cook | costello

Preliminary Civil Report – Stages 3 & 4

Carrington Estate

Residential Subdivision of Lot 1 DP 67692 & Lot 6 DP 417562

Carrington Estate, Karikari Peninsula

Project Number: 15813-001

Date: 30/08/2021

DOCUMENT CONTROL RECORD

Client:	Carrington Estate
Project description:	Civil Report for Stage 3 & 4 Residential Subdivision
Client address:	109 Matai Bay Road, Karikari Peninsula, 0483
Date of issue:	Monday, 30 August 2021
Status:	Issued for Resource Consent

Originator:



Luke Cody
Graduate Civil Engineer
BE(Hons)

Reviewed:



Sven McLeman
Civil Engineer
BE(Hons)

Approved for issue:



Philip Cook
Chartered Professional Engineer
BE(hons),Dip Ag, CPEng, CMEngNZ, IntPE(NZ), MACENZ,MInstD

ENGINEERING NEW ZEALAND OFFICIAL MEMBER

Telephone:	09 438 9529
Contact email:	ccl@coco.co.nz

Version	Date	Comment	By
1.0	07 July 2021	For review	Luke Cody
2.0	30 August 2021	For Resource Consent	Phil Cook

Table of Contents

1. Introduction 5
2. Desktop Study 6
2.1. Site Description 6
2.2. Northland Regional Council GIS Hazard Maps 7
2.3. Proposed Development 7
3. Onsite Investigations 8
3.1. Site Walkover Observations 8
4. Earthworks 9
4.1. Stage 3 9
4.2. Stage 4 9
5. Access 10
5.1. Stage 3 10
5.2. Stage 4 11
6. Stormwater 13
6.1. Stage 3 14
6.2.1. Catchment 3 14
6.2. Stage 4 14
6.1.1. Catchment 1 14
6.1.2. Catchment 2 15
7. Wastewater 16
7.1. Stage 3 16
7.2. Stage 4. 16
8. Water Supply 18
8.1. Potable Water 18
8.2. Fire Supply 18
9. Further Investigations 18
10. Conclusions 19
10.1. Hazards 19
10.2. Earthworks 19
10.3. Access 19
10.4. Stormwater 19
10.5. Wastewater 19
10.6. Water 19

11. Limitations 20
Appendix 1: Proposed Scheme Plans 21
Appendix 2: Lot suitability spreadsheet 24
Appendix 3: Stages 3 and 4 overview and cross sections displaying how lot house pads and roads are proposed to be formed. 31
Appendix 4: Stormwater catchment plans 39
Appendix 5: QGIS Hillshade diagram and steep area 41
Appendix 6: Road number reference 43
Appendix 7: Water storage calculations 45
Appendix 8: Firefighting requirements example from 4404 49

List of Figures

Figure 1: Far North Regional Council GIS Maps with Stage 3 & 4 subdivision schemes overlaid. 6
Figure 2: Northland Regional Council GIS Natural Hazards Map. 7

1. Introduction

Cook Costello has been engaged by Carrington Estate to provide a preliminary civil suitability report in support of a resource consent application to the Far North District Council.

It is proposed to develop a 36 Lot and 104 Lot subdivision which will be referred to as Stage 3 and Stage 4, respectively.

Stage 3 & 4 will be part of a larger development being undertaken by Carrington Estate that will be known as Edgewater Estate.

The proposed scheme plans for Stage 3 & 4 are shown in Figure 1 and Appendix 1.

The developments of Edgewater Estate have previously gained Resource Consents with the Far North District Council, but the project has been put on hold in the past. Previous Resource Consents numbers are:

- RC-2100195-RMASUB
- RC-2090139-RMAVAR
- RC-2060756-RMAVAR
- RC-2060032-RMASUB
- RC-2050973-RMASU
- RC-2050976- RMAVAR/A

This report considers the following aspects of site development:

- Access
- Earthworks
- Stormwater
- Wastewater
- Water supply
- Power and Telecommunication

A geotechnical report was completed on the 17/05/2021 titled “15813 – Carrington Estate Geotech Report Stages 3 and 4 which will be referred to as “Geotechnical report” throughout this document.

2. Desktop Study

A desktop study using regional geological maps and other published information has been completed to provide further information about the site. It should be noted these are regional-scale documents and should not be relied on for site-specific acceptance.

2.1. Site Description

Lot 1 DP 67692, which corresponds to the Stage 3 residential subdivision is approximately 4.3 Ha and is located directly north of De Surville Road and Doubtless Bay Drive. The site for Stage 3 is moderately steep and predominantly covered in dense manuka forest and shrubs.

Lot 1 DP 67692 and part of Lot 6 DP 417562, which corresponds to the Stage 4 residential subdivision is approximately 11.2 Ha and is located directly north of the Doubtless Bay Road and east of Matai Bay Road. The site for Stage 4 is moderately steep and predominantly covered in dense Manuka Forest and shrubs.

Stages 3 and 4 are bordered by several existing residential dwellings located to the west and south of the site.

The locations of the proposed subdivisions are shown in Figure 1 and scheme plans are attached as Appendix 1.



Figure 1: Far North Regional Council GIS Maps with Stage 3 & 4 subdivision schemes overlaid.

2.2. Northland Regional Council GIS Hazard Maps

The Northland Regional Council's Natural Hazards Map (Figure 2) indicates that some areas of Stage 3 & 4 subdivisions are located on erosion-prone land. The proposed subdivision sites have not been mapped by the Northland Regional Council as being susceptible to any other natural hazards.

All GIS maps supplied by the Northland Regional Council are regionally scaled documents and should not be relied on for site-specific acceptance.



Figure 2: Northland Regional Council GIS Natural Hazards Map.

2.3. Proposed Development

The proposed development is to create 140 new allotments.

Stage 3 will consist of 36 lots with access through road to vest Lot 37 and will connect to De Surville Road.

Stage 4 will consist of 104 lots with access provided through road to vest Lots 110 and 112 that connect to Mahia Bay Road and Doubtless Bay Drive.

No information has been provided to Cook Costello about the proposed dwellings nor their sizes however, it is expected these will be single and double-storey dwellings.

3. Onsite Investigations

3.1. Site Walkover Observations

A site visits for both Stages 3 & 4 was undertaken on 26 May 2021 by a Cook Costello civil engineer. The following observations were made during the site walkover:

- The sites are predominantly moderately sloping and covered in Maunka bush.
- There are several cleared paths that form rough vehicle access to the property.
- There were no signs of recent instability present at the site.
- It was observed that the most elevated section of Stage 4 – Lots 67-81, is reasonably steep and may require further discussion on lot size and suitability for access and building pads.

4. Earthworks

Earthworks for Stage 3 and 4 is extensive. The volumes below have been approximated for the development of the roading, infrastructure and approximated house pads only. Lot specific earthworks such as entrance and driveways will be calculated at the lot specific consent stage.

4.1. Stage 3

The development of roads and house pads for Stage 3 has been approximated at volume cut of 8000 m^3 and fill of 2200 m^3. For initial earthworks calculations a topsoil strip of 150 mm and subgrade of 300 mm has been used. The installation of civil infrastructure such as stormwater and wastewater pipes have an approximate trenching earthworks volume of 1300 m^3. Total earthworks balance for Stage 3 is estimated at 5800 m^3.

4.2. Stage 4

The development of roads and house pads for Stage 4 has been approximated at volume cut of 20350 m^3 and fill of 5400 m^3. For initial earthworks calculations a topsoil strip of 150 mm and subgrade of 300 mm has been used. The installation of civil infrastructure such as stormwater and wastewater pipes have an approximate trenching earthworks volume of 4300 m^3. Total earthworks balance for Stage 3 is estimated at 14950 m^3.

Total combined earthwork will be less than 50,000 m^3 for both stages. The approximated balance of 21000 m^3 can be stockpiled on land also owned by the client, close to the proposed subdivision site.

5. Access

All roads have been designed as per NZS4404-2010. Both stages are zoned general residential by FNDC district plan maps. FNDC 3.3.12.1 minimum width of all footpaths shall be 1.5 m. Refer to Appendix 6 for road reference numbers.

5.1. Stage 3

The proposed new allotments numbered 1-36 will gain access via Road to Vest Lot 37 from Doubtless Bay Road/De Surville Road to the south, shown on the subdivision scheme. Due to an expected increase in vehicles per day through the De Surville Road and Doubtless Bay Drive intersection. It is recommended that signage and road marking traffic controls to upgrade the intersection be part of the consent. The speed limit is 50 km/h. The sight distance along De Surville Road is compliant. The sight distance along Doubtless Bay Drive is not compliant. There is a sight distance of approximately 90 m before the road goes into a gully where there is a period of approximately 3 seconds where traffic is not visible. There is then visibility beyond 200 m. It may be necessary to instal permeant warning signs such as speed advisory or concealed (As per MOTSAM Part 1 Section 06 – modified PW-26 signs).

The proposed subdivision will comprise of 2 connected roads each terminating with a cul-de-sac turning head. A 1.5 m wide footpath is provided for on one side of each road for pedestrian access. These road accesses are to be two lane sealed carriageway with kerb and channel. The design speed for the proposed roads is 50 km/hr. Provision is to be made for individual entrances to each lot by the formation of a vehicle crossing kerb at each entrance and construction of a 5 m wide metal area to the boundary. New accessways will need to be constructed to service the 36 lots. We recommend a 3.0 m wide concrete drive is provided. Design details should be determined at the engineering design stage.

Approximated road grades and allotment access are as follows:

- RD01 climbs up from the corner of De Surville Road and Doubtless Bay Drive at a grade of between 13.5 and 14% for the first 100m and then traverses across the hillside at a grade of 12% terminating with a cul-de-sac at the summit. RD01 provides access to lots 10-31.
- RD02 connects with RD01 at chainage 30m from the start of RD01 and climbs at 12% across the hillside up to the chicane outside lot 33. From the chicane the road crests and descends to the end terminating at the cul-de-sac to tie in with the existing ground levels. RD02 provides access to lots 1-9 and 32-36.

During detailed design consideration should be given to lowering of the cul-de-sac of RD02, but careful design of drainage levels needs to be considered. The alignment of the cul-de-sac of RD02 both horizontally and vertically along with the reshaping of lot parcels 7-9, 25 and 26 could improve access to these lots. Lowering cul-de-sac RD02 would reduce the retaining wall required for fill on the LHS but increase the height of the retaining wall required on the RHS. Access to lots 35 and 36 would be made more difficult with the lowering of RD02 but a boundary adjustment to create longer lots similar to lot 26 with access from RD01 could be advantageous.

A retaining wall between the boundaries of the easement road to vest 37 and lot 25 would benefit lowering of the ROW giving better gradients to lots 7-9.

Retaining walls will be required around each of the cul-de-sacs to keep the road footprint within the road to vest boundary.

Retaining walls will be required behind lots 18-20 to provide for flat building pads on this steep section of the site.

Retaining walls below lots 6-10 would be required to provide flat areas on this steep area.

The natural slope angle of the site for lots 1-36 is generally steep with a gradient of 1h:7v (15%) up to 1h:1v (50%) in some places and therefore the construction of properties may require careful consideration and engineering.

