TPC TRAFFIC PLANNING CONSULTANTS LTD

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6 TEITEI DRIVE, OHAKUNE – PROPOSED EARTHWORKS – TRAFFIC ASSESSMENT

1. Introduction

The following assessment has been prepared in support of a resource consent application relating to an earthwork activity at 6 Teitei Drive, Ohakune.

The proposal involves construction of a culvert, 734 m^3 of on-site cut and fill earthworks to form a vehicular access onto Teitei Drive and realignment of a section of a pedestrian walkway which connects the public footpath onto Teitei Drive to Snowmass Drive. The location of the proposal and the proposed site access is shown in **Figure 1**.

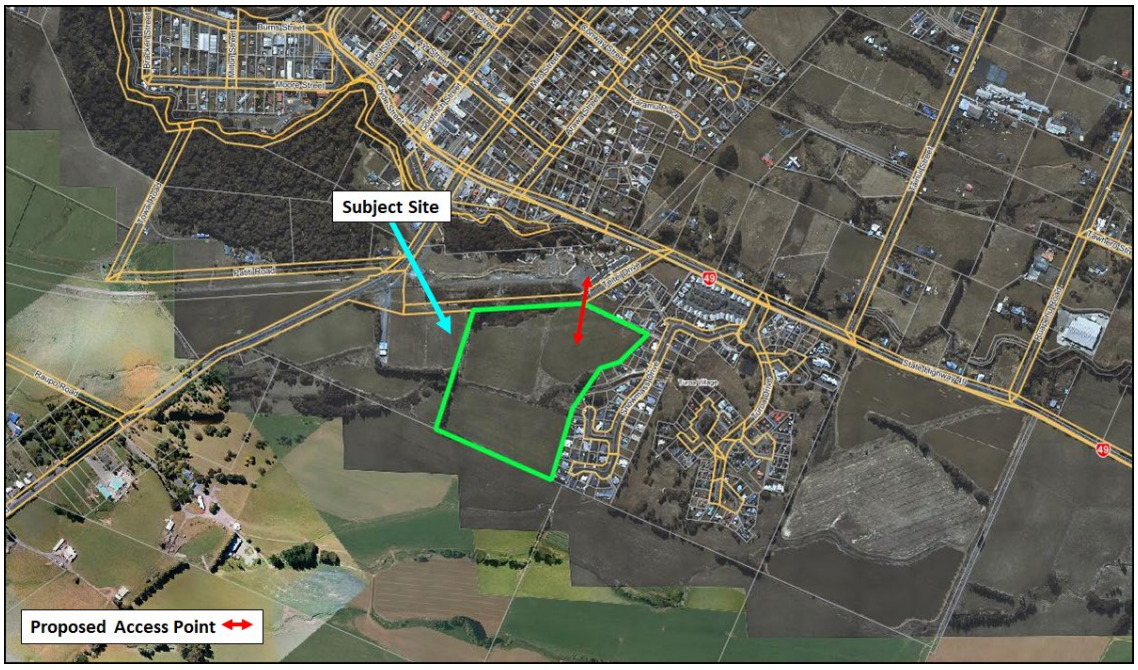

Figure 1: Site Location
Source: https://maps.ruapehudc.govt.nz/intramaps90/?project=Ruapehu

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2. Existing Transport Environment

Teitei Drive

Teitei Drive is a local road providing access to a public carpark associated with The Carrot Park Playground and to abutting properties. Teitei Drive has a carriageway width of some 6.5 metres providing one traffic lane in each direction and on-street parking along both sides of the carriageway. Public footpath is not provided within the road reserve however pedestrian paths are provided within Carrot Park for the length of Teitei Drive. Teitei Drive has a speed limit of 50 km/hr.

No traffic counts data is available for Teitei Drive; however, it is estimated that Teitei Drive has a traffic flow of some 200 vehicle movements per day and a peak hour traffic flow of some 20 vehicle movements per hour during peak holiday periods.

Raetihi Ohakune Road

Raetihi Ohakune Road is classified as a collector road which provides a key connection between State Highway 49 and State Highway 4. Near the proposed access, Raetihi Ohakune Road typically has a carriageway width of some 7.5 metres providing one traffic lane in each direction. Public footpaths are not provided on either side of the carriageway. There is a speed change sign provided immediately to the north of the site's access indicating an posted speed of 50 km/h for northbound vehicles and 100 km/h for southbound vehicles.

Information from NZTA ONRC database and MobileRoad suggests that Raetihi Ohakune Road has an ADT of 2,756 vehicles per day (vpd).

State Highway 49

State Highway 49 (SH49) runs in a general east-west direction and provides a connection between State Highway 1 at Waiouru in the east and State Highway 4 in the west, known as Tohunga Junction.

Near the subject site, SH49 has a carriageway width of some 10.0 metres providing one traffic lane in each direction and a narrow shoulder. There is a speed reduction sign provided to the west of the SH49/Teitei Drive intersection indicating an advised speed of 70 km/h for eastbound vehicles and 50 km/h for westbound vehicles. On-street parking is only permitted along the southern side of the carriageway and 'No Stopping Lines at All Times' are marked along the northern side of the carriageway.

Information from NZTA State Highway Traffic Monitoring[1] database suggests that near the subject site (ID: 04900011) SH49 carries a flow of 2,467 vehicles per day and an estimated peak hour flow of some 250 vehicles per hour.

3. Road Safety

Information from the New Zealand Transport Agency's 'Crash Analysis System' for the most recent five-year+ period from January 2019 to present (2024 data subject to reporting delays) along the entire length of Teitei Drive and along Raetihi Ohakune Road within 200 metres from the proposed site access shows that one non-injury crash was reported. The crash involved a vehicle losing control and colliding with the concrete verge of a bridge.

[1] Traffic flow estimation – https://maphub.nzta.govt.nz

4. Methodology & Predicted Vehicle Activity

A detail methodology of the construction activity has been provided in an Earthwork and Construction Management Plan prepared by Cheal and included within the application. The extent of works is detail in **Figure 2** below.

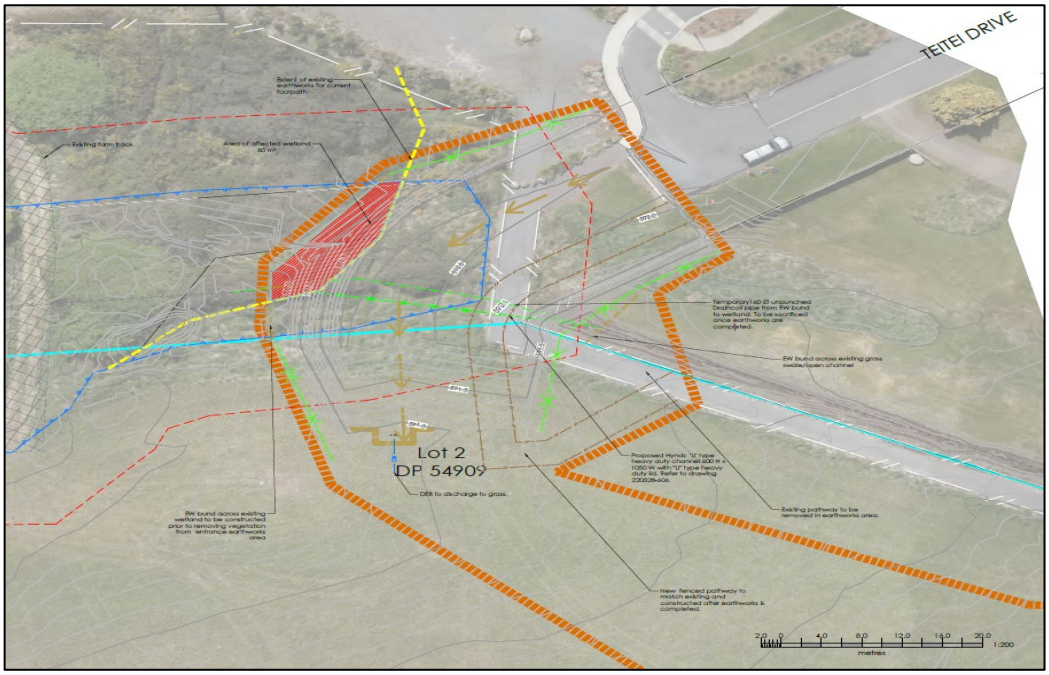

Figure 2: Site Plan
Image Source: Cheal

As part of the construction activity, the existing pedestrian walkway between Teitei Drive and Snowmass Drive will be temporality closed, realigned, and reopened once the project is completed. This will require the temporary closure of the walkway during the construction period. Appropriate signage and information will be communicated at the time of the closure to ensure alternative pedestrian connections are provided.

Construction related traffic effects are typically related to vehicle movements of trucks and their parking demands. The project will have several distinct steps where the activity will vary with respect to number of staff within the site and number of truck movements to and from the site.

There are anticipated to be overlaps of each step of activity, however they have been separated to provide a brief description of each and the estimated number of truck movements for the basis of assessment of effects on the surrounding road network.

The number of heavy vehicles anticipated to visit the site over the entire project is set out in **Table 1**. There is anticipated to be 82 trucks (164 truck movements) in total for the project. Based on each step taking no more than 3 working days on average, the number of trucks visiting the site is not anticipated to exceed 5 trucks per day (10 truck movements).

In addition to truck movements there will be small vehicle activity related mainly with construction staff. This is expected to relatively low for the initial stages of development and increases to a peak at around 10 people. This level of vehicle activity is expected to peak at around 24 vehicles movements per day.

Table 1: Predicted Truck Activity (Estimates)

Steps	Description	Number of Trucks
Site Establishment	Mobilisation and securing site Barriers, site offices and facilities Securing access points	10
Temporary Drainage	Cleaning the drain Installation of 160 mm drain pipe Construction of an earth bund to redirect water to the temporary drain	8
Land Clearing	Removal of the grass and vegetation	6
Construction	Installation of the new concrete channel including fill inside the culvert	16
Fencing	Installation of super silt fences and DEB (if required)	8
Earthwork	Cut and fill	8
Site rehabilitation	Stabilisation of all surfaces, grass areas, temporary surfaces Future proofing of site	16
Site Disestablishment	Removal of temporary works and ESC	10

5. Site Access

All truck activity is proposed to access the site via the existing gravel access off Raetihi Ohakune Road which is connected to the wider transport network via SH49. The proposed location on Raetihi Ohakune Road is illustrated in **Figure 3**.

The site access location has been chosen to provide a direct connection between the site and the wider road network and minimise interaction with residential activities, pedestrians, and other vehicle activities related to the Carrot Recreational Park.

Vehicle tracking analysis has also been enclosed in Attachment 1 illustrating that a large rigid truck can utilise the proposed access point on Raetihi Ohakune Road.

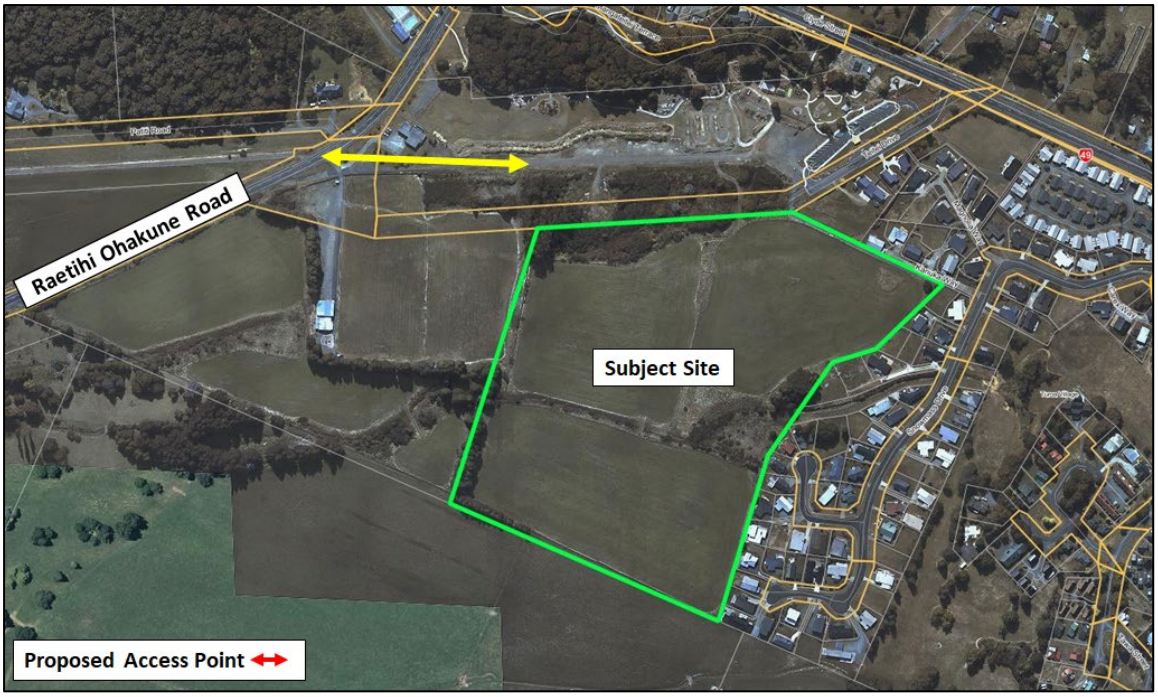

Figure 3: Site Access Location
Source: Ruapehudc.govt.nz

In respect of sight distance at the proposed access, the appropriate standard to use is the Land Transport Safety Authority publication "Guidelines for Visibility at Driveways". There are two components to the sight distance measurement, the first being the sight distance requirement and the second being the lines of clear sight. The sight distance/lines of clear sight required is dependent upon the traffic generation of the proposal, the 85th percentile speed of vehicles on the frontage road, and the classification of the frontage road.

For this location, the access is forecast to accommodate less than 200 vehicle movements per day, therefore classifying the accessway as low volume. The 85th percentile speed on Raetihi Ohakune Road is forecast to be no greater than 100 km/h for northbound vehicles (approaching 50 km/h zone) and 60 km/h for southbound vehicles (50 km/h posted speed and approaching 100 km/h zone).

As Raetihi Ohakune Road is classified as a collector road a minimum sight distance of 160 metres and 65 metres are required respectively. From a desktop study using Google Street View, it is confirmed that a minimum sight distance of 200 metres is available for the northbound vehicles and 150 metres is available for the southbound vehicles providing acceptable sight distances.

6. Assessment of Vehicle Activity

The need to introduce truck and other vehicle movements of any construction activity always has a potential to impact on the surrounding area and road network, but a certain degree of impact for what is normally a relatively short period of time (at least in the context of the life of the proposed development) is inevitable and should not normally be a reason for restricting development.

In terms of capacity, the surrounding road network can accommodate the anticipated truck movements per day associated with the proposal particularly during the off-peak times.

Furthermore, the application of a Construction Traffic Management Plan (CTMP) will ensure that any potential impact on the surrounding area can be minimised. The CTMP is prepared and approved prior to work commencing and where necessary seeks to control the times of operation (e.g. avoiding peak periods), routes used, and other matters to minimise potential impact.

The application of a CTMP will ensure that any potential effects on the surrounding area is appropriately managed. Where necessary, the CTMP should address the following objectives:

- Ensure that all construction traffic activities remain within the limits and standards approved under the consent and set out the management procedures and methods to be implemented in order to avoid, remedy, or mitigate potential adverse effects arising from construction traffic activities;
- Ensure the provision of safe and effective pedestrian access past the site during construction of the project;
- Always provide for the safety of everyone;
- Manage integration with other construction projects within the area;
- Implement measures to raise awareness of construction traffic activity;
- Specify measures to reduce vehicle traffic and parking demands associated with construction staff; and
- Provide a mechanism for addressing queries and responding to complaints.

7. Conclusion

Overall, it is considered that with the provision of a CTMP covering the details highlighted in Section 6 above can manage any construction traffic related effects without compromising the road network's function, capacity, or safety.

Therefore, from a traffic engineering perspective, it is considered that the proposal will have less than a minor effect.

Prepared by,

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Director

Attachment 1

Vehicle Tracking Analysis

MORPHUM environmental

Co-creating a thriving ecosystem

Teitei Drive Access Road

Teitei Drive Access Road Ecological Impact Assessment

Final

Prepared for Kainga Ora

Document Control

Client Name: Kainga Ora

Project Name: Teitei Drive Access Road

Project Number: P04109

Document: Teitei Drive Access Road Ecological Impact Assessment

Revision History

Status	Date Issued	Author	Reviewed By	Released By
Final	14/02/2014	9(2)(a)		

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Reviewer: 9(2)(a) **Signature:** 

Released by:

Reviewer: 9(2)(a) **Signature:** 

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1. Introduction

1.1. Purpose and Scope

Morphum Environmental Limited (Morphum) was engaged by Kainga Ora to prepare an Ecological Impact Assessment (EcIA) to support a resource consent application for the installation of an access road for a proposed residential development at Teitei Drive in Ohakune (the site, Figure 1). This EcIA follows an initial request to provide an assessment on the potential presence and status of wetlands on site, which was supported by the memo "Teitei Drive wetlands and stormwater" provided on the 17th of May, 2023 by Morphum.

The scope of this EcIA is to assess potential ecological effects on wetlands within the vicinity of the access road works footprint.

Figure 1: Proposed residential development location (yellow) and works impact footprint in red,

This assessment has been undertaken following the effects management hierarchy required to be assessed under the National Environmental Standards for Freshwater (NES:F) and the National Policy Statement for Freshwater (NPS:FM). The assessment of effects has been undertaken in accordance with the Environmental Institute of Australia and New Zealand EcIA Guidelines (2018, second edition) (EIANZ guidelines).

Further, the assessment considers Te Waiū-o-Te-Ika framework, of Ngāti Rangi, in ensuring that its outcomes align where possible with Ngā Toka Tupua (the intrinsic values which represent the essence of Te Waiū-o-Te-Ika, from the Crater Lake, Mt Ruapehu to the sea) (see section 1.3 below).

1.2. Site Overview

The proposed Kāinga Ora future housing area requires the development of an access road. This is located at the southwest end of Teitei Drive, approximately 500m from the Ohakune town centre. The new road installation that will connect the future housing development to the end of Teitei drive, will intersect with the footprint of an existing wetland.

The subject area hosts potential wetland and grassland habitat which was cleared alongside the adjacent pastures (which have been used for cutting hay/silage). Riparian trees of approximately 8-10 years old have passively re-established at the site The oldest and largest trees are exotic grey (*Salix cinerea*) and hybrid-crack willow (*Salix x fragilis)*, followed by endemic mānuka (*Leptospermum scoparium*).

Figure 2: Riparian trees growing along the margins wetland habitat, in the vicinity of the proposed access road.

The Landcare Research Land Cover Database (LCDB) v5.0 (Landcare Research, 2022) primarily classifies the land cover of the subject area and surrounds as *High Producing Exotic Grass Land* and did not have records of any wetlands. However, potential wetlands were discovered in the wider development area

(including the subject area) and assessed by the primary EcIA provided by Kahu (2023), with further assessments by Morphum, which provide additional ecological context.

1.3. Te Ao Māori context – Te Waiū-o-Te Ika

The hapū of Ngāti Rangi iwi are tangata whenua of the western and southern areas surrounding Mount Ruapehu, including Ohakune. These areas form headwaters of the Whangaehu River catchment.

Te Waiū-o-Te Ika framework, under the Ngāti Rangi Claims Settlement Act 2019, provides a framing for the management of freshwater spanning form Te Wai ā-moe (Crater Lake, Mount Ruapehu) to the sea along the Whangaehu River, from a Te Ao Māori lens. This framework recognises the intrinsic values (Ngā Toka Tupua) which represent Te Waiū-o-Te Ika. These values are to be considered in relation to activities which might affect the river:

- *Ko te Kāhui Maunga te mātāpuna o te ora:* The sacred mountain clan, the source of Te Waiū-o-Te-Ika, the source of life: hapū, iwi, and all communities draw sustenance and inspiration from the river's source on Ruapehu and extending to all reaches of the catchment.
- *He wai-ariki-rangi, he wai-ariki-nuku, tuku iho, tuku iho:* An interconnected whole; a river revered and valued from generation down to generation: hapū, iwi, and all communities are united in the best interests of the indivisible river as a gift to the future prosperity of our mokopuna.
- *Ko ngā wai tiehu ki ngā wai riki, tuku iho ki tai hei waiū, hei wai tōtā e:* Living, nurturing waters, providing potency to the land and its people from source to tributary to the ocean: Hapū, iwi, and all communities benefit physically, spiritually, culturally, and economically where water and its inherent life-supporting capacity is valued and enhanced.
- *Kia hua mai ngā kōrero o ngā wai, kia hua mai te wai ora e:* The latent potential of Te Waiū-o-Te-Ika, the latent potential of its hapū and iwi: uplifting the mana of Te Waiū-o-Te-Ika in turn uplifts the mana of its hapū and iwi, leading to prosperity and growth for hapū and iwi.

1.4. Methodology

Morphum visited the site on the 10th of May 2023, and again on the 24th of January 2024. On the first visit, the nearest rain gauge (Waiharuru, 6 km to the southeast) recorded 15 mm of total rainfall over the prior 10 days, and over 23 mm of rainfall were recorded throughout the day itself. On the subsequent visit, 57 mm total rainfall was recorded over the 10 days prior, and 17 mm throughout the day itself.

The Ministry for the Environment's Wetland Delineation Protocols (2022) (WDP) were applied to ecological features that could potentially host natural inland wetlands (Figure 4).

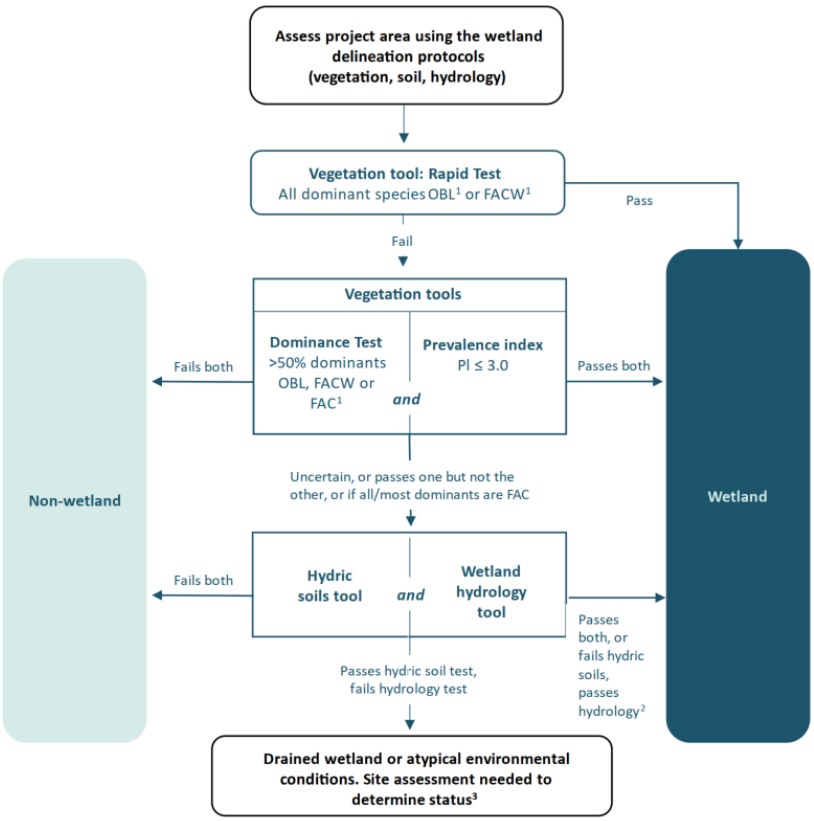

Figure 3: NES:F wetland determination flow diagram (MfE 2022)

Preliminary ecological assessments by Kahu (2023) identified 4 potential wetland areas on or close to the wider Kainga Ora housing development area (Figure 4). Three of these are along a watercourse system along the northern boundary of the housing development zone (Figure 4). The subject proposed access road intersects with the central-most northern wetland, wetland 2.

Eight points within the potential wetlands areas identified by Kahu were assessed by Morphum during the site visit in May 2023. The findings of the field assessment were provided in a memorandum from Morphum dated 17 May 2023, and are restated in the report. In each location a vegetation assessment and soil core assessment were undertaken, with soil sampling in accordance with the Hydric Soils – Field Identification Guide (Fraser *et al*. 2018).

The second visit on the 24th of January 2024 was to further assess the current ecological values of the subject site, particularly regarding: existing viable habitat for indigenous wildlife; plant composition, assemblage and indigeneity; potential for ecological enhancement; ecological effects resulting from the access road works. It is noted that Morphum could not gain access to private property upstream of the proposed access road location, so the following assessment is conservatively based on former investigations, supporting documentation, and visual assessment, where it regards this area.

2. Current Ecological Values

2.1. Ecological Context

The site is located southern part of the Tongariro Ecological District (ED) and historically would have been comprised of mixed podocarp-forest species assemblage. The original forest extent has been substantially reduced and modified due to human activity, primarily agriculture, and the surrounding area appears to have been managed as pasture for more than 80 years.

The ecological values assessed are limited to the wetlands along the northern boundary of the housing development site (wetland 1, 2 and 3 in Figure 4), which the new access road development will most directly impact.

Figure 4: Wetlands across the wider future development area as identified by Kahu (2023).

2.2. Current Wetland Characteristics – Vegetation & Hydrology

Wetland 1 (Figure 4) is upstream of the proposed accessway (Figure 5). Due to private property limiting access to the entire wetland body, visual assessment from the existing accessway was undertaken and supplemented with desktop reviews of previous assessments, include that performed by Kahu (2023).

From assessing aerial imagery, wetland 1 appears to be the remnant portion of a wetland that once extended as far as the eastern fence in the property it currently resides in (Figure 5). This wetland was likely historically fed by stream and farm channels upstream, but these have since been reduced to roughly 50% through development and landscaping. The installation of the current access footpath physically separated this wetland from wetland 2.

Wetland 1 has been identified as a wetland based upon this historic context, the current trough-topography of the area within the lawn, and the presence of facultative plant species including soft rush (*Juncus effusus*), and *sedge* species, alongside rank grasses, buttercups (*Ranunculus* .spp), and common yarrow (*Archilea millefolium*).

We were unable to determine the nature of drainage coming from wetland 1, however, it appears the stormwater swale which runs parallel along the Southern boundary of the property is diverting runoff which may have previously flowed through the wetland. It is assumed that stormwater flows are piped from a confluence of the wetland and stormwater swale directly above the existing accessway, through to wetland 2.

Figure 5: Left: wetland 1 (to the left), showing stormwater swale to the right. Assumed confluence is under blackberry and rank grass in the left foreground. Right: upper extent of wetland showing rank grass dominated nature.

Wetland 2 (Figure 4) was noted as a flooded gulley area downstream of the culvert that lies beneath the current access footpath to the site, where the access road will be installed. Plant diversity was nominal at this site and characterized by exotic species such as willow (*Salix* spp.) and blackberry (*Rubus fruticosus*), with some indigenous species such as mānuka and kiokio ferns (*Blechnum* spp.).

Although surface flooding amongst the rank grasses surrounding wetland 2 varied across site visits depending on recent rainfall levels, there were areas that indicated sustained inundation and pooling of water, indicating wetland per the hydrology tool (Figure 3).

Figure 6: Left: mānuka and kiokio fern growing in the narrow, upstream zone of wetland 2. Right: willow growing in the downstream water-induced zone of wetland 2.

There is an access track separating wetland 2 and wetland 3, which does not appear to have any pipes or culverts installed and is composed of a mixed gravel aggregate. The downstream portion of wetland 2 is at least partially induced as a result of this accessway, causing water to be retained above this barrier. This does not, however, alter the status of wetland 2 as a natural wetland under the NES:F or under the RMA.

Wetland 3 is immediately downstream of wetland 2, downstream of the gravel crossing. Vegetation is similar to wetland 2, although roughly 10 years older, and more diverse. It contains many indigenous plants such as wavy leaved coprosma (*Coprosma tenuifolia*), *Carex* species, and indigenous ferns including kiwakiwa (*cranfillia fluviatilis*), hard fern (*Paesia scaberula*) and prickly shield fern (*Polystichum vestitum*). Exotic species were also present, including Japanese honeysuckle (*Lonicera japonica*) and old man's beard (*Clematis vitalba*). Based on the evidence of regular flooding and very wet soils, wetland 3 can be considered a natural wetland under the NES:F.

The wetland 3 area was delineated primarily using the wetland hydrology present and supported with hydric soil assessments; as shown in Figure 3. Wetland 3 was followed downstream where the surface water disappeared. Accessibility for following the watercourse was restricted due to the dense vegetation. As such, there is uncertainty as to the end result of this water flow – it is assumed that flows eventually reach the groundwater aquifer and downstream surface waters of the upper Whangaehu river catchment.

Figure 7: Wetland area featuring indigenous ferns, waxy leaved coprosma and manuka.

Historical imagery from Retrolens[1] shows a railway line existed near this location and that there is likely to have been earthworks and other land transformation activities at this location in the past (Figure 7). There is currently no railway in this location.

[1] Retrolens.co.nz

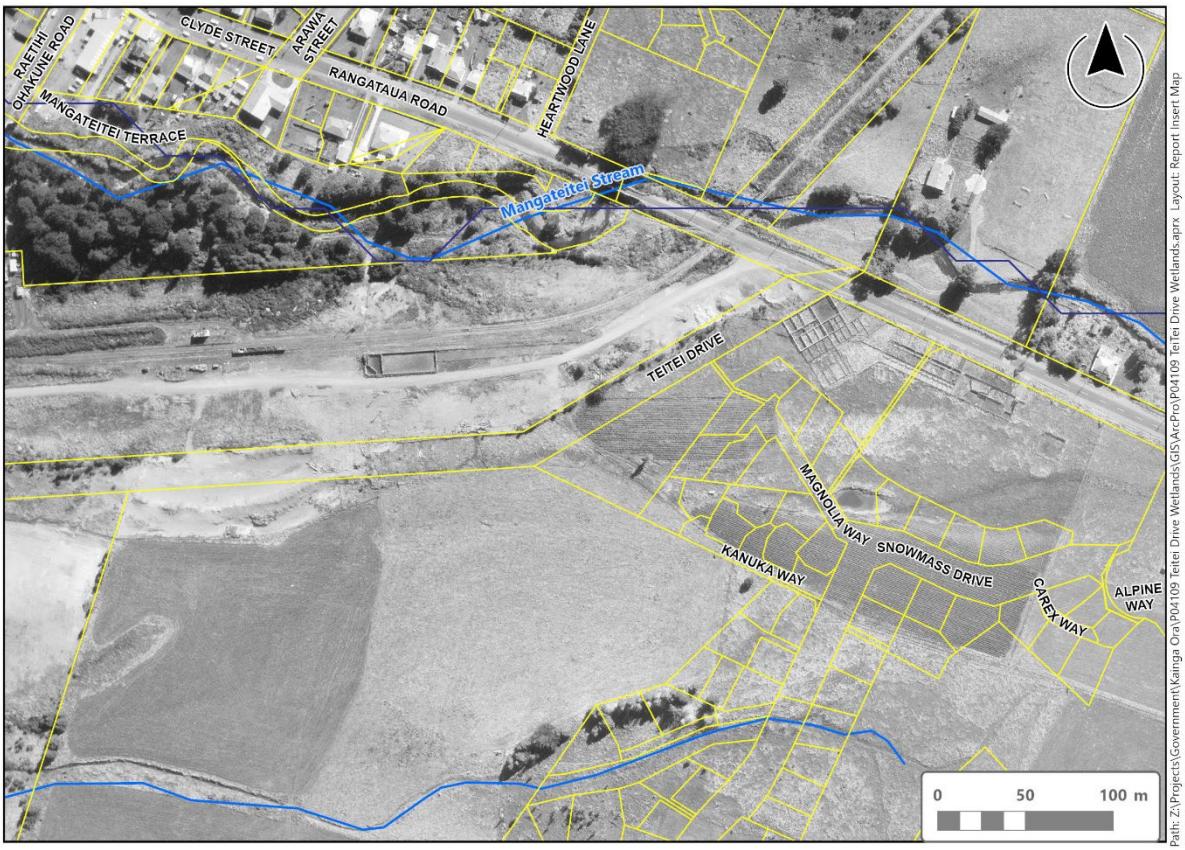

Figure 8: Aerial image of the site from 1963 showing railway to the north and earthworks into the north west of the site.

We recognise that wetland extents can vary seasonally. Wherever the topography was flat, our delineation is conservative in this respect. The majority of the wetland edge transitions abruptly into rising pastoral ground, providing a clear hydrology change.

2.3. Current Wetland Characteristics – Ecological Habitat, Fauna and Functions

During the 24th of January site visit, habitat availability for wildlife and ecosystem functions were assessed. Wetlands are important environments, as they provide both aquatic and terrestrial habitats and functions which can cater to a wide range of habitat and niche availability.

2.3.1. Freshwater

Due to the lack of surface hydrological connection to the downstream environment, it is considered very unlikely that any of the subject wetlands host freshwater fish. The deeper pools present in wetlands 2 and 3 host potential habitat for tuna, in the unlikely event that individuals have migrated overland during flood flows from neighbouring watercourses. The New Zealand Freshwater Fish Database (NIWA) shows longfin tuna (*Anguilla dieffenbachia,* at risk – declining) and shortfin tuna (*Anguilla australis*, not threatened) within the downstream catchment. Further desktop assessment of the larger Manawatu

area on iNaturalist shows that the nearest indigenous freshwater fish species observation was a longfin tuna, over 20 km from the site, north-west of Horopito town.

