Technology Park
Project No.: 08028
Engineer: Derek T. Ono
Date: 3/29/11

Area

Description: Pre-development onsite discharge [3]

Area (A):	68.77	acres
Impervious Area:	0.00	acres

Runoff Coefficient

Infiltration:	[Medium]	→	0.07
Relief:	[Flat]	→	0
Vegetal Cover:	[Good]	→	0.03
Development:	[Agricultural]	→	0.15
	Composite Runoff Coefficient:		0.25
	Impervious Runoff Coefficient:		0.95
	Weighted Runoff Coefficient (C):		0.25

Time of Concentration

Runoff Length:	3267	ft.
Average Slope:	3.0	%
Time of Concentration (T_c):	34	minutes

Intensity

Project Location: Kihei, Maui, Hawaii
Design Storm: 50-year recurrence interval, 1-hour duration

Rainfall Depth:	2.3	in.
Intensity (I):	3.12	in./hr.

Flow Rate

$Q = C \cdot I \cdot A$

$= 53.6$ $ft.^3/sec.$

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Wells Street Professional Center
2145 Wells Street, Suite 403
Wailuku, Maui, HI 96793

HYDROLOGIC CALCULATIONS - Surface Runoff

Project Name: Maui Research & Technology Park
Project No.: 08028
Engineer: Derek T. Ono
Date: 5/2/11

Area

Description: Pre-development onsite discharge [4]

Area (A):	24.83	acres
Impervious Area:	0.74	acres
Commercial Area:	0.6	acres

Runoff Coefficient

Infiltration:	[Medium]	→	0.07
Relief:	[Flat]	→	0
Vegetal Cover:	[Good]	→	0.03
Development:	[Agricultural]	→	0.15
		Composite Runoff Coefficient:	0.25
		Impervious Runoff Coefficient:	0.95
		Commercial Runoff Coefficient:	0.80
		Weighted Runoff Coefficient (C):	0.28

Time of Concentration

Runoff Length:	2410	ft.
Average Slope:	2.7	%
Time of Concentration (T_c):	31	minutes

Intensity

Project Location:	Kihei, Maui, Hawaii
Design Storm:	50-year recurrence interval, 1-hour duration
Rainfall Depth:	2.3 in.
Intensity (I):	3.22 in./hr.

Flow Rate

$Q = C \cdot I \cdot A$

$= 22.7$ $ft.^3/sec.$

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Wailuku, Maui, HI 96793

HYDROLOGIC CALCULATIONS - Surface Runoff

Project Name: Maui Research & Technology Park
Project No.: 08028
Engineer: Derek T. Ono
Date: 5/2/11

Area

Description: Pre-development onsite discharge [5]

Area (A):	66.39	acres
Impervious Area:	7.32	acres
Commercial Area:	8.3	acres

Runoff Coefficient

Infiltration:	[Medium]	→	0.07
Relief:	[Flat]	→	0
Vegetal Cover:	[Good]	→	0.03
Development:	[Agricultural]	→	0.15
		Composite Runoff Coefficient:	0.25
		Impervious Runoff Coefficient:	0.95
		Commercial Runoff Coefficient:	0.80
		Weighted Runoff Coefficient (C):	0.40

Time of Concentration

Runoff Length:	2679	ft.
Average Slope:	2.4	%
Time of Concentration (T_c):	33.5	minutes

Intensity

Project Location: Kihei, Maui, Hawaii
Design Storm: 50-year recurrence interval, 1-hour duration

Rainfall Depth:	2.3	in.
Intensity (I):	3.14	in./hr.

Flow Rate

$Q = C \cdot I \cdot A$

$= 82.5$ $ft.^3/sec.$

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Civil & Structural Engineers · Land Surveyors
Wells Street Professional Center
2145 Wells Street, Suite 403
Wailuku, Maui, HI 96793

HYDROLOGIC CALCULATIONS - Surface Runoff

Project Name: Maui Research & Technology Park
Project No.: 08028
Engineer: Derek T. Ono
Date: 5/2/11

Area

Description: Pre-development onsite discharge [6]

Area (A):	45.07	acres
Impervious Area:	1.40	acres
Commercial Area:	6.81	acres

Runoff Coefficient

Infiltration:	[Medium]	→	0.07
Relief:	[Flat]	→	0
Vegetal Cover:	[Good]	→	0.03
Development:	[Agricultural]	→	0.15
		Composite Runoff Coefficient:	0.25
		Impervious Runoff Coefficient:	0.95
		Commercial Runoff Coefficient:	0.80
		Weighted Runoff Coefficient (C):	0.35

Time of Concentration

Runoff Length:	2340	ft.
Average Slope:	3.8	%
Time of Concentration (T_c):	29	minutes

Intensity

Project Location: Kihei, Maui, Hawaii
Design Storm: 50-year recurrence interval, 1-hour duration

Rainfall Depth:	2.3	in.
Intensity (I):	3.31	in./hr.

