

# Memo

To: ABIB (Oamaru) Ltd – Hari De Alwis **Job No:** 1366

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From: Zibo Yang **Date:** 21 July 2023

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cc:

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Subject: Goodland Coastal Farm – Wetland Hydrological Assessment (Rev A)

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## 1 Background

Crang Consulting Ltd has assessed the surface water hydrology of the proposed Goodland Coastal Farm project located at 2127 Kaipara Coast Highway, Kakanui. The property is currently used for farming and is predominantly in pasture. An aerial photo of the site is shown below in Figure 1.



Figure 1. Existing Site

It is proposed to subdivide the property to create 25 house sites leaving a large residual lot and existing buildings for farming. Roads will be constructed to access the 25 house sites.

There were 29 potential wetlands identified on site by Wildlands ecological consultants, includes 24 natural wetlands and 5 man-made wetlands. Wildlands surveyed the locations and prepared plans for each wetland which has been used by Crang Civil in this assessment.

This memo outlines the potential changes to catchment hydrology due to the proposed earthworks within the site using TP108 analyses. As the primary concern is around the natural wetlands, the objective of the task was to understand the changes in catchment areas draining to the those wetlands and compare the peak flow rates for a range of storm events for both existing and proposed conditions. The identify of any alterations required to the drainage was then made and calculations rerun to ensure that the flows and volume changes are less than minor.

## 2 Summary of Calculations

Catchment hydrology was assessed using the TP108 rainfall-runoff calculation method. The analysis was completed for the 2- year ARI (average recurrence interval), 10-year ARI, and 100-year ARI. The analysis was based on changes to catchment areas and includes the increase in impervious due to roofs and roads. Soils were determined to be Type C throughout the site.

Catchments were delineated using the topographical survey. Rainfall data was extracted from NIWA's High Intensity Rainfall Design System (HIRDS). The TP108 calculations include a Climate Change Factor (assuming 2.1°C increase in temperature by 2090) applied to the design rainfall depth for each average recurrence interval storm as shown in Table 1 below.

**Table 1: TP108 Climate change factors**

ARI	Climate Change Factor
2	1.090
10	1.132
100	1.168

The results from the TP108 calculations are summarised in Tables 2. A copy of the wetland catchments plan is included in Appendix A of the memo, whilst the calculation details can be found in Appendix B.

Note that for Wetlands 14 and 15, the catchments for those wetlands have not changed and there is no development proposed nor revegetation within their catchments.

Table 2: Pre and post development peak flows for wetlands

	PRE-DEVELOPMENT				POSE-DEVELOPMENT				DIFFERENCE							
	Catchment Area (ha)	Peak Flow Rates m³/s			Catchment Area (ha)	Peak Flow Rates m³/s			Catchment Area		Peak Flow Rates m³/s			Peak Flow Rates %		
		ARI 2	ARI 10	ARI 100		ARI 2	ARI 10	ARI 100	(ha)	(%)	ARI 2	ARI 10	ARI 100	ARI 2	ARI 10	ARI 100
WETLAND 1	6.34	0.52	1.30	2.48	6.85	0.56	1.40	2.67	8.04	8.04	0.04	0.10	0.19	7.4	7.5	7.7
WETLAND 2	10.79	0.89	2.21	4.22	10.94	0.86	2.16	4.13	1.39	1.39	-0.03	-0.05	-0.09	-2.8	-2.3	-2.1
WETLAND 3	4.80	0.39	0.98	1.88	4.51	0.40	0.97	1.81	-0.29	-6.04	0.00	-0.02	-0.06	0.9	-1.7	-3.4
WETLAND 4	8.15	0.67	1.67	3.18	7.49	0.66	1.61	3.01	-0.66	-8.10	-0.01	-0.06	-0.17	-1.1	-3.7	-5.5
WETLAND 5	2.20	0.18	0.45	0.86	2.18	0.17	0.44	0.84	-0.02	-0.91	-0.01	-0.01	-0.02	-3.6	-2.8	-2.1
WETLAND 6	2.93	0.24	0.60	1.15	2.88	0.24	0.59	1.12	-0.05	-1.71	0.00	-0.01	-0.02	-1.7	-1.7	-1.8
WETLAND 7	2.51	0.21	0.51	0.98	2.40	0.19	0.47	0.92	-0.11	-4.38	-0.02	-0.04	-0.07	-9.2	-7.9	-6.7
WETLAND 8	2.59	0.21	0.53	1.01	2.66	0.22	0.55	1.05	0.07	2.70	0.01	0.02	0.04	5.0	4.2	3.5
WETLAND 9	7.56	0.62	1.55	2.95	8.11	0.67	1.67	3.18	0.55	7.28	0.05	0.12	0.22	8.1	7.7	7.5
WETLAND 10	7.89	0.65	1.61	3.08	8.34	0.69	1.72	3.27	0.45	5.70	0.04	0.10	0.18	6.6	6.2	6.0
WETLAND 11	5.57	0.46	1.14	2.18	5.13	0.44	1.08	2.04	-0.44	-7.90	-0.02	-0.06	-0.14	-4.1	-5.4	-6.5
WETLAND 12	6.53	0.54	1.34	2.55	5.95	0.51	1.25	2.37	-0.58	-8.88	-0.03	-0.08	-0.19	-4.8	-6.2	-7.3
WETLAND 13	2.95	0.24	0.60	1.15	2.95	0.24	0.60	1.14	0.00	0.00	0.00	-0.01	-0.01	-1.6	-1.2	-0.7
WETLAND 14	0.32	0.03	0.07	0.13	0.32	0.03	0.06	0.12	0.00	0.00	0.00	0.00	0.00	-2.7	-1.9	-1.2
WETLAND 15	0.84	0.07	0.17	0.33	0.84	0.07	0.17	0.32	0.00	0.00	0.00	0.00	0.00	-2.7	-1.9	-1.2
WETLAND 16	1.32	0.11	0.27	0.52	1.38	0.12	0.29	0.54	0.06	4.55	0.01	0.02	0.03	6.6	5.9	5.3
WETLAND 17	9.18	0.76	1.88	3.59	8.51	0.81	1.96	3.71	-0.67	-7.30	0.05	0.08	0.13	7.3	4.5	3.5
WETLAND 18	0.05	0.00	0.01	0.02	0.05	0.00	0.01	0.02	0.00	0.00	0.00	0.00	0.00	-2.7	-1.9	-1.2
WETLAND 19	3.83	0.32	0.78	1.50	3.63	0.30	0.74	1.41	-0.20	-5.22	-0.02	-0.05	-0.08	-5.9	-5.8	-5.6
WETLAND 20	1.35	0.11	0.28	0.53	1.27	0.12	0.28	0.52	-0.08	-5.93	0.01	0.00	-0.01	4.8	0.3	-1.9
WETLAND 21	4.01	0.33	0.82	1.57	4.01	0.32	0.80	1.55	0.00	0.00	-0.01	-0.02	-0.02	-2.7	-1.9	-1.2
WETLAND 22	2.17	0.18	0.44	0.85	2.17	0.17	0.44	0.84	0.00	0.00	0.00	-0.01	-0.01	-2.7	-1.9	-1.2
WETLAND 23	2.75	0.23	0.56	1.07	2.50	0.21	0.51	0.97	-0.25	-9.09	-0.02	-0.05	-0.10	-9.4	-9.4	-9.3
WETLAND 24	1.66	0.14	0.34	0.65	1.69	0.14	0.35	0.67	0.03	1.81	0.01	0.01	0.02	4.5	3.5	2.8

### **3 Conclusions**

Catchment areas for each wetland have been generally maintained with the proposed stormwater management on site. The largest change of peak flow discharge for each type of storm event are summarised as below:

2-year ARI: plus 0.03 m<sup>3</sup>/s and minus 0.05 m<sup>3</sup>/s

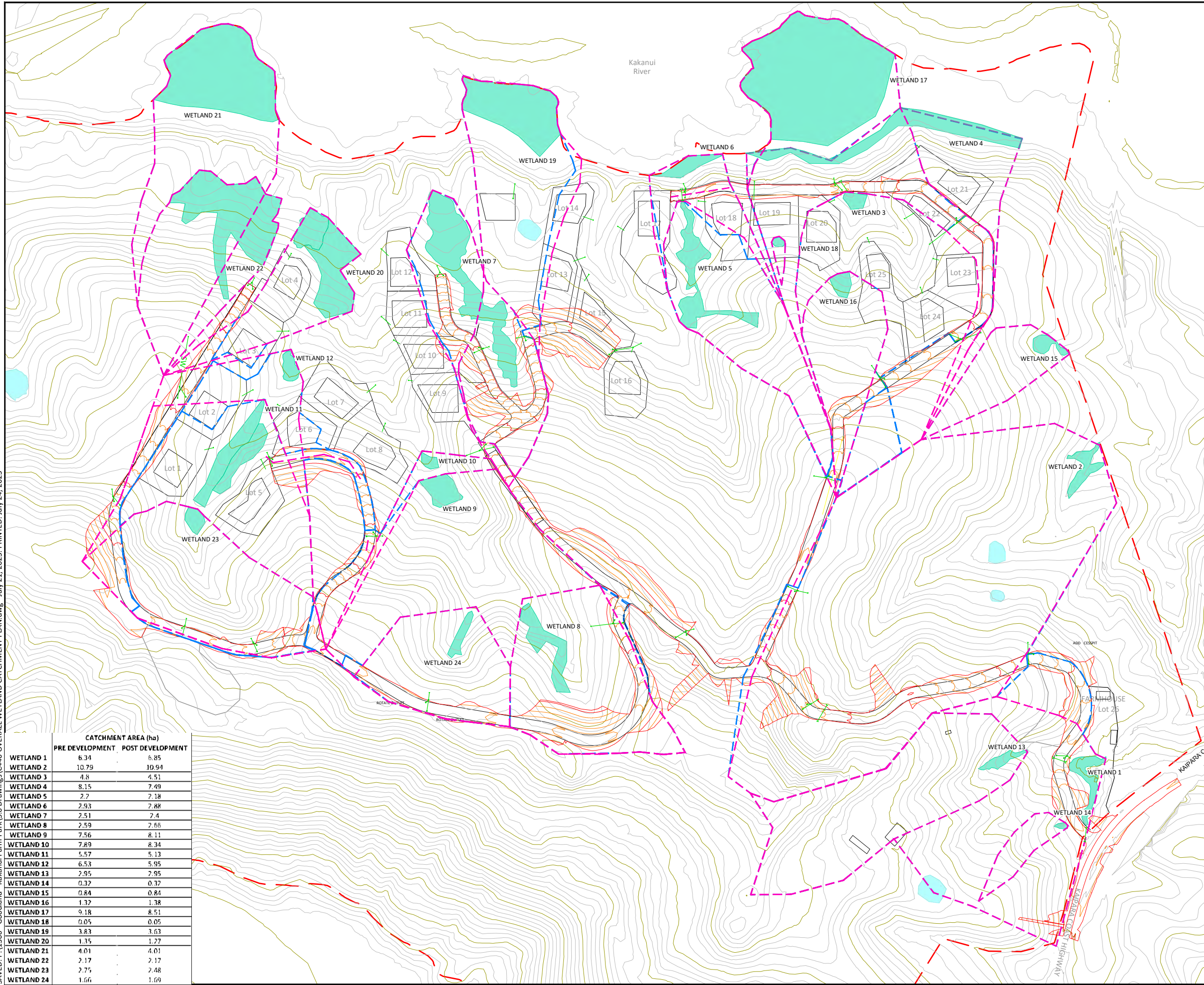
10 -year ARI: plus 0.08 m<sup>3</sup>/s and minus 0.08 m<sup>3</sup>/s

100-year ARI: plus 0.19 m<sup>3</sup>/s and minus 0.21 m<sup>3</sup>/s

Overall, the majority of the wetlands have relatively minor changes in hydrology, within 6% in the 2, 10 and 100-year ARI storm events. Therefore it is believed that the effects are less than minor.

## **APPENDIX A – WETLAND CATCHMENT PLAN**

SAVED: P:\1366 - Goodland - Kakanui Farm Park\5.0 Drawings\C440 OVERALL WETLAND CATCHMENT PLAN.dwg - July 21, 2023. PRINTED: July 24, 2023



**LEGEND**

<span style="color: red;">---</span> 60.0	PROPOSED CONTOURS
<span style="color: orange;">---</span> 52.0	EXISTING CONTOURS
<span style="color: red;">---</span> 60.0	EARTHWORKS EXTENT
<span style="color: red;">---</span> 52.0	
<span style="color: magenta;">---</span>	PRE-DEVELOPMENT CATCHMENT
<span style="color: blue;">---</span>	POST DEVELOPMENT CATCHMENT

- NOTES:**
1. PROPOSED CONTOURS SHOWN ARE FINISHED GROUND LEVELS
  2. SEDIMENT AND EROSION CONTROLS ARE TO BE OPERATIONAL, AS-BUILT AND APPROVED BY COUNCIL PRIOR TO BULK EARTHWORKS
  3. ALL FILL TO BE PLACED TO CLASS A COMPACTION STANDARD AND CERTIFIED BY A GEOTECHNICAL ENGINEER

**CONSENT ISSUE**

B	INFORMAL S92 RESPONSE	ZY	21/07/23
A	ORIGINAL	VC	21/12/22
REVISION	CHANGES	CHECKED	DATE

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CLIENT  
**ABIB (OAMARU) LTD**

PROJECT  
**GOODLAND COASTAL FARM**

TITLE  
**OVERALL WETLAND CATCHMENT PLAN**

DRAWN	TG	SCALE	A1 1:2000
DESIGNED	TG	SCALE	A3 1:4000
PROJECT No	DRAWING No	REVISION	
1366	C440	B	

	CATCHMENT AREA (ha)	
	PRE DEVELOPMENT	POST DEVELOPMENT
WETLAND 1	6.34	6.85
WETLAND 2	10.79	10.94
WETLAND 3	4.8	4.51
WETLAND 4	8.15	7.49
WETLAND 5	2.2	2.18
WETLAND 6	2.93	2.88
WETLAND 7	2.51	2.4
WETLAND 8	2.59	2.66
WETLAND 9	7.56	8.11
WETLAND 10	7.89	8.34
WETLAND 11	5.57	5.13
WETLAND 12	6.53	5.95
WETLAND 13	2.95	2.95
WETLAND 14	0.32	0.32
WETLAND 15	0.84	0.84
WETLAND 16	1.32	1.38
WETLAND 17	9.18	8.51
WETLAND 18	0.05	0.05
WETLAND 19	3.83	3.63
WETLAND 20	1.35	1.77
WETLAND 21	4.01	4.01
WETLAND 22	2.17	2.17
WETLAND 23	2.75	2.48
WETLAND 24	1.66	1.69

## **APPENDIX B – WETLAND CATCHMENT CALCULATIONS**

**TP108 Pond Sizing**  
**Worksheet 2: Graphical Peak Flow rate (Standard Version)**

Date: 21.07.2023  
 Calc by: TG

Project: GOODLAND COASTAL FARM  
 Location: 2127 KAIPARA COAST HIGHWAY  
 Job Number: 1366  
 Catchment Description: Wetland 1

Present

Developed Pervious Catchment

1. Data  
 Catchment Area A= 0.0634 km<sup>2</sup>  
 Runoff Curve No 74  
 Initial Abstraction 5 mm  
 Time of Concentration 0.17 hrs

2. Calculate Storage, S = (1000/CN - 10) x 25.4 89.2 mm

3. Average Recurrence Interval ARI

4. 24 hour rainfall depth, P<sub>24</sub> (mm)

5. Compute C\*

6. Specific peak flow rate q\*

7. Peak flow rate, q<sub>p</sub>

8. Runoff depth, Q<sub>24</sub> (mm)

9. Runoff Volume V<sub>24</sub> = 1000xQ<sub>24</sub>A (m<sup>3</sup>)

Storm 1	Storm 2	Storm 3	Storm 4
	2	10	100
	93	170	280
	0.32	0.47	0.60
	0.089	0.120	0.140
	0.522	1.298	2.478
	43.43	107.08	207.62
	2753	6789	13163

1. Runoff Curve Number (CN) and Initial Abstraction (Ia)				
Soil name and classification	Cover description (cover type, treatment & hydrologic condition)	Curve Number CN*	Area (ha)	Product of CN x area
Type C	Permeable Area	74	6.2940	465.76
Type C	Impermeable Area	98	0.0460	5
* from Appendix B			Totals =	6.3400
CN (weighted) = total producted / total area =				74.17
Ia (weighted) = 5 x pervious area / total area =				5.0 mm

Present

Developed

Impervious Catchment

1. Data  
 Catchment Area A= 0.0685 km<sup>2</sup>  
 Runoff Curve No 74  
 Initial Abstraction 4.9 mm  
 Time of Concentration 0.17 hrs

2. Calculate Storage, S = (1000/CN - 10) x 25.4 90.6 mm

3. Average Recurrence Interval ARI

4. 24 hour rainfall depth, P<sub>24</sub> (mm)

5. Compute C\*

6. Specific peak flow rate q\*

7. Peak flow rate, q<sub>p</sub>

8. Runoff depth, Q<sub>24</sub> (mm)

9. Runoff Volume V<sub>24</sub> = 1000xQ<sub>24</sub>A (m<sup>3</sup>)

Storm 1	Storm 2	Storm 3	Storm 4
	2	10	100
	93	170	280
	0.31	0.47	0.60
	0.088	0.120	0.139
	0.560	1.395	2.668
	43.21	106.65	207.00
	2960	7306	14180

2. Time of Concentration			
Channelisation factor	C =	0.80	(from Table 4.2)
Catchment length	L =	0.45	km (along drainage path)
Catchment slope	S <sub>c</sub> =	0.13	m/m (by equal area method)
Runoff factor, CN / (200 - CN) =		0.59	
t <sub>c</sub> = 0.14 C L <sup>0.66</sup> (CN / (200 - CN)) <sup>-0.55</sup> S <sub>c</sub> <sup>-0.30</sup>		0.162	hrs
Adopted t <sub>c</sub> =		0.17	hrs 0.17hrs min
SCS Lag for HEC-HMS	T <sub>p</sub> = 2 / 3 t <sub>c</sub>	0.11	hrs

10. Combine Results

Average recurrence Interval, ARI (yr)

Flow (Impervious + Pervious) m<sup>3</sup>/s

Runoff Volume (Impervious + Pervious) m<sup>3</sup>

Combined			
	2	10	100
0	0.039	0.098	0.191
0	207	517	1017

1. Runoff Curve Number (CN) and Initial Abstraction (Ia)				
Soil name and classification	Cover description (cover type, treatment & hydrologic condition)	Curve Number CN*	Area (ha)	Product of CN x area
Type C	Permeable Area	73	6.6540	485.74
Type C	Impermeable Area	98	0.1960	19
* from Appendix B			Totals =	6.8500
CN (weighted) = total producted / total area =				73.72
Ia (weighted) = 5 x pervious area / total area =				4.9 mm