While fish species are likely poorly represented, indigenous wetland invertebrates were observed in wetland 2 and 3, such as blue damselfly (*Austrolestes colensonis*), Carove's giant dragonfly (*Uropetala carove*). Red damselfly (*Xanthocnemis zealandica*) and Smith's dragonfly (*Procordulia smithii*) have also been sighted in the Ohukane area on iNaturalist. Although no detailed invertebrate surveys were taken, the abundance of predatory *Odonata* species indicates an abundance of freshwater invertebrate prey species within the Teitei wetland area, on which the *Odonata* nymphs will be predating.

2.3.2. Terrestrial

Regarding terrestrial habitat, the canopy extent of wetlands 2 and 3 is too reduced in extent and quality to properly support either indigenous gecko or bird species – wetland 1 does not host woody species. Only a single song thrush (*Turdus philomelos*) was observed foraging in the ground, and no birds or bird nests were observed in the upper branches of the trees. The dominance of exotic willow species in the canopy likely exacerbates this issue further, providing little applicable food or niche habitat for indigenous birds and reptiles. Additionally, the proximity of the site to residential housing, and edge dynamics of the narrow habitat will be facilitating predation from domestic and potentially feral cats and dogs, further making the terrestrial habitat unviable for indigenous species habitation. Regardless, many indigenous bird species have been observed in the wider area on iNaturalist, and likely visit the Teitei wetland for food foraging.

Common species such as pīwakawaka (*Rhipidura fuliginosa*), tūī (*Prosthemadera novaeseelandiae*), Kererū (*Hempiphaga novaeseelandiae*), and ruru (*Ninox novaeseelandiae*) have all been observed in and around Teitei drive, and rarer species such as bellbird (*Anthornis melanura*), New Zealand falcon (*Falco novaeseelandiae*), North Island robin (*Petroica longipes*), and North Island rifleman (*Acanthisitta chloris granti*) have all been observed in the Ohakune town area, and have the potential to inhabit Teitei wetland should ecological improvements to the site be made.

Wet, moisture retaining rank grasses surround the riparian area of the wetlands provides very little suitable dry habitat for potential skink species. No indigenous reptile species have been observed in the greater Ohakune region on INaturalist.

2.3.3. Wetland Functions

Wetlands are important carbon sinks, sequestering an exponentially greater amount of carbon than forests, depending on the wetland classification. They are also important natural water filtration systems, binding chemicals and sediments to root matter and biological soil, removing them from the water cycle. However, the wetland habitat in proximity to the proposed works area showed little evidence of effectively providing either of these ecological services, or others. This is likely due to the wider subject area, including the three wetlands, being so recently modified by anthropogenic activities, only recently being allowed to revert (or convert) to wetland habitat. Wetlands 2 and 3 possessed very little biological soil, and very few wetland plant species for filtration. The only indigenous species observed growing within the water detention level was an unidentified juncus grass species (*Juncus* spp.), growing in a single 50 cm by 50 cm patch. As noted, the main body of wetland 1 could not be accessed – so comment on soil condition is not possible.

Following our site visit and desktop review, the EIANZ guidelines have been utilised to describe the current ecological values of the wetland within the site. For reference, the EIANZ guideline methodology summary tables are presented in Appendix 1.

2.4. Ecological Valuation

The following tables provides an assessment of the ecological values of the three wetlands along the norther boundary, utilising the assessment matters from the EIANZ guidelines. The ecological value of the wetland and associated vegetation has been considered **Very Low** due to the dominance of exotics and weeds and its induced formation.

Table 1: Summary of ecological values for the wetland 1, the eastern-most wetland.

Feature	Ecological Value (EIANZ, 2018)	Reasoning
Representativeness	**Very Low**	The wetland is dominated by exotic facultative pasture species, and is not representative of a natural wetland vegetation community.
Rarity/Distinctiveness	**Low**	Wetland habitat is threatened regionally and nationally, however, none of the species present are considered threatened, nor of botanical note.
Diversity and Pattern	**Very Low**	Highly modified environment, the current indigenous species diversity is extremely low and below the expected level for natural wetland habitat.
Ecological Context	**Low**	Due to human impacts, the wetland has limited ecological function. Not likely to support nationally or locally threatened or uncommon species. May provide low-quality habitat for avifauna, however, appears to be isolated with no apparent hydrological connectivity, therefore, there is limited habitat for aquatic fauna.

Table 2: Summary of ecological values for wetland 2, the central wetland immediately downstream of the access road site.

Feature	Ecological Value (EIANZ, 2018)	Reasoning
Representativeness	**Very Low**	The wetland is dominated by exotic canopy species and surrounded by facultative pasture vegetation and invasive weeds. Minor indigenous plant regeneration, but otherwise not representative of natural wetland vegetation community.
Rarity/Distinctiveness	**Low**	Wetland habitat is threatened regionally and nationally, however, none of the species present are considered threatened, nor of botanical note.
Diversity and Pattern	**Very Low**	Highly modified environment, the current indigenous species diversity is low, and below the expected level for natural wetland habitat.
Ecological Context	**Low**	Wetland is likely a consequence of modification, resulting in limited ecological function. Not likely to support nationally or locally threatened or uncommon species. May provide low-quality habitat for avifauna, however, appears to be isolated with no apparent hydrological connectivity, therefore, there is limited habitat for aquatic fauna.

Table 3: Summary of ecological values for wetland 3, the western-most and largest wetland located downstream of the access road site.

Feature	Ecological Value (EIANZ, 2018)	Reasoning
Representativeness	**Low**	The wetland is dominated by exotic canopy species and surrounded by large invasive weeds and indigenous ferns. Some facultative indigenous plant regeneration, but still not representative of natural wetland vegetation community.
Rarity/Distinctiveness	**Low**	Wetland habitat is threatened regionally and nationally, however, none of the species present are considered threatened, nor of botanical note.
Diversity and Pattern	**Low**	Highly modified environment, the current indigenous species diversity is low, and below the expected level for natural wetland habitat.
Ecological Context	**Low**	Wetland has been significantly modified by historic human activities, resulting in limited ecological function. Not likely to support nationally or locally threatened or uncommon species. May provide low-quality habitat for avifauna, however, appears to be isolated with no apparent hydrological connectivity, therefore, there is limited habitat for aquatic fauna.

The potential ecological value of all three wetlands have been assessed as **Low**, overall, due to its induced nature, historic anthropogenic land-use changes, and isolated nature of the wetlands.

3. Proposed Activities and Potential Effects

An assessment of the potential ecological impacts resulting from the proposed activities has been based on the resource consent plans by Cheal (*Kainga Ora Homes and Communities, 6 Teitei Drive, Ohakune*. Dated 23/05/2023), Earthworks Proposed Contour Plan (Cheal, revision 1 dated 2 June 2023) as well as the construction methodology details supplied in discussions with the project team. The proposed access development will include the following discretionary activities:

- Access road development, which includes earthworks and land disturbance within 10 m wetland 1 and 2, and the replacement of a culvert which is adjacent to the wetland.
- Vegetation removal within, and within 10 meters of wetland 1 and 2.
- Wetland reclamation of the downstream extent of wetland 1 and upstream extent of wetland 2 via replacement and extension of the culvert under the access way.

It is acknowledged that the proposed works have the potential to result in adverse ecological effects on the wetlands 1 and 2. Effects are likely to be both temporary; related to construction activities, and permanent; related to the loss of wetland extent.

It is considered that wetland 3 will not be adversely affected by the proposed works, as culvert installation (as addressed below) and accessway construction is not expected to alter the hydrological profile or flow regime of the wetland due to the features described above. It is considered highly unlikely that sediment discharges from the works site will reach wetland 3 with wetland 2 and the fill constructed pathway buffering the wetland from such discharges. Therefore, avoidance and minimisation of discharges are addressed with regard to wetlands 1 and 2 only in the following sections.

The following potential effects are expected to be associated with the proposed activities and are discussed further below:

- Erosion and sediment effects from land disturbance.
- Wetland effects.

We understand that the access way culvert (30.59 m long, 1 m diameter) is planned to meet permitted activity standards under the NES:F. The culvert is not anticipated to have an operational adverse effect on the wetlands as existing flows and upstream drainage inverts will be maintained; nor will it drain the wetlands. The imbedded culvert will allow for fish passage, however, there is a low likelihood of any fish being present due to limited downstream connectivity of the watercourse.

3.1. Erosion and Sedimentation Effects

Earthworks will be required for development of services and the roading itself. These effects are limited to wetland 1 and wetland 2, which both partially fall within the access road works footprint.

For all land disturbance activities, there is a risk of uncontrolled sediment discharge to the receiving environment. Sediment is a contaminant as defined in the Resource Management Act (RMA) and has the potential to cause a range of adverse effects in the receiving environment including smothering of benthic habitat, direct mortality of indigenous freshwater fish through asphyxiation from clogged gills, and changes to water quality, including physio-chemical indicators pH and clarity.

As there is limited downstream connectivity, our consideration is that there is also limited dispersal range for sediment discharge from the wetland, should any unintended discharge occur. Furthermore, due to the limited available aquatic habitat, the magnitude of effect of unmitigated sediment discharge on the wetland is considered as **Low**.

3.2. Wetland and Freshwater Effects

The access road footprint passes through the extent of two natural habitats that meet the definition of natural wetlands under the NES:F. The works will require earthworks and vegetation clearance within the impacted portions of both wetland 1 and 2. This assessment is framed in respect of the potential effects on the values as set out in subpart 3, specific requirements of the NPS:FM, being:

- Ecosystem health (water quality, water quantity, habitat, aquatic life and ecological processes).
- Indigenous biodiversity.
- Hydrological functioning.

The magnitude of potential effects on the biophysical values on the wetlands are outlined and discussed below. Duration and timescale (permanence) of proposed construction and effects on the natural wetland have also been considered. Considering the below assessments and noting the absence of sensitive or threatened species and limited downstream connectivity, the overall magnitude of effect of the proposed activities on the wetland has been assessed as **Low.**

3.2.1. Water Quality

The construction works and ongoing operation of the accessway has the potential to result in the discharge of various vehicle and roading sources contaminants into the freshwater environment. Earthworks water quality effects were discussed in section 3.1.

As works will be within 10 m of the wetlands and within the upstream extent of wetland 2, and downstream extent of wetland 1, there is a risk for spills of contaminants, such as cement-laden water. Concrete or cement can impact water quality by increasing pH and alkalinity, leading to chemical burns and mortality in aquatic flora and fauna. Even small volumes of concrete contamination can substantially alter the water chemistry and take a long time to recover.

Additionally, there is the risk of spills such as fuels and lubricants associated with machinery during construction. These substances are ecotoxic; spills of sufficient volume could kill aquatic fauna and degrade aquatic habitats.

3.2.2. Water Quantity

Wetland 1 and the stormwater swale running parallel to it (Figure 5), both feed into wetland 2 through the access path culvert. The earthworks are not anticipated to require diversion of water from the current flow between wetland 1 and wetland 2. There may be some delay to overland flows resulting from impoundment associated with sediment controls and the installation of the culvert, but this will be short term and is not expected to result in discernible effects on wetland hydrology. The construction of the impermeable surfaces will result in localised diversions of overland and stormwater flows, however, these are all downslope of the wetlands and unlikely to alter the hydrological regime within the wetlands themselves.

3.2.3. Habitat, Aquatic & Terrestrial Life, Ecological Processes

The proposed works will involve vegetation clearance within, and extent reduction of, wetland 1 and 2, in order to facilitate the installation of the new culvert and roading. The vegetation that is to be cleared is a mixture of exotic pasture grass and associated invasive plants such as willow and broom.

As there is a limited amount of potential habitat for wildlife species (per Section 2.3 and 2.4), the removal of vegetation will not significantly reduce habitat availability for indigenous species. The approximate habitat area that will be removed in wetland 2 is approximately 370 m^2. In wetland 1, up to 139 m^2 of habitat will be removed. This represents less than 15% of the total wetland extent along the northern boundary. This is not expected to result distinguishable effects on ecological processes of the wetland.

3.2.4. Biodiversity and hydrology

The impacted wetland extents are dominated by exotic, primarily invasive vegetation. Works within the wetland are not expected to adversely affect the overall condition nor ecological value of indigenous biodiversity. The fact that the wetland is currently disconnected from other watercourses further enforces that there are unlikely to be any indigenous fish present, although it is possible tuna could migrate overland during flood events from nearby rivers and streams.

The hydrology of the wetlands are maintained by the flow from the upstream wetland and stormwater swale in the urban garden area into wetland, which is also being induced by the gravel fill pathway at the downstream end, dividing wetland 2 and 3 (Figure 5). The proposed works will not alter either of these features. Inflow from the works site is low with no defined channels. Temporary diversions for sediment control and the installation of the culvert may have temporary effects on wetland hydrology, however, over the longer term the site hydrology is expected to remain relatively similar to its existing state.

The accessway culvert will be installed to meet NES:F permitted activity standards and is unlikely to have any adverse effects on the wetland hydrology.

3.2.5. Effects summary

The expected level of ecological effects of the proposed activities on the effect wetland extents, prior to implementing effects management methodologies, have been assessed as **Low**.

3.3. Te Waiū-o-Te-Ika assessment

Whilst the overall ecological effects are assessed as **Low**, we recognise that all freshwaters within Te Waiū-o-Te-Ika hold intrinsic value to tangata whenua.

As noted, the subject wetlands are highly modified (induced) and degraded, and disconnected on the surface from the Mangawhero River (a tributary of the Whangaehu River). So long as groundwater connectivity and recharge remain unimpeded, they are unlikely to induce changes in the health of the river. However, works within wetland 1 and 2 will result in a reduction of wetland habitat extent.

Currently, the degraded state of the wetlands likely impacts the connection that the Ohakune hapū and wider community have with them, and this connection is central to Te Waiū-o-Te-Ika framework. Therefore, in order to uphold the framework and its values, the proposed effects management will

ensure to enhance the overall wellbeing of the wetlands and strive to improve the community's connection to them, through this enhancement.

4. Ecological Impact Assessment and Management

The current ecological values of the wetland have been described based on field observations in conjunction with a review of the existing literature. The expected work activities and associated levels and nature of effect have been described and set out in Section 3. This section discusses proposed effects management methodologies and utilises the findings of Sections 2 and 3 to provide an assessment of the post-mitigation level of ecological effects based on the EIANZ guidelines.

4.1. Erosion and Sedimentation

Sedimentation effects related to earthworks are to be minimised and mitigated through the implementation of best practice erosion and sediment control methodologies, such as those within Auckland Council's Guideline Document 2016//005 *Erosion and Sediment Control Guide for Land Disturbing Activities in the Auckland Region* (GD05). The use of best practice erosion and sediment controls would be considered appropriate to address any potential sediment impacts on water quality. There are no known site-specific constraints that would prevent erosion and sediment control being in accordance with best practice.

The mixing of any concrete and similar products should only be undertaken in the dry to minimise the potential for any spillage; the use of ready-mix concrete is encouraged to minimise cement works onsite. Additionally, an area should be identified onsite, away from any watercourses and with adequate containment, to receive any excess concrete material prior to disposal. No washing or cleaning of wet cement material or equipment should be undertaken onsite where runoff could enter site watercourses. Once cured, concrete would be inert and not be expected to generate contaminants.

Refuelling of machinery during construction should be undertaken away from watercourses. To further minimise the risk of a spills to the environment, a spill kit should be kept on site (during both the construction phases) and all staff trained in its appropriate use.

4.2. Loss and Degradation of Wetland Habitat

In order to enable access to the future residential housing area, the access road needs to be developed, requiring the loss of some wetland extent. The wetland habitat loss that will result from the installation of the access road will be a small portion of the total wetland area present along the northern boundary (less than 15%). Further, the current ecological conditions of the wetland area are highly modified, as an accumulative result of the historic human activities over the past century, particularly due to agricultural land-use practices that have affected both hydrology and biodiversity. The area is dominated by exotic and invasive vegetation. For these reasons, we do not consider that the reduction in wetland habitat extent will significantly impact the overall hydrological or ecological value of the wetland area.

Nevertheless, the NPS:FM requires that the work activities do not result in the loss of either values or extent of a natural wetland without rigorous application of the effects management hierarchy via avoidance, minimisation, remediation, offsetting or compensation.

Avoidance of effects on wetlands 1 and 2 have been considered by the project team through the ongoing design processes, by consideration of alternative access routes to the site. However, with another natural wetland and a permanent watercourse on the site's southern boundary, existing

residential housing along the eastern boundary, and private land bordered by a high traffic road on the western boundary, relocating the accessway could have either a potentially greater ecological impact, or impinge on private landownership and infrastructure. The existing accessway means an extension of an existing structure and connection to an existing public road (Teitei Drive), rather than creation of an entirely new structure. It also follows planned roading routes. Alternatives to avoid the wetlands were determined not to be feasible, or to have greater adverse effects.

Minimisation of effects has been undertaken by the project team to ensure the accessway meets, but does not exceed current and potential future traffic requirements regarding its extent. The ESCP as described in section 4.1 will ensure earthworks effects are minimised/mitigated to meet best practice.

Where earthworks and vegetation clearance are required to enable works, but revegetation is feasible, this will be undertaken via the planting of a suitable eco-sourced riparian assemblage, in coordination with landscape planning for the site.

Following avoidance, minimisation and remediation, the residual permanent loss of wetland habitat extent must be addressed via offsetting or, if feasible solutions are exhausted, compensation.

The isolation of the site suggests there is currently a very low likelihood of indigenous fish and therefore fish salvage is not expected to be required.

4.2.1. Values

We consider that the control of invasive exotic plant species to support the re-establishment of wetland plant species within the remaining un-impacted enhancement opportunity wetland habitat extent (2170 $m^{2,}$ Figure 9) would substantially increase the overall ecological value of the remaining, greater extent of the wetland area, while also increasing viable habitat availability for indigenous fish, reptile, and invertebrate species.

Invasive species – particularly willow and blackberry – supress indigenous plant succession and can contribute excess organic matter to the wetland, degrading water quality; with willow root mass also impacting flows. Wetland functions such as carbon sequestration and water quality enhancement will also be improved by the proposed control. Improving ecological conditions by reducing the abundance of invasive exotic species will also substantially improve the cultural values of the site for local hapū, iwi and community, per the Te Waiū-o-Te Ika value of *Kia hua mai ngā kōrero o ngā wai, kia hua mai te wai ora e* (Section 1.3).

Invasive plant management will include willow and blackberry control within the wetland body, as well as other exotic weeds. It is recommended that this control is undertaken via manual methods (including, where appropriate, stump pasting or drilling and poisoning) to avoid contaminating the waterbody. This should be incorporated into a sitewide enhancement plan. The total enhancement area is substantially larger than the impact area, and whilst degraded, holds substantial enhancement potential. Therefore, offsetting of the loss of ecological values on site to achieve a **Net-Gain** in ecological values by removing invasive exotic plant pressures and providing for indigenous species succession will be achieved.

4.2.2. Extent

The loss of wetland extent is relatively restricted, with ~370 m^2 of habitat expected to be lost from wetland 2, and 140 m^2 from wetland 1 (Figure 9). From field assessments, there is very little potential area for the develop additional wetland extent for offsetting within the Kianga Ora housing development property area. This is primarily due to a lack of clear evidence of further historical wetland

extent, and resultant daylighting opportunities. It is our recommendation that the offsetting of extent is not undertaken where this is neither ecologically beneficial nor conducive to a positive enhancement or conservation outcome. Nonexclusively, connection to biodiversity corridors, potential to achieve natural hydrological functionality, and provision of minimum viable habitat to support indigenous communities and ecological functions should all be provided for.

Thus, we consider it preferable to instead provide ecologically appropriate compensation by focusing on further improving the ecological attributes of the remaining wetland extent post-works, which are, in their current state, of low value in accordance with the EIANZ ecological values schema (section 2.2 Wetland Characteristics). A 2170 m^2 area of remaining, unaffected wetland has been isolated in Figure 9. Roughly 830 m^2 of this enhancement opportunity area lies within the Kainga Ora legal parcel, while the remainder is within a paper road.

Further improvements to the ecology of the enhancement opportunity wetland habitat would have a greater positive impact on local biodiversity than undertaking earth works to create additional wetland extent in areas that are unlikely to have ever been natural wetland. Further enhancing and supplementing the existing wetland habitat, along with its associated riparian buffer would help ensure that the mana of the wetland is able to be properly reflected through the health and abundance of indigenous species true to the indigenous ecology of the area, providing a functioning wetland habitat that will be beneficial to local residents, while complementing the many green spaces that the housing development is intending to provide for residents.

As a compensation action, the planting of indigenous wetland plants using locally eco-sourced species within the wetland body is advised, as well as undertaking planting of an indigenous riparian buffer surrounding the wetland. A recommendation is the provision of a detailed planting plan as a condition of consent, such that it could be developed with the incorporation of any other site enhancement opportunities. It is also advised that this planting considers view corridors into the wetland and provision of amenity for the local community. Ngāti Rangi hapū should be provided the opportunity to collaborate on this planting planning – there may be species of local significance they wish to include.

With the water quality and water quantity within the wetland expected to remain unchanged, and the facilitation of indigenous regeneration within the impacted wetland extent via offsetting of lost values, and compensation for lost extent, it is not expected that the access road development will substantially alter the current ecological values of the wetland. We note that any offset and compensation areas should be protected in perpetuity from future development, following enhancement works.

An overall **Net-Gain** in ecological values is expected, with a Net-Loss of wetland extent compensated for by increasing the overall wetland habitat and revitalising indigenous biodiversity within the wetland and surrounding riparan buffer. Accordingly, the post-management magnitude of effect for the impacted wetland areas have been assessed as **Very Low** (see Table 4).

Table 4: Summary of level of effect of the proposed activities prior to, and including, implemented controls.

Impact	Ecological Value (EIANZ, 2018)	Magnitude (after effects management)	Level of effect with management
Loss and degradation of wetland habitat in wetlands 1 and 2	**Low**	**Low** – ecological enhancement actions within the remaining extent of wetland 2 for the overall betterment of ecological functions and indigenous biodiversity via offsetting and compensation actions; and the negligible impact earthworks will have on hydrology, means that the overall ecological impact after effects management is very low.	**Very Low**

Figure 9: Likely impacted wetland extents by access road works, alongside un-impacted wetland enhancement opportunity potential area. Wetland 1 is to the east of the existing access road; wetland 2 is to the west.

5. Summary and Recommendations

This Ecological Impact Assessment has been prepared to support the lodgement of a Resource Consent application for the proposed development of an access road to a future Kainga Ora housing area at the southeastern terminus of Teitei Drive, Ohakune.

Previously, an overarching ecological assessment for the site was undertaken by Kahu (2023), followed by a wetlands and stormwater assessment memorandum by Morphum (2023), both of which this report draws on via the inclusion of an assessment of the wetlands along the northern border of the housing development, and the impact the new access road will have upon the wetlands, primarily the central wetland.

An assessment utilising the EIANZ Ecological Impact Assessment Guidelines (2018) has been undertaken of the wetland to determine its ecological values, as well as the magnitude and level of effect resulting from the proposed construction activities.

The wetland is considered to be of low ecological value due to its low biodiversity, high presence of exotic and invasive plant species, and its induced and highly modified characteristics meaning that it is not resemblant of a natural wetland that may be expected for the area (low-land mixed podocarp forest).

Potential effects have been considered as the following:

- Erosion and sediment effects from land disturbance.
- Effects of wetland habitat loss and degradation.
- Effects on wetland hydrology.

Effects management measures include:

- Implementing best practice erosion and sediment control methodologies.
- Containment of fuels and cement.
- Offsetting of wetland value loss via ecological enhancement of the existing wetland by control of indigenous exotic plants,
- Compensation of wetland extent loss via further ecological enhancement of the existing wetland and surrounding riparian buffer by planting of indigenous wetland and terrestrial plant species.

The following detailed recommendations are provided, in addition to the preliminary construction methodology, to further mitigate ecological risks:

- Any temporary sediment stockpiling or machinery refuelling is undertaken away from site watercourses.
- Maintain a fully stocked spill kit on site, during both construction and operations phases, and ensure staff are trained in its appropriate use.
- Invasive species removal and control within remaining wetland extent to offset for the loss of ecological values, alongside indigenous species re-establishment facilitated by a site-specific planting plan to compensate for the loss of wetland extent. This should be incorporated into a site wide planting plan focused on improving the overall ecological value, biodiversity and amenity values of the remaining wetland extent along the northern edge of the housing development.

The overall level of effect (with effects management) for the proposed works has been assessed as very low. As per the EIANZ Guidelines, a low or very low level of effect should not normally be of concern, provided normal design, construction and operational care is exercised to minimise any adverse effects, and any impact management developed during project planning is implemented as intended.

6. References

Auckland Council (2016). Erosion and Sediment Control Guide for Land Disturbing Activities in the Auckland Region, Guideline Document 2016/005 (GD05).

Clarkson, B. (2013). A vegetation tool for wetland delineation in New Zealand. Landcare Research.

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Fraser, S., Singleton, P., & Clarkson, B. (2018). Hydric soils – field identification guide. Landcare Research

Kahu (2023). Stream Assessment Report for The Proposed Development At 6 Teitei Drive Ohakune. Prepared by Rachel Griffiths of Kahu, dated 15 June 2023.

Landcare Research (2020). Land Cover Database (LCDB) version 5, Mainland New Zealand. Retrieved from LRIS portal: https://lris.scinfo.org.nz/layer/48423-lcdb-v5.1-land-cover-database-version-5-mainland-new-zealand. Accessed 17/02/2023.

Ministry for the Environment (2022). Wetland delineation protocols. Wellington: Ministry for the Environment.

Morphum (2023). Teitei Drive wetlands and stormwater. Prepared by Andrew Rossaak, dated 17 May 2023.

Appendix 1 EIANZ Assessment Methodology

Table 5: Assigning value to species, vegetation, and habitats (summarised from EIANZ, 2018)

Value	Species Values	Vegetation/Habitat Values
Very High	Nationally threatened species found in the (Zone of Influence) ZOI[2] either permanently or seasonally	Area rates High for 3 or four attributes (Representativeness, Rarity/distinctiveness, Diversity and pattern, Ecological context). Likely to be national important and recognised as such
High	Species listed as At Risk – Declining, found in the ZOI either permanently or seasonally	Area rates High for 2 of the attributes, Moderate and Low for the remainder, or Area rates High for 1 assessment matters, Moderate for the remainder Likely to be regionally important and recognised as such
Moderate	Species listed as any other category of At Risk, found in the ZOI either permanently or seasonally, or Locally (ED) uncommon or distinctive species	Area rates High for 1 assessment matters, Moderate and Low for the remainder, or Area rates Moderate for 2 or more of the attributes, Low or Very Low for the remainder Likely to be important at the level of the Ecological District
Low	Nationally and locally common indigenous species	Area rates Low or Very Low for majority of assessment matters and Moderate for 1 Limited ecological value other than as for habitat for tolerant indigenous species
Negligible	Exotic species, including pest species having recreational value	Area rates Very Low for 3 matters and Moderate, Low or Very Low for remainder

[2] The Zone of Influence (ZOI) refers to all land, water bodies and receiving environments that could be potentially impacted by the project.

Table 6: Criteria for describing magnitude of effect (summarised from EIANZ, 2018)

Magnitude	Description
Very High	Total loss of or major alteration to key features of the baseline condition causing a fundamental change or complete loss of the character, composition, or attributes of the site.
High	Major loss or major alteration to key features of the baseline condition causing a fundamental change of the character, composition, or attributes of the site.
Moderate	Loss or alteration of one or more key features of the baseline condition causing a partial change to the character, composition, or attributes of the site.
Low	Minor shift away from baseline conditions. Change may be discernible, but underling character, composition, or attributes of the site will be similar to pre-development.
Negligible	Very slight change from existing baseline condition. Change barely distinguishable.

Table 7: Criteria for describing level of effects (from EIANZ, 2018)

Ecological Value	Very High	High	Moderate	Low	Negligible
Magnitude					
Very High	Very High	Very High	High	Moderate	Low
High	Very High	Very High	Moderate	Low	Very Low
Moderate	High	High	Moderate	Low	Very Low
Low	Moderate	Low	Low	Very Low	Very Low
Negligible	Low	Very Low	Very Low	Very Low	Very Low
Positive	Net gain	Net gain	Net gain	Net gain	Net gain

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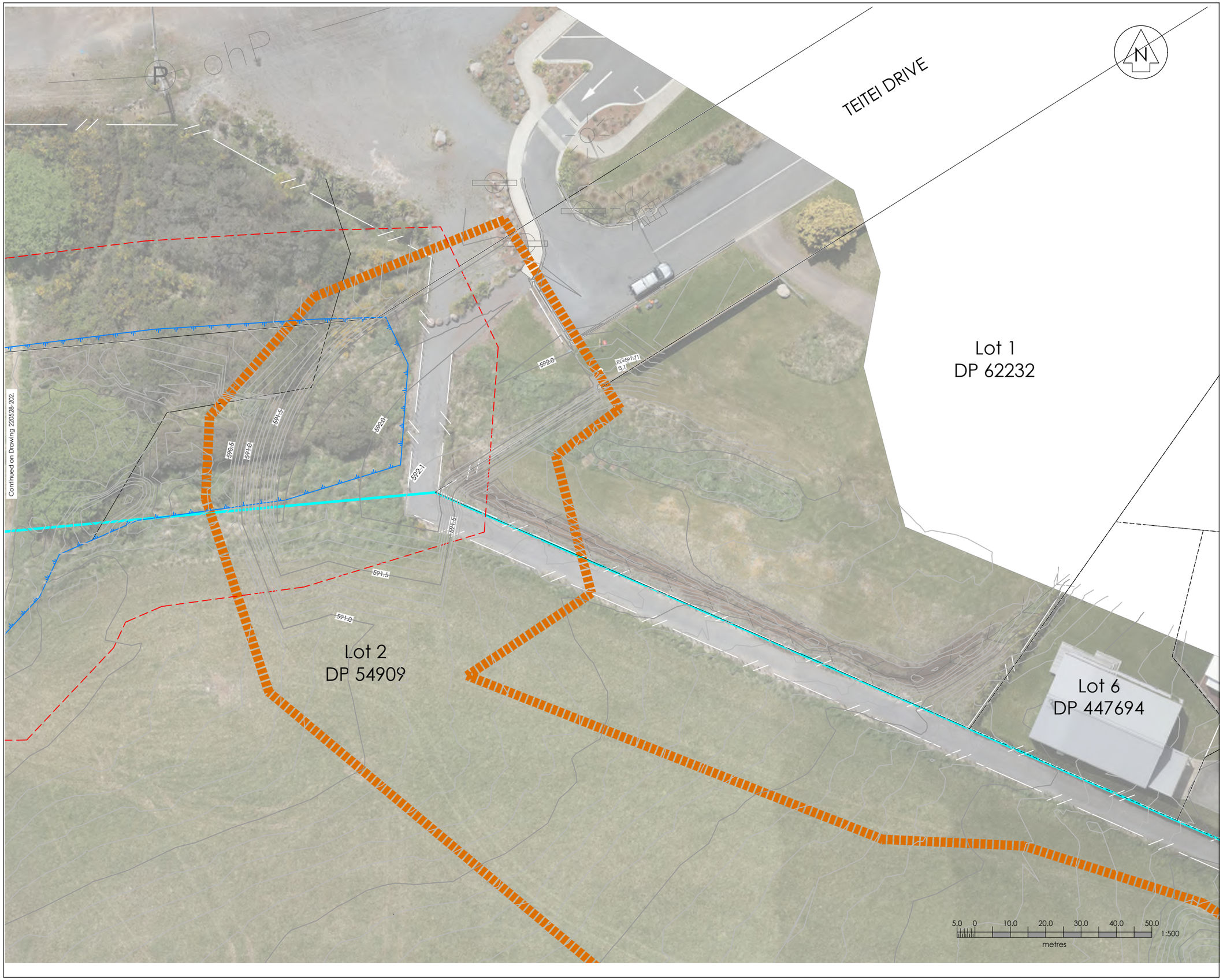

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NOTES:

1. All work shall be done in accordance with NZS 4404:2010.
2. Reduced Levels are in terms of NZ Vertical Datum 2016
   Level Origin : EBC7 OIT IV DP 44819
   RL : 595.70
   Contour Interval = Major 0.5m
   Minor 0.1m
3. Contractor to locate and identify existing utility location and depths prior to construction. The project engineer shall be informed of any discrepancies to the information depicted on these plans immediately for revised drawings.
4. Contractor shall install and maintain all stormwater, dust and erosion control during construction as per earthworks management plan and the Greater Wellington Regional Council "Erosion and Sediment Control Guideline for Land Disturbing Activities for the Wellington Region".
5. All disturbed areas shall be re-topsoiled and grassed within 30 days upon completion of contract works.
   Dust control shall be maintained until grassed areas have become established.

