Appendix 5

Integrated Three Waters Report

B&A

Onoke Heights Limited

THREE WATERS DESIGN REPORT

19103 - 67 Dip Road, Kamo, Whangarei

Project Reference: 19103
November 25, 2021

DOCUMENT CONTROL

Version	Issued For	Date	Prepared By	Reviewed &Authorised By
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CONTENTS

1 PROJECT DESCRIPTION

LDE Ltd was engaged by Onoke Heights Limited to provide a report covering the three waters infrastructure and stormwater pond design for resource consent for the proposed residential subdivision and development at 67 Dip Road, Kamo, Whangarei.

Figure 1 - Site location plan, outlined in blue. Sourced from Whangarei District Council (WDC) GIS.

As with any new development water, wastewater and stormwater servicing and management is required.

The water supplies additional demand can be serviced either on the public network or with an onsite water supply which can consist of either an extension of the public system or the use of water tanks or water bores. As this development is to be smaller urban sized lots, an extension of the water network is proposed.

With wastewater, disposal connection to a public system is proposed due to the smaller lot sizes. Smaller lot areas below about 2000m² are not generally suitable for OSW disposal systems as there is generally insufficient land area available to install suitable disposal fields.

With stormwater, new impervious areas are created, and these areas require stormwater management devices to be utilised to minimise their impact on the environment. To attenuate runoff for the new impervious areas within the proposed site, the pre-development and post-development scenarios were modelled in HEC-HMS software. Additionally, the quality of stormwater runoff from high contaminant generating surfaces such as roads and carparks must be treated before discharge to minimise their impact on the health of the receiving ecosystem so the ponds design has incorporated water quality. Extended detention is also proposed to mitigate effects on the stream into which the proposed pond will discharge.

The design presented in this report is in accordance with Whangarei District Council's and Northland Regional Council's requirements in terms of mitigating stormwater runoff from impervious areas, with a stormwater pond providing water quality, extended detention, and stormwater attenuation to predevelopment flows for the 2, 10 and 100yr storms, including an increase of 20% for climate change.

2 WATER

The councils water reservoir is located immediately above the northern end of the site which will service the development. There are also existing public water mains running along the boundaries of the site which serve the surrounding developments. There will simply be an extension of these public water mains into the development provide both water supply to the new dwellings and firefighting water supply which we expect to come from the mains in Dip road.

The 95 new residential lots will require the following additional water supply capacity assuming 300ltrs/day/person with 4 people per dwelling.

Peak day demand = 2.0 x PF

- 2.0 x 300(l/day) x 4(people) x 95(lots) = 228,000ltrs/day

Peak hourly demand = 5 x PF/24hrs

- 5 x 300(l/day) x 4(people) x 95(lots)/24(hrs)= 23,750ltrs/hour

3 WASTEWATER

The wastewater servicing the development will be an extension of the existing public reticulation from Tuatara Road. It is not practical to connect to the reticulation network along Dip Road as this requires the network to cross the existing stream on the southern boundary of the subject site which would involve pipe bridging, as such the extension into the development is to be provided from Tuatara Road.

The additional wastewater flows that will be generated by the development are as follows:

Dry weather peak daily flow = 2.5 x ADWF

- 2.5 x 200(l/day) x 4(people) x 95(lots) = 190,000ltrs/day

Peak wet weather flow (PWWF) = 5 x ADWF

- 5 x 200(l/day) x 4(people) x 95(lots) = 380,000ltrs/day

4 HYDROLOGICAL ASSESSMENT

4.1 Pre-Development

The subject site, shown in the aerial photo in Figure 2, has an area of approximately 6.9ha which is currently covered in grass with trees. The northern half of the site comprises of a converging south facing slope of up to 11 degrees. The southern part of the site comprises of waning slopes towards the stream on the southern end of the subject site.

Figure 2 - Aerial photo of site indicated in blue. Sourced WDC GIS.

4.2 Post-Development

It is proposed to subdivide the site creating 95 new residential lots with majority of the areas between 340m^2 and 1050m^2. The lots are proposed to be accessed via an extension of Tuatara Road to Dip Road. The proposed scheme plan can be seen in Figure 3 below.

