ENGINEERING INFRASTRUCTURE ASSESSMENT REPORT

MURIWAI DOWNS GOLF PROJECT
FOR: "THE BEARS HOME PROJECT MANAGEMENT COMPANY LTD"
PROJECT No: 1976

Prepared by Date:

DECEMBER 2021

MCKENZIE & CO.

DOCUMENT CONTROL RECORD

PROJECT:	Muriwai Downs Golf Project
CLIENT:	The Bears Home Project Management Ltd
PROJECT LOCATION:	451, 610, 614, 670, 697 Muriwai Road, Muriwai, Auckland
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Appendices:

1. Introduction

McKenzie and Co Consultants Ltd have been engaged by The Bears Home Project Management Ltd (the Applicant) to prepare an Engineering Infrastructure Assessment report in support of the Resource Consent application for the proposed Muriwai Downs Golf Resort development (the Project).

The aim of this report is to identify and address the key infrastructure requirements relevant to the Project. The report provides information regarding potential infrastructure enhancement required to adequately service the Project pursuant to the approving authority (Auckland Council) requirements.

The report is based on publicly available information (e.g., Auckland Council GeoMaps, beforeUdig and NZ Geology Maps) as well as other specialist information and provides comment on items that will be addressed, specifically related to:

- Bulk earthworks,
- Sediment and erosion control,
- Stormwater management, treatment and disposal
- Onsite wastewater, treatment and disposal
- Onsite potable and non-potable water supply,
- Private and public roading and
- Utility services

Further specialised documents have also been prepared by MCCL in conjunction with this report to provide guidance for sustainable strategies for the Project to reduce adverse effects or impacts on the receiving environment. These documents are as follows:

- Construction Environmental Plan (CEMP).
- Dust Management Plan (DMP)

These reports should be read in conjunction with the consent application's drawings, calculations, and other supporting documents referred to in this report. We note that these reports referred to above do not extend to engineering aspects associated with golf course irrigation, drainage and internal access tracks.

It is anticipated that a Stormwater Management Plan (SWMP) will be provided for approval as part of a condition of resource consent.

2. Site Information

The subject site is located adjacent to Muriwai Road as shown in Figure 1 below:

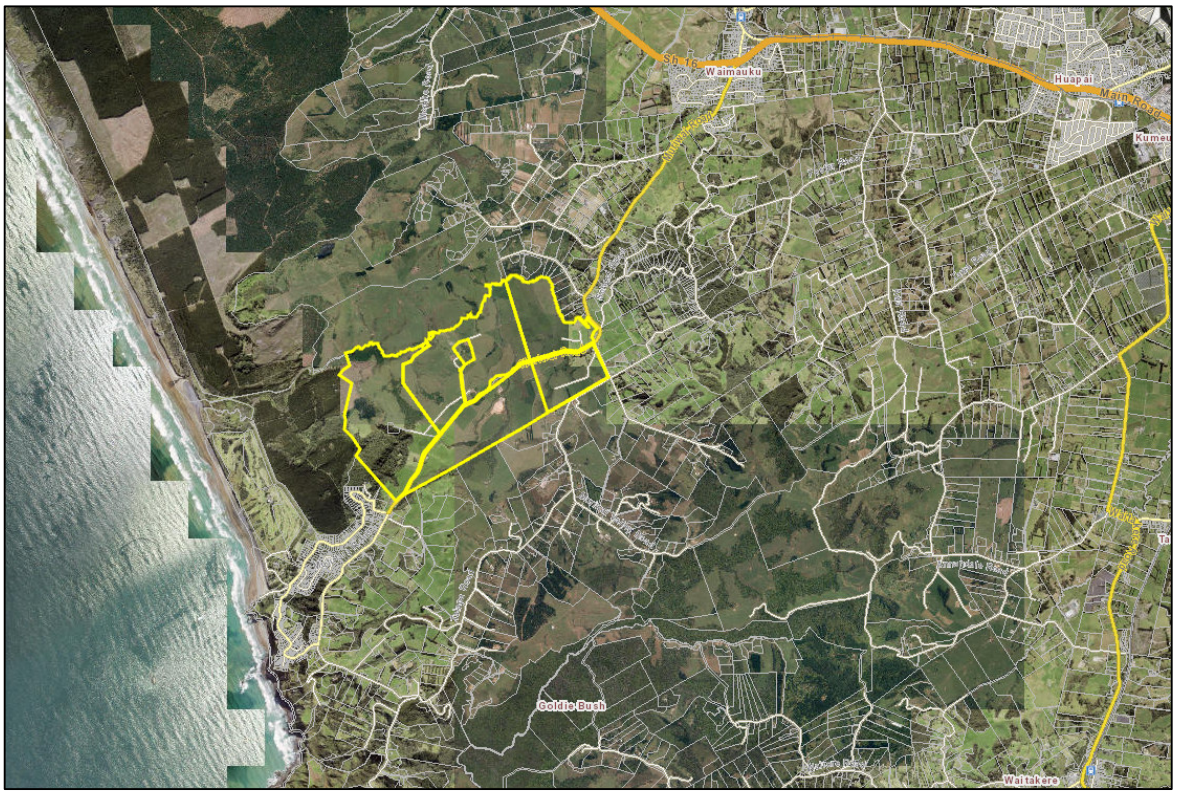

Figure 1 – Site Location (courtesy of Auckland Council GeoMaps)

2.1 Site Description

The overall site is comprised of 507 ha of pastural farmland, native bush and water bodies across various separate tittles summarised in Table 1 below. These land titles are collectively known as the Muriwai Downs Property. Muriwai Road divides the Muriwai Downs property into 2 separate portions with the northern portion more prominent in size.

The northern portion of property features land formations characterised as rolling terrain with fall generally from the more elevated southern portions near Muriwai Road towards the north boundary defined by a prominent gulley feature drained by the Ōkiritoto Stream. Midway along the Ōkiritoto Stream alignment is a series of elevation changes resulting in a series of waterfalls over rock ledges into pools below – (Ōkiritoto and Toroānui Falls). From these waterfall features the Ōkiritoto Stream continues in a west direction through a large wetland area.

There are several other incising gully features predominately across the west portion of site which form a series of intermittent streams all tributing into the main permanent Ōkiritoto Stream along the north boundary.

There is an existing sandstone quarry which operates form the southern portion of the property (697 Muriwai Road). This southern portion of the property falls from Muriwai Road in a south to southeast direction. There are three prominent gully features which consist of intermittent streams and associated wetland features. Two main streams traverse the east and western perimeters of the main quarry operation, and both join to ultimately connect into the Ōkiritoto Stream to the north via an existing culvert crossing under Muriwai Road.

The property includes pockets of high value ecological resources including kauri forest, extensive wetlands (including the Ōkiritoto Wetland) and a large inland dune lake (Lake Ōkaihau). Some of these areas are denoted as

Significant Ecological Areas (SEA) and Outstanding Natural Features (ONF) under the Auckland Council Unitary Plan (AUP).

A Quality-sensitive Aquifer Management Area also underlies much of the property hence there are provisions in the AUP that protect the water quality of this aquifer.

Table 1 - Existing Site Summary Table

EXISTING SITE SUMMARY INFORMATION	
SITE ADDRESS	• 451 Muriwai Road, Muriwai Valley • 610 Muriwai Road, Muriwai Valley • 614 Muriwai Road, Muriwai Valley • 670 Muriwai Road, Muriwai Valley • 680 Muriwai Road, Muriwai Valley • 697 Muriwai Road, Muriwai Valley
LEGAL DESCRIPTION	• Lot 4 DP 187060, Lot 3 DP 196479, Sec 3 SO 41485 (112.6571ha) • Lot 2 DP 196478 (140.8011ha) • Lot 1 DP 196478 (5.4989ha) • Lot 1 DP 187057 (143.9175ha) • Lot 1 DP 163736 (1.8781ha) • Lot 5 DP 187061 (101.4371ha)
CURRENT LAND USE	• Site predominantly utilised as pastural land use with residential dwellings and sheds located on site.
ZONE	• Rural – Rural Production Zone
CURRENT BUILDING COVERAGE	• N / A
HISTORICAL LAND USE	• Rural
OVERLAYS *(Refer to Figure 2 for AUP planning overlays)*	• Natural Resources: Significant Ecological Area • Quality-Sensitive Aquifer Management Areas – Kaipara Sand Aquifer (rp) • Natural Resources: Lake Management Areas Overlay (Natural and Urban Lake) [rp] - Lake Okaihau, Natural • Natural Heritage: Outstanding Natural Features – Toroanui and Okiritoto Falls (within 610 Muriwai Road) • Natural Heritage: Outstanding Natural Features Overlay [rcp/dp] - ID 225, Toroanui and Okiritoto Falls • Natural Heritage: Outstanding Natural Features Overlay [rcp/dp] - ID 72, Lake Okaihau

Refer to Figure 2 (below) for AUP Overlay Map of the site:

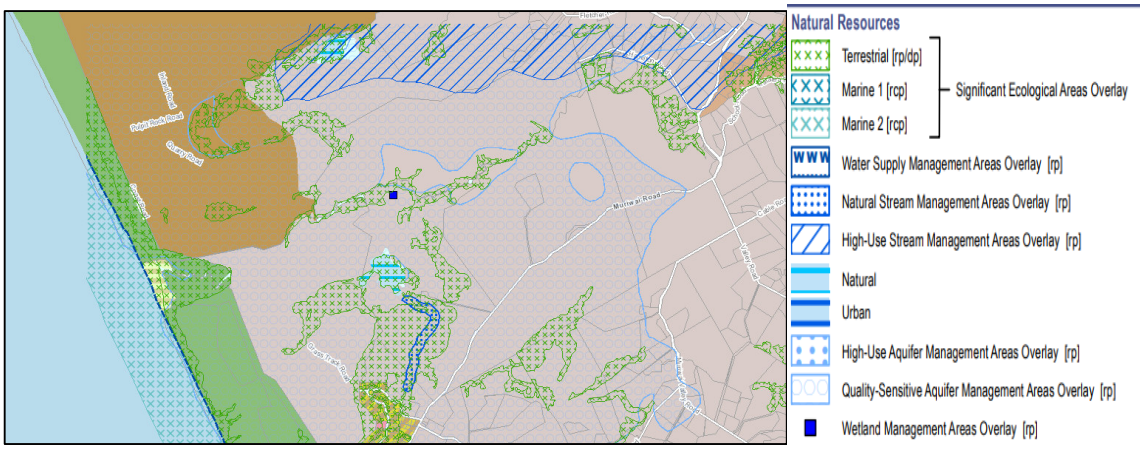

Figure 2 – Auckland Unitary Overlay Plan (Courtesy AUP GeoMaps)

2.2 Geology

With reference to NZ Geological Mapping: 1:250,000 Map of Auckland Area, refer to Figure 3 (below), there is indication that the site is primarily, underlain with cemented dune sands and associated facies (i.e., Awhitu Group).