Flow Rate

$Q = C \cdot I \cdot A$

$= 52.9$ $ft.^3/sec.$

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Wells Street Professional Center
2145 Wells Street, Suite 403
Wailuku, Maui, HI 96793

HYDROLOGIC CALCULATIONS - Surface Runoff

Project Name: Maui Research & Technology Park
Project No.: 08028
Engineer: Derek T. Ono
Date: 3/29/11

Area

Description: Pre-development onsite discharge [7]

Area (A):	40.48	acres
Impervious Area:	0.00	acres

Runoff Coefficient

Infiltration:	[Medium]	→	0.07
Relief:	[Flat]	→	0
Vegetal Cover:	[Good]	→	0.03
Development:	[Agricultural]	→	0.15
	Composite Runoff Coefficient:		0.25
	Impervious Runoff Coefficient:		0.95
	Weighted Runoff Coefficient (C):		0.25

Time of Concentration

Runoff Length:	2497	ft.
Average Slope:	3.0	%
Time of Concentration (T_c):	30.5	minutes

Intensity

Project Location: Kihei, Maui, Hawaii
Design Storm: 50-year recurrence interval, 1-hour duration

Rainfall Depth:	2.3	in.
Intensity (I):	3.23	in./hr.

Flow Rate

$Q = C \cdot I \cdot A$

$= 32.7$ ft.^{3}/sec.

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Wells Street Professional Center
2145 Wells Street, Suite 403
Wailuku, Maui, HI 96793

HYDROLOGIC CALCULATIONS - Surface Runoff

Project Name: Maui Research & Technology Park
Project No.: 08028
Engineer: Derek T. Ono
Date: 3/29/11

Area

Description: Pre-development onsite discharge [8]

Area (A):	32.53	acres
Impervious Area:	0.00	acres

Runoff Coefficient

Infiltration:	[Medium]	→	0.07
Relief:	[Flat]	→	0
Vegetal Cover:	[Good]	→	0.03
Development:	[Agricultural]	→	0.15
	Composite Runoff Coefficient:		0.25
	Impervious Runoff Coefficient:		0.95
	Weighted Runoff Coefficient (C):		0.25

Time of Concentration

Runoff Length:	2104	ft.
Average Slope:	4.1	%
Time of Concentration (T_c):	28	minutes

Intensity

Project Location: Kihei, Maui, Hawaii
Design Storm: 50-year recurrence interval, 1-hour duration

Rainfall Depth:	2.3	in.
Intensity (I):	3.36	in./hr.

Flow Rate

$Q = C \cdot I \cdot A$

$= 27.3$ ft.^{3}/sec.

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2145 Wells Street, Suite 403
Wailuku, Maui, HI 96793

HYDROLOGIC CALCULATIONS - Surface Runoff

Project Name: Maui Research & Technology Park
Project No.: 08028
Engineer: Derek T. Ono
Date: 3/29/11

Area

Description: Pre-development onsite discharge [9]

Area (A):	5.75	acres
Impervious Area:	0.00	acres

Runoff Coefficient

Infiltration:	[Medium]	→	0.07
Relief:	[Rolling]	→	0.03
Vegetal Cover:	[Good]	→	0.03
Development:	[Agricultural]	→	0.15
		Composite Runoff Coefficient:	0.28
		Impervious Runoff Coefficient:	0.95
		Weighted Runoff Coefficient (C):	0.25

Time of Concentration

Runoff Length:	659	ft.
Average Slope:	5.6	%
Time of Concentration (T_c):	16.5	minutes

Intensity

Project Location: Kihei, Maui, Hawaii
Design Storm: 50-year recurrence interval, 1-hour duration

Rainfall Depth:	2.3	in.
Intensity (I):	4.13	in./hr.

Flow Rate

$Q = C \cdot I \cdot A$

$= 5.9$ $ft.^3/sec.$

APPENDIX C-3

Post-Development Onsite Surface Runoff (50-yr./1-hr.)

Warren S. Unemori Engineering, Inc.
Civil & Structural Engineers · Land Surveyors
Wells Street Professional Center
2145 Wells Street, Suite 403
Wailuku, Maui, HI 96793

HYDROLOGIC CALCULATIONS - Surface Runoff

Project Name: Maui Research & Technology Park
Project No.: 08028
Engineer: Derek T. Ono
Date: 3/29/11

Area

Description: Post-development onsite discharge [1]

Area (A): 30.52 acres

Runoff Coefficient

Weighted Runoff Coefficient (C): 0.55

Time of Concentration

Runoff Length: 880 ft.
Average Slope: 4.1 %
Time of Concentration (T_c): 20 minutes

Intensity

Project Location: Kihei, Maui, Hawaii
Design Storm: 50-year recurrence interval, 1-hour duration
Rainfall Depth: 2.3 in.
Intensity (I): 3.80 in./hr.

Flow Rate

$Q = C \cdot I \cdot A$

$= 63.8$ $ft.^3/sec.$

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Wells Street Professional Center
2145 Wells Street, Suite 403
Wailuku, Maui, HI 96793

HYDROLOGIC CALCULATIONS - Surface Runoff

Project Name: Maui Research & Technology Park
Project No.: 08028
Engineer: Derek T. Ono
Date: 3/29/11

Area

Description: Post-development onsite discharge [2]

Area (A): 85.22 acres

Runoff Coefficient

Weighted Runoff Coefficient (C): 0.55

Time of Concentration

Runoff Length: 2000 ft.
Average Slope: 3.0 %
Time of Concentration (T_c): 29 minutes

Intensity

Project Location: Kihei, Maui, Hawaii
Design Storm: 50-year recurrence interval, 1-hour duration
Rainfall Depth: 2.3 in.
Intensity (I): 3.31 in./hr.