Legend:

- Stage 1 (Extent of Works)
- Assessed wetland extent
- Assessesd wetland Buffer

Rev	Date	Amendment	By	Chk	App
A	17/01/24	Resource Consent	RFK		

Project Title

Kainga Ora
Homes and Communities
6 Teitei Drive, Ohakune

Drawing Title

Entrance Earthworks
Proposed Contour Plan

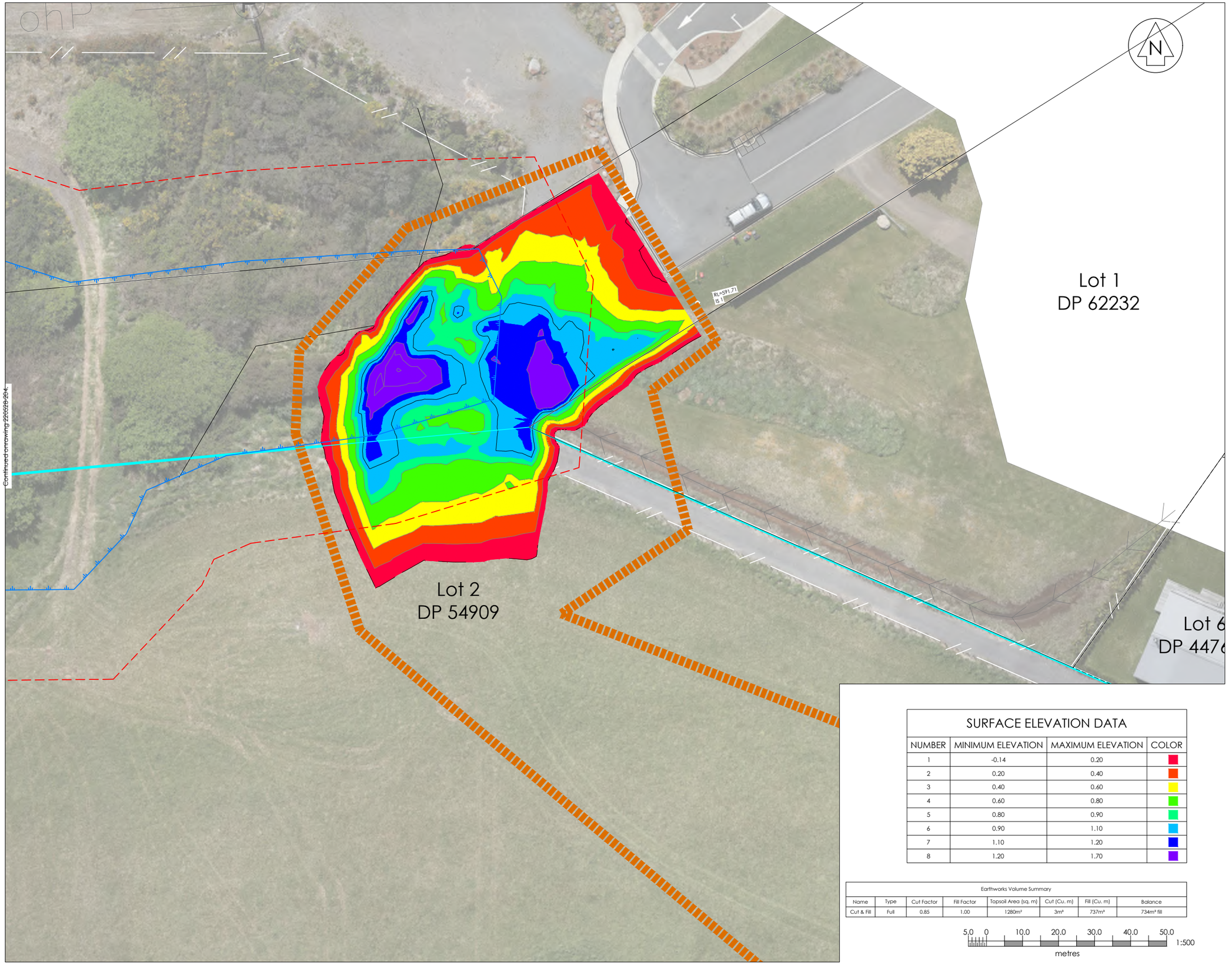
Surveyed	G Ripoli	02/11/22	GR
Designed	R.Kilgour	05/23	RFK
Drawn	P.Harris	18/05/23	PH
Checked	R.Kigour	18/05/23	RFK
Approved	S.Prasad	22/05/23	SP

Status **INFORMATION**

DRAFT NOT FOR CONSTRUCTION

Scale A1 1:200 | A1
A3 1:400

Drawing Number 220528-206 | Rev A



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2. Reduced Levels are in terms of NZ Vertical Datum 2016
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   Dust control shall be maintained until grassed areas have become established.

Legend:

- Stage 1 (Extent of Works)
- Assessed wetland extent
- Assessesd wetland Buffer

SURFACE ELEVATION DATA

NUMBER	MINIMUM ELEVATION	MAXIMUM ELEVATION	COLOR
1	-0.14	0.20	
2	0.20	0.40	
3	0.40	0.60	
4	0.60	0.80	
5	0.80	0.90	
6	0.90	1.10	
7	1.10	1.20	
8	1.20	1.70	

Earthworks Volume Summary

Name	Type	Cut Factor	Fill Factor	Topsoil Area (sq. m)	Cut (Cu. m)	Fill (Cu. m)	Balance
Cut & Fill	Full	0.85	1.00	1280m²	3m³	737m³	734m³ fill

5.0 0 10.0 20.0 30.0 40.0 50.0 1:500
metres

Rev	Date	Amendment	By	Chk	App
A	17/01/24	Entrance construction	RFK		

Project Title

Kainga Ora
Homes and Communities
6 Teitei Drive, Ohakune

Drawing Title

Entrance Earthworks
Proposed Cut & Fill Plan

Surveyed	G. Ripoli	02/11/22	GP
Designed	R.Kilgour	05/23	RK
Drawn	P.Harris	18/05/23	PH
Checked	R.Kilgour	18/05/23	RFK
Approved	S.Prasad	22/05/23	SP

Status INFORMATION

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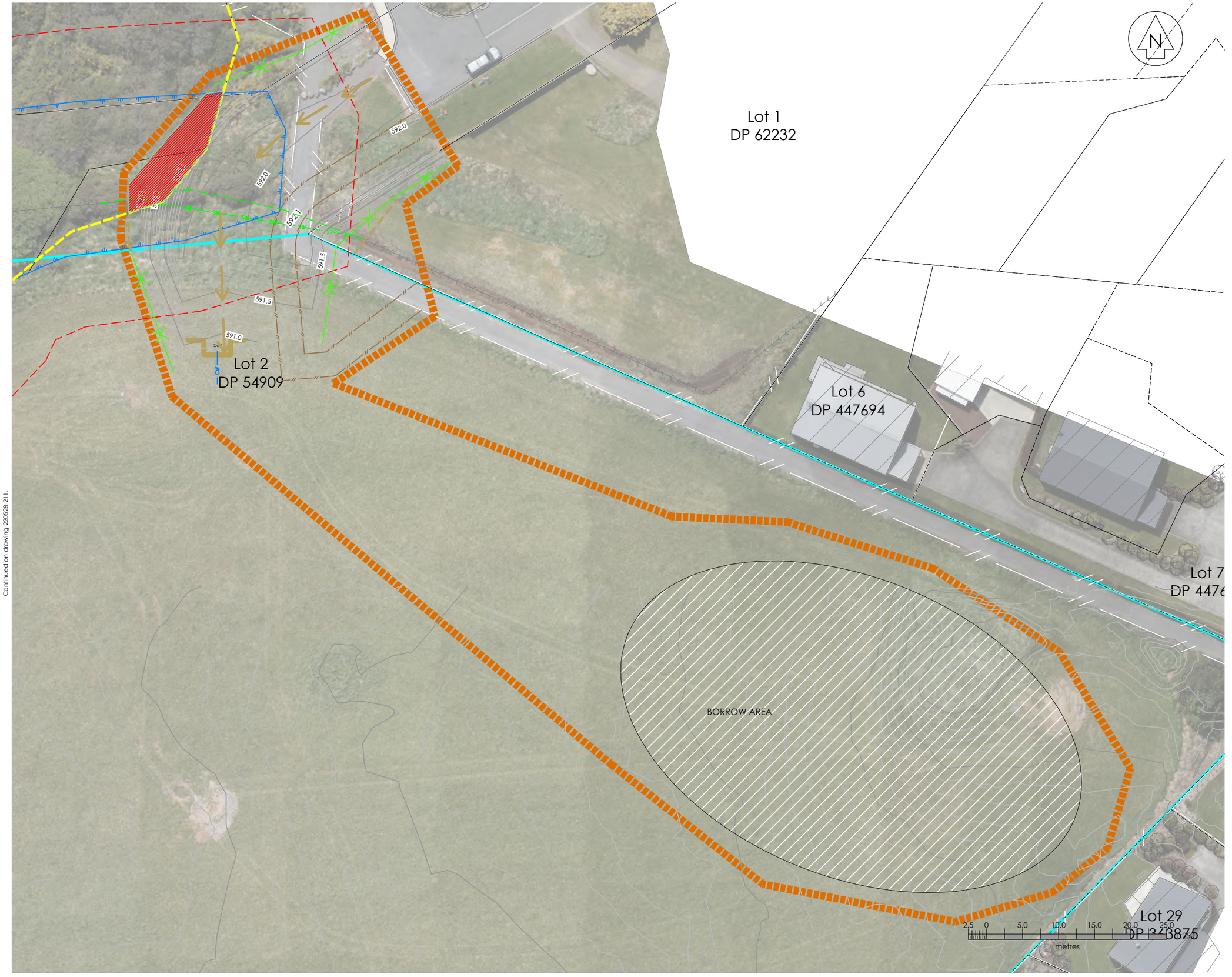
A3 1:200

Drawing Number 220528-207 | Rev A



Continued on drawing 220528-211.

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NOTES:

1. All work shall be done in accordance with NZS 4404:2010.
2. Reduced Levels are in terms of NZ Vertical Datum 2016
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4. Contractor shall install and maintain all stormwater, dust and erosion control during construction as per earthworks management plan and the Greater Wellington Regional Council "Erosion and Sediment Control Guideline for Land Disturbing Activities in the Wellington Region".
5. All disturbed areas shall be re-topsoiled and grassed within 30 days upon completion of contract works.
   Dust control shall be maintained until grassed areas have become established.

Earthworks Legend: (EW)

- Stage 1 (Extent of Works)
- Clean water flow
- Clean water diversion bund
- Dirty water flow
- Dirty water diversion bund
- Silt fence/ Super silt fence
- DEB — Decanting earth bund
- Proposed stormwater culvert
- Existing stormwater drain
- Extent of assessed wetalnd
- 10 m wetland buffer zone

Rev	Date	Amendment	By	Chk	App
A	17/01/24	Resource Consent	RFK		

Project Title

Kainga Ora
Homes and Communities
6 Teitei Drive, Ohakune

Drawing Title

Entrance Earthworks
Ezrthworks Extent
and Borrow Area

Surveyed	G. Ripoli	02/11/23	GR
Designed	R.Kilgour	05/23	RK
Drawn	P.Harris	18/05/23	PH
Checked	R.Kilgour	18/05/23	RK
Approved	S.Prasad	22/05/23	RK

Status **INFORMATION**

DRAFT NOT FOR CONSTRUCTION

Scale A1 1:250 | A1
A3 1:500

Drawing Number 220528-208 | Rev A

Continued on drawing 220528-211.

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NOTES:

1. All work shall be done in accordance with NZS 4404:2010.
2. Reduced Levels are in terms of NZ Vertical Datum 2016
   Level Origin : EBC7 OIT IV DP 44819
   RL : 595.70
   Contour Interval = Major 0.5m
   Minor 0.1m
3. Contractor to locate and identify existing utility location and depths prior to construction. The project engineer shall be informed of any discrepancies to the information depicted on these plans immediately for revised drawings.
4. Contractor shall install and maintain all stormwater, dust and erosion control during construction as per earthworks management plan and the Waikato Regional Council Erosion and Sediment Control - "Guidelines for soil disturbing activities".
5. All disturbed areas shall be re-topsoiled and grassed within 30 days upon completion of contract works.
   Dust control shall be maintained until grassed areas have become established.

Earthworks Legend: (EW)

- Stage 1 (Extent of Works)
- CW — Clean water flow
- CW — Clean water diversion bund
- DW — Dirty water flow
- DW — Dirty water diversion bund
- Silt fence/ Super silt fence
- DEB — Decanting earth bund
- SW — Proposed stormwater culvert
- Existing stormwater drain
- Extent of assessed wetalnd
- 10 m wetland buffer zone

Rev	Date	Amendment	By	Chk	App
A	17/01/24	Resource Consent	RFK		

Project Title

Kainga Ora
Homes and Communities
6 Teitei Drive, Ohakune

Drawing Title

Entrance Earthworks
Proposed Sediment & Erosion
Control Plan

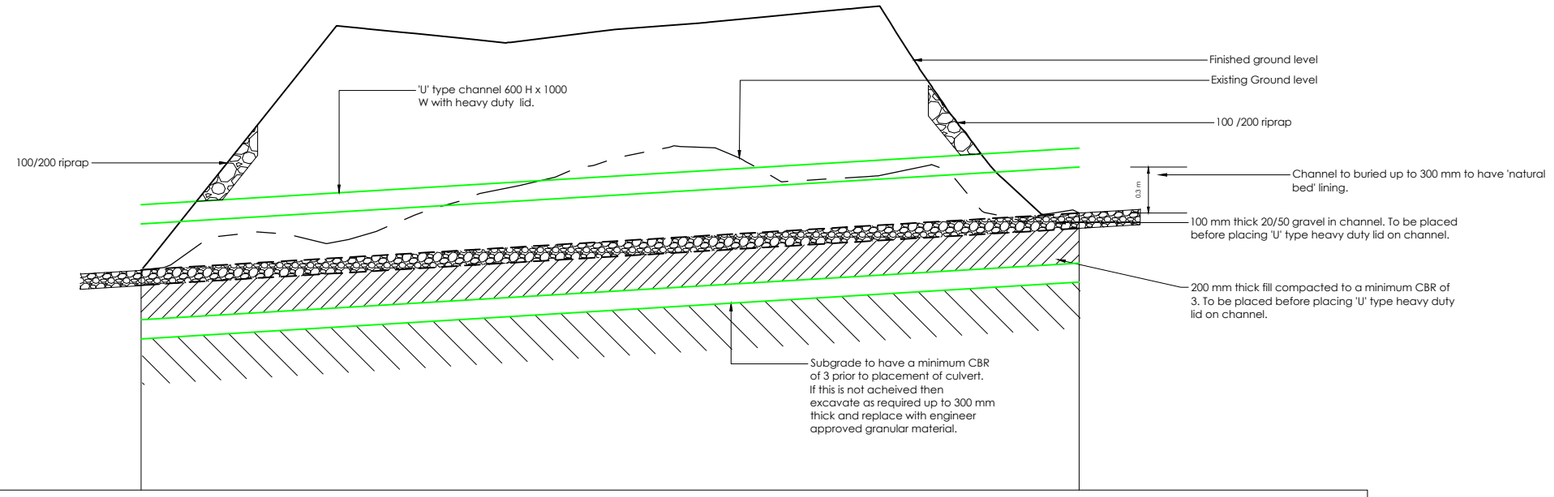
Surveyed	G. Ripoll	02/11/23	GR
Designed	R.Kilgour	05/23	RK
Drawn	P.Harris	18/05/23	PH
Checked	R.Kigour	18/05/23	RK
Approved	S.Prasad	22/05/23	RK

Status **INFORMATION**

DRAFT NOT FOR CONSTRUCTION

Scale A1 1:200 | A1
A3 1:400

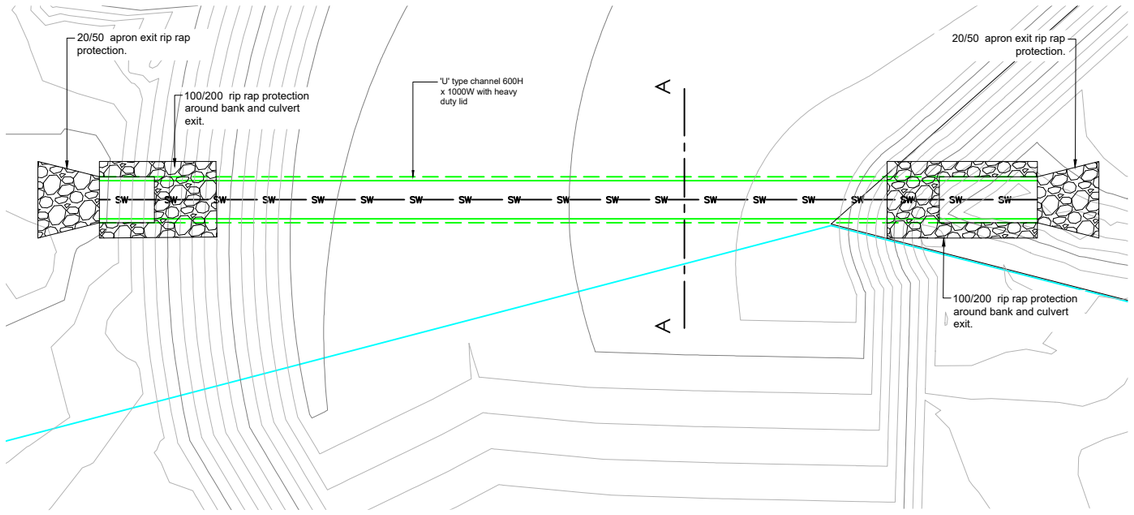
Drawing Number 220528-213 | Rev A



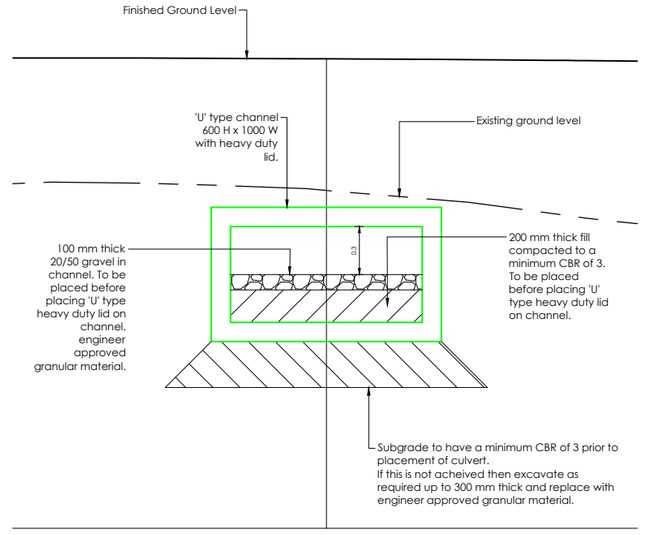
Datum RL 589.00

Depth to Invert			
Invert Level	590.11		590.48
Lid Level			
Chainage			
Pipe Size & Gradient		30.59m 'U' Type Channel 600 H x 1000 W 1.21%	

Long Section
Scale H1:100
V 1:500



Plan
Scale 1:100



Cross Section A
Scale 1:20

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NOTES:

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5. All disturbed areas shall be re-topsoiled and grassed within 30 days upon completion of contract works.
   Dust control shall be maintained until grassed areas have become established.
6. All manholes to have scruffy dome lids.

Rev	Date	Amendment	By	Chk	App
A	24/01/24	Pre Application	RFK		

Project Title

Kainga Ora
Homes and Communities
6 Teitei Drive, Ohakune

Drawing Title

Entrance Stormwater
Proposed Layout
Long Section & Cross Section

Surveyed	G. Ripoli	02/11/22	GR
Designed	R. Kilgour	05/23	RFK
Drawn	P.Harris	11/05/23	PH
Checked	R. Kilgour	18/05/23	RFK
Approved	S. Prasad	23/05/23	SP

Status INFORMATION

DRAFT NOT FOR CONSTRUCTION

Scale A1 As Shown | A1
A3 As Shown

Drawing Number 220528-606 | Rev A

Kainga Ora – Homes and Communities

6 Teitei Drive, Ohakune

Earthworks and Construction Management Plan

220528
23 February 2024

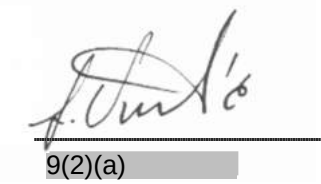
cheal

Kainga Ora – Homes and Communities

6 Teitei Drive Ohakune

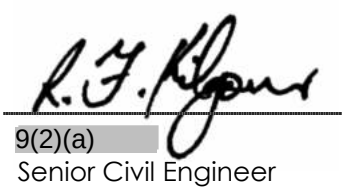
Earthworks and Construction Management Plan

Prepared by:



9(2)(a)
BE Civil, CMEngNZ

Reviewed and Approved by:



9(2)(a)
Senior Civil Engineer
BE (Hons) Civil, CPEng, CMEngNZ, IntPE (NZ)

Date:	23 February 2024
Reference:	220528
Status:	Final
Revision:	NA
Previous Revision Date:	NA

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Appendices -

1. Cheal Consultants Earthworks Plans 220528-205 to 208;
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   Entrance Stormwater Proposed Layout, Long Section & Cross Section 220528-606
2. Calculations for Erosion & Sediment Control Design
3. Noise Management Assessment
4. Relevant Sections from Horizons Regional Council Guidelines
5. Template As-Built Certificates for Sediment Controls.

1. INTRODUCTION

1.1. Proposed Activity

The following Earthworks and Construction Management Plan is preliminary by nature; its purpose is to provide a pathway forward for Land Use Consent for the development of the Kainga Ora – Homes and Communities access to site on Teitei Drive, Ohakune and it encompasses both Earthworks Management and Construction Management. This plan is preliminary and is to be updated, finalised and provided to the contractor to adhere to the conditions of the Resource Consent set by Ruapehu District Council (RDC).

The proposal is to create an access/ entrance way to the site in a manner that minimises the effect on the environment or the neighbouring properties and will enable future works to be continued within this property.

The site will involve up to approximately 735m^3 of cut to fill to form the new access, as shown on plans 200790-205 to 208 attached in Appendix 3. The earthworks will be undertaken to ensure minimal areas of open land at any one time.

The earthworks are to commence once Resource Consent is granted, a contractor has been engaged for the works and their CMP has been approved by RDC.

Erosion and sediment controls will be required for the works. The following report identifies the controls to be implemented and the attached drawings indicate the locations of these controls.

All erosion and sediment controls will remain in place until all disturbed areas have been stabilised.

1.2. Site Description

The site's legal description is Lot 2 DP 54909 and is contained in Record of Title WN24D/752. This site has an irregular shape but can be approximated as a square shaped block of land with an approximate area of 9.5ha. The works covered in this plan are to replace the rural entrance currently off a gravel access in Council land that connects Teitei Drive to Raetihi Ohakune Road, north of the site, with a new access off Teitei Drive. Once the earthworks have been completed, the existing entrance will be redeveloped as part of the existing wetland, which will be covered under a separate part of the resource consent.

The site generally sits on a flat piece of land gently sloping down towards the west.

There is a gravel footpath from Teitei Drive to Snowmass Drive, with an existing open drain running east to west adjacent to the footpath and then under the footpath to a wetland along the northern boundary of the site.

Residential structures are located on Teitei Drive and in Turoa Village to the north and east of the site. There is a drain centrally located within the site running east to west and a drain at the northern end of western boundary running to the south and connecting to the central drain before discharging to the west.

The site is presently grassed, and the topography (contours) can be seen on drawing 220528-205 attached in Appendix 3.

Figure 1 – Site Location

1.3. Geotechnical Context of the Site

Soil type of the overall site is topsoil on sands, silts and clays. A geotechnical investigation has been undertaken with in-depth testing and reporting for the entire site.

2. EROSION AND SEDIMENT CONTROL

2.1. General

The earthworks construction site will be controlled via earth bunds, silt fences, a temporary culvert and possibly a Decanting Earth Bund (DEB). The earth bunds and bypass culvert and silt fences will be installed to separate clean water from the earthworks site and to divert dirty water to the possible DEB, as shown on Drawing 220528-213 attached in Appendix 1.

All erosion and sediment controls will be constructed and maintained in general accordance with the document entitled 'Erosion and Sediment Control Guidelines for Land Disturbing Activities in the Wellington Region", dated February 2021, together with the appropriate updated factsheets found on the HRC website (Guidelines), wherever possible.

2.2. Monitoring and Maintenance

All erosion and sediment controls will be inspected on a weekly basis by the site foreman during dry weather, as well as prior to and immediately following significant rainfall events.

All maintenance requirements identified during routine inspections of erosion and sediment controls will be implemented as soon as practicable and in any case prior to a significant rainfall event.

2.3. Erosion Control

2.3.1. Clean Water Earth Bund

A clean water diversion bund is to be installed upstream and downstream of the EW site. The upstream bund will prevent stormwater from flowing onto the construction area from the existing open channel and will collect the runoff and direct it to a temporary 160 diameter culvert and discharge to the wetland on the downstream side of the earthworks. The downstream earth bund will separate the wetland from the earthworks area and prevent sediment from entering the wetland.

The temporary culvert is to replace the existing 100 diameter culvert.

The clean water diversion bund shall be constructed as per the Horizon Regional Council (HRC) Guidelines.

2.3.2. Dirty Water Channel

The dirty water channel will be created by the formation of the earthworks and will direct the water to a grass/vegetation area acting as a filter strip or to a DEB.

The runoff from the steepest section of earthworks, other than the banks at the entrance, are to be controlled with silt fences which have a triangular channel section with 1:50 side slopes and a longitudinal gradient of 1:12.

Calculations (see Enclosure 2) show that the runoff from the entrance construction site will be 8 ls^{-1} with a velocity of 0.45 ms^{-1} and a maximum flow depth of 17mm.

2.3.3. Stabilised Construction Entrance

A stabilised construction entrance shall be installed at the existing entrance of the gravel access road that connects Teitei Drive to Raetihi Ohakune Road. It shall consist of 150mm thick layer of 50-75mm washed aggregate placed on a filter cloth base which will be a minimum of 10m long and 4m wide as per the HRCs Guidelines.

2.3.4. Silt Fence

Super silt fences are to be constructed along the toes of banks as indicated on drawing 220528-213 to control sediment laden runoff from earthworks banks as shown on the drawings.

Stockpile locations shall have silt fences located on the down stream side of each pile.

2.3.5. Stabilisation - Topsoil, Grass Seeding and Straw Mulch

Following the completion of earthworks, the entrance way will be covered with metal to form a two-way vehicle access site for future development. The sacrificial metal will prevent erosion, dust control and minimise runoff of sediment. A fenced public walkway shall be constructed as well to replace the existing pedestrian connection to Snowmass Drive.

The remainer of the site will be topsoiled, sown with grass seed (either traditional or hydrosoil) and where necessary straw mulch shall be placed to provide immediate stabilisation of all exposed surfaces and batters. All controls shall remain in place until stabilisation occurs and approval is granted from HRC to remove controls. Controls such as bunds, silt fence and the DEB may be removed just prior to stabilisation provided fine weather and stabilisation occurs immediately (same day) following removal of controls.

2.4. Sediment Control

2.4.1. Filter Strips

Grass/vegetation acting as filter strips, as per Auckland Regional Councils Tp10 Chapter 9 clause 4.2, shall be used for sediment control. This is due to the small size of the earthwork's areas. The justification for their use is small flows and low velocities generated by the earthwork's areas. Dense grass/vegetation greater than 50mm high should be more than sufficient to control sediment and supporting calculations can be found in Appendix 2 showing that a filter strip, a minimum of 1m wide and 7m long, is more than sufficient to filter and retain flows from the proposed sites.

2.4.2. Decanting Earth Bund (DEB)

If required, a DEB is proposed to control the catchment at the entrance of the site as the maximum catchment size is below 0.3ha, shown on drawing 220528-207. It is expected that no DEB will be required as the earthworks are from small sites and the discharge velocity from the different sites will be less than 0.5 ms^{-1} and therefore is less than the critical erosion velocity to cause anything more than minor erosion.

If the DEB is required, the discharge will be to the grass area south of the proposed entrance site. The DEB is required to be 20m^3 per 1000m^2 of catchment area contributing to the DEB. Given the contributing area is approximately 0.1 ha and the volume of the DEB is to be 20m^3, with approximate dimensions of 4.0m x 10.0m x 0.5m. If required, the final dimensions can be submitted with the final E&CMP.

2.4.3. Borrow Area

The borrow area is most likely to not need a sediment control as the borrow area once topsoil has been stripped, will form a pit or depression. In the borrow area there is a significant stretch of existing grassed area between the entrance construction and borrow area which will act as a filter strip as above. Monitoring shall be observed to indicate whether bunds or silt fences may be required for the borrow area.

2.4.4. Haul Road

There is likely to be a maximum of two trucks operating between the entrance construction area and the borrow with a maximum of 75 truck movements, it is therefore highly unlikely that there will be any damage to the existing vegetation in the short construction period.

2.5. Flocculation Management Plan

Although highly unlikely due to relatively small sites and flat slopes, flocculation of the DEB (if required) will be implemented if determined necessary following soil bench testing and development of a Flocculation Management Plan. This bench testing and subsequent management plan preparation (if necessary) will be completed before implementation of flocculation management for this site is required. This Flocculation Management Plan will describe the bench testing that has been performed on the sediment from this site, as well as the procedures to follow for flocculation of the DEB if required. All equipment necessary to implement flocculation of the DEB is to be kept on site at all times, ready for deployment if/when required.

3. SEDIMENT CONTROL AS-BUILTS

All sediment controls are to be certified as being constructed in accordance with this Plan (once approved). Template As-Built certificates are attached for reference.

4. CONSTRUCTION PROGRAMME

Construction works are anticipated to commence on site once Consent is approved, and a contractor has been engaged by the Client. The timeframe for completion of earthworks will be somewhat dependant on the nature of the soils encountered and the prevailing weather, although it is expected that all bulk earthworks will be completed within one to two weeks of commencement.

Weather patterns for the forthcoming construction period will be reviewed and any extraordinary precautionary measures taken in the event of a predicted extreme weather event. In any emergency situation resulting from extreme events occurring which exceed the design event for each control measure, both the Contractor and the Engineer will be on 24hour call-out should emergency works be required. Machinery will be available on site at all times to be used in an emergency situation to mitigate effects of runoff on the site and/or neighbouring properties.

<u>Stages of Works</u>

1. Pre-start Site Meeting Prior to earthworks commencing, an on-site meeting will be held between the contractor, Ruapehu District Council and Horizons Regional Council staff to discuss the approved Earthworks and Construction Management Plan and ensure all measures are in place.

2. The earth bunds, the temporary bypass culvert and super silt fences shall be placed:

    a. Carefully clear the area of the drain leaving the vegetation on the ground for erosion protection. Install the temporary 160mm diameter culvert. This to be done parallel to the existing drain and 100mm diameter culvert, as shown on drawing 220528-213. An earth bund will be constructed in a manner that all water is redirected to enter the temporary drain with allowance for a freeboard.

3. Site clearance and stripping of vegetation.

4. Construction of stormwater culvert:

    a. Once the drain is isolated from the earthworks, the channel will start from the outlet towards the inlet, while maintaining both ends undisturbed to maintain a natural barrier to prevent the channel flowing through works.
    b. While works in the concrete channel are complete, including the fill inside the culvert, special attention will be taken in accordance with a Fish Management Plan (if required by consent) to be completed including impact minimisation and supervision requirements.
    c. This methodology will be discussed at the pre-start meeting and will be part of the updated CMP.

5. Installation of super silt fences and DEB (if required).

6. Earthworks cut to fill and temporary works.

7. Site rehabilitation and stabilisation of all surfaces, grass areas and those temporary surfaces as sacrificial metal to future proof the site.

8. Controls will be dis-established with the approval of HRC. Removal of the Temporary works and ESC.

5. DUST CONTROL

Dust nuisance is a potential effect when vegetation is removed, and the bare soil is exposed to the elements. Windy conditions or the movements of heavy machinery can then generate dust. In order to suppress dust a water cart will be available on site when required.

Upon completion of the earthworks, it is envisaged that the entire site will be covered in grass, except for stabilised entrance.

6. NOISE CONTROL

Please refer to the Noise Management Assessment by Marshall Acoustic in Appendix 3.

7. CONSTRUCTION TIMETABLE

Construction works are anticipated to commence on site in April 2024. All sediment controls will be constructed prior to any earthworks commencing on site. The timeframe for completion of earthworks will be around 2 weeks depending on the prevailing weather.

7.1. Construction Signs

Prior to the commencement of works on site, including the implementation of the final, resource consented E&CMP, the contractor shall include the information below as part of the site signage adjacent to entrance of site works, and maintain them throughout the period of works. The signs will display the following information:

- The consent holder
- The main site contractor
- A 24-hour contact telephone number and the name and position of the appointed person
- A clear explanation that the contact telephone number is for the purpose of receiving comment, complaints, and information from the site works.

Signs shall remain in place for the duration of the works and details updated within course of works.

7.2. Site Access

Due to the limited width of the project site, primary access to the site for construction equipment will be obtained off Teitei Drive via the existing gravel access road track west of this entrance. This is to minimise disruption to the existing road with heavy vehicles and also due to the location of the drain traversing the area of works from east to west. All equipment will be safely stored/parked inland on the site beyond the construction area.

7.3. Hours of Work

Hours of work for heavy machinery shall be limited to:

- Weekdays ..... 7.00am to 7.00pm
- Saturdays ..... 7.30am to 3.00pm
- Sundays and Public Holidays ..... Nil.