Across the eastern portion of the site, there is evidence of alluvial deposits (Tauranga Group) and a small area located across the central portion to the site that will be underlain with basalt flow and pillow lavas (i.e., Waiatarua Formation).

Across the northern and southern portions of the site there are small areas of volcaniclastic sandstone and siltstone (i.e., Nihotupu Formation). Towards the western portion of the site the geology map indicates the presence of mobile sand dunes (i.e., Kariotahi Group).

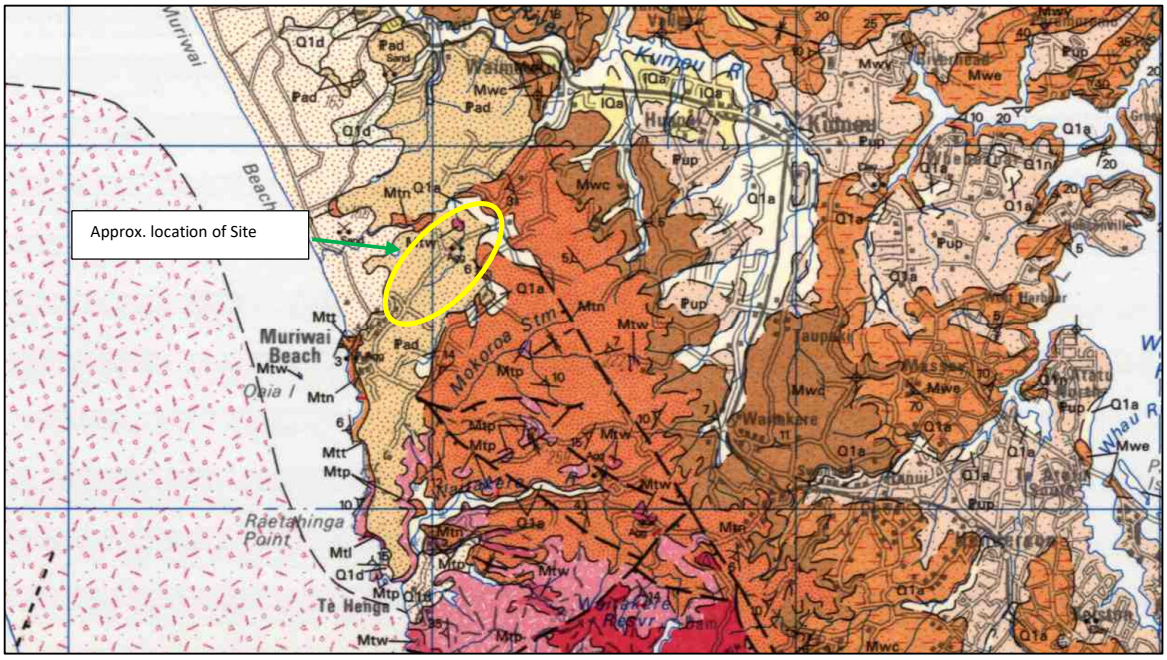

Figure 3 - Site Geology Map Auckland 1:250,000 (Courtesy of GNS)

Landers Geotechnical Consultants Ltd (LGC) have undertaken a Geotechnical Investigation to ascertain and identify any broad geotechnical constraints for the Project (see Appendix 4 of the AEE). The particular focus for the LGC's site investigation was to assess geotechnical suitability and stability of the land earmarked for the future development of the proposed Lodge, Clubhouse, Sports Academy and the Golf and Property Maintenance Complex

(GPMC). The Geotechnical Investigation Report (GIR) prepared by LGC provides further detailed information to help inform future earthworks and construction stages. For further detailed information refer to the report attached to the AEE (Appendix 4).

A further detailed geological mapping assessment was carried out by Riley Consultants Ltd at the proposed water reservoir site. The Geotechnical Investigation Report (GIR) prepared by Riley's provides further detailed information to help inform future earthworks and construction stages particular to the water reservoir. For further detailed information refer to the report attached to the AEE (Appendix 4).

3. The Project

The Project comprises the construction, operation and maintenance of the following physical site components:

- An international, marquee standard 19-hole golf course with warm-up fairway and short-game practice area;
- A Clubhouse;
- A Sports Academy including; an academy building, academy driving range, practice green, 9-hole short course, and indoor and outdoor tennis facilities;
- A Golf and Property Maintenance Complex;
- A Luxury Lodge which includes accommodation, a wellness centre and retreat;
- Dining facilities including a clubhouse and lodge restaurants and a café at the Sports Academy;
- Groundwater and surface water abstraction facilities;
- Off-line water storage reservoir;
- Significant ecological restoration and enhancement works; and
- Various supporting infrastructure associated with the above items.

Refer to Figure 4 (below) and MCCL engineering drawings (Appendix A) for details pertaining to the Project layout.

Figure 4 – Proposed Preliminary Master Plan Layout (Courtesy of Kyle Phillips Golf Course Design)

3.1. Lodge

The lodge is proposed to be located within the western portion of the site east of Lake Ōkaihau. It will include the following;

- Carparking;
- Main lodge building including:
- Reception;

- Office space;
- Toilets;
- Kitchens;
- A bar;
- Indoor and outdoor dining;
- Lodge Suites;
- A yoga / meeting room;
- A plant and equipment room, easily accessed from the covered throughway.
- A range of accommodation units, a lodge residence and a retreat
- A wellness centre, separated from the main accommodation areas in a private corner of the lodge complex footprint.

The footprint area of the Lodge is approximately 8ha. The wellness centre will be located to the southeast portion of the main resort lodge area and will host wellness centre building, various pools, saunas, and spa facilities.

Stormwater and wastewater from these amenities will be managed as part of the wider Project reticulation and treatment infrastructure as detailed in the supporting engineering drawing package at Appendix A. Appropriate treatment prior to disposal to the receiving environment will be carried out in accordance with Auckland Council and New Zealand Building Code regulatory standards (i.e., green roof, private reticulation, soakage pits, raingardens, swales, and stabilised outlets). Design will be further detailed at the Building Consent stage.

Potable water supply is proposed to be provided via an onsite production bore and pump facility located southeast of the Lodge.

The Lodge will host various connecting service lanes, paths and carparking facilities which will all be connected to a main private access road (Roads 2 & 8 as shown on Mckenzie and Co drawing 1976-1-300 series) providing access to and from Muriwai Road. This private access road (Road 1) will form the main access to both the lodge and clubhouse and will require some upgrading works for connection onto Muriwai Road in accordance with Auckland Transport Code of Practice (ATCoP).

3.2. Golf Course

The proposed 19-hole golf course is to be constructed across the northern, western, and central portions of the Property. The golf course comprises the following features:

- 19-holes of golf;
- Two practice greens;
- A warm-up fairway;
- A short game practice area; and
- Various tracks and paths.

Two restrooms and rain shelter areas are also included – one near the 7th tee and the other within a "Halfway House" near the 12th and 17th tees.

Various pedestrian and golf cart pathways will also be constructed to connect access to each golf hole. These works will include constructing some bridges (i.e. boardwalks) over the wetland (SEA) areas.

3.3. Clubhouse

The proposed Club house building (approx. 1,500m^2) will be located to the east of the Lodge area.

The Clubhouse facility will include the following:

- Carparking;
- Entry lobby;

- A pro shop;
- Administration space;
- Restaurant and bar space;
- A member's lounge;
- Guest toilets;
- Golf cart storage;
- Bulk storage areas;
- A maintenance and equipment room;
- A caddie area;
- Administration space;
- Male and female changing rooms with showers, basins, and toilets; and
- A kitchen.

Stormwater and wastewater for the Clubhouse and amenities will be managed as part of the wider Project reticulation and treatment infrastructure as detailed in the supporting engineering drawing pack. Appropriate treatment prior to disposal to the receiving environment will be carried out in accordance with relevant regulatory standard requirements (i.e., green roof, private reticulation, raingardens, swales, and stabilised outlets). Design will be further detailed at the Building Consent stage.

Potable water supply is proposed to be provided via the same onsite production bore and pump facility supplying the Lodge.

A main carpark facility (approx. 4,150m^2) will be located to the southeast of the main Clubhouse building and will be accessible via the proposed main private access road (Road 1) from Muriwai Road. The Clubhouse will host a series of sealed pedestrian paths for connection to the golf course, carpark and warm-up facility.

3.4. Sports Academy

The proposed Sports Academy will be located within the central portion of the Property and will comprise:

- Carparking;
- Two entry lobbies;
- A staff break room;
- A storeroom;
- Toilets with day lockers and showers;
- Two physiotherapy rooms;
- A meeting room;
- Four indoor teaching studios;
- A multi-purpose room;
- Office space;
- 16 covered hitting bays;
- A café comprising necessary kitchen and storage spaces;
- A golf practice green;
- A 9-hole short golf course; and
- Tennis facilities (including toilets) providing both indoor and outdoor playing options.

Stormwater for the Sports Academy and amenities will be treated and disposed onsite in accordance with regulatory standard requirements (options for treatment and disposal include private reticulation, raingardens, swales and stabilised outlets). Wastewater for the Sports Academy will be managed as part of the wider wastewater Project

reticulation, treatment and disposal infrastructure as detailed in the supporting engineering drawing pack. Appropriate wastewater treatment prior to disposal to the receiving environment. Design will be further detailed at the Building Consent stage.

Potable water supply is proposed to be provided via onsite rainwater harvesting tanks with reserve supply to be topped up from the water supply from the onsite production bore.

The Sports Academy complex will host a carparking facility adjacent to the main building which will connect to a second main private access road (Road 5) off Muriwai Road. This private access road will form the main access to the academy, GPMC s and existing private residence and farm buildings and its current connection to Muriwai Road will require relocating towards the west and will be designed in accordance with ATCoP.

3.5. Golf and Property Maintenance Complex

The proposed Golf and Property Maintenance Complex (GPMC) will be located to the north-east of the Sports Academy. The GPMC will be comprise the following:

- An equipment store / workshop;
- A fuel area that will be covered with a roof and bunded;
- A biological wash water recycling area;
- Offices for golf course maintenance staff (GMC Offices);
- A chemical / fertilizer storage building;
- Materials bays for sand, gravel etc;
- A dedicated space for green waste / compost / rubbish / recycling;
- A bulk store; and
- An operations building.