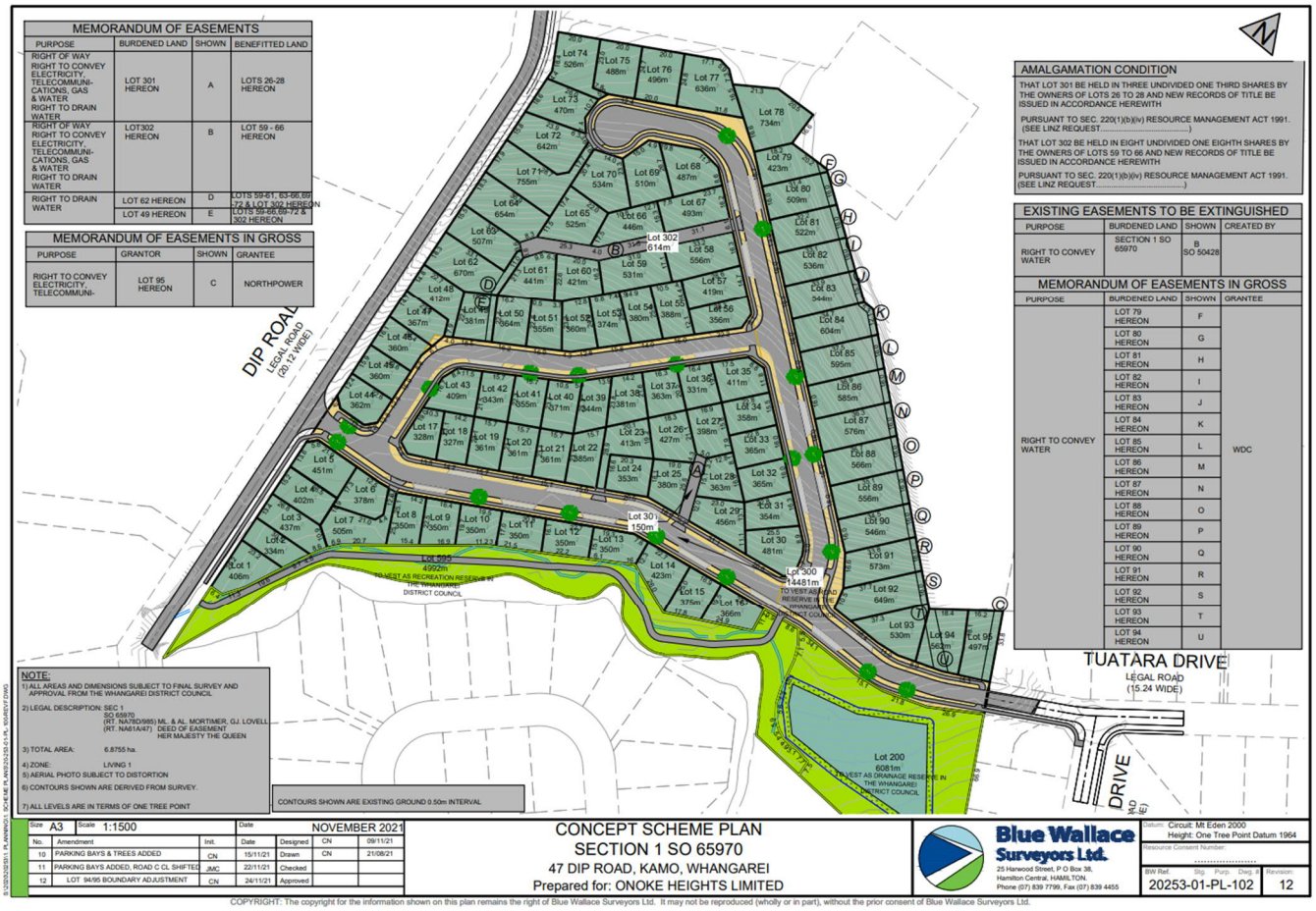


Figure 3 - Proposed scheme plan provided by Blue Wallace Surveyors Ltd.

It is proposed to construct a stormwater pond within the south-eastern end of the subdivision to provide attenuation and water quality treatment for runoff from the development. To achieve this, the pond has been designed to meet the requirements of Auckland Council's GD01.

The proposed lots have been divided into impervious and pervious components with 60% of the lot area being nominated as impervious and the remaining 40% pervious. The road reserve area was nominated a curve number of 90 based on a weighted average between the road, footpaths and berms. Refer to Figure 4 below for catchment areas and pond location.

Figure 4 – Catchment areas and pond location.

Table 1 – Pre and Post Development catchment areas and curve numbers.

Pre-Development		
Description	Curve Number (CN)	Area (m^2)
Grassed areas - Pervious	70	66,955
Total		66,955
Post Development		
Description	Curve Number (CN)	Area (m^2)
(Catchments B & C) Residential Lots - Impervious	98	21,695
(Catchments B & C) Residential Lots - Pervious	70	14,463

(Catchment D) Road Reserve (Road, Footpaths, Berms)	90	15,245
(Catchments A) Unmitigated Bush Area	70	9,375
(Catchment E) Unmitigated Lots – Pervious	70	2,471
(Catchments E) Unmitigated Lots - Impervious	98	3,706
Total		66,955

Catchment E comprises of unmitigated lots on the southern boundary that will be directly piped to the stream through its own small outfall structure and will not be attenuated by the proposed stormwater pond. Stormwater from the bush located outside the northern boundary of the site will drain into the proposed development and through the stormwater pond. Although this bush area is not part of the development, this has been taken into account into the pond design as Catchment A. Catchment G will not be developed and drains directly into the stream downstream of any developed areas.

4.3 Soil Classification

From the LDE geotechnical investigation of the site, the site is underlain by volcanic soils. For the purposes of stormwater modelling, we have assessed these soils beneath the site as being between Soil Class B&C soils as defined in the Whangarei Environmental Engineering Standards.

4.4 Flood Risk

A retaining wall is proposed on the southern boundaries of Lots 14,15 and 16 of the subject site which will sit on the edge of the 100-year flood plain outlined on WDC GIS Flood Hazard map and in Figure 5 below. A cross section was taken from the edge of the Lot 15 boundary to the adjacent side of the stream to model the peak water level for the 100-year ARI storm. Refer to Figure 5 below for location of section analysed.

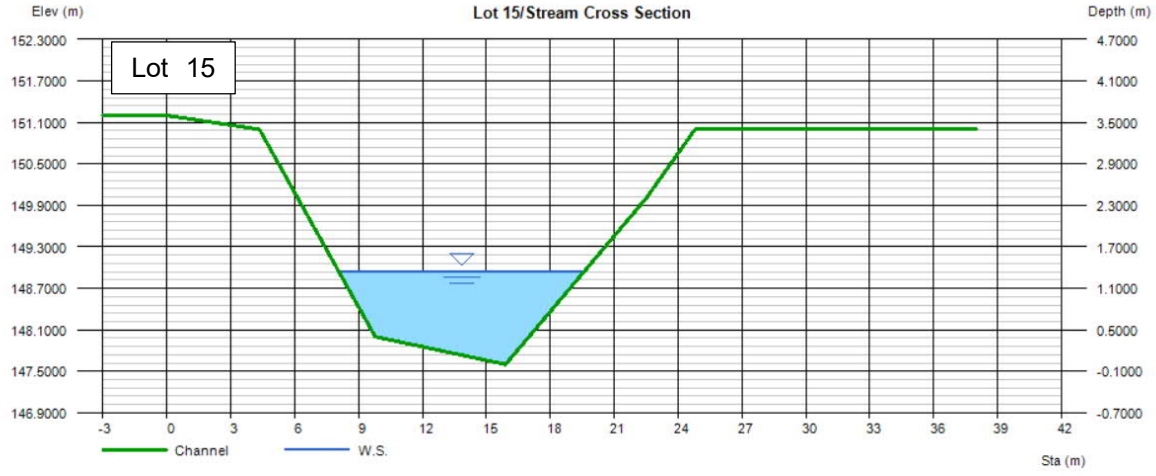
Figure 5. Cross section analysed from Lot 15 across stream.