Work outside these hours will be permitted for emergencies only.

The unloading and loading of material onto and from the site will need to take place during hours of works as specified above. A traffic management plan prepared by Traffic Management consultants is provided as part of the application.

All heavy machinery shall be well maintained and if required fitted with appropriate standard mufflers and silencers to meet noise levels as per the Noise Management Assessment and any further conditions of the Land Use Consent.

7.4. Contractor Programme of Works

This will be provided following granted Resource Consent and prior Earthworks commencing.

8. MAINTENANCE, MONITORING AND REPORTING PROCEDURES

Weekly formal site meetings will be held between the Engineer, Principal and Contractor at which time the condition of all Erosion and Sediment Control measures will be monitored and any maintenance requirements identified. Representatives of both HRC and RDC are welcome to attend the site meetings to review the sediment controls at the same time. Minutes will be taken at each site meeting for reporting purposes. In between site meetings, the Contractor will be responsible for maintaining all measures in good operational condition.

At the site meetings, predicted weather patterns for the forthcoming week will be reviewed and any extraordinary precautionary measures taken in the event of a predicted extreme weather event. In any emergency situation resulting from extreme events occurring which exceed the design event for each control measure, both the Contractor and the Engineer will be on 24hour call-out should emergency works be required. Machinery will be always available on site to be used in an emergency to mitigate effects of runoff on the site and/or neighbouring properties.

9. ARCHAEOLOGICAL DISCOVERIES

If earthworks unearth any Waahi Tapu or archaeological sites, work in the affected area will cease immediately and the appropriate authority will be contacted. The appropriate Tangata Whenua or the Historic Places Trust or the Police will be contacted as required. Subject to any legal requirements of the Police, Heritage New Zealand Pouhere Taonga Act 2014, Antiquities Act 1975 and any other governing legislation, the following protocol shall apply and follow as part of this Earthworks Management Plan for each Stage:

a) Where, during earthworks, any archaeological site, artefact or human remains are accidentally discovered or are suspected to have been discovered:

   i. All works in the vicinity shall cease immediately.

   In cases other than suspected human remains:

   ii. The contractor shall immediately secure the area and advise the consent holder and the Heritage New Zealand of the occurrence.

   iii. The consent holder must consult with tangata whenua and the Heritage New Zealand to determine what further actions are appropriate to safeguard the site or its contents before work may recommence.

Where human remains are suspected:

iv. The contractor shall immediately secure the area in a way which ensures human remains are not further disturbed. The contractor shall advise the consent holder of the steps to take without delay.

v. The consent holder shall notify the police, tangata whenua and Heritage New Zealand of the suspected human remains as soon as practically possible after the remains have been disturbed.

vi. Earthmoving operations in the affected area will remain halted until the police, tangata whenua and the Heritage New Zealand have given approval for earthmoving operations to recommence.

b) Should a waahi tapu be uncovered during earthworks or other construction work, work in the affected area shall stop immediately and the consent holder shall consult with tangata whenua to determine what further actions are appropriate to safeguard the site or its contents before work recommences.

Work will not resume until the appropriate authority has provided the necessary approval.

10. REVIEW PROCEDURES

A copy of the consent required Earthworks and Construction Management Plans shall be kept on site at all times. Due to a change in construction methodology or as a result of experience on site, should any amendments be required to the Plan then a new Revision will be issued to all affected parties ASAP. All changes must be confirmed in writing by the consent holder and the HRC (acting in a technical capacity) prior to implementation of the necessary changes, where possible. For example, alterations required during an emergency event situation may be made without requiring approval in writing but must be followed up by a revised document approved by all parties ASAP.

11. CONTACT DETAILS

The personnel responsible for the design and implementation of this CMP are:

Design – Ray Kilgour of Cheal Consultants
Ph (021) 506 008
Email 9(2)(a)
Implementation, operation and maintenance. TBC

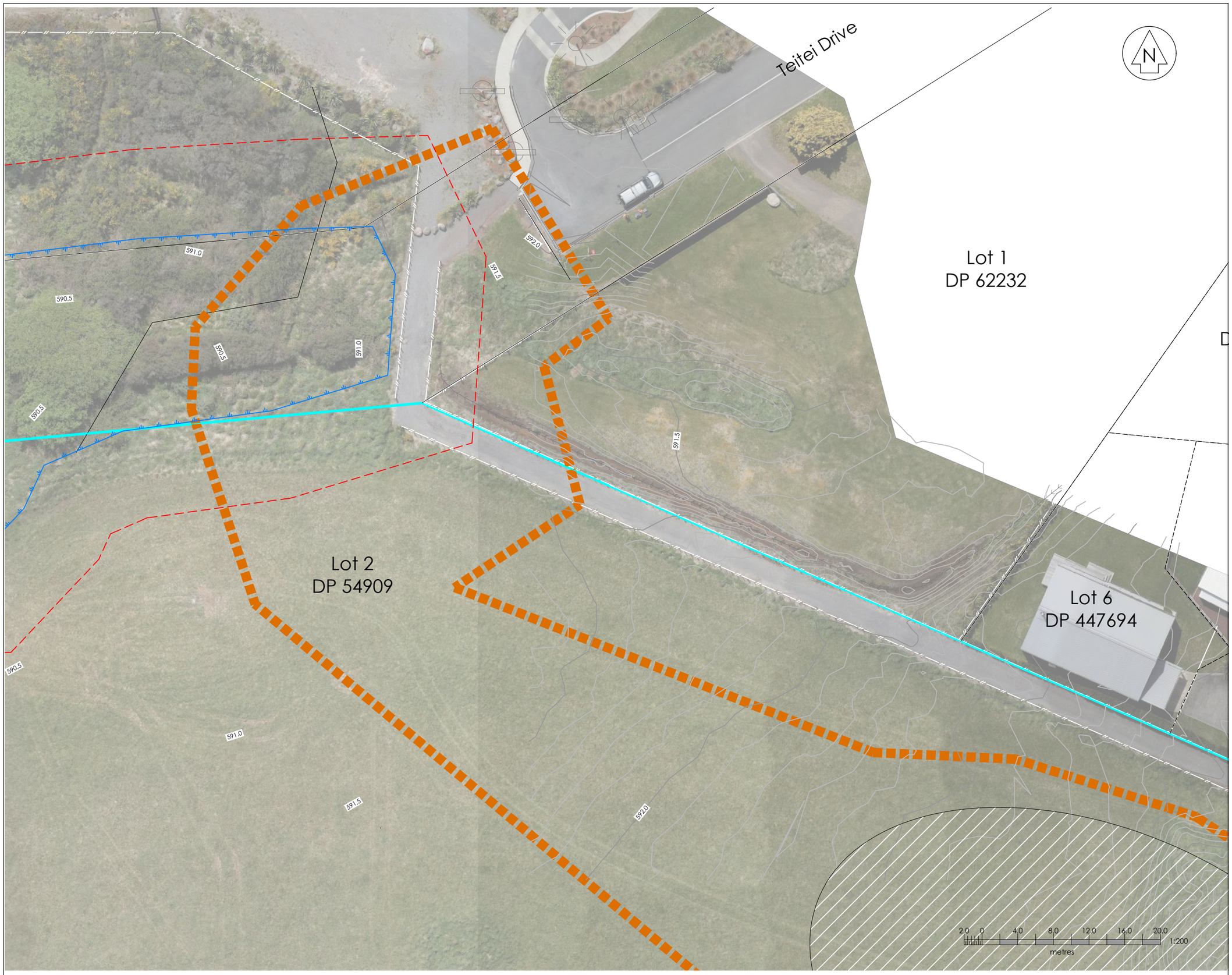
Consent Holder –
Ph:
Email:

Appendix 1

Cheal Consultants
Earthworks Plans
220528-205 to 208

Erosion and Sediment
Control Plan 220528-213

Entrance Stormwater
Proposed Layout, Long
Section & Cross Section
220528-606



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4. Contractor shall install and maintain all stormwater, dust and erosion control during construction as per earthworks management plan and the Greater Wellington Regional Council "Erosion and Sediment Control Guideline for Land Disturbing Activities in the Wellington Region".
5. All disturbed areas shall be re-topsoiled and grassed within 30 days upon completion of contract works.
   Dust control shall be maintained until grassed areas have become established.

Legend:

- Extent of Works
- Assessed Wetland Extent
- Assessed Wetland Buffer
- Existing Fence
- Existing Drain
- Site Boundary
- Existing Lot Boundaries

Rev	Date	Amendment	By	Chk	App
A	23/02/24	Resource Consent	JZL	RFK	LU

Project Title

Kainga Ora
Homes and Communities
6 Teitei Drive, Ohakune

Drawing Title

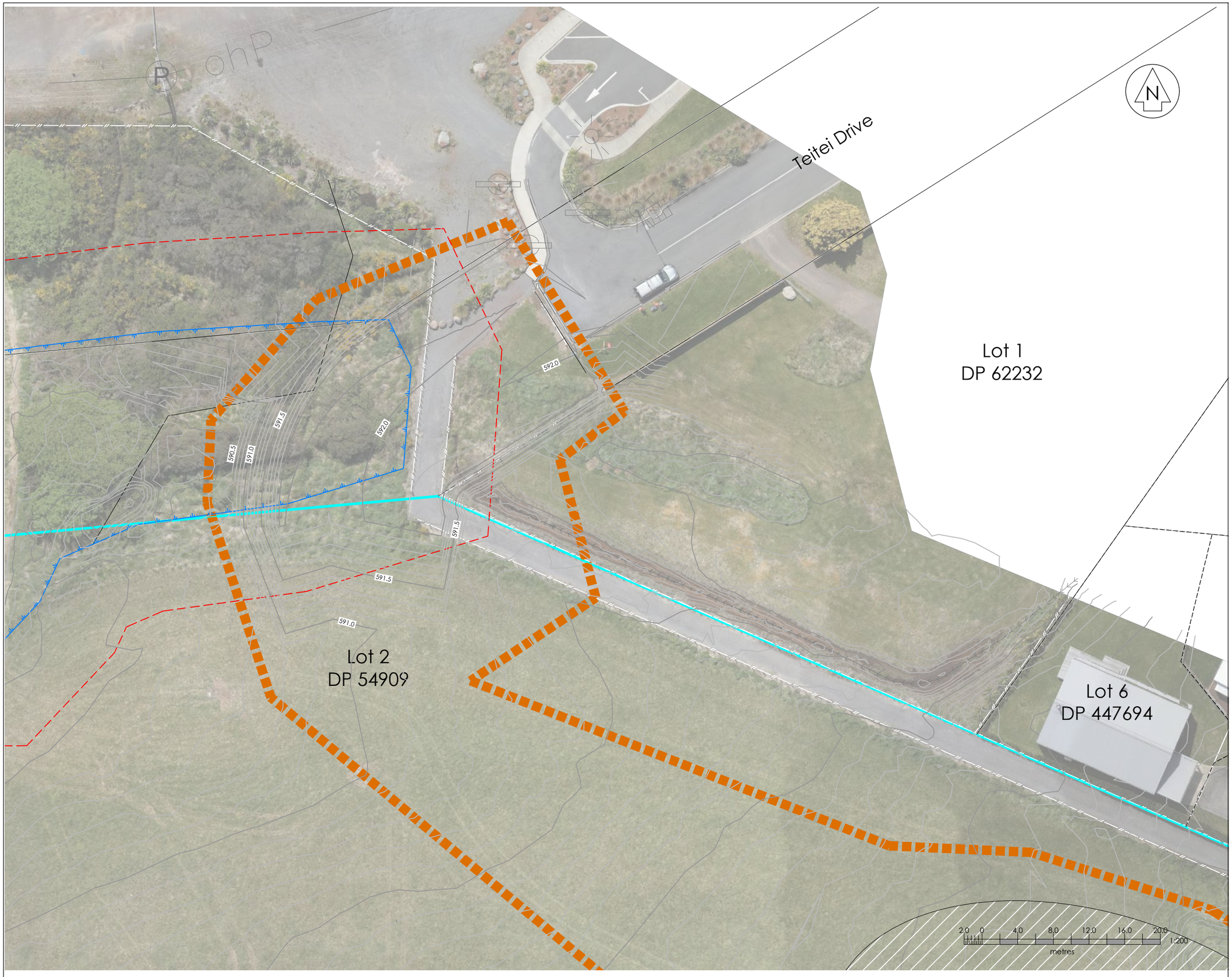
Entrance Earthworks
Existing Contour Plan

Surveyed			
Designed	R.Kilgour	05/23	RFK
Drawn	J.Li	23/02/24	JZL
Checked	R.Kilgour	23/02/24	RFK
Approved	L.Uriate	23/02/24	LU

Status **RESOURCE CONSENT**

Scale A1 1:200 | A1
A3 1:400

Drawing Number 220528-205 | Rev A



cheal

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   Dust control shall be maintained until grassed areas have become established.

Legend:

- Extent of Works
- Assessed Wetland Extent
- Assessed Wetland Buffer
- Existing Fence
- Existing Drain
- Site Boundary
- Existing Lot Boundaries

Rev	Date	Amendment	By	Chk	App
A	23/02/24	Resource Consent	JZL	RFK	LU

Project Title

Kainga Ora
Homes and Communities
6 Teitei Drive, Ohakune

Drawing Title

Entrance Earthworks
Proposed Contour Plan

Surveyed			
Designed	R.Kilgour	05/23	RFK
Drawn	J.Li	23/02/24	JZL
Checked	R.Kilgour	23/02/24	RFK
Approved	L.Uriate	23/02/24	LU

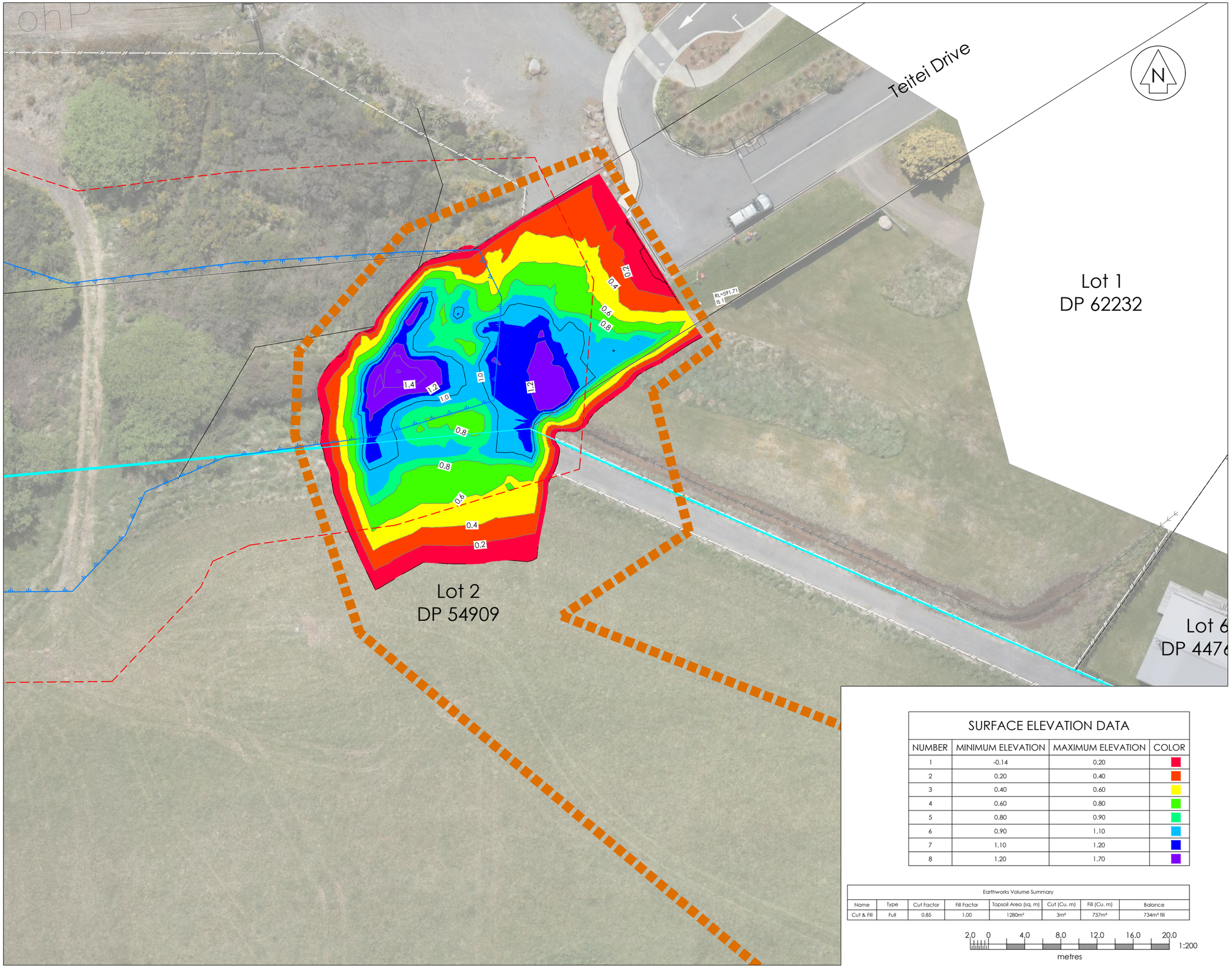
Status **RESOURCE CONSENT**

Scale A1 1:200
A3 1:400

A1

Drawing Number 220528-206

Rev A



SURFACE ELEVATION DATA

NUMBER	MINIMUM ELEVATION	MAXIMUM ELEVATION	COLOR
1	-0.14	0.20	
2	0.20	0.40	
3	0.40	0.60	
4	0.60	0.80	
5	0.80	0.90	
6	0.90	1.10	
7	1.10	1.20	
8	1.20	1.70	

Earthworks Volume Summary

Name	Type	Cut Factor	Fill Factor	Topsoil Area (sq. m)	Cut (Cu. m)	Fill (Cu. m)	Balance
Cut & Fill	Full	0.85	1.00	1280m²	3m³	737m³	734m³ fill

2.0 0 4.0 8.0 12.0 16.0 20.0 1:200
metres

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www.cheal.co.nz

NOTES:

1. All work shall be done in accordance with NZS 4404:2010.
2. Reduced Levels are in terms of NZ Vertical Datum 2016
   Level Origin : EBC7 OIT IV DP 44819
   RL : 595.70
3. Contractor to locate and identify existing utility location and depths prior to construction. The project engineer shall be informed of any discrepancies to the information depicted on these plans immediately for revised drawings.
4. Contractor shall install and maintain all stormwater, dust and erosion control during construction as per earthworks management plan and the Greater Wellington Regional Council "Erosion and Sediment Control Guideline for Land Disturbing Activities in the Wellington Region".
5. All disturbed areas shall be re-topsoiled and grassed within 30 days upon completion of contract works.
   Dust control shall be maintained until grassed areas have become established.

Legend:

- Extent of Works
- Assessed Wetland Extent
- Assessed Wetland Buffer
- Existing Fence
- Existing Drain
- Site Boundary
- Existing Lot Boundaries

Rev	Date	Amendment	By	Chk	App
A	23/02/24	Resource Consent	JZL	RFK	LU

Project Title
Kainga Ora
Homes and Communities
6 Teitei Drive, Ohakune

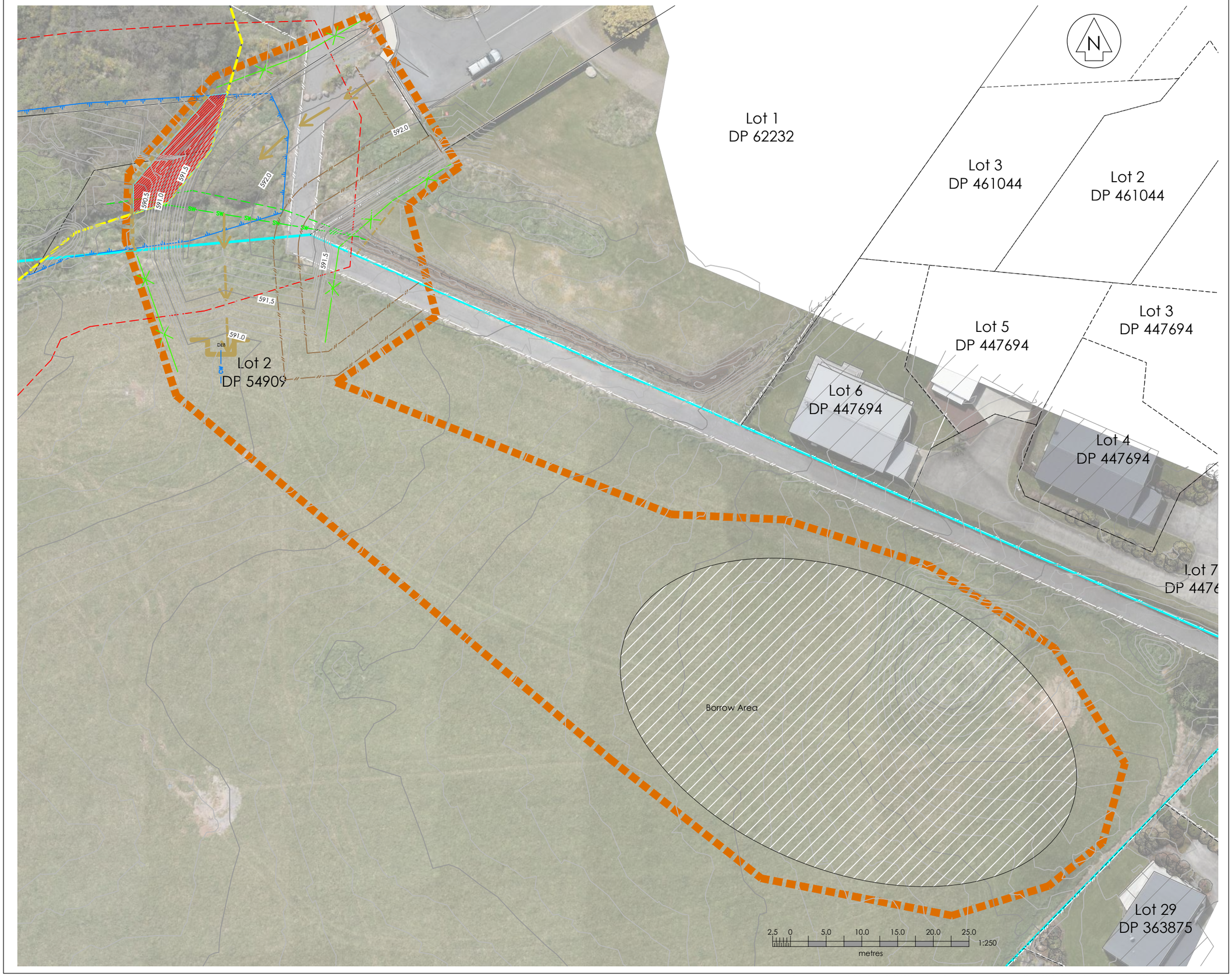
Drawing Title
Entrance Earthworks
Proposed Cut & Fill Plan

Surveyed			
Designed	R.Kilgour	05/23	RfK
Drawn	J.Li	23/02/24	JZL
Checked	R.Kilgour	23/02/24	RFK
Approved	L.Uriate	23/02/24	LU

Status **RESOURCE CONSENT**

Scale A1 1:200 | A1
A3 1:400

Drawing Number 220528-207 | Rev A



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NOTES:

1. All work shall be done in accordance with NZS 4404:2010.
2. Reduced Levels are in terms of NZ Vertical Datum 2016
   Level Origin : EBC7 OIT IV DP 44819
   RL : 595.70
   Contour Interval = Major 0.5m
   Minor 0.1m
3. Contractor to locate and identify existing utility location and depths prior to construction. The project engineer shall be informed of any discrepancies to the information depicted on these plans immediately for revised drawings.
4. Contractor shall install and maintain all stormwater, dust and erosion control during construction as per earthworks management plan and the Greater Wellington Regional Council "Erosion and Sediment Control Guideline for Land Disturbing Activities in the Wellington Region".
5. All disturbed areas shall be re-topsoiled and grassed within 30 days upon completion of contract works.
   Dust control shall be maintained until grassed areas have become established.

Earthworks Legend: (EW)

- Extent of Works
- Dirty Water Flow
- Diversion Bund
- Silt Fence/Super Silt Fence
- DEB — Decanting Earth Bund
- SW SW — Proposed Stormwater Culvert
- Existing Stormwater Drain
- Extent of Assessed Wetland
- 10 m Wetland Buffer Zone

Rev	Date	Amendment	By	Chk	App
A	23/02/24	Resource Consent	JZL	RFK	LU

Project Title

Kainga Ora
Homes and Communities
6 Teitei Drive, Ohakune

Drawing Title

Entrance Earthworks
Earthworks Extent
and Borrow Area

Surveyed			
Designed	R.Kilgour	05/23	RFK
Drawn	J.Li	23/02/24	JL
Checked	R.Kigour	23/02/24	RFK
Approved	L.Uriate	23/02/24	LU

Status **RESOURCE CONSENT**

Scale A1 1:250 | A1
A3 1:500

Drawing Number 220528-208 | Rev A

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NOTES:

1. All work shall be done in accordance with NZS 4404:2010.
2. Reduced Levels are in terms of NZ Vertical Datum 2016
   Level Origin : EBC7 OIT IV DP 44819
   RL : 595.70
   Contour Interval = Major 0.5m
   Minor 0.1m
3. Contractor to locate and identify existing utility location and depths prior to construction. The project engineer shall be informed of any discrepancies to the information depicted on these plans immediately for revised drawings.
4. Contractor shall install and maintain all stormwater, dust and erosion control during construction as per earthworks management plan and the Greater Wellington Regional Council "Erosion and Sediment Control Guideline for Land Disturbing Activities in the Wellington Region".
5. All disturbed areas shall be re-topsoiled and grassed within 30 days upon completion of contract works.
   Dust control shall be maintained until grassed areas have become established.

Earthworks Legend: (EW)

- Extent of Works
- Dirty Water Flow
- Diversion Bund
- Silt fence/Super Silt Fence
- DEB — Decanting Earth Bund
- SW SW — Proposed Stormwater Culvert
- Existing Stormwater Drain
- Extent of Assessed Wetland
- 10 m Wetland Buffer Zone

Rev	Date	Amendment	By	Chk	App
A	23/02/24	Resource Consent	JZL	RFK	LU

Project Title

Kainga Ora
Homes and Communities
6 Teitei Drive, Ohakune

Drawing Title

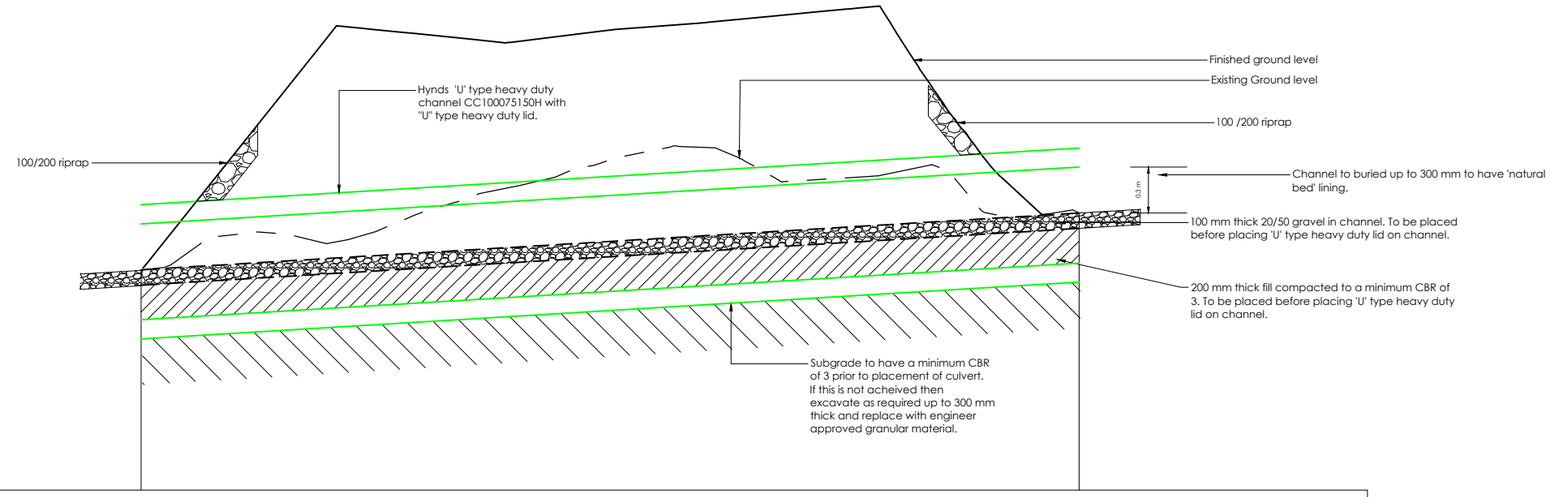
Entrance Earthworks
Proposed Sediment & Erosion Control Plan

Surveyed			
Designed	R.Kilgour	05/23	RFK
Drawn	J.Li	23/02/24	JZL
Checked	R.Kilgour	23/02/24	RFK
Approved	L.Uriate	23/02/24	LU

Status **RESOURCE CONSENT**

Scale A1 1:200 | A1
A3 1:400

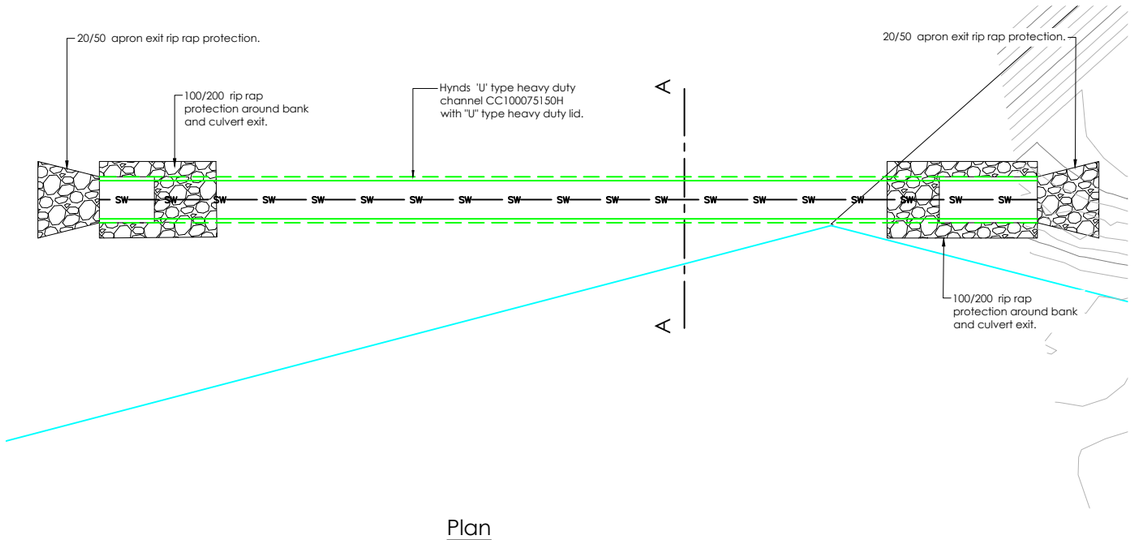
Drawing Number 220528-213 | Rev A



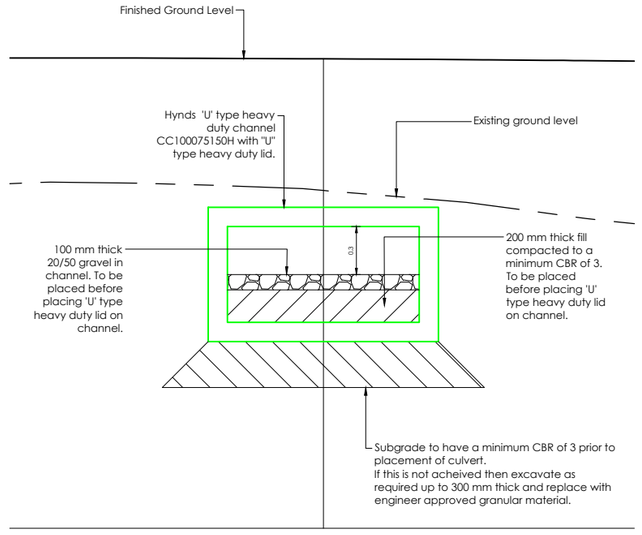
Datum RL 589.00

Depth to Invert			
Invert Level	590.11		590.48
Lid Level			
Chainage			
Pipe Size & Gradient		30.59m 'U' Type Channel 600 H x 1000 W 1.21%	

Long Section
Scale H1:100
V 1:500



Plan
Scale 1:100



Cross Section A
Scale 1:20

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NOTES:

1. All work shall be done in accordance with the NZS 4404:2010.
2. Reduced Levels are in terms of NZ Vertical Datum 2016
   Level Origin : EBC7 OIT IV DP 44819
   RL : 595.70
3. Contractor to locate and identify existing utility location and depths prior to construction. The project engineer shall be informed of any discrepancies to the information depicted on these plans immediately for revised drawings.
4. Contractor shall install and maintain all stormwater, dust and erosion control during construction as per earthworks management plan and the Greater Wellington Regional Council Erosion and Sediment Control - "Guidelines for soil disturbing activities".
5. All disturbed areas shall be re-topsoiled and grassed within 30 days upon completion of contract works.
   Dust control shall be maintained until grassed areas have become established.
6. All manholes to have scruffy dome lids.