Stormwater for the GPMC will be treated and disposed onsite in accordance with regulatory standard requirements (options for treatment and disposal include private reticulation, raingardens, swales and stabilised outlets). These will be further detailed at the Building Consent stage. Wastewater for the GPMC will be managed as part of the wider wastewater Project reticulation, treatment and disposal infrastructure as detailed in the supporting engineering drawing package – (Appendix A). Design will be further detailed at the Building Consent stage.

Similar to the Sports Academy, potable water supply is proposed to be provided via onsite rainwater harvesting tanks with reserve supply to be topped up from the water supply from the onsite production bore.

The GPMC will have staff carparking facilities which will be accessible via the extension to the second private access road (Road 5) servicing the Sports Academy which will be connected to Muriwai Road.

3.6. Water Reservoir

It is proposed to construct a lined water reservoir (volume = 140,000m^3) on the southern side of Muriwai Road (451 & 697 Muriwai Road) for onsite irrigation purposes. This formed reservoir will store water sourced from:

- A production bore located to north of Muriwai Road,
- A high flow intake from the Rarautaua Stream.

Water supply to the reservoir and onto the irrigation network will be distributed via a pressure network which will be further detailed at the Building Consent stage.

3.7. Private Residences

The existing residences (i.e., 451, 610 & 614 Muriwai Road) across the property will be retained. Onsite amenities (e.g., stormwater, wastewater and water supply) for these dwellings will remain unchanged.

4.0 Earthworks

4.1 Summary of Site Geological Conditions for Earthworks

Bulk earthworks will be required to achieve the desired design and layout requirements for the golf course development and other built elements of the wider Project.

Two separate geotechnical investigative assessments were carried out for the Project with assessment for the land proposed for development of the Lodge, Clubhouse, Sports Academy, GPMC and golf course conducted by LGC, which is attached to the AEE (Appendix 4 of the AEE).

A second detailed geological mapping and geotechnical investigation of the land designated for the proposed water reservoir was conducted by Riley Consultants Ltd, which is attached to the AEE (Appendix 4 of the AEE).

A summary of these reports concluded the following based on the current layout for the Project:

- Lodge:

Steeper landform with ground exhibiting soil creep/seated slope instability is evident across the western portion of site. A building line restriction has been imposed based on results of the slope stability analysis. Areas subjected to development within this restriction zone will require specific engineering mitigation measures to meet acceptable minimum factor of safety (FOS). These may include a palisade wall with anchors. These would be subject to further investigation at the detailed design stage.

Generally, the buildings and infrastructure in locations outside these limit zones are anticipated to lie upon the Awhitu geology group of soils. These would be suitable for undertaking earthworks and are expected to be suitable for NZS3604 foundation systems having ultimate bearing capacity of 300 kPa. The soils are likely to be classified as Class S (slight) to H (high) which will be subject to further investigations and laboratory testing for confirmation at detailed design stage and confirmed in the geotechnical completion report.

- Clubhouse/Sports Academy and GPMC:

Gentle rolling landform with no perceived geotechnical constraints, provided that the amenity buildings and structures are set back from the steep sides to the existing gully features in proximity.
Similarly, these amenities are proposed to be located in the central portion of the site where underlying soil geology is likely to be Awhitu group, which should be anticipated as suitable for earthworks and NZS3604 foundations systems.

- Golf Course (i.e., fairways, greens, and tee's):

No perceived geotechnical constraints. Large scale earthworks may be required in some areas to achieve the desired landform and golf course geometry, so it is recommended that further geotechnical analysis on any potential land stability issues should be undertaken in the final earthworks design process. LGC also recommended for permanent cut and fill batters up to 2m height and angle no steeper than 1(v) in 2(h) should be acceptable and should be planted or stabilised as soon as is practical to minimise risk of erosion to sandy soils.

- Water Reservoir

The geology of the site designated for the reservoir is generally comprised of mostly sandy dune deposits (i.e., Awhitu geology).

Liquefaction and slope stability analysis were carried out with no liquefaction considered to present any credible risk. Slope stability was assessed under several scenarios, and all appeared to achieve the minimum FOS requirements with deformation predicted to be <5mm.

Riley's have recommended that a synthetic liner is used and that counterfort drains should be applied along the rear cut area to minimise and reduce the risk of surficial saturation. For further details pertaining the proposed Water Reservoir, refer to MCCL Engineering Drawings (Appendix A).

It should be noted that further specific investigations are to be carried out to confirm specific parameters for design

for the water reservoir spillway based on the recommendations outlined in the Riley's Geotechnical Investigation Report (GIR) – attached in AEE (Appendix 4).

In summary, all geotechnical related construction works for the Project shall be undertaken in accordance with the recommendations, and under the supervision of the Project's geotechnical engineers. A geotechnical completion report will be prepared at the completion of all the civil and bulk earthworks for this application by a suitably qualified Geotechnical Engineer.

4.1.1 Earthworks near Lake Okaihau

WWLA have carried out a Water Balance Assessment '*Lake Ōkaihau, Lake Water Balance Assessment*' (Appendix 7 of the AEE) on the existing Lake Ōkaihau and have recommended that assuming that no deep excavations or deep (>2m) linear infrastructure installed (such as pipe trenches) that could potentially enhance seepage losses from the lake, the lake water balance will remain unchanged. This recommendation has been taken into consideration and only minor/shallow graded earthworks are proposed in this area therefore avoiding any seepage losses.

4.2 Earthworks and Management

Earthworks will be carried out in the general areas as depicted on MCCL Earthworks Drawings attached in Appendix A.

Earthwork's operations will be carried out to undertake the:

- Site clearance and establishment of Environmental controls.
- Land Contamination Management.
- Formation of golf course landform to desired gradients and geometry.
- Construction of subsoil drainage.
- Formation of golf course amenities (e.g., warm-up fairway and other golf playing areas).
- Formation of building platforms.
- Formation of water storage reservoir.
- Construction of the private roads and carparking facilities.
- Construction of private drainage (SW & WW) and water supply reticulation.
- Installation of utilities (e.g., power and telecommunication).

Earthwork operations within the Awhitu group soils are likely to comprise mainly sandy material making earthworks easy to execute with conventional plant and machinery. Cut slopes in these types of soils are prone to scour and erosion if left unprotected and exposed to rainfall and surface flows. To reduce the time of the open face exposure, stabilisation of these slopes will be undertaken as soon as practical.

Materials in the eastern lower lying areas are likely to be of Tauranga Group alluvial type material. These materials could potentially be high in moisture content. Should materials borrowed from these lower lying areas for engineered fill be high in moisture content, they may require conditioning by air or combination of lime/cement mixing with dryer materials. During the earthwork's operations onsite investigation and laboratory testing of in-situ samples may be required to determine optimal compaction control for the specific materials being place as engineered fill. This determination will be provided by advice from the geotechnical engineer base on the test results.

A preliminary assessment of the proposed volumes for the earthwork operations has been undertaken with the earthwork quantities estimated by comparing the existing surface before stripping topsoil, and the proposed finished surface (i.e., finished levels.).

The estimated volumes are as follows:

Golf Course and Amenities (North side)-:	Earthworks Area	= 917,000 m^2
	Cut (solid measure)	= 440,000 m^3
	Fill (solid measure)	= 439,000 m^3
Water Reservoir (South side)-:	Earthworks Area	= 83.050 m^2
	Cut (solid measure)	= 150,000 m^3
	Fill (solid measure)	= 150,000 m^3

It is envisaged that all the fill material will be sourced from on-site excavations, and surplus material and topsoil will be disposed on site where possible.

The earthworks will be managed and mitigated in accordance with Auckland Council (Council) Guideline Document 2016/05 "Erosion and Sediment Control Guide for Land Disturbing Activities in the Auckland Region (GD05)".

The earthworks will also be undertaken in accordance with the design drawings and engineering specifications prepared by MCCL with advice from the golf course architect and geotechnical engineer. It is proposed to carry out all permanent earthworks to an engineered standard (with supervision, testing, and completion documentation carried out by the geotechnical engineering professional).

It should be noted that the ground profile may be further refined during the detailed design phase to optimise and reduce the volume of cut-to-waste. However, levels are not envisaged to change significantly from those shown on the engineering drawings at Appendix A.

4.3 Earthworks Concept

Inclement weather conditions (e.g., significant rainfall events, high winds) and the extended use of heavy earthmoving plant and equipment will tend to generate sediment runoff. Planning and design of the proposed earthworks activities are required to allow development of the site and ensure all adverse environmental effects are minimised. In particular, the staging and sequencing of earthworks activities, with the inclusion of specifically designed erosion and sediment control devices, have been proposed. Particular attention has been given to the risk of sediment contamination of the receiving environment (i.e., streams and wetlands) and the spread of dust emission from the earthworks and construction activities. The result of this approach should significantly reduce the volume of sediment leaving the site, thus protecting receiving environments from excessive sedimentation and water quality degradation.

The general principles adopted during the earthwork's activities, which will be incorporated in the Environmental Sediment and Erosion Control Plan (ESCP), are as follows:

- Install sediment controls (silt fences) around any Kauri Dieback contaminated areas and carryout works as per the Kauri Die Back Guidelines.
- Minimise the disturbance area due to earthwork activities as much as practically possible by staging earthworks and progressively stabilising exposed areas following completion.
- Where possible, divert all clean water runoff away from the works affected areas (e.g exposed/unconsolidated), thus reducing the contributing catchment to the exposed earthwork areas.
- Intercept and divert sediment-laden runoff (i.e., dirty water) from exposed areas to specifically designed treatment devices prior to discharging into the downstream environment.
- Regularly monitor and inspect the erosion and sediment control devices and undertake any maintenance necessary to maximise their efficiency and effectiveness.

- Implement measures to prevent construction traffic tracking sediment and other materials attached to the undercarriage and tyres onto Muriwai Road.
- In the event of forecasted inclement weather conditions, stabilise the site as far as practicably possible and if required close operations that may be impacted down. Inspect measures following the passing of the inclement weather conditions prior to remobilising activities.
- Ongoing assessment of the erosion and sediment control measures and, if situation arises, make adjustments to earthwork processes and procedures and /or sediment controls.
- Ensure site staff and sub-contractors have adequate training and are aware of the requirements of the ESCP and the relevant resource consent conditions prior to the works commencing.