Flow Rate

$Q = C \cdot I \cdot A$

$= 155.1 \text{ ft.}^3/\text{sec.}$

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Wells Street Professional Center
2145 Wells Street, Suite 403
Wailuku, Maui, HI 96793

HYDROLOGIC CALCULATIONS - Surface Runoff

Project Name: Maui Research & Technology Park
Project No.: 08028
Engineer: Derek T. Ono
Date: 5/2/11

Area

Description: Post-development onsite discharge [3]

Area (A):	68.77	acres
Impervious Area:	10.94	acres
Commercial Area:	46.45	acres

Runoff Coefficient

Infiltration:	[Medium]	→	0.07
Relief:	[Flat]	→	0
Vegetal Cover:	[Good]	→	0.03
Development:	[Agricultural]	→	0.15
		Composite Runoff Coefficient:	0.25
		Impervious Runoff Coefficient:	0.95
		Commercial Runoff Coefficient:	0.80
		Weighted Runoff Coefficient (C):	0.73

Time of Concentration

Runoff Length:	3267	ft.
Average Slope:	3.0	%
Time of Concentration (T_c):	34	minutes

Intensity

Project Location: Kihei, Maui, Hawaii
Design Storm: 50-year recurrence interval, 1-hour duration

Rainfall Depth:	2.3	in.
Intensity (I):	3.12	in./hr.

Flow Rate

$Q = C \cdot I \cdot A$

$= 157.2$ ft.^{3}/sec.

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Wells Street Professional Center
2145 Wells Street, Suite 403
Wailuku, Maui, HI 96793

HYDROLOGIC CALCULATIONS - Surface Runoff

Project Name: Maui Research & Technology Park
Project No.: 08028
Engineer: Derek T. Ono
Date: 5/2/11

Area

Description: Post-development onsite discharge [4]

Area (A):	24.83	acres
Impervious Area:	3.34	acres
Commercial Area:	20.04	acres

Runoff Coefficient

Infiltration:	[Medium]	→	0.07
Relief:	[Flat]	→	0
Vegetal Cover:	[Good]	→	0.03
Development:	[Agricultural]	→	0.15
		Composite Runoff Coefficient:	0.25
		Impervious Runoff Coefficient:	0.95
		Commercial Runoff Coefficient:	0.80
		Weighted Runoff Coefficient (C):	0.79

Time of Concentration

Runoff Length:	2410	ft.
Average Slope:	2.7	%
Time of Concentration (T_c):	31	minutes

Intensity

Project Location: Kihei, Maui, Hawaii
Design Storm: 50-year recurrence interval, 1-hour duration

Rainfall Depth:	2.3	in.
Intensity (I):	3.22	in./hr.

Flow Rate

$Q = C \cdot I \cdot A$

$= 63.0$ ft.^{3}/sec.

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Wailuku, Maui, HI 96793

HYDROLOGIC CALCULATIONS - Surface Runoff

Project Name: Maui Research & Technology Park
Project No.: 08028
Engineer: Derek T. Ono
Date: 5/2/11

Area

Description: Post-development onsite discharge [5]

Area (A):	66.39	acres
Impervious Area:	9.69	acres
Commercial Area:	55.40	acres

Runoff Coefficient

Infiltration:	[Medium]	→	0.07
Relief:	[Flat]	→	0
Vegetal Cover:	[Good]	→	0.03
Development:	[Agricultural]	→	0.15
		Composite Runoff Coefficient:	0.25
		Impervious Runoff Coefficient:	0.95
		Commercial Runoff Coefficient:	0.80
		Weighted Runoff Coefficient (C):	0.81

Time of Concentration

Runoff Length:	2679	ft.
Average Slope:	2.4	%
Time of Concentration (T_c):	33.5	minutes

Intensity

Project Location: Kihei, Maui, Hawaii
Design Storm: 50-year recurrence interval, 1-hour duration

Rainfall Depth:	2.3	in.
Intensity (I):	3.14	in./hr.

Flow Rate

$Q = C \cdot I \cdot A$

$= 169.1$ ft.^{3}/sec.

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2145 Wells Street, Suite 403
Wailuku, Maui, HI 96793

HYDROLOGIC CALCULATIONS - Surface Runoff

Project Name: Maui Research & Technology Park
Project No.: 08028
Engineer: Derek T. Ono
Date: 5/2/11

Area

Description: Post-development onsite discharge [6]

Area (A):	45.07	acres
Impervious Area:	3.36	acres
Commercial Area:	34.27	acres

Runoff Coefficient

Infiltration:	[Medium]	→	0.07
Relief:	[Flat]	→	0
Vegetal Cover:	[Good]	→	0.03
Development:	[Agricultural]	→	0.15
		Composite Runoff Coefficient:	0.25
		Impervious Runoff Coefficient:	0.95
		Commercial Runoff Coefficient:	0.80
		Weighted Runoff Coefficient (C):	0.72

Time of Concentration

Runoff Length:	2340	ft.
Average Slope:	3.8	%
Time of Concentration (T_c):	29	minutes

Intensity

Project Location: Kihei, Maui, Hawaii
Design Storm: 50-year recurrence interval, 1-hour duration

Rainfall Depth:	2.3	in.
Intensity (I):	3.31	in./hr.