A 10 m x 10 m building pad has been placed centrally on each lot to show typical cut at 1:1 slope angle and fill at 1:2. A spreadsheet displaying relevant access grades for the proposed Lots in stage 4 has been included in Appendix 2. The main findings are that Lots 1-2, 10-24 and 27-36 can be serviced by accessways with a grade of 20% or less. Lots 3-9 and 25-26 are services by accessways with grades between 21 and 35%. Specific engineering design may be required to provide access to lots with access grades greater than 25%.

5.2. Stage 4

The proposed new allotments for Stage 4 will gain access from Doubtless Bay Drive to the south and from Matai Bay Road to the north, shown on the subdivision scheme plan as Lots 112 and 110 Roads to Vest.

The current speed limit at the proposed Doubtless Bay Drive intersection is 50 km/h this requires sight distances of over 110m which are proficient. The current speed limit at the Matai Bay Road intersection is 100 km/h. As per Austroads the minimum sight distance is 170 m. The northern sight distance does not meet this requirement. The intersection of Road to Vest Lot 110 and Matai Bay Road will need a specific engineered design by a suitability qualified engineer.

Stage 4 is accessed by roads RD03-RD10. RD03 is the main arterial road that runs centrally through the subdivision from which RD03-07 branch off. A turnaround area provided for at the end of each road terminating with a cul-de-sac turning head. Lots 1-5 are to be accessed from Doubtless Bay Drive. Lots 102-104 are accessed from Matai Bay Road.

A 1.5 m wide footway is provided for on one side of each road for pedestrian access. These road accesses are to be two lane sealed carriageway with kerb and channel each side. The design speed for the access roads is 50 km/hr. Provision is to be made for individual entrances to each lot by the formation of a vehicle crossing kerb at each entrance and construction of a 5 m wide metal area to the boundary. All internal roads must have a grade not exceeding 1 in 5. Within the first 5 m of any access the grade must not exceed 1 in 8. Through preliminary design stages this has been deemed as practical for all internal roads but will need to be checked in greater detail at the detailed design stage.

For individual lot access, for lots 1-104 the natural slope angle of the site is generally steep with a gradient of up to 1h:2.5v in some places and therefore the construction of properties may require careful consideration and engineering. A spreadsheet displaying relevant access grades for the proposed Lots in Stage 4 has been included in Appendix 2. The main findings are that Lots 1-37, 44, 46, 51, 54-56, 63-65, 71-73 and 76-104 can be serviced by accessways with a grade of 20% or less. Lots 38-45, 47-49, 52-53, 57-62, 66-70 and 73-75 are serviced by accessways with grades between 21 and 46%. Options to be investigated to provide access to these lots are:

Approximated road grades and allotment access are as follows:

- RD03 climbs up from Doubtless Bay Drive at a grade of up to 16% for the first 220m and then climbing at 11% to the road crest outside lot 57 then descending at 8% to the cul-de-sac termination head. RD03 provides access to lots 6-7, 27-30 and 54-71.
- RD04 is a 60m long cul-de-sac with a max grade of 6%. RD04 provides access to lots 8-14.
- RD05 provides access to lots 31-35, 37 and 39.
- RD06 descends at grades between 3 and 12% down to the cul-de-sac turning head and provides access to lots 15-20, 25-26 and 46-53.
- RD07 climbs at grades of 12.1 and 14.4% to the cul-de-sac termination at the summit and provides access to lots 36, 38, 40-45 and 72-81.
- RD08 is a small 20m long cul-de-sac off RD06 descending at 20%. This cul-de-sac provides access to only 3 lots 21,22 and 24 (there is no lot 23 shown on subdivision plan). This could be replaced with a less costly ROW.
- RD09 has a maximum grade of 13% that intersects with Matai Bay Road and provides access to lots 82-101.

Lots 41-45 and 79-81 will require careful design because of the steepness of the ground and access to lots sloping steep downhill to the properties. Appendix 5 displays the steep areas of concern. If we could lower the cul-de-sac of RD07 and put in a retaining wall to the NE boundary to tie-in to the neighboring land would make access onto lots 76-81 easier. Lots 41 to 45 could be serviced with a shared Right of Way (ROW) off RD07 with retaining walls between RD07 and the ROW.

Also included in Appendix 2 is the lot suitability for the formation of a flat building pad. Examples of cut and fill with one cross section example for Stage 4 is displayed in Appendix 3.

The final location of the new dwellings and accessways is to be determined by the purchasers and detailed on their building consent applications.

6. Stormwater

There are three proposed catchment areas to be considered. Catchments 1 & 2 cover Stage 4 while Catchment 3 covers Stage 3.

The proposed development will create impervious areas in the form of roads, driveways, and residential housing.

For the proposed roads, stormwater runoff will be controlled by curb and channel along the road edge leading to sumps and controlled to existing infrastructure via a piped network

It is proposed to include onsite stormwater attenuation for every allotment. This will likely be in the form of individual attenuation tanks. The attenuated stormwater will then enter the proposed stormwater infrastructure in the road boundary.

The attenuated stormwater produced by the proposed allotments will be transported to the proposed stormwater infrastructure via open channels if attenuated stormwater is to be discharged overland via spreader bars (so that greater infiltration can be achieved) or piped directly to the proposed infrastructure from the attenuation tank outlets.

There is also an option to provide onsite stormwater treatment via soakage pits. However, this option may not be practicable due to the expected low soakage rates of the clay soils in the proposed subdivision location.

To attenuate the increase in stormwater runoff produced by the proposed new roads the following two options are proposed:

1. Each allotment will be required to over attenuate stormwater runoff to offset, an area of the road runoff based on a percentage of road area to allotment size.
2. Another option may be to provide stormwater attenuation of the new impervious area by using one of the proposed allotments downstream of the proposed subdivisions and near the entrance to the existing stormwater network as a stormwater attenuation/detention pond. It is proposed allotment 27 for Stage 4 (Catchment 2) and allotment 24 for Stage 3 will be used for these ponds

The attenuated stormwater would then enter the existing stormwater systems in the existing developed areas.

As mentioned previously, stormwater runoff will enter a piped system via sumps along the road. An alternative option to the piped network which can be explored is creating open channel drains along the subdivision's internal roads. The alternative option proposes that stormwater runoff from the proposed lots will drain to the road and enter sumps located in the road curb and channel. These sumps can then outlet via a bubble up type system to open channel stormwater drains. The open channel drains will need to be on the downstream side of the roads. Weirs may be used to improve the open channel storage and reduce flow velocities. These open channel drains will be used to transport stormwater and provide additional soakage capacity and overland flow paths for stormwater.

6.1. Stage 3

6.2.1. Catchment 3

Stormwater attenuation design for each individual allotment will need to be completed at the building consent stage based off the lot specific use. The attenuation tanks from the specified lots that are able to direct stormwater to the road will link into the proposed piped stormwater system within the road boundary. There will be numerous allotments that will require easement to drain stormwater from other lots. Road runoff will be controlled by the following methods. All road to vest lots are to be designed with curb and channel. The curb and channel will collect runoff, directing it to sumps in various low/flat sections of the roads which will then transfer the stormwater via pipes to existing infrastructure.

The stormwater in Stage 3 is captured in Catchment 3 as per Appendix 3. Stormwater runoff from roads and attenuation tanks will be piped under the proposed roads and enter existing infrastructure located on Doubtless Bay Drive and De Surville Road. It is proposed that attenuated stormwater from Catchment 3 will travel to the ocean via the proposed pipe system and existing open channel flow paths. It is not expected that the existing infrastructure will encounter any downstream constraints as it drains directly to the ocean.

Lots 19-23 and 2-9 will drain attenuated stormwater directly into existing stormwater flow paths via spreader bars as it is not possible for these allotments to access the proposed stormwater infrastructure in the proposed road formation. There is only manuka bush below these allotments so the stormwater runoff will not impact any other sections

6.2. Stage 4

Stormwater attenuation design for each individual allotment will need to be completed at the building consent stage based off the lot specific use. The attenuation tanks from the specified lots that are able to direct stormwater to the road will link into the proposed piped stormwater system within the road boundary. There will be numerous allotments that will require easement to drain stormwater from other lots. Road runoff will be controlled by the following methods. All road to vest lots are to be designed with curb and channel. The curb and channel will collect runoff, directing it to sumps in various low/flat sections of the roads which will then transfer the stormwater via pipes to existing infrastructure.

6.1.1. Catchment 1

The northern end of road to vest, Lot 110 and the upstream lots will drain through a piped / open channel via Easement Lot 105. The southern end of Lot 110 and the associated Lots will drain to sumps located at the northern end of the Matai Bay Road, the internal intersection of Lot 110 and at the downstream end of Lot 106. Proposed Lot 106 will provide open channel flow for the remainder of Catchment 1. All stormwater collected from Catchment 1 will then be piped along Matai Bay Road to the proposed stormwater retention pond to the north of the catchment. It is proposed that attenuated stormwater from Catchment 1 will flow north to an existing pond located in the north-west section of Lot 6 DP 417562. The suitability and capacity of the pond will need to be investigated further and upgraded if necessary.

Proposed road 8 will need to be redesigned as a possible shared accessway for proposed Lots 21, 22, and 24. This is due to there being no existing path to control stormwater runoff from proposed road 8 except for onsite attenuation / soakage in the downstream Lots. There is an opportunity to install stormwater infrastructure to service these lots in proposed Lot 22. There is an existing wastewater main that currently terminated in proposed Lot 22 and follows the boundary of 9 Doubtless Bay Drive (Lot 18 DP 69243). The proposed stormwater infrastructure could follow the same path as the existing wastewater infrastructure.

Another option is to install stormwater infrastructure along the boundary of 48 Matai Bay Road (Lot 26 DP 69243). This section is currently vacant so would be the preferable option. Permission from the existing property owners would need to be obtained

6.1.2. Catchment 2

Catchment 2 captures the proposed development stormwater runoff from the southern section of Stage 3. Attenuated runoff will be piped along the northern side of Doubtless Bay Drive to an existing stormwater culvert where it will enter the existing stormwater system. If the option of implementing a stormwater attenuation/retention pond on proposed Lot 27 is used, then all stormwater runoff with enter the pond and slowly drain to the existing open channel. The existing open channel then flows to an existing pond downstream in the subdivision below via a piped system and existing open channel flow paths.

7. Wastewater

Initial discussions with council have indicated that the existing capacity of the wastewater infrastructure that will service the proposed development will be insufficient. Therefore, developers and council will need to work together to develop a timeframe for upgrading and making additional capacity available in the system as the proposed subdivision come online.

Discussion around developer contributions need to be considered early as it is the understanding of Cook Costello (informed by the client) that there has been previous development contribution paid by our client to upgrade the wastewater network which has been consumed by others in the region, notably not our client.

7.1. Stage 3

Stage 3 will require gravity wastewater 150 mm diameter pipes along RD01 and RD02. These lines will connect to a manhole located at the intersection of RD01 and RD02. A collector pipe will be required along Lots 28,29,33,32. Lots 2-10 will be serviced by a collector pipe which will require an easement over the neighbouring property Lot 2 DP 153434 to access the FNDC asset on Doubtless Bay Drive. If an easement is not obtained over Lot 2 DP 153434 then Lots 2-10 will need individual pumps to pump wastewater up towards the wastewater main located within RD02 boundary. These low-pressure pumping systems are now widely used within developments where conventional gravity systems and pumpstations to be vested in Council are impractical and uneconomic.