Hydraflow Express software modelling of the stream was used to determine the peak water levels in proximity of the site. The stations and elevations of the stream were input into the user defined model to model the shape of the stream channel based on WDC GIS contours as well as the survey completed of the base of the stream.

Although the flood plain extends further into the boundary of Lot 16, the stream bed adjacent the lot is at approximately RL 144 whereas the RL of the lot 16 boundary is at approximately RL 151. There is a 7m difference

between the stream bed and the lot 16 boundary and therefore this was not considered the critical section. Instead, a section from the boundary of lot 15 through the stream was taken which was the lowest difference in elevations and the critical section, to analyse the risk of flooding.

The subject stream is assumed to have a peak flow of approximately 36m^3/s during a 100-year ARI storm (assuming an SCS type 1a storm distribution) with a catchment area of slightly less than 180 hectares with a time of concentration of 31mins. Based on the results we can see that the peak water level during a 100-year ARI storm is at RL 148.9 which is approximately 2.1m lower than the Lot 15 boundary at RL151.0 and as such, we can deem that the construction of the proposed retaining walls which will raise the platform level up to approximately RL154 along the boundaries will have no impact on the flood levels. Refer to Figure 6 below for the peak water level during a 100-year ARI storm. Note the stream channel cross section has a flow capacity well in excess of 100m3/s through this area without affecting either of the existing lots.



Depth	Q	Area	Veloc	Wp	Yc	TopWidth	Energy
(m)	(cms)	(sqm)	(m/s)	(m)	(m)	(m)	(m)
1.3503	36.00	10.37	3.4731	12.0520	1.4630	11.5564	1.9656

Figure 6. Hydraflow Express Stream model adjacent to Lot 15 existing ground levels.

5 COUNCIL REQUIREMENTS

5.1 Northland Regional Council SW requirements

Water and Soil Plan

8.3.5 Stormwater

During dry weather, contaminants such as dirt, oil, grease, and heavy metals tend to accumulate on the streets, footpaths, carparks, roofs and similar hard surfaces within urban areas. When it rains, the stormwater carries the accumulated contaminants with it into the stormwater drainage systems which in turn flow directly into nearby streams, rivers or estuaries. Such urban stormwater runoff receives little or no treatment before being discharged

into natural water bodies. Heavy metals have been found in the Upper Whangarei Harbour sediments that exceed the standards recommended for aquatic life.

These contaminants will remain in the receiving environment and will accumulate over time as stormwater discharges continue. Stormwater discharges are generally authorised by discharge permits based on a stormwater management plan. Stormwater management plans are widely used in terms of the design of the stormwater system. However, these have focused on the capacity of the stormwater system to accept runoff, with little or no attention given to stormwater quality. The plans, however, provide a useful basis upon which to institute quality controls which are available and used both in New Zealand and overseas.

8.5.6 Issues Relating to Stormwater Discharges

1. The levels of heavy metals, sediments and other contaminants, which are potentially harmful to aquatic life, in stormwater runoff.
2. The lack of attention to quality controls in stormwater system design.
3. The contribution of runoff from industrial sites to contaminant loadings in urban stormwater, including those from ancient spills.
4. The deliberate or careless disposal of oil and other household and commercial wastes to stormwater systems.

8.17 Specific Policies for Stormwater Diversions and Discharges

1. To manage the diversion and discharge of stormwater in a way that provides safeguards against flooding and maintains or enhances water quality.
2. To require the inclusion of water quality controls as far as practicable in existing stormwater management systems that are known to be causing concentrations of contaminants within the receiving environment that are in excess of applicable water quality and/or sediment quality guidelines.
3. To manage the diversion and discharge or stormwater in urban areas through long duration resource consents that are supported by comprehensive stormwater management plans.
4. To promote best practice for stormwater management design, including low impact options.
5. To promote stormwater management practices that avoid or minimise the discharge of contaminants from industrial and trade premises into stormwater drainage systems.
6. To encourage activities to operate in accordance with industry standards and/or environmental guidelines where these are intended to avoid, remedy or mitigate the adverse effects of stormwater contamination.
7. To permit the discharge of stormwater from hazardous substance storage areas and industrial or trade premises if sufficient safeguards are adopted to avoid, remedy or mitigate the potential adverse effects associated with stormwater contamination.
8. To promote public awareness of the adverse effects of stormwater discharges on natural waters, including awareness of the adverse effects of household waste introduced into stormwater systems.

5.2 Whangarei District Council Three Water Management

Three Waters Management implements provisions to manage the impact of land use and subdivision on water resources, namely stormwater, wastewater and water supply:

- Stormwater systems manage the quality and quantity of stormwater runoff to minimise flood damage and to protect people, land, infrastructure and the receiving environment from adverse effects.
- Wastewater systems collect and convey wastewater for subsequent treatment and disposal. This will normally consist of either connection to the reticulated wastewater network, or on-site treatment and disposal (either individual or communal in nature).
- A water supply is necessary to ensure that a sufficient quality and quantity of water is available to all properties.

Whangarei district council three waters policy objectives are as follows:

1. TMW-01 Connections - Ensure that connection to reticulated three waters networks is provided for within a reticulated area.
2. TWM-O2 – Reticulated Networks - Maintain the effectiveness, efficiency and sustainability of reticulated three waters networks.
3. TWM-O3 – Integrated Infrastructure - Plan and provide for three waters infrastructure in an integrated and comprehensive manner.
4. TWM-O4 – Private Systems - Ensure that private three waters systems are provided where connections are not provided to reticulated networks
5. TWM-O5 – Adverse Effects - Minimise adverse effects from stormwater and wastewater on people, property, infrastructure, the receiving environment and cultural values.