Flow Rate

$Q = C \cdot I \cdot A$

$= 107.5$ ft.^{3}/sec.

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2145 Wells Street, Suite 403
Wailuku, Maui, HI 96793

HYDROLOGIC CALCULATIONS - Surface Runoff

Project Name: Maui Research & Technology Park
Project No.: 08028
Engineer: Derek T. Ono
Date: 5/2/11

Area

Description: Post-development onsite discharge [7]

Area (A):	40.48	acres
Impervious Area:	3.34	acres
Commercial Area:	34.30	acres

Runoff Coefficient

Infiltration:	[Medium]	→	0.07
Relief:	[Flat]	→	0
Vegetal Cover:	[Good]	→	0.03
Development:	[Agricultural]	→	0.15
		Composite Runoff Coefficient:	0.25
		Impervious Runoff Coefficient:	0.95
		Commercial Runoff Coefficient:	0.80
		Weighted Runoff Coefficient (C):	0.77

Time of Concentration

Runoff Length:	2497	ft.
Average Slope:	3.0	%
Time of Concentration (T_c):	30.5	minutes

Intensity

Project Location:	Kihei, Maui, Hawaii
Design Storm:	50-year recurrence interval, 1-hour duration
Rainfall Depth:	2.3 in.
Intensity (I):	3.23 in./hr.

Flow Rate

$Q = C \cdot I \cdot A$

$= 101.2$ $ft.^3/sec.$

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Wailuku, Maui, HI 96793

HYDROLOGIC CALCULATIONS - Surface Runoff

Project Name: Maui Research & Technology Park
Project No.: 08028
Engineer: Derek T. Ono
Date: 5/2/11

Area

Description: Post-development onsite discharge [8]

Area (A):	32.53	acres
Impervious Area:	1.29	acres
Commercial Area:	28.74	acres

Runoff Coefficient

Infiltration:	[Medium]	→	0.07
Relief:	[Flat]	→	0
Vegetal Cover:	[Good]	→	0.03
Development:	[Agricultural]	→	0.15
		Composite Runoff Coefficient:	0.25
		Impervious Runoff Coefficient:	0.95
		Commercial Runoff Coefficient:	0.80
		Weighted Runoff Coefficient (C):	0.76

Time of Concentration

Runoff Length:	2104	ft.
Average Slope:	4.1	%
Time of Concentration (T_c):	28	minutes

Intensity

Project Location:	Kihei, Maui, Hawaii
Design Storm:	50-year recurrence interval, 1-hour duration
Rainfall Depth:	2.3 in.
Intensity (I):	3.36 in./hr.

Flow Rate

$Q = C \cdot I \cdot A$

$= 83.5$ $ft.^3/sec.$

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Wells Street Professional Center
2145 Wells Street, Suite 403
Wailuku, Maui, HI 96793

HYDROLOGIC CALCULATIONS - Surface Runoff

Project Name: Maui Research & Technology Park
Project No.: 08028
Engineer: Derek T. Ono
Date: 5/2/11

Area

Description: Post-development onsite discharge [9]

Area (A):	5.75	acres
Impervious Area:	0.21	acres
Commercial Area:	5.39	acres

Runoff Coefficient

Infiltration:	[Medium]	→	0.07
Relief:	[Rolling]	→	0.03
Vegetal Cover:	[Good]	→	0.03
Development:	[Agricultural]	→	0.15
		Composite Runoff Coefficient:	0.28
		Impervious Runoff Coefficient:	0.95
		Commercial Runoff Coefficient:	0.80
		Weighted Runoff Coefficient (C):	0.79

Time of Concentration

Runoff Length:	659	ft.
Average Slope:	5.6	%
Time of Concentration (T_c):	16.5	minutes

Intensity

Project Location:	Kihei, Maui, Hawaii
Design Storm:	50-year recurrence interval, 1-hour duration
Rainfall Depth:	2.3 in.
Intensity (I):	4.13 in./hr.

Flow Rate

$Q = C \cdot I \cdot A$

$= 18.8$ $ft.^3/sec.$

APPENDIX C-4

Post-Development Onsite Surface Runoff
Impact of Roadways and Residential Areas (50-yr./1-hr.)

Warren S. Unemori Engineering, Inc.
Civil & Structural Engineers · Land Surveyors
Wells Street Professional Center
2145 Wells Street, Suite 403
Wailuku, Maui, HI 96793

HYDROLOGIC CALCULATIONS - Surface Runoff

Project Name: Maui Research & Technology Park
Project No.: 08028
Engineer: Derek T. Ono
Date: 3/29/11

Area

Description: Post-development onsite discharge [1]
(for roadways and residential areas)

Area (A): 30.52 acres

Runoff Coefficient

Weighted Runoff Coefficient (C): 0.55

Time of Concentration

Runoff Length: 880 ft.
Average Slope: 4.1 %
Time of Concentration (T_c): 20 minutes

Intensity

Project Location: Kihei, Maui, Hawaii
Design Storm: 50-year recurrence interval, 1-hour duration
Rainfall Depth: 2.3 in.
Intensity (I): 3.80 in./hr.