These principles are generally in accordance with Auckland Council Guideline Document GD05. Furthermore, the future earthworks contract developed for the site will place specific responsibilities on the Contractor for the environmental management of the site. As part of this management, the Contractor will be responsible for providing an Environment Management Plan and implement adequate erosion and sediment control measures to protect downstream receiving environments.

4.4 Staging of Construction & Methodology

Due to nature and size of the Project, earthworks and construction activities will occur at several differing locations across the site simultaneously. The preliminary earthworks approach is to stage the activities (as indicated in Figure 5) to make earthworks and construction more manageable and efficient.

One approach taken, could see the site separated into 4 main phases of works as depicted in below:

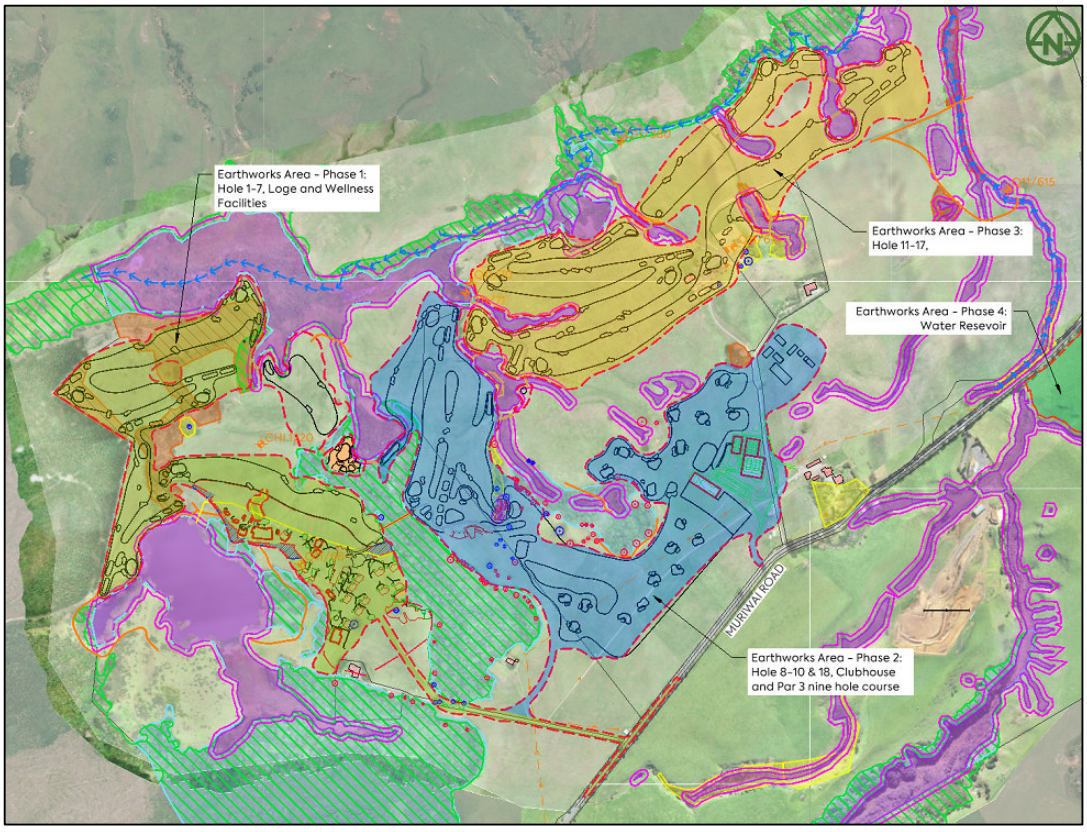

Figure 5 – Site Layout with Preliminary Earthworks Staging concept

Phase 1 would potentially consist of Holes 1-7 of the golf course including the Lodge and Wellness facilities.

Phase 2 would encompass Holes 8-10, 18 of the golf course, the Clubhouse, Sports Academy, Maintenance Facility

and including surrounding amenities (e.g. driving range and par 3 course)

Phase 3 would encompass Holes 11-17 of the golf course.

Phase 4 would be the Water Reservoir works and could be operated independently due to the location of the works area on the opposite side of Muriwai Road away from the main development area of works to the northwest.

The stages shown above have been conceptually outlined in the Contractors final Construction and Environmental Management Plan (CEMP), however final details for the proposed phasing of works will need to be discussed and agreed between the selected Contractor, Engineer, and the principal (i.e., the applicant) based on more detailed methodology. Once agreed and approved this phasing strategy will be finalised in the CEMP and will require approval from the regulatory authority prior to commencement of the works.

4.5 Land Contamination

A Detailed Site Investigation (DSI) has been prepared by Pattle Delamore Partners Ltd (PDP) which supplements further detail to the previous Preliminary Site Investigation (PSI), which are attached to the AEE (see Appendix 6). Various areas across the site which were categorised under the Hazardous Activity and Industry List (HAIL) and these areas identified were further investigated with soil sample retrieved for testing to determine the likelihood of human health and environmental risk.

The areas identified in the PSI were as follows and as shown in Figure 6 below:

- Historical Kumara Crop located in the centre of the site near Muriwai Road.
- A sheep spray shower and Woolshed area located in the central north portion of site.
- Storage area for treated timber.
- Historical boarding house located in the northwest corner of site.

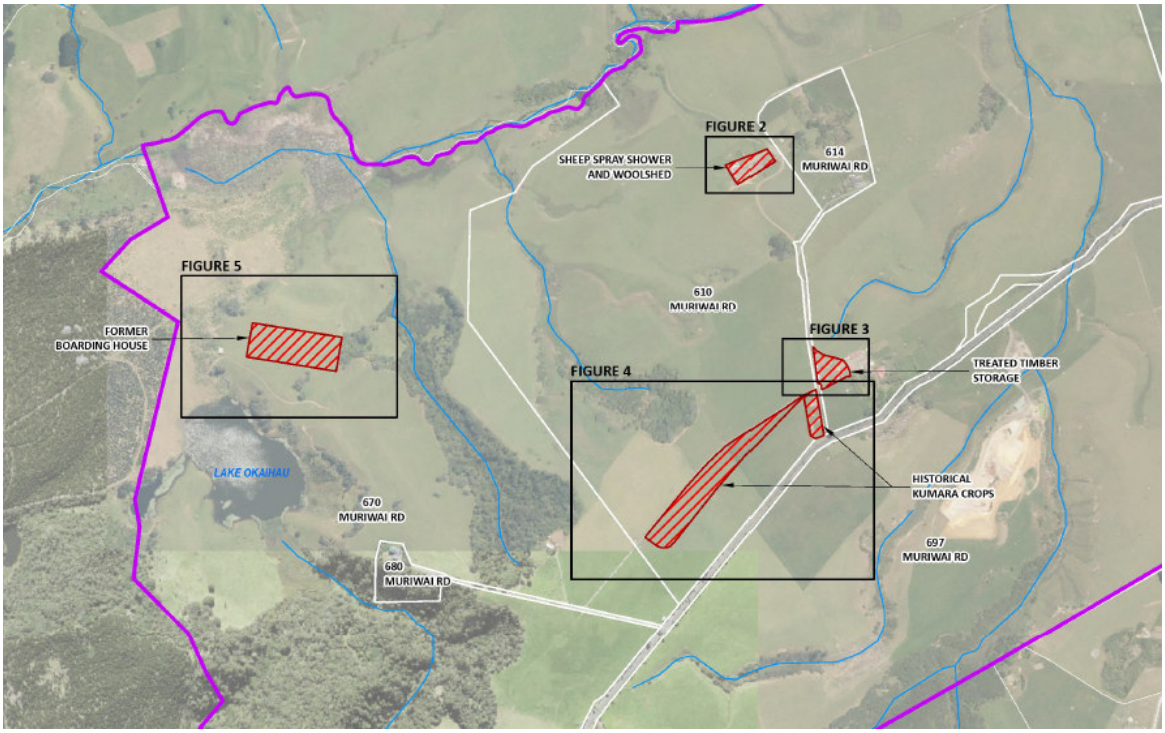

Figure 6 - Location of sampling areas (Courtesy of PDP)

The recommendations based on the finding from the PSI are summarised below:

- Soil disturbance and change in land use associated with the Project is not considered to pose any unacceptable risk to human health nor the environment.
- The Applicant does not require a consent for contaminated land rules under the AUP, however a controlled

activity consent for the proposed soil disturbance will need to be sought.

- A Site Management Plan (SMP) will be required prior to undertaking any land disturbing activities (i.e., earthworks) and this will detail the appropriate soil handling and disposal measures to be implemented by the Contractor.
- Soil from the locations of the former boarding house, sheep spray shower and woolshed including the timber storage area cannot be considered as clean fill and hence cannot be re-used onsite. These soils will need to be disposed of at an appropriately licenced disposal facility. This does not apply to soil disturbance within the area demarked as the historical kumara crops area.

The Contractor will be required to carry out the works in accordance with SMP. These areas of works remediated will need to be inspected by the site Contamination Specialist who will inspect for clearance prior to issuing the Site Validation Report (SVR).

4.6 Erosion and Sediment Control

The management and design of the sediment, erosion, and dust control measures at the site have been assessed based on the total area of the earthwork activities. Refer to drawings 1976-1-230 series in Appendix A for details of the PreliminaryESCP. The following outlines methods to mitigate the effects of the proposed land disturbing activities at the site and provides preliminary designs for specific devices based on the proposed staging of the works.

It should be noted that due to the sensitive receiving environment, a conservative approach for sediment control measures has been taken with all ponds and decants proposed to be oversized to accommodate larger rain events that is specified in GD05. Additionally, the approach also proposes to install additional secondary devices downstream of sediment retention ponds (SRP) and dirty water diversion bunds for additional protection of these sensitive areas.

4.6.1 Sediment & Erosion Mitigation Measures

The following control measures will be implemented by the contractor to control sediment-laden runoff and to prevent erosion of exposed and unconfined ground. These control measures are in accordance with GD05. Typical details of the preliminary concepts are shown on MCCL Drawings: 1976-230 – 244 (Appendix A).

It is anticipated that a condition of consent will stipulate that the final Sediment and Erosion Control measures will be proposed by the Contractor and approved by the council prior to works starting. Below are the assumed measures that will be carried out as a minimum.