Whangarei district council policies are as follows

Policies	Explanation	Development Assessment
TWM-P1 – Three waters Infrastructure	To ensure that three waters resources are appropriately managed by requiring subdivision and development to provide three waters infrastructure that: • Is coordinated, integrated and compatible with the existing infrastructure and capacities. • Enables the existing network to be expanded or extended to adjacent land where that	The proposed stormwater ponds will limit peak flows to predevelopment level for the 2, 10 and 100yr storm events, with a 20% allowance for climate change. They will include an extended detention volume to address erosion effects on the stream network that they discharge into and provide water quality treatment for the roads within the development, based on 1/3rd of the 2yr storm.

	land is suitable for future reticulated development.	
TWM-P2 – Reticulated Areas	To sustainably and efficiently manage three waters resources by avoiding private three waters systems where connection to the reticulated network is practicable or where failure to connect may compromise the future extension of the reticulated network.	The development will provide stormwater, water and wastewater connections for each lot. Water and wastewater will connect to the existing public systems, with additional public network extensions undertaken as part of the development. Stormwater will discharge into a new public SW network that discharges into the stream. There will be one outlet point from the pond which discharges to the stream on the southern end of the site, and another smaller outfall for the lower lying lots.
TWM-P3 – Capacity	To manage the scale and design of subdivision and development where connection is provided to reticulated three waters networks to ensure that there is sufficient capacity in the reticulated networks, and where necessary require upgrades and/or extensions to the reticulated networks.	The water and wastewater networks will be extended to service the development. The new public stormwater system including the proposed stormwater pond, will mitigate effects for up to a 1% AEP. This will minimise additional effects on downstream areas.
TWM-P4 – Future Development	To ensure that reticulated three waters infrastructure is designed to accommodate planned and future development.	The water network already extends past the boundary of the proposed development, so it is not considered necessary to extend this network other than to service the proposed development. The development upstream at top of the hillside is council owned land and will not be developed, hence neither stormwater or wastewater reticulation extension is proposed.
TWM-P5 – Vested Assets	To require vested assets, and connections to vested assets, to be designed and constructed in a manner that protects the ongoing	All three waters infrastructure will be designed in accordance with relevant councils and NZ engineering standards

	operation, maintenance and upgrading of that asset.	and will be vested to council as part of the development.
TWM-P6 – Private Systems	To ensure that where connection to a reticulated three waters network is not available or practicable that provision can be made for: 1. A water supply. 2. The treatment, disposal, and where appropriate attenuation, of stormwater in a way that does not lead to significant adverse effects on or off site. 3. Management of wastewater via: a. An on-site wastewater treatment system; or b. Approval to connect to a private wastewater system.	All lots shall be able to connect into the extended public three waters network and no private systems are necessary. The water, stormwater and gravity wastewater systems will be vested to council.
TWM-P7 – Flooding	To reduce the risk of flood hazards or increased upstream and downstream flood levels resulting from stormwater discharges.	Flows from the development will be reduced to below predevelopment levels for up to a 1% AEP, and will include a 20% rainfall increase for climate change. Stormwater flows within the development will include both a piped reticulation system and secondary flow paths to manage stormwater flows up to a 1%AEP.
TWM-P8 – Integrated Three Waters Assessments	To require Integrated Three Waters Assessments for large scale developments to: 1. Manage three waters in an integrated and comprehensive manner. 2. Enable and recognise the benefits of green infrastructure and low impact and water sensitive design.	A stormwater pond will be installed as part of the development which will protect the receiving environment. The water and wastewater will be connected to the public systems to mitigate the effects of more intensive urban development.
TWM-P9 – Infrastructure	To require subdividers and developers to meet the costs of any	The subdivision will install the infrastructure necessary to service the

	upgrades or extensions of reticulated three waters infrastructure which are attributed to the impacts of the subdivision or development.	proposed development as part of its construction. No network upgrades apart from inside the subject site are required as part of the development.

With reference to Whangarei District Council's engineering standards, ponds should be designed generally in accordance with TP10/GD01, which are Auckland Council's standards for stormwater design for development and are considered a suitable set of guidelines for Northland with similar catchments and geology.

The design the stormwater ponds generally requires the following:

- An extended detention volume of 34.5mm for the site to be released over a 24hr period, This slow release volume is to minimise stream erosion and increase water quality in the pond. In accordance with the technical guidance on pond design that GD01 is based upon (TR2013-024) a 70mm (to minimise blockage risks) or larger orifice has been used to manage these flows.
- The pond is designed with capacity to mitigate post development flows to equal or less than the pre-development 24 hour 2, 10 and 100 year storm events to prevent the development increasing the flooding risks downstream.
- The Whangarei District Council's engineering standards also require new developments to apply a 20% increase to the design storm runoff figures to address future increases resulting from climate change effects this has been incorporated into the post development model.

6 PROPOSED STORMWATER MITIGATION METHODOLOGY

6.1 Proposed Devices

Due to the constraints of the site, it is proposed to mitigate the effects of the development using the following devices:

- A stormwater pond has been designed to collect the stormwater runoff from impervious and pervious areas of each lot, the road reserve and the bushed area. The pond has been designed with the necessary outlet configuration to mitigate the 2yr, 10yr and 100yr storm events to equal or less than pre-development rates, which ensures that it does not affect downstream areas with any increases in flow rates. The water will discharge from the pond into the stream running along the southern boundary of the development.
- Additional to the 2,10 and 100yr storm event mitigation an extended detention volume has been allowed for in the pond with a 24hr drain down period designed in accordance with Auckland Council's GD01. The extended detention reduces the stream erosion and increases water quality in the pond for the runoff from all the individual lots and road reserve areas and will help improve the overall quality of the stream the pond discharges to.

- The full water quality treatment volume for all areas of the development is provided within the pond (1731m^3). 50% of this shall be provided as dead storage and the rest as live storage with the extended detention storage.
- A forebay is included in the pond design to ensure settlement of sediments as required under Auckland Council's GD01. The pond will also drain completely through soakage during the drier periods.

6.2 Modelling Inputs

A HEC-HMS model was developed based on a SCS Type 1A storm profile determined from HIRDS V4 rainfall data for the site, and the hydrological parameters outlined in Table 1 above.

