ENGINEERING REPORT

on the

PROPOSED DEVELOPMENT

of

LOT 29 DP 497629

1215 SOUTH ROAD, OAKURA

CLIENT : Oakura Farm Park Ltd
1215 South Road
Oakura

DOCUMENT NUMBER : RPT-2351-04 Rev A

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TABLE OF CONTENTS

1. INTRODUCTION

Red Jacket have been engaged to provide civil engineering services as part of the proposed Wairau Estate development located at Wairua Road, Oakura, Lot 29 DP 482991. The proposed development is shown on the McKinlay Surveyors Ltd scheme plan below, Figure 1.1, and Appendix I.

The purpose of this report is to complete a high-level assessment of the proposed stormwater management system for the Wairau Estate development. This includes assessing the existing upstream catchment, potential hydrological effects due to the proposed development, and potential downstream impacts.

This report should be read in conjunction with the Red Jacket hearing submission report.

This report is specifically prepared for the request for further information in relation to Item 4.80 of the S42A Report.

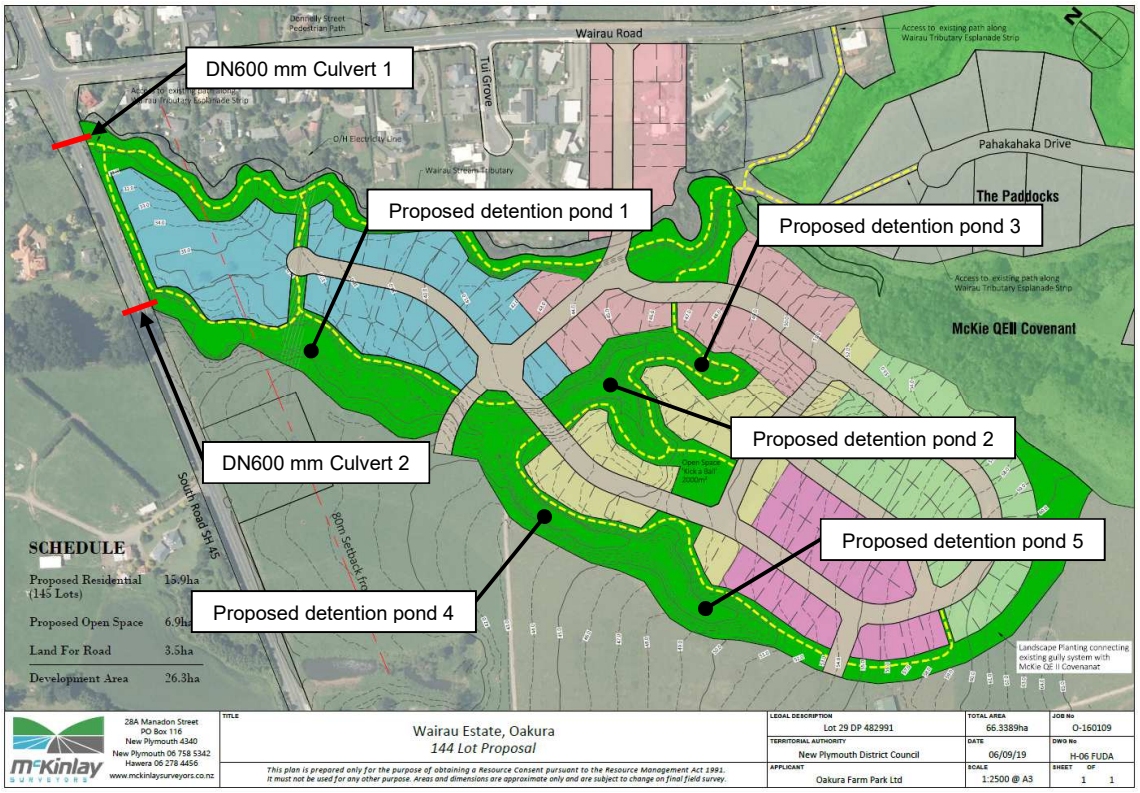

Figure 1.1: McKinlay Surveyors Ltd – Scheme Plan

1.1. PROPOSED DESIGN

The proposed Wairau Estate subdivision is currently grazed paddocks with general fall to the north and north-east. The site surface runoff is collected in several low-lying water courses and open drains, which fall towards the northern corner of site. The site ultimately discharges to two existing DN600 culverts under State Highway 45, SH45. One culvert is located at the Wairau Road intersection and the other culvert is located 180 m south-west of the Wairau Road intersection.

The proposed Wairau Estate development comprise of creating approximately 145 residential Lots and a series of new sealed local roads to be vested with NPDC.

Our basis of design is for the post-development stormwater runoff to be collected, detained and discharged to the existing DN600 culvert in the northern corner of the site approximately 180 m south of the Wairau Road intersection. The discharge at the DN600 culvert shall be no greater than pre-development flow, shall not increase peak flows and/or flooding elevation at the culvert structure.

Peak flows at the confluence zone at the Wairau Stream approximately 600 mm north of the existing SH45 culvert, shall remain the same or less than existing.

To maintain pre-development peak flows and existing flooding elevation, it is proposed to install a stormwater detention pond in the northern corner of the site, for the proposed Wairau Estate development.

The proposed detention ponds will be situated in the existing natural low points within the proposed development, an unnamed tributary of the Wairau Stream utilising the existing DN600 culvert discharge at SH45.

For the purpose of this high-level design the pond systems have been modelled as a single pond structure. The multiple pond system is a viable option as they will be interlinked and utilise a single outlet to the downstream environment. The multiple pond structures shall be designed at detailed design phase.

The following sections detail the analysis of the existing catchments, design of the proposed stormwater management system and discharge to the existing environment.

2. HYDROLOGICAL ANALYSIS

The existing upstream catchments and catchments contributing to the proposed stormwater management system have been analysed using the US Army Corps of Engineers HEC-HMS 4.3 Hydrologic Modelling System, Refer Appendix III for design outputs.