- Stabilised Construction Entrance and Wheel Wash

A stabilised entrance consisting compacted aggregate on a filter cloth base will be located at the two proposed intersections with Muriwai Road where construction traffic will be entering and leaving the site. This will prevent the site access becoming a sediment source; minimise dust generation and the tracking of soil and sediment onto Muriwai Road. Minimum specification for stabilised entrances in accordance with GD05 is as Figure 6 below:

Table 9: Stabilised entranceway specifications

Design parameter	Specification
Aggregate size	50 - 150 mm washed aggregate
Minimum thickness	150 mm
Minimum length	10 m
Minimum width	4 m

Figure 7 – GD05 Table 9: Stabilised Entrance Specifications

Wheel wash facilities shall be incorporated for the construction entrance points. Wheel washes will consist of a shallow pit (stabilised with roading aggregates) and will be filled with water. The purpose of the wash is to clean the tyres of construction vehicles and therefore, reduce the amount of sediment being tracked onto Muriwai Road. Shaker ramps similar to cattle stops will be installed adjacent to the wheel wash. These will help displace sediment from construction vehicle tyres and will also allow for additional cleaning of tyres by water blasting if required (with runoff directed to sediment bunds). The wheel washes will maintain a permanent pool depth of approximately 500mm, and water will be replenished regularly with dirty water to be pumped to sediment bunds prior to discharge into the SRP or decanting earth bunds (DEB).

- Silt Fencing

Silt fences will be utilised at various locations during construction. The silt fences will detain flows from the construction areas so deposition of transported sediment can occur through settlement at the location of the fence.

Silt fences will be used for areas where fall to the SRP and decants DEB are not possible. Super silt fences will be installed adjacent to the downstream boundaries to the wetland and SEA areas and will remain in place throughout the earthwork's stages.

Furthermore, super silt fences will be utilised around the work areas for the stormwater outfalls and the construction of the bridge piers for the proposed pedestrian bridging over the wetland and stream areas. The design and implementation of these site wide silt fences will be in accordance with GD05.

- Diversion Bunds and Contour Drains

Clean water diversion bunds and channels will be used to intercept overland flow from the upper catchment not affected by earthworks to divert clean runoff around the exposed earthworks area. The channels will be designed for the 5% AEP rainfall event and will include 300mm freeboard. Construction of the clean water diversion bunding will be progressively stabilised with topsoil and seeded or in some instances geotextile as these are constructed.

Dirty water diversion bunds and channels are to be constructed to intercept silt laden runoff and divert into the sediment retention ponds and or decants. All bunds and channels will be designed for the 5% AEP storm and include 300mm freeboard.

Where longitudinal gradients of the bunded drains exceed 2%, or where flow velocities are high, the channels should be lined with either rocks (i.e. rock checks) or geofabric cloth to prevent erosion of the underlying soils. In some instances, rocks or geotextile cloth can be also utilised for more immediate and effective protection form scour and erosion.

Contour drains will be constructed to intercept runoff from sloping land and divert to runoff diversion channels and or bunds on a minimal gradient. Contour drains will limit the slope length and reduce concentrated flows, thus

minimising the potential for erosive actions resulting from the overland flow. Contour drains should be implemented prior to inclement weather conditions or areas that are waiting to achieve full stabilisation.

- Sediment Retention Ponds

SRP will be used to treat sediment-laden runoff from the exposed earthwork areas and to reduce the volume of sediment entering the streams and wetland areas.

The proposed location of the SRP will be positioned on the lower land formations of each earthwork catchments, as shown on MCCL Drawings: 1976-230-244 at Appendix A.

The contributing catchment area for all SRP have been limited to areas <5 ha each. The minimum capacity of the SRP will be 300m^3 for each hectare of contributing catchment (i.e. 3% of the contributing catchment). An additional 20% of the calculated volume is used as a sediment forebay. Refer to Drawing 1976-1-297 (Appendix A) for further specific details pertaining to each proposed SRP to be implemented on site.

An additional 20% storage is proposed in all ponds to provide additional volume during higher rainfall events as an added safety of factor. This approach is to a higher standard than what is required under GD05.

The SRP will remain in operation for the duration of the earthworks operations until either full stabilisation is achieved or reduced exposed areas can be controlled via other measures (e.g., decanting earth bunds and or silt fencing). The SRP will be sized assuming 1.0ha of the catchment exposed at any one time throughout the earthwork's operations.

The SRP will be constructed and maintained in general accordance with GD05. The SRP will be constructed and orientated which allows the emergency spillway to discharge across the natural downslope contours which will be stabilised.

For the SRP to operate effectively, chemical treatment will be utilised to treat the collected sediment-laden runoff. This will further reduce the quantity of sediment potentially discharged from the site into the SRP. The chemical liquid coagulant will be added to the incoming flows to the SRP via a rainfall-activated system. The coagulant neutralises the electrostatic forces between the fine sediment particles, thus accelerating coagulation and rate of sedimentation within an SRP.

The rainfall activated chemical system and the layout will be designed and constructed in accordance with GD05. The Contractor will be responsible for the preparation and implementation of the Chemical Treatment Plan (CTMP). The plan will specify the chemicals to be used and the required dosage rates based on benchmark testing of the soils onsite.

- Decanting Earth Bunds

All DEB have been oversized to provide additional containment volume in the impounded areas to accommodate for larger rainfall events.

There are several areas of proposed earthworks that are not practical to be treated by SRP which are predominantly in and around the stream/wetland (SEA) areas. It is therefore proposed to install DEB to treat runoff from these areas. The bunds will incorporate floating decant structures designed to provide appropriate dead and live storage and reduce the amount of sediment leaving the site by detaining the runoff.

As mentioned, the DEB have been conservatively sized to accommodate a volume of approximately 3% of the catchment rather than 2% as per GD05 recommendations. These devices can be utilised for slopes that are greater than 10% (where maximum catchment area is approximately 0.3ha).

The DEB will be designed to pass the 1% AEP rainfall storm event via a controlled spillway (i.e. geotextile lining). DEB will also incorporate a level spreader at the inlet and have a 3:1 length to width ratio.

Floating decant structures for the DEB will be incorporated to reduce the amount of sediment leaving the site by detaining the runoff. The use of a floating decant in accordance with GD05 Guidelines for a SRP will further

facilitate settlement of sediments before discharge. This will also allow lifting of decants during chemical batch dosing.

- Batch Dosing

Batch dosing will largely be undertaken as a reactive treatment measure to impounded runoff that may require further treatment. A minimum of 100mm depth of clarity should be observed prior to decanting water from any DEB and SRP structures. To enhance the effectiveness of sediment removal from the containment areas and reduce settlement periods, batch dosing with chemical liquid coagulant Poly Aluminium Chloride may be required. The recommended dosing volumes based on the containment volumes for the DEB and SRP devices and shall be set out in the CTMP.

The floating decant structures within the containment devices will be raised prior to mixing chemicals until visual and quality tests have been carried out. Bench testing will be regularly carried out by the contractor to ensure the design suits the site characteristics and runoff. Where the pH of the SRP and or DEB stormwater discharge falls below pH5.5, chemical treatment can cease. Should this fluctuate within +/- 1 of natural levels, the Contractor shall seek advice from a suitably qualified professional to determine what appropriate actions shall be taken.

- Mulching

Mulching will be used to provide rapid protection of exposed soils where earthworks require immediate stabilisation. Mulching would be mechanically applied to ensure even spread and appropriate application. For smaller non accessible areas hand mulch can be adopted. The mulch will protect exposed soils from the erosive forces of raindrop impact and overland flow during inclement weather conditions. Mulching also prevents the drying of the exposed soil by retaining and trapping moisture, controlling weeds, and promoting the establishment of desirable vegetation. The mulch (i.e., straw) would be applied as a short-term control and applied so total coverage of exposed soils is achieved. Mulch can also be used in conjunction with a seed and fertilizer programme to inhibit germination of seed.

- Dust

All exposed earthwork areas will be maintained to minimise the release of dust emissions into the atmosphere. In the event of dust generation becoming obvious through earthwork activities, appropriate measures to reduce the dust emissions to acceptable levels will be undertaken by the Contractor.

Methods to be adopted for the dust control measures are as follows:

- Ensure the exposed or unconsolidated earthwork on construction activities areas remain in a damp condition utilising water trucks as necessary until surfaces have been stabilised.
- Limit site traffic speed to a level to reduce the production of dust generation into the atmosphere (i.e. recommended limit 10-15km/hr).
- Stage or phase earthworks during construction to isolate and reduce the area of exposed or unconsolidated earthworks.
- If necessary, earthwork activities may be limited in specific areas during periods of high wind.

4.6.2 Management and Operations of ESC Measures

As part of the earthworks contract, the Contractor will be responsible for providing adequate sediment and erosion control measures in accordance with the ESCP to protect downstream environments from excessive sediment discharge and water quality degradation. The Contractor will formulate a plan for approval by the regulatory authority.

Regular maintenance should be carried out during the operational life of the sediment, dust, and erosion control devices by the contractor. Inspections will be carried out by the Contractor after every significant rainfall event and during periods of prolonged rainfall. Checks would include inspection for scour and erosion as well as signs of a possible breaching for devices. Any signs of inefficiencies and or failure should be repaired immediately. Regular

removal of sediment accumulation shall be removed to ensure the design capacity of the device is maintained. Maintenance of all devices shall be carried throughout the duration of the construction activities until these areas are secure and stabilised.

MCCL have prepared a preliminary Dust Management Plan (DMP) which will set a pathway for how the Contractor can manage dust emissions onsite. The Contractor will be responsible for the management of dust emissions onsite and shall prepare and implement a DMP to be approved by the Engineer to the Contract and Auckland Council representative.

In the event of any accidental or uncontrolled sediment or dust discharge, the Contractor will employ the following measures:

- Temporarily cease or stop earthworks in the affected area immediately until mitigation and corrective action measures can be implemented. The Contractor can then recommence works and monitor.
- For dust emissions, water applied to the exposed surfaces in order to reduce the production of dust into the atmosphere is recommended. Reduce or stop traffic movements across the site.
- For sediment discharges, repair existing sediment control devices and/or construct secondary devices to intercept and prevent further migration of sediment-laden runoff from entering the downstream system.
- Notify the site engineer immediately of any event. The Contractor will provide details of the mitigation measures employed to the site engineer prior to recommencing earthworks.

The Contractor will nominate an appropriately qualified and experienced person to be responsible for the environment controls during earthworks and construction activities on the site. The nominated person will be the main contact to receive complaints. The contact details shall be readily displayed with their 24-hour contact details for the purpose of responding to complaints. A typical procedure for responding to a complaint is as follows:

- The Contractor's nominated representative should contact the engineer and provide details for the cause of the complaint. The Contractor would also provide options to rectify the cause of the complaint.
- The Contractor/Engineer to the Contract would liaise with the complainant to discuss the mitigation options, if applicable.
- The Contractor would carry out the remedial measures following the approval from the Engineer to the Contract.