A time of concentration of 10 minutes was used due to the relatively small catchment lengths.

The rainfall data was increased by 20% in the post development model to account for the increases in storm intensity and frequency as a result of climate change.

6.3 Results

Table 3 below shows the pre-development and post-development peak flow rates produced by the proposed design. The full output tables from the HEC-HMS modelling are appended to this report.

Table 3 - Pre and Post Development peak flow rates from the development.

Storm Event (ARI)	Pre Development (m^3/s)	Post Development (m^3/s)
2	0.3576	0.3537
10	0.6912	0.6892
100	1.2464	1.2415

The results show that the proposed design attenuates post-development peak flows to equal or less than the pre-development peak flows.

If impermeable areas greater than those analysed in this design are proposed, then a revision of the design presented in this report will be required.

6.4 Stormwater Device Design

6.4.1 Stormwater Pond

- The footprint of the permanent pond water level covers an area of approximately 718m^2 at RL145.3m, with the depth being approximately 2.5m.

- The extended detention storage area available between the permanent water level and RL146.1m is approximately 1040m^3.
- Above the extended detention level at RL146.1m the pond as modelled will utilise 3127m^3 of volume to control up to the 100-year storm event with the expected levels during a 100 year storm to reach RL147.6m which is a maximum water depth of 4.8m from the pond base.
- The volumes and elevations for the various storm event storage are summarised in Table 5 below.

Table 4 - Pond storage at respective elevations.

Elevation (RL)	Area (m^2)	Volume (m^3)	Cumulative Volume (m^3)
142.8	38	N/A	N/A
145.3	718	945	945
145.4	863	79	1024
147.9	2204	3834	4858
148	2859	253	5112

Table 5 - Pond volumes and respective elevations for storm event storage.

Storage Event	Elevation (RL)	Cumulative Pond Volume (m^3)
Dead Storage	145.3	945
Extended Detention	146.1	1985
2 year Live Storage	146.7	3018
10 year Live Storage	147.1	3632
100 year Live Storage	147.6	4398
Total Pond Capacity	148.0	5112

- The pond will incorporate a 1m wide bench as a safety precaution to allow anyone to exit the water should anyone inadvertently enter the pond. This bench has been incorporated into the design at RL145.4m.
- The dead storage volume (945m^3) will provide water quality treatment most of which will slowly drain through soakage.
- A Ø100mm low flow outlet will control the permanent pond levels around RL 145.3, with the extended detention volume being above this level.
- The top of the pond bank is a 3m width at RL148m, this allows 0.3m freeboard from the 100yr storm event level. Additionally, the pond shall have an emergency drain into the stream installed. This is capable of discharging events in the unlikely event that the manhole overflow is blocked.
- The outfall structure of the pond will have outlets as shown in Table 6 below. A drawing of the outlet structure and pond dimensions is appended to this report.

Table 6 - Pond outlet structure summary.

Outlet	Elevation (RL)	Description
Outlet 1	145.3	Ø100mm orifice outlet
Outlet 2	146.1	Ø400mm orifice outlet

Outlet 3	146.7	Ø375mm orifice outlet
Outlet 4	147.1	Ø400mm orifice outlet
Emergency Spillway	147.7	Ø2050mm manhole overflow
Manhole Outlet	142.8	Ø1050mm outlet

- A forebay with a minimum 30% volume of 260m^3 shall be provided at the inlet to the pond to capture coarse sediments before they enter the pond. Access shall be provided to the forebay such that sediments can be cleaned out.
- A 3m wide access track shall be formed from the top of the pond down with access onto this track via a shared concrete accessway at a maximum grade of 1:4 which will also serve as the overland flow path into the pond.
- A capped 150mm PVC outlet has been installed at the base of the pond discharging into the outlet manhole, this outlet is to be only used if de-watering the pond is required for maintenance purposes, and will drain the pond completely.
- The pond will be formed so that any overflow in excess of the ponds capacity drains into the manhole and out via the outlet pipe and in an extreme case via a 3m wide spillway, should the pipe become blocked for any reason.

7 LIMITATIONS

This report has been prepared exclusively for Onoke Heights Limited with respect to the particular brief given to us. Information, opinions and recommendations contained in it cannot be used for any other purpose or by any other entity without our review and written consent. LDE Ltd accepts no liability or responsibility whatsoever for or in respect of any use or reliance upon this report by any third party.

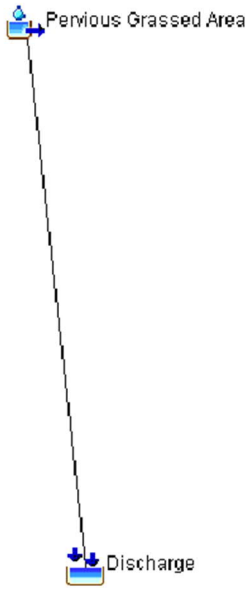
APPENDIX A
HIRDS V4 RAINFALL DATA

2, 10 AND 100 YEAR ARI STORM +20%CC RAINFALL INTENSITY (MM/H)