The hydraulic model has been prepared based on the following assumptions:

a) NIWA Rainfall Intensity Data, HIRDS RCP 6.0 for the period 2081 – 2100, as shown in Appendix II. One event has been used across the full catchment.

b) The hydrological analysis has assessed the peak discharge for design storms of 20%, 10%, and 1% AEP.

c) The temporal pattern for the 24-hour design storm has been based on the ARC Guidelines for Stormwater Runoff Modelling, TP 108, using site specific 24-hour rainfall data.

d) A time of concentration for each individual catchment has been established using the US Soil Conservation Service method and verified using the Ramser Kirpich method.

e) Rainfall runoff curve numbers are based on US Army Corps of Engineers HEC-HMS hydrologic Modelling System, Technical Reference Manual.

f) Hydrologic Soil Group B has been used based on existing subsoil conditions, being a sandy SILT, Taranaki volcanic ash.

g) Catchment topography is based on a combination of historic survey and NPDC GIS information.

h) Initial abstraction has been set at 5 mm for pervious areas and 0 mm for impervious areas, as per ARC Guidelines for Stormwater Runoff Modelling, TP 108.

2.1. CATCHMENT ANALYSIS

The contributing catchments have been assessed as the proposed Wairau Estate development and existing upstream catchments to the south. Catchment extents are illustrated in Figure 2.1 below, refer Appendix IV for full plan.

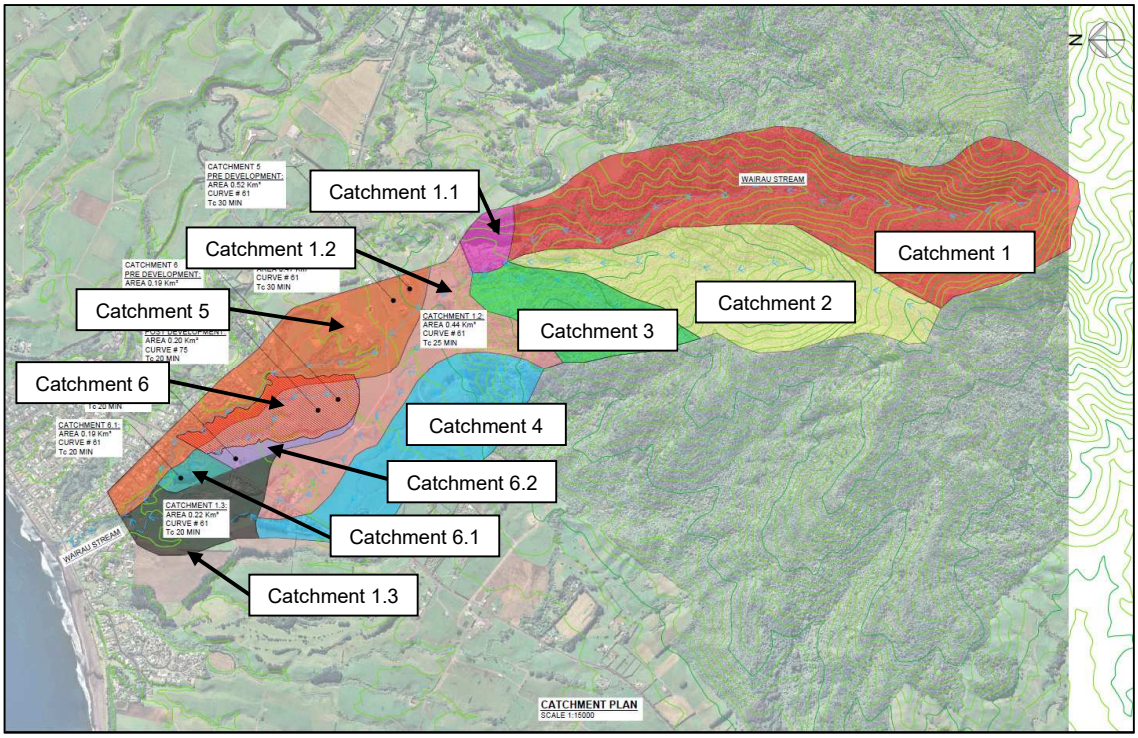

Figure 2.1: Catchment plan

Catchment characteristics used to establish peak flows are detailed in Table 2.1 below:

Table 2.1: Catchment Characteristics

Identity	Status	Cover Type	Hydrologic Soil Group	Curve Number	Catchment Area	Time of Concentration
Catchment 1	Existing	Bush Cover	B	55	1.45 km²	20 min
Catchment 1.1	Existing	Pasture for Grazing	B	61	0.07 km²	10 min
Catchment 1.2	Existing	Pasture for Grazing	B	61	0.44 km²	25 min
Catchment 1.3	Existing	Pasture for Grazing	B	61	0.22 km²	20 min
Catchment 2	Existing	Bush Cover	B	55	0.78 km²	20 min
Catchment 3	Existing	Bush Cover	B	55	0.32 km²	20 min
Catchment 4	Existing	Bush Cover	B	55	1.45 km²	10 min
Catchment 5	Existing	Pasture and housing	B	61	0.52 km²	30 min
	Developed	Pasture and housing	B	61	0.47 km²	30 min
Catchment 6	Existing	Pasture for Grazing	B	61	0.15 km²	20 min
	Developed	Residential Housing	B	75	0.20 km²	20 min
Catchment 6.1	Existing	Pasture for Grazing	B	61	0.04 km²	20 min
Catchment 6.2	Existing	Pasture for Grazing	B	61	0.04 km²	20 min

2.2. PEAK CATCHMENT FLOWS

Peak catchment flows have been calculated using HEC-HMS 4.3 design software and site-specific 24-hour design storms based on ARC Guidelines for Stormwater Runoff Modelling, TP 108.