The Contractor will also be responsible to prepare a finalised ESCP for review by the Engineer to the Contract and approval by Auckland Council. The Contractor will implement/construct these proposed controls and provide as constructed (as-built) information to Engineer for review prior to inspection and approval of the controls by Auckland Council.

5.0 Roading

The Project will involve the construction of a new private road network and carparking facilities to service the various proposed site amenities across the Project. The proposed construction of these main private access roads will be built to Auckland Transport standards and ensure the requirements of the AUP are satisfied. Carparking facilities for the Project will also adopt Auckland Transport and NZS4121 standards for their geometric layout design and construction.

The existing accessway at the western end of the site will be upgraded to provide shared vehicle access to the Lodge, Golf Course, Clubhouse and the existing dwelling at 670 Muriwai Rd. This Lodge and Clubhouse access will be designed to accommodate a full right turn bay.

A new crossing at the eastern end of the site will be designed and constructed to provide shared vehicle access to the Sports Academy, GPMC and ongoing access to 614 Muriwai Rd, the existing farm and nearby farm buildings. This new accessway replaces an existing crossing located approximately 50m to the east. The new Sports Academy and Service access will be designed according to the NZTA PPM Diagram D

Refer to MCCL drawings 1976-1-300-308B, 320-330 and 1976-1-360-362 (Appendix A) which show the layout and typical cross sections for these proposed vehicle crossings and internal private roads.

5.1 Private Access Roads (Clubhouse & Lodge)

5.1.1 Roads 1, 4 & 7:

The southernmost intersection with Muriwai Road will provide private access via Road 1 to the Clubhouse. Roads 4 and 7 connecting off Road 1 will provide access to carparking and turning head for the helicopter pad area.

Typical Road Geometry:

- 2 x 3.0m lanes (6.0m wide), flexible pavement with asphalt wearing course (30mm) and minimum 3% crossfall.
- Pavement based on CBR >3 and will be subject to in situ CBR testing to confirm pavement.
- Asphalt pavement confined within concrete edge beams to allow stormwater discharge as non -concentrated flow into the roadside treatment swales.
- 1.0m wide berm each side of pavement both with 3%.

2m wide swale drain (grass) with subsoil drainage to treat and dispose stormwater runoff to controlled outlets.

5.1.2 Carparking Facilities (Clubhouse and Helicopter Pad)

Carparking facilities will be provided for patrons to the golf club via a ring road connection off Road 1, 4 & 7.

Typical Carpark Geometry:

- 7m aisle widths with 3m x 6m parking bays.
- Pavement based on CBR >3 and will be subject to in situ CBR testing to confirm pavement.
- Flexible pavement with asphalt wearing course (40mm DG10) and minimum 3% crossfall.
- Asphalt pavements confined within a combination of kerb & nib and edge beams for easy discharge of stormwater flows into treatment swales and raingardens,
- Combination of 2-3m wide swale drains (grass) with subsoil drainage and raingardens to treat and dispose stormwater runoff to controlled outlets.

5.1.3 Roads 2 & 8 (Lodge)

Access to the Lodge will continue north as Road 2 from the internal intersection of Roads 1 and 3. At approximately CH350, Road 2 changes from flexible pavement (i.e., asphalt) to a more ridged reinforced concrete pavement. Road 2 continues north as concrete pavement to a turning head fronting the main lodge building. There will be a minor private access road and carparking facilities feeding off the Road 2 which will service the Wellness Centre. Several local access lanes will also feed of Road 2 between the Wellness Centre and the main Lodge building to service the stand-alone accommodation units.

Access to the accommodation units and hillside retreats to the west and north of the main Lodge building will be via local access roads connecting of Road 8. Road 8 intersects with Road 2 adjacent to the Wellness Centre and feeds around the western side of the main complex and to the north.

There will be a several carpark facilities available for the Lodge with the main carpark (Zone A and& B) accessible off Road 8 located immediately west of the intersection with Road 2.

Typical Road Geometry (Road 2):

- For Road 2 (CH0-Ch350) - 2 x 3.0m lanes (6.0m wide), flexible pavement with asphalt wearing course (30mm) and minimum 3% crossfall.
- For Road 2 (CH350- CH590) – 2 x 3.0m lanes (6.0m wide), flexible pavement with 175mm 25MPa reinforced concrete wearing course and minimum 3% crossfall.
- Pavement based on CBR >3 and will be subject to in situ CBR testing to confirm pavement.
- Asphalt pavement confined within concrete edge beams to allow stormwater discharge as non -concentrated flow into the roadside treatment swales. No kerbs are to be provided for the concrete pavement so to allow for easy sheet flow discharge into swales.
- 1.0m wide berm each side of asphalt pavement both with 3% cross-fall.
- 2m wide swale drain (grass) with subsoil drainage to treat and dispose stormwater runoff to controlled outlets.

Typical Road Geometry (Road 8):

- For Road 8 (Ch0-CH340) – 2 x 2.25m lanes (4.50m wide), flexible pavement with 175mm 25MPa reinforced concrete wearing course and minimum 3% crossfall.
- Pavement based on CBR >3 and will be subject to in situ CBR testing to confirm pavement.
- No kerbs are to be provided for the concrete pavement so to allow for easy sheet flow discharge into swales.
- 2m wide swale drain (grass) with subsoil drainage to treat and dispose stormwater runoff to controlled outlets.

Typical Carpark Geometry (Lodge):

- 7m aisle widths with 3m x 6m parking bays.
- Pavement based on CBR >3 and will be subject to in situ CBR testing to confirm pavement.
- Flexible pavement with asphalt wearing course (40mm DG10) and minimum 3% crossfall. Subsoil drainage to be connected to
- Asphalt pavements confined within concrete edge beams for easy discharge of stormwater sheet flows into raingardens for treatment prior to discharge via stabilised outlets.

5.2 Private Access Roads (Sports Academy, GPMC and Farm)

5.2.1 Road 5 (Sport Academy, GPMC and Farm)

The northern private access road being, will intersect with Muriwai Road to provide access to the proposed Sports Academy, GPMC as well as maintaining access to the existing farm and residential dwellings to be retained. Access to the Sports Academy, GPMC and farms will be via Road 5.

Typical Road Geometry:

- 2 x 3.0m lanes (6.0m wide), flexible pavement with asphalt wearing course (30mm) and minimum 3% crossfall.
- Pavement based on CBR >3 and will be subject to in situ CBR testing to confirm pavement.
- Asphalt pavement confined within concrete edge beams to allow stormwater discharge as non -concentrated flow into the roadside treatment swales.
- 1.0m wide berm each side of pavement both with 3%
- 2m wide swale drain (grass) with subsoil drainage to treat and dispose stormwater runoff to controlled outlets.

5.2.2 Carparking Facilities (Sports Academy and GPMC)

Carparking facilities will be provided for patrons to the academy and staff to the maintenance facility via a connection off Road 5.

Typical Carpark Geometry:

- 7m aisle widths with 3m x 6m parking bays for the Sports Academy.
- 7m aisle widths with 3m x 5m parking bays for the GPMC.
- Pavement based on CBR >3 and will be subject to in situ CBR testing to confirm pavement.
- Flexible pavement with asphalt wearing course (40mm DG10) and minimum 3% crossfall.
- Asphalt pavements confined within a combination of kerb and nib and edge beams for easy discharge of stormwater sheet flows into treatment swales and raingardens,
- Combination of 2-3m wide swale drains (grass) with subsoil drainage and raingardens to treat and dispose stormwater runoff to controlled outlets.

5.3 Road Widening – Muriwai Road

Approximately 200m of road upgrade works will be required to construct the two proposed private road intersections (Roads 1 & 5) with Muriwai Road. The works will entail road widening, pavement construction, associated roadside drainage works and road marking including signage.

The construction of these intersections will be designed in accordance with the ATCoP to ensure the geometric design ensures safe entry and egress to and from the Project. A detailed traffic impact assessment will also be carried out by a Traffic Engineer to confirm design parameters and requirements for these proposed intersection works. A separate Engineering Approval (EPA) will be sought by the applicant with further detailed design to be provided for approval.

Once the EPA is granted, the Contractor will be required to apply for a Corridor Access Request (CAR) and implement an approved Traffic Management Plan (TMP) prior commencing with the upgrade works.

Refer to MCCL drawings 1976-1-315-317 which show the roading layout and typical, long-sections and cross sections for the Muriwai Road intersection upgrade.

6.0 Stormwater

A separate Stormwater Management Plan (SWMP) for the Project will be prepared to set out guidance and pathway to ensure the appropriate management of stormwater with no resulting impact or adverse effect on the receiving environment.

The SWMP will follow the principles of water sensitive design (Auckland Council – GD04, 2015/004) and also Stormwater Management Devices in the Auckland Region GD01 guidelines through the following methods:

- Retention provided through a combination of at source soakage and infiltration at source.
- A number of buildings will be fitted with rainwater tanks for reuse.
- Detention of additional runoff generated from impervious services such as roads and carparks will be managed through a combination of raingardens, filter strips and soakage basins.
- Treatment of runoff from contaminant generating surfaces such as carparks and roads utilising green treatment solutions such as rain gardens, filtration strips and swales upstream of discharge points where practical.

6.1 Stormwater Background

The site (rural) is located within the northern portion of the Ōkiritoto catchment which feeds into the Ōkiritoto Stream. Intermittent tributary streams across (i.e. incised gully's) the west and southeast portion of the site all connect into the Ōkiritoto Stream which defines the northern boundary to site. These natural watercourses all have various wetland featured areas associated with them.

From the site, the Ōkiritoto stream traverse's westward to ultimately discharge into the Tasman Sea at Muriwai Beach (approximately 1.5km downstream of the site). Information available on the AUP viewer indicates the site not to be located within a SMAF zone and Auckland Council GeoMaps information indicates that there is no public stormwater network available for the Project to divert or direct stormwater discharge into.