Flow Rate

$Q = C \cdot I \cdot A$
$= 63.8$ $ft.^3/sec.$

Warren S. Unemori Engineering, Inc.
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Wells Street Professional Center
2145 Wells Street, Suite 403
Wailuku, Maui, HI 96793

HYDROLOGIC CALCULATIONS - Surface Runoff

Project Name: Maui Research & Technology Park
Project No.: 08028
Engineer: Derek T. Ono
Date: 3/29/11

Area

Description: Post-development onsite discharge [2]
(for roadways and residential areas)

Area (A): 85.22 acres

Runoff Coefficient

Weighted Runoff Coefficient (C): 0.55

Time of Concentration

Runoff Length: 2000 ft.
Average Slope: 3.0 %
Time of Concentration (T_c): 29 minutes

Intensity

Project Location: Kihei, Maui, Hawaii
Design Storm: 50-year recurrence interval, 1-hour duration
Rainfall Depth: 2.3 in.
Intensity (I): 3.31 in./hr.

Flow Rate

$Q = C \cdot I \cdot A$

$= 155.1$ $ft.^3/sec.$

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HYDROLOGIC CALCULATIONS - Surface Runoff

Project Name: Maui Research & Technology Park
Project No.: 08028
Engineer: Derek T. Ono
Date: 5/2/11

Area

Description: Post-development onsite discharge [3]
(for roadways and residential areas)

Area (A):	68.77	acres
Impervious Area:	10.94	acres

Runoff Coefficient

Infiltration:	[Medium]	→	0.07
Relief:	[Flat]	→	0
Vegetal Cover:	[Good]	→	0.03
Development:	[Agricultural]	→	0.15
		Composite Runoff Coefficient:	0.25
		Impervious Runoff Coefficient:	0.95
		Weighted Runoff Coefficient (C):	0.38

Time of Concentration

Runoff Length:	3267	ft.
Average Slope:	3.0	%
Time of Concentration (T_c):	34	minutes

Intensity

Project Location: Kihei, Maui, Hawaii
Design Storm: 50-year recurrence interval, 1-hour duration

Rainfall Depth:	2.3	in.
Intensity (I):	3.12	in./hr.

Flow Rate

$Q = C \cdot I \cdot A$

$= 81.5$ $ft.^3/sec.$

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HYDROLOGIC CALCULATIONS - Surface Runoff

Project Name: Maui Research & Technology Park
Project No.: 08028
Engineer: Derek T. Ono
Date: 5/2/11

Area

Description: Post-development onsite discharge [4]
(for roadways and residential areas)

Area (A):	24.83	acres
Impervious Area:	3.34	acres

Runoff Coefficient

Infiltration:	[Medium]	→	0.07
Relief:	[Flat]	→	0
Vegetal Cover:	[Good]	→	0.03
Development:	[Agricultural]	→	0.15
		Composite Runoff Coefficient:	0.25
		Impervious Runoff Coefficient:	0.95
		Weighted Runoff Coefficient (C):	0.34

Time of Concentration

Runoff Length:	2410	ft.
Average Slope:	2.7	%
Time of Concentration (T_c):	31	minutes

Intensity

Project Location: Kihei, Maui, Hawaii
Design Storm: 50-year recurrence interval, 1-hour duration

Rainfall Depth:	2.3	in.
Intensity (I):	3.22	in./hr.

Flow Rate

$Q = C \cdot I \cdot A$

$= 27.5$ $ft.^3/sec.$

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HYDROLOGIC CALCULATIONS - Surface Runoff

Project Name: Maui Research & Technology Park
Project No.: 08028
Engineer: Derek T. Ono
Date: 5/2/11

Area

Description: Post-development onsite discharge [5]
(for roadways and residential areas)

Area (A):	66.39	acres
Impervious Area:	9.69	acres
Commercial Area:	8.30	acres

Runoff Coefficient

Infiltration:	[Medium]	→	0.07
Relief:	[Flat]	→	0
Vegetal Cover:	[Good]	→	0.03
Development:	[Agricultural]	→	0.15
		Composite Runoff Coefficient:	0.25
		Impervious Runoff Coefficient:	0.95
		Commercial Runoff Coefficient:	0.80
		Weighted Runoff Coefficient (C):	0.42

Time of Concentration

Runoff Length:	2679	ft.
Average Slope:	2.4	%
Time of Concentration (T_c):	33.5	minutes

Intensity

Project Location: Kihei, Maui, Hawaii
Design Storm: 50-year recurrence interval, 1-hour duration

Rainfall Depth:	2.3	in.
Intensity (I):	3.14	in./hr.