The design storms used in the analysis are illustrated in Figure 2.2 below, catchment peak flows are detailed Table 2.2 below:

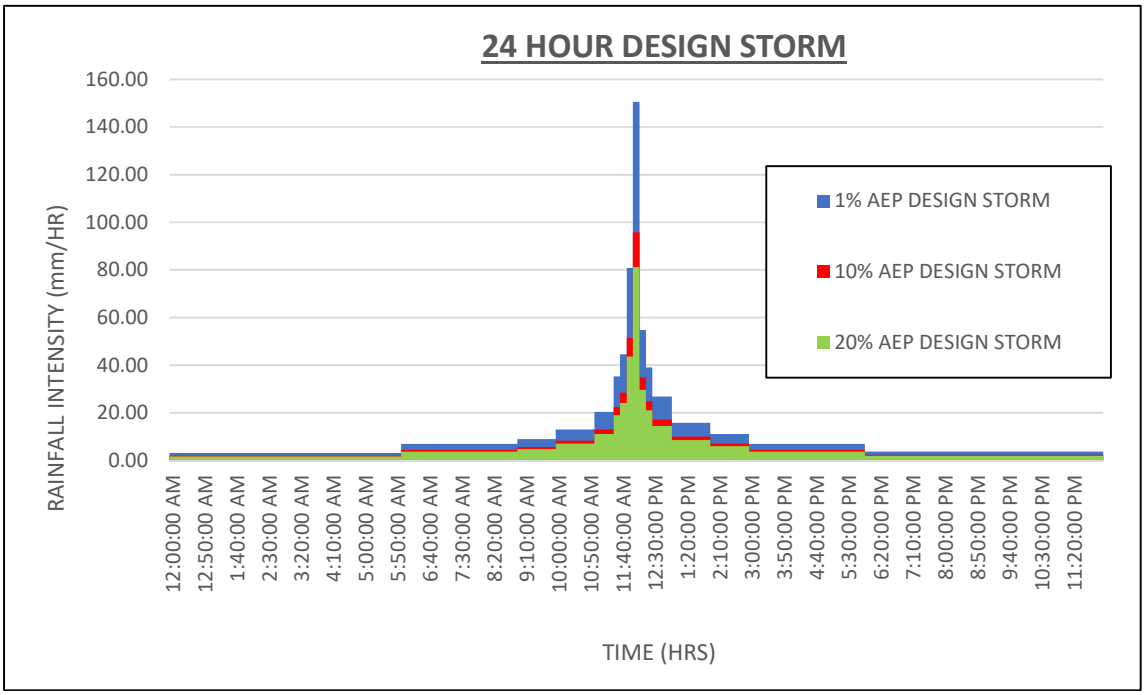

Figure 2.2: Site-Specific 24-Hour Design Storm

Table 2.2: Catchment Peak Flows

Identity	Status	20% AEP (m^3/sec)	10% AEP (m^3/sec)	1% AEP (m^3/sec)
Catchment 1	Existing	8.55	11.33	23.85
Catchment 1.1	Existing	0.62	0.81	1.64
Catchment 1.2	Existing	2.78	3.65	7.45
Catchment 1.3	Existing	1.53	2.01	4.09
Catchment 2	Existing	4.62	6.13	12.89
Catchment 3	Existing	2.41	3.19	6.69
Catchment 4	Existing	3.69	4.84	9.86
Catchment 5	Existing	3.06	4.02	8.02
	Developed	2.75	3.61	7.35
Catchment 6	Existing	1.32	1.73	3.52
	Developed	2.04	2.58	4.82
Catchment 6.1	Existing	0.36	0.47	0.96
Catchment 6.2	Existing	0.29	0.37	0.76

3. STORMWATER DETENTION POND DESIGN

The proposed stormwater management system, detention pond has been modelled using HEC-HMS 4.3, based on the peak catchment discharges detailed in Section 2.2 above.

The detention pond has been designed to have a peak flow discharge no greater than pre-development during design storms of 20%, 10%, and 1% AEP, and to have no impact on the peak flows and food elevations at the DN600 culvert under SH45 and no impact at the downstream confluence zone where the unnamed tributary meets the Wairau Stream.

The purpose of this design approach is to minimise impacts to the receiving environment during a range of design storm scenarios.

The proposed detention pond shall be located within the extents of the proposed development utilising the topography of the unnamed tributary. The discharge location shall be prior to the SH45 culvert crossing.

The proposed detention pond design is a high-level analysis of the proposed development and is subject to detailed design at the time of subdivision consent.

The HEC-HMS 4.3 Basin Model is illustrated in Figure 3.1 below.