The downstream FNDC wastewater asset pipes located in De Surville Road are 100mm diameter. There are two potential options as follows. The potential daily flow from Stage 3 is 20160L. A 20m^3 tank may be installed at the base of the Stage 3 in proposed Lot 1 or Lot 24. The tank will attenuate the wastewater and pump to the existing infrastructure during off peak times.

The second option may be to pipe the wastewater via a 150mm gravity main along De Surville Road and Whatuwhiwhi Road to an existing manhole to join the existing network. Proposed Lots 18-23 will require individual pumps per lot to pump the wastewater upstream to the main located in the road boundary.

Pipe grades, flow velocities and pipe depths will need to be designed and checked at the detailed design stage.

7.2. Stage 4.

The northern end of Stage 4 (Lots 89-94) will be piped along RD09 via a 150mm gravity pipe. The 150mm pipe will travel through a right to convey wastewater easement over Lot 105 to a proposed manhole located at the Matai Bay Road end of Lot 105. Lots 94-104 will connect to a wastewater main located along the roadside of sections 102-104 to Lot 105. It is then proposed to pump the wastewater via a rising main uphill along Matai Bay Road to a council manhole asset SP3683. Lots 82-88 will connect to a wastewater main located along proposed RD09 to the intersection of Matai Bay Road where it will connect to council manhole asset SP3683. Lots 46-63 will connect to a wastewater main along proposed RD06 to Lot 106 and connect to council manhole asset SP3683. Lots 16-26 will connect

to a wastewater main along the southwest boundary of Lots 17-22. This main will then connect to council manhole asset SP3684. Proposed Lots 64-70 will connect to a wastewater main along proposed RD03. Proposed Lots 71-78 will connect to a wastewater main located along proposed RD07. The wastewater mains from RD03, RD04, and RD07 will connect to the main along RD03. The main along RD03 will connect into a main located along Doubtless Bay Drive collection connections from Lots 1-6. A wastewater main will need to be installed along the southeast side of Stage 4 to collect the lots located along the southeast boundary. The proposed main located along the southeast boundary (Doubtless Bay Drive), and RD03 will connect to the council system via pump station SP3134, located on the road edge of Lot 36 DP 73179.

8. Water Supply

8.1. Potable Water

There is currently no potable water supply available to these lots. Surrounding residents currently with no potable water supply obtain water via on-site rainwater harvesting. Rainwater harvest is also appropriate for the proposed subdivision Stage 3 and 4.

The most convenient method of potable water supply for new households is by means of individual household on-site rainwater harvesting. The use of rainwater harvesting has the added benefit of contributing to stormwater retention and minimising the impact of post-development stormwater runoff. This can provide significant benefits to the design and operations of downstream stormwater systems.

Preliminary tank sizing has been estimated at 50000L capacity for a 1 in 20yr drought event (Enough for 7 weeks of zero rainfall and supply of 250l/day/person (4 people)). It is important to ensure that the rainwater tanks are sized correctly to suit the household needs. Generally, the larger the tank, the more reliable and effective it is in conserving water or managing stormwater.

Using The Climate and weather of northland – NIWA, 3rd edition report and the median annual rainfall for Kaitaia Aero Ews for the period of 1981-2010 (Table 6), the applicability of a household with 4 people using 250L per person per day with a 50 m^3 tank supply was tested. The roof area used for rain collection was 200 m^2. The results as seen in Appendix 7 show that if a 50 m^3 tank is refilled twice a year then the demand and rainfall harvest supply balance throughout the year for a median rainfall year.

The water tank size will depend on the volume of water needed, the amount of rainfall in the area, the area of the collection surface and the security of the supply needed. The specific sizing and details of rainwater tanks will be household-specific, and this will be finalised at the detailed design stage.

8.2. Fire Supply

On-site storage for fire-fighting supply is required as there will be no reticulated water supply for the subdivision. Firefighting water supply of 45 m^3 must be available within 90 of the dwelling. This may be inclusive of tank supply possibly located in the road boundary and individual onsite tank capacity of water supply. The location of proposed 20 m^3 fire supply storage tanks within the road boundaries will be specified at a later stage. An example of the required water storage for fire-fighting supply is included in Appendix 8. All water infrastructure must comply with SNZ PAS 4509:2003 and be approved by the fire department.

9. Further Investigations

A more detailed site-specific civil investigation will be required for each individual lot of the subdivisions once the design and exact locations of the proposed buildings have been confirmed. This site-specific investigation should include further civil design once the location and orientation of buildings have been finalised.

10. Conclusions

Overall, the site is suitable for residential development. A number the detailed evaluations have identified clarifications which will be needed addressed for final design. It is recommended that council condition the consent accordingly.

Detailed design plans should be prepared for FNDC Council Engineering Plan approval and prior to any construction starting.

10.1. Hazards

The Northland Regional Council's Natural Hazards Map indicates that some areas of Stages 3 & 4 are located on erosion-prone land. The proposed subdivision sites have not been mapped by the Northland Regional Council as being susceptible to any other natural hazards.

10.2. Earthworks

The sites that are to be developed for reasonable step and will require earthworks and retaining to provide appropriate access and building areas. The total volume of earthworks is less than 50,000 m^3. The approximated balance of 21000 m^3 can be stockpiled on land also owned by the client, in close proximity to the proposed subdivision site.

10.3. Access

Appropriate roading and access can be provided to each lot.

10.4. Stormwater

Stormwater can be collected controlled and attenuate to minimise any effects.

10.5. Wastewater

Wastewater can be collected controlled and piped to the council system. It is understood a discussion with council is needed to finalise upgrading details and contributions.

10.6. Water

Rainwater harvesting is deemed appropriate for water and firefighting supply

11. Limitations

This report has been prepared for the benefit of Carrington Estate as our clients with respect to a proposed subdivision development and for Far North District Council approval of the proposal as defined in the brief. It shall not be relied upon for any other purpose. The reliance by other parties on the information or opinions contained in this report shall, without our prior review and agreement in writing, be at such parties' sole risk.

Opinions and judgments expressed herein are based on our understanding and interpretation of current regulatory standards, and should not be construed as legal opinions. Where opinions or judgments are to be relied on they should be independently verified with appropriate legal advice.

Any recommendations, opinions, or guidance provided by Cook Costello in this report are limited to technical engineering requirements and are not made under the Financial Advisers Act 2008.

Recommendations and opinions in this report are based on data from testing and observations undertaken on site. The nature and continuity of subsoil conditions and information away from tests site specific survey data are inferred and it must be appreciated that actual conditions could vary considerably from the assumed model.

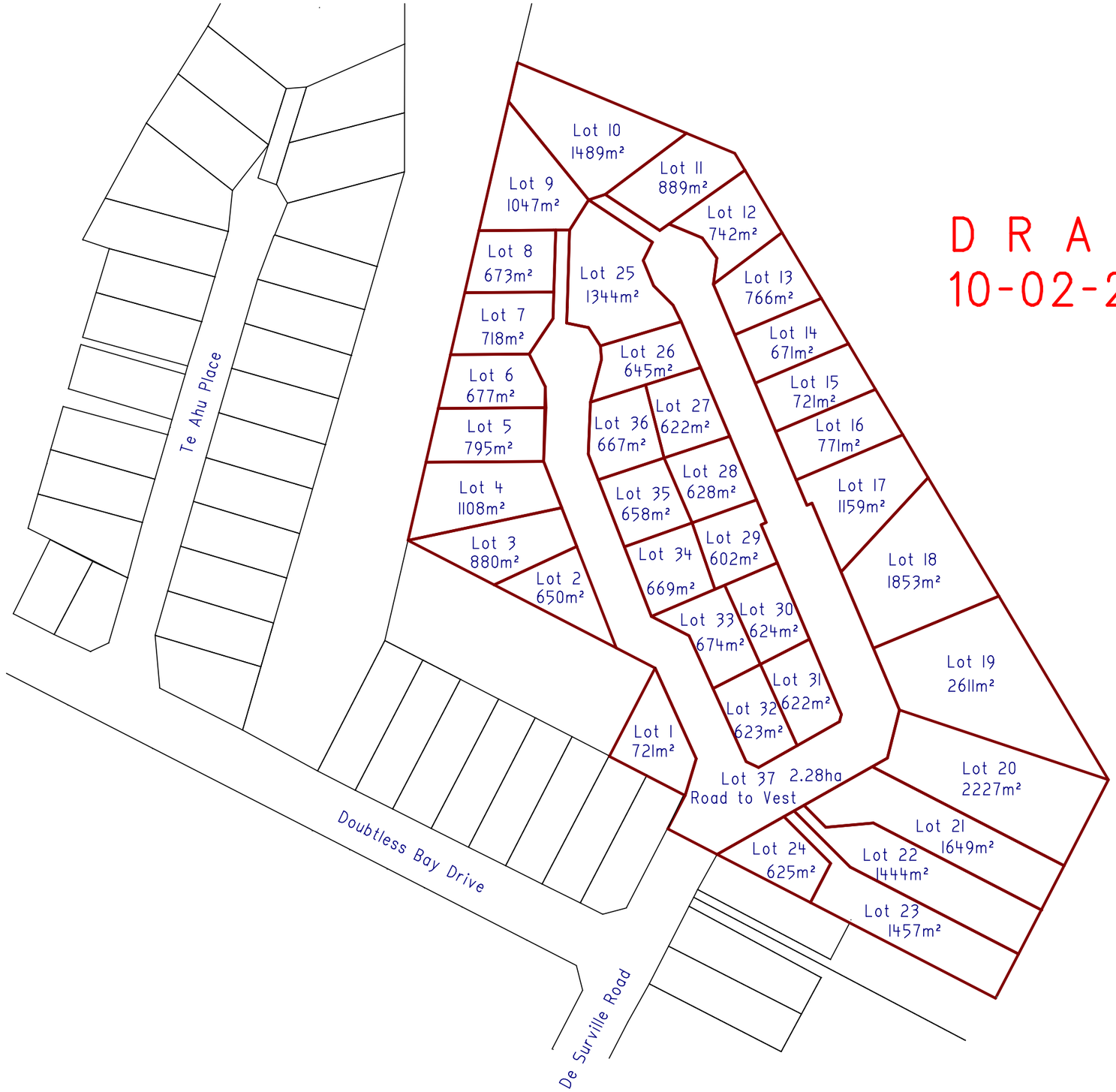
During design, excavation and construction, the site should be examined by a Cook Costello Engineer or Engineering Geologist to judge whether the exposed subsoils are compatible with the inferred conditions on which the report has been based. It is possible that the nature of the ground surface once clearing is completed may require further investigation and the modification of the design based on this report. In any event, it is essential that the firm is notified if there is any variation from those described in the report as it may affect the design parameters recommended in the report.

Cook Costello have performed the services for this project in accordance with the standard agreement for consulting services and current professional standards for environmental site assessment. No guarantees are either expressed or implied.