2. Time of Concentration			
Channelisation factor	C =	0.80	(from Table 4.2)
Catchment length	L =	0.45	km (along drainage path)
Catchment slope	S <sub>c</sub> =	0.13	m/m (by equal area method)
Runoff factor, CN / (200 - CN) =		0.58	
t <sub>c</sub> = 0.14 C L <sup>0.66</sup> (CN / (200 - CN)) <sup>-0.55</sup> S <sub>c</sub> <sup>-0.30</sup>		0.163	hrs
Adopted t <sub>c</sub> =		0.17	hrs 0.17hrs min
SCS Lag for HEC-HMS	T <sub>p</sub> = 2 / 3 t <sub>c</sub>	0.11	hrs

Runoff Volumes m <sup>3</sup>	Pre-Deve	Post-Dev	Difference	Difference (%)
Area (ha)	6.34	6.85	0.51	8.04
ARI 2	2753.48	2960.12	206.64	7.50
ARI 10	6789.03	7305.68	516.65	7.61
ARI 100	13163.25	14179.75	1016.50	7.72
Peak Flow Rates m <sup>3</sup> /s	Pre-Deve	Post-Dev	Difference	Difference (%)
Area (ha)	6.34	6.85	0.51	8.04
ARI 2	0.52	0.56	0.04	7.39
ARI 10	1.30	1.40	0.10	7.51
ARI 100	2.48	2.67	0.19	7.70

TP108 Pond Sizing  
Worksheet 2: Graphical Peak Flow rate (Standard Version)

Date: 21.07.2023  
Calc by: TG

Project: GOODLAND COASTAL FARM  
Location: 2127 KAIPARA COAST HIGHWAY  
Job Number: 1366  
Catchment Description: Wetland 2

Present

Developed Pervious Catchment

1. Data  
Catchment Area A= 0.108 km<sup>2</sup>  
Runoff Curve No 74  
Initial Abstraction 5 mm  
Time of Concentration 0.17 hrs

2. Calculate Storage, S = (1000/CN - 10) x 25.4 89.2 mm

3. Average Recurrence Interval ARI

4. 24 hour rainfall depth, P<sub>24</sub> (mm)

5. Compute C\*

6. Specific peak flow rate q\*

7. Peak flow rate, q<sub>p</sub>

8. Runoff depth, Q<sub>24</sub> (mm)

9. Runoff Volume V<sub>24</sub> = 1000xQ<sub>24</sub>A (m<sup>3</sup>)

Storm 1	Storm 2	Storm 3	Storm 4
	2	10	100
	93	170	280
	0.32	0.47	0.60
	0.089	0.120	0.140
	0.888	2.209	4.217
	43.43	107.08	207.62
	4686	11554	22402

pre 1. Runoff Curve Number (CN) and Initial Abstraction (Ia)				
Soil name and classification	Cover description (cover type, treatment & hydrologic condition)	Curve Number CN*	Area (ha)	Product of CN x area
Type C	Permeable Area	74	10.7900	798.46
	Impermeable Area	98	0.0000	0
* from Appendix B			Totals =	798
CN (weighted) = total producted / total area =			74.00	
Ia (weighted) = 5 x pervious area / total area =			5.0 mm	

Present

Developed

Impervious Catchment

1. Data  
Catchment Area A= 0.1094 km<sup>2</sup>  
Runoff Curve No 74  
Initial Abstraction 4.9 mm  
Time of Concentration 0.19 hrs

2. Calculate Storage, S = (1000/CN - 10) x 25.4 91.2 mm

3. Average Recurrence Interval ARI

4. 24 hour rainfall depth, P<sub>24</sub> (mm)

5. Compute C\*

6. Specific peak flow rate q\*

7. Peak flow rate, q<sub>p</sub>

8. Runoff depth, Q<sub>24</sub> (mm)

9. Runoff Volume V<sub>24</sub> = 1000xQ<sub>24</sub>A (m<sup>3</sup>)

Storm 1	Storm 2	Storm 3	Storm 4
	2	10	100
	93	170	280
	0.31	0.47	0.60
	0.085	0.116	0.135
	0.863	2.158	4.130
	43.04	106.36	206.62
	4709	11636	22604

pre 2. Time of Concentration			
Channelisation factor .....	C =	0.80	(from Table 4.2)
Catchment length .....	L =	0.59	km (along drainage path)
Catchment slope .....	S <sub>c</sub> =	0.15	m/m (by equal area method)
Runoff factor, CN / (200 - CN) =		0.59	
t <sub>c</sub> = 0.14 C L <sup>0.66</sup> (CN / (200 - CN)) <sup>-0.55</sup> S <sub>c</sub> <sup>-0.30</sup>		0.188	hrs
Adopted t <sub>c</sub> =		0.19	hrs 0.17hrs min
SCS Lag for HEC-HMS .....	T <sub>p</sub> = 2 / 3 t <sub>c</sub>	0.13	hrs

post 1. Runoff Curve Number (CN) and Initial Abstraction (Ia)				
Soil name and classification	Cover description (cover type, treatment & hydrologic condition)	Curve Number CN*	Area (ha)	Product of CN x area
Type C	Permeable Area	73	10.6862	780.09
	Impermeable Area	98	0.2538	25
* from Appendix B			Totals =	805
CN (weighted) = total producted / total area =			73.58	
Ia (weighted) = 5 x pervious area / total area =			4.9 mm	

10. Combine Results  
Average recurrence Interval, ARI (yr)  
Flow (Impervious + Pervious) m<sup>3</sup>/s  
Runoff Volume (Impervious + Pervious) m<sup>3</sup>

Combined			
Average recurrence Interval, ARI (yr)	Flow (Impervious + Pervious) m <sup>3</sup> /s	Runoff Volume (Impervious + Pervious) m <sup>3</sup>	
0	2	10	100
0.000	-0.025	-0.050	-0.087
0	22	82	202

post 2. Time of Concentration			
Channelisation factor .....	C =	0.80	(from Table 4.2)
Catchment length .....	L =	0.59	km (along drainage path)
Catchment slope .....	S <sub>c</sub> =	0.15	m/m (by equal area method)
Runoff factor, CN / (200 - CN) =		0.58	
t <sub>c</sub> = 0.14 C L <sup>0.66</sup> (CN / (200 - CN)) <sup>-0.55</sup> S <sub>c</sub> <sup>-0.30</sup>		0.189	hrs
Adopted t <sub>c</sub> =		0.19	hrs 0.17hrs min
SCS Lag for HEC-HMS .....	T <sub>p</sub> = 2 / 3 t <sub>c</sub>	0.13	hrs

Runoff Volumes m <sup>3</sup>	Pre-Deve	Post-Deve	Difference	Difference (%)
Area (ha)	10.79	10.94	0.15	1.39
ARI 2	4686.13	4708.61	22.49	0.48
ARI 10	11554.20	11636.32	82.12	0.71
ARI 100	22402.44	22604.25	201.81	0.90
Peak Flow Rates m <sup>3</sup> /s	Pre-Deve	Post-Deve	Difference	Difference (%)
Area (ha)	10.79	10.94	0.15	1.39
ARI 2	0.89	0.86	-0.03	-2.82
ARI 10	2.21	2.16	-0.05	-2.28
ARI 100	4.22	4.13	-0.09	-2.06

TP108 Pond Sizing  
Worksheet 2: Graphical Peak Flow rate (Standard Version)

Date: 04.04.2023  
Calc by: TG

Project: GOODLAND COASTAL FARM  
Location: 2127 KAIPARA COAST HIGHWAY  
Job Number: 1366  
Catchment Description: Wetland 3

Present (circled)      Developed      Pervious Catchment

- Data  
Catchment Area A= 0.048 km<sup>2</sup>  
Runoff Curve No 74  
Initial Abstraction 5 mm  
Time of Concentration 0.17 hrs
- Calculate Storage, S = (1000/CN - 10) x 25.4      89.2 mm

- Average Recurrence Interval ARI
- 24 hour rainfall depth, P<sub>24</sub> (mm)
- Compute C\*
- Specific peak flow rate q\*
- Peak flow rate, q<sub>p</sub>
- Runoff depth, Q<sub>24</sub> (mm)
- Runoff Volume V<sub>24</sub> = 1000xQ<sub>24</sub>A (m<sup>3</sup>)

Storm 1	Storm 2	Storm 3	Storm 4
	2	10	100
	93	170	280
	0.32	0.47	0.60
	0.089	0.120	0.140
	0.395	0.982	1.876
	43.43	107.08	207.62
	2085	5140	9966

pre 1. Runoff Curve Number (CN) and Initial Abstraction (Ia)				
Soil name and classification	Cover description (cover type, treatment & hydrologic condition)	Curve Number CN*	Area (ha)	Product of CN x area
Type C	Permeable Area	74	4.8000	355.20
	Impermeable Area	98	0.0000	0
* from Appendix B			Totals =	4.8000    355
CN (weighted) = total producted / total area =			74.00	
Ia (weighted) = 5 x pervious area / total area =			5.0 mm	

Present      Developed (circled)      Impervious Catchment

- Data  
Catchment Area A= 0.0451 km<sup>2</sup>  
Runoff Curve No 76  
Initial Abstraction 4.4 mm  
Time of Concentration 0.17 hrs
- Calculate Storage, S = (1000/CN - 10) x 25.4      79.2 mm

- Average Recurrence Interval ARI
- 24 hour rainfall depth, P<sub>24</sub> (mm)
- Compute C\*
- Specific peak flow rate q\*
- Peak flow rate, q<sub>p</sub>
- Runoff depth, Q<sub>24</sub> (mm)
- Runoff Volume V<sub>24</sub> = 1000xQ<sub>24</sub>A (m<sup>3</sup>)

Storm 1	Storm 2	Storm 3	Storm 4
	2	10	100
	93	170	280
	0.35	0.50	0.63
	0.095	0.126	0.143
	0.398	0.966	1.812
	46.54	112.06	214.12
	2099	5054	9657

pre 2. Time of Concentration				
Channelisation factor	C =	0.80	(from Table 4.2)	
Catchment length	L =	0.40	km (along drainage path)	
Catchment slope	S <sub>c</sub> =	0.14	m/m (by equal area method)	
Runoff factor, CN / (200 - CN) =		0.59		
t <sub>c</sub> = 0.14 C L <sup>0.66</sup> (CN / (200 - CN)) <sup>-0.55</sup> S <sub>c</sub> <sup>-0.30</sup>		0.149	hrs	
Adopted t <sub>c</sub> =		0.17	hrs	0.17hrs min
SCS Lag for HEC-HMS		T <sub>p</sub> = 2 / 3 t <sub>c</sub>	0.11	hrs

- Combine Results  
Average recurrence Interval, ARI (yr)  
Flow (Impervious + Pervious) m<sup>3</sup>/s  
Runoff Volume (Impervious + Pervious) m<sup>3</sup>

Combined				
ARI	0	2	10	100
Flow (Impervious + Pervious) m <sup>3</sup> /s	0.000	0.003	-0.016	-0.064
Runoff Volume (Impervious + Pervious) m <sup>3</sup>	0	14	-86	-309

post 1. Runoff Curve Number (CN) and Initial Abstraction (Ia)				
Soil name and classification	Cover description (cover type, treatment & hydrologic condition)	Curve Number CN*	Area (ha)	Product of CN x area
Type C	Permeable Area	73	3.9276	286.71
	Impermeable Area	98	0.5824	57
* from Appendix B			Totals =	4.5100    344
CN (weighted) = total producted / total area =			76.23	
Ia (weighted) = 5 x pervious area / total area =			4.4 mm	

Runoff Volumes m <sup>3</sup>				
Area (ha)	Pre-Deve	Post-Deve	Difference	Difference (%)
ARI 2	2084.65	2099.07	14.42	0.69
ARI 10	5139.96	5053.92	-86.04	-1.67
ARI 100	9965.87	9656.69	-309.18	-3.10

Peak Flow Rates m <sup>3</sup> /s				
Area (ha)	Pre-Deve	Post-Deve	Difference	Difference (%)
ARI 2	0.39	0.40	0.00	0.87
ARI 10	0.98	0.97	-0.02	-1.65
ARI 100	1.88	1.81	-0.06	-3.42

post 2. Time of Concentration				
Channelisation factor	C =	0.80	(from Table 4.2)	
Catchment length	L =	0.40	km (along drainage path)	
Catchment slope	S <sub>c</sub> =	0.14	m/m (by equal area method)	
Runoff factor, CN / (200 - CN) =		0.62		
t <sub>c</sub> = 0.14 C L <sup>0.66</sup> (CN / (200 - CN)) <sup>-0.55</sup> S <sub>c</sub> <sup>-0.30</sup>		0.145	hrs	
Adopted t <sub>c</sub> =		0.17	hrs	0.17hrs min
SCS Lag for HEC-HMS		T <sub>p</sub> = 2 / 3 t <sub>c</sub>	0.11	hrs

TP108 Pond Sizing  
Worksheet 2: Graphical Peak Flow rate (Standard Version)

Date: 21.07.2023  
Calc by: TG

Project: GOODLAND COASTAL FARM  
Location: 2127 KAIPARA COAST HIGHWAY  
Job Number: 1366  
Catchment Description: Wetland 4

Present (circled)      Developed      Pervious Catchment

1. Data  
Catchment Area A= 0.0815 km<sup>2</sup>  
Runoff Curve No 74  
Initial Abstraction 5 mm  
Time of Concentration 0.17 hrs

2. Calculate Storage, S = (1000/CN - 10) x 25.4      89.2 mm

3. Average Recurrence Interval ARI

4. 24 hour rainfall depth, P<sub>24</sub> (mm)

5. Compute C\*

6. Specific peak flow rate q\*

7. Peak flow rate, q<sub>p</sub>

8. Runoff depth, Q<sub>24</sub> (mm)

9. Runoff Volume V<sub>24</sub> = 1000xQ<sub>24</sub>A (m<sup>3</sup>)

Storm 1	Storm 2	Storm 3	Storm 4
	2	10	100
	93	170	280
	0.32	0.47	0.60
	0.089	0.120	0.140
	0.671	1.668	3.185
	43.43	107.08	207.62
	3540	8727	16921

pre 1. Runoff Curve Number (CN) and Initial Abstraction (Ia)				
Soil name and classification	Cover description (cover type, treatment & hydrologic condition)	Curve Number CN*	Area (ha)	Product of CN x area
Type C	Permeable Area	74	8.1500	603.10
	Impermeable Area	98	0.0000	0
* from Appendix B			Totals =	603.10
CN (weighted) = total producted / total area =		74.00		
Ia (weighted) = 5 x pervious area / total area =		5.0 mm		

Present      Developed (circled)      Impervious Catchment

1. Data  
Catchment Area A= 0.0749 km<sup>2</sup>  
Runoff Curve No 76  
Initial Abstraction 4.3 mm  
Time of Concentration 0.17 hrs

2. Calculate Storage, S = (1000/CN - 10) x 25.4      78.9 mm

3. Average Recurrence Interval ARI

4. 24 hour rainfall depth, P<sub>24</sub> (mm)

5. Compute C\*

6. Specific peak flow rate q\*

7. Peak flow rate, q<sub>p</sub>

8. Runoff depth, Q<sub>24</sub> (mm)

9. Runoff Volume V<sub>24</sub> = 1000xQ<sub>24</sub>A (m<sup>3</sup>)

Storm 1	Storm 2	Storm 3	Storm 4
	2	10	100
	93	170	280
	0.35	0.51	0.63
	0.096	0.126	0.144
	0.663	1.606	3.011
	46.63	112.20	214.29
	3492	8404	16051

pre 2. Time of Concentration			
Channelisation factor .....	C =	0.80	(from Table 4.2)
Catchment length .....	L =	0.44	km (along drainage path)
Catchment slope .....	S <sub>c</sub> =	0.14	m/m (by equal area method)
Runoff factor, CN / (200 - CN) =		0.59	
t <sub>c</sub> = 0.14 C L <sup>0.66</sup> (CN / (200 - CN)) <sup>-0.55</sup> S <sub>c</sub> <sup>-0.30</sup>		0.156	hrs
Adopted t <sub>c</sub> =		0.17	hrs      0.17hrs min
SCS Lag for HEC-HMS .....		T <sub>p</sub> = 2 / 3 t <sub>c</sub>	0.11 hrs

post 1. Runoff Curve Number (CN) and Initial Abstraction (Ia)				
Soil name and classification	Cover description (cover type, treatment & hydrologic condition)	Curve Number CN*	Area (ha)	Product of CN x area
Type C	Permeable Area	73	6.5040	474.79
	Impermeable Area	98	0.9860	97
* from Appendix B			Totals =	571.79
CN (weighted) = total producted / total area =		76.29		
Ia (weighted) = 5 x pervious area / total area =		4.3 mm		

10. Combine Results  
Average recurrence Interval, ARI (yr)  
Flow (Impervious + Pervious) m<sup>3</sup>/s  
Runoff Volume (Impervious + Pervious) m<sup>3</sup>

Combined			
0	2	10	100
0.000	-0.008	-0.062	-0.174
0	-47	-324	-871

post 2. Time of Concentration			
Channelisation factor .....	C =	0.80	(from Table 4.2)
Catchment length .....	L =	0.44	km (along drainage path)
Catchment slope .....	S <sub>c</sub> =	0.14	m/m (by equal area method)
Runoff factor, CN / (200 - CN) =		0.62	
t <sub>c</sub> = 0.14 C L <sup>0.66</sup> (CN / (200 - CN)) <sup>-0.55</sup> S <sub>c</sub> <sup>-0.30</sup>		0.152	hrs
Adopted t <sub>c</sub> =		0.17	hrs      0.17hrs min
SCS Lag for HEC-HMS .....		T <sub>p</sub> = 2 / 3 t <sub>c</sub>	0.11 hrs

Runoff Volumes m <sup>3</sup>	Pre-Deve	Post-Dev	Difference	Difference (%)
Area (ha)	8.15	7.49	-0.66	-8.10
ARI 2	3539.57	3492.48	-47.09	-1.33
ARI 10	8727.22	8403.54	-323.68	-3.71
ARI 100	16921.21	16050.65	-870.56	-5.14
Peak Flow Rates m <sup>3</sup> /s	Pre-Deve	Post-Dev	Difference	Difference (%)
Area (ha)	8.15	7.49	-0.66	-8.10
ARI 2	0.67	0.66	-0.01	-1.14
ARI 10	1.67	1.61	-0.06	-3.71
ARI 100	3.18	3.01	-0.17	-5.46