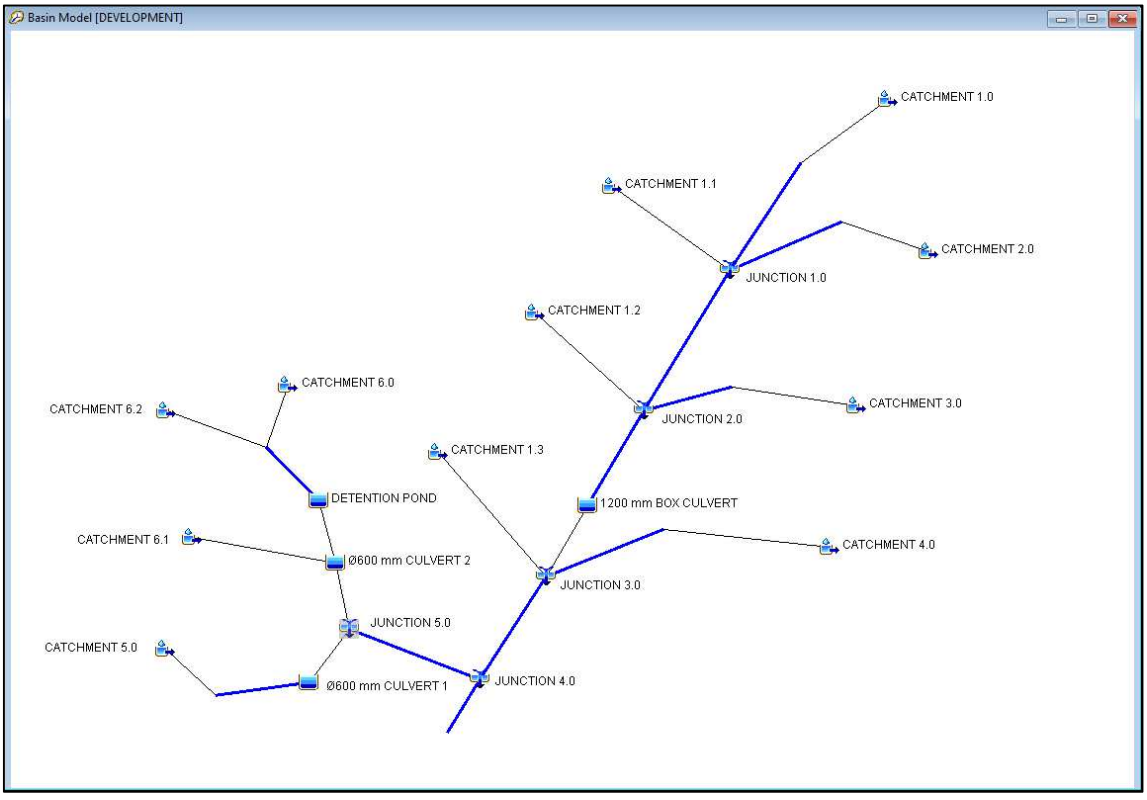

Figure 3.1: HEC-HMS Basin Model – Developed Subdivision

3.1. DETENTION POND VOLUME

The proposed detention pond volume has been designed to accommodate up to a 1% AEP design storm within the extents of the proposed pond structure, whilst discharging at less than pre-development flow. The pond discharge shall not increase downstream peak flows or flooding heights. Pond capacity is detailed in Table 3.0 below:

Table 3.1 Detention Pond Storage Elevation

Elevation (m)	Reduced Level (RL)	Volume (1000 m³)	Outlet
0.00	27.00	0.00	Invert DN300
1.67	28.67	7.52	20% AEP Pond level
1.70	28.70	7.65	Invert DN450
2.07	29.07	9.32	10% AEP Pond level
2.60	29.60	11.70	Spillway Invert
2.97	29.97	13.37	1% AEP Pond level
3.00	30.00	13.50	Top of Pond

3.2. DETENTION POND PEAK FLOWS

The outlet structure from the detention pond to the unnamed tributary of the Wairau Stream has been designed using HEC-HMS 4.3. The pond discharges via a proposed DN300 low level outlet pipe in conjunction with a DN450 high level outlet pipe and an overflow spillway.

The peak discharges from the pond outlet structures are detailed in Table 3.2 below:

Table 3.2 Detention Pond Outlet Peak Flows

Design Storm	DN300 Peak Flow (m³/sec	DN450 Peak Flow (m³/sec)	Spillway Peak Flow (m³/sec)	Post-development Peak Flow (m³/sec)	Pre-development Peak Flow (m³/sec)
20% AEP	0.28	-	-	0.28	1.41
10% AEP	0.31	0.12	-	0.43	1.85
1% AEP	0.36	0.45	1.60	2.41	3.78

As detailed above, the pond outlet structures have a total combined design peak flow less than pre-development flow for all design storm scenarios considered.

Therefore, there shall be no increase in pre-development peak flows resulting from the proposed development.

4. DOWN STREAM EFFECTS

From our analysis of the catchment and proposed development we have identified two critical points as detailed below:

- The downstream DN600 culvert structure under SH45. Identified as Ø600 mm CULVERT 2 in HEC-HMS Model, refer Figure 3.1.
- The confluence zone with the Wairau Stream. Identified as JUNCTION 4 in HEC-HMS Model, refer Figure 3.1.

The critical points have been analysed using HEC-HMS incorporating the proposed Wairau Estate development and proposed detention pond structure.

The peak discharges and relative peak elevations and time to peaks at the critical points are detailed in Table 4.1 and 4.2 below:

Table 4.1 DN600 Culvert Structure

	DN600 Culvert Structure Under SH45 - Ø600 mm CULVERT 2			
Design Storm	**Status**	**Peak Flow (m^3/sec)**	**Peak Elevation (RL m)**	**Time of Peak (24 hr)**
20% AEP	Pre-Development	0.24	26.51	14:28
	Post-Development	0.24	26.51	20:53
10% AEP	Pre-Development	0.35	26.54	14:15
	Post-Development	0.31	26.60	18:23
1% AEP	Pre-Development	0.73	27.26	13:59
	Post-Development	0.73	27.25	15:50

Table 4.2 Wairau Stream Confluence

	Wairau Stream Confluence – JUNCTION 4		
Design Storm	**Status**	**Peak Flow (m^3/sec)**	**Time of Peak (24 hr)**
20% AEP	Pre-Development	8.09	12:32
	Post-Development	7.93	12:31
10% AEP	Pre-Development	10:93	12:26
	Post-Development	10:72	12:26
1% AEP	Pre-Development	57.20	12:26
	Post-Development	56.74	12:26

As detailed above, our model indicates no increase in peak flow or peak flood elevation at the SH45 culvert and no increase in peak flow and minor differences in time to peak at the confluence with the Wairau Stream for all design storm scenarios considered.

It can be concluded that the proposed Wairau Estate development in conjunction with the proposed detention pond (subject to detailed design) will have a no more than minor effect on the Wairau Stream confluence point for all design storm scenarios considered.

The peak flow from the proposed Wairau Estate development comprises of less than 5% (range of 1.5% to 3.5%) of the total peak flow at the confluence point across all design storm scenarios considered. It can be concluded that the proposed development will have a negligible impact on the existing downstream environment for all design storm scenarios considered.

5. SEDIMENT CONTROL MEASURES

All stormwater runoff generated from the proposed Wairau Estate development shall be channelled to the proposed detention pond. Stormwater from this pond shall discharge to the Wairau Stream utilizing the existing DN600 culvert structure crossing SH45.

The detention pond shall be constructed in accordance with the Waikato Regional Council (WRC) Earthworks Guidelines (adopted by the Taranaki Regional Council).

The proposed contributing area (road carriageway) to the detention ponds is approximately 3.5 ha. The site is relatively flat, less than average 10% grade across the site with an approximate catchment length of 700 m.

Based on the WRC earthworks guidelines and the catchment characteristics the pond volume shall be no less than 3% of the contributing area with a forebay no less than 1% of the pond volume. This equates to a pond volume no less than 1,050 m³ and a forebay no less than 105 m³, refer Figure 5.1 below for typical pond layout.