There is no investigation that is thorough enough to preclude the presence of materials at the site which presently, or in the future, may be considered hazardous. Because regulatory evaluation criteria are constantly changing, concentrations of contaminants present and considered to be acceptable now may in the future become subject to different regulatory standards which cause them to become unacceptable and require further remediation for this site to be suitable for the existing or proposed land use activities.

Cook Costello are familiar with the site and consider it advantageous to continue on with detailed engineering design to prepare a comprehensive set of engineering plans and specifications for Council approval and construction. We welcome the opportunity to continue with this work.

Appendix 1: Proposed Scheme Plans



D R A F T
10-02-2021

THIS DRAWING AND DESIGN REMAINS THE PROPERTY OF VON STURMERS AND MAY NOT BE REPRODUCED WITHOUT THE WRITTEN PERMISSION OF SURVEYING & PLANNING SOLUTIONS

AREAS AND MEASUREMENTS SUBJECT TO FINAL SURVEY

This plan and accompanying report(s) have been prepared for the purpose of obtaining a Resource Consent only and for no other purpose. Use of this plan and/or information on it for any other purpose is at the user's risk.

VON STURMERS
Registered Land Surveyors, Planners & Land Development Consultants
Ph: (09) 408 6000
Email: kaitaia@saps.co.nz
131 Commerce St
P.O. Box 128
Kaitaia

STAGE 3 - RESIDENTIAL
CARRINGTON

PREPARED FOR: CARRINGTON RESORT

	Name	Date
Survey		
Design		
Drawn	SH	10-02-2021
Rev		

ORIGINAL SCALE NTS SHEET SIZE A3

Surveyors Ref. No: 14889
Series
Sheet 3 of 5

Lot 105
343m²
Lot 104
1033m²
Lot 94
762m²
Lot 93
874m²
Lot 95
778m²
Lot 92
1344m²
Lot 103
985m²
Lot 96
599m²
Lot 91
949m²
Lot 97
591m²
Lot 90
723m²
Lot 98
605m²
Lot 89
956m²
Lot 99
570m²
Lot 110
535lm²
Road to Vest
756m²
Lot 102
Lot 100
537m²
Lot 88
699m²
Lot 101
620m²
Lot 87
971m²
Lot 86
1191m²
Lot 85
940m²
Lot 84
801m²
Lot 106
281m²
Lot 83
771m²
Lot 63
857m²
Lot 82
898m²
Lot 62
740m²
Lot 64
827m²
Lot 46
953m²
Lot 61
679m²
Lot 65
1163m²
Lot 47
647m²
Lot 60
552m²
Lot 66
911m²
Lot 48
713m²
Lot 81
1268m²
Lot 59
657m²
Lot 67
853m²
Lot 49
1112m²
Lot 80
1020m²
Lot 58
702m²
Lot 68
729m²
Lot 50
876m²
Lot 79
1337m²
Lot 57
597m²
Lot 69
736m²
Lot 26
562m²
Lot 51
539m²
Lot 78
718m²
Lot 77
809m²
Lot 25
711m²
Lot 56
666m²
Lot 70
834m²
Lot 52
675m²
Lot 76
755m²
Lot 24
649m²
Lot 74
811m²
Lot 75
1000m²
Lot 45
1203m²
Lot 71
660m²
Lot 72
650m²
Lot 73
679m²
Lot 55
662m²
Lot 44
1134m²
Lot 53
673m²
Lot 43
1381m²
Lot 22
1440m²
Lot 20
811m²
Lot 112
1.96ha
Road to Vest
Lot 42
1530m²
Lot 54
787m²
Lot 40
1008m²
Lot 41
1434m²
Lot 36
653m²
Lot 38
600m²
Lot 21
988m²
Lot 19
769m²
Lot 39
1646m²
Lot 35
782m²
Lot 37
767m²
Lot 18
671m²
Lot 17
628m²
Lot 34
2016m²
Lot 15
665m²
Lot 16
673m²
Lot 13
840m²
Lot 12
822m²
Lot 14
642m²
Lot 31
698m²
Lot 32
688m²
Lot 33
1403m²
Lot 11
678m²
Lot 1
598m²
Lot 30
1196m²
Lot 10
778m²
Lot 2
612m²
Lot 9
680m²
Lot 8
766m²
Lot 3
620m²
Lot 4
654m²
Lot 5
735m²
Lot 6
694m²
Lot 7
725m²
Lot 29
712m²
Lot 28
573m²
Lot 27
944m²
Matai Bay Road
Doubtless Bay Drive

N

D R A F T
10-02-2021

THIS DRAWING AND DESIGN REMAINS THE PROPERTY OF VON STURMERS AND MAY NOT BE REPRODUCED WITHOUT THE WRITTEN PERMISSION OF SURVEY & PLANNING SOLUTIONS

AREAS AND MEASUREMENTS SUBJECT TO FINAL SURVEY

This plan and accompanying report(s) have been prepared for the purpose of obtaining a Resource Consent only and for no other purpose. Use of this plan and/or information on it for any other purpose is at the user's risk.

Surveyors Ref. No: 14889
Series
Sheet 2 of 5

PREPARED FOR: CARRINGTON RESORT

VON STURMERS
Registered Land Surveyors, Planners & Land Development Consultants
Ph: (09) 408 6000
Email: kaitaia@saps.co.nz
131 Commerce St
P.O. Box 128
Kaitaia

STAGE 4 - RESIDENTIAL CARRINGTON

	Name	Date
Survey		
Design		
Drawn	SH	10-02-2021
Rev		

ORIGINAL
SCALE NTS
SHEET SIZE A3

Appendix 2: Lot suitability spreadsheet

Lots 104 Lot #	Suitable House Pad (No land development required)	Driveway access grade	Retaining wall required to FRONTAGE (m)	Fill required to REAR (m)	Retaining wall required to REAR (m)	Single storey	Two storey	Average Slope (%)	Comments
1	y	20%	0		2		Y		
2	y	20%	0		2		Y		
3	y	11%	0		2		Y		
4	y	10%	0		2		Y		
5	y	9%	0		1		Y		
6	y	5%	0		2		Y		
7	y	7%	0		3		Y		
8		20%	2		2		Y		
9		25%	2		3		Y		
10		20%	2-3		2		Y		
11		14%	1		0.5		Y		
12		15%	1		0.5		Y		
13		14%	1		0.5		Y		
14		16%	1-2		1		Y		
15		15%	1-2		1		Y		
16		10%	2		1		Y		
17		22%	1-2		1		Y		
18		16%	2		1		Y		
19	y	15%	0		0.5		Y		
20		20%	1		1		Y		
21		8%	1		1		Y		
22	y	5%	0.5		1		Y		
23	Missing house lot								
24	y	6%	0.5		1		Y		
25	y	20%	0-1		2		Y		
26	y	20%	0.5		2		Y		
27		19%	0-2.5		1		Y		

28		19%	2-4		1		Y		
29		16%	2-4		2		Y		
30		18%	1-3		2		Y		
31		20%	0.5		1		Y		
32		20%	1.5-2		2		Y		
33		20%	1		3-4		Y		20% driveway achievable on angle
34		20%	1-2		2.5-4		Y		
35		20%	0-3		0-3		Y		
36		16%	0-3		0-3		Y		
37	y	16%	0		3		Y		
38		31%	4-6		0	N	N		
39		26%	2		0-4		Y		
40		25%	3		3		Y		
41		30%	0-4		0-4		Y		
42		26%	1.5-5.5		0-3		Y		
43		25%	1.5-6		0-3	N	N		
44		18%	6		0-2	N	N		
45		35%	7		5+	N	N		
46	y	20%	0		2-4		Y		
47	y	27%	1		4		Y		
48	y	25%	0.5		4.5-5.5	N	N		
49	y	30%	1-2		2-6	N	N		
50	y	18%	0.5		1.5-2.5		Y		
51	y	18%	0.5		3		Y		
52	y	26%	0.5		3		Y		
53	y	22%	0.5		3		Y		
54		15%	1-2		0-1		Y		
55		15%	2-2.5	0	0		Y		
56		18%	2.5-3	0	0		Y		
57		28%	2-3.5	0-1			Y		
58		30%	3	1-2		N	Y		
59		25%	3	1-1.5			Y		

60		25%	3	1			Y		
61		27%	2-3	0-1.5			Y		
62		26%	2-3	0-1.5			Y		
63		20%	1-2	1-3			Y		
64		20%	1-3	1-2			Y		
65		20%	0-2		3-5		Y		
66		30%	0-3		3-4	N	Y		
67		33%	2		4-4.5	N	Y		
68		30%	0-2		3.5-4.5	N	Y		
69	y	26%	0		5	N	N		
70	y	23%	0.5		3-4	N	Y		
71	y	15%	1		2-4.5		Y		
72	y	15%	0-2		2.5-4.5		Y		
73	y	32%	0.5		1.5-4.5		Y		
74		46%	2		2-7	N	N		
75	y	40%	0		5		Y		
76	y	20%	0		2-4		Y		
77		20%	3-4		1		Y		
78	y	15%	0-1.5		0-1		Y		
79		12%	3-4	1.5			Y		
80		15%	2-4	3			Y		
81		20%	2-4	3			Y		
82	y	20%	0		3		Y		
83	y	20%	0		3		Y		
84	y	20%	0		3		Y		
85	y	20%	0		3		Y		
86	y	20%	0		3		Y		
87	y	20%	0		3		Y		
88	y	20%	0		2.5		Y		
89	y	20%	1-2	1-2			Y		
90	y	17%	0-2	1-2			Y		
91		16%	0-2	1-2			Y		
92	y	20%	1-1.5	0-0.5			Y		

93	y	17%	0-1	0-1			Y		
94	y	12%	0-1	1-1.5			Y		
95	y	20%	0-1.5	0-1.5			Y		
96		18%	0-2	1.5			Y		
97		15%	1	2			Y		
98	y	14%	0-0.5	0.5-1.5			Y		
99	y	16%	0.5-1.5	0-1			Y		
100		15%	1-2	1-2			Y		
101		15%	2-3	0			Y		Access from RD09
102		20%	1-2	0-2			Y		
103		16%	0-2	0-2			Y		
104		20%	0-2	0-2			Y		