TP108 Pond Sizing  
Worksheet 2: Graphical Peak Flow rate (Standard Version)

Date: 21.07.2023  
Calc by: TG

Project: GOODLAND COASTAL FARM  
Location: 2127 KAIPARA COAST HIGHWAY  
Job Number: 1366  
Catchment Description: Wetland 5

Present (circled)      Developed      Pervious Catchment

1. Data  
Catchment Area A= 0.022 km<sup>2</sup>  
Runoff Curve No 74  
Initial Abstraction 5 mm  
Time of Concentration 0.17 hrs

2. Calculate Storage, S = (1000/CN - 10) x 25.4 = 89.2 mm

3. Average Recurrence Interval ARI

4. 24 hour rainfall depth, P<sub>24</sub> (mm)

5. Compute C\*

6. Specific peak flow rate q\*

7. Peak flow rate, q<sub>p</sub>

8. Runoff depth, Q<sub>24</sub> (mm)

9. Runoff Volume V<sub>24</sub> = 1000xQ<sub>24</sub>A (m<sup>3</sup>)

Storm 1	Storm 2	Storm 3	Storm 4
	2	10	100
	93	170	280
	0.32	0.47	0.60
	0.089	0.120	0.140
	0.181	0.450	0.860
	43.43	107.08	207.62
	955	2356	4568

pre 1. Runoff Curve Number (CN) and Initial Abstraction (Ia)				
Soil name and classification	Cover description (cover type, treatment & hydrologic condition)	Curve Number CN*	Area (ha)	Product of CN x area
Type C	Permeable Area	74	2.2000	162.80
	Impermeable Area	98	0.0000	0
* from Appendix B			Totals =	2.2000
CN (weighted) = total producted / total area =			74.00	
Ia (weighted) = 5 x pervious area / total area =			5.0 mm	

Present      Developed (circled)      Impervious Catchment

1. Data  
Catchment Area A= 0.0218 km<sup>2</sup>  
Runoff Curve No 73  
Initial Abstraction 5.0 mm  
Time of Concentration 0.17 hrs

2. Calculate Storage, S = (1000/CN - 10) x 25.4 = 93.9 mm

3. Average Recurrence Interval ARI

4. 24 hour rainfall depth, P<sub>24</sub> (mm)

5. Compute C\*

6. Specific peak flow rate q\*

7. Peak flow rate, q<sub>p</sub>

8. Runoff depth, Q<sub>24</sub> (mm)

9. Runoff Volume V<sub>24</sub> = 1000xQ<sub>24</sub>A (m<sup>3</sup>)

Storm 1	Storm 2	Storm 3	Storm 4
	2	10	100
	93	170	280
	0.31	0.46	0.59
	0.086	0.118	0.138
	0.175	0.438	0.842
	42.31	105.14	204.98
	922	2292	4468

pre 2. Time of Concentration			
Channelisation factor	C =	0.80	(from Table 4.2)
Catchment length	L =	0.29	km (along drainage path)
Catchment slope	S <sub>c</sub> =	0.15	m/m (by equal area method)
Runoff factor, CN / (200 - CN) =	0.59		
t <sub>c</sub> = 0.14 C L <sup>0.66</sup> (CN / (200 - CN)) <sup>-0.55</sup> S <sub>c</sub> <sup>-0.30</sup>	0.117	hrs	
Adopted tc =	0.17	hrs	0.17hrs min
SCS Lag for HEC-HMS	..... Tp = 2 / 3 t <sub>c</sub>	0.11	hrs

post 1. Runoff Curve Number (CN) and Initial Abstraction (Ia)				
Soil name and classification	Cover description (cover type, treatment & hydrologic condition)	Curve Number CN*	Area (ha)	Product of CN x area
Type C	Permeable Area	73	2.1800	159.14
	Impermeable Area	98	0.0000	0
* from Appendix B			Totals =	2.1800
CN (weighted) = total producted / total area =			73.00	
Ia (weighted) = 5 x pervious area / total area =			5.0 mm	

10. Combine Results  
Average recurrence Interval, ARI (yr)  
Flow (Impervious + Pervious) m<sup>3</sup>/s  
Runoff Volume (Impervious + Pervious) m<sup>3</sup>

Combined			
0	2	10	100
0.000	-0.007	-0.013	-0.018
0	-33	-64	-99

post 2. Time of Concentration			
Channelisation factor	C =	0.80	(from Table 4.2)
Catchment length	L =	0.29	km (along drainage path)
Catchment slope	S <sub>c</sub> =	0.15	m/m (by equal area method)
Runoff factor, CN / (200 - CN) =	0.57		
t <sub>c</sub> = 0.14 C L <sup>0.66</sup> (CN / (200 - CN)) <sup>-0.55</sup> S <sub>c</sub> <sup>-0.30</sup>	0.118	hrs	
Adopted tc =	0.17	hrs	0.17hrs min
SCS Lag for HEC-HMS	..... Tp = 2 / 3 t <sub>c</sub>	0.11	hrs

Runoff Volumes m <sup>3</sup>	Pre-Deve	Post-Dev	Difference	Difference (%)
Area (ha)	2.20	2.18	-0.02	-0.91
ARI 2	955.47	922.27	-33.20	-3.47
ARI 10	2355.81	2292.01	-63.80	-2.71
ARI 100	4567.69	4468.48	-99.21	-2.17
Peak Flow Rates m <sup>3</sup> /s	Pre-Deve	Post-Dev	Difference	Difference (%)
Area (ha)	2.20	2.18	-0.02	-0.91
ARI 2	0.18	0.17	-0.01	-3.60
ARI 10	0.45	0.44	-0.01	-2.83
ARI 100	0.86	0.84	-0.02	-2.12

TP108 Pond Sizing  
Worksheet 2: Graphical Peak Flow rate (Standard Version)

Date: 21.07.2023  
Calc by: TG

Project: GOODLAND COASTAL FARM  
Location: 2127 KAIPARA COAST HIGHWAY  
Job Number: 1366  
Catchment Description: Wetland 6

Present (circled)      Developed      Pervious Catchment

- Data  
Catchment Area A= 0.0293 km<sup>2</sup>  
Runoff Curve No 74  
Initial Abstraction 5 mm  
Time of Concentration 0.17 hrs
- Calculate Storage, S = (1000/CN - 10) x 25.4      89.2 mm

- Average Recurrence Interval ARI
- 24 hour rainfall depth, P<sub>24</sub> (mm)
- Compute C\*
- Specific peak flow rate q\*
- Peak flow rate, q<sub>p</sub>
- Runoff depth, Q<sub>24</sub> (mm)
- Runoff Volume V<sub>24</sub> = 1000xQ<sub>24</sub>A (m<sup>3</sup>)

Storm 1	Storm 2	Storm 3	Storm 4
	2	10	100
	93	170	280
	0.32	0.47	0.60
	0.089	0.120	0.140
	0.241	0.600	1.145
	43.43	107.08	207.62
	1273	3138	6083

pre 1. Runoff Curve Number (CN) and Initial Abstraction (Ia)				
Soil name and classification	Cover description (cover type, treatment & hydrologic condition)	Curve Number CN*	Area (ha)	Product of CN x area
Type C	Permeable Area	74	2.9300	216.82
	Impermeable Area	98	0.0000	0
* from Appendix B			Totals =	217
CN (weighted) = total producted / total area =			74.00	
Ia (weighted) = 5 x pervious area / total area =			5.0 mm	

Present      Developed (circled)      Impervious Catchment

- Data  
Catchment Area A= 0.0288 km<sup>2</sup>  
Runoff Curve No 74  
Initial Abstraction 4.8 mm  
Time of Concentration 0.17 hrs
- Calculate Storage, S = (1000/CN - 10) x 25.4      89.6 mm

- Average Recurrence Interval ARI
- 24 hour rainfall depth, P<sub>24</sub> (mm)
- Compute C\*
- Specific peak flow rate q\*
- Peak flow rate, q<sub>p</sub>
- Runoff depth, Q<sub>24</sub> (mm)
- Runoff Volume V<sub>24</sub> = 1000xQ<sub>24</sub>A (m<sup>3</sup>)

Storm 1	Storm 2	Storm 3	Storm 4
	2	10	100
	93	170	280
	0.32	0.47	0.60
	0.089	0.120	0.140
	0.237	0.589	1.125
	43.49	107.12	207.62
	1253	3085	5979

pre 2. Time of Concentration			
Channelisation factor .....	C =	0.80	(from Table 4.2)
Catchment length .....	L =	0.29	km (along drainage path)
Catchment slope .....	S <sub>c</sub> =	0.15	m/m (by equal area method)
Runoff factor, CN / (200 - CN) =		0.59	
t <sub>c</sub> = 0.14 C L <sup>0.66</sup> (CN / (200 - CN)) <sup>-0.55</sup> S <sub>c</sub> <sup>-0.30</sup>		0.117	hrs
Adopted to =		0.17	hrs      0.17hrs min
SCS Lag for HEC-HMS .....	T <sub>p</sub> = 2 / 3 t <sub>c</sub>	0.11	hrs

- Combine Results  
Average recurrence Interval, ARI (yr)  
Flow (Impervious + Pervious) m<sup>3</sup>/s  
Runoff Volume (Impervious + Pervious) m<sup>3</sup>

Combined			
0	2	10	100
0.000	-0.004	-0.010	-0.020
0	-20	-53	-104

post 1. Runoff Curve Number (CN) and Initial Abstraction (Ia)				
Soil name and classification	Cover description (cover type, treatment & hydrologic condition)	Curve Number CN*	Area (ha)	Product of CN x area
Type C	Permeable Area	73	2.7725	202.39
	Impermeable Area	98	0.1075	11
* from Appendix B			Totals =	213
CN (weighted) = total producted / total area =			73.93	
Ia (weighted) = 5 x pervious area / total area =			4.8 mm	

Runoff Volumes m <sup>3</sup>	Pre-Deve	Post-Dev	Difference	Difference (%)
Area (ha)	2.93	2.88	-0.05	-1.71
ARI 2	1272.51	1252.61	-19.90	-1.56
ARI 10	3137.52	3084.93	-52.59	-1.68
ARI 100	6083.33	5979.48	-103.85	-1.71
Peak Flow Rates m <sup>3</sup> /s	Pre-Deve	Post-Dev	Difference	Difference (%)
Area (ha)	2.93	2.88	-0.05	-1.71
ARI 2	0.24	0.24	0.00	-1.65
ARI 10	0.60	0.59	-0.01	-1.75
ARI 100	1.15	1.12	-0.02	-1.75

post 2. Time of Concentration			
Channelisation factor .....	C =	0.80	(from Table 4.2)
Catchment length .....	L =	0.29	km (along drainage path)
Catchment slope .....	S <sub>c</sub> =	0.15	m/m (by equal area method)
Runoff factor, CN / (200 - CN) =		0.59	
t <sub>c</sub> = 0.14 C L <sup>0.66</sup> (CN / (200 - CN)) <sup>-0.55</sup> S <sub>c</sub> <sup>-0.30</sup>		0.117	hrs
Adopted to =		0.17	hrs      0.17hrs min
SCS Lag for HEC-HMS .....	T <sub>p</sub> = 2 / 3 t <sub>c</sub>	0.11	hrs

TP108 Pond Sizing  
Worksheet 2: Graphical Peak Flow rate (Standard Version)

Date: 21.07.2023  
Calc by: TG

Project: GOODLAND COASTAL FARM  
Location: 2127 KAIPARA COAST HIGHWAY  
Job Number: 1366  
Catchment Description: Wetland 7

Present (circled)      Developed      Pervious Catchment

1. Data  
Catchment Area A= 0.0251 km<sup>2</sup>  
Runoff Curve No 74  
Initial Abstraction 5 mm  
Time of Concentration 0.17 hrs

2. Calculate Storage, S = (1000/CN - 10) x 25.4      89.2 mm

3. Average Recurrence Interval ARI

4. 24 hour rainfall depth, P<sub>24</sub> (mm)

5. Compute C\*

6. Specific peak flow rate q\*

7. Peak flow rate, q<sub>p</sub>

8. Runoff depth, Q<sub>24</sub> (mm)

9. Runoff Volume V<sub>24</sub> = 1000xQ<sub>24</sub>A (m<sup>3</sup>)

Storm 1	Storm 2	Storm 3	Storm 4
	2	10	100
	93	170	280
	0.32	0.47	0.60
	0.089	0.120	0.140
	0.207	0.514	0.981
	43.43	107.08	207.62
	1090	2688	5211

pre 1. Runoff Curve Number (CN) and Initial Abstraction (Ia)				
Soil name and classification	Cover description (cover type, treatment & hydrologic condition)	Curve Number CN*	Area (ha)	Product of CN x area
Type C	Permeable Area	74	2.5100	185.74
	Impermeable Area	98	0.0000	0
* from Appendix B			Totals =	2.5100
CN (weighted) = total producted / total area =			74.00	
Ia (weighted) = 5 x pervious area / total area =			5.0 mm	

Present      Developed (circled)      Impervious Catchment

1. Data  
Catchment Area A= 0.024 km<sup>2</sup>  
Runoff Curve No 72  
Initial Abstraction 4.7 mm  
Time of Concentration 0.17 hrs

2. Calculate Storage, S = (1000/CN - 10) x 25.4      98.8 mm

3. Average Recurrence Interval ARI

4. 24 hour rainfall depth, P<sub>24</sub> (mm)

5. Compute C\*

6. Specific peak flow rate q\*

7. Peak flow rate, q<sub>p</sub>

8. Runoff depth, Q<sub>24</sub> (mm)

9. Runoff Volume V<sub>24</sub> = 1000xQ<sub>24</sub>A (m<sup>3</sup>)

Storm 1	Storm 2	Storm 3	Storm 4
	2	10	100
	93	170	280
	0.30	0.45	0.58
	0.084	0.116	0.136
	0.187	0.473	0.916
	41.42	103.46	202.59
	994	2483	4862

pre 2. Time of Concentration			
Channelisation factor	C =	0.80	(from Table 4.2)
Catchment length	L =	0.34	km (along drainage path)
Catchment slope	S <sub>c</sub> =	0.17	m/m (by equal area method)
Runoff factor, CN / (200 - CN) =	0.59		
t <sub>c</sub> = 0.14 C L <sup>0.66</sup> (CN / (200 - CN)) <sup>-0.55</sup> S <sub>c</sub> <sup>-0.30</sup>	0.126	hrs	
Adopted t <sub>c</sub> =	0.17	hrs	0.17hrs min
SCS Lag for HEC-HMS	T <sub>p</sub> = 2 / 3 t <sub>c</sub>	0.11	hrs

post 1. Runoff Curve Number (CN) and Initial Abstraction (Ia)				
Soil name and classification	Cover description (cover type, treatment & hydrologic condition)	Curve Number CN*	Area (ha)	Product of CN x area
Type C	Permeable Area	73	2.2624	165.16
	Impermeable Area	98	0.1376	13
* from Appendix B			Totals =	2.4000
CN (weighted) = total producted / total area =			74.43	
Ia (weighted) = 5 x pervious area / total area =			4.7 mm	

10. Combine Results  
Average recurrence Interval, ARI (yr)  
Flow (Impervious + Pervious) m<sup>3</sup>/s  
Runoff Volume (Impervious + Pervious) m<sup>3</sup>

Combined			
0	2	10	100
0.000	-0.019	-0.041	-0.065
0	-96	-205	-349

post 2. Time of Concentration			
Channelisation factor	C =	0.80	(from Table 4.2)
Catchment length	L =	0.34	km (along drainage path)
Catchment slope	S <sub>c</sub> =	0.17	m/m (by equal area method)
Runoff factor, CN / (200 - CN) =	0.59		
t <sub>c</sub> = 0.14 C L <sup>0.66</sup> (CN / (200 - CN)) <sup>-0.55</sup> S <sub>c</sub> <sup>-0.30</sup>	0.125	hrs	
Adopted t <sub>c</sub> =	0.17	hrs	0.17hrs min
SCS Lag for HEC-HMS	T <sub>p</sub> = 2 / 3 t <sub>c</sub>	0.11	hrs

Runoff Volumes m <sup>3</sup>	Pre-Deve	Post-Deve	Difference	Difference (%)
Area (ha)	2.51	2.40	-0.11	-4.38
ARI 2	1090.10	993.97	-96.13	-8.82
ARI 10	2687.77	2483.00	-204.77	-7.62
ARI 100	5211.32	4862.23	-349.09	-6.70
Peak Flow Rates m <sup>3</sup> /s	Pre-Deve	Post-Deve	Difference	Difference (%)
Area (ha)	2.51	2.40	-0.11	-4.38
ARI 2	0.21	0.19	-0.02	-9.22
ARI 10	0.51	0.47	-0.04	-7.92
ARI 100	0.98	0.92	-0.07	-6.66

TP108 Pond Sizing  
Worksheet 2: Graphical Peak Flow rate (Standard Version)

Date: 21.07.2023  
Calc by: TG

Project: GOODLAND COASTAL FARM  
Location: 2127 KAIPARA COAST HIGHWAY  
Job Number: 1366  
Catchment Description: Wetland 8

Present (circled)      Developed      Pervious Catchment

1. Data  
Catchment Area A= 0.0259 km<sup>2</sup>  
Runoff Curve No 74  
Initial Abstraction 5 mm  
Time of Concentration 0.17 hrs

2. Calculate Storage, S = (1000/CN - 10) x 25.4 = 89.2 mm

3. Average Recurrence Interval ARI

4. 24 hour rainfall depth, P<sub>24</sub> (mm)

5. Compute C\*

6. Specific peak flow rate q\*

7. Peak flow rate, q<sub>p</sub>

8. Runoff depth, Q<sub>24</sub> (mm)

9. Runoff Volume V<sub>24</sub> = 1000xQ<sub>24</sub>A (m<sup>3</sup>)

Storm 1	Storm 2	Storm 3	Storm 4
	2	10	100
	93	170	280
	0.32	0.47	0.60
	0.089	0.120	0.140
	0.213	0.530	1.012
	43.43	107.08	207.62
	1125	2773	5377

1. Runoff Curve Number (CN) and Initial Abstraction (Ia)				
Soil name and classification	Cover description (cover type, treatment & hydrologic condition)	Curve Number CN*	Area (ha)	Product of CN x area
Type C	Permeable Area	74	2.5900	191.66
	Impermeable Area	98	0.0000	0
* from Appendix B			Totals =	192
CN (weighted) = total producted / total area =			74.00	
Ia (weighted) = 5 x pervious area / total area =			5.0 mm	