Flow Rate

$Q = C \cdot I \cdot A$

$= 87.7$ $ft.^3/sec.$

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HYDROLOGIC CALCULATIONS - Surface Runoff

Project Name: Maui Research & Technology Park
Project No.: 08028
Engineer: Derek T. Ono
Date: 5/2/11

Area

Description: Post-development onsite discharge [6]
(for roadways and residential areas)

Area (A):	45.07	acres
Impervious Area:	3.36	acres
Commercial Area:	6.81	acres

Runoff Coefficient

Infiltration:	[Medium]	→	0.07
Relief:	[Flat]	→	0
Vegetal Cover:	[Good]	→	0.03
Development:	[Agricultural]	→	0.15
		Composite Runoff Coefficient:	0.25
		Impervious Runoff Coefficient:	0.95
		Commercial Runoff Coefficient:	0.80
		Weighted Runoff Coefficient (C):	0.39

Time of Concentration

Runoff Length:	2340	ft.
Average Slope:	3.8	%
Time of Concentration (T_c):	29	minutes

Intensity

Project Location: Kihei, Maui, Hawaii
Design Storm: 50-year recurrence interval, 1-hour duration

Rainfall Depth:	2.3	in.
Intensity (I):	3.31	in./hr.

Flow Rate

$Q = C \cdot I \cdot A$

$= 57.5$ $ft.^3/sec.$

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HYDROLOGIC CALCULATIONS - Surface Runoff

Project Name: Maui Research & Technology Park
Project No.: 08028
Engineer: Derek T. Ono
Date: 5/2/11

Area

Description: Post-development onsite discharge [7]
(for roadways and residential areas)

Area (A):	40.48	acres
Impervious Area:	3.34	acres

Runoff Coefficient

Infiltration:	[Medium]	→	0.07
Relief:	[Flat]	→	0
Vegetal Cover:	[Good]	→	0.03
Development:	[Agricultural]	→	0.15
		Composite Runoff Coefficient:	0.25
		Impervious Runoff Coefficient:	0.95
		Weighted Runoff Coefficient (C):	0.31

Time of Concentration

Runoff Length:	2497	ft.
Average Slope:	3.0	%
Time of Concentration (T_c):	30.5	minutes

Intensity

Project Location: Kihei, Maui, Hawaii
Design Storm: 50-year recurrence interval, 1-hour duration

Rainfall Depth:	2.3	in.
Intensity (I):	3.23	in./hr.

Flow Rate

$Q = C \cdot I \cdot A$

$= 40.2$ $ft.^3/sec.$

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HYDROLOGIC CALCULATIONS - Surface Runoff

Project Name: Maui Research & Technology Park
Project No.: 08028
Engineer: Derek T. Ono
Date: 5/2/11

Area

Description: Post-development onsite discharge [8]
(for roadways and residential areas)

Area (A):	32.53	acres
Impervious Area:	1.29	acres

Runoff Coefficient

Infiltration:	[Medium]	→	0.07
Relief:	[Flat]	→	0
Vegetal Cover:	[Good]	→	0.03
Development:	[Agricultural]	→	0.15
		Composite Runoff Coefficient:	0.25
		Impervious Runoff Coefficient:	0.95
		Weighted Runoff Coefficient (C):	0.28

Time of Concentration

Runoff Length:	2104	ft.
Average Slope:	4.1	%
Time of Concentration (T_c):	28	minutes

Intensity

Project Location: Kihei, Maui, Hawaii
Design Storm: 50-year recurrence interval, 1-hour duration

Rainfall Depth:	2.3	in.
Intensity (I):	3.36	in./hr.

Flow Rate

$Q = C \cdot I \cdot A$

$= 30.4$ ft.^{3}/sec.

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HYDROLOGIC CALCULATIONS - Surface Runoff

Project Name: Maui Research & Technology Park
Project No.: 08028
Engineer: Derek T. Ono
Date: 5/2/11

Area

Description: Post-development onsite discharge [9]
(for roadways and residential areas)

Area (A):	5.75	acres
Impervious Area:	0.21	acres

Runoff Coefficient

Infiltration:	[Medium]	→	0.07
Relief:	[Rolling]	→	0.03
Vegetal Cover:	[Good]	→	0.03
Development:	[Agricultural]	→	0.15
		Composite Runoff Coefficient:	0.28
		Impervious Runoff Coefficient:	0.95
		Weighted Runoff Coefficient (C):	0.30

Time of Concentration

Runoff Length:	659	ft.
Average Slope:	5.6	%
Time of Concentration (T_c):	16.5	minutes

Intensity

Project Location: Kihei, Maui, Hawaii
Design Storm: 50-year recurrence interval, 1-hour duration

Rainfall Depth:	2.3	in.
Intensity (I):	4.13	in./hr.

Flow Rate

$Q = C \cdot I \cdot A$

$= 7.2$ $ft.^3/sec.$

APPENDIX C-5

Post-Development Onsite Surface Runoff
Impact of Commercial Areas (50-yr./1-hr.)