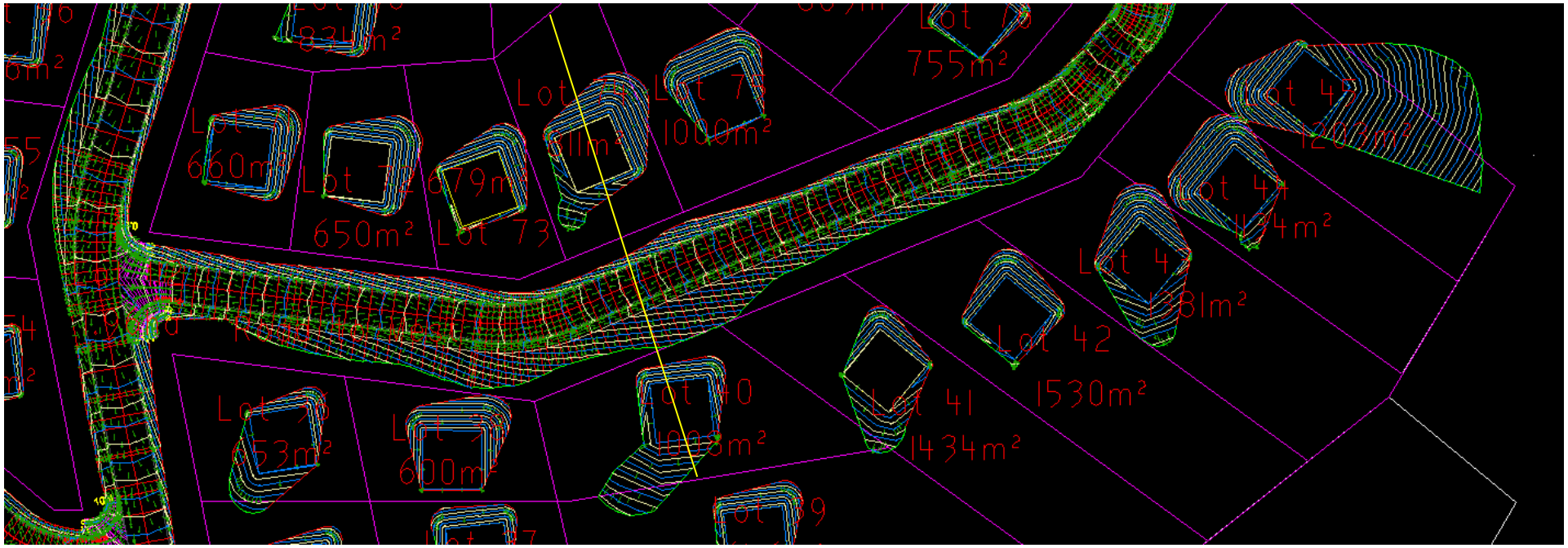
Lots 36 Lot #	Suitable House Pad (No land development required)	Driveway access grade	Retaining wall required to FRONTAGE (m)	Fill required to REAR (m)	Retaining wall required to REAR (m)	Single storey	Two storey	Average Slope (%)	Comments
1		15%	1	1		Y	Y	15	
2		18%	0-3	0-1.5		y	Y	20	
3		25%	0.5	3.5		y	Y	25	
4		33%	1-3.5	5		n	Y	35	
5		33%	5	4-4.5		n	Y	30	
6		38%	6	0-3		n	Y	30	
7		30%	3-5.5	0-2		n	Y	30	20% driveway possible if 2 storey building with 3m retaining
8		35%	3-4.1	3		n	Y	30	
9		35%	7	3		n	N	40-50	V Steep - Difficult to construct PAD
10		16%	4-5		2	n	Y	37	Easement from top of cul-de-sac 25% grade
11		7%	0-1		3-5	n	Y	32	
12		20%	0		4	y?	Y	30	
13		25%	0-1		3-4	y?	Y	27	
14		20%	0.5		2.5-4.5	y?	Y	20	
15		20%	1-2		1-2	y	Y	25	
16		20%	1-2		2	y	Y	30	
17		20%	1		1-3	y	Y	20	Driveway to the south of lot natural grade up to 20%
18		16%	0-2	fill		y	Y	30	
19		19%	1.5-3.5	fill		n	Y	35	
20		20%	3		3	n	Y	40	Driveway to the south of lot natural grade up to 20%
21		11%	3		2	n	Y	50	
22		13%	1-2	fill		n	Y	30	

23		13%	0.5	fill		y	Y	15	
24		16%	0.5		1	y	Y	15	
25		35%	3		3	n	Y	30-50	
26		20%	1-2	fill		n	Y	25-30	
27		20%	2-3	fill		n	Y	25	
28		25%	1.5-2.5	fill		n	Y	25	
29		16%	0-1	fill		y	Y	20	
30		17%	0.5-1.5	fill		y	Y	18	
31		18%	0.5-1.5	fill		y	Y	17	
32		16%	0		1-1.5	y	Y	17	
33		17%	0		1-2	y	Y	18	
34		15%	0		2-4	y	Y	16	
35		19%	0		2-4	y	Y	30	
36		30%	0		4	y	Y	30	

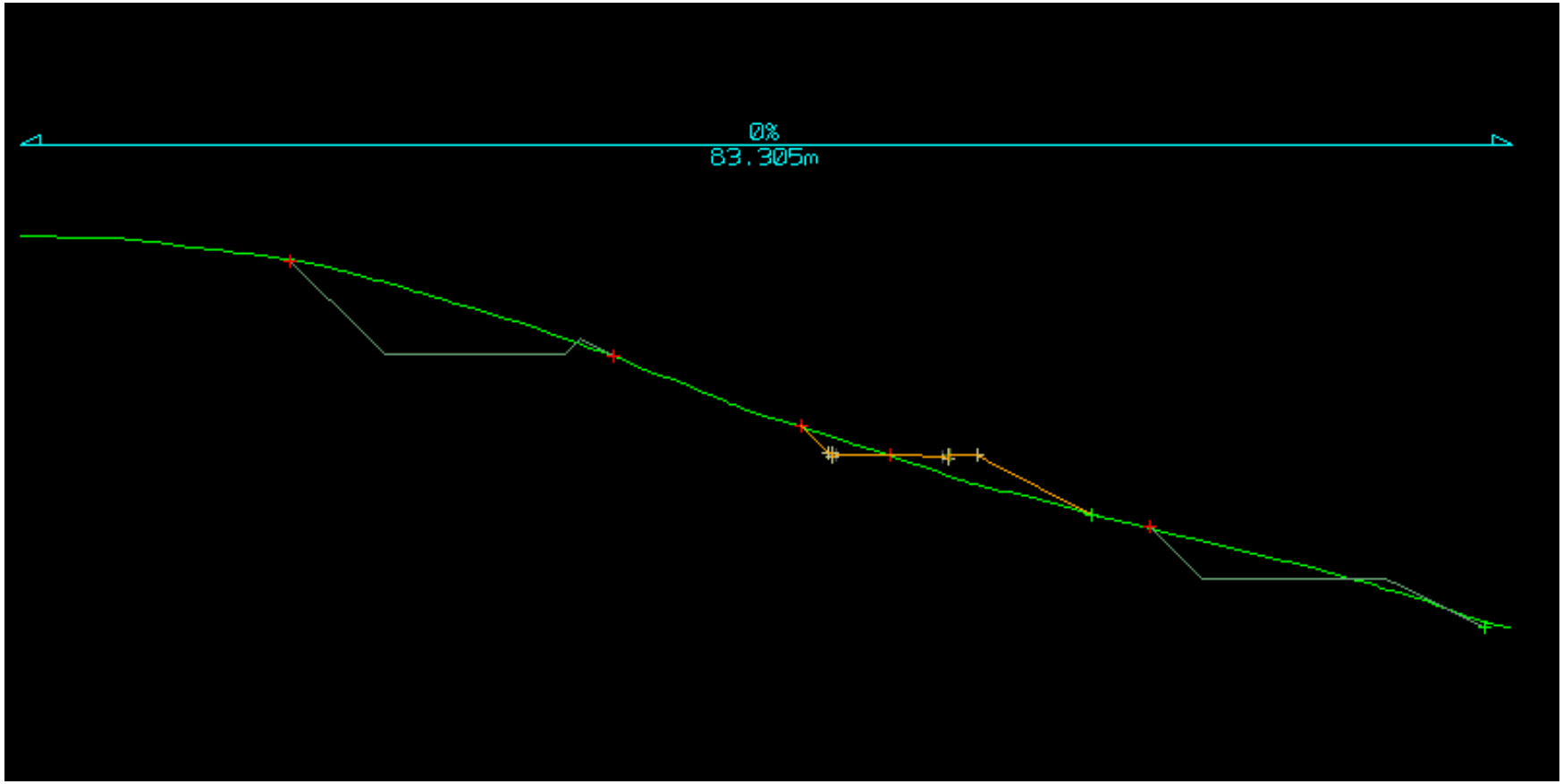
Appendix 3: Stages 3 and 4 overview and cross sections displaying how lot house pads and roads are proposed to be formed.



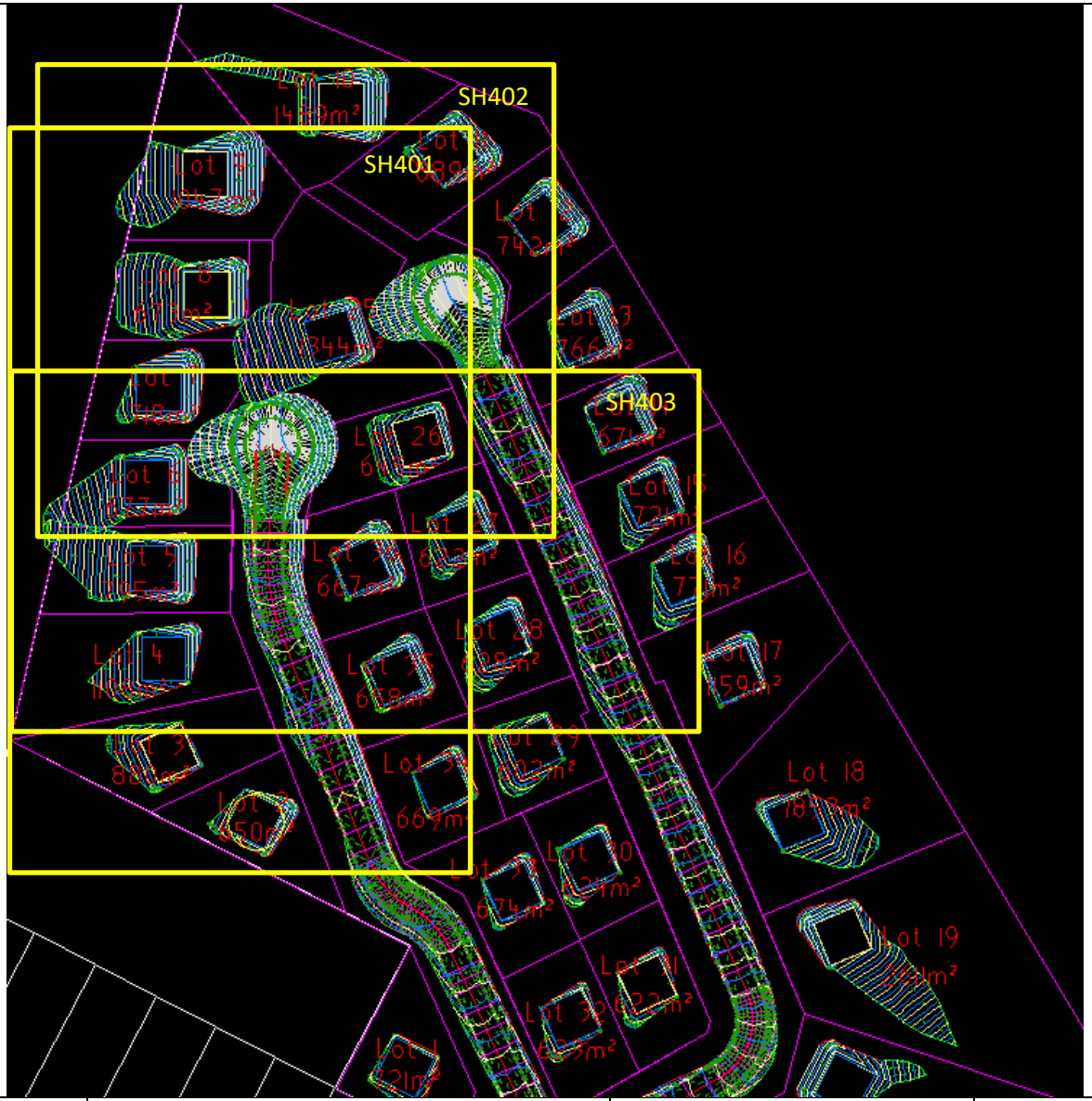
SCALES:	Not To Scale		**STAGE 4 EXAMPLE HOUSE PADS AND ROADING CUT/FILL** **Address: 109 Matai Bay Road, Karikari Peninsula.**	cook | costello Consulting Engineers	DATE:	31/08/21	SH300
DRAWN:	LC	31/08/21			CCL JOB No:	15813-001	
					Client:	Carrington Estate	
					Client contact		Rev 0