Present      Developed (circled)      Impervious Catchment

1. Data  
Catchment Area A= 0.0266 km<sup>2</sup>  
Runoff Curve No 75  
Initial Abstraction 4.7 mm  
Time of Concentration 0.17 hrs

2. Calculate Storage, S = (1000/CN - 10) x 25.4 = 86.3 mm

3. Average Recurrence Interval ARI

4. 24 hour rainfall depth, P<sub>24</sub> (mm)

5. Compute C\*

6. Specific peak flow rate q\*

7. Peak flow rate, q<sub>p</sub>

8. Runoff depth, Q<sub>24</sub> (mm)

9. Runoff Volume V<sub>24</sub> = 1000xQ<sub>24</sub>A (m<sup>3</sup>)

Storm 1	Storm 2	Storm 3	Storm 4
	2	10	100
	93	170	280
	0.33	0.48	0.61
	0.091	0.122	0.141
	0.224	0.552	1.048
	44.41	108.62	209.61
	1181	2889	5576

2. Time of Concentration			
Channelisation factor	C =	0.80	(from Table 4.2)
Catchment length	L =	0.26	km (along drainage path)
Catchment slope	S <sub>c</sub> =	0.14	m/m (by equal area method)
Runoff factor, CN / (200 - CN) =	0.59		
t <sub>c</sub> = 0.14 C L <sup>0.66</sup> (CN / (200 - CN)) <sup>-0.55</sup> S <sub>c</sub> <sup>-0.30</sup>	0.112	hrs	
Adopted t <sub>c</sub> =	0.17	hrs	0.17hrs min
SCS Lag for HEC-HMS	T <sub>p</sub> = 2 / 3 t <sub>c</sub>	0.11	hrs

10. Combine Results  
Average recurrence Interval, ARI (yr)  
Flow (Impervious + Pervious) m<sup>3</sup>/s  
Runoff Volume (Impervious + Pervious) m<sup>3</sup>

Combined			
0	2	10	100
0.000	0.011	0.022	0.036
0	56	116	198

1. Runoff Curve Number (CN) and Initial Abstraction (Ia)				
Soil name and classification	Cover description (cover type, treatment & hydrologic condition)	Curve Number CN*	Area (ha)	Product of CN x area
Type C	Permeable Area	73	2.4860	181.48
	Impermeable Area	98	0.1740	17
* from Appendix B			Totals =	199
CN (weighted) = total producted / total area =			74.64	
Ia (weighted) = 5 x pervious area / total area =			4.7 mm	

Runoff Volumes m <sup>3</sup>	Pre-Deve	Post-Dev	Difference	Difference (%)
Area (ha)	2.59	2.66	0.07	2.70
ARI 2	1124.84	1181.21	56.37	5.01
ARI 10	2773.44	2889.18	115.75	4.17
ARI 100	5377.42	5575.62	198.20	3.69
Peak Flow Rates m <sup>3</sup> /s	Pre-Deve	Post-Dev	Difference	Difference (%)
Area (ha)	2.59	2.66	0.07	2.70
ARI 2	0.21	0.22	0.01	4.98
ARI 10	0.53	0.55	0.02	4.16
ARI 100	1.01	1.05	0.04	3.54

2. Time of Concentration			
Channelisation factor	C =	0.80	(from Table 4.2)
Catchment length	L =	0.26	km (along drainage path)
Catchment slope	S <sub>c</sub> =	0.14	m/m (by equal area method)
Runoff factor, CN / (200 - CN) =	0.60		
t <sub>c</sub> = 0.14 C L <sup>0.66</sup> (CN / (200 - CN)) <sup>-0.55</sup> S <sub>c</sub> <sup>-0.30</sup>	0.111	hrs	
Adopted t <sub>c</sub> =	0.17	hrs	0.17hrs min
SCS Lag for HEC-HMS	T <sub>p</sub> = 2 / 3 t <sub>c</sub>	0.11	hrs

TP108 Pond Sizing  
Worksheet 2: Graphical Peak Flow rate (Standard Version)

Date: 21.07.2023  
Calc by: TG

Project: GOODLAND COASTAL FARM  
Location: 2127 KAIPARA COAST HIGHWAY  
Job Number: 1366  
Catchment Description: Wetland 9

Present (circled)      Developed      Pervious Catchment

1. Data  
Catchment Area A= 0.0756 km<sup>2</sup>  
Runoff Curve No 74  
Initial Abstraction 5 mm  
Time of Concentration 0.17 hrs

2. Calculate Storage, S = (1000/CN - 10) x 25.4      89.2 mm

3. Average Recurrence Interval ARI

4. 24 hour rainfall depth, P<sub>24</sub> (mm)

5. Compute C\*

6. Specific peak flow rate q\*

7. Peak flow rate, q<sub>p</sub>

8. Runoff depth, Q<sub>24</sub> (mm)

9. Runoff Volume V<sub>24</sub> = 1000xQ<sub>24</sub>A (m<sup>3</sup>)

Storm 1	Storm 2	Storm 3	Storm 4
	2	10	100
	93	170	280
	0.32	0.47	0.60
	0.089	0.120	0.140
	0.622	1.547	2.954
	43.43	107.08	207.62
	3283	8095	15696

pre 1. Runoff Curve Number (CN) and Initial Abstraction (Ia)				
Soil name and classification	Cover description (cover type, treatment & hydrologic condition)	Curve Number CN*	Area (ha)	Product of CN x area
Type C	Permeable Area	74	7.5600	559.44
	Impermeable Area	98	0.0000	0
* from Appendix B			Totals =	7.5600
CN (weighted) = total producted / total area =			74.00	
Ia (weighted) = 5 x pervious area / total area =			5.0 mm	

Present      Developed (circled)      Impervious Catchment

1. Data  
Catchment Area A= 0.0811 km<sup>2</sup>  
Runoff Curve No 74  
Initial Abstraction 4.8 mm  
Time of Concentration 0.17 hrs

2. Calculate Storage, S = (1000/CN - 10) x 25.4      88.5 mm

3. Average Recurrence Interval ARI

4. 24 hour rainfall depth, P<sub>24</sub> (mm)

5. Compute C\*

6. Specific peak flow rate q\*

7. Peak flow rate, q<sub>p</sub>

8. Runoff depth, Q<sub>24</sub> (mm)

9. Runoff Volume V<sub>24</sub> = 1000xQ<sub>24</sub>A (m<sup>3</sup>)

Storm 1	Storm 2	Storm 3	Storm 4
	2	10	100
	93	170	280
	0.32	0.48	0.60
	0.089	0.121	0.140
	0.672	1.667	3.177
	43.78	107.59	208.26
	3551	8726	16890

pre 2. Time of Concentration			
Channelisation factor	C =	0.80	(from Table 4.2)
Catchment length	L =	0.43	km (along drainage path)
Catchment slope	S <sub>c</sub> =	0.13	m/m (by equal area method)
Runoff factor, CN / (200 - CN) =	0.59		
t <sub>c</sub> = 0.14 C L <sup>0.66</sup> (CN / (200 - CN)) <sup>-0.55</sup> S <sub>c</sub> <sup>-0.30</sup>	0.161	hrs	
Adopted t <sub>c</sub> =	0.17	hrs	0.17hrs min
SCS Lag for HEC-HMS	T <sub>p</sub> = 2 / 3 t <sub>c</sub>	0.11	hrs

post 1. Runoff Curve Number (CN) and Initial Abstraction (Ia)				
Soil name and classification	Cover description (cover type, treatment & hydrologic condition)	Curve Number CN*	Area (ha)	Product of CN x area
Type C	Permeable Area	73	7.7344	564.61
	Impermeable Area	98	0.3756	37
* from Appendix B			Totals =	8.1100
CN (weighted) = total producted / total area =			74.16	
Ia (weighted) = 5 x pervious area / total area =			4.8 mm	

10. Combine Results  
Average recurrence Interval, ARI (yr)  
Flow (Impervious + Pervious) m<sup>3</sup>/s  
Runoff Volume (Impervious + Pervious) m<sup>3</sup>

Combined			
0	2	10	100
0.000	0.050	0.120	0.222
0	268	630	1193

post 2. Time of Concentration			
Channelisation factor	C =	0.80	(from Table 4.2)
Catchment length	L =	0.43	km (along drainage path)
Catchment slope	S <sub>c</sub> =	0.13	m/m (by equal area method)
Runoff factor, CN / (200 - CN) =	0.59		
t <sub>c</sub> = 0.14 C L <sup>0.66</sup> (CN / (200 - CN)) <sup>-0.55</sup> S <sub>c</sub> <sup>-0.30</sup>	0.161	hrs	
Adopted t <sub>c</sub> =	0.17	hrs	0.17hrs min
SCS Lag for HEC-HMS	T <sub>p</sub> = 2 / 3 t <sub>c</sub>	0.11	hrs

Runoff Volumes m <sup>3</sup>	Pre-Deve	Post-Dev	Difference	Difference (%)
Area (ha)	7.56	8.11	0.55	7.28
ARI 2	3283.33	3550.85	267.52	8.15
ARI 10	8095.44	8725.91	630.47	7.79
ARI 100	15696.24	16889.67	1193.43	7.60
Peak Flow Rates m <sup>3</sup> /s	Pre-Deve	Post-Dev	Difference	Difference (%)
Area (ha)	7.56	8.11	0.55	7.28
ARI 2	0.62	0.67	0.05	8.07
ARI 10	1.55	1.67	0.12	7.73
ARI 100	2.95	3.18	0.22	7.52

TP108 Pond Sizing  
Worksheet 2: Graphical Peak Flow rate (Standard Version)

Date: 21.07.2023  
Calc by: TG

Project: GOODLAND COASTAL FARM  
Location: 2127 KAIPARA COAST HIGHWAY  
Job Number: 1366  
Catchment Description: Wetland 10

Present (circled)      Developed      Pervious Catchment

1. Data  
Catchment Area A= 0.0789 km<sup>2</sup>  
Runoff Curve No 74  
Initial Abstraction 5 mm  
Time of Concentration 0.17 hrs

2. Calculate Storage, S = (1000/CN - 10) x 25.4      89.2 mm

3. Average Recurrence Interval ARI

4. 24 hour rainfall depth, P<sub>24</sub> (mm)

5. Compute C\*

6. Specific peak flow rate q\*

7. Peak flow rate, q<sub>p</sub>

8. Runoff depth, Q<sub>24</sub> (mm)

9. Runoff Volume V<sub>24</sub> = 1000xQ<sub>24</sub>A (m<sup>3</sup>)

Storm 1	Storm 2	Storm 3	Storm 4
	2	10	100
	93	170	280
	0.32	0.47	0.60
	0.089	0.120	0.140
	0.649	1.615	3.083
	43.43	107.08	207.62
	3427	8449	16381

pre 1. Runoff Curve Number (CN) and Initial Abstraction (Ia)				
Soil name and classification	Cover description (cover type, treatment & hydrologic condition)	Curve Number CN*	Area (ha)	Product of CN x area
Type C	Permeable Area	74	7.8900	583.86
	Impermeable Area	98	0.0000	0
* from Appendix B			Totals =	7.8900
CN (weighted) = total producted / total area =			74.00	
Ia (weighted) = 5 x pervious area / total area =			5.0 mm	

Present      Developed (circled)      Impervious Catchment

1. Data  
Catchment Area A= 0.0834 km<sup>2</sup>  
Runoff Curve No 74  
Initial Abstraction 4.8 mm  
Time of Concentration 0.17 hrs

2. Calculate Storage, S = (1000/CN - 10) x 25.4      88.2 mm

3. Average Recurrence Interval ARI

4. 24 hour rainfall depth, P<sub>24</sub> (mm)

5. Compute C\*

6. Specific peak flow rate q\*

7. Peak flow rate, q<sub>p</sub>

8. Runoff depth, Q<sub>24</sub> (mm)

9. Runoff Volume V<sub>24</sub> = 1000xQ<sub>24</sub>A (m<sup>3</sup>)

Storm 1	Storm 2	Storm 3	Storm 4
	2	10	100
	93	170	280
	0.32	0.48	0.61
	0.090	0.121	0.140
	0.692	1.716	3.267
	43.87	107.73	208.44
	3659	8985	17384

pre 2. Time of Concentration			
Channelisation factor	C =	0.80	(from Table 4.2)
Catchment length	L =	0.47	km (along drainage path)
Catchment slope	S <sub>c</sub> =	0.12	m/m (by equal area meth)
Runoff factor, CN / (200 - CN) =	0.59		
t <sub>c</sub> = 0.14 C L <sup>0.66</sup> (CN / (200 - CN)) <sup>-0.55</sup> S <sub>c</sub> <sup>-0.30</sup>	0.171	hrs	
Adopted t <sub>c</sub> =	0.17	hrs	0.17hrs min
SCS Lag for HEC-HMS	T <sub>p</sub> = 2 / 3 t <sub>c</sub>	0.11	hrs

post 1. Runoff Curve Number (CN) and Initial Abstraction (Ia)				
Soil name and classification	Cover description (cover type, treatment & hydrologic condition)	Curve Number CN*	Area (ha)	Product of CN x area
Type C	Permeable Area	73	7.9320	579.04
	Impermeable Area	98	0.4080	40
* from Appendix B			Totals =	8.3400
CN (weighted) = total producted / total area =			74.22	
Ia (weighted) = 5 x pervious area / total area =			4.8 mm	

post 2. Time of Concentration			
Channelisation factor	C =	0.80	(from Table 4.2)
Catchment length	L =	0.47	km (along drainage path)
Catchment slope	S <sub>c</sub> =	0.12	m/m (by equal area meth)
Runoff factor, CN / (200 - CN) =	0.59		
t <sub>c</sub> = 0.14 C L <sup>0.66</sup> (CN / (200 - CN)) <sup>-0.55</sup> S <sub>c</sub> <sup>-0.30</sup>	0.170	hrs	
Adopted t <sub>c</sub> =	0.17	hrs	0.17hrs min
SCS Lag for HEC-HMS	T <sub>p</sub> = 2 / 3 t <sub>c</sub>	0.11	hrs

10. Combine Results  
Average recurrence Interval, ARI (yr)  
Flow (Impervious + Pervious) m<sup>3</sup>/s  
Runoff Volume (Impervious + Pervious) m<sup>3</sup>

Combined			
0	2	10	100
0.000	0.043	0.101	0.184
0	232	536	1003

Runoff Volumes m <sup>3</sup>	Pre-Deve	Post-Dev	Difference	Difference (%)
Area (ha)	7.89	8.34	0.45	5.70
ARI 2	3426.65	3658.60	231.95	6.77
ARI 10	8448.81	8984.98	536.17	6.35
ARI 100	16381.40	17384.06	1002.67	6.12
Peak Flow Rates m <sup>3</sup> /s	Pre-Deve	Post-Dev	Difference	Difference (%)
Area (ha)	7.89	8.34	0.45	5.70
ARI 2	0.65	0.69	0.04	6.63
ARI 10	1.61	1.72	0.10	6.23
ARI 100	3.08	3.27	0.18	5.97

TP108 Pond Sizing  
Worksheet 2: Graphical Peak Flow rate (Standard Version)

Date: 21.07.2023  
Calc by: TG

Project: GOODLAND COASTAL FARM  
Location: 2127 KAIPARA COAST HIGHWAY  
Job Number: 1366  
Catchment Description: Wetland 11

Present (circled)      Developed      Pervious Catchment

1. Data  
Catchment Area A= 0.0557 km<sup>2</sup>  
Runoff Curve No 74  
Initial Abstraction 5 mm  
Time of Concentration 0.17 hrs

2. Calculate Storage, S = (1000/CN - 10) x 25.4      89.2 mm

3. Average Recurrence Interval ARI

4. 24 hour rainfall depth, P<sub>24</sub> (mm)

5. Compute C\*

6. Specific peak flow rate q\*

7. Peak flow rate, q<sub>p</sub>

8. Runoff depth, Q<sub>24</sub> (mm)

9. Runoff Volume V<sub>24</sub> = 1000xQ<sub>24</sub>A (m<sup>3</sup>)

Storm 1	Storm 2	Storm 3	Storm 4
	2	10	100
	93	170	280
	0.32	0.47	0.60
	0.089	0.120	0.140
	0.458	1.140	2.177
	43.43	107.08	207.62
	2419	5964	11565

pre 1. Runoff Curve Number (CN) and Initial Abstraction (Ia)				
Soil name and classification	Cover description (cover type, treatment & hydrologic condition)	Curve Number CN*	Area (ha)	Product of CN x area
Type C	Permeable Area	74	5.5700	412.18
	Impermeable Area	98	0.0000	0
* from Appendix B			Totals =	5.5700
CN (weighted) = total producted / total area =			74.00	
Ia (weighted) = 5 x pervious area / total area =			5.0 mm	

Present      Developed (circled)      Impervious Catchment

1. Data  
Catchment Area A= 0.0513 km<sup>2</sup>  
Runoff Curve No 75  
Initial Abstraction 4.6 mm  
Time of Concentration 0.17 hrs

2. Calculate Storage, S = (1000/CN - 10) x 25.4      83.6 mm

3. Average Recurrence Interval ARI

4. 24 hour rainfall depth, P<sub>24</sub> (mm)

5. Compute C\*

6. Specific peak flow rate q\*

7. Peak flow rate, q<sub>p</sub>

8. Runoff depth, Q<sub>24</sub> (mm)

9. Runoff Volume V<sub>24</sub> = 1000xQ<sub>24</sub>A (m<sup>3</sup>)

Storm 1	Storm 2	Storm 3	Storm 4
	2	10	100
	93	170	280
	0.33	0.49	0.62
	0.092	0.124	0.142
	0.439	1.078	2.036
	45.20	109.90	211.30
	2319	5638	10840

pre 2. Time of Concentration			
Channelisation factor	C =	0.80	(from Table 4.2)
Catchment length	L =	0.40	km (along drainage path)
Catchment slope	S <sub>c</sub> =	0.13	m/m (by equal area meth)
Runoff factor, CN / (200 - CN) =	0.59		
t <sub>c</sub> = 0.14 C L <sup>0.66</sup> (CN / (200 - CN)) <sup>-0.55</sup> S <sub>c</sub> <sup>-0.30</sup>	0.151	hrs	
Adopted t <sub>c</sub> =	0.17	hrs	0.17hrs min
SCS Lag for HEC-HMS	T <sub>p</sub> = 2 / 3 t <sub>c</sub>	0.11	hrs

post 1. Runoff Curve Number (CN) and Initial Abstraction (Ia)				
Soil name and classification	Cover description (cover type, treatment & hydrologic condition)	Curve Number CN*	Area (ha)	Product of CN x area
Type C	Permeable Area	73	4.6717	341.03
	Impermeable Area	98	0.4583	45
* from Appendix B			Totals =	5.1300
CN (weighted) = total producted / total area =			75.23	
Ia (weighted) = 5 x pervious area / total area =			4.6 mm	

post 2. Time of Concentration			
Channelisation factor	C =	0.80	(from Table 4.2)
Catchment length	L =	0.40	km (along drainage path)
Catchment slope	S <sub>c</sub> =	0.13	m/m (by equal area meth)
Runoff factor, CN / (200 - CN) =	0.60		
t <sub>c</sub> = 0.14 C L <sup>0.66</sup> (CN / (200 - CN)) <sup>-0.55</sup> S <sub>c</sub> <sup>-0.30</sup>	0.149	hrs	
Adopted t <sub>c</sub> =	0.17	hrs	0.17hrs min
SCS Lag for HEC-HMS	T <sub>p</sub> = 2 / 3 t <sub>c</sub>	0.11	hrs