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HYDROLOGIC CALCULATIONS - Surface Runoff

Project Name: Maui Research & Technology Park
Project No.: 08028
Engineer: Derek T. Ono
Date: 3/29/11

Area

Description: Post-development onsite discharge [1]
(for commercial areas)

Area (A): 30.52 acres

Runoff Coefficient

Infiltration:	[Medium]	→	0.07
Relief:	[Flat]	→	0
Vegetal Cover:	[Good]	→	0.03
Development:	[Agricultural]	→	0.15
	Composite Runoff Coefficient:		0.25
	Weighted Runoff Coefficient (C):		0.25

Time of Concentration

Runoff Length: 880 ft.
Average Slope: 4.1 %
Time of Concentration (T_c): 20 minutes

Intensity

Project Location: Kihei, Maui, Hawaii
Design Storm: 50-year recurrence interval, 1-hour duration
Rainfall Depth: 2.3 in.
Intensity (I): 3.80 in./hr.

Flow Rate

$Q = C \cdot I \cdot A$
$= 29.0$ $ft.^3/sec.$

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HYDROLOGIC CALCULATIONS - Surface Runoff

Project Name: Maui Research & Technology Park
Project No.: 08028
Engineer: Derek T. Ono
Date: 3/29/11

Area

Description: Post-development onsite discharge [2]
(for commercial areas)

Area (A): 85.22 acres

Runoff Coefficient

Infiltration:	[Medium]	→	0.07
Relief:	[Flat]	→	0
Vegetal Cover:	[Good]	→	0.03
Development:	[Agricultural]	→	0.15
	Composite Runoff Coefficient:		0.25
	Weighted Runoff Coefficient (C):		0.25

Time of Concentration

Runoff Length: 2000 ft.
Average Slope: 3.0 %
Time of Concentration (T_c): 29 minutes

Intensity

Project Location: Kihei, Maui, Hawaii
Design Storm: 50-year recurrence interval, 1-hour duration
Rainfall Depth: 2.3 in.
Intensity (I): 3.31 in./hr.

Flow Rate

$Q = C \cdot I \cdot A$
$= 70.5 \text{ ft.}^3/\text{sec.}$

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HYDROLOGIC CALCULATIONS - Surface Runoff

Project Name: Maui Research & Technology Park
Project No.: 08028
Engineer: Derek T. Ono
Date: 5/2/11

Area

Description: Post-development onsite discharge [3]
(for commercial areas)

Area (A):	68.77	acres
Commercial Area:	46.45	acres

Runoff Coefficient

Infiltration:	[Medium]	→	0.07
Relief:	[Flat]	→	0
Vegetal Cover:	[Good]	→	0.03
Development:	[Agricultural]	→	0.15
		Composite Runoff Coefficient:	0.25
		Commercial Runoff Coefficient:	0.80
		Weighted Runoff Coefficient (C):	0.60

Time of Concentration

Runoff Length:	3267	ft.
Average Slope:	3.0	%
Time of Concentration (T_c):	34	minutes

Intensity

Project Location:	Kihei, Maui, Hawaii
Design Storm:	50-year recurrence interval, 1-hour duration
Rainfall Depth:	2.3 in.
Intensity (I):	3.12 in./hr.

Flow Rate

$Q = C \cdot I \cdot A$

$= 128.7$ $ft.^3/sec.$

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HYDROLOGIC CALCULATIONS - Surface Runoff

Project Name: Maui Research & Technology Park
Project No.: 08028
Engineer: Derek T. Ono
Date: 5/2/11

Area

Description: Post-development onsite discharge [4]
(for commercial areas)

Area (A):	24.83	acres
Impervious Area:	0.74	acres
Commercial Area:	20.04	acres

Runoff Coefficient

Infiltration:	[Medium]	→	0.07
Relief:	[Flat]	→	0
Vegetal Cover:	[Good]	→	0.03
Development:	[Agricultural]	→	0.15
		Composite Runoff Coefficient:	0.25
		Impervious Runoff Coefficient:	0.95
		Commercial Runoff Coefficient:	0.80
		Weighted Runoff Coefficient (C):	0.71

Time of Concentration

Runoff Length:	2410	ft.
Average Slope:	2.7	%
Time of Concentration (T_c):	31	minutes

Intensity

Project Location: Kihei, Maui, Hawaii
Design Storm: 50-year recurrence interval, 1-hour duration

Rainfall Depth:	2.3	in.
Intensity (I):	3.22	in./hr.

Flow Rate

$Q = C \cdot I \cdot A$

$= 57.1$ $ft.^3/sec.$

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HYDROLOGIC CALCULATIONS - Surface Runoff

Project Name: Maui Research & Technology Park
Project No.: 08028
Engineer: Derek T. Ono
Date: 5/2/11

Area

Description: Post-development onsite discharge [5]
(for commercial areas)

Area (A):	66.39	acres
Impervious Area:	7.32	acres
Commercial Area:	55.40	acres

Runoff Coefficient

Infiltration:	[Medium]	→	0.07
Relief:	[Flat]	→	0
Vegetal Cover:	[Good]	→	0.03
Development:	[Agricultural]	→	0.15
	Composite Runoff Coefficient:		0.25
	Impervious Runoff Coefficient:		0.95
	Commercial Runoff Coefficient:		0.80
	Weighted Runoff Coefficient (C):		0.79

Time of Concentration

Runoff Length:	2679	ft.
Average Slope:	2.4	%
Time of Concentration (T_c):	33.5	minutes

Intensity

Project Location:	Kihei, Maui, Hawaii
Design Storm:	50-year recurrence interval, 1-hour duration
Rainfall Depth:	2.3 in.
Intensity (I):	3.14 in./hr.