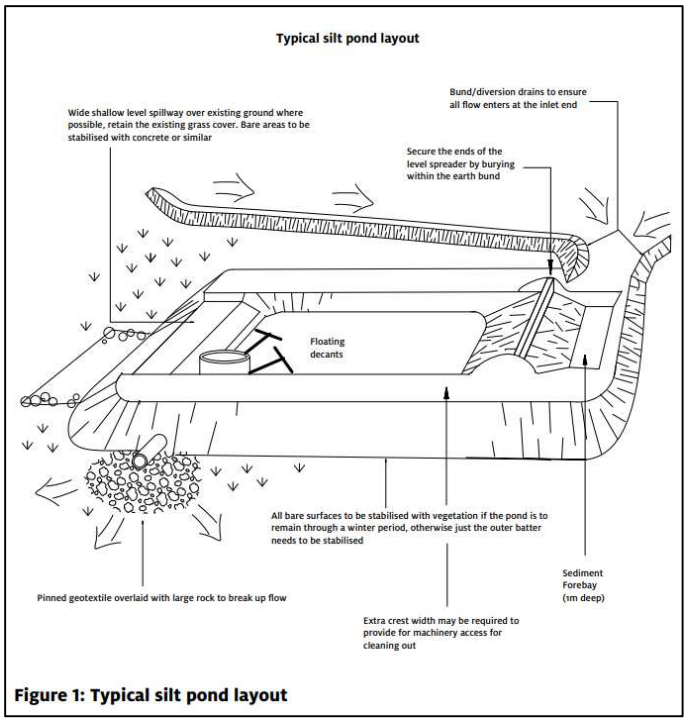

Figure 5.1: WRC – Typical Silt Pond Layout

The proposed detention pond volume is approximately 11,700 m³ to the level of the spillway, this is in excess of the required WRC volume 1,050 m³.

The proposed pond is subject to detailed design and shall be designed in accordance with the WRC earthworks guidelines to minimise the discharge of sediment from the proposed development to the downstream receiving environment.

6. CONCLUSION

Based on the analysis undertaken and the results of our HEC-HMS model:

a. There is sufficient capacity within the proposed Wairau Estate detention pond to accommodate up to a 1% AEP design storm within the extents of the existing unnamed tributary.

b. The proposed detention pond servicing the proposed Wairau Estate development does not increase the pre-development peak flow at the discharge point for a 20%, 10% and up to a 1% AEP design storm.

c. The proposed Wairau Estate development in conjunction with the proposed detention pond has a no more than minor effect on the downstream DN600 mm culvert crossing SH45 and the downstream confluence with the Wairau Stream, for a 20%, 10% and up to a 1% AEP design storm.

d. The peak flow from the proposed Wairau Estate development comprises of less than 5% (range of 1.5% to 3.5%) of the total peak flow at the confluence point across all design storm scenarios considered. It can be concluded that the proposed development will have a negligible impact on the existing downstream environment for all design storm scenarios considered.

e. The proposed detention pond servicing the Wairau Estate development is subject to detailed design and shall be designed in accordance with the WRC earthworks guidelines.

7. LIMITATIONS

This assessment is prepared for your use as owners and for your agents for the stated purpose and cannot be used for any other purpose or by others unless authority is given by Red Jacket Ltd.

APPENDIX I MCKINLAY SURVEYORS SCHEME PLAN

Donnelly Street
Pedestrian Path

Wairau Road

Tui Grove

Access to existing path along
Wairau Tributary Esplanade Strip

O/H Electricity Line

Wairau Stream Tributary

Pahakahaka Drive

The Paddocks

Access to existing path along
Wairau Tributary Esplanade Strip

Access to existing path along
Wairau Tributary Esplanade Strip

McKie QEII Covenant

Powerco

South Road SH 45

80m Setback from SH 45

Open Space
'Kick a Ball'
2000m²

Landscape Planting connecting
existing gully system with
McKie QE II Covenanat

SCHEDULE

Proposed Residential (145 Lots)	15.9ha
Proposed Open Space	6.9ha
Land For Road	3.5ha
Development Area	26.3ha

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28A Manadon Street
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TITLE	LEGAL DESCRIPTION	TOTAL AREA	JOB No
Wairau Estate, Oakura *144 Lot Proposal*	Lot 29 DP 482991	66.3389ha	O-160109
	TERRITORIAL AUTHORITY New Plymouth District Council	DATE 06/09/19	DWG No H-06 FUDA
This plan is prepared only for the purpose of obtaining a Resource Consent pursuant to the Resource Management Act 1991. It must not be used for any other purpose. Areas and dimensions are approximate only and are subject to change on final field survey.	APPLICANT Oakura Farm Park Ltd	SCALE 1:2500 @ A3	SHEET OF 1 1

APPENDIX II HIRDS NIWA RAINFALL DATA

HIRDS V4 Intensity-Duration-Frequency Results									
Site name: Wairau Estate Subdivision									
Coordinate system: WGS84									
Longitude: 173.96									
Latitude: -39.14									
Rainfall intensities (mm/hr) RCP6.0 for the period 2081-2100									
ARI	**AEP**	**10m**	**20m**	**30m**	**1h**	**2h**	**6h**	**12h**	**24h**
1.58	0.633	77.8	52.6	41.6	27.8	18.2	8.98	5.65	3.53
2	0.5	85.2	57.6	45.6	30.4	20	9.85	6.21	3.86
5	0.2	111	75	59.4	39.6	26	12.8	8.09	5.02
10	0.1	131	88.2	69.9	46.6	30.6	15.1	9.53	5.91
20	0.05	151	102	81	54	35.4	17.5	11	6.85
30	0.033	164	111	87.8	58.5	38.4	19	12	7.42
40	0.025	173	117	92.7	61.8	40.6	20.1	12.7	7.85
50	0.02	181	122	96.8	64.5	42.4	21	13.2	8.19
60	0.017	187	126	100	66.7	43.8	21.7	13.7	8.48
80	0.012	197	133	105	70.3	46.2	22.9	14.4	8.92
100	0.01	205	138	110	73.1	48	23.8	15	9.29
250	0.004	239	161	128	85.1	55.9	27.7	17.4	10.8