10. Combine Results  
Average recurrence Interval, ARI (yr)  
Flow (Impervious + Pervious) m<sup>3</sup>/s  
Runoff Volume (Impervious + Pervious) m<sup>3</sup>

Combined			
0	2	10	100
0.000	-0.019	-0.062	-0.141
0	-100	-326	-725

Runoff Volumes m <sup>3</sup>	Pre-Deve Post-Dev Difference Difference (%)			
	Area (ha)	5.57	5.13	-0.44
ARI 2	2419.07	2318.65	-100.42	-4.15
ARI 10	5964.49	5638.00	-326.49	-5.47
ARI 100	11564.56	10839.83	-724.73	-6.27
Peak Flow Rates m <sup>3</sup> /s	Pre-Deve Post-Dev Difference Difference (%)			
	Area (ha)	5.57	5.13	-0.44
ARI 2	0.46	0.44	-0.02	-4.12
ARI 10	1.14	1.08	-0.06	-5.43
ARI 100	2.18	2.04	-0.14	-6.47

TP108 Pond Sizing  
Worksheet 2: Graphical Peak Flow rate (Standard Version)

Date: 21.07.2023  
Calc by: TG

Project: GOODLAND COASTAL FARM  
Location: 2127 KAIPARA COAST HIGHWAY  
Job Number: 1366  
Catchment Description: Wetland 12

Present (circled)      Developed      Pervious Catchment

- Data  
Catchment Area A= 0.0653 km<sup>2</sup>  
Runoff Curve No 74  
Initial Abstraction 5 mm  
Time of Concentration 0.17 hrs
- Calculate Storage,  $S = (1000/CN - 10) \times 25.4 \times 89.2$  mm

- Average Recurrence Interval ARI
- 24 hour rainfall depth, P<sub>24</sub> (mm)
- Compute C\*
- Specific peak flow rate q\*
- Peak flow rate, q<sub>p</sub>
- Runoff depth, Q<sub>24</sub> (mm)
- Runoff Volume V<sub>24</sub> = 1000xQ<sub>24</sub>A (m<sup>3</sup>)

Storm 1	Storm 2	Storm 3	Storm 4
	2	10	100
	93	170	280
	0.32	0.47	0.60
	0.089	0.120	0.140
	0.537	1.337	2.552
	43.43	107.08	207.62
	2836	6992	13558

pre 1. Runoff Curve Number (CN) and Initial Abstraction (Ia)				
Soil name and classification	Cover description (cover type, treatment & hydrologic condition)	Curve Number CN*	Area (ha)	Product of CN x area
Type C	Permeable Area	74	6.5300	483.22
	Impermeable Area	98	0.0000	0
* from Appendix B			Totals =	6.5300
CN (weighted) = total producted / total area =		74.00		
Ia (weighted) = 5 x pervious area / total area =		5.0 mm		

Present      Developed (circled)      Impervious Catchment

- Data  
Catchment Area A= 0.0595 km<sup>2</sup>  
Runoff Curve No 75  
Initial Abstraction 4.5 mm  
Time of Concentration 0.17 hrs
- Calculate Storage,  $S = (1000/CN - 10) \times 25.4 \times 83.0$  mm

- Average Recurrence Interval ARI
- 24 hour rainfall depth, P<sub>24</sub> (mm)
- Compute C\*
- Specific peak flow rate q\*
- Peak flow rate, q<sub>p</sub>
- Runoff depth, Q<sub>24</sub> (mm)
- Runoff Volume V<sub>24</sub> = 1000xQ<sub>24</sub>A (m<sup>3</sup>)

Storm 1	Storm 2	Storm 3	Storm 4
	2	10	100
	93	170	280
	0.33	0.49	0.62
	0.093	0.124	0.142
	0.512	1.254	2.365
	45.37	110.19	211.67
	2700	6556	12595

pre 2. Time of Concentration			
Channelisation factor	C =	0.80	(from Table 4.2)
Catchment length	L =	0.46	km (along drainage path)
Catchment slope	S <sub>c</sub> =	0.13	m/m (by equal area method)
Runoff factor, CN / (200 - CN) =		0.59	
$t_c = 0.14 C L^{0.66} (CN / (200 - CN))^{-0.55} S_c^{-0.30}$		0.168	hrs
Adopted t <sub>c</sub> =		0.17	hrs      0.17hrs min
SCS Lag for HEC-HMS		T <sub>p</sub> = 2 / 3 t <sub>c</sub>	0.11 hrs

- Combine Results  
Average recurrence Interval, ARI (yr)  
Flow (Impervious + Pervious) m<sup>3</sup>/s  
Runoff Volume (Impervious + Pervious) m<sup>3</sup>

Combined			
0	2	10	100
0.000	-0.026	-0.083	-0.187
0	-136	-436	-963

Runoff Volumes m <sup>3</sup>	Pre-Deve	Post-Dev	Difference	Difference (%)
Area (ha)	6.53	5.95	-0.58	-8.88
ARI 2	2836.00	2699.70	-136.29	-4.81
ARI 10	6992.49	6556.07	-436.42	-6.24
ARI 100	13557.73	12594.61	-963.12	-7.10
Peak Flow Rates m <sup>3</sup> /s	Pre-Deve	Post-Dev	Difference	Difference (%)
Area (ha)	6.53	5.95	-0.58	-8.88
ARI 2	0.54	0.51	-0.03	-4.76
ARI 10	1.34	1.25	-0.08	-6.18
ARI 100	2.55	2.37	-0.19	-7.32

post 1. Runoff Curve Number (CN) and Initial Abstraction (Ia)				
Soil name and classification	Cover description (cover type, treatment & hydrologic condition)	Curve Number CN*	Area (ha)	Product of CN x area
Type C	Permeable Area	73	5.3872	393.27
	Impermeable Area	98	0.5628	55
* from Appendix B			Totals =	5.9500
CN (weighted) = total producted / total area =		75.36		
Ia (weighted) = 5 x pervious area / total area =		4.5 mm		

post 2. Time of Concentration			
Channelisation factor	C =	0.80	(from Table 4.2)
Catchment length	L =	0.46	km (along drainage path)
Catchment slope	S <sub>c</sub> =	0.13	m/m (by equal area method)
Runoff factor, CN / (200 - CN) =		0.60	
$t_c = 0.14 C L^{0.66} (CN / (200 - CN))^{-0.55} S_c^{-0.30}$		0.166	hrs
Adopted t <sub>c</sub> =		0.17	hrs      0.17hrs min
SCS Lag for HEC-HMS		T <sub>p</sub> = 2 / 3 t <sub>c</sub>	0.11 hrs

TP108 Pond Sizing  
Worksheet 2: Graphical Peak Flow rate (Standard Version)

Date: 21.07.2023  
Calc by: TG

Project: GOODLAND COASTAL FARM  
Location: 2127 KAIPARA COAST HIGHWAY  
Job Number: 1366  
Catchment Description: Wetland 13

Present (circled)      Developed      Pervious Catchment

1. Data  
Catchment Area A= 0.0295 km<sup>2</sup>  
Runoff Curve No 74  
Initial Abstraction 5 mm  
Time of Concentration 0.17 hrs

2. Calculate Storage, S = (1000/CN - 10) x 25.4      89.2 mm

3. Average Recurrence Interval ARI

4. 24 hour rainfall depth, P<sub>24</sub> (mm)

5. Compute C\*

6. Specific peak flow rate q\*

7. Peak flow rate, q<sub>p</sub>

8. Runoff depth, Q<sub>24</sub> (mm)

9. Runoff Volume V<sub>24</sub> = 1000xQ<sub>24</sub>A (m<sup>3</sup>)

Storm 1	Storm 2	Storm 3	Storm 4
	2	10	100
	93	170	280
	0.32	0.47	0.60
	0.089	0.120	0.140
	0.243	0.604	1.153
	43.43	107.08	207.62
	1281	3159	6125

pre 1. Runoff Curve Number (CN) and Initial Abstraction (Ia)				
Soil name and classification	Cover description (cover type, treatment & hydrologic condition)	Curve Number CN*	Area (ha)	Product of CN x area
Type C	Permeable Area	74	2.9500	218.30
Type C	Impermeable Area	98	0.0460	5
* from Appendix B			Totals =	2.9960
CN (weighted) = total producted / total area =			74.37	
Ia (weighted) = 5 x pervious area / total area =			4.9 mm	

Present      Developed (circled)      Impervious Catchment

1. Data  
Catchment Area A= 0.0295 km<sup>2</sup>  
Runoff Curve No 73  
Initial Abstraction 4.9 mm  
Time of Concentration 0.17 hrs

2. Calculate Storage, S = (1000/CN - 10) x 25.4      92.1 mm

3. Average Recurrence Interval ARI

4. 24 hour rainfall depth, P<sub>24</sub> (mm)

5. Compute C\*

6. Specific peak flow rate q\*

7. Peak flow rate, q<sub>p</sub>

8. Runoff depth, Q<sub>24</sub> (mm)

9. Runoff Volume V<sub>24</sub> = 1000xQ<sub>24</sub>A (m<sup>3</sup>)

Storm 1	Storm 2	Storm 3	Storm 4
	2	10	100
	93	170	280
	0.31	0.47	0.59
	0.087	0.119	0.139
	0.239	0.597	1.144
	42.80	105.96	206.08
	1263	3126	6079

pre 2. Time of Concentration			
Channelisation factor .....	C =	0.80	(from Table 4.2)
Catchment length .....	L =	0.36	km (along drainage path)
Catchment slope .....	S <sub>c</sub> =	0.15	m/m (by equal area meth)
Runoff factor, CN / (200 - CN) =	0.59		
t <sub>c</sub> = 0.14 C L <sup>0.66</sup> (CN / (200 - CN)) <sup>-0.55</sup> S <sub>c</sub> <sup>-0.30</sup>	0.135	hrs	
Adopted tc =	0.17	hrs	0.17hrs min
SCS Lag for HEC-HMS .....	Tp = 2 / 3 t <sub>c</sub>	0.11	hrs

post 1. Runoff Curve Number (CN) and Initial Abstraction (Ia)				
Soil name and classification	Cover description (cover type, treatment & hydrologic condition)	Curve Number CN*	Area (ha)	Product of CN x area
Type C	Permeable Area	73	2.9040	211.99
Type C	Impermeable Area	98	0.0460	5
* from Appendix B			Totals =	2.9500
CN (weighted) = total producted / total area =			73.39	
Ia (weighted) = 5 x pervious area / total area =			4.9 mm	

10. Combine Results  
Average recurrence Interval, ARI (yr)  
Flow (Impervious + Pervious) m<sup>3</sup>/s  
Runoff Volume (Impervious + Pervious) m<sup>3</sup>

Combined			
0	2	10	100
0.000	-0.004	-0.007	-0.008
0	-19	-33	-45

Runoff Volumes m <sup>3</sup>	Pre-Deve	Post-Dev	Difference	Difference (%)
Area (ha)	2.95	2.95	0.00	0.00
ARI 2	1281.19	1262.55	-18.64	-1.46
ARI 10	3158.93	3125.87	-33.06	-1.05
ARI 100	6124.86	6079.40	-45.46	-0.74
Peak Flow Rates m <sup>3</sup> /s	Pre-Deve	Post-Dev	Difference	Difference (%)
Area (ha)	2.95	2.95	0.00	0.00
ARI 2	0.24	0.24	0.00	-1.57
ARI 10	0.60	0.60	-0.01	-1.15
ARI 100	1.15	1.14	-0.01	-0.73

post 2. Time of Concentration			
Channelisation factor .....	C =	0.80	(from Table 4.2)
Catchment length .....	L =	0.36	km (along drainage path)
Catchment slope .....	S <sub>c</sub> =	0.15	m/m (by equal area meth)
Runoff factor, CN / (200 - CN) =	0.58		
t <sub>c</sub> = 0.14 C L <sup>0.66</sup> (CN / (200 - CN)) <sup>-0.55</sup> S <sub>c</sub> <sup>-0.30</sup>	0.136	hrs	
Adopted tc =	0.17	hrs	0.17hrs min
SCS Lag for HEC-HMS .....	Tp = 2 / 3 t <sub>c</sub>	0.11	hrs

TP108 Pond Sizing  
Worksheet 2: Graphical Peak Flow rate (Standard Version)

Date: 21.07.2023  
Calc by: TG

Project: GOODLAND COASTAL FARM  
Location: 2127 KAIPARA COAST HIGHWAY  
Job Number: 1366  
Catchment Description: Wetland 14

Present (circled)      Developed      Pervious Catchment

1. Data  
Catchment Area A= 0.0032 km<sup>2</sup>  
Runoff Curve No 74  
Initial Abstraction 5 mm  
Time of Concentration 0.17 hrs

2. Calculate Storage, S = (1000/CN - 10) x 25.4      89.2 mm

3. Average Recurrence Interval ARI

4. 24 hour rainfall depth, P<sub>24</sub> (mm)

5. Compute C\*

6. Specific peak flow rate q\*

7. Peak flow rate, q<sub>p</sub>

8. Runoff depth, Q<sub>24</sub> (mm)

9. Runoff Volume V<sub>24</sub> = 1000xQ<sub>24</sub>A (m<sup>3</sup>)

Storm 1	Storm 2	Storm 3	Storm 4
	2	10	100
	93	170	280
	0.32	0.47	0.60
	0.089	0.120	0.140
	0.026	0.065	0.125
	43.43	107.08	207.62
	139	343	664

pre 1. Runoff Curve Number (CN) and Initial Abstraction (Ia)				
Soil name and classification	Cover description (cover type, treatment & hydrologic condition)	Curve Number CN*	Area (ha)	Product of CN x area
Type C	Permeable Area	74	0.3200	23.68
Type C	Impermeable Area	98	0.0000	0
* from Appendix B			Totals =	0.3200
CN (weighted) = total product / total area =			74.00	
Ia (weighted) = 5 x pervious area / total area =			5.0 mm	

Present      Developed (circled)      Impervious Catchment

1. Data  
Catchment Area A= 0.0032 km<sup>2</sup>  
Runoff Curve No 73  
Initial Abstraction 5.0 mm  
Time of Concentration 0.17 hrs

2. Calculate Storage, S = (1000/CN - 10) x 25.4      93.9 mm

3. Average Recurrence Interval ARI

4. 24 hour rainfall depth, P<sub>24</sub> (mm)

5. Compute C\*

6. Specific peak flow rate q\*

7. Peak flow rate, q<sub>p</sub>

8. Runoff depth, Q<sub>24</sub> (mm)

9. Runoff Volume V<sub>24</sub> = 1000xQ<sub>24</sub>A (m<sup>3</sup>)

Storm 1	Storm 2	Storm 3	Storm 4
	2	10	100
	93	170	280
	0.31	0.46	0.59
	0.086	0.118	0.138
	0.026	0.064	0.124
	42.31	105.14	204.98
	135	336	656

pre 2. Time of Concentration			
Channelisation factor .....	C =	0.80	(from Table 4.2)
Catchment length .....	L =	0.14	km (along drainage path)
Catchment slope .....	S <sub>c</sub> =	0.19	m/m (by equal area meth)
Runoff factor, CN / (200 - CN) =		0.59	
t <sub>c</sub> = 0.14 C L <sup>0.66</sup> (CN / (200 - CN)) <sup>-0.55</sup> S <sub>c</sub> <sup>-0.30</sup>		0.067	hrs
Adopted to =		0.17	hrs      0.17hrs min
SCS Lag for HEC-HMS .....	T <sub>p</sub> = 2 / 3 t <sub>c</sub>	0.11	hrs

post 1. Runoff Curve Number (CN) and Initial Abstraction (Ia)				
Soil name and classification	Cover description (cover type, treatment & hydrologic condition)	Curve Number CN*	Area (ha)	Product of CN x area
Type C	Permeable Area	73	0.3200	23.36
Type C	Impermeable Area	98	0.0000	0
* from Appendix B			Totals =	0.3200
CN (weighted) = total product / total area =			73.00	
Ia (weighted) = 5 x pervious area / total area =			5.0 mm	

10. Combine Results  
Average recurrence Interval, ARI (yr)  
Flow (Impervious + Pervious) m<sup>3</sup>/s  
Runoff Volume (Impervious + Pervious) m<sup>3</sup>

Combined			
ARI	Flow	Volume	
0	2	10	100
0.000	-0.001	-0.001	-0.002
0	-4	-6	-8

Runoff Volumes m <sup>3</sup>	Pre-Deve	Post-Deve	Difference	Difference (%)
	Area (ha)	0.32	0.32	0.00
ARI 2	138.98	135.38	-3.60	-2.59
ARI 10	342.66	336.44	-6.22	-1.82
ARI 100	664.39	655.92	-8.47	-1.27
Peak Flow Rates m <sup>3</sup> /s	Pre-Deve	Post-Deve	Difference	Difference (%)
	Area (ha)	0.32	0.32	0.00
ARI 2	0.03	0.03	0.00	-2.71
ARI 10	0.07	0.06	0.00	-1.94
ARI 100	0.13	0.12	0.00	-1.22

post 2. Time of Concentration			
Channelisation factor .....	C =	0.80	(from Table 4.2)
Catchment length .....	L =	0.14	km (along drainage path)
Catchment slope .....	S <sub>c</sub> =	0.19	m/m (by equal area meth)
Runoff factor, CN / (200 - CN) =		0.57	
t <sub>c</sub> = 0.14 C L <sup>0.66</sup> (CN / (200 - CN)) <sup>-0.55</sup> S <sub>c</sub> <sup>-0.30</sup>		0.068	hrs
Adopted to =		0.17	hrs      0.17hrs min
SCS Lag for HEC-HMS .....	T <sub>p</sub> = 2 / 3 t <sub>c</sub>	0.11	hrs

TP108 Pond Sizing  
Worksheet 2: Graphical Peak Flow rate (Standard Version)