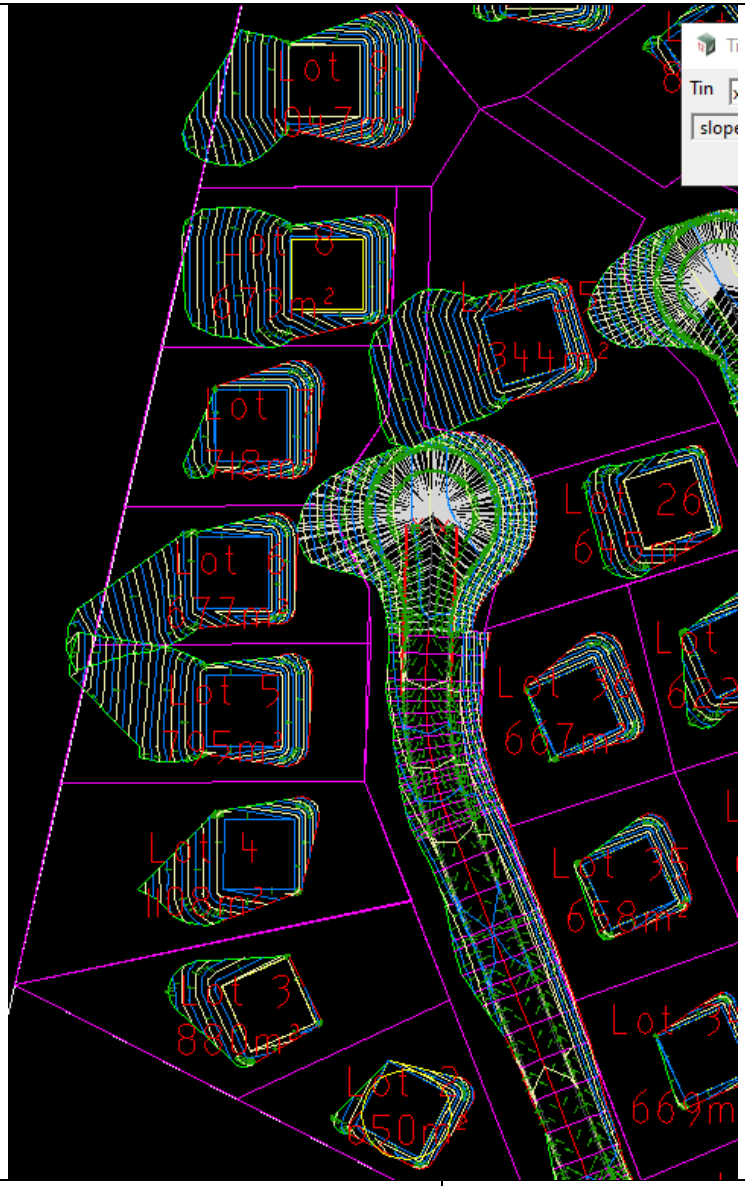
SCALES:	Not To Scale		**STAGE 4 EXAMPLE HOUSE PADS AND ROADING CUT/FILL WITH CROSS SECTION** **Address: 109 Matai Bay Road, Karikari Peninsula.**	cook | costello Consulting Engineers	DATE:	31/08/21	SH301
DRAWN:	LC	31/08/21			CCL JOB No:	15813-001	
					Client:	Carrington Estate	
					Client contact		Rev 0



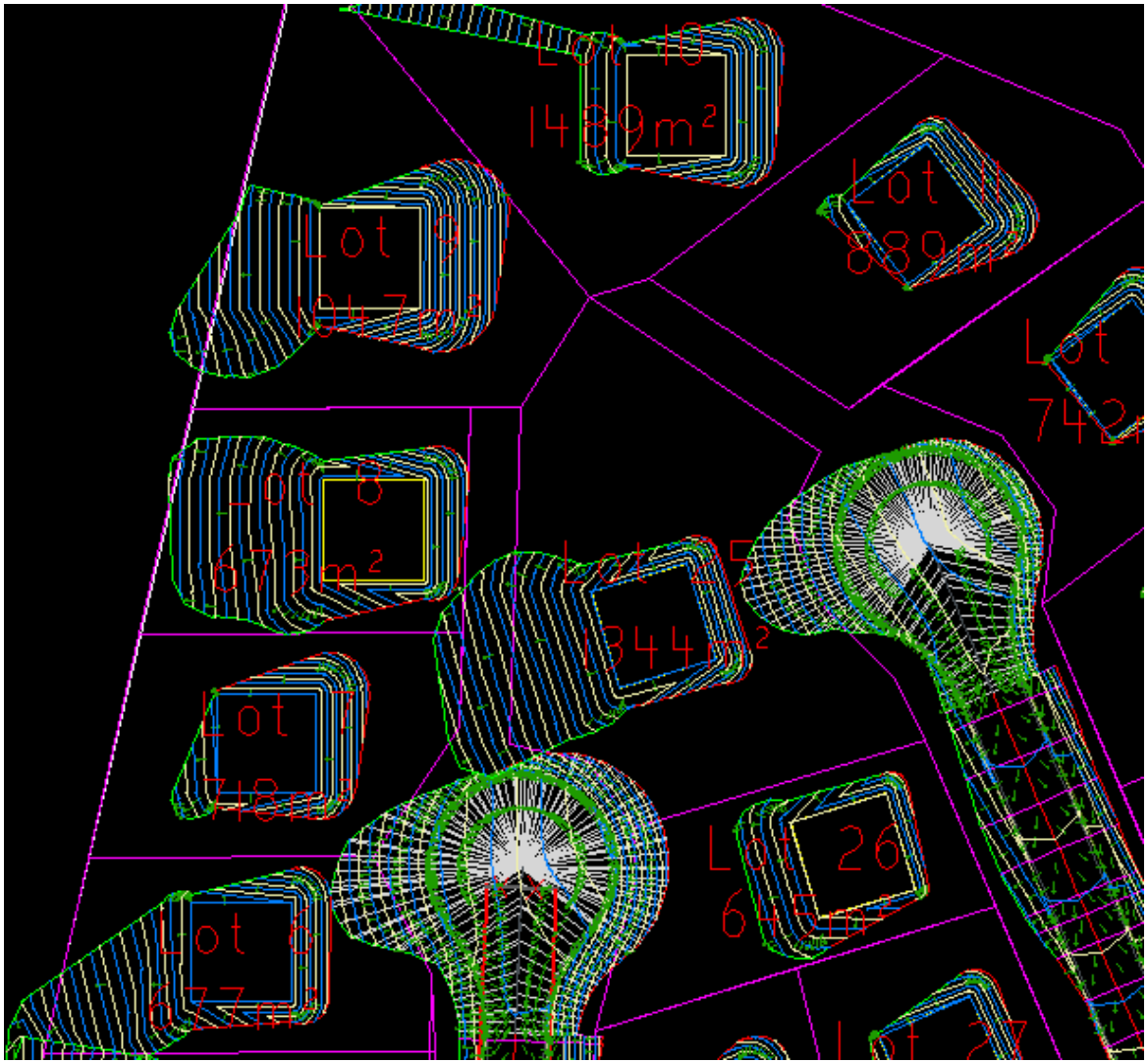
SCALES:	Not To Scale		**STAGE 4 EXAMPLE HOUSE PADS AND ROADING CUT/FILL CROSS SECTION AS DISPLAYED ON SH301** **Address: 109 Matai Bay Road, Karikari Peninsula.**	cook | costello Consulting Engineers	DATE:	31/08/21	SH302
DRAWN:	LC	31/08/21			CCL JOB No:	15813-001	
					Client:	Carrington Estate	
					Client contact		Rev 0



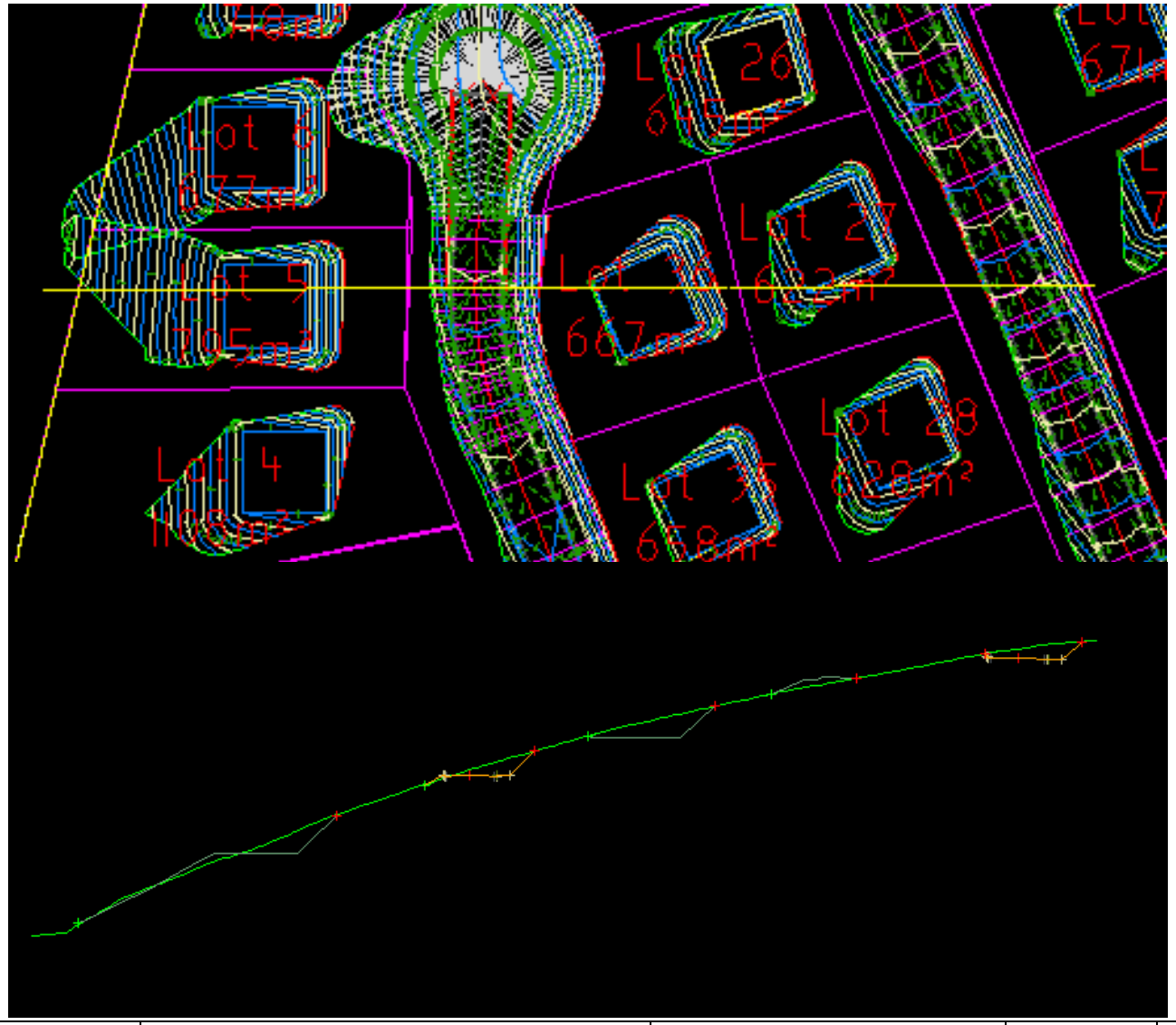
SCALES:	Not To Scale		**STAGE 3 EXAMPLE HOUSE PADS AND ROADING CUT/FILL** **Address: 109 Matai Bay Road, Karikari Peninsula.**	cook | costello Consulting Engineers	DATE:	31/08/21	SH400
DRAWN:	LC	31/08/21			CCL JOB No:	15813-001	
					Client:	Carrington Estate	
					Client contact		Rev 0