Rev	Date	Amendment	By	Chk	App
A	23/02/24	Resource Consent	JZL	RFK	LU

Project Title

Kainga Ora
Homes and Communities
6 Teitei Drive, Ohakune

Drawing Title

Entrance Stormwater
Proposed Layout
Long Section & Cross Section

Surveyed			
Designed	R.Kilgour	05/23	RFK
Drawn	J.Li	23/02/24	JZL
Checked	R.Kilgour	23/02/24	RFK
Approved	L.Uriate	23/02/24	LU

Status **RESOURCE CONSENT**

Scale A1 As Shown | A1
A3 As Shown

Drawing Number 220528-606 | Rev A

Appendix 2

Calculations for Erosion & Sediment Control Design

Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, Feb 8 2024

220528 Kainga Ora Ohakune Entrance Earthworks dirty water channel

Triangular

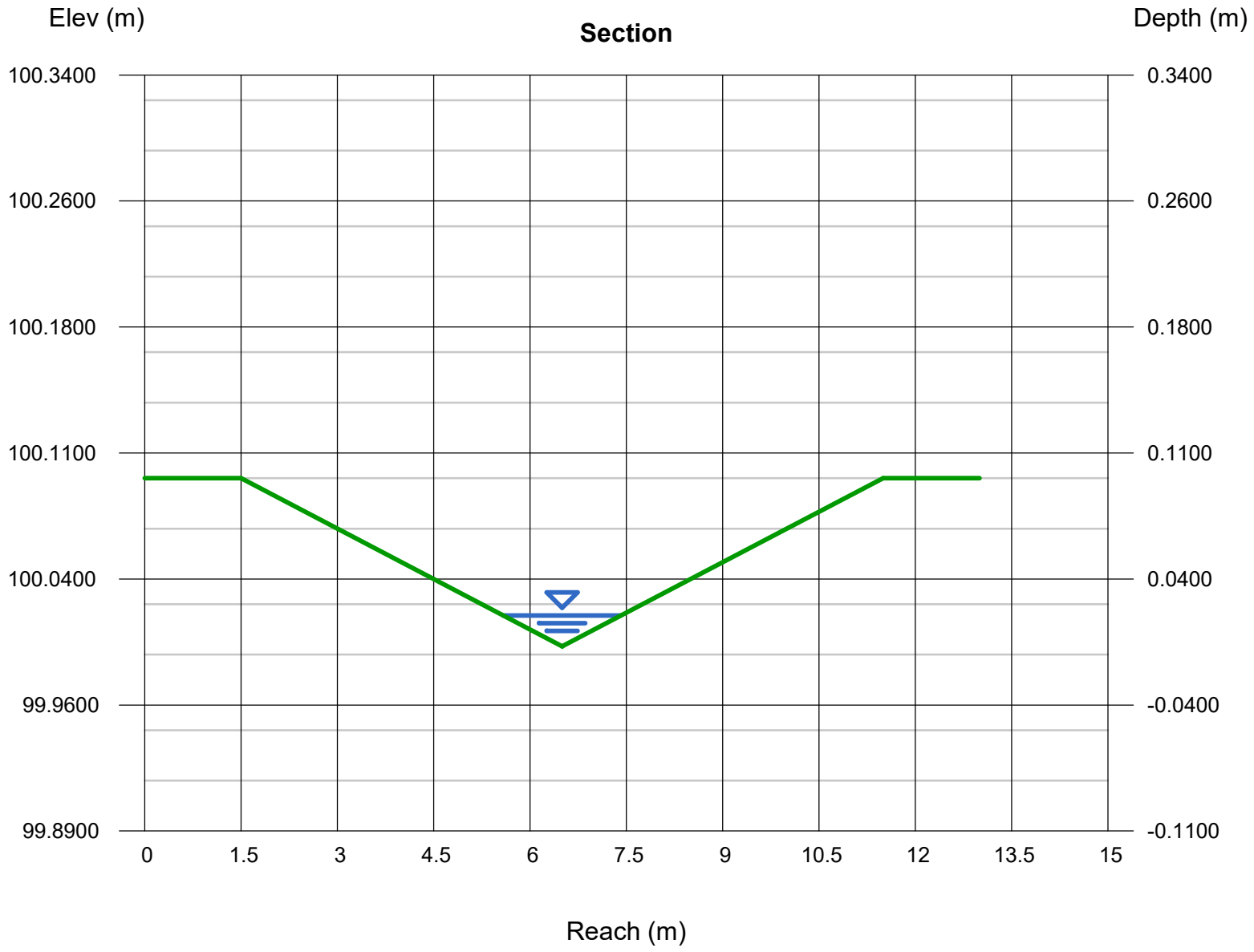
Side Slopes (z:1)	= 50.0000, 50.0000
Total Depth (m)	= 0.1000
Invert Elev (m)	= 100.0000
Slope (%)	= 8.3000
N-Value	= 0.020

Calculations

Compute by:	Known Q
Known Q (cms)	= 0.0080

Highlighted

Depth (m)	= 0.0183
Q (cms)	= 0.008
Area (sqm)	= 0.0167
Velocity (m/s)	= 0.4784
Wetted Perim (m)	= 1.8292
Crit Depth, Yc (m)	= 0.0244
Top Width (m)	= 1.8288
EGL (m)	= 0.0300



Project	Kainga Ora Home and 6 Teitei Drive, Ohakune	Date: Job Number	13-Feb-24 220528

On Site detention system — Total Area: 1025

Earthworks

Catchment Area	Description	C (runoff coeff)	Area m²	CA
Roof	Impervious	0.95	0	0
Gravel	Impervious	0.6	1025	615
Concrete	Impervious	0.9	0	0
Grass	Pervious	0.3	0	0
		TOTAL	**1025**	**615**

Sizing Discharge Outlet Pipe

Total CA	615	
n (surface value)	0.035	
L (flow length)=	60	m
s (slope)=	8.30	%

t (Time of Conc.) = 10 minutes

Using Historical HiRDs Data

ARI *10* years

I (intensity)= 49.2 mm/hour

Q (runoff) **=** **8.41** l/s excl climate change

Project	Kainga Ora Ohakune				
Job No	220528				
Swale		**Catchment**		**Rainfall**	

Worksheet Filter Strip Tmt

By	RK	Date	11/11/2019
Checked		Date	

1. Runoff Curve Number (CN) and Initial Abstraction (Ia)

Inputs =

Soil name and classification	Cover description (cover type, treatment, and hydrologic condition)	Curve Number CN		Area (ha)	CN x area
Group A	Pasture/grassed/vegetated areas	39		0.0000	0.0
	Other Impervious surfaces	98		0.1025	10.0
		Total		0.1025	10.0
	CN (weighted) = total product/total area =				98.0
	Ia (weighted) = (5xperv area)/total area =				0.00

2. Time of Concentration

		Data		
Channelisation factor	C =	0.80	(from TP 108 Table 4.2)	
Catchment length	L =	60	m (along rd drainage path)	Available swale length 50 m
Catchment length	L =	0.004	km (along drainage path)	
Catchment slope	Sc =	0.0830	m/m	
Runoff factor, (CN/200-CN) =		**0.961**		
t_c =	$0.14xCxL^{0.66x}(CN/(200-CN))^{-0.55}xSc^{-0.30}$ =	0.0063	hrs (calculated)	
SCS Lag for HEC-HMS, $t_p = 2/3\ t_c$ =		0.0042	hrs	

3. Graphical Peak Flow Rate

			Data	
Catchment Area	A =		0.0010	km^2 (from 1 above)
Runoff Curve Number	CN =		98.000	(from 1 above)
Initial Abstraction	I_a =		0.00	mm (from 1 above)
Time of Concentration	t_c=		0.17	hrs; from 2; increase to min value of 0.17h if needed
Storage	S=	((1000/CN)-10)x25.4	5.2	mm

Rainfall data

ARI (yr event)		Units	2	1/3 of 2yr	5	10	50	100	34.5
24 hour rainfall depth	P_{24}	mm	**10.3**	**3.4**		**17.3**			**34.5**

Filter strip design

The rainfall has been multiplied by 1.5 as per WWDG 21.5.1

Data	Area (km^2)	CN	Ia (mm)	S (mm)
Perv	0.00000	39.0	5.0	397.3
Imperv	0.00103	98.0	0.0	5.2

1. Runoff rate

a	P24 (1/3 2yr storm)		3.4	mm	
b-e	Peak rainfall rate		2.3	mm/h	16.2 x P24/24h - based on 10min time of concentration - conservative
		Pervious	Imp		
	S	397.3	5.2	mm	From above
	Ia	5.0	0.0	mm	From above
	runoff/rain	-0.017	0.436		(P24 - 2Ia)*(P24-2Ia+4S)/(P24-2Ia+2S)^2
	Qp	0.0000	0.0003	m^3/s	Peak rainfall rate(mm/h) x runoff/rain x area (km^2)/3.6 = m^3/s
f	Qp (comb)	0.0003		m^3/s	Perv + imperv Qs
g	Qp (atten)	0.0003		m^3/s	0.89 x Qp (comb)

Design Steps

1	Vegetation	Grass, 50-150mm tall		
	Design depth of flow (d)	25	mm	recommended
	Filter strip slope (s)	0.0100	m/m	Filter strip slope - this may differ from catchment slope above
2	Mannings n	1.0875		For 150mm grass and d>60, n = 0.013*d^-1.2/(0.75+25*s), d in m
		0.5169		For 150mm grass and d<60, n = 0.153*d^-0.33/(0.75+25*s), d in m
		0.7529		For 50mm grass and d>75, n = 0.009*d^-1.2/(0.75+25*s), d in m
		0.5175		For 50mm grass and d<75, n = (0.54-228*d^2.5)/(0.75+25*s), d in m
	Applicable n	0.1000		Select from above, or see note 1
3a	Filter strip shape	rectangular		
3b	No of strips	1		
	Q/strip =	0.0003	m^3/s	
4	Strip dimensions			
	Strip minimum width, T	0.12	m	(Q/strip*n)/(d^1.67*s^0.5)
	Selected width	1.00	m	Increased from min to reduce 10yr vel by (only if reqd)
5	Area, A (per strip)	0.03	m^2	T*d
6	Flow velocity	0.010	m/s	OK if <0.4m/s? OK
7	Required length	5.53	m	To achieve 9 min minimum hydraulic residence time'

Stability check - 10yr storm

a	P24 (10yr storm)		17.3	mm	
b-e	Peak rainfall rate		11.7	mm/h	16.2 x P24/24h
		Pervious	Impervious		
	S	397.3	5.2	mm	From above
	Ia	5.0	0.0	mm	From above
	runoff/rain	0.018	0.860		(P24 - 2Ia)*(P24-2Ia+4S)/(P24-2Ia+2S)^2
	Qp	0.000	0.003	m^3/s	Peak rainfall rate(mm/h) x runoff/rain x area (km^2)/3.6 = m^3/s, note 1
f	Qp (comb)	0.003		m^3/s	Perv + imperv Qs
g	Qp (atten)	0.003		m^3/s	0.89 x Qp (comb)
	Flow vel.	0.10		m/s	OK if < 1.5m/s?

Notes:

1. For filter strip, appropriate n values may be 0.035 for grass/pasture; 0.050 for light brush/weeds; 0.070 for dense brush; 0.10 for dense trees
2. Filter strips generally applicable to longitudinal slopes of 1-5% (max slope of contributing catchment = 5% unless energy dissipation provided); max water depth above vegetation of 25mm; max lateral slope of 2% (refer Table 9-1).
2. For filter strips, max velocity <0.4m/s while minimum length based on achieving 9min minimum hydraulic residence time.

Appendix 3

Noise Management Assessment

MARSHALL DAY Acoustics

KĀINGA ORA OHAKUNE CONSTRUCTION NOISE AND VIBRATION ASSESSMENT

Rp 001 20240008 | 7 February 2024

Level 4, 24 Garden Place
PO Box 19039
Hamilton 3244
T: +64 7 834 3022
www.marshallday.com

Project: **KĀINGA ORA OHAKUNE**

Prepared for: **Cheal Consultants**
Level 1
533 Anglesea Street
Hamilton 3204

Attention: **Ray Kilgour**

Report No.: **Rp 001 20240008**

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Document Control

Status:	Rev:	Comments	Date:	Author:	Reviewer:
DRAFT	00	-	7 Feb. 2024	9(2)(a)	

Cover Photo: Creative Agency 514-806-1644

TABLE OF CONTENTS

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1.0 REPORT SUMMARY AND CONCLUSIONS

Our assessment shows that earthworks from the proposed Kāinga Ora development (the Project) will exceed the relevant construction noise limit and marginally comply with the recommended vibration amenity limit at the closest receivers. We recommend that construction noise and vibration effects are mitigated and managed via a Construction Noise and Vibration Management Plan (CNVMP). With effective management, construction noise and vibration effects from this short-term work can be acceptably controlled.

Marshall Day Acoustics has been engaged by Cheal Consultants to assess construction noise and vibration related to the proposed Kāinga Ora subdivision development, located on Teitei Drive, Ohakune. This is in response to a s92 request from Ruapehu District Council (Council) relating to an application for subdivision and land use consent.

We calculate that typical daytime construction noise will exceed the relevant Ruapehu District Plan (RDP) limits at the closest receiver by up to 6 dB.

We calculate that construction vibration will marginally comply with the recommended amenity limit at the closest receiver during the operation of a vibratory sheep foot roller.

We recommend that construction activities are managed via a CNVMP. With effective management in place, the effects will be acceptably controlled.

The report includes proposed consent conditions.

A glossary of terminology is provided in Appendix A.

2.0 PROJECT SITE AND DESCRIPTION

2.1 Site description

The Project is a subdivision development located at 6 Teitei Drive, Ohakune. The site is bounded by residential receivers on the northern, eastern and southern boundaries, and by an Active Reserve zone to the northwest.

Figure 1 shows the site location and nearby receivers. Figure 2 shows the zoning of the site and surroundings. A site plan showing the extent of earthworks is attached in Appendix B.

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Figure 1: Site location and surrounding receivers

A list of sensitive receivers within 50m of the Project is included in Table 1. If compliance is shown at these receivers, then it can be inferred with confidence for all other receivers not included in the assessment.

Table 1: Sensitive receivers within 50m

Receiver	Address/location	Zoning / Usage	Min. distance to works (m)
R1	1 Kanuka Way	Residential / dwelling	31
R2	4 Kanuka Way	Residential / dwelling	18
R3	5 Kanuka Way	Residential / dwelling	23
R4	6 Kanuka Way	Residential / dwelling	10
R5	26 Snowmass Drive	Residential / dwelling	7
R6	30 Snowmass Drive	Residential / dwelling	25
R7	30C Snowmass Drive	Residential / dwelling	24
R8	30D Snowmass Drive	Residential / dwelling	32

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Figure 2: RDP zones

https://maps.ruapehudc.govt.nz/intramaps90/?project=Ruapehu

2.2 Project description

The Project will consist of entrance earthworks to allow future development on the site.

The following plant will be used on site:

- 20T excavator
- Truck and trailer
- 4T sheep's foot roller
- Motorscraper
- 10T bulldozer

Construction will occur between 7.30am – 6pm, Monday to Saturday. Sundays and public holidays will be excluded. The construction period is expected to be 1 – 2 weeks.

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3.0 ACOUSTIC PERFORMANCE STANDARDS

RDP Rule DR3.3.1(a) requires construction noise to comply with the limits contained in NZS 6803:1999. The "short-term duration" construction limits will apply to the Project. The RDP contains no requirements relating to construction vibration, so we have applied the limits contained in DIN 4150-3:1999 as best practice.

3.1 Construction Noise

RDP Rule DR3.3.1(a) states that:

Construction noise emanating from a site shall meet the limits recommended in, and shall be measured and assessed in accordance with, NZS6803:1999 "Acoustics – Construction Noise".

The expected length of the construction project is 1 – 2 weeks. Therefore, the "short-term[1]" limits from Table 2 of NZS 6803:1999 are the relevant project limits. In summary, the limits during normal construction hours of 0730 to 1800 hours are 80 dB L_{Aeq} and 95 dB L_{AFmax}.

Refer to Appendix C for the full set of NZS 6803:1999 residential limits.

3.2 Construction Vibration

The RDP does not contain any provisions for construction vibration. We therefore recommend the following criteria based on our experience and best practice.

3.2.1 Recommended building damage criteria

For this assessment, we have applied the limits contained in DIN 4150-3:1999 "Structural vibration Part 3: Effects of vibration on structures." These limits are for avoiding cosmetic building damage, such as cracking in paint or plasterwork. Cosmetic building damage effects are deemed 'minor damage' in this Standard and can generally be easily repaired. The Standard states: "Experience has shown that if these values are complied with, damage that reduces the serviceability of the building will not occur." Much higher vibration levels (i.e., an order of magnitude higher) would be needed for potential structural damage.

The short-term (transient)[2] vibration limits in Figure 2 overleaf apply at building foundations in any axis.

[1] NZS 6803:1999 defines "short-term" as construction work at any one location for less than 14 calendar days.

[2] Short-term (transient) vibration is "*vibration which does not occur often enough to cause structural fatigue and which does not produce resonance in the structure being evaluated*".

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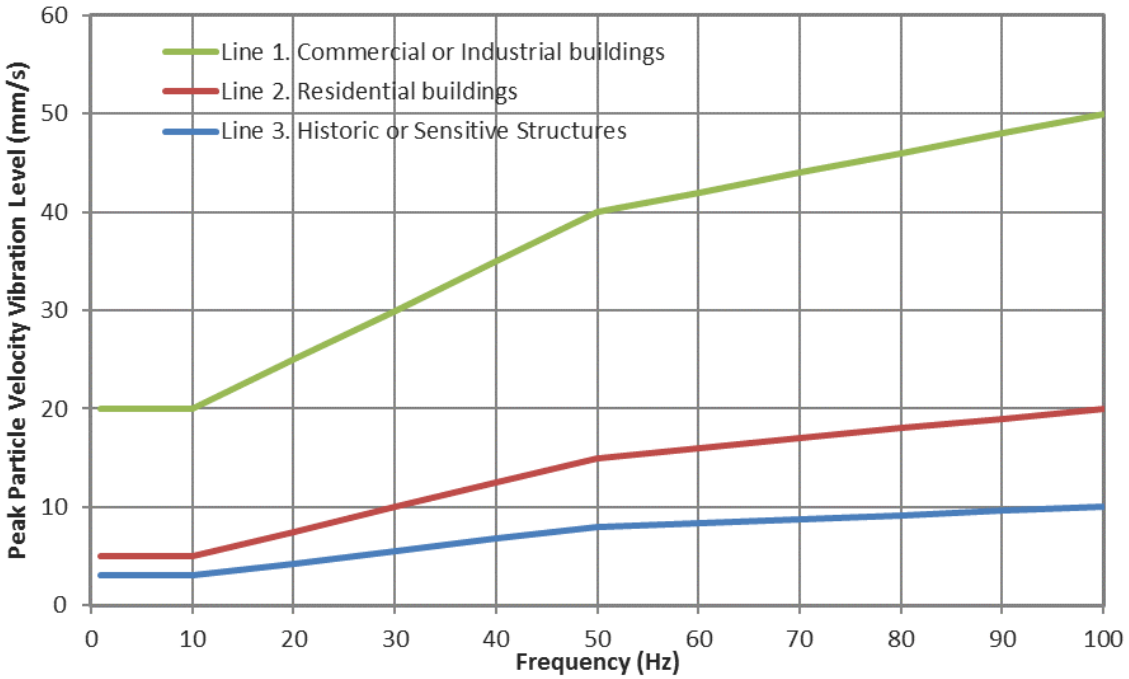
Figure 3: Short term (transient) vibration at building foundations (DIN 4150-3 1999: Figure 1)



The limits for short and long-term vibration are summarised in Table 2. Here, vibration levels apply at the highest floor rather than the foundations.

Table 2: Vibration at horizontal plane of highest floor (DIN 4150-3 1999: Tables 1 and 3)

Structure Type	Peak Particle Velocity Vibration Level (mm/s)	
	Short-term (transient)	Long-term (continuous)[3, 4]
Line 1. Commercial or Industrial buildings	40	10
Line 2. Residential buildings	15	5
Line 3. Historic or Sensitive Structures	8	2.5

3.2.2 Recommended amenity limit criterion

While the primary vibration concern is typically cosmetic building damage (Section 3.2.1), people may be disturbed at significantly lower levels. However, structural vibration damage can only occur at an order of magnitude well above the threshold of perception (Table 3).

Likely subjective responses to vibration levels are described in BS 5228[5], with additional levels added to provide a fuller picture, are shown in Table 3.

Based on our experience, we recommend an amenity criterion of 2mm/s PPV. This criterion should only be used as a CNVMP threshold to trigger communication and consultation (Section 6.1).

[3] Long-term (continuous) vibration includes types not covered by the short-term vibration definition

[4] The long-term (continuous) criteria can apply at all floor levels, but levels are normally highest at the top floor

[5] British Standard BS 5228-2:2009 *Code of practice for noise and vibration control on construction and open sites – Part 2: Vibration*

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Table 3: Subjective response to vibration levels

Vibration level	Likely subjective response
0.14mm/s PPV	Just perceptible in particularly sensitive environments
0.3 mm/s PPV	Just perceptible in normal residential environments
1 mm/s PPV	Typically acceptable with prior notification
2 mm/s PPV	Vibration would clearly be felt. However, can typically be tolerated in indoor environments such as offices, houses and retail, if it occurs intermittently during the day and where there is effective prior engagement.
5mm/s PPV	Highly unsettling for both workplaces and dwellings. If exposure is prolonged, some people may want to leave the building. Computer screens would shake, and items could fall off shelves if they are not level.
10 mm/s PPV	Likely to be intolerable for any more than a very brief period

4.0 CONSTRUCTION NOISE ASSESSMENT

We predict Project construction noise will sometimes exceed the limits contained in the RDP for the closest receivers. We anticipate noise effects from this short-term work can be acceptably controlled with the recommended CNVMP.

4.1 Calculated typical construction noise levels

We have predicted construction noise levels for the Project, shown in Table 4. The table includes the sound power level, calculated level at the three closest receivers, and the minimum distance required to comply with the construction noise limit (refer to Section 3.1).

Noise from construction activities will exceed the RDP noise limits at the closest receivers by up to 6 dB. We recommend these activities are managed via a CNVMP. With effective management and given the expected duration of the project will be no more than two weeks, we expect the effects can be acceptably controlled.

In addition, we note that many of the receivers (particularly at 30 Snowmass Drive) are intended to be booked as holiday homes for ski-field access. It may be possible to undertake these earthworks during the summer months while the dwellings are unoccupied.

Table 4: Calculated construction noise levels for three closest receivers

Equipment	Sound Power	Façade Noise Level (dB L_{Aeq})			Limit Setback (m)
	(dB L_{WA})	R1[3]	R2[4]	R3[5]	80 dB L_{Aeq}
20T excavator	103	**81**	78	73	8
Truck and trailer	105	**83**	**80**	75	10
4T roller	103	**81**	78	73	8
Scraper	108[6]	**86**	**83**	78	14
10T bulldozer	106	**84**	**81**	76	11

Notes to table:

(1) Appendix A provides an explanation of technical terms
(2) In accordance with Section C.2 of NZS 6803: 1999 results include of 3 dB facade reflection
(3) R1 represents façade of 26 Snowmass Drive located 7m from the edge of construction
(4) R2 represents façade of 6 Kanuka Way located 10 m from the edge of construction

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(5) R3 represents façade of 4 Kanuka Way located 18 m distance from the edge of construction
(6) We have used 108 dB L_{WA} assuming the scraper will be pulled by a tractor (BS5228-1:2009 Table D9.16)
(7) The maximum noise level limit (90 dB L_{AFmax}) will be readily complied with at all receivers

4.2 Construction noise prediction methodology

The contractor will develop a detailed construction programme prior to the commencement of construction activities. This will form part of the CNVMP. We have assumed an indicative construction methodology for our calculations in its absence.

We have calculated construction noise in general accordance with the method detailed in Annex D[6] of NZS 6803:1999. The method considers the sound power level, periods of operation, distance from source to receiver and screening of each source, as well as façade reflection and the degree of soft ground attenuation.

5.0 CONSTRUCTION VIBRATION ASSESSMENT

We predict construction vibration will comply with the recommended limits aside from marginal compliance with the amenity limit at the closest receiver where vibratory compaction is used. This will trigger communication and consultation with the affected receiver via a CNVMP. We anticipate the effects can be acceptably controlled.

5.1 Construction vibration high-level screening assessment

We have undertaken a high-level vibration screening assessment for construction activities. Using the identified high-vibration source we have calculated the vibration level received at the closest dwelling.

Table 5 lists the activity, the identified highest-vibration source associated with that activity and the closest source-to-receiver distance. A 4T sheep foot roller will be used during earthworks; however, these are not typically vibratory, and the use of a vibratory function is not confirmed. We have included this in our assessment for completeness.

The vibration screening assessment indicates compaction with a vibratory roller will marginally comply with the recommended 2 mm/s amenity threshold at the closest receiver. This is expected to occur only for a short period where earthworks are carried out close to the site boundary, and therefore receivers.

Given the marginal compliance, we recommend that this activity is managed via a CNVMP (where a vibratory roller is used; excludes non-vibratory compaction). An exceedance of the amenity limit will trigger communication and consultation with the affected receiver (26 Snowmass Dr). With effective management, we anticipate the effects will be acceptably controlled. This effect can be avoided by not using a vibratory roller.

Table 5: Screening summary table

Activity	Source	Min. Rec (distance, m)	Vibration Level mm/s PPV
Compaction	4T vibratory roller	7	2

[6]Annex D refers to BS5228-1: 1997 (now superseded by BS 5228-1:2009)

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6.0 MITIGATION AND MANAGEMENT

Potential management and mitigation measures are discussed below.

6.1 Communication and Consultation

The most important tool for managing construction noise and vibration is consultation and communication. Any stakeholders affected by noise or vibration levels higher than specified in this report would need to be communicated with in relation to the proposed works, including timing.

Communication should occur with stakeholders prior to works being carried out, by means of letter drop or in person.

6.2 Avoidance of Unnecessary Noise

At many construction sites it can be observed that some practices unnecessarily increase noise levels. Those include the sounding of horns when a truck is fully laden, truck air-brake release and the utilisation of audible, often tonal, reversing alarms.

These issues can be avoided, or noise levels reduced, by means of:

- changed construction site management;
- fitting of efficient mufflers to trucks;
- maintenance of equipment to a high standard; and
- the replacement of audible reversing alarms with visual or lower noise broadband audible reversing alarms.

Where these measures are implemented, they would form a part of best practice management and mitigation of construction noise.

Other unnecessary noise may include shouting, loose tail gates and noise from radios played loudly. These can be avoided with good site management and are generally addressed in any management plan.

6.3 Construction Noise and Vibration Management Plan

It is common practice for infrastructure projects of significant size to have a CNVMP as part of the Construction Management Plan. These contain information on site management, mitigation, communication, complaints procedures and similar issues.

The purpose of a CNVMP is to reduce construction noise effects through selecting the best practicable option in terms of timing of activities, equipment selection and mitigation measures (or a combination thereof).

The minimum requirements of a CNVMP are set out in NZS 6803:1999 Section 8 and Annex E.

The CNVMP should contain, but not be limited to:

- A summary of the project noise and vibration criteria
- A summary of construction noise and vibration assessment / prediction
- General construction practices, management and mitigation
- Noise and vibration management and mitigation measures specific to activities and/or receiving environments
- Monitoring and reporting requirements
- Procedures for handling complaints
- Procedures for review of the CNVMP throughout the project

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A CNVMP should be implemented for the project and some specific activities where exceedance of the noise limits is predicted. It should be kept up to date regarding actual timing / equipment use and methodologies, should these change at any point during the construction process.

7.0 RECOMMENDED CONDITIONS OF CONSENT

We propose the following conditions, should the consent be granted.

Construction Noise and Vibration

1. Construction noise shall be measured and assessed in accordance with the provisions of New Zealand Standard NZS 6803:1999 "Acoustics – Construction Noise" and comply with the limits in the following table except where authorised by the required Construction Noise and Vibration Management Plan (CNVMP) in Condition 3.

Time	Weekdays (dBA)		Saturdays (dBA)		Sundays and Public Holidays (dBA)	
	L_{eq}	L_{max}	L_{eq}	L_{max}	L_{eq}	L_{max}
0630 – 0730	65	75	45	75	45	75
0730 – 1800	80	95	80	95	55	85
1800 – 2000	75	90	45	75	45	75
2000 – 0630	45	75	45	75	45	75

2. Except as provided for in Condition 3, all construction work must comply with the vibration limits in German Industrial Standard DIN 4150- 3(1999) Structural Vibration – Part 3 Effects of Vibration on Structures when measured in accordance with that Standard on any structure not on the same site. The activity must be included in the CNVMP required by Condition 3.
3. The consent holder shall engage a suitably qualified person to prepare a CNVMP. The CNVMP shall identify the best practicable option for management and mitigation of noise and vibration, including where full compliance with the levels in Conditions 1 and 2 cannot be achieved at all times. The CNVMP shall as a minimum include but not be limited to the following information:
    (a) Construction noise and vibration criteria;
    (b) Identification of the most affected premises where there exists the potential for noise and vibration effects;
    (c) Description and duration of the works, anticipated equipment and the processes to be undertaken;
    (d) Hours of operation, including specific times and days when construction activities causing noise and vibration would occur;
    (e) Mitigation options where noise and vibration levels are predicted or demonstrated to approach or exceed the relevant limits. Specific noise and vibration mitigation measures must be implemented which may include, but are not limited to, acoustic screening, time management procedures and alternative construction methodologies;
    (f) The erection of temporary construction noise barriers where appropriate;
    (g) Schedule and methods for monitoring and reporting on construction noise and vibration;
4. The CNVMP shall be submitted to Ruapehu District Council for certification prior to construction commencing on the site.

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5. The consent holder shall, at all times, comply with the terms of the approved CNVMP.

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APPENDIX A GLOSSARY OF TERMINOLOGY

A-weighting	A set of frequency-dependent sound level adjustments that are used to better represent how humans hear sounds. Humans are less sensitive to low and very high frequency sounds. Sound levels using an "A" frequency weighting are expressed as dB A. Alternative ways of expressing A-weighted decibels are dBA or dB(A).
dB	Decibel. The unit of sound level.
L_{Aeq}	The equivalent continuous A-weighted sound level. Commonly referred to as the average sound level and is measured in dB.
L_{AFmax}	The A-weighted maximum sound level. The highest sound level which occurs during the measurement period. Usually measured with a fast time–weighting i.e. L_{AFmax}
L_w	Sound Power Level. The calculated level of total sound power radiated by a sound source. Usually A-weighted i.e. L_{WA}.
PPV	Peak Particle Velocity. The measure of the vibration aptitude, zero to maximum. Used for building structural damage assessment.
Vibration	When an object vibrates, it moves rapidly up and down or from side to side. The magnitude of the sensation when feeling a vibrating object is related to the vibration velocity. Vibration can occur in any direction. When vibration velocities are described, it can be either the total vibration velocity, which includes all directions, or it can be separated into the vertical direction (up and down vibration), the horizontal transverse direction (side to side) and the horizontal longitudinal direction (front to back).