Date: 21.07.2023  
Calc by: TG

Project: GOODLAND COASTAL FARM  
Location: 2127 KAIPARA COAST HIGHWAY  
Job Number: 1366  
Catchment Description: Wetland 15

Present (circled)      Developed      Pervious Catchment

1. Data  
Catchment Area A= 0.0084 km2  
Runoff Curve No 74  
Initial Abstraction 5 mm  
Time of Concentration 0.17 hrs

2. Calculate Storage, S = (1000/CN - 10) x 25.4      89.2 mm

3. Average Recurrence Interval ARI

4. 24 hour rainfall depth, P<sub>24</sub> (mm)

5. Compute C\*

6. Specific peak flow rate q\*

7. Peak flow rate, q<sub>p</sub>

8. Runoff depth, Q<sub>24</sub> (mm)

9. Runoff Volume V<sub>24</sub> = 1000xQ<sub>24</sub>A (m3)

Storm 1	Storm 2	Storm 3	Storm 4
	2	10	100
	93	170	280
	0.32	0.47	0.60
	0.089	0.120	0.140
	0.069	0.172	0.328
	43.43	107.08	207.62
	365	899	1744

pre 1. Runoff Curve Number (CN) and Initial Abstraction (Ia)				
Soil name and classification	Cover description (cover type, treatment & hydrologic condition)	Curve Number CN*	Area (ha)	Product of CN x area
Type C	Permeable Area	74	0.8400	62.16
Type C	Impermeable Area	98	0.0000	0
* from Appendix B			Totals =	0.8400
CN (weighted) = total producted / total area =			74.00	
Ia (weighted) = 5 x pervious area / total area =			5.0 mm	

Present      Developed (circled)      Impervious Catchment

1. Data  
Catchment Area A= 0.0084 km2  
Runoff Curve No 73  
Initial Abstraction 5.0 mm  
Time of Concentration 0.17 hrs

2. Calculate Storage, S = (1000/CN - 10) x 25.4      93.9 mm

3. Average Recurrence Interval ARI

4. 24 hour rainfall depth, P<sub>24</sub> (mm)

5. Compute C\*

6. Specific peak flow rate q\*

7. Peak flow rate, q<sub>p</sub>

8. Runoff depth, Q<sub>24</sub> (mm)

9. Runoff Volume V<sub>24</sub> = 1000xQ<sub>24</sub>A (m3)

Storm 1	Storm 2	Storm 3	Storm 4
	2	10	100
	93	170	280
	0.31	0.46	0.59
	0.086	0.118	0.138
	0.067	0.169	0.324
	42.31	105.14	204.98
	355	883	1722

pre 2. Time of Concentration			
Channelisation factor	C =	0.80	(from Table 4.2)
Catchment length	L =	0.21	km (along drainage path)
Catchment slope	S <sub>c</sub> =	0.17	m/m (by equal area meth)
Runoff factor, CN / (200 - CN) =	0.59		
t <sub>c</sub> = 0.14 C L <sup>0.66</sup> (CN / (200 - CN)) <sup>-0.55</sup> S <sub>c</sub> <sup>-0.30</sup>	0.090	hrs	
Adopted t <sub>c</sub> =	0.17	hrs	0.17hrs min
SCS Lag for HEC-HMS	T <sub>p</sub> = 2 / 3 t <sub>c</sub>	0.11	hrs

10. Combine Results  
Average recurrence Interval, ARI (yr)  
Flow (Impervious + Pervious) m3/s  
Runoff Volume (Impervious + Pervious) m3

Combined			
0	2	10	100
0.000	-0.002	-0.003	-0.004
0	-9	-16	-22

post 1. Runoff Curve Number (CN) and Initial Abstraction (Ia)				
Soil name and classification	Cover description (cover type, treatment & hydrologic condition)	Curve Number CN*	Area (ha)	Product of CN x area
Type C	Permeable Area	73	0.8400	61.32
Type C	Impermeable Area	98	0.0000	0
* from Appendix B			Totals =	0.8400
CN (weighted) = total producted / total area =			73.00	
Ia (weighted) = 5 x pervious area / total area =			5.0 mm	

Runoff Volumes m <sup>3</sup>	Pre-Deve	Post-Dev	Difference	Difference (%)
Area (ha)	0.84	0.84	0.00	0.00
ARI 2	364.81	355.37	-9.45	-2.59
ARI 10	899.49	883.16	-16.33	-1.82
ARI 100	1744.03	1721.80	-22.23	-1.27
Peak Flow Rates m <sup>3</sup> /s	Pre-Deve	Post-Dev	Difference	Difference (%)
Area (ha)	0.84	0.84	0.00	0.00
ARI 2	0.07	0.07	0.00	-2.71
ARI 10	0.17	0.17	0.00	-1.94
ARI 100	0.33	0.32	0.00	-1.22

post 2. Time of Concentration			
Channelisation factor	C =	0.80	(from Table 4.2)
Catchment length	L =	0.21	km (along drainage path)
Catchment slope	S <sub>c</sub> =	0.17	m/m (by equal area meth)
Runoff factor, CN / (200 - CN) =	0.57		
t <sub>c</sub> = 0.14 C L <sup>0.66</sup> (CN / (200 - CN)) <sup>-0.55</sup> S <sub>c</sub> <sup>-0.30</sup>	0.091	hrs	
Adopted t <sub>c</sub> =	0.17	hrs	0.17hrs min
SCS Lag for HEC-HMS	T <sub>p</sub> = 2 / 3 t <sub>c</sub>	0.11	hrs

TP108 Pond Sizing  
Worksheet 2: Graphical Peak Flow rate (Standard Version)

Date: 21.07.2023  
Calc by: TG

Project: GOODLAND COASTAL FARM  
Location: 2127 KAIPARA COAST HIGHWAY  
Job Number: 1366  
Catchment Description: Wetland 16

Present (circled)      Developed      Pervious Catchment

1. Data  
Catchment Area A= 0.0132 km<sup>2</sup>  
Runoff Curve No 74  
Initial Abstraction 5 mm  
Time of Concentration 0.17 hrs

2. Calculate Storage, S = (1000/CN - 10) x 25.4      89.2 mm

3. Average Recurrence Interval ARI

4. 24 hour rainfall depth, P<sub>24</sub> (mm)

5. Compute C\*

6. Specific peak flow rate q\*

7. Peak flow rate, q<sub>p</sub>

8. Runoff depth, Q<sub>24</sub> (mm)

9. Runoff Volume V<sub>24</sub> = 1000xQ<sub>24</sub>A (m<sup>3</sup>)

Storm 1	Storm 2	Storm 3	Storm 4
	2	10	100
	93	170	280
	0.32	0.47	0.60
	0.089	0.120	0.140
	0.109	0.270	0.516
	43.43	107.08	207.62
	573	1413	2741

pre 1. Runoff Curve Number (CN) and Initial Abstraction (Ia)				
Soil name and classification	Cover description (cover type, treatment & hydrologic condition)	Curve Number CN*	Area (ha)	Product of CN x area
Type C	Permeable Area	74	1.3200	97.68
	Impermeable Area	98	0.0000	0
* from Appendix B			Totals =	1.3200      98
CN (weighted) = total producted / total area =			74.00	
Ia (weighted) = 5 x pervious area / total area =			5.0 mm	

Present      Developed (circled)      Impervious Catchment

1. Data  
Catchment Area A= 0.0138 km<sup>2</sup>  
Runoff Curve No 75  
Initial Abstraction 4.7 mm  
Time of Concentration 0.17 hrs

2. Calculate Storage, S = (1000/CN - 10) x 25.4      86.6 mm

3. Average Recurrence Interval ARI

4. 24 hour rainfall depth, P<sub>24</sub> (mm)

5. Compute C\*

6. Specific peak flow rate q\*

7. Peak flow rate, q<sub>p</sub>

8. Runoff depth, Q<sub>24</sub> (mm)

9. Runoff Volume V<sub>24</sub> = 1000xQ<sub>24</sub>A (m<sup>3</sup>)

Storm 1	Storm 2	Storm 3	Storm 4
	2	10	100
	93	170	280
	0.32	0.48	0.61
	0.091	0.122	0.141
	0.116	0.286	0.543
	44.31	108.47	209.41
	612	1497	2890

pre 2. Time of Concentration			
Channelisation factor .....	C =	0.80	(from Table 4.2)
Catchment length .....	L =	0.29	km (along drainage path)
Catchment slope .....	S <sub>c</sub> =	0.15	m/m (by equal area method)
Runoff factor, CN / (200 - CN) =	0.59		
t <sub>c</sub> = 0.14 C L <sup>0.66</sup> (CN / (200 - CN)) <sup>-0.55</sup> S <sub>c</sub> <sup>-0.30</sup>	0.117	hrs	
Adopted t <sub>c</sub> =	0.17	hrs	0.17hrs min
SCS Lag for HEC-HMS .....	T <sub>p</sub> = 2 / 3 t <sub>c</sub>	0.11	hrs

post 1. Runoff Curve Number (CN) and Initial Abstraction (Ia)				
Soil name and classification	Cover description (cover type, treatment & hydrologic condition)	Curve Number CN*	Area (ha)	Product of CN x area
Type C	Permeable Area	73	1.2936	94.43
	Impermeable Area	98	0.0864	8
* from Appendix B			Totals =	1.3800      103
CN (weighted) = total producted / total area =			74.57	
Ia (weighted) = 5 x pervious area / total area =			4.7 mm	

10. Combine Results  
Average recurrence Interval, ARI (yr)  
Flow (Impervious + Pervious) m<sup>3</sup>/s  
Runoff Volume (Impervious + Pervious) m<sup>3</sup>

Combined			
0	2	10	100
0.000	0.007	0.016	0.027
0	38	83	149

post 2. Time of Concentration			
Channelisation factor .....	C =	0.80	(from Table 4.2)
Catchment length .....	L =	0.29	km (along drainage path)
Catchment slope .....	S <sub>c</sub> =	0.15	m/m (by equal area method)
Runoff factor, CN / (200 - CN) =	0.59		
t <sub>c</sub> = 0.14 C L <sup>0.66</sup> (CN / (200 - CN)) <sup>-0.55</sup> S <sub>c</sub> <sup>-0.30</sup>	0.116	hrs	
Adopted t <sub>c</sub> =	0.17	hrs	0.17hrs min
SCS Lag for HEC-HMS .....	T <sub>p</sub> = 2 / 3 t <sub>c</sub>	0.11	hrs

Runoff Volumes m <sup>3</sup>	Pre-Deve	Post-Dev	Difference	Difference (%)
Area (ha)	1.32	1.38	0.06	4.55
ARI 2	573.28	611.54	38.26	6.67
ARI 10	1413.49	1496.83	83.34	5.90
ARI 100	2740.61	2889.87	149.26	5.45
Peak Flow Rates m <sup>3</sup> /s	Pre-Deve	Post-Dev	Difference	Difference (%)
Area (ha)	1.32	1.38	0.06	4.55
ARI 2	0.11	0.12	0.01	6.63
ARI 10	0.27	0.29	0.02	5.87
ARI 100	0.52	0.54	0.03	5.30

TP108 Pond Sizing  
Worksheet 2: Graphical Peak Flow rate (Standard Version)

Date: 21.07.2023  
Calc by: TG

Project: GOODLAND COASTAL FARM  
Location: 2127 KAIPARA COAST HIGHWAY  
Job Number: 1366  
Catchment Description: Wetland 17

Present (circled)      Developed      Pervious Catchment

1. Data  
Catchment Area A= 0.0918 km<sup>2</sup>  
Runoff Curve No 74  
Initial Abstraction 5 mm  
Time of Concentration 0.17 hrs

2. Calculate Storage, S = (1000/CN - 10) x 25.4      89.2 mm

3. Average Recurrence Interval ARI

4. 24 hour rainfall depth, P<sub>24</sub> (mm)

5. Compute C\*

6. Specific peak flow rate q\*

7. Peak flow rate, q<sub>p</sub>

8. Runoff depth, Q<sub>24</sub> (mm)

9. Runoff Volume V<sub>24</sub> = 1000xQ<sub>24</sub>A (m<sup>3</sup>)

Storm 1	Storm 2	Storm 3	Storm 4
	2	10	100
	93	170	280
	0.32	0.47	0.60
	0.089	0.120	0.140
	0.755	1.879	3.587
	43.43	107.08	207.62
	3987	9830	19060

pre 1. Runoff Curve Number (CN) and Initial Abstraction (Ia)				
Soil name and classification	Cover description (cover type, treatment & hydrologic condition)	Curve Number CN*	Area (ha)	Product of CN x area
Type C	Permeable Area	74	9.1800	679.32
	Impermeable Area	98	0.0000	0
* from Appendix B			Totals =	9.1800
CN (weighted) = total producted / total area =		74.00		
Ia (weighted) = 5 x pervious area / total area =		5.0 mm		

Present      Developed (circled)      Impervious Catchment

1. Data  
Catchment Area A= 0.0851 km<sup>2</sup>  
Runoff Curve No 75  
Initial Abstraction 4.5 mm  
Time of Concentration 0.21 hrs

2. Calculate Storage, S = (1000/CN - 10) x 25.4      82.8 mm

3. Average Recurrence Interval ARI

4. 24 hour rainfall depth, P<sub>24</sub> (mm)

5. Compute C\*

6. Specific peak flow rate q\*

7. Peak flow rate, q<sub>p</sub>

8. Runoff depth, Q<sub>24</sub> (mm)

9. Runoff Volume V<sub>24</sub> = 1000xQ<sub>24</sub>A (m<sup>3</sup>)

Storm 1	Storm 2	Storm 3	Storm 4
	2	10	100
	93	170	280
	0.34	0.49	0.62
	0.103	0.136	0.156
	0.810	1.964	3.713
	45.46	110.32	211.85
	3868	9388	18028

pre 2. Time of Concentration			
Channelisation factor	C =	0.80	(from Table 4.2)
Catchment length	L =	0.60	km (along drainage path)
Catchment slope	S <sub>c</sub> =	0.11	m/m (by equal area meth)
Runoff factor, CN / (200 - CN) =	0.59		
t <sub>c</sub> = 0.14 C L <sup>0.66</sup> (CN / (200 - CN)) <sup>-0.55</sup> S <sub>c</sub> <sup>-0.30</sup>	0.209 hrs		
Adopted t <sub>c</sub> =	0.21 hrs      0.17hrs min		
SCS Lag for HEC-HMS	..... Tp = 2 / 3 t <sub>c</sub>	0.14 hrs	

post 1. Runoff Curve Number (CN) and Initial Abstraction (Ia)				
Soil name and classification	Cover description (cover type, treatment & hydrologic condition)	Curve Number CN*	Area (ha)	Product of CN x area
Type C	Permeable Area	73	7.6840	560.93
	Impermeable Area	98	0.8260	81
* from Appendix B			Totals =	8.5100
CN (weighted) = total producted / total area =		75.43		
Ia (weighted) = 5 x pervious area / total area =		4.5 mm		

10. Combine Results  
Average recurrence Interval, ARI (yr)  
Flow (Impervious + Pervious) m<sup>3</sup>/s  
Runoff Volume (Impervious + Pervious) m<sup>3</sup>

Combined			
0	2	10	100
0.000	0.055	0.085	0.125
0	-119	-442	-1031

post 2. Time of Concentration			
Channelisation factor	C =	0.80	(from Table 4.2)
Catchment length	L =	0.60	km (along drainage path)
Catchment slope	S <sub>c</sub> =	0.11	m/m (by equal area meth)
Runoff factor, CN / (200 - CN) =	0.61		
t <sub>c</sub> = 0.14 C L <sup>0.66</sup> (CN / (200 - CN)) <sup>-0.55</sup> S <sub>c</sub> <sup>-0.30</sup>	0.205 hrs		
Adopted t <sub>c</sub> =	0.21 hrs      0.17hrs min		
SCS Lag for HEC-HMS	..... Tp = 2 / 3 t <sub>c</sub>	0.14 hrs	

Runoff Volumes m <sup>3</sup>	Pre-Deve	Post-Dev	Difference	Difference (%)
Area (ha)	9.18	8.51	-0.67	-7.30
ARI 2	3986.90	3868.31	-118.59	-2.97
ARI 10	9830.17	9388.20	-441.97	-4.50
ARI 100	19059.72	18028.37	-1031.36	-5.41
Peak Flow Rates m <sup>3</sup> /s	Pre-Deve	Post-Dev	Difference	Difference (%)
Area (ha)	9.18	8.51	-0.67	-7.30
ARI 2	0.76	0.81	0.05	7.27
ARI 10	1.88	1.96	0.08	4.51
ARI 100	3.59	3.71	0.13	3.49

TP108 Pond Sizing  
Worksheet 2: Graphical Peak Flow rate (Standard Version)

Date: 21.07.2023  
Calc by: TG

Project: GOODLAND COASTAL FARM  
Location: 2127 KAIPARA COAST HIGHWAY  
Job Number: 1366  
Catchment Description: Wetland 18

Present (circled)      Developed      Pervious Catchment

1. Data  
Catchment Area A= 0.0005 km<sup>2</sup>  
Runoff Curve No 74  
Initial Abstraction 5 mm  
Time of Concentration 0.17 hrs

2. Calculate Storage, S = (1000/CN - 10) x 25.4      89.2 mm

3. Average Recurrence Interval ARI

4. 24 hour rainfall depth, P<sub>24</sub> (mm)

5. Compute C\*

6. Specific peak flow rate q\*

7. Peak flow rate, q<sub>p</sub>

8. Runoff depth, Q<sub>24</sub> (mm)

9. Runoff Volume V<sub>24</sub> = 1000xQ<sub>24</sub>A (m<sup>3</sup>)

Storm 1	Storm 2	Storm 3	Storm 4
	2	10	100
	92.65	170	280
	0.32	0.47	0.60
	0.089	0.120	0.140
	0.004	0.010	0.020
	43.43	107.08	207.62
	22	54	104

pre 1. Runoff Curve Number (CN) and Initial Abstraction (Ia)				
Soil name and classification	Cover description (cover type, treatment & hydrologic condition)	Curve Number CN*	Area (ha)	Product of CN x area
Type C	Permeable Area	74	0.0500	3.70
	Impermeable Area	98	0.0000	0
* from Appendix B			Totals =	4
CN (weighted) = total produced / total area =			74.00	
Ia (weighted) = 5 x pervious area / total area =			5.0 mm	

Present      Developed (circled)      Impervious Catchment

1. Data  
Catchment Area A= 0.0005 km<sup>2</sup>  
Runoff Curve No 73  
Initial Abstraction 5.0 mm  
Time of Concentration 0.17 hrs