Flow Rate

$Q = C \cdot I \cdot A$

$= 163.9$ $ft.^3/sec.$

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HYDROLOGIC CALCULATIONS - Surface Runoff

Project Name: Maui Research & Technology Park
Project No.: 08028
Engineer: Derek T. Ono
Date: 5/2/11

Area

Description: Post-development onsite discharge [6]
(for commercial areas)

Area (A):	45.07	acres
Impervious Area:	1.40	acres
Commercial Area:	34.27	acres

Runoff Coefficient

Infiltration:	[Medium]	→	0.07
Relief:	[Flat]	→	0
Vegetal Cover:	[Good]	→	0.03
Development:	[Agricultural]	→	0.15
		Composite Runoff Coefficient:	0.25
		Impervious Runoff Coefficient:	0.95
		Commercial Runoff Coefficient:	0.80
		Weighted Runoff Coefficient (C):	0.69

Time of Concentration

Runoff Length:	2340	ft.
Average Slope:	3.8	%
Time of Concentration (T_c):	29	minutes

Intensity

Project Location: Kihei, Maui, Hawaii
Design Storm: 50-year recurrence interval, 1-hour duration

Rainfall Depth:	2.3	in.
Intensity (I):	3.31	in./hr.

Flow Rate

$Q = C \cdot I \cdot A$

$= 102.9$ ft.^{3}/sec.

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HYDROLOGIC CALCULATIONS - Surface Runoff

Project Name: Maui Research & Technology Park
Project No.: 08028
Engineer: Derek T. Ono
Date: 5/2/11

Area

Description: Post-development onsite discharge [7]
(for commercial areas)

Area (A):	40.48	acres
Commercial Area:	34.30	acres

Runoff Coefficient

Infiltration:	[Medium]	→	0.07
Relief:	[Flat]	→	0
Vegetal Cover:	[Good]	→	0.03
Development:	[Agricultural]	→	0.15
	Composite Runoff Coefficient:		0.25
	Commercial Runoff Coefficient:		0.80
	Weighted Runoff Coefficient (C):		0.72

Time of Concentration

Runoff Length:	2497	ft.
Average Slope:	3.0	%
Time of Concentration (T_c):	30.5	minutes

Intensity

Project Location:	Kihei, Maui, Hawaii	
Design Storm:	50-year recurrence interval, 1-hour duration	
Rainfall Depth:	2.3	in.
Intensity (I):	3.23	in./hr.

Flow Rate

$Q = C \cdot I \cdot A$

$= 93.6$ $ft.^3/sec.$

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HYDROLOGIC CALCULATIONS - Surface Runoff

Project Name: Maui Research & Technology Park
Project No.: 08028
Engineer: Derek T. Ono
Date: 5/2/11

Area

Description: Post-development onsite discharge [8]
(for commercial areas)

Area (A):	32.53	acres
Commercial Area:	28.74	acres

Runoff Coefficient

Infiltration:	[Medium]	→	0.07
Relief:	[Flat]	→	0
Vegetal Cover:	[Good]	→	0.03
Development:	[Agricultural]	→	0.15
		Composite Runoff Coefficient:	0.25
		Commercial Runoff Coefficient:	0.80
		Weighted Runoff Coefficient (C):	0.74

Time of Concentration

Runoff Length:	2104	ft.
Average Slope:	4.1	%
Time of Concentration (T_c):	28	minutes

Intensity

Project Location:	Kihei, Maui, Hawaii
Design Storm:	50-year recurrence interval, 1-hour duration
Rainfall Depth:	2.3 in.
Intensity (I):	3.36 in./hr.

Flow Rate

$Q = C \cdot I \cdot A$

$= 80.4$ $ft.^3/sec.$

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HYDROLOGIC CALCULATIONS - Surface Runoff

Project Name: Maui Research & Technology Park
Project No.: 08028
Engineer: Derek T. Ono
Date: 5/2/11

Area

Description: Post-development onsite discharge [9]
(for commercial areas)

Area (A):	5.75	acres
Commercial Area:	5.39	acres

Runoff Coefficient

Infiltration:	[Medium]	→	0.07
Relief:	[Rolling]	→	0.03
Vegetal Cover:	[Good]	→	0.03
Development:	[Agricultural]	→	0.15
		Composite Runoff Coefficient:	0.28
		Commercial Runoff Coefficient:	0.80
		Weighted Runoff Coefficient (C):	0.77

Time of Concentration

Runoff Length:	659	ft.
Average Slope:	5.6	%
Time of Concentration (T_c):	16.5	minutes

Intensity

Project Location:	Kihei, Maui, Hawaii
Design Storm:	50-year recurrence interval, 1-hour duration
Rainfall Depth:	2.3 in.
Intensity (I):	4.13 in./hr.

Flow Rate

$Q = C \cdot I \cdot A$

$= 18.2$ $ft.^3/sec.$