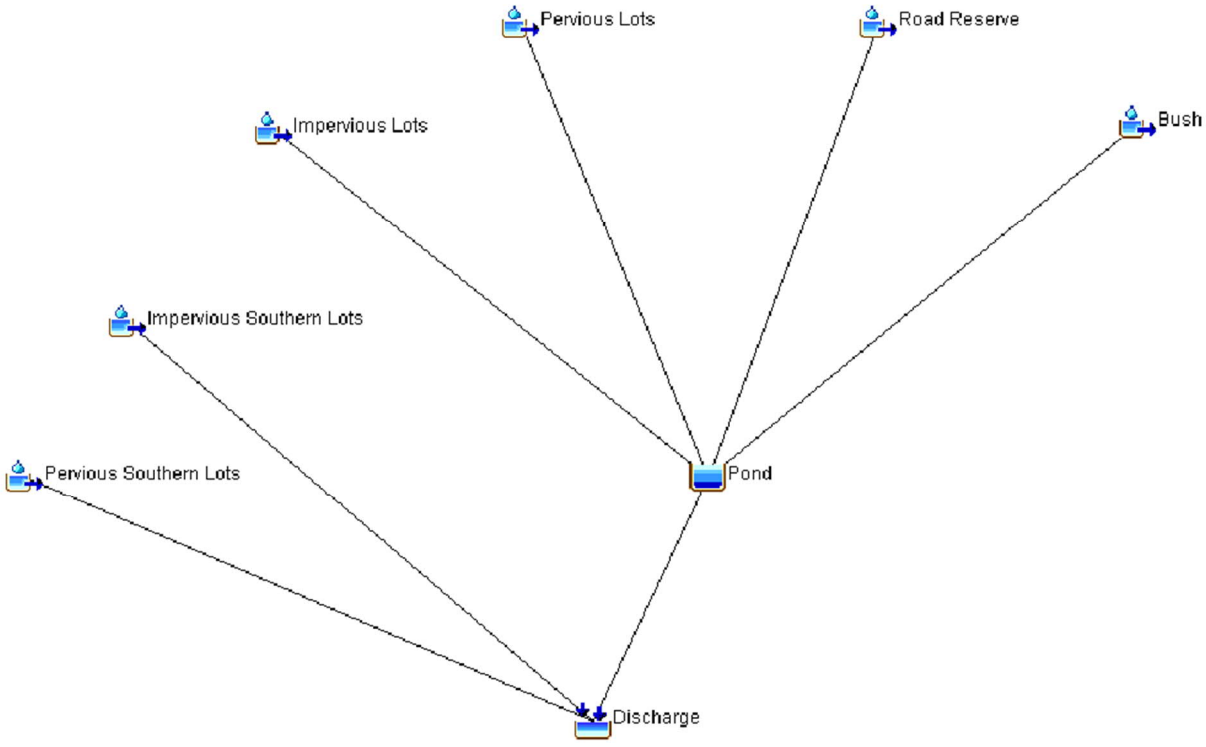
ARI	10m	20m	30m	60m	2h	6h	12h	24h	48h	72h
2	96.0	69.2	57.0	41.4	29.5	16.7	11.4	7.7	4.8	3.6
5	127.1	92.6	76.1	55.3	39.1	22.0	15.0	10.1	6.3	4.7
10	152.9	111.4	91.6	66.4	46.8	26.3	17.8	11.9	7.4	5.5
20	181.8	131.9	108.9	78.6	55.3	31.0	21.0	13.7	8.6	6.3
30	199.2	145.0	119.8	86.2	61.0	34.0	23.0	14.9	9.4	6.9
40	211.9	155.2	128.0	92.1	64.5	36.0	24.3	15.6	9.8	7.2
50	223.1	162.8	134.9	97.2	68.5	37.7	25.6	16.2	10.3	7.5
60	231.6	169.4	140.4	101.5	71.1	39.1	26.5	16.8	10.6	7.7
80	246.2	180.2	149.4	107.1	75.6	41.5	28.1	17.7	11.1	8.1
100	257.8	189.0	156.0	111.8	78.5	43.7	29.5	18.4	11.5	8.4

APPENDIX B
HEC HMS MODEL
SCHEMATICS
AND OUTPUTS

PRE DEVELOPMENT SCHEMATIC



POST DEVELOPMENT SCHEMATIC



2-YEAR ARI STORM PRE DEVELOPMENT RESULTS

Project: 67 Dip Road, Kamo Simulation Run: 2yr pre

Start of Run: 01Jan2000, 00:00
End of Run: 02Jan2000, 00:00
Compute Time: 24Nov2021, 10:33:24
Basin Model: Pre development
Meteorologic Model: 2yr pre
Control Specifications: 24hr

Show Elements: All Eleme... Volume Units: (●) MM ( ) 1000 M3 Sorting: Hydrolo...

Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (MM)
Pervious Grassed Area	0.066955	0.3576	01Jan2000, 08:00	85.628
Discharge	0.066955	0.3576	01Jan2000, 08:00	85.628

2-YEAR ARI STORM POST DEVELOPMENT RESULTS

Project: 67 Dip Road, Kamo Simulation Run: 2yr post
Reservoir: Pond

Start of Run: 01Jan2000, 00:00
End of Run: 02Jan2000, 00:00
Compute Time: 24Nov2021, 11:03:12
Basin Model: Post development
Meteorologic Model: 2yr post
Control Specifications: 24hr

Volume Units: (●) MM ( ) 1000 M3

Computed Results

Peak Inflow: 0.5865 (M3/S)
Peak Discharge: 0.3159 (M3/S)
Inflow Volume: 147.639 (MM)
Discharge Volume: 129.064 (MM)
Date/Time of Peak Inflow: 01Jan2000, 08:00
Date/Time of Peak Discharge: 01Jan2000, 08:25
Peak Storage: 1.925 (1000 M3)
Peak Elevation: 146.645 (M)

Project: 67 Dip Road, Kamo Simulation Run: 2yr post
Sink: Discharge

Start of Run: 01Jan2000, 00:00
End of Run: 02Jan2000, 00:00
Compute Time: 24Nov2021, 11:03:12
Basin Model: Post development
Meteorologic Model: 2yr post
Control Specifications: 24hr

Volume Units: (●) MM ( ) 1000 M3

Computed Results

Peak Discharge: 0.3537 (M3/S)
Volume: 131.179 (MM)
Date/Time of Peak Discharge 01Jan2000, 08:15

10-YEAR ARI STORM PRE DEVELOPMENT RESULTS

Project: 67 Dip Road, Kamo Simulation Run: 10yr pre

Start of Run: 01Jan2000, 00:00
End of Run: 02Jan2000, 00:00
Compute Time: 24Nov2021, 10:33:29
Basin Model: Pre development
Meteorologic Model: 10yr pre
Control Specifications: 24hr

Show Elements: All Eleme... Volume Units: (•) MM ( ) 1000 M3 Sorting: Hydrolo...

Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (MM)
Pervious Grassed Area	0.066955	0.6912	01Jan2000, 08:00	158.231
Discharge	0.066955	0.6912	01Jan2000, 08:00	158.231

10-YEAR ARI STORM POST DEVELOPMENT RESULTS

Project: 67 Dip Road, Kamo Simulation Run: 10yr post
Reservoir: Pond

Start of Run: 01Jan2000, 00:00
End of Run: 02Jan2000, 00:00
Compute Time: 24Nov2021, 11:04:32
Basin Model: Post development
Meteorologic Model: 10yr post
Control Specifications: 24hr

Volume Units: (•) MM ( ) 1000 M3

Computed Results

Peak Inflow: 0.9758 (M3/S)
Peak Discharge: 0.6205 (M3/S)
Inflow Volume: 243.893 (MM)
Discharge Volume: 224.697 (MM)
Date/Time of Peak Inflow: 01Jan2000, 08:00
Date/Time of Peak Discharge: 01Jan2000, 08:20
Peak Storage: 2.543 (1000 M3)
Peak Elevation: 147.062 (M)

Project: 67 Dip Road, Kamo Simulation Run: 10yr post
Sink: Discharge

Start of Run: 01Jan2000, 00:00
End of Run: 02Jan2000, 00:00
Compute Time: 24Nov2021, 11:04:32
Basin Model: Post development
Meteorologic Model: 10yr post
Control Specifications: 24hr

Volume Units: (•) MM ( ) 1000 M3

Computed Results

Peak Discharge: 0.6892 (M3/S)
Volume: 226.888 (MM)
Date/Time of Peak Discharge 01Jan2000, 08:15

100-YEAR ARI STORM PRE DEVELOPMENT RESULTS

Project: 67 Dip Road, Kamo Simulation Run: 100yr pre

Start of Run: 01Jan2000, 00:00
End of Run: 02Jan2000, 00:00
Compute Time: 24Nov2021, 10:33:33
Basin Model: Pre development
Meteorologic Model: 100yr pre
Control Specifications: 24hr

Show Elements: All Eleme... Volume Units: (•) MM ( ) 1000 M3 Sorting: Hydrolo...

Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (MM)
Pervious Grassed Area	0.066955	1.2464	01Jan2000, 08:00	277.736
Discharge	0.066955	1.2464	01Jan2000, 08:00	277.736

100-YEAR ARI STORM POST DEVELOPMENT RESULTS

Project: 67 Dip Road, Kamo Simulation Run: 100yr post
Reservoir: Pond

Start of Run: 01Jan2000, 00:00
End of Run: 02Jan2000, 00:00
Compute Time: 24Nov2021, 11:03:57
Basin Model: Post development
Meteorologic Model: 100yr post
Control Specifications: 24hr

Volume Units: (•) MM ( ) 1000 M3

Computed Results

Peak Inflow: 1.5850 (M3/S)
Peak Discharge: 1.1212 (M3/S)
Inflow Volume: 395.086 (MM)
Discharge Volume: 374.280 (MM)
Date/Time of Peak Inflow: 01Jan2000, 08:00
Date/Time of Peak Discharge: 01Jan2000, 08:15
Peak Storage: 3.356 (1000 M3)
Peak Elevation: 147.611 (M)

Project: 67 Dip Road, Kamo Simulation Run: 100yr post
Sink: Discharge

Start of Run: 01Jan2000, 00:00
End of Run: 02Jan2000, 00:00
Compute Time: 24Nov2021, 11:03:57
Basin Model: Post development
Meteorologic Model: 100yr post
Control Specifications: 24hr

Volume Units: (•) MM ( ) 1000 M3

Computed Results

Peak Discharge: 1.2415 (M3/S)
Volume: 376.633 (MM)
Date/Time of Peak Discharge 01Jan2000, 08:10

APPENDIX C
LDE DRAWINGS

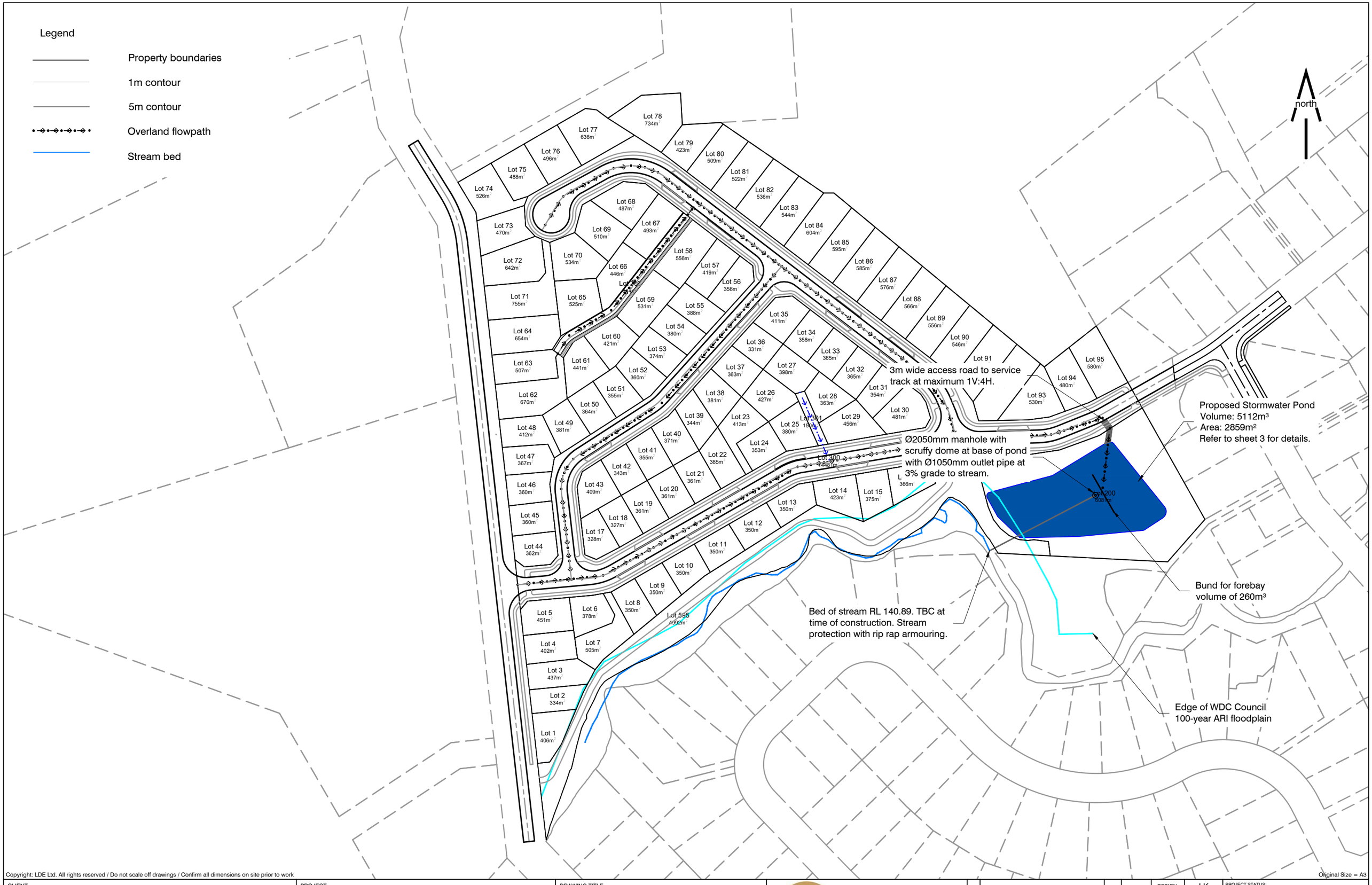
Project Number: 19103
Project Office: Warkworth
Project Manager: Aaron Holland