2. Calculate Storage, S = (1000/CN - 10) x 25.4      93.9 mm

3. Average Recurrence Interval ARI

4. 24 hour rainfall depth, P<sub>24</sub> (mm)

5. Compute C\*

6. Specific peak flow rate q\*

7. Peak flow rate, q<sub>p</sub>

8. Runoff depth, Q<sub>24</sub> (mm)

9. Runoff Volume V<sub>24</sub> = 1000xQ<sub>24</sub>A (m<sup>3</sup>)

Storm 1	Storm 2	Storm 3	Storm 4
	2	10	100
	92.65	170	280
	0.31	0.46	0.59
	0.086	0.118	0.138
	0.004	0.010	0.019
	42.31	105.14	204.98
	21	53	102

pre 2. Time of Concentration			
Channelisation factor	C =	0.80	(from Table 4.2)
Catchment length	L =	0.29	km (along drainage path)
Catchment slope	S <sub>c</sub> =	0.15	m/m (by equal area method)
Runoff factor, CN / (200 - CN) =	0.59		
t <sub>c</sub> = 0.14 C L <sup>0.66</sup> (CN / (200 - CN)) <sup>-0.55</sup> S <sub>c</sub> <sup>-0.30</sup>	0.117	hrs	
Adopted t <sub>c</sub> =	0.17	hrs	0.17hrs min
SCS Lag for HEC-HMS	T <sub>p</sub> = 2 / 3 t <sub>c</sub>	0.11	hrs

post 1. Runoff Curve Number (CN) and Initial Abstraction (Ia)				
Soil name and classification	Cover description (cover type, treatment & hydrologic condition)	Curve Number CN*	Area (ha)	Product of CN x area
Type C	Permeable Area	73	0.0500	3.65
	Impermeable Area	98	0.0000	0
* from Appendix B			Totals =	4
CN (weighted) = total produced / total area =			73.00	
Ia (weighted) = 5 x pervious area / total area =			5.0 mm	

10. Combine Results  
Average recurrence Interval, ARI (yr)  
Flow (Impervious + Pervious) m<sup>3</sup>/s  
Runoff Volume (Impervious + Pervious) m<sup>3</sup>

Combined			
0	2	10	100
0.000	0.000	0.000	0.000
0	-1	-1	-1

Runoff Volumes m <sup>3</sup>	Pre-Deve	Post-Dev	Difference	Difference (%)
Area (ha)	0.05	0.05	0.00	0.00
ARI 2	21.72	21.15	-0.56	-2.59
ARI 10	53.54	52.57	-0.97	-1.82
ARI 100	103.81	102.49	-1.32	-1.27
Peak Flow Rates m <sup>3</sup> /s	Pre-Deve	Post-Dev	Difference	Difference (%)
Area (ha)	0.05	0.05	0.00	0.00
ARI 2	0.00	0.00	0.00	-2.71
ARI 10	0.01	0.01	0.00	-1.94
ARI 100	0.02	0.02	0.00	-1.22

post 2. Time of Concentration			
Channelisation factor	C =	0.80	(from Table 4.2)
Catchment length	L =	0.29	km (along drainage path)
Catchment slope	S <sub>c</sub> =	0.15	m/m (by equal area method)
Runoff factor, CN / (200 - CN) =	0.57		
t <sub>c</sub> = 0.14 C L <sup>0.66</sup> (CN / (200 - CN)) <sup>-0.55</sup> S <sub>c</sub> <sup>-0.30</sup>	0.118	hrs	
Adopted t <sub>c</sub> =	0.17	hrs	0.17hrs min
SCS Lag for HEC-HMS	T <sub>p</sub> = 2 / 3 t <sub>c</sub>	0.11	hrs

TP108 Pond Sizing  
Worksheet 2: Graphical Peak Flow rate (Standard Version)

Date: 21.07.2023  
Calc by: TG

Project: GOODLAND COASTAL FARM  
Location: 2127 KAIPARA COAST HIGHWAY  
Job Number: 1366  
Catchment Description: Wetland 19

Present (circled)      Developed      Pervious Catchment

1. Data  
Catchment Area A= 0.0383 km<sup>2</sup>  
Runoff Curve No 74  
Initial Abstraction 5 mm  
Time of Concentration 0.17 hrs

2. Calculate Storage, S = (1000/CN - 10) x 25.4      89.2 mm

3. Average Recurrence Interval ARI

4. 24 hour rainfall depth, P<sub>24</sub> (mm)

5. Compute C\*

6. Specific peak flow rate q\*

7. Peak flow rate, q<sub>p</sub>

8. Runoff depth, Q<sub>24</sub> (mm)

9. Runoff Volume V<sub>24</sub> = 1000xQ<sub>24</sub>A (m<sup>3</sup>)

Storm 1	Storm 2	Storm 3	Storm 4
	2	10	100
	93	170	280
	0.32	0.47	0.60
	0.089	0.120	0.140
	0.315	0.784	1.497
	43.43	107.08	207.62
	1663	4101	7952

pre 1. Runoff Curve Number (CN) and Initial Abstraction (Ia)				
Soil name and classification	Cover description (cover type, treatment & hydrologic condition)	Curve Number CN*	Area (ha)	Product of CN x area
Type C	Permeable Area	74	3.8300	283.42
	Impermeable Area	98	0.0000	0
* from Appendix B			Totals =	3.8300
CN (weighted) = total producted / total area =			74.00	
Ia (weighted) = 5 x pervious area / total area =			5.0 mm	

Present      Developed (circled)      Impervious Catchment

1. Data  
Catchment Area A= 0.0363 km<sup>2</sup>  
Runoff Curve No 74  
Initial Abstraction 4.9 mm  
Time of Concentration 0.17 hrs

2. Calculate Storage, S = (1000/CN - 10) x 25.4      90.8 mm

3. Average Recurrence Interval ARI

4. 24 hour rainfall depth, P<sub>24</sub> (mm)

5. Compute C\*

6. Specific peak flow rate q\*

7. Peak flow rate, q<sub>p</sub>

8. Runoff depth, Q<sub>24</sub> (mm)

9. Runoff Volume V<sub>24</sub> = 1000xQ<sub>24</sub>A (m<sup>3</sup>)

Storm 1	Storm 2	Storm 3	Storm 4
	2	10	100
	93	170	280
	0.31	0.47	0.60
	0.088	0.120	0.139
	0.297	0.739	1.413
	43.16	106.56	206.88
	1567	3868	7510

pre 2. Time of Concentration			
Channelisation factor	C =	0.80	(from Table 4.2)
Catchment length	L =	0.29	km (along drainage path)
Catchment slope	S <sub>c</sub> =	0.15	m/m (by equal area method)
Runoff factor, CN / (200 - CN) =	0.59		
t <sub>c</sub> = 0.14 C L <sup>0.66</sup> (CN / (200 - CN)) <sup>-0.55</sup> S <sub>c</sub> <sup>-0.30</sup>	0.117	hrs	
Adopted t <sub>c</sub> =	0.17	hrs	0.17hrs min
SCS Lag for HEC-HMS	T <sub>p</sub> = 2 / 3 t <sub>c</sub>	0.11	hrs

post 1. Runoff Curve Number (CN) and Initial Abstraction (Ia)				
Soil name and classification	Cover description (cover type, treatment & hydrologic condition)	Curve Number CN*	Area (ha)	Product of CN x area
Type C	Permeable Area	73	3.5324	257.87
	Impermeable Area	98	0.0976	10
* from Appendix B			Totals =	3.6300
CN (weighted) = total producted / total area =			73.67	
Ia (weighted) = 5 x pervious area / total area =			4.9 mm	

10. Combine Results  
Average recurrence Interval, ARI (yr)  
Flow (Impervious + Pervious) m<sup>3</sup>/s  
Runoff Volume (Impervious + Pervious) m<sup>3</sup>

Combined			
0	2	10	100
0.000	-0.019	-0.045	-0.083
0	-97	-233	-442

post 2. Time of Concentration			
Channelisation factor	C =	0.80	(from Table 4.2)
Catchment length	L =	0.29	km (along drainage path)
Catchment slope	S <sub>c</sub> =	0.15	m/m (by equal area method)
Runoff factor, CN / (200 - CN) =	0.58		
t <sub>c</sub> = 0.14 C L <sup>0.66</sup> (CN / (200 - CN)) <sup>-0.55</sup> S <sub>c</sub> <sup>-0.30</sup>	0.117	hrs	
Adopted t <sub>c</sub> =	0.17	hrs	0.17hrs min
SCS Lag for HEC-HMS	T <sub>p</sub> = 2 / 3 t <sub>c</sub>	0.11	hrs

Runoff Volumes m <sup>3</sup>	Pre-Deve	Post-Dev	Difference	Difference (%)
Area (ha)	3.83	3.63	-0.20	-5.22
ARI 2	1663.38	1566.64	-96.74	-5.82
ARI 10	4101.26	3868.15	-233.11	-5.68
ARI 100	7951.93	7509.80	-442.14	-5.56
Peak Flow Rates m <sup>3</sup> /s	Pre-Deve	Post-Dev	Difference	Difference (%)
Area (ha)	3.83	3.63	-0.20	-5.22
ARI 2	0.32	0.30	-0.02	-5.91
ARI 10	0.78	0.74	-0.05	-5.77
ARI 100	1.50	1.41	-0.08	-5.58

TP108 Pond Sizing  
Worksheet 2: Graphical Peak Flow rate (Standard Version)

Date: 21.07.2023  
Calc by: TG

Project: GOODLAND COASTAL FARM  
Location: 2127 KAIPARA COAST HIGHWAY  
Job Number: 1366  
Catchment Description: Wetland 20

Present (circled)      Developed      Pervious Catchment

1. Data  
Catchment Area A= 0.0135 km<sup>2</sup>  
Runoff Curve No 74  
Initial Abstraction 5 mm  
Time of Concentration 0.17 hrs

2. Calculate Storage, S = (1000/CN - 10) x 25.4 = 89.2 mm

3. Average Recurrence Interval ARI

4. 24 hour rainfall depth, P<sub>24</sub> (mm)

5. Compute C\*

6. Specific peak flow rate q\*

7. Peak flow rate, q<sub>p</sub>

8. Runoff depth, Q<sub>24</sub> (mm)

9. Runoff Volume V<sub>24</sub> = 1000xQ<sub>24</sub>A (m<sup>3</sup>)

Storm 1	Storm 2	Storm 3	Storm 4
	2	10	100
	93	170	280
	0.32	0.47	0.60
	0.089	0.120	0.140
	0.111	0.276	0.528
	43.43	107.08	207.62
	586	1446	2803

pre 1. Runoff Curve Number (CN) and Initial Abstraction (Ia)				
Soil name and classification	Cover description (cover type, treatment & hydrologic condition)	Curve Number CN*	Area (ha)	Product of CN x area
Type C	Permeable Area	74	1.3500	99.90
	Impermeable Area	98	0.0000	0
* from Appendix B			Totals =	1.3500
CN (weighted) = total producted / total area =			74.00	
Ia (weighted) = 5 x pervious area / total area =			5.0 mm	

Present      Developed (circled)      Impervious Catchment

1. Data  
Catchment Area A= 0.0127 km<sup>2</sup>  
Runoff Curve No 77  
Initial Abstraction 4.1 mm  
Time of Concentration 0.17 hrs

2. Calculate Storage, S = (1000/CN - 10) x 25.4 = 74.2 mm

3. Average Recurrence Interval ARI

4. 24 hour rainfall depth, P<sub>24</sub> (mm)

5. Compute C\*

6. Specific peak flow rate q\*

7. Peak flow rate, q<sub>p</sub>

8. Runoff depth, Q<sub>24</sub> (mm)

9. Runoff Volume V<sub>24</sub> = 1000xQ<sub>24</sub>A (m<sup>3</sup>)

Storm 1	Storm 2	Storm 3	Storm 4
	2	10	100
	93	170	280
	0.36	0.52	0.65
	0.099	0.128	0.146
	0.116	0.277	0.517
	48.16	114.61	217.40
	612	1456	2761

pre 2. Time of Concentration			
Channelisation factor	C =	0.80	(from Table 4.2)
Catchment length	L =	0.31	km (along drainage path)
Catchment slope	S <sub>c</sub> =	0.16	m/m (by equal area method)
Runoff factor, CN / (200 - CN) =	0.59		
t <sub>c</sub> = 0.14 C L <sup>0.66</sup> (CN / (200 - CN)) <sup>-0.55</sup> S <sub>c</sub> <sup>-0.30</sup>	0.118	hrs	
Adopted t <sub>c</sub> =	0.17	hrs	0.17hrs min
SCS Lag for HEC-HMS	T <sub>p</sub> = 2 / 3 t <sub>c</sub>	0.11	hrs

post 1. Runoff Curve Number (CN) and Initial Abstraction (Ia)				
Soil name and classification	Cover description (cover type, treatment & hydrologic condition)	Curve Number CN*	Area (ha)	Product of CN x area
Type C	Permeable Area	73	1.0470	76.43
	Impermeable Area	98	0.2230	22
* from Appendix B			Totals =	1.2700
CN (weighted) = total producted / total area =			77.39	
Ia (weighted) = 5 x pervious area / total area =			4.1 mm	

10. Combine Results  
Average recurrence Interval, ARI (yr)  
Flow (Impervious + Pervious) m<sup>3</sup>/s  
Runoff Volume (Impervious + Pervious) m<sup>3</sup>

Combined			
0	2	10	100
0.000	0.005	0.001	-0.010
0	25	10	-42

post 2. Time of Concentration			
Channelisation factor	C =	0.80	(from Table 4.2)
Catchment length	L =	0.25	km (along drainage path)
Catchment slope	S <sub>c</sub> =	0.17	m/m (by equal area method)
Runoff factor, CN / (200 - CN) =	0.63		
t <sub>c</sub> = 0.14 C L <sup>0.66</sup> (CN / (200 - CN)) <sup>-0.55</sup> S <sub>c</sub> <sup>-0.30</sup>	0.098	hrs	
Adopted t <sub>c</sub> =	0.17	hrs	0.17hrs min
SCS Lag for HEC-HMS	T <sub>p</sub> = 2 / 3 t <sub>c</sub>	0.11	hrs

Runoff Volumes m <sup>3</sup>	Pre-Deve	Post-Dev	Difference	Difference (%)
Area (ha)	1.35	1.27	-0.08	-5.93
ARI 2	586.31	611.62	25.31	4.32
ARI 10	1445.61	1455.50	9.89	0.68
ARI 100	2802.90	2760.97	-41.93	-1.50
Peak Flow Rates m <sup>3</sup> /s	Pre-Deve	Post-Dev	Difference	Difference (%)
Area (ha)	1.35	1.27	-0.08	-5.93
ARI 2	0.11	0.12	0.01	4.75
ARI 10	0.28	0.28	0.00	0.31
ARI 100	0.53	0.52	-0.01	-1.91

TP108 Pond Sizing  
Worksheet 2: Graphical Peak Flow rate (Standard Version)

Date: 21.07.2023  
Calc by: TG

Project: GOODLAND COASTAL FARM  
Location: 2127 KAIPARA COAST HIGHWAY  
Job Number: 1366  
Catchment Description: Wetland 21

Present (circled)      Developed      Pervious Catchment

- Data  
Catchment Area A= 0.0401 km<sup>2</sup>  
Runoff Curve No 74  
Initial Abstraction 5 mm  
Time of Concentration 0.17 hrs
- Calculate Storage, S = (1000/CN - 10) x 25.4      89.2 mm

- Average Recurrence Interval ARI
- 24 hour rainfall depth, P<sub>24</sub> (mm)
- Compute C\*
- Specific peak flow rate q\*
- Peak flow rate, q<sub>p</sub>
- Runoff depth, Q<sub>24</sub> (mm)
- Runoff Volume V<sub>24</sub> = 1000xQ<sub>24</sub>A (m<sup>3</sup>)

Storm 1	Storm 2	Storm 3	Storm 4
	2	10	100
	92.65	170	280
	0.32	0.47	0.60
	0.089	0.120	0.140
	0.330	0.821	1.567
	43.43	107.08	207.62
	1742	4294	8326

pre 1. Runoff Curve Number (CN) and Initial Abstraction (Ia)				
Soil name and classification	Cover description (cover type, treatment & hydrologic condition)	Curve Number CN*	Area (ha)	Product of CN x area
Type C	Permeable Area	74	4.0100	296.74
	Impermeable Area	98	0.0000	0
* from Appendix B			Totals =	4.0100
CN (weighted) = total producted / total area =			74.00	
Ia (weighted) = 5 x pervious area / total area =			5.0 mm	

Present      Developed (circled)      Impervious Catchment

- Data  
Catchment Area A= 0.0401 km<sup>2</sup>  
Runoff Curve No 73  
Initial Abstraction 5.0 mm  
Time of Concentration 0.17 hrs
- Calculate Storage, S = (1000/CN - 10) x 25.4      93.9 mm

- Average Recurrence Interval ARI
- 24 hour rainfall depth, P<sub>24</sub> (mm)
- Compute C\*
- Specific peak flow rate q\*
- Peak flow rate, q<sub>p</sub>
- Runoff depth, Q<sub>24</sub> (mm)
- Runoff Volume V<sub>24</sub> = 1000xQ<sub>24</sub>A (m<sup>3</sup>)

Storm 1	Storm 2	Storm 3	Storm 4
	2	10	100
	92.65	170	280
	0.31	0.46	0.59
	0.086	0.118	0.138
	0.321	0.805	1.548
	42.31	105.14	204.98
	1696	4216	8220

pre 2. Time of Concentration			
Channelisation factor	C =	0.80	(from Table 4.2)
Catchment length	L =	0.41	km (along drainage path)
Catchment slope	S <sub>c</sub> =	0.15	m/m (by equal area method)
Runoff factor, CN / (200 - CN) =	0.59		
t <sub>c</sub> = 0.14 C L <sup>0.66</sup> (CN / (200 - CN)) <sup>-0.55</sup> S <sub>c</sub> <sup>-0.30</sup>	0.148	hrs	
Adopted tc =	0.17	hrs	0.17hrs min
SCS Lag for HEC-HMS	Tp = 2 / 3 t <sub>c</sub>	0.11	hrs

- Combine Results  
Average recurrence Interval, ARI (yr)  
Flow (Impervious + Pervious) m<sup>3</sup>/s  
Runoff Volume (Impervious + Pervious) m<sup>3</sup>

Combined			
0	2	10	100
0.000	-0.009	-0.016	-0.019
0	-45	-78	-106

post 1. Runoff Curve Number (CN) and Initial Abstraction (Ia)				
Soil name and classification	Cover description (cover type, treatment & hydrologic condition)	Curve Number CN*	Area (ha)	Product of CN x area
Type C	Permeable Area	73	4.0100	292.73
	Impermeable Area	98	0.0000	0
* from Appendix B			Totals =	4.0100
CN (weighted) = total producted / total area =			73.00	
Ia (weighted) = 5 x pervious area / total area =			5.0 mm	