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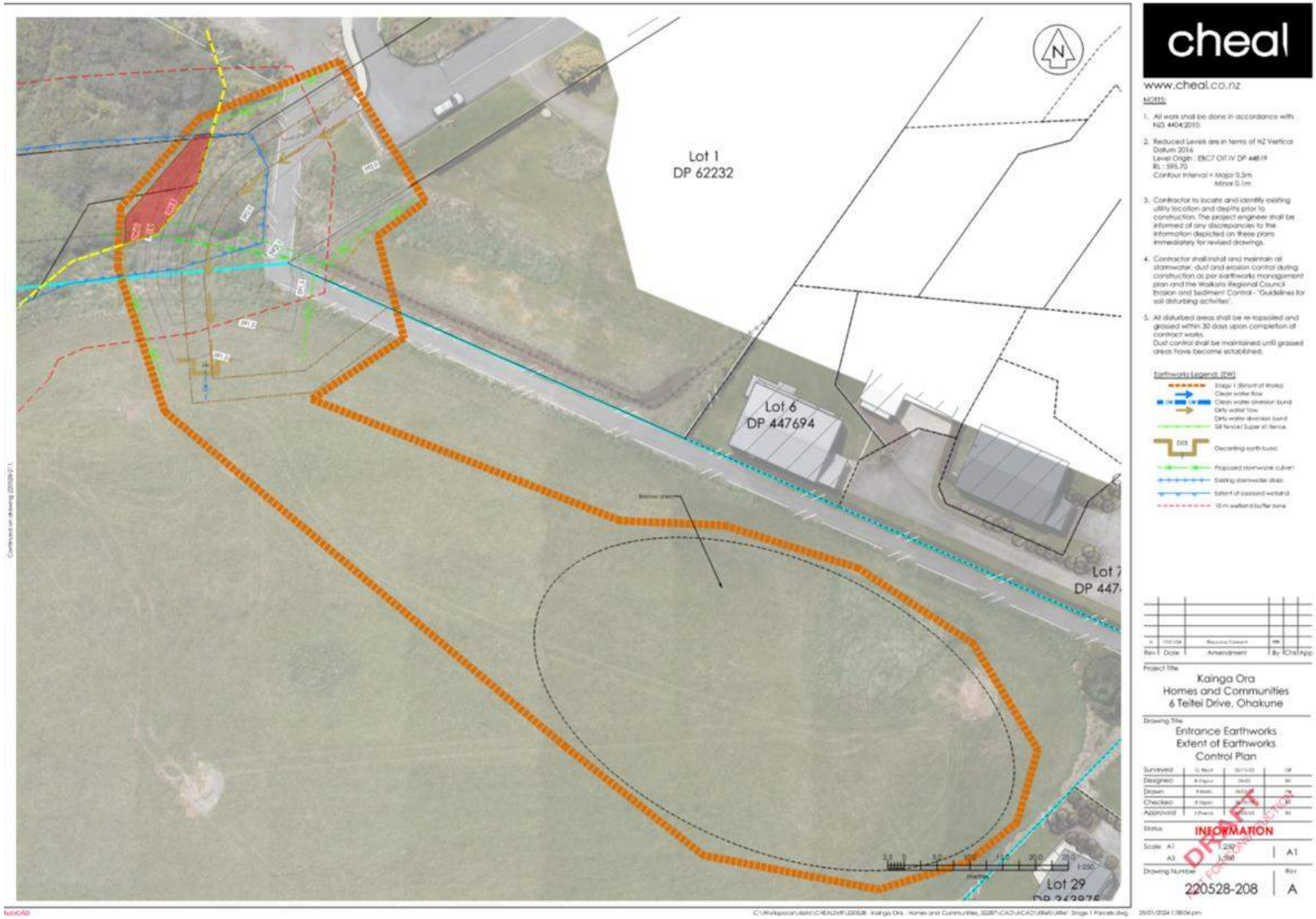
APPENDIX B SITE EARTHWORKS PLAN



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APPENDIX C NZS 6803:1999 NOISE LIMITS

NZS 6803:1999 sets out the following noise limits for residential zones.

Table 6: – Recommended upper limits for construction noise received in residential zones and dwellings in rural areas

Time of week	Time period	Duration of work					
		Typical duration (dBA)		Short-term duration (dBA)		Long-term duration (dBA)	
		L_{eq}	L_{max}	L_{eq}	L_{max}	L_{eq}	L_{max}
Weekdays	0630-0730	60	75	65	75	55	75
	0730-1800	75	90	80	95	70	85
	1800-2000	70	85	75	90	65	80
	2000-0630	45	75	45	75	45	75
Saturdays	0630-0730	45	75	45	75	45	75
	0730-1800	75	90	80	95	70	85
	1800-2000	45	75	45	75	45	75
	2000-0630	45	75	45	75	45	75
Sundays and public holidays	0630-0730	45	75	45	75	45	75
	0730-1800	55	85	55	85	55	85
	1800-2000	45	75	45	75	45	75
	2000-0630	45	75	45	75	45	75

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Appendix 4

Relevant Sections from Horizons Regional Council Guidelines

Earthworks series – erosion and sediment control factsheet

Stabilised construction entrance

DEFINITION

A stabilised pad of aggregate on a filter cloth base located at any point where traffic will be entering or leaving a construction site.

PURPOSE

To prevent site access points from becoming sediment sources and to help minimise dust generation and disturbance of areas adjacent to the road frontage by giving a defined entry/exit point.

APPLICATION

Use a stabilised construction entrance at all points of construction site ingress and egress, with a construction plan limiting traffic to these entrances only. They are particularly useful on small construction sites but can be used for all projects.

DESIGN

- Clear the entrance and exit area of all vegetation, roots and other unsuitable material and properly grade it.
- Provide drainage to carry run off from the stabilised construction entrance to a sediment control measure.
- Place aggregate to the specifications below and smooth it.

Stabilised construction entrance

AGGREGATE SPECIFICATIONS	
Aggregate size	50-75mm washed
Thickness	150mm minimum
Length	10m minimum
Width	4m minimum

Maintenance

Maintain the stabilised construction entrance in a condition to prevent sediment from leaving the construction site.
After each rainfall inspect any structure used to trap sediment from the stabilised construction entrance and clean out as necessary.
When wheel washing is also required, ensure this is done on an area stabilised with aggregate which drains to an approved sediment retention facility.

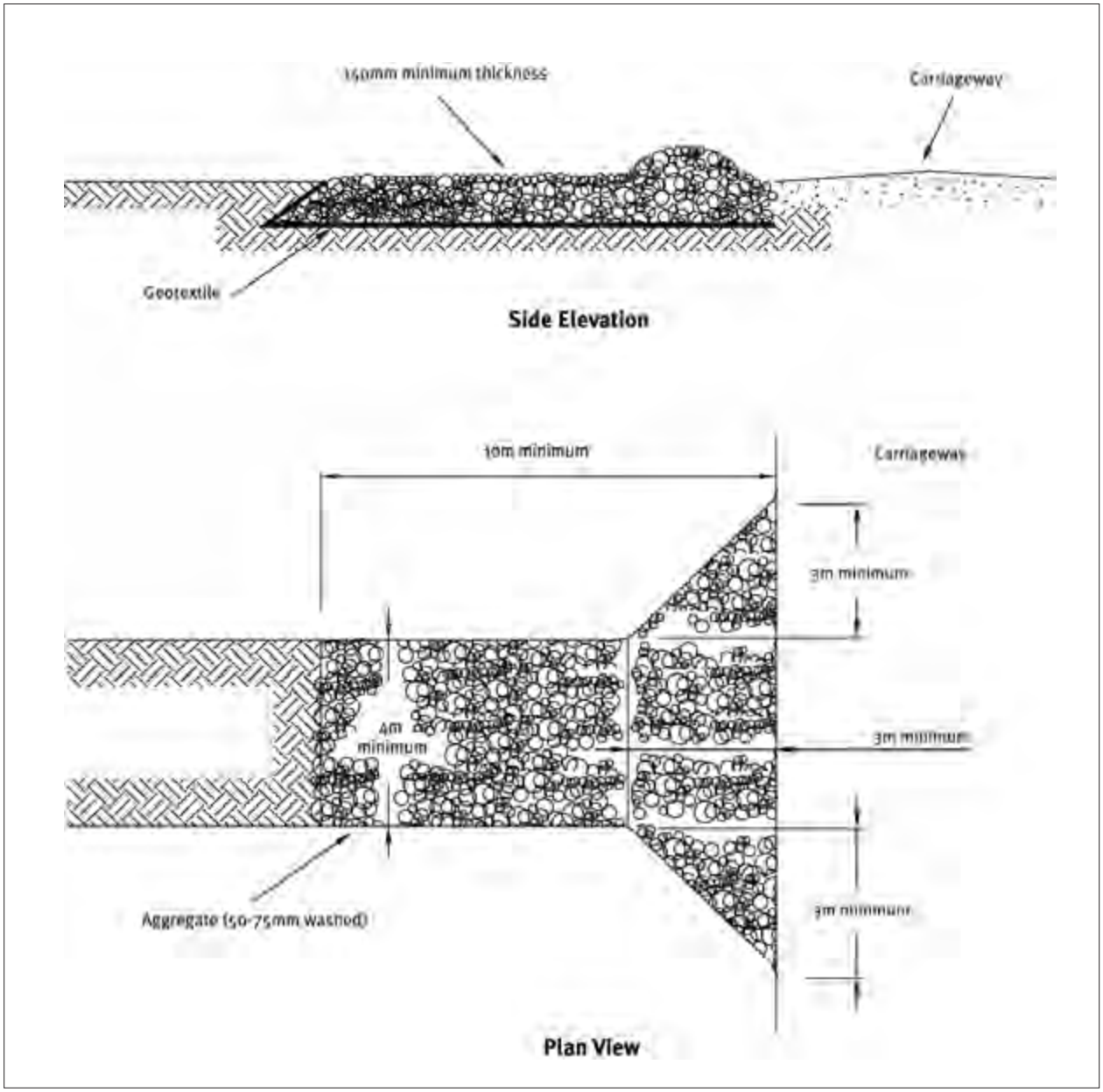


Figure 13: Stabilised construction entrance

Earthworks series – erosion and sediment control factsheet

Decanting earth bund

DEFINITION

A temporary berm or ridge of compacted earth constructed to create impoundment areas where ponding of run off can occur, and suspended material can settle before run off is discharged.

PURPOSE

Used to intercept sediment-laden run off and reduce the amount of sediment leaving the site by detaining sediment-laden run off.

APPLICATION

Decanting earth bunds can be constructed across disturbed areas and around construction sites and subdivisions. Keep them in place until the disturbed areas are permanently stabilised or adequately replaced by other means.

Decanting earth bunds can assist the settling of sediment laden run off, and are particularly useful for controlling run off after topsoiling and grassing before vegetation becomes established. Where works are occurring within the berm area, compact the topsoil over the berm area as bunds adjacent and parallel to the berm. This will act as an impoundment area and controlled outfall while also keeping overland flow away from the construction area.

DESIGN

- Decanting earth bunds need a constructed outlet structure and spillway, (see follow sections of this guide). The depth should be measured from the base of the decanting earth bund to the top of the primary spillway.
- Construct the decanting earth bunds such that the maximum contributing catchment does not exceed 0.3ha
- Lay the discharge pipe at a 1-2 per cent gradient, compact fill appropriately and incorporate an anti-seep collar.
  - Ensure all anti-seep collars and their connections are watertight.
- Use a flexible thick rubber coupling to provide a connection between the decant arm and the primary spillway or discharge pipe. Fasten the flexible coupling using strap clamps and glue and /or screws to prevent it coming off.
- Ensure the section of pipe leading through the decanting earth bunds and continuing downslope below the decanting earth bunds is non-perforated.
- On earthwork sites with slopes less than 10 per cent and less than 200m in length, construct the decanting earth bund with a minimum volume of 2 per cent of the contributing catchment ($20m^3$ for each 1000 square metres of contributing catchment).
- On sites with slopes greater than 10 per cent and/or 200m in length, construct decanting earth bunds with a minimum volume of 3 per cent of the contributing catchment ($30m^3$ capacity for each 1000 square metres of contributing catchment).

- Where possible, install the discharge pipes through the embankment as the embankment is being constructed.
- Fully stabilise the external batter face by vegetative or other means immediately after construction.
- Ensure all external bare areas associated with the decanting earth bund are stabilised in a manner consistant with the guidelines, such as mulch, cloth or vegetation.

DESIGN – EMERGENCY SPILLWAY

Stabilise the emergency spillway by lining it with a strong woven low permeability geotextile overlaid with a soft non-woven needle punched geotextile. Ensure the geotextile is pinned at 0.5m centres over the full area of the emergency spillway.

If there is sand, pumice or other erodible material under the spillways geotextile lining, install a waterproof layer underneath the geotextile, and an alternative method to pinning the geotextile is as follows:

- Bury the edges of the geotextile as per Figure 1.
- Connect a No 8 gauge wire between two waratah standards on either side of the spillway invert, tighten to hold the geotextile down as shown in Figure 1.
- If there is sand, pumice or other erodible material in the decanting earth bund embankment then an antiseep collar must be installed during the construction of the embankment.
- Ensure that all decanting earth bund embankments are compacted appropriately, particularly around the outlet pipe.
- Where possible, construct emergency spillways in well vegetated, undisturbed ground (not fill) and discharge over long grass. The emergency spillway must be located behind the decant system as far away as possible from the inlet.
- If the emergency spillway is constructed on exposed soil, provide complete erosion protection by means such as grouted riprap, asphalt, erosion matting/ geotextile or concrete.
- Construct the emergency spillway with a minimum of 100-150mm freeboard height above the primary spillway invert.
- The minimum emergency spillway dimensions are 2 metres wide with 250mm freeboard

Figure 1:

Connect to waratah on both sides, tighten wire

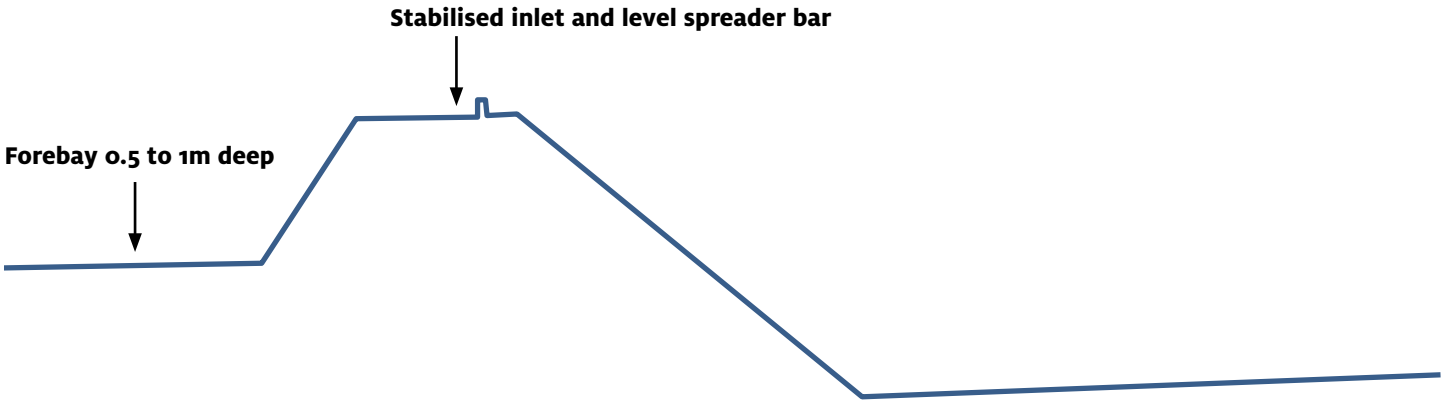
Waratahs	
No 8 gauge wire	

DESIGN – OPTIONAL FOREBAY

Benefits include the ability to clean deposition from the front of the control structure without damaging the 'clean' discharge side of the control.

- Construct a forebay with a volume equal to 10 percent of the pond design volume.
- The forebay is to extend the full width of the main pond and is to be 0.5 to 1 m deep.
- Inlets into the forebay are to be stabilised.
- Access to the forebay is to be maintained at all times to allow easy and frequent removal of accumulated sediments by an excavator.
- Sediment should also be removed after every large storm event and or when 20% of the pond volume is accumulated sediment.

Figure 2:



DESIGN – T-BAR DECANT

T-bar decants must be able to operate through the full live storage depth of the sediment retention pond.

- Position the decant inlet to provide 50 per cent live storage volume with a minimum distance of 5m of flat ground from the inlet. Otherwise raise the inlet so the dead storage level extends out at least this far.
- The decant rate is to be equal to 3 litres per second per hectare. Set the decant rate by drilling the correct amount of 10mm holes in the decant. For a 1,000 square metre contributing catchment 13 X 10mm holes will provide 0.3 litres per second. For a 1,500 square metre contributing catchment 20 x 10mm holes will provide 0.45 litres per second.
- The DEB must be set up so that all inflows enter as far as possible away from the decant.
- Ensure that a primary spillway (upstand riser) is constructed as part of the T-Bar decant, as detailed in figure 3.
- Ensure that the T-bar decant float is securely fastened with steel strapping directly on top of the decant arm and weight it to keep the decant arm submerged just below the surface through all stages of the decant cycle. This will also minimise the potential for blockage of the decant slots by floating debris.
- Position the T-bar decant at the correct height by supporting the decant arm between waratahs as detailed in figure 3.

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Waikato Regional Council earthworks factsheet series no. 2. September 2014 (4035)

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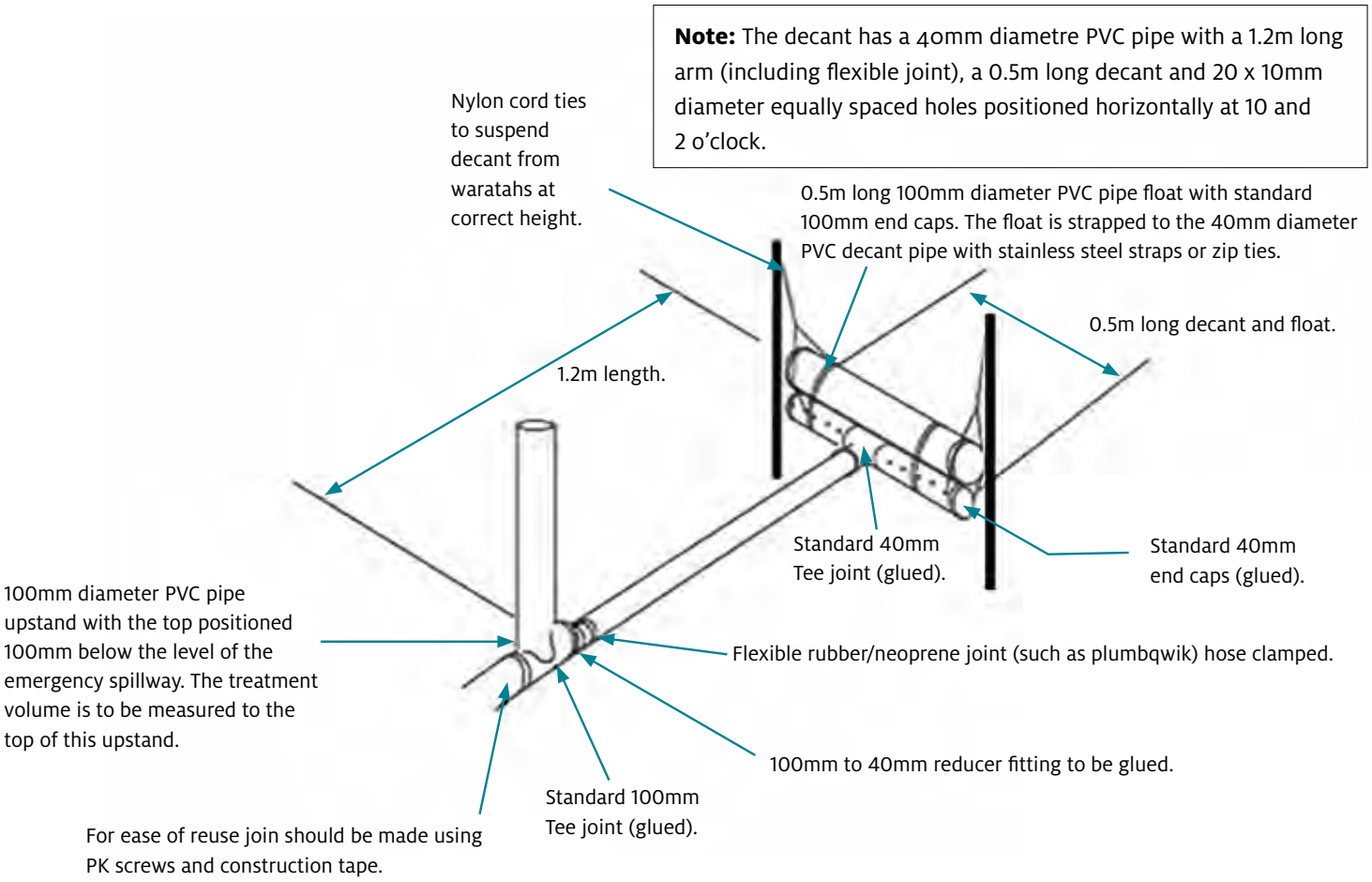
Te Kaunihera ā Rohe o Waikato

Figure 3: 40mm decant with upstand for decanting earth bund.



MAINTENANCE

Inspect and maintain decanting earth bunds regularly and after each rainfall event to check for accumulated sediment which may cause overtopping. Check any discharge points for signs of scouring and install further armouring or other stabilisation if scouring is evident.

Earthworks series – erosion and sediment control factsheet

Sediment Retention Pond (SRP)

DEFINITION

A temporary pond formed by excavation into natural ground or by the construction of an embankment, and incorporating a device to dewater the pond at a rate that will allow suspended sediment to settle out.

PURPOSE

To treat sediment-laden run off and reduce the volume of sediment leaving a site, thus protecting downstream environments from excessive sedimentation and water quality degradation.

APPLICATION

Sediment retention ponds are appropriate where treatment of sediment-laden run off is necessary, and are the appropriate control measure for exposed catchments of more than 0.3ha. It is vital that the sediment retention pond is maintained until the disturbed area is fully protected against erosion by permanent stabilisation.

The location of the sediment retention pond needs to be carefully considered in terms of the overall project, available room for construction and maintenance and the final location of any permanent stormwater retention facilities that may be constructed at a later stage.

Another major consideration is whether drainage works can be routed to the sediment retention pond until such time as the site is fully stabilised.

The general design approach is to create an impoundment of sufficient volume to capture a significant proportion of the design run off event, and to provide quiescent (stilling) conditions, which promote the settling of suspended sediment.

The sediment retention pond design is such that very large run off events will receive at least partial treatment and smaller run off events will receive a high level of treatment. To achieve this, the energy of the inlet water needs to be low to minimise re-suspension of sediment and the decant rate of the outlet also needs to be low to minimise water currents and to allow sufficient detention time for the suspended sediment to settle out.

Specific design criteria are discussed below, but can be summarised as the following:

- Use sediment retention ponds for bare areas of bulk earthworks of 0.3ha or greater.
- Restrict catchment areas to less than 5.0ha per sediment retention pond. This limits the length of overland flow paths and reduces maintenance problems.

- Locate sediment retention ponds so as to provide a convenient collection point for sediment laden flows from the catchment area. This will require strategic use of cut-offs, run off diversion channels and contour drains.
- Locate sediment retention ponds to allow access for removing sediment from the pond.
- Locate sediment retention ponds to allow the spillway to discharge over undisturbed, well vegetated ground.
- Do not locate sediment retention ponds within watercourses.
- Embankment and spillway stability are generally the weak point in sediment retention pond construction. Correct compaction, particularly around emergency spillways, discharge pipes and anti-seep collars, will keep the system robust.

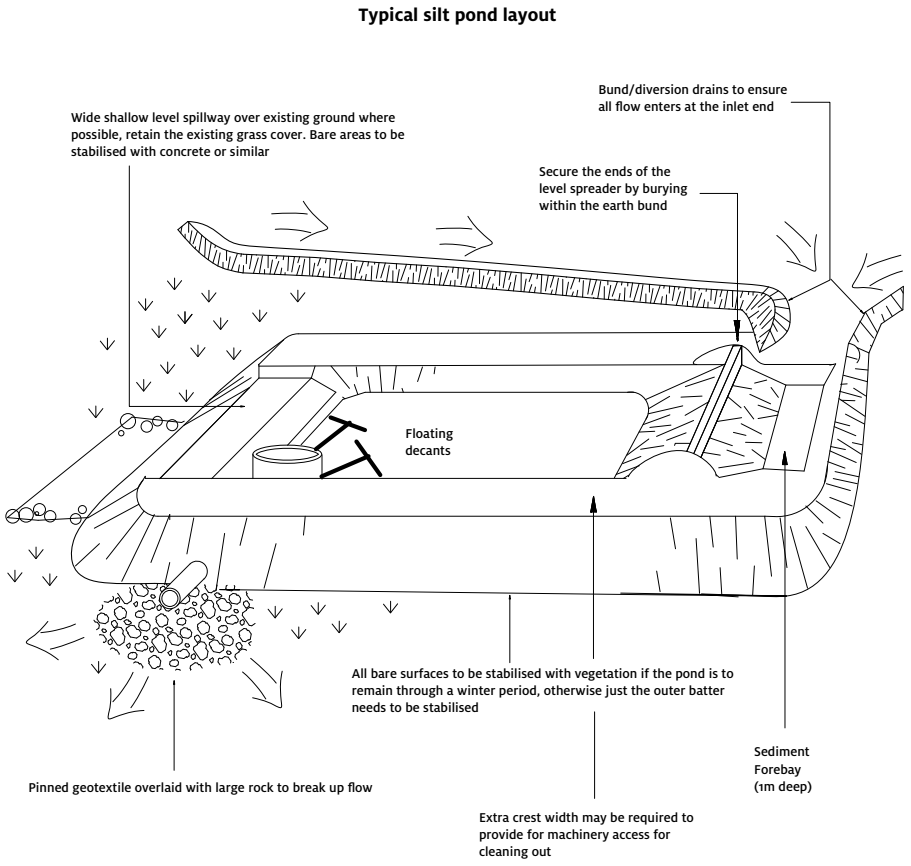


Figure 1: Typical silt pond layout

DESIGN - SIZE OF THE POND

Calculate the volume of the sediment retention pond using the depth measured from the base of the sediment retention pond to the top of the primary spillway. The following design criteria apply:

- On earthwork sites with slopes less than 10 per cent and less than 200m in length, construct a sediment retention pond with a minimum volume of 2 per cent of the contributing catchment (200m^3 for each ha of contributing catchment).
- On sites with slopes greater than 10 per cent and/or more than 200m in length, construct sediment retention ponds with a minimum volume of 3 per cent of the contributing catchment (300 m^3 capacity for each ha of contributing catchment).
- An additional 10 per cent of this volume is to be used as a sediment forebay.
- The slope angle is determined by the steepest slope within a 50m radius of the sediment retention pond inlet or by the average slope angle over the contributing catchment, whichever is the greater.
- On sites that are particularly steep, have a high clay content or have sensitive downstream environments, a greater sediment retention pond volume and/or the use of chemical treatment may be required.
- Clean out sediment retention ponds when the volume of sediment accumulated within them reaches 20 per cent of the design volume.
- Clearly show the sediment retention pond dimensions necessary to obtain the required volume, as detailed above, on the site's erosion and sediment control plan(s).

DESIGN - DEAD STORAGE (PERMANENT STORAGE)

Dead storage is the component of impoundment volume that does not decant and remains in the sediment retention pond. It is important for dissipating the energy of inflows.

- Ensure dead storage is a minimum of 30 per cent of the total sediment retention pond storage by positioning the lowest decant 0.54 - 0.8m above the invert of the sediment retention pond.

DESIGN - LIVE STORAGE (DECANT STORAGE)

- Live storage is the volume between the lowest decant outlet level and the top of the sediment retention pond primary spillway.
- Ensure that the live storage volume capacity is 70 per cent of the total sediment retention pond storage.
- The approved decant design detailed in these guidelines allows the decant system to be raised as sediment deposition increases, thereby maintaining the percentage volume of live storage.

Sediment retention pond showing decant system.

DESIGN - DECANTING/OUTLET DE-WATERING DEVICE

- De-water the sediment retention pond to remove the relatively clean water without removing any of the settled sediment, and without removing any appreciable quantities of floating debris.
- The use of a floating T-bar de-watering device, which allows for the decanting of the cleaner surface water from the top of the water column, is required.
- The required decant rate from a sediment retention pond is 3 litres/second/ha of contributing catchment. This rate ensures that appropriate detention times are achieved.
- A standard T-bar design is detailed in figure 2 for various sized catchments. Single decant without manhole riser needs to have a primary spillway (upstand riser) installed.
- To achieve a decant rate of 4.5 litres/second per decant, for a 1.5 ha catchment, drill 200 10mm diameter holes positioned evenly over the decant.Holes can be blocked as required for smaller catchments. Block out 65 holes if a decant rate of 3 l/sec is required.
- T-bar decants must be able to operate through the full live storage depth of the sediment retention pond.
- If two decant systems are required, ensure the lower T-bar decant operates through the full live storage depth of the sediment retention pond. The upper T-bar decant is to operate through the upper 50 per cent of the live storage depth of the sediment retention pond only.
- If three decant systems are to be used, then the lower T-bar decant operates through the full live storage depth and the second T-bar decant through the upper two thirds of live storage depth of the sediment retention pond. The upper T-bar decant operates through the upper one third of live storage depth of the sediment retention pond.
- Ensure that the T-bar decant float is securely fastened with steel strapping directly on top of the decant arm, and weight it to keep the decant arm submerged just below the surface through all stages of the decant cycle. This will also minimise the potential for blockage of the decant slots by floating debris. The most successful method found to date is to weight the decant arm by strapping a 1.8m long waratah between the float and the decant (approximately 4kg of weight).
- Position the T-bar decant at the correct height by supporting the decant arm between warratahs as detailed in figure 2.
- Lay the discharge pipe at a 1 - 2 per cent gradient, compact the fill material around it using a machine compactor and incorporate anti-seep collars with the following criteria:
    - Install collars around the pipe to increase the seepage length along the pipe with a spacing of approximately 10m.
    - The vertical projection of each collar is 1m.
    - Ensure all anti seep collars and their connections are watertight.
- Use a flexible thick rubber coupling to provide a connection between the decant arm and the primary spillway or discharge pipe. To provide sufficient flexibility (such as is required for the lower decant arm) install two couplings. Fasten the flexible coupling using strap clamps and glue.

- Where a concrete riser decant system is utilised, ensure the lower decant connection is positioned on an angle upwards from the horizontal so as to split the operational angle that the decant works through. This will reduce the deformation force on the coupling used.

T-Bar decant

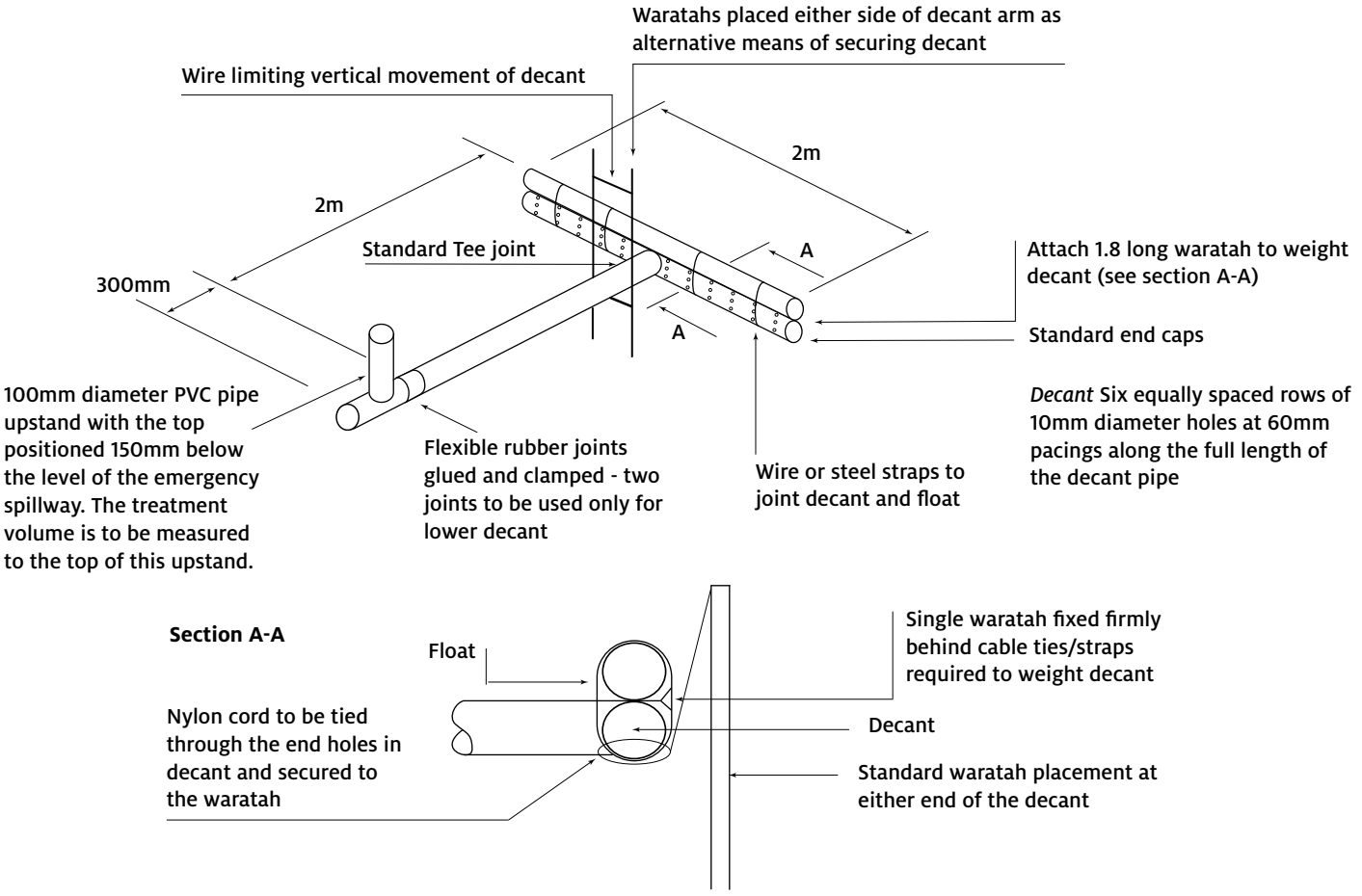


Figure 2: T-Bar decant

DESIGN - FOREBAY

- Construct a forebay with a volume equal to 10 per cent of the pond design volume. On sites with slopes less than 10 per cent and lengths less than 200m this equates to a forebay volume of 0.2 per cent of the contributing catchment area - 0.2 m^3 per 100 m^2 of contributing catchment. On sites with slopes greater than 10 per cent and lengths greater than 200m, forebay volume is equivalent to 0.3 per cent of the contributing catchment area ie: 0.3 m^3 per 100 m^2 of contributing catchment.
- The forebay is to extend the full width of the main pond and is to be 0.5 to 1m deep.
- All inlets into the forebay are to be stabilised.
- Access to the forebay is to be maintained at all times to allow easy and frequent removal of accumulated sediments by an excavator. Sediment should also be removed after every large storm event.