Stormwater Pond Drawings for

67 Dip Road, Kamo

Whangarei

CONTENTS				
SHEET	DESCRIPTION	ISSUE DATE	STATUS	REVISION
1	Stormwater Pond Location	24/11/2021	For Information	B
2	Stormwater Pond Catchment Areas	24/11/2021	For Information	B
3	Stormwater Pond Section	16/11/2021	For Information	A



Original Size = A3

CLIENT
Onoke Heights Limited

PROJECT
67 Dip Road Subdivision
Kamo, Whangarei

DRAWING TITLE
Stormwater Pond Location

LDE LAND DEVELOPMENT & ENGINEERING LTD.

No.	REVISION	BY	DATE
B	Updated lot boundaries	LK	24/11/2021
A	For Information	LK	16/11/2021

DESIGN:	LK
DRAWN:	LK
DATE:	16/11/21
CHECKED:	AH
SCALE A3:	1:1750

PROJECT STATUS: For Information
PROJECT: 19103
SHEET: 01 of 03
DRAWING No: C1
REV: B

Legend

- Property boundaries
- 1m contour
- 5m contour
- Overland flowpath
- Stream bed

north

Catchment A 9375m² (Bushed area outside of development)

Catchment B
26,014m²

Catchment C
10,294m²

Catchment D
14,481m²

Catchment E 6177m²

Catchment G 4992m² (Not included in pond design)

Original Size = A3

CLIENT
Onoke Heights Limited

PROJECT
67 Dip Road Subdivision
Kamo, Whangarei

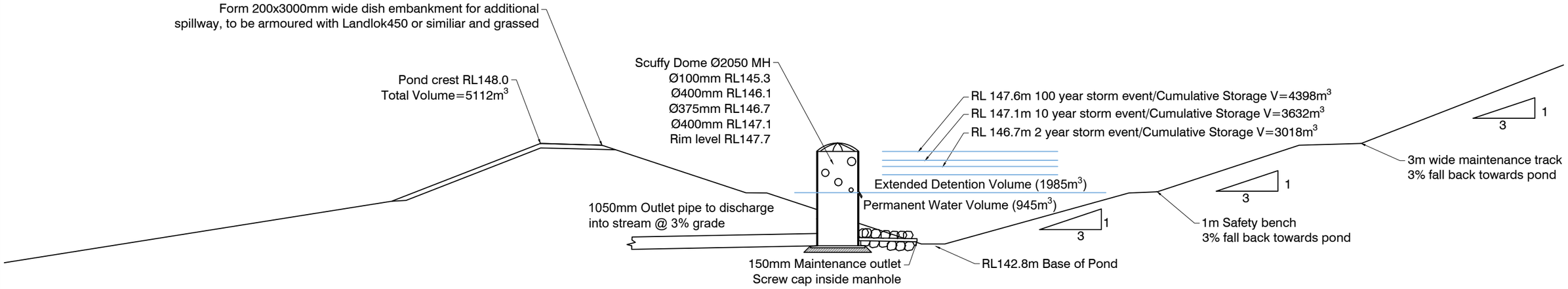
DRAWING TITLE
Stormwater Pond Catchment Areas

LDE LAND DEVELOPMENT & ENGINEERING LTD.

No.	REVISION	BY	DATE
B	Updated catchment areas	LK	24/11/2021
A	For Information	LK	16/11/2021

DESIGN:	LK
DRAWN:	LK
DATE:	16/11/21
CHECKED:	AH
SCALE A3:	1:1750

PROJECT STATUS: For Information
PROJECT: 19103
SHEET: 02of 03
DRAWING No: C2
REV: B



Original Size = A3

CLIENT
Onoke Heights Limited

PROJECT
67 Dip Road Subdivision
Kamo, Whangarei

DRAWING TITLE
Stormwater Pond Section

LAND DEVELOPMENT & ENGINEERING LTD.

No.	REVISION	BY	DATE
A	For Information	LK	16/11/2021

DESIGN:	LK
DRAWN:	LK
DATE:	16/11/21
CHECKED:	AH
SCALE A3:	NTS

PROJECT STATUS: For Information

PROJECT: 19103

SHEET: 03 of 03

DRAWING No: C3

REV: A

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