APPENDIX III HEC-HMS OUTPUTS

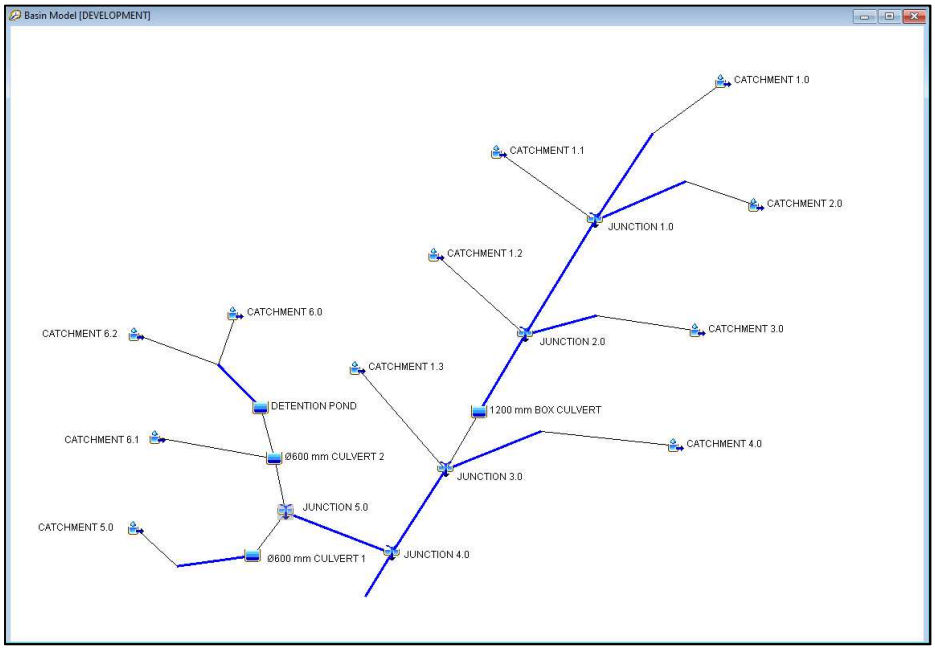


Figure A3.1: Basin Model

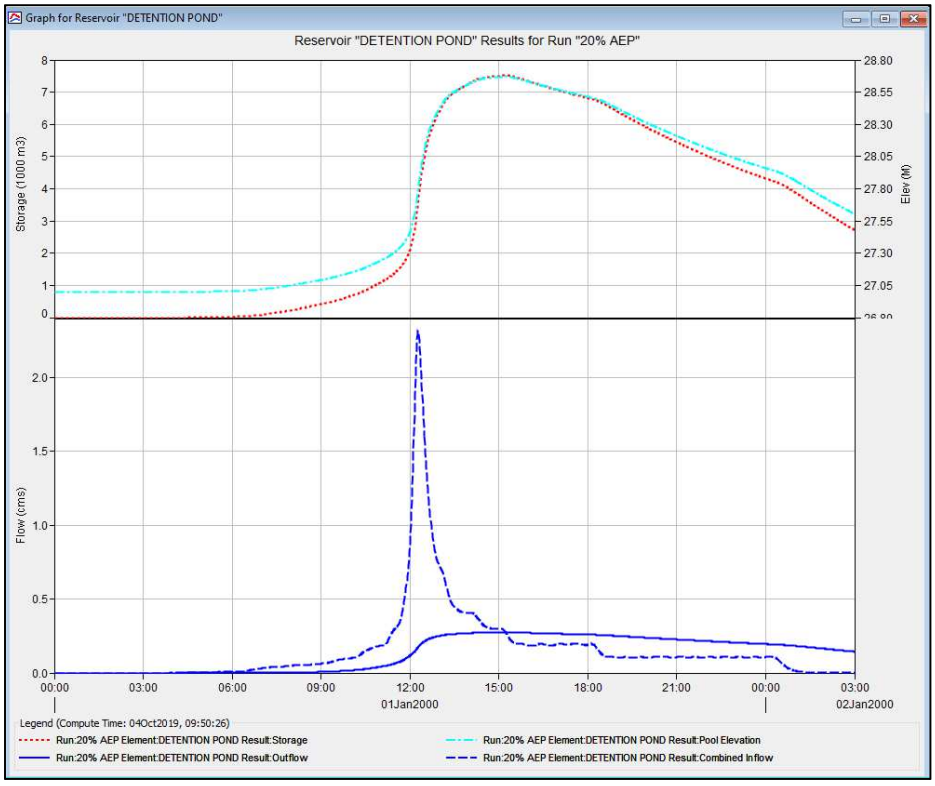


Figure A3.2: 20% AEP Flow / Storage Graph

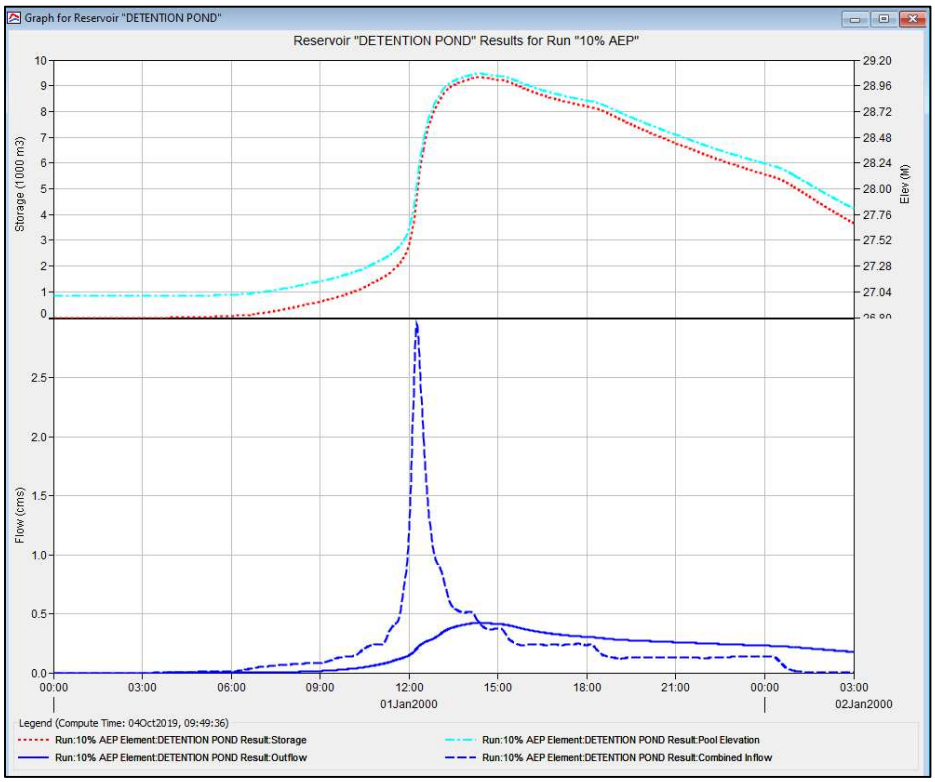


Figure A3.3: 10% AEP Flow / Storage Graph

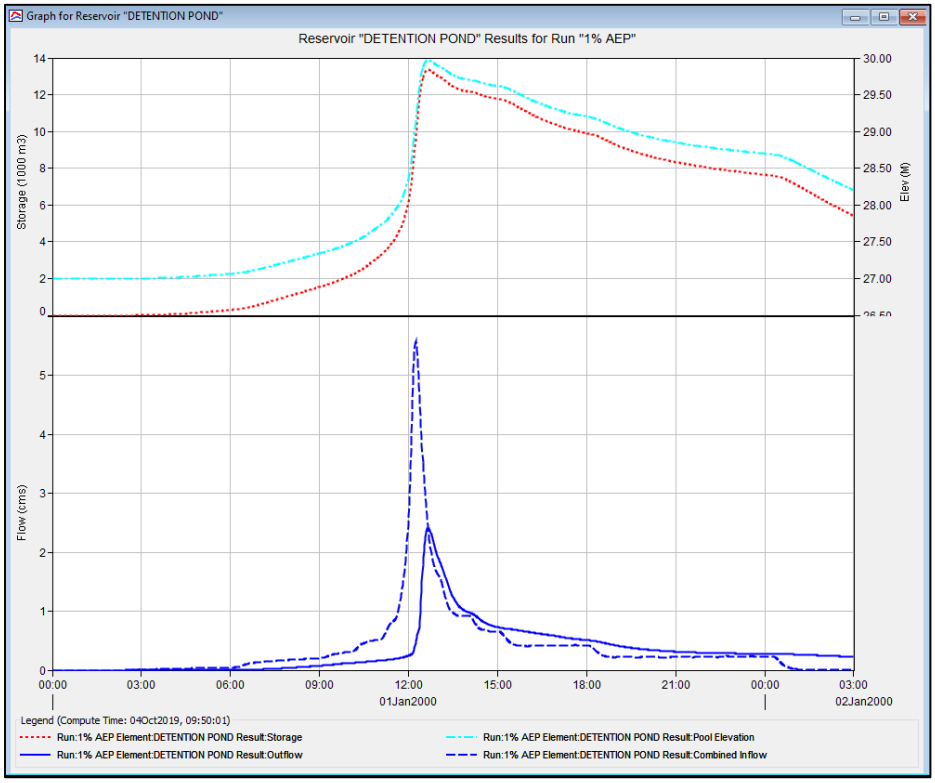


Figure A3.4: 1% AEP Flow / Storage Graph