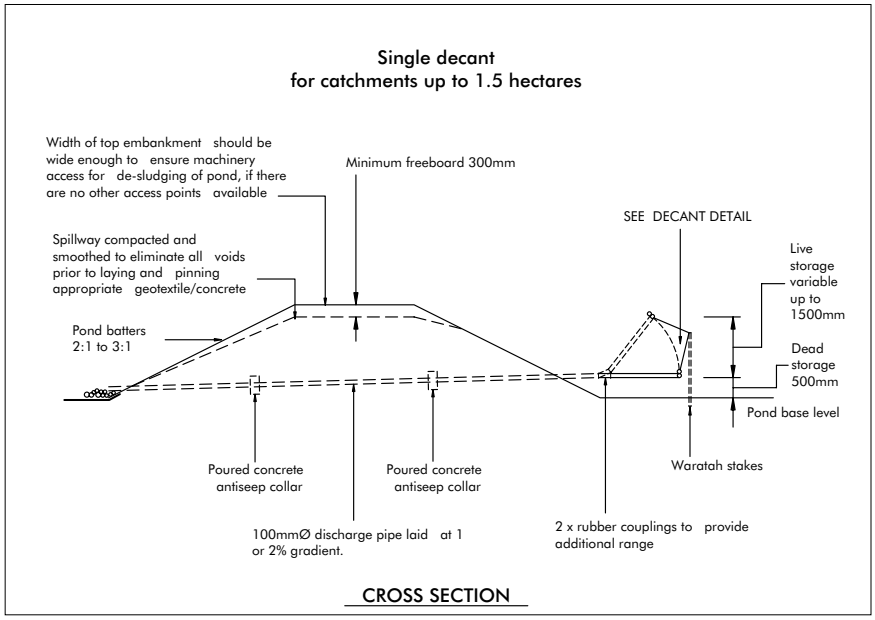


Figure 3: Cross section of single decant

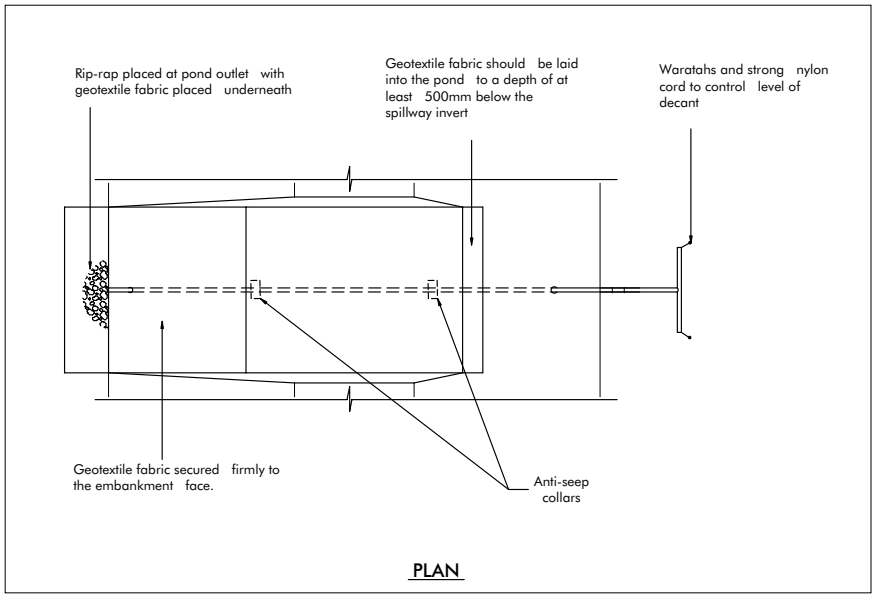


Figure 4: Plan view of decant

DESIGN - SHAPE OF THE POND

- Ensure the length to width ratio of the sediment retention pond is no less than 3:1 and no greater than 5:1. The length of the sediment retention pond is measured as the distance between the inlet and the outlet (decant system). A 2:1 ratio may be used if the pond depth is no greater than 1m.
- Maximise the distance between the inlet and the outlet (including the emergency spillway) to reduce the risk of short circuiting and to promote quiescent conditions. If this cannot be achieved by correctly positioning the inlet and outlets, install baffles to achieve the appropriate length to width ratio design.
- Ensure that the sediment retention pond has a level spreader as described in figure 5 to promote the even and gradual dissipation of the heavier inflow water across the full area of the sediment retention pond.

DESIGN - EMBANKMENT

- Thoroughly compact the sediment retention pond embankment, with material laid in 150mm layers and compacted to engineering standards.
- Before building a sediment retention pond, install sediment controls such as silt fences below the construction area and maintain them to a functional standard until the sediment retention pond batters are fully stabilised.
- Where possible, install the discharge pipes through the embankment as the embankment is being constructed.
- Fully stabilise the external batter face by vegetative or other means immediately after construction.
- Ensure all bare areas associated with the sediment retention pond (including internal batters) are stabilised with vegetation if the sediment retention pond is to remain in use over winter.

DESIGN - POND LEVEL SPREADER

- Incorporate a pond level spreader between the forebay and the main pond to spread inflow velocities, thereby allowing rapid dissipation of inflow energies. Combine the pond level spreader with a well compacted and smoothed inlet batter (no steeper than a 3:1 gradient), stabilised over its entire area. The essential design feature is to ensure the pond level spreader is completely level, non-erodible and spans the full width of the sediment retention pond.
- Stabilise the level spreader and inlet embankment to the base of the pond with a layer of strong woven low permeability geotextile overlaid with a layer of soft non-woven needle punched geotextile. Pin at 500mm centres.
- To ensure even inflows, install a trenched and pegged 150mm x 50mm timber weir or similar across the full width of the inlet. Bund the edges with compacted earth to prevent outflanking and line to prevent erosion. This timber weir is haunched using site concrete which also serves to toe in the geotextile protection that will be required.
- Position the top of the pond level spreader weir 100 – 200mm above the invert of the emergency spillway.

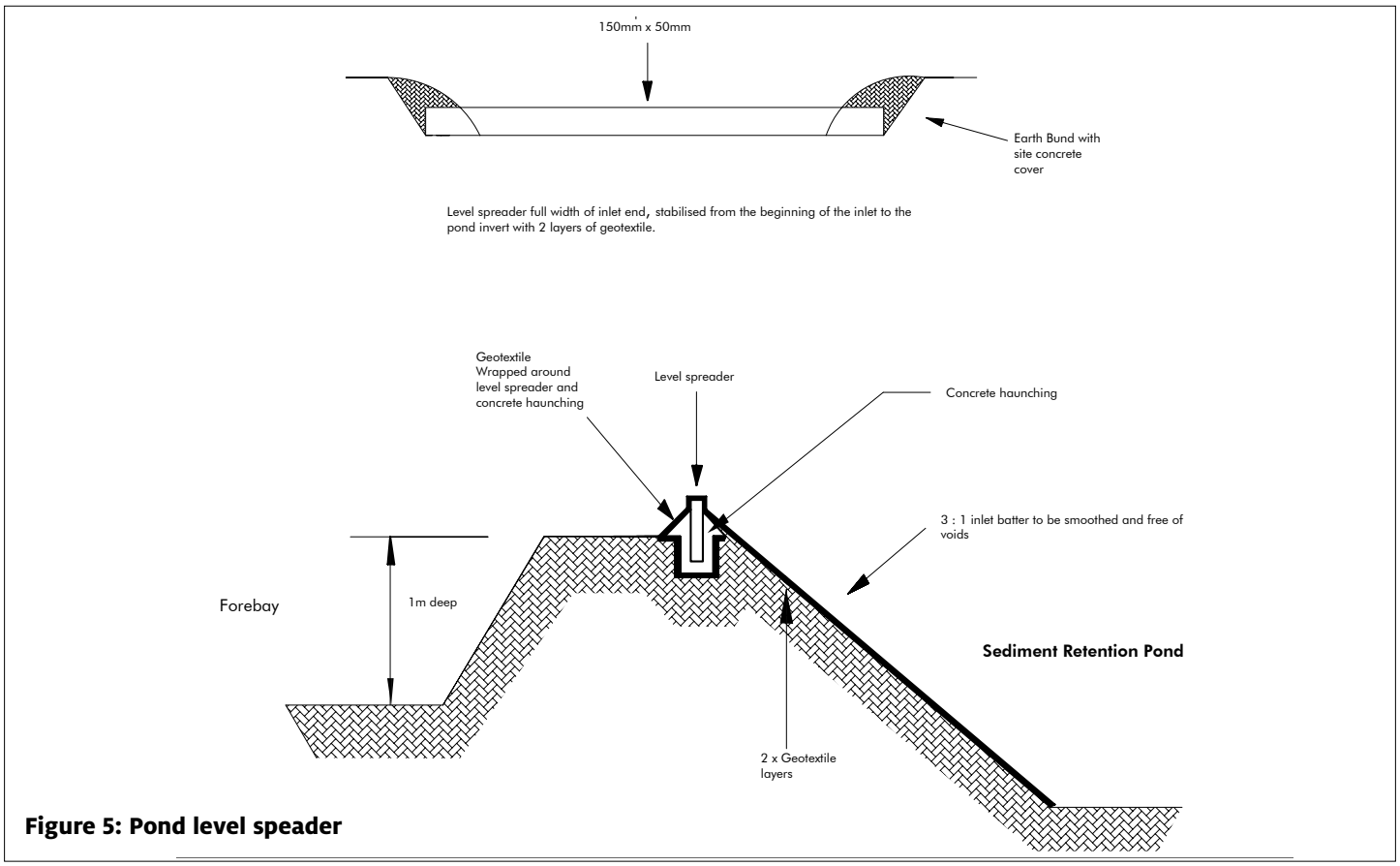


Figure 5: Pond level speader

OPTIONAL ENHANCEMENTS

- Install one or more silt fences accross the width of the sediment retention pond.
- Slope the base of the pond towards the inlet end. This will reduce sediment travelling to the decant end of the pond.

DESIGN - DEPTH OF POND

- Sediment retention pond depths may be 1 - 2m deep, but no deeper than 2m. Deeper ponds are more likely to cause short circuiting problems during larger storm events and require specifically designed floating decant systems.
- The decant design in these guidelines operates through a maximum live storage range of 1.5m.

DESIGN - PRIMARY SPILLWAY

- For catchments up to 1.5ha use a discharge and primary spillway pipe diameter of 100mm.
- For contributing catchments between 1.5 and 3ha in area, use a discharge and primary spillway pipe diameter of 150mm.
- Where contributing catchments are 3ha or greater a concrete manhole riser and a minimum 300mm diameter outlet pipe must be used as a primary spillway. The concrete manhole riser must have a sealed bottom and be weighted to prevent floating.
- If the sediment retention pond is to operate over the winter and the contributing catchment is fully stabilised, disconnect the T-bar decant to reduce the frequency of emergency spillway activation and consequent erosion.
- Where a primary spillway upstand riser is used, place the top of the riser a minimum 600mm lower than the top of the sediment retention pond embankment and a minimum 300mm lower than the emergency spillway crest. Ensure the riser and the discharge pipe connections are all completely watertight.

SPILLWAY

- An emergency spillway is essential for all sediment retention ponds.
- Emergency spillways must be capable of accommodating the critical 1 per cent AEP event without eroding.
- Emergency spillways must discharge onto stabilised ground. The emergency spillway must be located at the outlet end of the pond behind or beside the decant system.
- The emergency spillway crest and outer batter requires a very high standard of stabilisation with the fill material well compacted.
- Construct the emergency spillway as a stabilised trapezoidal cross section. The trapezoidal cross sections need to be continued down the outside batter to avoid flows outflanking the geotextile.
- When utilising geotextile for emergency spillway stabilisation purposes, the batter face must be smooth and all voids filled.
- If geotextile is used, a strong woven low permeability geotextile is laid first and then covered with a soft non-woven needle punched geotextile. Ensure the geotextile is pinned at 0.5m centres over the full area of the emergency spillway.
- Where possible, construct emergency spillways in well vegetated, undisturbed ground (not fill) and discharge over long grass.
- Construct the emergency spillway with a minimum of 300 mm freeboard height above the primary spillway invert.

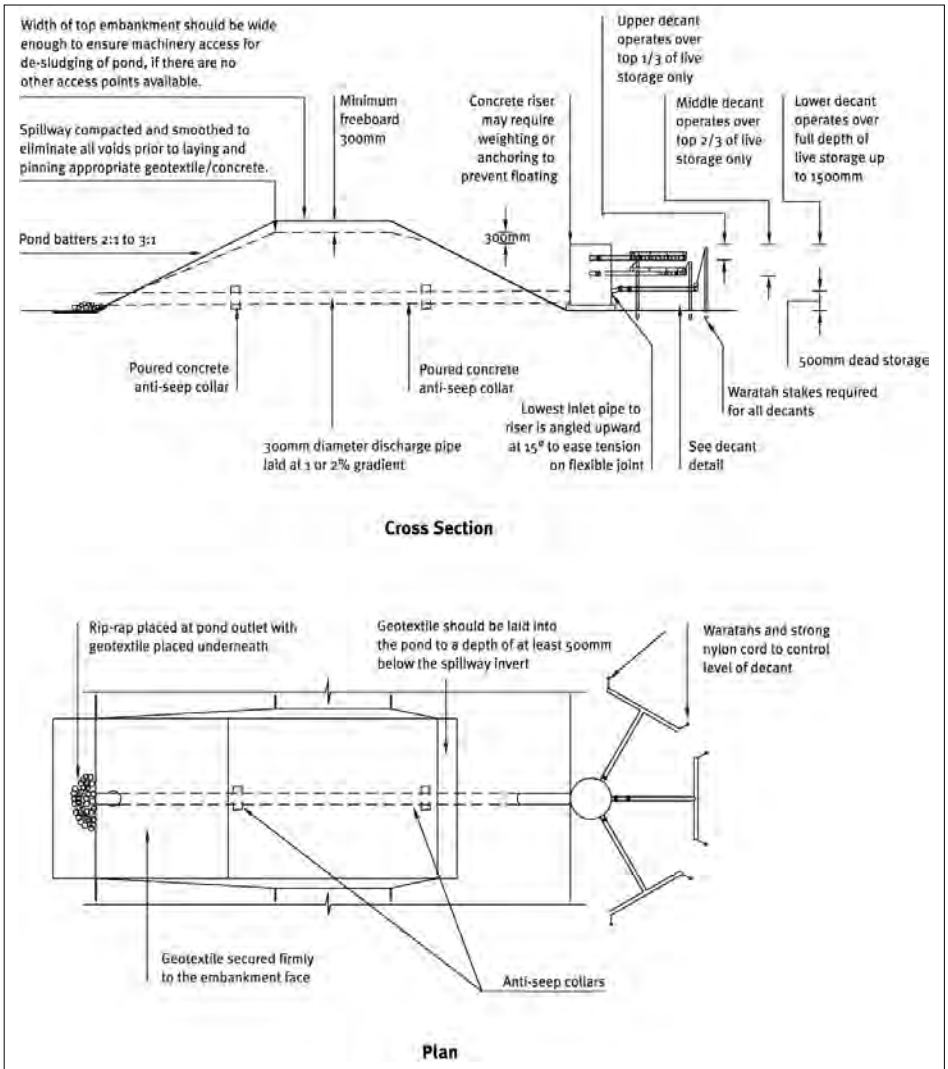


Figure 6: Cross sections of plan SRP emergency spillway

CONSTRUCTION SPECIFICATIONS

- Construct a fabric silt fence across the downslope end of the proposed works.
- Clear areas under proposed fills of topsoil or other unsuitable material down to competent material. Large fill embankments may need to be keyed in.
- Use only approved fill.
- Place and compact fill in layers as per the engineer's specifications.
- Do not place pervious materials such as sand or gravel within the fill material.
- Construct fill embankments approximately 10 per cent higher than the design height to allow for settlement of the material. Install appropriate pipe work and anti-seep collars during the construction of the embankment and compact around these appropriately.
- Install and stabilise the emergency spillway.
- Install and stabilise the level spreader.
- Securely attach the decant system to the horizontal pipework. Make all connections watertight. Place any manhole riser on a firm foundation of impervious soil.
- Do not place pervious material such as sand or scoria around the discharge pipe or the anti-seep collars.
- Check sediment retention pond freeboard for differential settlement and rectify as necessary.
- Stabilise both internal and external batters with vegetation.

POND MAINTENANCE AND DISPOSAL OF SEDIMENT

- Clean out sediment retention ponds before the volume of accumulated sediment reaches 20 per cent of the total sediment retention pond volume. To assist in gauging sediment loads, clearly mark the 20 per cent volume height on the decant riser.
- Clean out sediment retention ponds with high capacity sludge pumps, or with excavators (long reach excavators if needed) loading onto sealed tip trucks or to a secure area immediately adjacent to the pond.
- The erosion and sediment control plan (ESCP) should identify disposal locations for the sediment removed from the sediment retention pond. Deposit the sediment in such a location so that it does not lead to a direct discharge to receiving environments. Stabilise all disposal sites as required and approved in the site's ESCP.
- Inspect sediment retention ponds a minimum of once per week and before every forecasted rainfall event. Inspect for correct operation after every run off event. Immediately repair any damage to sediment retention ponds caused by erosion or construction equipment.

SAFETY

Sediment retention ponds are attractive to children and can become safety hazards if not appropriately fenced and if safety rules are not followed. Low gradient pond batters provide an additional safety measure. Check the safety requirements of the city or district council authority and the Occupational Safety and Health branch of the Department of Labour.

CHEMICAL TREATMENT

Some chemicals can be used successfully to promote flocculation (clumping together) of suspended solids in the sediment retention pond to increase the particle mass and speed the rate of settling:

- Poly Aluminium Chloride (PAC)
- poly-DADMAC
- Haloklear
- Crystalfloc

Chemical dosing systems are likely to be required where the design sediment retention pond volume cannot be achieved because of site constraints and/or where a high level of treatment is required because of the sensitivity of the receiving environment. Chemical treatment is also more likely to be required where the clay component is high or when specifically requested by council.

All chemical treatments require flocculation mangement plans to be submitted and approved by Waikato Regional Council before commencing any flocculation method.

Waikato Regional Council
Private Bag 3038
Waikato Mail Centre
Hamilton 3240

For more information call Waikato Regional Council's freephone on 0800 800 401 or visit www.waikatoregion.govt.nz.

Waikato Regional Council earthworks factsheet series no. 2. December 2014 (4035)

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Appendix 5

Template As-Built Certificates for Sediment Controls

Decanting Earth Bund (DEB) As-built Certification Sheet

Bund name/number:

Contributing catchment area (m^2)		
Dead storage volume and height	Volume (m^3)	Height
Live storage volume and height	Volume (m^3)	Height
Bunds adequately compacted	Y ☐	N ☐
Emergency spillway width and depth	Width	Depth
Emergency spillway stabilisation type	Type	
Discharge point stabilised?	Y ☐	N ☐
Freeboard between primary and emergency spillway?	mm	
Decant discharge rate	litre per second	
Flexi join attached securely sealed	Y ☐	N ☐
Anti-seep collars installed (Pumice or sand soils only)	Y ☐	N ☐
Waikato Regional Council approved variations to device (please list)		

Please sign below to confirm that the information in this sheet is accurate and the device identified on this sheet has been constructed in accordance with the Waikato Regional Council approved erosion and sediment control plan for the site and the "Erosion and Sediment Control Guidelines for Soil Disturbing Activities", January 2009 document or Waikato Regional Council approved variations.

Suitably qualified person (name and company): _____

Signed and dated: _____

Please provide surveyed drawings of as-builts, which include all of the above details along with this certification sheet. An example of a suitable DEB as-built is attached.

Note: As-builts are not approved by Waikato Regional Council. Responsibility for construction of the structures and accuracy of the as-builts rests with the certifying agent. This list is not exhaustive and should be used to highlight some key "Erosion and Sediment Control Guidelines for Soil Disturbing Activities" requirements.

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Example: Scaled drawing as built - Decanting Earth Bund

Catchment area _____

Total storage volume _____

Dead storage volume _____

Live storage volume _____

Minimum bund height _____

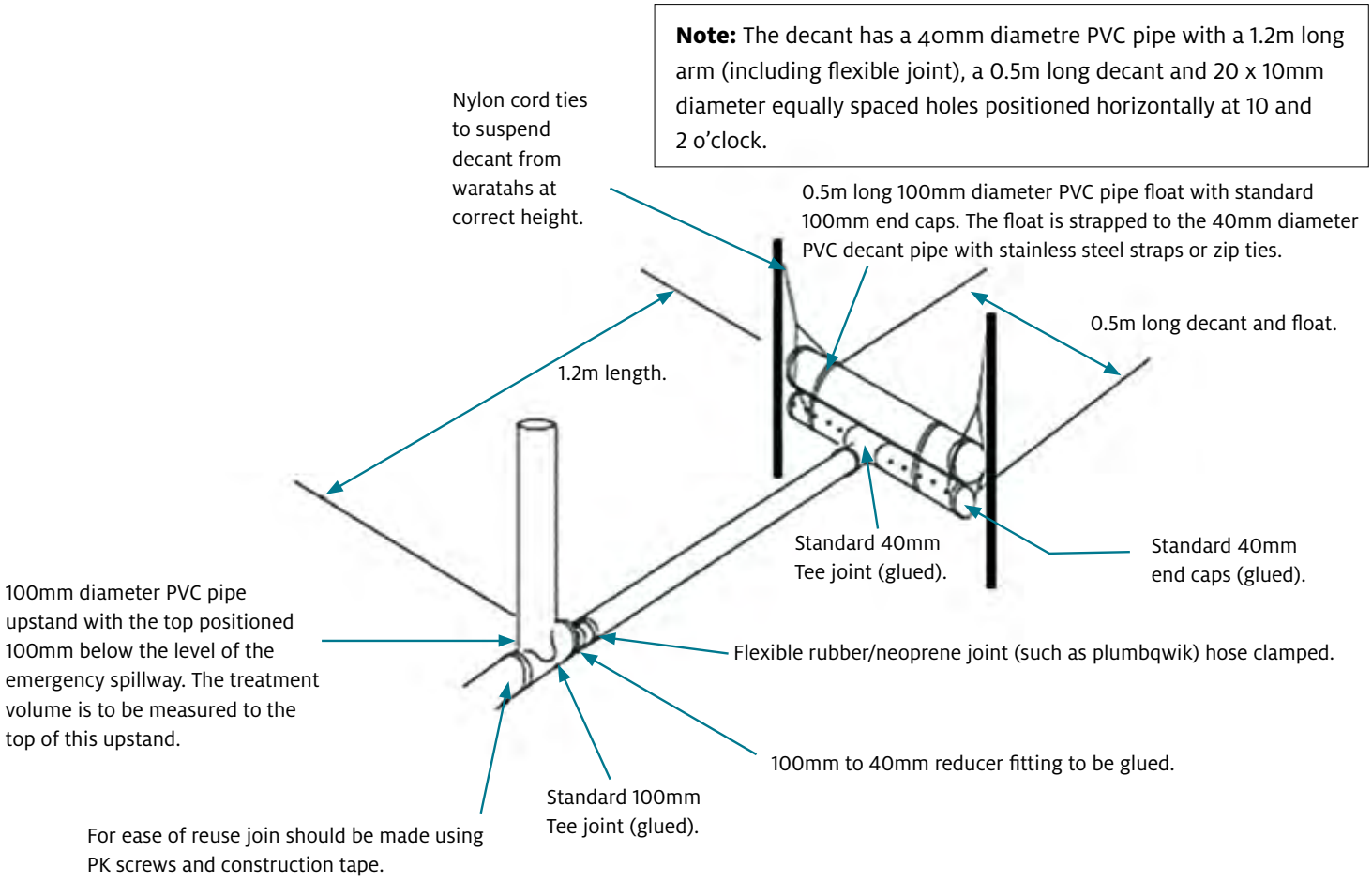
Emergencey spillway width _____

Note: where the as built information differs from the approved ESCP or Waikato Regional Council guidelines, data supporting its compliance is to be provided.

As-Builts are not approved by Waikato Regional Council. Responsibility for construction of the structures and accuracy of the As-Builts rests with the certifying agent. This list is not exhaustive and should only be used to highlight some of the key requirements.

40mm decant with upstand for decanting earth bund.

Note: The decant has a 40mm diametre PVC pipe with a 1.2m long arm (including flexible joint), a 0.5m long decant and 20 x 10mm diameter equally spaced holes positioned horizontally at 10 and 2 o'clock.



Diversion bund/channel As-built Certification Sheet

Diversion Name/number:

Contributing catchment area (m^2)		
Maximum gradient in diversion contributing catchment (%)		
Maximum gradient of bund/channel (%)		
Bunds adequately compacted and stabilised/ Method of compaction	Y ☐	N ☐
Armouring required?	Y ☐ N ☐	Type:
Diversion able to convey the 20% AEP event with 300mm freeboard?	Y ☐	N ☐
Discharge point stabilised?	Y ☐	N ☐
Flows directed to treatment device for dirty water diversion and offsite for cleanwater diversion?	Y ☐	N ☐
Bund a minimum of 550mm high & 2m wide	Y ☐	N ☐
Diversion inlet 3:1 or flatter?	Y ☐	N ☐
Diversion embankment 2:1 or flatter	Y ☐	N ☐
Diversion channel width 1m minimum	Y ☐	N ☐
Waikato Regional Council approved variations to device (please list)		

Please sign below to confirm that the information in this sheet is accurate and the device identified on this sheet has been constructed in accordance with the Waikato Regional Council approved Erosion & Sediment Control Plan for the site and the "Erosion and Sediment Control Guidelines for Soil Disturbing Activities", January 2009 document or Waikato Regional Council approved variations.

Suitably Qualified Person (Name and company):_____

Signed and Dated:_____

Please provide surveyed drawings of as-builts, which include all of the above details along with this certification sheet. An example of a suitable diversion bund/channel as-built is attached.

Note: As-builts are not approved by Waikato Regional Council. Responsibility for construction of the structures and accuracy of the as-builts rests with the certifying agent. This list is not exhaustive and should be used to highlight some key "Erosion and Sediment Control Guidelines for Soil Disturbing Activities" requirements.

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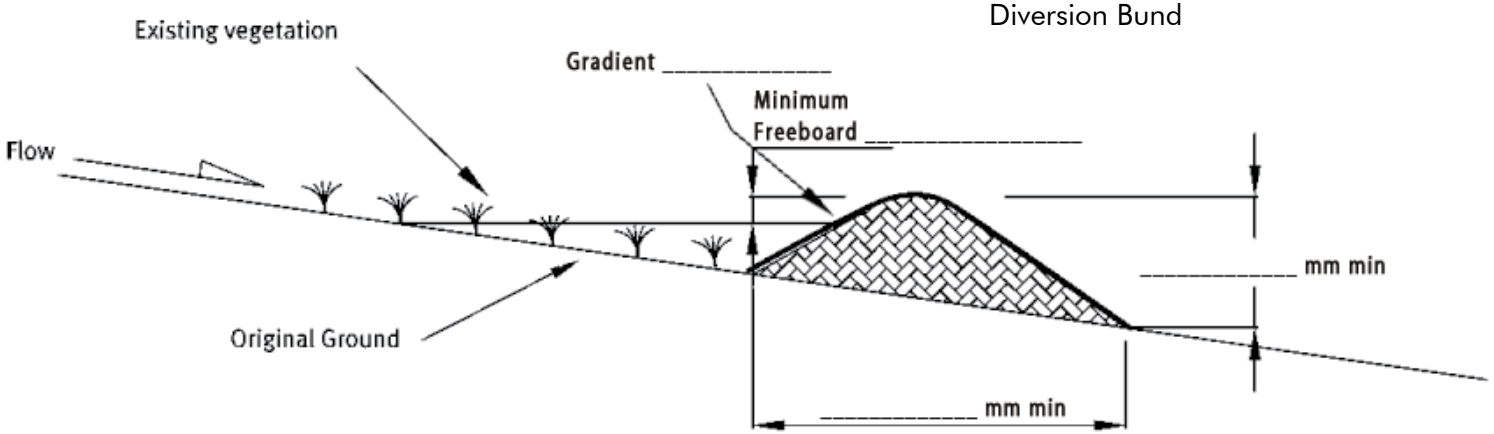
Example: Scaled drawing as built - Diversion Bund

Catchment area _____

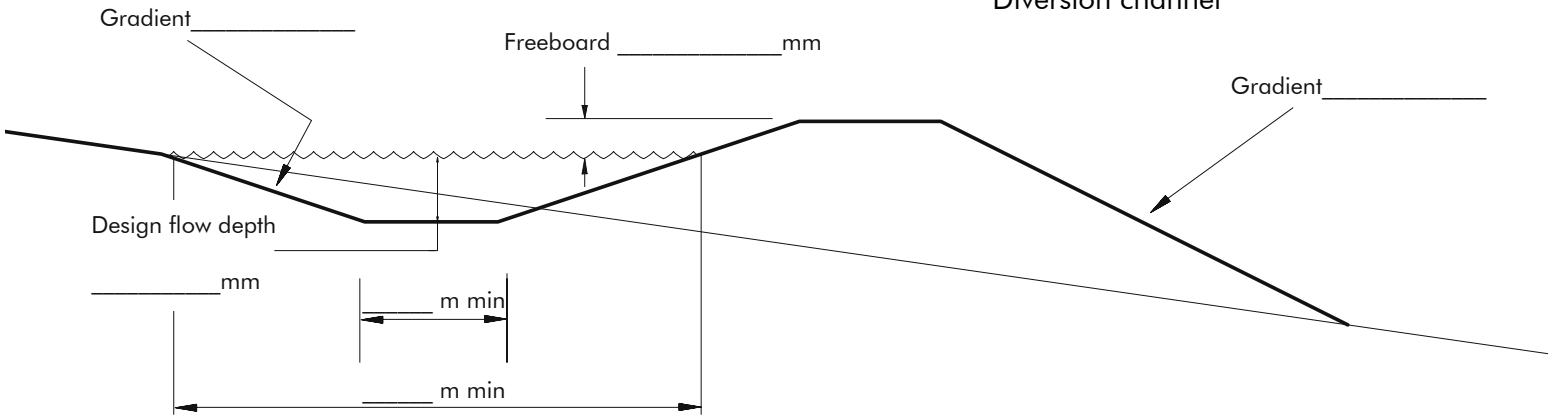
20% AEP event peak flow_____

Diversion capacity_____



Cross Section

Example: Scaled drawing as built - Diversion channel



Cross Section

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Sediment retention pond (SRP) As-built Certification Sheet

SRP name/number:

Contributing catchment area: (m^2)		
Dead storage volume and depth	Volume (m^3)	Height
Live storage volume and depth	Volume (m^3)	Height
SRP dimensions set at SRP base	Length	Width
SRP dimensions at primary spillway height	Length	Width
Primary spillway diameter		mm
Length to width ratio:		
Inlet batter 3:1	Y ☐	N ☐
Embankments adequately compacted/method of compaction		
Emergency spillway width and depth	Width	Depth
Emergency spillway able to pass 100 year event	Y ☐	N ☐
Emergency spillway stabilisation type		
Discharge point stabilised?	Y ☐	N ☐
Outlet pipe diameter		
Anti-seep collars installed	Y ☐	N ☐
Freeboard between primary & emergency spillway?	Y ☐	N ☐
Number of floating decants		
Weighted manhole riser	Y ☐	N ☐
Level spreader level?	Y ☐	N ☐
Level spreader full width of srp?	Y ☐	N ☐
Level spreader stabilisation type		
Level spreader haunched with concrete	Y ☐	N ☐
Waikato Regional Council approved variations to device (please list)		
Decant discharge rate		litres per second

Please sign below to confirm that the as-built information in this sheet is accurate and the device identified on this sheet has been constructed in accordance with the Waikato Regional Council approved Erosion & Sediment Control Plan for the site and the "Erosion and Sediment Control Guidelines for Soil Disturbing Activities", January 2009 document or Waikato Regional Council approved variations.

Suitably qualified person (name and company): _____

Signed and dated: _____

Please provide surveyed drawings of as-builts, which include all of the above details along with this certification sheet. An example of a suitable SRP as-built is attached.

Note: As-builts are not approved by Waikato Regional Council. Responsibility for construction of the structures and accuracy of the as-builts rests with the certifying agent. This list is not exhaustive and should be used to highlight some key "Erosion and Sediment Control Guidelines for Soil Disturbing Activities" requirements.