Runoff Volumes m <sup>3</sup>	Pre-Deve	Post-Dev	Difference	Difference (%)
Area (ha)	4.01	4.01	0.00	0.00
ARI 2	1741.55	1696.46	-45.09	-2.59
ARI 10	4294.01	4216.04	-77.97	-1.82
ARI 100	8325.65	8219.55	-106.10	-1.27
Peak Flow Rates m <sup>3</sup> /s	Pre-Deve	Post-Dev	Difference	Difference (%)
Area (ha)	4.01	4.01	0.00	0.00
ARI 2	0.33	0.32	-0.01	-2.71
ARI 10	0.82	0.80	-0.02	-1.94
ARI 100	1.57	1.55	-0.02	-1.22

post 2. Time of Concentration			
Channelisation factor	C =	0.80	(from Table 4.2)
Catchment length	L =	0.41	km (along drainage path)
Catchment slope	S <sub>c</sub> =	0.15	m/m (by equal area method)
Runoff factor, CN / (200 - CN) =	0.57		
t <sub>c</sub> = 0.14 C L <sup>0.66</sup> (CN / (200 - CN)) <sup>-0.55</sup> S <sub>c</sub> <sup>-0.30</sup>	0.149	hrs	
Adopted tc =	0.17	hrs	0.17hrs min
SCS Lag for HEC-HMS	Tp = 2 / 3 t <sub>c</sub>	0.11	hrs

TP108 Pond Sizing  
Worksheet 2: Graphical Peak Flow rate (Standard Version)

Date: 21.07.2023  
Calc by: TG

Project: GOODLAND COASTAL FARM  
Location: 2127 KAIPARA COAST HIGHWAY  
Job Number: 1366  
Catchment Description: Wetland 22

Present (circled)      Developed      Pervious Catchment

1. Data  
Catchment Area A= 0.0217 km<sup>2</sup>  
Runoff Curve No 74  
Initial Abstraction 5 mm  
Time of Concentration 0.17 hrs

2. Calculate Storage, S = (1000/CN - 10) x 25.4      89.2 mm

3. Average Recurrence Interval ARI

4. 24 hour rainfall depth, P<sub>24</sub> (mm)

5. Compute C\*

6. Specific peak flow rate q\*

7. Peak flow rate, q<sub>p</sub>

8. Runoff depth, Q<sub>24</sub> (mm)

9. Runoff Volume V<sub>24</sub> = 1000xQ<sub>24</sub>A (m<sup>3</sup>)

Storm 1	Storm 2	Storm 3	Storm 4
	2	10	100
	92.65	170	280
	0.32	0.47	0.60
	0.089	0.120	0.140
	0.179	0.444	0.848
	43.43	107.08	207.62
	942	2324	4505

pre 1. Runoff Curve Number (CN) and Initial Abstraction (Ia)				
Soil name and classification	Cover description (cover type, treatment & hydrologic condition)	Curve Number CN*	Area (ha)	Product of CN x area
Type C	Permeable Area	74	2.1700	160.58
	Impermeable Area	98	0.0000	0
* from Appendix B			Totals =	2.1700
CN (weighted) = total producted / total area =			74.00	
Ia (weighted) = 5 x pervious area / total area =			5.0 mm	

Present      Developed (circled)      Impervious Catchment

1. Data  
Catchment Area A= 0.0217 km<sup>2</sup>  
Runoff Curve No 73  
Initial Abstraction 5.0 mm  
Time of Concentration 0.17 hrs

2. Calculate Storage, S = (1000/CN - 10) x 25.4      93.9 mm

3. Average Recurrence Interval ARI

4. 24 hour rainfall depth, P<sub>24</sub> (mm)

5. Compute C\*

6. Specific peak flow rate q\*

7. Peak flow rate, q<sub>p</sub>

8. Runoff depth, Q<sub>24</sub> (mm)

9. Runoff Volume V<sub>24</sub> = 1000xQ<sub>24</sub>A (m<sup>3</sup>)

Storm 1	Storm 2	Storm 3	Storm 4
	2	10	100
	92.65	170	280
	0.31	0.46	0.59
	0.086	0.118	0.138
	0.174	0.436	0.838
	42.31	105.14	204.98
	918	2281	4448

pre 2. Time of Concentration			
Channelisation factor	C =	0.80	(from Table 4.2)
Catchment length	L =	0.29	km (along drainage path)
Catchment slope	S <sub>c</sub> =	0.15	m/m (by equal area method)
Runoff factor, CN / (200 - CN) =	0.59		
t <sub>c</sub> = 0.14 C L <sup>0.66</sup> (CN / (200 - CN)) <sup>-0.55</sup> S <sub>c</sub> <sup>-0.30</sup>	0.117	hrs	
Adopted t <sub>c</sub> =	0.17	hrs	0.17hrs min
SCS Lag for HEC-HMS	T <sub>p</sub> = 2 / 3 t <sub>c</sub>	0.11	hrs

post 1. Runoff Curve Number (CN) and Initial Abstraction (Ia)				
Soil name and classification	Cover description (cover type, treatment & hydrologic condition)	Curve Number CN*	Area (ha)	Product of CN x area
Type C	Permeable Area	73	2.1700	158.41
	Impermeable Area	98	0.0000	0
* from Appendix B			Totals =	2.1700
CN (weighted) = total producted / total area =			73.00	
Ia (weighted) = 5 x pervious area / total area =			5.0 mm	

10. Combine Results  
Average recurrence Interval, ARI (yr)  
Flow (Impervious + Pervious) m<sup>3</sup>/s  
Runoff Volume (Impervious + Pervious) m<sup>3</sup>

Combined			
ARI	Flow	Volume	
0	2	10	100
0.000	-0.005	-0.009	-0.010
0	-24	-42	-57

post 2. Time of Concentration			
Channelisation factor	C =	0.80	(from Table 4.2)
Catchment length	L =	0.29	km (along drainage path)
Catchment slope	S <sub>c</sub> =	0.15	m/m (by equal area method)
Runoff factor, CN / (200 - CN) =	0.57		
t <sub>c</sub> = 0.14 C L <sup>0.66</sup> (CN / (200 - CN)) <sup>-0.55</sup> S <sub>c</sub> <sup>-0.30</sup>	0.118	hrs	
Adopted t <sub>c</sub> =	0.17	hrs	0.17hrs min
SCS Lag for HEC-HMS	T <sub>p</sub> = 2 / 3 t <sub>c</sub>	0.11	hrs

Runoff Volumes m <sup>3</sup>	Pre-Deve Post-Dev Difference Difference (%)			
	Area (ha)	ARI 2	ARI 10	ARI 100
Area (ha)	2.17	2.17	0.00	0.00
ARI 2	942.44	918.03	-24.40	-2.59
ARI 10	2323.69	2281.50	-42.19	-1.82
ARI 100	4505.40	4447.98	-57.42	-1.27
Peak Flow Rates m <sup>3</sup> /s	Pre-Deve Post-Dev Difference Difference (%)			
	Area (ha)	ARI 2	ARI 10	ARI 100
Area (ha)	2.17	2.17	0.00	0.00
ARI 2	0.18	0.17	0.00	-2.71
ARI 10	0.44	0.44	-0.01	-1.94
ARI 100	0.85	0.84	-0.01	-1.22

TP108 Pond Sizing  
Worksheet 2: Graphical Peak Flow rate (Standard Version)

Date: 21.07.2023  
Calc by: TG

Project: GOODLAND COASTAL FARM  
Location: 2127 KAIPARA COAST HIGHWAY  
Job Number: 1366  
Catchment Description: Wetland 23

Present (circled)      Developed      Pervious Catchment

1. Data  
Catchment Area A= 0.0275 km<sup>2</sup>  
Runoff Curve No 74  
Initial Abstraction 5 mm  
Time of Concentration 0.17 hrs

2. Calculate Storage, S = (1000/CN - 10) x 25.4      89.2 mm

3. Average Recurrence Interval ARI

4. 24 hour rainfall depth, P<sub>24</sub> (mm)

5. Compute C\*

6. Specific peak flow rate q\*

7. Peak flow rate, q<sub>p</sub>

8. Runoff depth, Q<sub>24</sub> (mm)

9. Runoff Volume V<sub>24</sub> = 1000xQ<sub>24</sub>A (m<sup>3</sup>)

Storm 1	Storm 2	Storm 3	Storm 4
	2	10	100
	93	170	280
	0.32	0.47	0.60
	0.089	0.120	0.140
	0.226	0.563	1.075
	43.43	107.08	207.62
	1194	2945	5710

pre 1. Runoff Curve Number (CN) and Initial Abstraction (Ia)				
Soil name and classification	Cover description (cover type, treatment & hydrologic condition)	Curve Number CN*	Area (ha)	Product of CN x area
Type C	Permeable Area	74	2.7500	203.50
	Impermeable Area	98	0.0000	0
* from Appendix B			Totals =	2.7500
CN (weighted) = total producted / total area =			74.00	
Ia (weighted) = 5 x pervious area / total area =			5.0 mm	

Present      Developed (circled)      Impervious Catchment

1. Data  
Catchment Area A= 0.025 km<sup>2</sup>  
Runoff Curve No 74  
Initial Abstraction 4.8 mm  
Time of Concentration 0.17 hrs

2. Calculate Storage, S = (1000/CN - 10) x 25.4      90.2 mm

3. Average Recurrence Interval ARI

4. 24 hour rainfall depth, P<sub>24</sub> (mm)

5. Compute C\*

6. Specific peak flow rate q\*

7. Peak flow rate, q<sub>p</sub>

8. Runoff depth, Q<sub>24</sub> (mm)

9. Runoff Volume V<sub>24</sub> = 1000xQ<sub>24</sub>A (m<sup>3</sup>)

Storm 1	Storm 2	Storm 3	Storm 4
	2	10	100
	93	170	280
	0.32	0.47	0.60
	0.089	0.120	0.139
	0.205	0.510	0.975
	43.32	106.83	207.24
	1083	2671	5181

pre 2. Time of Concentration			
Channelisation factor	C =	0.80	(from Table 4.2)
Catchment length	L =	0.25	km (along drainage path)
Catchment slope	S <sub>c</sub> =	0.05	m/m (by equal area method)
Runoff factor, CN / (200 - CN) =	0.59		
t <sub>c</sub> = 0.14 C L <sup>0.66</sup> (CN / (200 - CN)) <sup>-0.55</sup> S <sub>c</sub> <sup>-0.30</sup>	0.149	hrs	
Adopted t <sub>c</sub> =	0.17	hrs	0.17hrs min
SCS Lag for HEC-HMS	T <sub>p</sub> = 2 / 3 t <sub>c</sub>	0.11	hrs

post 1. Runoff Curve Number (CN) and Initial Abstraction (Ia)				
Soil name and classification	Cover description (cover type, treatment & hydrologic condition)	Curve Number CN*	Area (ha)	Product of CN x area
Type C	Permeable Area	73	2.4200	176.66
	Impermeable Area	98	0.0800	8
* from Appendix B			Totals =	2.5000
CN (weighted) = total producted / total area =			73.80	
Ia (weighted) = 5 x pervious area / total area =			4.8 mm	

10. Combine Results  
Average recurrence Interval, ARI (yr)  
Flow (Impervious + Pervious) m<sup>3</sup>/s  
Runoff Volume (Impervious + Pervious) m<sup>3</sup>

Combined			
ARI	Flow	Volume	
0	2	10	100
0.000	-0.021	-0.053	-0.100
0	-111	-274	-529

post 2. Time of Concentration			
Channelisation factor	C =	0.80	(from Table 4.2)
Catchment length	L =	0.25	km (along drainage path)
Catchment slope	S <sub>c</sub> =	0.05	m/m (by equal area method)
Runoff factor, CN / (200 - CN) =	0.58		
t <sub>c</sub> = 0.14 C L <sup>0.66</sup> (CN / (200 - CN)) <sup>-0.55</sup> S <sub>c</sub> <sup>-0.30</sup>	0.149	hrs	
Adopted t <sub>c</sub> =	0.17	hrs	0.17hrs min
SCS Lag for HEC-HMS	T <sub>p</sub> = 2 / 3 t <sub>c</sub>	0.11	hrs

Runoff Volumes m <sup>3</sup>	Pre-Deve Post-Dev Difference Difference (%)			
	Area (ha)	2.75	2.50	-0.25
ARI 2	1194.33	1083.05	-111.28	-9.32
ARI 10	2944.77	2670.80	-273.96	-9.30
ARI 100	5709.61	5181.09	-528.52	-9.26
Peak Flow Rates m <sup>3</sup> /s	Pre-Deve Post-Dev Difference Difference (%)			
	Area (ha)	2.75	2.50	-0.25
ARI 2	0.23	0.21	-0.02	-9.41
ARI 10	0.56	0.51	-0.05	-9.38
ARI 100	1.07	0.97	-0.10	-9.28

TP108 Pond Sizing  
Worksheet 2: Graphical Peak Flow rate (Standard Version)

Date: 21.07.2023  
Calc by: TG

Project: GOODLAND COASTAL FARM  
Location: 2127 KAIPARA COAST HIGHWAY  
Job Number: 1366  
Catchment Description: Wetland 24

Present (circled)      Developed      Pervious Catchment

1. Data  
Catchment Area A= 0.0166 km<sup>2</sup>  
Runoff Curve No 74  
Initial Abstraction 5 mm  
Time of Concentration 0.17 hrs

2. Calculate Storage, S = (1000/CN - 10) x 25.4 = 89.2 mm

3. Average Recurrence Interval ARI

4. 24 hour rainfall depth, P<sub>24</sub> (mm)

5. Compute C\*

6. Specific peak flow rate q\*

7. Peak flow rate, q<sub>p</sub>

8. Runoff depth, Q<sub>24</sub> (mm)

9. Runoff Volume V<sub>24</sub> = 1000xQ<sub>24</sub>A (m<sup>3</sup>)

Storm 1	Storm 2	Storm 3	Storm 4
	2	10	100
	93	170	280
	0.32	0.47	0.60
	0.089	0.120	0.140
	0.137	0.340	0.649
	43.43	107.08	207.62
	721	1778	3447

pre 1. Runoff Curve Number (CN) and Initial Abstraction (Ia)				
Soil name and classification	Cover description (cover type, treatment & hydrologic condition)	Curve Number CN*	Area (ha)	Product of CN x area
Type C	Permeable Area	74	1.6600	122.84
	Impermeable Area	98	0.0000	0
* from Appendix B			Totals =	1.6600
CN (weighted) = total producted / total area =			74.00	
Ia (weighted) = 5 x pervious area / total area =			5.0 mm	

Present      Developed (circled)      Impervious Catchment

1. Data  
Catchment Area A= 0.0169 km<sup>2</sup>  
Runoff Curve No 75  
Initial Abstraction 4.6 mm  
Time of Concentration 0.17 hrs

2. Calculate Storage, S = (1000/CN - 10) x 25.4 = 85.7 mm

3. Average Recurrence Interval ARI

4. 24 hour rainfall depth, P<sub>24</sub> (mm)

5. Compute C\*

6. Specific peak flow rate q\*

7. Peak flow rate, q<sub>p</sub>

8. Runoff depth, Q<sub>24</sub> (mm)

9. Runoff Volume V<sub>24</sub> = 1000xQ<sub>24</sub>A (m<sup>3</sup>)

Storm 1	Storm 2	Storm 3	Storm 4
	2	10	100
	93	170	280
	0.33	0.48	0.61
	0.091	0.122	0.141
	0.143	0.352	0.667
	44.59	108.92	210.01
	754	1841	3549

pre 1. Runoff Curve Number (CN) and Initial Abstraction (Ia)			
Channelisation factor	C =	0.80	(from Table 4.2)
Catchment length	L =	0.14	km (along drainage path)
Catchment slope	S <sub>c</sub> =	0.18	m/m (by equal area method)
Runoff factor, CN / (200 - CN) =	0.59		
t <sub>c</sub> = 0.14 C L <sup>0.66</sup> (CN / (200 - CN)) <sup>-0.55</sup> S <sub>c</sub> <sup>-0.30</sup>	0.067	hrs	
Adopted t <sub>c</sub> =	0.17	hrs	0.17hrs min
SCS Lag for HEC-HMS	T <sub>p</sub> = 2 / 3 t <sub>c</sub>	0.11	hrs

post 1. Runoff Curve Number (CN) and Initial Abstraction (Ia)				
Soil name and classification	Cover description (cover type, treatment & hydrologic condition)	Curve Number CN*	Area (ha)	Product of CN x area
Type C	Permeable Area	73	1.5700	114.61
	Impermeable Area	98	0.1200	12
* from Appendix B			Totals =	1.6900
CN (weighted) = total producted / total area =			74.78	
Ia (weighted) = 5 x pervious area / total area =			4.6 mm	

10. Combine Results  
Average recurrence Interval, ARI (yr)  
Flow (Impervious + Pervious) m<sup>3</sup>/s  
Runoff Volume (Impervious + Pervious) m<sup>3</sup>

Combined			
0	2	10	100
0.000	0.006	0.012	0.018
0	33	63	103

Runoff Volumes m <sup>3</sup>	Pre-Deve	Post-Dev	Difference	Difference (%)
Area (ha)	1.66	1.69	0.03	1.81
ARI 2	720.94	753.58	32.63	4.53
ARI 10	1777.57	1840.68	63.11	3.55
ARI 100	3446.53	3549.09	102.56	2.98
Peak Flow Rates m <sup>3</sup> /s	Pre-Deve	Post-Dev	Difference	Difference (%)
Area (ha)	1.66	1.69	0.03	1.81
ARI 2	0.14	0.14	0.01	4.51
ARI 10	0.34	0.35	0.01	3.55
ARI 100	0.65	0.67	0.02	2.81

post 2. Time of Concentration			
Channelisation factor	C =	0.80	(from Table 4.2)
Catchment length	L =	0.14	km (along drainage path)
Catchment slope	S <sub>c</sub> =	0.18	m/m (by equal area method)
Runoff factor, CN / (200 - CN) =	0.60		
t <sub>c</sub> = 0.14 C L <sup>0.66</sup> (CN / (200 - CN)) <sup>-0.55</sup> S <sub>c</sub> <sup>-0.30</sup>	0.067	hrs	
Adopted t <sub>c</sub> =	0.17	hrs	0.17hrs min
SCS Lag for HEC-HMS	T <sub>p</sub> = 2 / 3 t <sub>c</sub>	0.11	hrs