6.2 Proposed Site Coverage

The Project will result in the increase to impervious coverage which will generate stormwater runoff (i.e. volume and peak flow rate) that will need to be controlled with appropriate mitigation. Future impervious coverage for the Project comprises the following estimated areas based on the current master plan:

Lodge

Total Roof Coverage:	9,000m^2 - (Lodge, accom & retreat units, and wellness centre)
Concrete & Asphalt Road:	6,850m^2 - (Roads 1, 2, 8 incl local connecting roads)
Sealed Carparking:	3,600m^2 - (Carparking & individual carpark, accom & retreat units)
Pedestrian paths and cart paths:	2,640m^2

Clubhouse

Total Roof Coverage:	1,125m^2
Road Asphalt:	6,250m^2 – (Road, incl road widening Muriwai Road)
Carparking & Access:	7,210m^2 - (Roads 1 & 7, incl cart/pedestrian access to clubhouse and helicopter pads)

Sports Academy & GPMC

Total Roof Coverage:	6,080m^2

Road Asphalt:	4,380m^2
Carpark	9,550m^2
Tennis Courts:	1,762m^2
Pedestrian Paths:	650m^2
Golf Course	
Total Cart Pathways:	9,510m^2

The total impervious coverage associated with the Project is estimated at approximately 68,600m^2 (6.9ha) across the entire site area of 507Ha which is in the order of 1.4% coverage of the total site area.

6.3 Stormwater Pre-Development Catchments vs Post-Development Catchments

The grading of the site has carefully considered the predevelopment flows. The final grading has ensured that the receiving wetlands are not affected by the new levels and the post development catchments have been designed to follow the predevelopment catchments as best as possible to ensure hydraulic neutrality. Stormwater treatment devices and also soakage outlets promote retention (recharge of groundwater).

Refer to MCCL Drawing 1976-1-450 to 457 contained in Appendix A showing the pre/post development catchments

6.4 Stormwater Requirements (AUP)

The site is not located within a SMAF area under the AUP. However, in accordance with the AUP, the Project will be considered a Restricted Discretionary Activity with impervious coverage exceeding 5,000m^2 outside an urban area as per (A5) of Activity Table E8.4.1.

It is therefore appropriate to provide stormwater mitigation in accordance with AUP rule E.8.6.4.1 (3) requiring hydraulic mitigation in accordance with Table E10.6.3.1.1 as detailed below:

Table E10.6.3.1.1 Hydrology mitigation requirements

Stormwater management area control	Hydrology mitigation requirements
(1) Except as provided for in (2) below the following applies:	
Stormwater management area – Flow 1	(a) provide retention (volume reduction) of at least 5mm runoff depth for the impervious area for which hydrology mitigation is required; and (b) provide detention (temporary storage) and a drain down period of 24 hours for the difference between the pre-development and post-development runoff volumes from the 95th percentile, 24 hour rainfall event minus the 5 mm retention volume or any greater retention volume that is achieved, over the impervious area for which hydrology mitigation is required.

Figure 8 – Table E10.6.3.1.1 Hydraulic Mitigation Requirements (Courtesy AUP Operative in part)

The stormwater mitigation should include measures to minimise any increase in the volume of runoff and control the rate of runoff to the pre-development level (i.e. neutrality) where practical). This mitigation measure should incorporate the design principals and guidelines as set out in the Auckland Council Guideline Document 2017/001 (GD01) – "Stormwater Management Devices in the Auckland Region".

The Project will therefore incorporate a combination of the following stormwater mitigation measures:

- Green living roofs for the main Lodge and Clubhouse buildings.
- Onsite soakage devices (i.e. pits) for the accommodation units and hidden retreat units within the Lodge area.
- Onsite roof water harvesting tanks for the Sports Academy and GMPC buildings.
- Linear treatment swale drains to accept sheet flow from private access roads across the Project.

- Offline raingarden devices to accept runoff from sealed high contaminant generating carpark facilities across the Project.
- Stormwater reticulation to convey collection of stormwater runoff for controlled discharge and connection to onsite stormwater devices prior to discharge via stabilised outlets (i.e. erosion protection) onto land upgradient from gully features.

6.4.1 Green Living Roofs

It is proposed to incorporate "green living roofs" for both the main Lodge building and Clubhouse building. These devices will offer some level of retention and will treat runoff from the roof catchments. Treated overflow will connect into the private reticulation for discharge into adjacent gulley features via stabilised outlets.

Exact details are yet to be finalised for these devices, however detailed design in accordance with Council and New Zealand Building Code (NZBC) standards will be provided at the Building Consent stage.

6.4.2 Onsite Soakage

The site largely falls within the Awhitu Group geological area which comprises primarily of underlying sands and cemented sands. These soil types will present the potential opportunity for onsite infiltration and hence the opportunity for disposal of roof water from the proposed standalone accommodation and hidden retreat units into the subsoil ground water table (i.e. recharge). We note that LGC have recommended that any soakage devices shall be avoided within the building limit line (i.e. in proximity to steep slopes).

This will be carried out constructing soakage pits in locations suitable to cater for each individual unit. These proposed soakage pits will be designed in accordance with Council and NZBC standards and will typically be filled with an approved drainage scoria (i.e. ±50% void area) and wrapped in a geofabric material (e.g. Bidim A14 or similar approved) for filtration. Further geotechnical investigations specifically for soil infiltration rates, will need to be determined to adequately size each device. These will be further detailed at the Building Consent stage.

6.4.3 Rainwater Harvesting

Rainwater harvesting tanks are proposed for the Sports Academy and GPMC. This will provide onsite retention in accordance with the AUP requirements.

The AUP requirements for retention on site are based on E10.6.3.1.1 and hence the volume for the Sports Academy and GMPC is 17.9m^3 (i.e., 3,570m^2 x 0.005m = 17.9m^3) and 12,5m^3 (i.e., 2,500m^2 x 0.005m = 12.5m^3) respectively. Therefore, we would recommend a minimum retention (harvesting) volume of 25m^3 for each facility.

The runoff from all future roof areas should be connected to these proposed rainwater harvesting tanks via a sealed connection from the downpipes (i.e., syphon system if required). An overflow will be provided at the top of the retention tank/s and will connect into the private reticulated drainage prior to discharge via the stabilised outlet. We note that the roof area (2,500m^2) has been included in the catchment to size for the offline rain gardens, hence providing a minimum 25m^3 harvesting tank with overflow connect to the rain garden would be sufficient. However, we would recommend a minimum volume of 50m^3 be provided to cater for extra storage through the dryer months.

6.4.4 Linear Treatment Swale Drains

It is anticipated that much of the runoff will predominately be associated with the private access roads and future carparking. These will generally be constructed in locations that have gentle rolling terrain. Given the nature of activities to be undertaken on the site, relatively low traffic volumes are expected (at least compared to other car park purposes such as shopping malls or supermarkets etc). As a result, contaminant generation will be on the lower end of the scale.

Non-concentrated discharge from these impervious road areas (totalling approximately 23,900m^2) is therefore unlikely to result in any significant issues as these will be mitigated by wide engineered linear swales drains. These

swales will typically be 2-3m wide, vegetated (grass) profiles with subsoil drainage incorporated into the invert of the swale. These swales will promote conveyance of sheet flow runoff from the road pavement surface at a slower controlled rate to allow higher residual time for the flow to infiltrate the underlying soils thus assisting to remove pollutants and or suspended particles.

The swales will be connected at the downstream locations with daylighting the subsoil drainage or connection to reticulation pipes for controlled discharge via stabilised discharge outlets.

6.4.5 Offline Rain Gardens

A similar concept for the onsite car parking facilities will see a combination of swale and raingardens to accept the sheet flows. The Project will have 5 high contaminant generating carparks. Surface runoff from these carparking areas will be directed into individual rain garden devices via swale drains and or stormwater drainage pipe connections. The raingardens have been preliminary sized appropriately for the contributing catchments and will provide the required retention and detention volume as per Auckland Council GD04 standards and requirements.

We note that raingardens RG 4 & 5 have been sized to service the sealed vehicular areas as well as the rainwater harvesting tank overflow from the GPMC roof areas.

Below is a summary table with specific details calculated on each raingarden and should be read in conjunction with the attached MCCL Drawings attached in Appendix A:

RAINGARDEN DESIGN								
RAINGARDEN NAME	Cirtex RAINSMART® stormwater modules		W	L	Area	RG Top	WQV Level	RG Base
			m	m	m^2	RL	RL	RL
RG 1	width:	0.400	1.80	41.70	88.00	87.75	87.95	86.71
	length:	0.715						
RG 2	width:	0.400	1.80	43.60	78.00	95.77	95.97	94.73
	length:	0.715						
RG 3	width:	0.400	IRREGULAR SHAPE		77.00	77.88	78.08	76.84
	length:	0.715						
RG 4	width:	0.400	IRREGULAR SHAPE		185.00	88.00	88.20	86.96
	length:	0.715						
RG 5	width:	0.400	IRREGULAR SHAPE		126.00	90.70	90.90	89.66
	length:	0.715						

Figure 9 – Summary of Raingarden Design Details prepared by MCCL

6.4.6 Stormwater Reticulation

Installation of new private stormwater reticulation will provide suitable connections for each future building and accommodate the collection of surface runoff from the common roads and carparking areas for stabilised discharge to land.

The proposed stormwater reticulation and systems for the Project will been designed to comply with the Auckland Council's Stormwater Code of Practice (SWCoP) and NZBC.

6.5 Stormwater Design Assessment

Activity Table E8.4.1 confirms the internal roading proposed for the Project is considered a Restricted Discretionary Activity (A5). Considering other impermeable surfaces (e.g. building roofs) the Project is also considered a discretionary activity (A10). We provide the following assessment against applicable activity standards E8.6.1 and Standard E8.6.4.1:

- Road generated stormwater will discharge to the natural slopes and channels across the site and there is no direct reliance upon any existing infrastructure.

- Appropriately designed swales and discharge outlet structures will ensure the diversion and discharge will not cause or increase scouring or erosion at the point of discharge or downstream.
- The design of all stormwater treatment, diversion and discharge devices will ensure there is no increase in flooding of any other properties in rainfall events up to the 10 per cent annual exceedance probability (AEP); or any increased inundation of buildings on other properties in events up to the 1 per cent annual exceedance probability (AEP).
- No increase in nuisance or damage to other properties will result.
- With regards to the performance standard requiring mitigation in accordance with E10.6.3.1.1, this will be achieved using a combination of green living roofs, onsite soakage pits, harvesting tanks, swale drains and raingardens across the Project.
- Overall, given the vast areas of pasture surface and the proposed use of linear swale drains in combination with soakage devices and rain gardens at the site, suitable treatment of stormwater will be achieved.

6.6 Assessment of Wetland Catchments

As already discussed, bulk earthworks will be required to achieve the desired design and layout requirements for the golf course development and other built elements for the wider Project. The proposed works will involve some changes to the existing landform and hence will result in minor changes to the catchment areas contributing into the existing wetland features across the site.