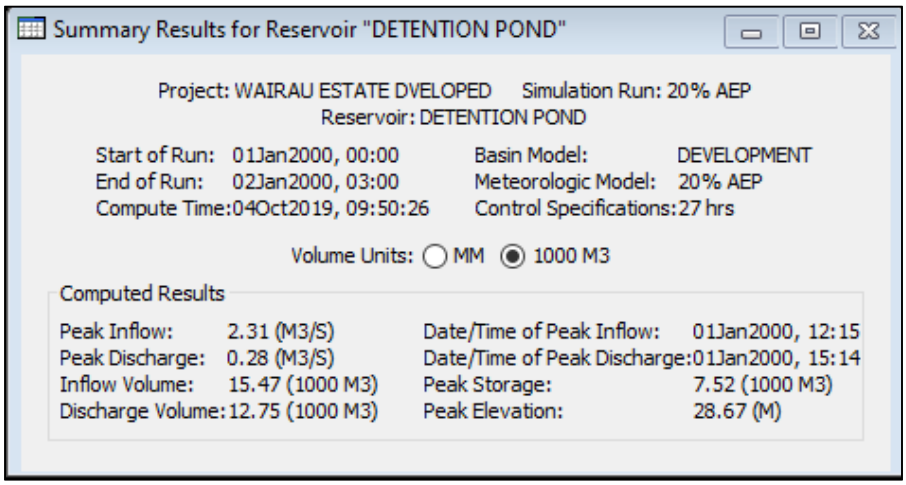


Figure A3.5: 20% AEP Detention Pond Summary Table

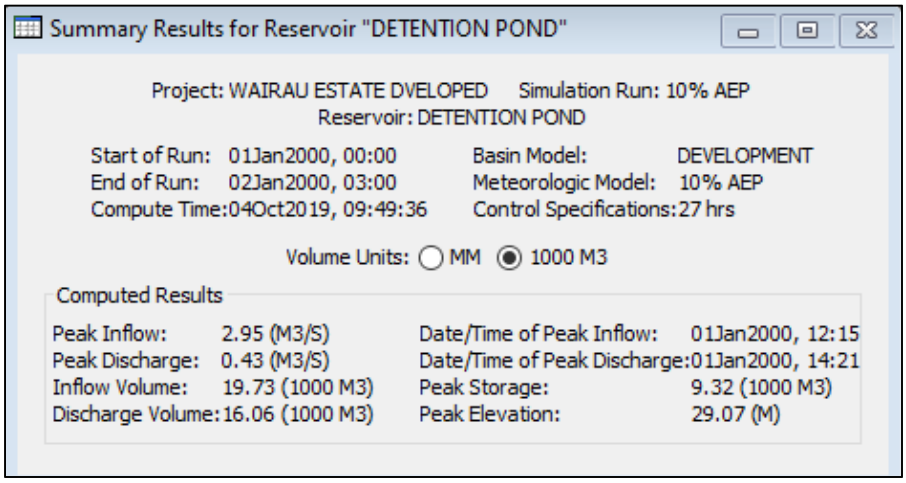


Figure A3.6: 10% AEP Detention Pond Summary Table

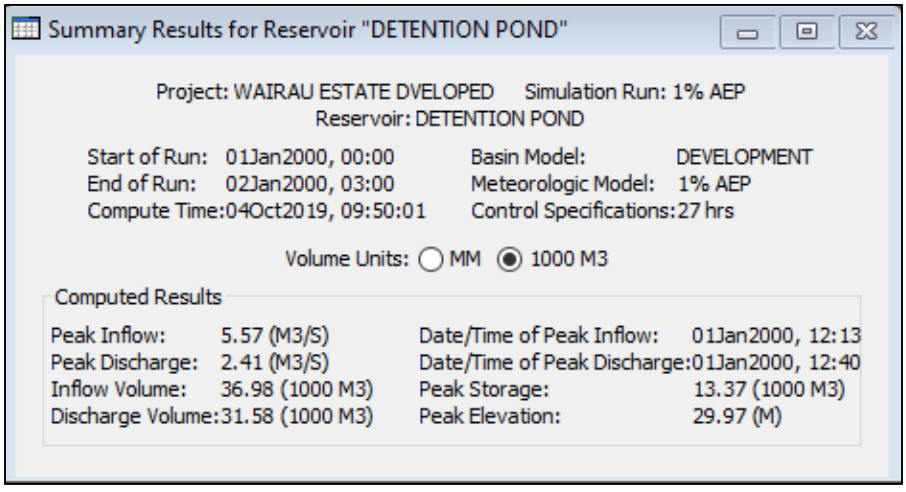
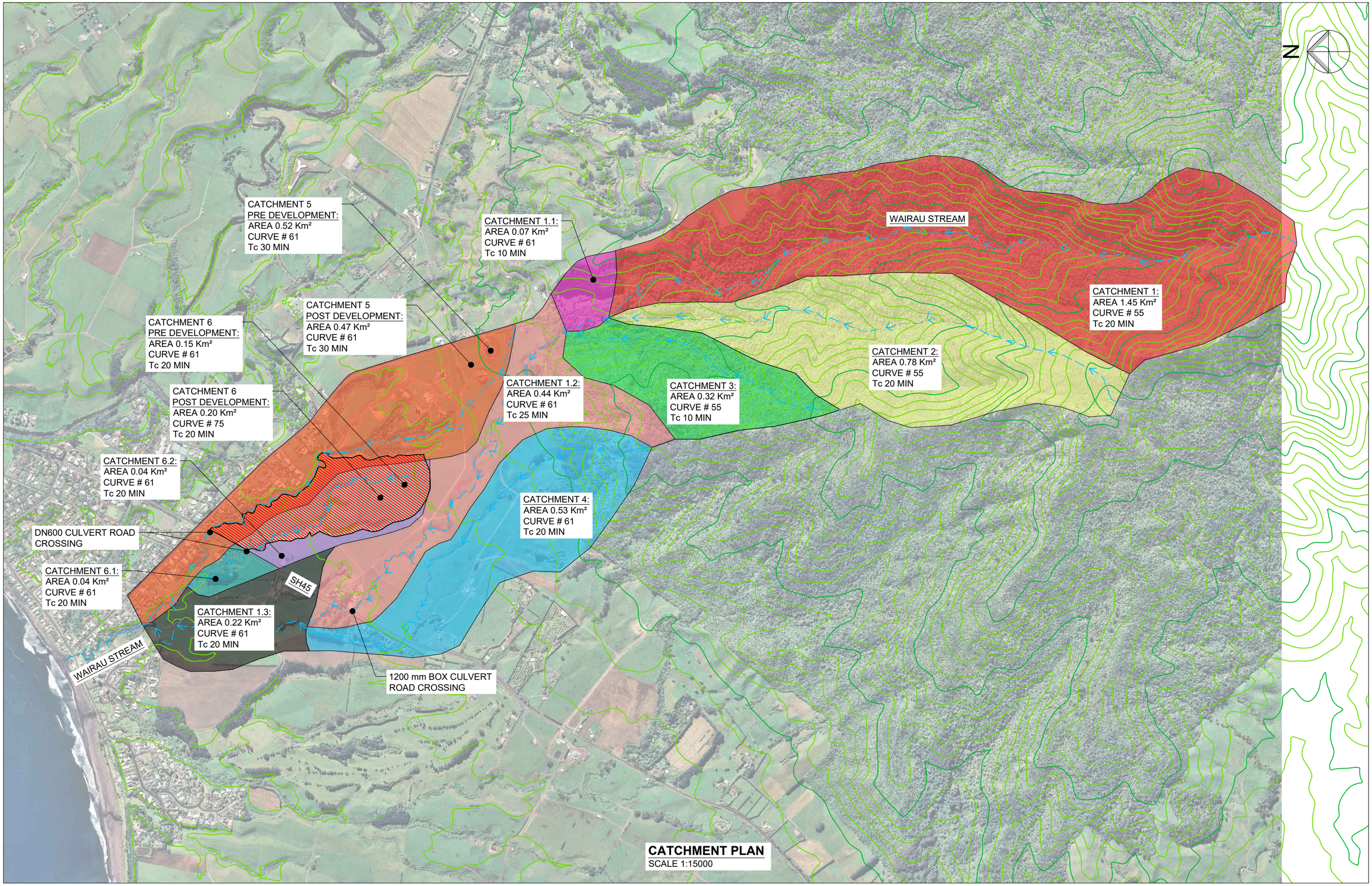


Figure A3.7: 1% AEP Detention Pond Summary Table

APPENDIX IV RJL CATCHMENT PLAN



CATCHMENT PLAN
SCALE 1:15000

REDJACKET
3 DAVIDSON STREET
NEW PLYMOUTH 4310
Ph. 06 759 0999

DATE	REV	REV RECORD	BY	CHD	VER	APP
03/10/19	A	ISSUED TO CLIENT	LB	CM	-	-

Client: OAKURA FARM PARK

Project: WAIRAU ESTATE SUBDIVISION
1215 SOUTH ROAD
OAKURA

Sheet Title: CATCHMENT PLAN

Drawing No.: 100-366
REV.: A
Job No.: 2351
Sheet No.: C1-1
A3