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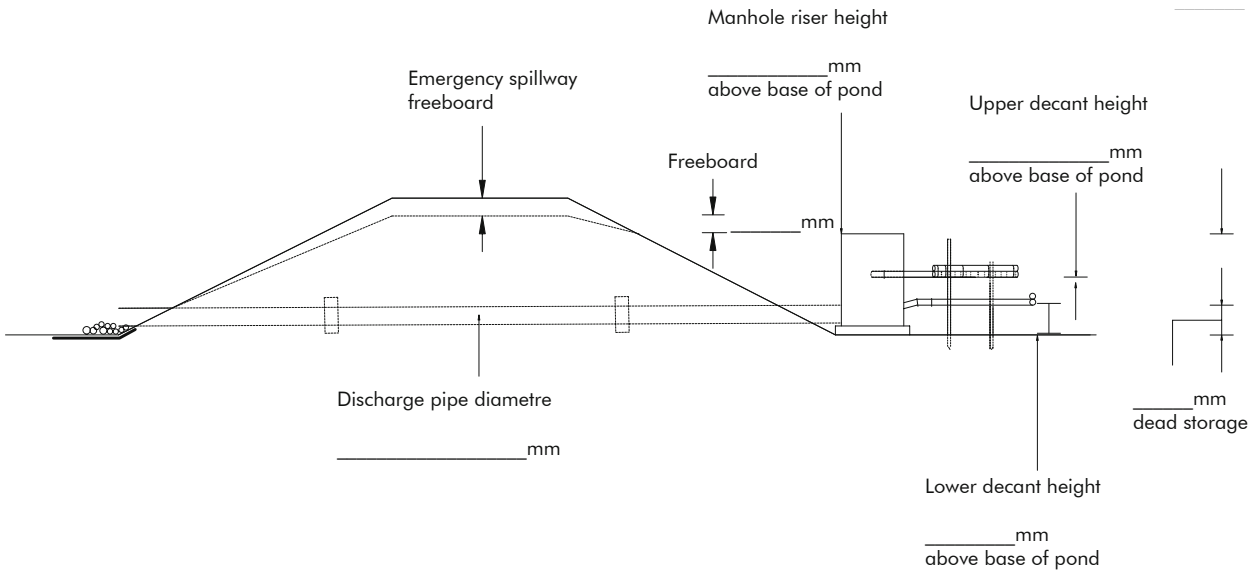
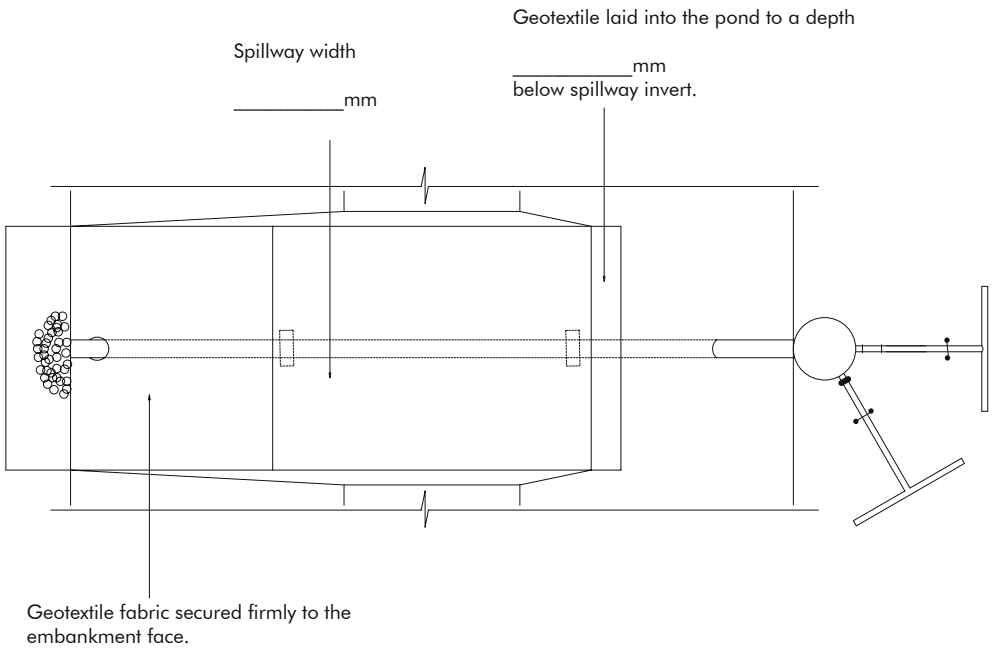


CROSS SECTION



PLAN

Example: Scaled drawing as built - Sediment retention pond

SRP No/Name _____

Catchment area _____

As built volume _____

Decant rate _____

forebay volume_____

Note: where the as built information differs from the approved ESCP or Waikato Regional Council guidelines, data supporting its compliance is to be provided.

As-Builts are not approved by Waikato Regional Council. Responsibility for construction of the structures and accuracy of the As-Builts rests with the certifying agent. This list is not exhaustive and should only be used to highlight some of the key requirements.

Silt/Super silt fence (SF) As-built Certification Sheet

Silt/super silt fence name/number:

Contributing catchment area (m^2)		
Spacing between support posts (m)		
Support wire installed	Y ☐	N ☐
Trenched into ground minimum of 200mm	Y ☐	N ☐
Joins sealed	Y ☐	N ☐
Spacing between returns (m)	Y ☐	N ☐
Length of returns (m)		
Silt fence intercepting only sheet flows	Y ☐	N ☐
Chain mesh/netting backing (super sf)	Y ☐	N ☐
Double layer of fabric (super sf)	Y ☐	N ☐
Waikato Regional Council approved variations to device (please list)		

Please sign below to confirm that the information in this sheet is accurate and the device identified on this sheet has been constructed in accordance with the Waikato Regional Council approved Erosion & Sediment Control Plan for the site and the "Erosion and Sediment Control Guidelines for Soil Disturbing Activities", January 2009 document or Waikato Regional Council approved variations.

Suitably qualified person (name and company)_____

Signed and dated:_____

Please provide drawings of as-builts, which include all of the above details along with this certification sheet. An example of a suitable silt fence/super silt fence as-built is overleaf.

Note: As-builts are not approved by Waikato Regional Council. Responsibility for construction of the structures and accuracy of the as-builts rests with the certifying agent. This list is not exhaustive and should be used to highlight some key "Erosion and Sediment Control Guidelines for Soil Disturbing Activities" requirements.

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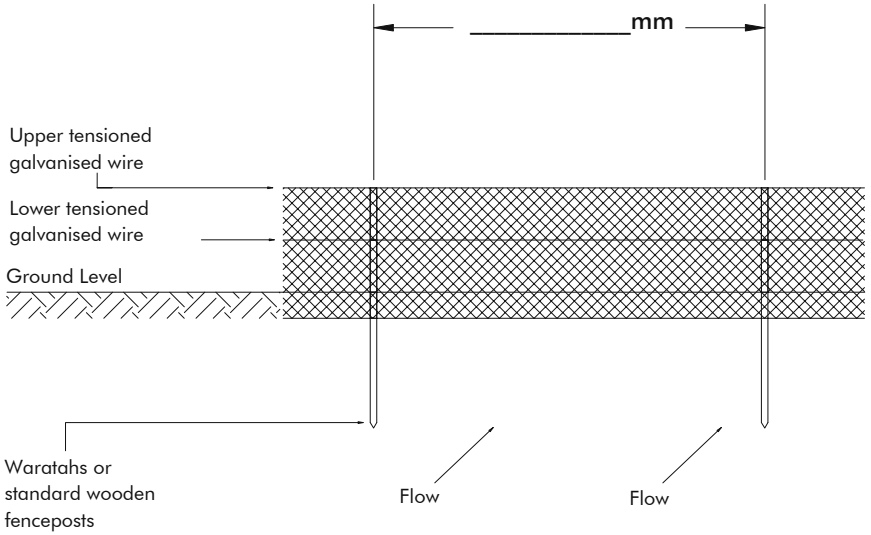
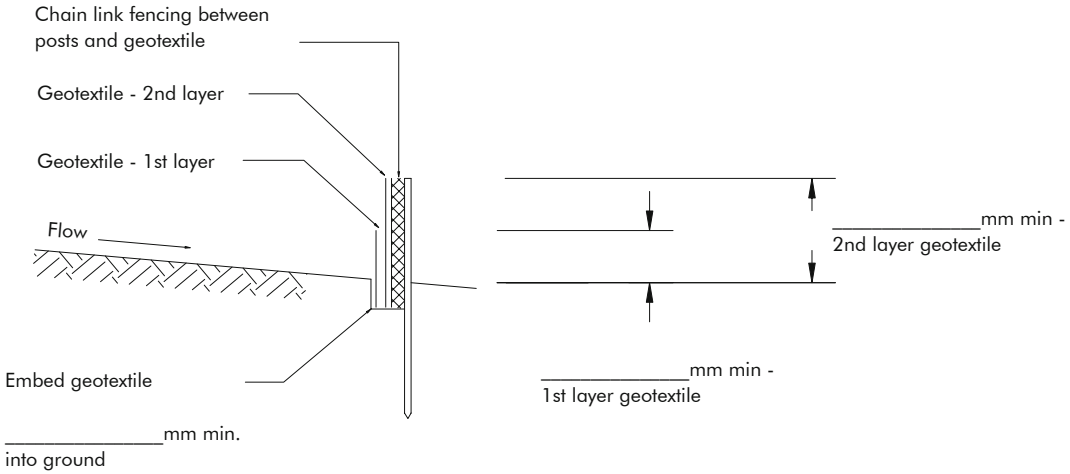
Example: Scaled drawing as built -
Super silt fence

Standard detail
for Super Silt Fence



ELEVATION



CROSS SECTION

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MARSHALL DAY Acoustics

KĀINGA ORA OHAKUNE CONSTRUCTION NOISE AND VIBRATION ASSESSMENT

Rp 001 20240008 | 7 February 2024

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Project: **KĀINGA ORA OHAKUNE**

Prepared for: **Cheal Consultants**
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533 Anglesea Street
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Attention: **Ray Kilgour**

Report No.: **Rp 001 20240008**

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Document Control

Status:	Rev:	Comments	Date:	Author:	Reviewer:
DRAFT	00	-	7 Feb. 2024	C. Fenemore	M. Cottle

Cover Photo: Creative Agency 514-806-1644

TABLE OF CONTENTS

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1.0 REPORT SUMMARY AND CONCLUSIONS

Our assessment shows that earthworks from the proposed Kāinga Ora development (the Project) will exceed the relevant construction noise limit and marginally comply with the recommended vibration amenity limit at the closest receivers. We recommend that construction noise and vibration effects are mitigated and managed via a Construction Noise and Vibration Management Plan (CNVMP). With effective management, construction noise and vibration effects from this short-term work can be acceptably controlled.

Marshall Day Acoustics has been engaged by Cheal Consultants to assess construction noise and vibration related to the proposed Kāinga Ora subdivision development, located on Teitei Drive, Ohakune. This is in response to a s92 request from Ruapehu District Council (Council) relating to an application for subdivision and land use consent.

We calculate that typical daytime construction noise will exceed the relevant Ruapehu District Plan (RDP) limits at the closest receiver by up to 6 dB.

We calculate that construction vibration will marginally comply with the recommended amenity limit at the closest receiver during the operation of a vibratory sheep foot roller.

We recommend that construction activities are managed via a CNVMP. With effective management in place, the effects will be acceptably controlled.

The report includes proposed consent conditions.

A glossary of terminology is provided in Appendix A.

2.0 PROJECT SITE AND DESCRIPTION

2.1 Site description

The Project is a subdivision development located at 6 Teitei Drive, Ohakune. The site is bounded by residential receivers on the northern, eastern and southern boundaries, and by an Active Reserve zone to the northwest.

Figure 1 shows the site location and nearby receivers. Figure 2 shows the zoning of the site and surroundings. A site plan showing the extent of earthworks is attached in Appendix B.

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Figure 1: Site location and surrounding receivers

A list of sensitive receivers within 50m of the Project is included in Table 1. If compliance is shown at these receivers, then it can be inferred with confidence for all other receivers not included in the assessment.

Table 1: Sensitive receivers within 50m

Receiver	Address/location	Zoning / Usage	Min. distance to works (m)
R1	1 Kanuka Way	Residential / dwelling	31
R2	4 Kanuka Way	Residential / dwelling	18
R3	5 Kanuka Way	Residential / dwelling	23
R4	6 Kanuka Way	Residential / dwelling	10
R5	26 Snowmass Drive	Residential / dwelling	7
R6	30 Snowmass Drive	Residential / dwelling	25
R7	30C Snowmass Drive	Residential / dwelling	24
R8	30D Snowmass Drive	Residential / dwelling	32

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Figure 2: RDP zones

https://maps.ruapehudc.govt.nz/intramaps90/?project=Ruapehu

2.2 Project description

The Project will consist of entrance earthworks to allow future development on the site.

The following plant will be used on site:

- 20T excavator
- Truck and trailer
- 4T sheep's foot roller
- Motorscraper
- 10T bulldozer

Construction will occur between 7.30am – 6pm, Monday to Saturday. Sundays and public holidays will be excluded. The construction period is expected to be 1 – 2 weeks.

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3.0 ACOUSTIC PERFORMANCE STANDARDS

RDP Rule DR3.3.1(a) requires construction noise to comply with the limits contained in NZS 6803:1999. The "short-term duration" construction limits will apply to the Project. The RDP contains no requirements relating to construction vibration, so we have applied the limits contained in DIN 4150-3:1999 as best practice.

3.1 Construction Noise

RDP Rule DR3.3.1(a) states that:

Construction noise emanating from a site shall meet the limits recommended in, and shall be measured and assessed in accordance with, NZS6803:1999 "Acoustics – Construction Noise".

The expected length of the construction project is 1 – 2 weeks. Therefore, the "short-term[1]" limits from Table 2 of NZS 6803:1999 are the relevant project limits. In summary, the limits during normal construction hours of 0730 to 1800 hours are 80 dB L_{Aeq} and 95 dB L_{AFmax}.

Refer to Appendix C for the full set of NZS 6803:1999 residential limits.

3.2 Construction Vibration

The RDP does not contain any provisions for construction vibration. We therefore recommend the following criteria based on our experience and best practice.

3.2.1 Recommended building damage criteria

For this assessment, we have applied the limits contained in DIN 4150-3:1999 "Structural vibration Part 3: Effects of vibration on structures." These limits are for avoiding cosmetic building damage, such as cracking in paint or plasterwork. Cosmetic building damage effects are deemed 'minor damage' in this Standard and can generally be easily repaired. The Standard states: "Experience has shown that if these values are complied with, damage that reduces the serviceability of the building will not occur." Much higher vibration levels (i.e., an order of magnitude higher) would be needed for potential structural damage.

The short-term (transient)[2] vibration limits in Figure 2 overleaf apply at building foundations in any axis.

[1] NZS 6803:1999 defines "short-term" as construction work at any one location for less than 14 calendar days.

[2] Short-term (transient) vibration is "*vibration which does not occur often enough to cause structural fatigue and which does not produce resonance in the structure being evaluated*".

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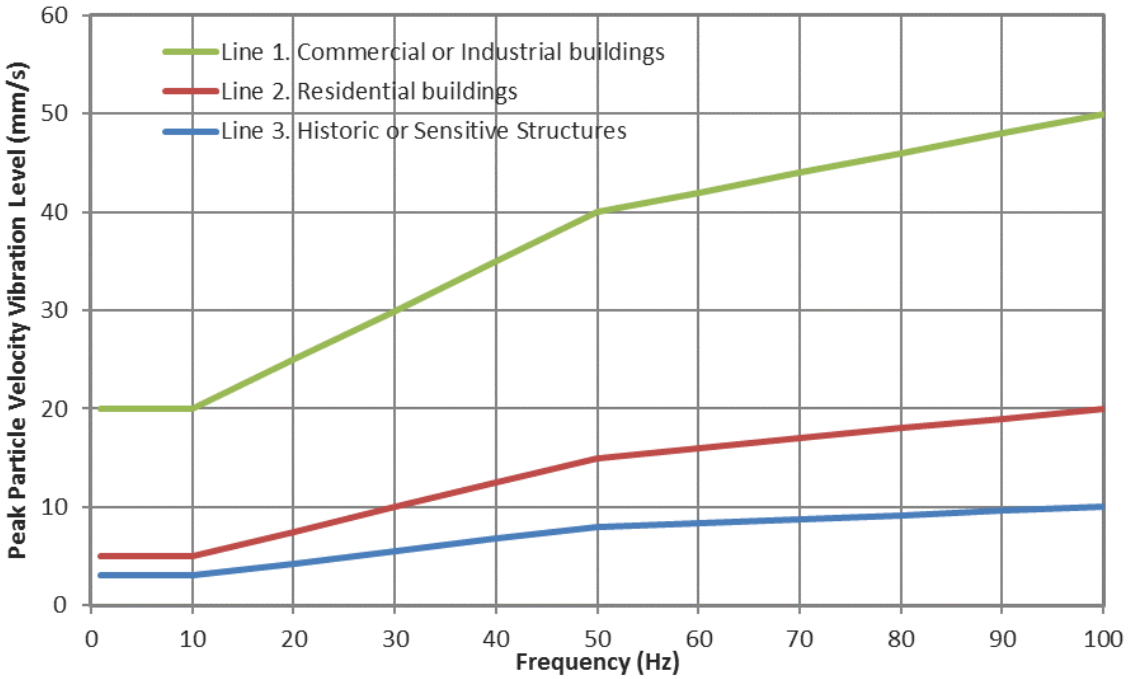
Figure 3: Short term (transient) vibration at building foundations (DIN 4150-3 1999: Figure 1)



The limits for short and long-term vibration are summarised in Table 2. Here, vibration levels apply at the highest floor rather than the foundations.

Table 2: Vibration at horizontal plane of highest floor (DIN 4150-3 1999: Tables 1 and 3)

Structure Type	Peak Particle Velocity Vibration Level (mm/s)	
	Short-term (transient)	Long-term (continuous)[3, 4]
Line 1. Commercial or Industrial buildings	40	10
Line 2. Residential buildings	15	5
Line 3. Historic or Sensitive Structures	8	2.5

3.2.2 Recommended amenity limit criterion

While the primary vibration concern is typically cosmetic building damage (Section 3.2.1), people may be disturbed at significantly lower levels. However, structural vibration damage can only occur at an order of magnitude well above the threshold of perception (Table 3).

Likely subjective responses to vibration levels are described in BS 5228[5], with additional levels added to provide a fuller picture, are shown in Table 3.

Based on our experience, we recommend an amenity criterion of 2mm/s PPV. This criterion should only be used as a CNVMP threshold to trigger communication and consultation (Section 6.1).

[3] Long-term (continuous) vibration includes types not covered by the short-term vibration definition

[4] The long-term (continuous) criteria can apply at all floor levels, but levels are normally highest at the top floor

[5] British Standard BS 5228-2:2009 *Code of practice for noise and vibration control on construction and open sites – Part 2: Vibration*

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Table 3: Subjective response to vibration levels

Vibration level	Likely subjective response
0.14mm/s PPV	Just perceptible in particularly sensitive environments
0.3 mm/s PPV	Just perceptible in normal residential environments
1 mm/s PPV	Typically acceptable with prior notification
2 mm/s PPV	Vibration would clearly be felt. However, can typically be tolerated in indoor environments such as offices, houses and retail, if it occurs intermittently during the day and where there is effective prior engagement.
5mm/s PPV	Highly unsettling for both workplaces and dwellings. If exposure is prolonged, some people may want to leave the building. Computer screens would shake, and items could fall off shelves if they are not level.
10 mm/s PPV	Likely to be intolerable for any more than a very brief period

4.0 CONSTRUCTION NOISE ASSESSMENT

We predict Project construction noise will sometimes exceed the limits contained in the RDP for the closest receivers. We anticipate noise effects from this short-term work can be acceptably controlled with the recommended CNVMP.

4.1 Calculated typical construction noise levels

We have predicted construction noise levels for the Project, shown in Table 4. The table includes the sound power level, calculated level at the three closest receivers, and the minimum distance required to comply with the construction noise limit (refer to Section 3.1).

Noise from construction activities will exceed the RDP noise limits at the closest receivers by up to 6 dB. We recommend these activities are managed via a CNVMP. With effective management and given the expected duration of the project will be no more than two weeks, we expect the effects can be acceptably controlled.

In addition, we note that many of the receivers (particularly at 30 Snowmass Drive) are intended to be booked as holiday homes for ski-field access. It may be possible to undertake these earthworks during the summer months while the dwellings are unoccupied.

Table 4: Calculated construction noise levels for three closest receivers

Equipment	Sound Power	Façade Noise Level (dB L_{Aeq})			Limit Setback (m)
	(dB L_{WA})	R1[3]	R2[4]	R3[5]	80 dB L_{Aeq}
20T excavator	103	**81**	78	73	8
Truck and trailer	105	**83**	**80**	75	10
4T roller	103	**81**	78	73	8
Scraper	108[6]	**86**	**83**	78	14
10T bulldozer	106	**84**	**81**	76	11

Notes to table:

(1) Appendix A provides an explanation of technical terms
(2) In accordance with Section C.2 of NZS 6803: 1999 results include of 3 dB facade reflection
(3) R1 represents façade of 26 Snowmass Drive located 7m from the edge of construction
(4) R2 represents façade of 6 Kanuka Way located 10 m from the edge of construction

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(5) R3 represents façade of 4 Kanuka Way located 18 m distance from the edge of construction
(6) We have used 108 dB L_{WA} assuming the scraper will be pulled by a tractor (BS5228-1:2009 Table D9.16)
(7) The maximum noise level limit (90 dB L_{AFmax}) will be readily complied with at all receivers

4.2 Construction noise prediction methodology

The contractor will develop a detailed construction programme prior to the commencement of construction activities. This will form part of the CNVMP. We have assumed an indicative construction methodology for our calculations in its absence.

We have calculated construction noise in general accordance with the method detailed in Annex D[6] of NZS 6803:1999. The method considers the sound power level, periods of operation, distance from source to receiver and screening of each source, as well as façade reflection and the degree of soft ground attenuation.

5.0 CONSTRUCTION VIBRATION ASSESSMENT

We predict construction vibration will comply with the recommended limits aside from marginal compliance with the amenity limit at the closest receiver where vibratory compaction is used. This will trigger communication and consultation with the affected receiver via a CNVMP. We anticipate the effects can be acceptably controlled.

5.1 Construction vibration high-level screening assessment

We have undertaken a high-level vibration screening assessment for construction activities. Using the identified high-vibration source we have calculated the vibration level received at the closest dwelling.

Table 5 lists the activity, the identified highest-vibration source associated with that activity and the closest source-to-receiver distance. A 4T sheep foot roller will be used during earthworks; however, these are not typically vibratory, and the use of a vibratory function is not confirmed. We have included this in our assessment for completeness.

The vibration screening assessment indicates compaction with a vibratory roller will marginally comply with the recommended 2 mm/s amenity threshold at the closest receiver. This is expected to occur only for a short period where earthworks are carried out close to the site boundary, and therefore receivers.

Given the marginal compliance, we recommend that this activity is managed via a CNVMP (where a vibratory roller is used; excludes non-vibratory compaction). An exceedance of the amenity limit will trigger communication and consultation with the affected receiver (26 Snowmass Dr). With effective management, we anticipate the effects will be acceptably controlled. This effect can be avoided by not using a vibratory roller.

Table 5: Screening summary table

Activity	Source	Min. Rec (distance, m)	Vibration Level mm/s PPV
Compaction	4T vibratory roller	7	2

[6]Annex D refers to BS5228-1: 1997 (now superseded by BS 5228-1:2009)

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6.0 MITIGATION AND MANAGEMENT

Potential management and mitigation measures are discussed below.

6.1 Communication and Consultation

The most important tool for managing construction noise and vibration is consultation and communication. Any stakeholders affected by noise or vibration levels higher than specified in this report would need to be communicated with in relation to the proposed works, including timing.

Communication should occur with stakeholders prior to works being carried out, by means of letter drop or in person.

6.2 Avoidance of Unnecessary Noise

At many construction sites it can be observed that some practices unnecessarily increase noise levels. Those include the sounding of horns when a truck is fully laden, truck air-brake release and the utilisation of audible, often tonal, reversing alarms.

These issues can be avoided, or noise levels reduced, by means of:

- changed construction site management;
- fitting of efficient mufflers to trucks;
- maintenance of equipment to a high standard; and
- the replacement of audible reversing alarms with visual or lower noise broadband audible reversing alarms.

Where these measures are implemented, they would form a part of best practice management and mitigation of construction noise.

Other unnecessary noise may include shouting, loose tail gates and noise from radios played loudly. These can be avoided with good site management and are generally addressed in any management plan.

6.3 Construction Noise and Vibration Management Plan

It is common practice for infrastructure projects of significant size to have a CNVMP as part of the Construction Management Plan. These contain information on site management, mitigation, communication, complaints procedures and similar issues.

The purpose of a CNVMP is to reduce construction noise effects through selecting the best practicable option in terms of timing of activities, equipment selection and mitigation measures (or a combination thereof).

The minimum requirements of a CNVMP are set out in NZS 6803:1999 Section 8 and Annex E.

The CNVMP should contain, but not be limited to:

- A summary of the project noise and vibration criteria
- A summary of construction noise and vibration assessment / prediction
- General construction practices, management and mitigation
- Noise and vibration management and mitigation measures specific to activities and/or receiving environments
- Monitoring and reporting requirements
- Procedures for handling complaints
- Procedures for review of the CNVMP throughout the project

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A CNVMP should be implemented for the project and some specific activities where exceedance of the noise limits is predicted. It should be kept up to date regarding actual timing / equipment use and methodologies, should these change at any point during the construction process.

7.0 RECOMMENDED CONDITIONS OF CONSENT

We propose the following conditions, should the consent be granted.

Construction Noise and Vibration

1. Construction noise shall be measured and assessed in accordance with the provisions of New Zealand Standard NZS 6803:1999 "Acoustics – Construction Noise" and comply with the limits in the following table except where authorised by the required Construction Noise and Vibration Management Plan (CNVMP) in Condition 3.

Time	Weekdays (dBA)		Saturdays (dBA)		Sundays and Public Holidays (dBA)	
	L_{eq}	L_{max}	L_{eq}	L_{max}	L_{eq}	L_{max}
0630 – 0730	65	75	45	75	45	75
0730 – 1800	80	95	80	95	55	85
1800 – 2000	75	90	45	75	45	75
2000 – 0630	45	75	45	75	45	75

2. Except as provided for in Condition 3, all construction work must comply with the vibration limits in German Industrial Standard DIN 4150- 3(1999) Structural Vibration – Part 3 Effects of Vibration on Structures when measured in accordance with that Standard on any structure not on the same site. The activity must be included in the CNVMP required by Condition 3.
3. The consent holder shall engage a suitably qualified person to prepare a CNVMP. The CNVMP shall identify the best practicable option for management and mitigation of noise and vibration, including where full compliance with the levels in Conditions 1 and 2 cannot be achieved at all times. The CNVMP shall as a minimum include but not be limited to the following information:
    (a) Construction noise and vibration criteria;
    (b) Identification of the most affected premises where there exists the potential for noise and vibration effects;
    (c) Description and duration of the works, anticipated equipment and the processes to be undertaken;
    (d) Hours of operation, including specific times and days when construction activities causing noise and vibration would occur;
    (e) Mitigation options where noise and vibration levels are predicted or demonstrated to approach or exceed the relevant limits. Specific noise and vibration mitigation measures must be implemented which may include, but are not limited to, acoustic screening, time management procedures and alternative construction methodologies;
    (f) The erection of temporary construction noise barriers where appropriate;
    (g) Schedule and methods for monitoring and reporting on construction noise and vibration;
4. The CNVMP shall be submitted to Ruapehu District Council for certification prior to construction commencing on the site.

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5. The consent holder shall, at all times, comply with the terms of the approved CNVMP.

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APPENDIX A GLOSSARY OF TERMINOLOGY

A-weighting	A set of frequency-dependent sound level adjustments that are used to better represent how humans hear sounds. Humans are less sensitive to low and very high frequency sounds. Sound levels using an "A" frequency weighting are expressed as dB A. Alternative ways of expressing A-weighted decibels are dBA or dB(A).
dB	Decibel. The unit of sound level.
L_{Aeq}	The equivalent continuous A-weighted sound level. Commonly referred to as the average sound level and is measured in dB.
L_{AFmax}	The A-weighted maximum sound level. The highest sound level which occurs during the measurement period. Usually measured with a fast time–weighting i.e. L_{AFmax}
L_w	Sound Power Level. The calculated level of total sound power radiated by a sound source. Usually A-weighted i.e. L_{WA}.
PPV	Peak Particle Velocity. The measure of the vibration aptitude, zero to maximum. Used for building structural damage assessment.
Vibration	When an object vibrates, it moves rapidly up and down or from side to side. The magnitude of the sensation when feeling a vibrating object is related to the vibration velocity. Vibration can occur in any direction. When vibration velocities are described, it can be either the total vibration velocity, which includes all directions, or it can be separated into the vertical direction (up and down vibration), the horizontal transverse direction (side to side) and the horizontal longitudinal direction (front to back).

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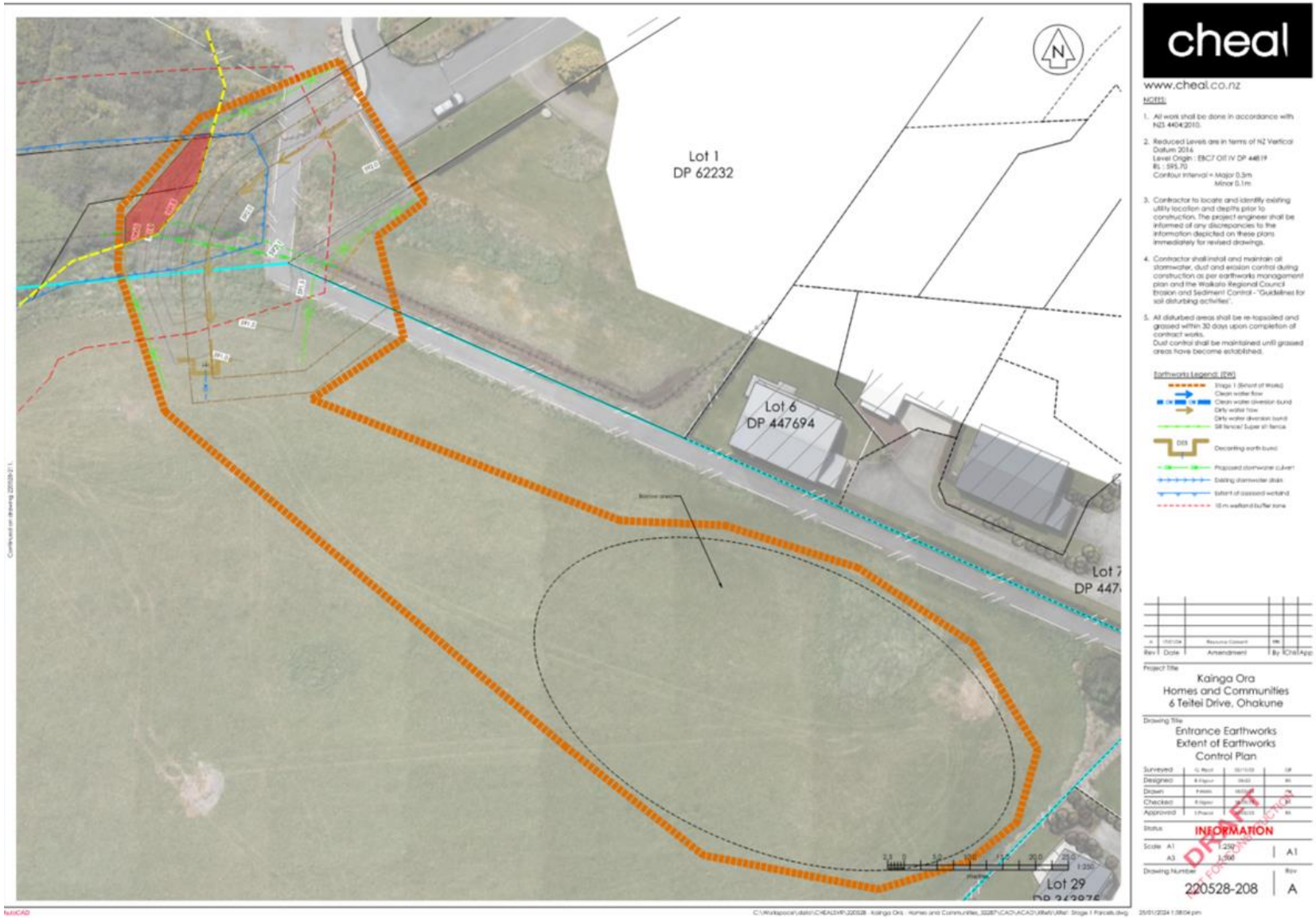
APPENDIX B SITE EARTHWORKS PLAN



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APPENDIX C NZS 6803:1999 NOISE LIMITS

NZS 6803:1999 sets out the following noise limits for residential zones.

Table 6: – Recommended upper limits for construction noise received in residential zones and dwellings in rural areas

Time of week	Time period	Duration of work					
		Typical duration (dBA)		Short-term duration (dBA)		Long-term duration (dBA)	
		L_{eq}	L_{max}	L_{eq}	L_{max}	L_{eq}	L_{max}
Weekdays	0630-0730	60	75	65	75	55	75
	0730-1800	75	90	80	95	70	85
	1800-2000	70	85	75	90	65	80
	2000-0630	45	75	45	75	45	75
Saturdays	0630-0730	45	75	45	75	45	75
	0730-1800	75	90	80	95	70	85
	1800-2000	45	75	45	75	45	75
	2000-0630	45	75	45	75	45	75
Sundays and public holidays	0630-0730	45	75	45	75	45	75
	0730-1800	55	85	55	85	55	85
	1800-2000	45	75	45	75	45	75
	2000-0630	45	75	45	75	45	75

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