SCALES:	Not To Scale		**STAGE 3 EXAMPLE HOUSE PADS AND ROADING CUT/FILL** **Address: 109 Matai Bay Road, Karikari Peninsula.**	cook | costello Consulting Engineers	DATE:	31/08/21	SH401
DRAWN:	LC	31/08/21			CCL JOB No:	15813-001	
					Client:	Carrington Estate	
					Client contact		Rev 0

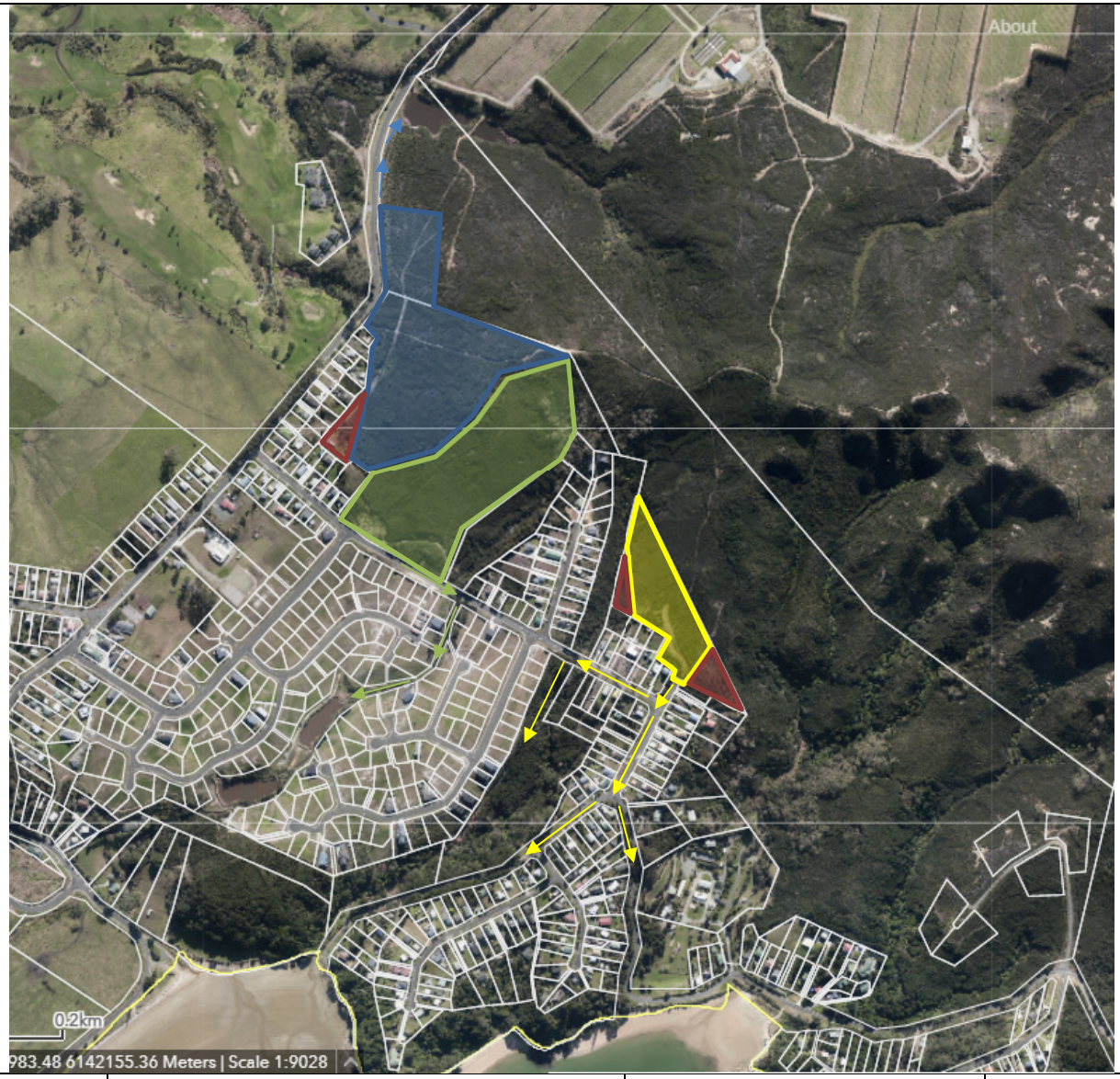


SCALES:	Not To Scale		**STAGE 3 EXAMPLE HOUSE PADS AND ROADING CUT/FILL** **Address: 109 Matai Bay Road, Karikari Peninsula.**	cook | costello Consulting Engineers	DATE:	31/08/21	SH402
DRAWN:	LC	31/08/21			CCL JOB No:	15813-001	
					Client:	Carrington Estate	
					Client contact		Rev 0



SCALES:	Not To Scale		**STAGE 3 EXAMPLE HOUSE PADS AND ROADING CUT/FILL WITH CROSS-SECTION** **Address: 109 Matai Bay Road, Karikari Peninsula.**	cook | costello Consulting Engineers	DATE:	31/08/21	SH403
DRAWN:	LC	31/08/21			CCL JOB No:	15813-001	
					Client:	Carrington Estate	
					Client contact		Rev 0

Appendix 4: Stormwater catchment plans

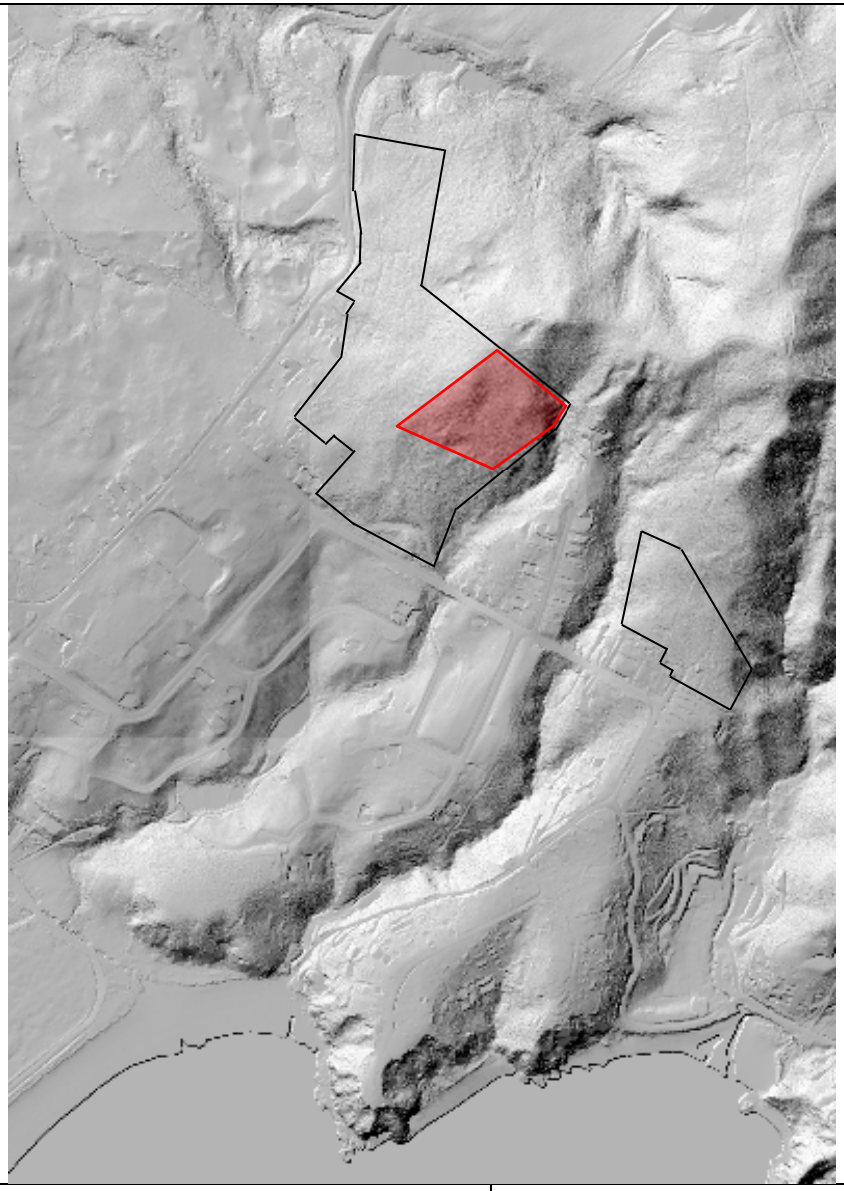


KEY

- Catchment 1
- Catchment 2
- Catchment 3
- Alternate treatment

SCALES:	Not To Scale		**STORMWATER CATCHMENTS AND POTENTIAL FLOWPATH**	cook | costello Consulting Engineers	DATE:	01/06/21	
DRAWN:	LC	01/06/21	**Address: Lot 1 DP 67692 & Lot 6 DP 417562, Boubtless Bay Road, KariKari Peninsula.**		CCL JOB No:	15813-010	
					Client:	Carrington Resort Jade LP	
					Client contact		Rev 0

Appendix 5: QGIS Hillshade diagram and steep area



SCALES:	Not To Scale		**Stage 3 & 4 residential subdivision QGIS hillshade – Steep area** **Address: Lot 1 DP 67692 & Lot 6 DP 417562, Boubtless Bay Road, KariKari Peninsula.**	cook | costello Consulting Engineers	DATE:	31/08/21	
DRAWN:	LC	31/08/21			CCL JOB No:	15813-010	
					Client:	Carrington Resort Jade LP	
					Client contact		Rev 0

Appendix 6: Road number reference



SCALES:	Not To Scale		**Road Reference Numbers** **Address: Lot 1 DP 67692 & Lot 6 DP 417562, Doubtless Bay Road, KariKari Peninsula.**	cook | costello Consulting Engineers	DATE:	31/08/21	
DRAWN:	LC	31/08/21			CCL JOB No:	15813-010	
					Client:	Carrington Resort Jade LP	
					Client contact		Rev 0

Appendix 7: Water storage calculations

Using Kaitia Aero Ews data
Start with 50m3 of storage
Months where tank refill may be required

month	Monthly Rain mm	Volume stored per month (200m2 roof area) m3	Volume used per month (250l/p/day 4 people) m3	Left over m3
Jan	69	13.8	31	32.8
feb	121	24.2	29	28
mar	86	17.2	31	14.2
apr	119	23.8	30	8
may	138	27.6	31	4.6
jun	125	25	30	45
jul	136	27.2	31	41.2
aug	104	20.8	31	31
sep	93	18.6	30	19.6
oct	93	18.6	31	7.2
nov	73	14.6	30	34.6
dec	99	19.8	31	23.4

Rainfall

Rainfall distribution

Northland is a narrow peninsula with no part more than 50 kilometres from the sea. This causes winds to be very moist with abundant rainfall throughout the region. Distribution patterns are related to orography: rainfalls range from about 1000 mm in low-lying coastal areas, to approximately 2000 mm at higher elevations. Figure 12 shows the distribution of median annual rainfall based on the 1981-2010 period.

Seasonal influences on rainfall distribution are also quite well defined. Table 6 lists monthly rainfall normals and percentage of annual total for the period 1981-2010 for selected stations. This table shows a clearly defined winter rainfall maximum. The north and east of the region gets 35 to 40 percent of its annual rainfall in the period June to August while stations to the south and west receive about 30 to 35 percent during these three winter months. 18 to 20 percent of Northland annual rainfall is experienced during the summer months (December to February).

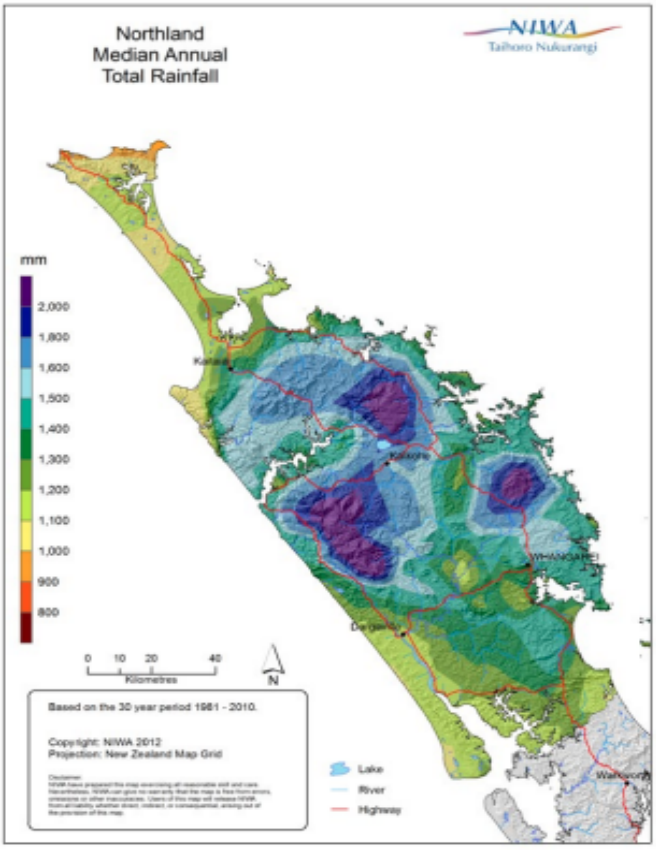


Figure 12. Northland median annual rainfall, 1981-2010.

Table 6. Monthly/annual rainfall normals (a; mm); percentage of annual total for each month (b; %).

Location		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
Cape Reinga Aws	a	58	65	56	109	96	103	128	95	85	61	57	76	988
	b	6	7	6	11	10	10	13	10	9	6	6	8	
Kaitaia Observatory	a	85	93	81	96	135	151	169	144	128	99	87	100	1367
	b	6	7	6	7	10	11	12	11	9	7	6	7	
Kaitaia Aero Ews	a	69	121	86	119	138	125	136	104	93	93	73	99	1253
	b	5	10	7	9	11	10	11	8	7	7	6	8	
Kaeo Northland	a	88	102	120	140	144	169	200	170	148	113	102	100	1596
	b	6	6	8	9	9	11	12	11	9	7	6	6	
Rawene 2	a	78	72	89	98	128	145	164	142	118	91	83	91	1299
	b	6	6	7	8	10	11	13	11	9	7	6	7	
Opononi	a	86	65	93	94	124	144	133	116	105	93	92	88	1234
	b	7	5	8	8	10	12	11	9	8	8	7	7	
Kaikohe Aws	a	110	106	109	140	139	152	188	159	124	100	96	109	1532
	b	7	7	7	9	9	10	12	10	8	6	6	7	

Table 6 continued.

Location		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
Kerikeri Airport	a	122	117	138	145	154	185	205	182	162	127	114	123	1775
	b	7	7	8	8	9	10	12	10	9	7	6	7	
Russell	a	91	87	116	117	130	144	172	146	121	97	89	90	1400
	b	7	6	8	8	9	10	12	10	9	7	6	6	
Waipoua Visitor Centre	a	89	82	103	97	146	177	166	153	132	110	93	94	1443
	b	6	6	7	7	10	12	11	11	9	8	6	7	
Whangarei Airport	a	78	98	117	103	110	132	169	127	110	84	76	97	1300
	b	6	8	9	8	8	10	13	10	8	6	6	7	
Dargaville 2	a	64	69	102	107	97	121	141	109	109	82	63	74	1137
	b	6	6	9	9	9	11	12	10	10	7	6	7	

The distribution of monthly rainfall is shown in Figure 13. The 10 percentile, 90 percentile and mean values for each month are shown along with maximum and minimum recorded values for several stations.

One of the most marked characteristics of the rainfall regime in Northland is its great variability from month to month and year to year. Rainfall variability can be described by the coefficient of variation (the ratio of the standard deviation to the mean, expressed as a percentage). Table 7 gives seasonal and annual variability for stations in Northland and for selected sites in other regions for comparative purposes.

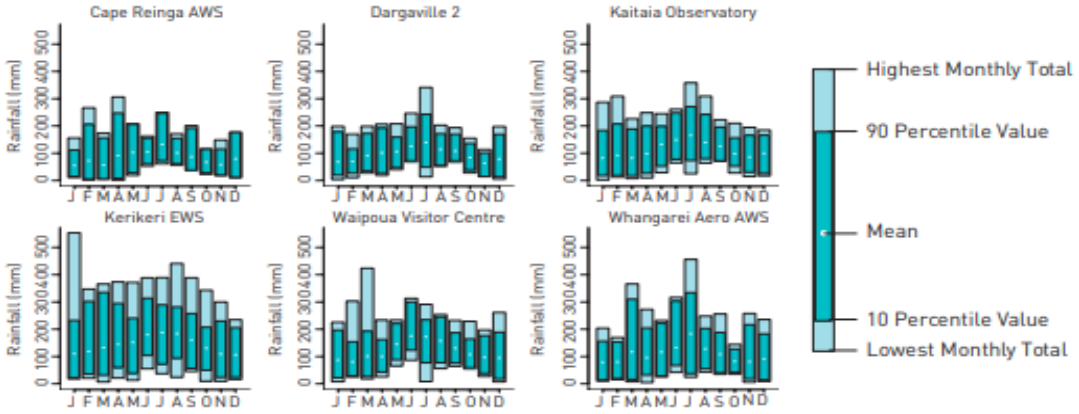


Figure 13. Monthly rainfall for selected Northland stations.

Table 7. Seasonal variability of rainfall (Coefficient of variation).

Location	Summer	Autumn	Winter	Spring
Cape Reinga	46	75	25	45
Kaitaia Observatory	41	34	24	19
Kaeo Northland	50	45	30	31
Rawene 2	42	32	29	25
Kaikohe AWS	47	45	38	33
Kerikeri EWS	46	39	28	32
Waipoua Visitor Centre	42	25	23	31
Whangarei Aero AWS	37	41	33	31
Dargaville 2	37	21	24	17
Auckland	47	24	27	25
Wellington	42	38	30	36
Christchurch	37	27	42	32
Westport	24	28	20	17

Appendix 8: Firefighting requirements example from 4404

E7 Example 2

A house (without a sprinkler system) is to be built out in the country, where there is no street reticulation.

Step 1 = FW2 (non-sprinkler protected house of proposed floor area 300 m^2)

Step 2 =

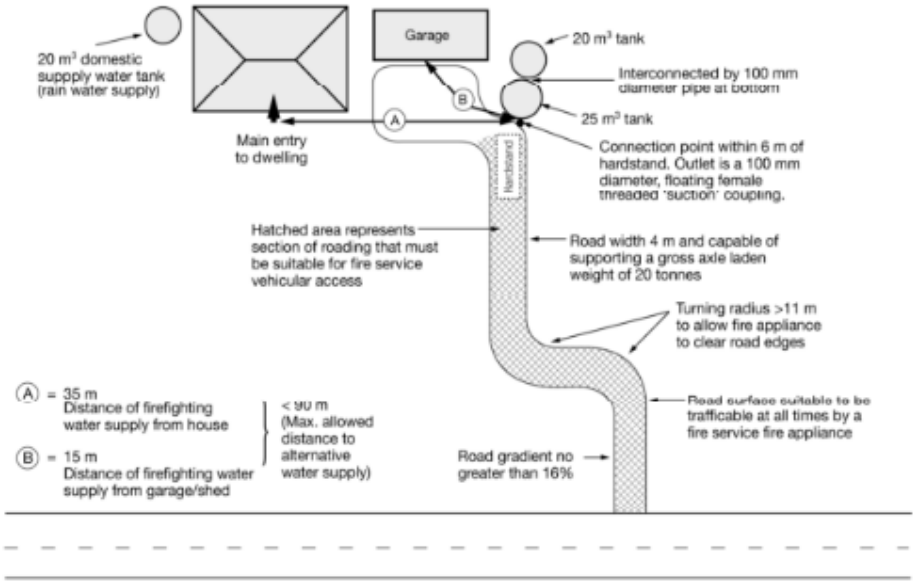


Figure E2 – Firefighting water supply requirements for an unsprinklered house with no access to a reticulated water supply

Step 3 = Not applicable

Step 4 = See plan. Conditions meet requirements as neither distance A or B exceed 90 m.

Step 5 = See plan. 'Suction coupling' compliant with SNZ PAS 4505 to be installed.

Total firefighting water supply = 20 m^3 + 25 m^3
= 45 m^3
= FW 2

Copyright SNZ