As shown in our attached calculations (Appendix E), we have assessed the pre and post development scenarios to determine that there will be a minor fluctuation in contributing catchment sizes in comparison to what is existing which is considered insignificant.

There will be some changes required to the existing landform to construct the proposed water reservoir. located between the two existing gully features (i.e. wetland) to the south of Muriwai Road. The proposed landform changes will result in some minor increase to the catchment areas to the east of the reservoir site and a decrease in area to the western contributing catchments. These catchments are generally located at the lower end of larger upper catchments contributing to the wetland features and hence the changes would be less than minor.

Based on our assessment, we would consider these fluctuations in catchment areas and resulting peak flow discharges into the wetland areas to be less than minor and therefore would envisage the proposed landform changes to be inconsequential with no adverse effects to downstream environment.

All amended catchments have been reviewed by the Project's expert hydrologist and ecologist and have been deemed to be acceptable

7.0 Flood Hazards

The site comprises a large sized rural property with rolling pasture and several lower lying gully features which make up a series of intermittent streams and wetlands areas. These all tribute into the more permanent Ōkiritoto Stream. Auckland Council GeoMap data indicates these natural stream and wetland areas would be subjected to flooding during a 1% AEP storm event - refer light blue areas in Figure 10 (below).

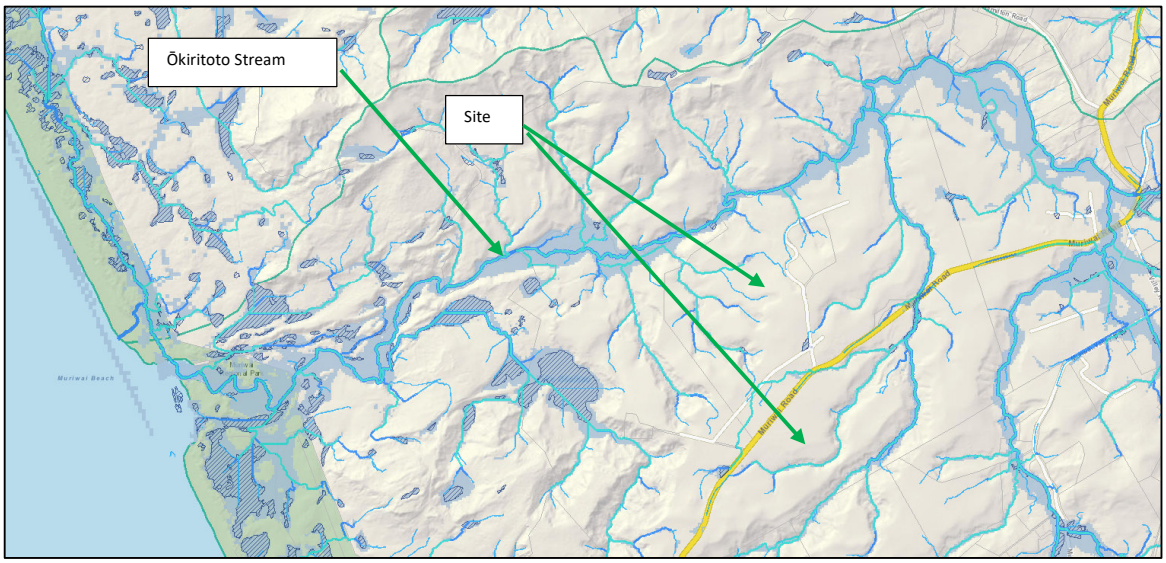

Figure 10- 1% AEP Overland Flow Path & Flood Plain (Courtesy of Auckland Council GeoMaps)

This flooding will not pose any significant impacts to the Project as these flow paths and flood plains are largely contained within the lower lying incised gully features. All buildings and amenities for the Project are well clear of these Council identified flood hazard areas.

We note that any secondary flow path features (minor) that will be in proximity to any internal private roading infrastructure are only gentle depressions across the terrain and are likely to be non-concentrated flows. These secondary flow paths will be maintained and managed with the use of formed swales and culverts across road alignments to maintain their natural flow patterns.

The Project results in inconsequential changes to the existing natural flow pattern of stormwater and no conceivable impact on flood plain functions. There is also suitable space available for the proposed buildings and service amenity provisions including effluent disposal. All buildings/structures will be designed and constructed in accordance with the NZBC.

8.0 On-site Wastewater

The Project will result in the generation of domestic wastewater typical of offices, accommodation, and function facilities. Minor amounts of maintenance equipment wash-water are also generated at the GPMC. The site will not generate any industrial or trade process wastewater.

The site's location is such that it cannot be connected to any public wastewater network either adjacent to the site or in near proximity. Therefore, all wastewater generated will need to be collected, treated and disposed on site. Refer to Drawings 1976-L1-500 – 502, 1976-CH1-503 – 506A, 1976-AC1-507 – 508A in Appendix A.

The following outlines the key principals and overall approach adopted for wastewater management on site along with relevant references to design criteria to demonstrate overall quality and quantity outputs expected. Detail design for all wastewater management components will be undertaken at building consent stage.

8.1 Wastewater Generating

The wastewater generation will come from a variety of locations across the site. To determine the volume of wastewater it is necessary to establish the number of people potentially at or occupying each location. The following table outlines the maximum potential number of users on site and their expected wastewater average daily generation.

Table 2 – Summary Population Generation

Activity	No People	Est daily use (L)	Total Daily use (L)	m^3/day	Volume Totals (m^3)
Clubhouse					
Guests	50	75	3750	3.75	
Staff[4]	18	40	720	0.72	
Caddies[5]	28	75	2100	2.1	
Office					
Staff	25	40	1000	1	7.57
GPMC					
Staff	23	40	920	0.92	
Operation building					
Staff	30	40	1200	1.2	2.12
Sports Academy					
Sports Academy & Tennis buildings					
Staff[2]	15	40	600	0.6	

[1] Refer Golf Course and Maintenance Report prepared by NZ Sports Turf Institute & Steve Marsden Turf Services.

Offices	25	40	1000	1	
Guests	30	40	1200	1.2	
Café					
Staff[3]	7	40	280	0.28	
Guests	100	75	7500	7.5	10.58
The Lodge					
Main Lodge building					
Staff	30	60	1800	1.8	
Guests[1]	52	150	7800	7.8	
Meeting Yoga House					
Guests	10	40	400	0.4	
Wellness Centre					
Guests	20	40	800	0.8	
Accommodation					
Guests[1]	52	40	2080	2.08	12.88
Golf Course Toilets					33.15
Toilets	2	250	500	0.5	0.5
[1]	Guests of lodge are also staying in accommodation				

2	Café staff 9 over week assessed as 75% total on any day
3	Academy staff 12 over week assessed as 75% total on any day
4	Club house staff 25 over week assessed as 75% total on any day
5	Club house 40 caddies over week assessed as 75% total on any day

8.2 Site Wastewater Reticulation

Collection of wastewater on site will be via a new private on-site reticulation system comprising gravity mains that drain wastewater to private pump stations. Refer to MCCL Drawings 1976-1-500, 1976-L1-500-501, 1976CH1-503-506A & 1976-AC1-507-508A which have been prepared in Appendix A which demonstrate the indicative concept and route of the wastewater network.

The site is essentially split into two wastewater catchments with the Sports Academy and GPMC in the central part of the site gravitating to a single pump station that transfers it to the treatment and disposal area in the southern part of the site.

The Lodge and Clubhouses centre located in the western portion of the site separately serviced in the same way.

The collection system will be privately owned but will be designed to public standards (Watercare) as typically used in subdivisions, for example 150dia mains with typical 1050dia manholes and changes of direction and grade. The pump stations will be a pre-packaged plant type installed below ground and more than 100m from any waterbody. The pump stations will provide 24 hours storage for their respective contributing flows (Refer Table 3).

Emergency overflows from the pump stations are not considered necessary in this instance as the inflow can be controlled and facility closed in the event of any major disruption.

Detail design will be undertaken at Building Consent stage.

8.3 Wastewater Treatment Approach

Treatment of wastewater generated from the Lodge, Clubhouse, Sports Academy and GPMC will be treated using a high-quality proprietary system appropriately designed to cater for maximum expected wastewater flows (average and maximum peak). The system will provide for primary, secondary, and tertiary treatment.

While no decisions have yet been made on the treatment system type, there are several manufacturers and installers in New Zealand who have experience with designing, installing and maintaining these types of proprietary system. Two suppliers are being considered:

- Reflections Wastewater Treatment Solutions and
- Innoflow Wastewater Specialists.

8.3.1 Primary Treatment

In general, primary treatment will be achieved through a multi chambered tank or tanks of an appropriate total volume to provide sufficient Hydraulic Retention Time for the expected rates of wastewater generated. The design will also allow for some buffer storage and operational flexibility so that treatment can be brought online progressively, manage high generation peaks, slowed down during periods of lower wastewater generation such as winter months.

8.3.2 Secondary Treatment

Secondary treatment will likely consist of a Textile Media treatment process in conjunction with recirculation and associated recirculation tanks. Secondary treatment assists in reducing nutrient levels within the effluent.

8.3.3 Tertiary Treatment

As a final component UV filtering of the final effluent is proposed prior to land disposal.

Treated effluent will be discharged to a holding tank for disposal to the soakage field. This tank will typically be sized to accommodate the single expected daily flow to provide storage and peak flow period management.

8.4 Maintenance

All plant and equipment will be maintained in accordance with manufacturer and installer recommendations to ensure ongoing high performance of the system.

8.5 Disposal

Disposal of treated effluent on site will be to land via a pressure compensating dripper line network installed in a designated land disposal area adjacent to Muriwai Road near the entrance to the Lodge and Clubhouse.

Auckland Regional Council Technical Publication No 58 (TP58) has been referenced to ascertain appropriate application loading rates and dimensions for the disposal field (refer Figure 11).

Table 5.1: TP58 Soil Category Description (comparison with AS/NZS:1547 2000)

Soil Category	Soil Description TP 58 3rd Edition		*Soil Category*	*Soil Description AS/NZS 1547:2000.*
1	Gravel, coarse sand - rapid draining		*1*	*Gravels and sands - rapidly drained*
2	Coarse to medium sand - free Draining		*2*	*Sandy loams - well drained*
3	Medium-fine and loamy sand - good drainage		*3*	*Loams - moderately well drained*
4	Sandy loam, loam and silt loam - moderate drainage		*4*	*Clay loams - imperfectly drained*
5	Sandy clay-loam, clay-loam and silty clay-loam – moderate to slow drainage		*5*	*Light clays - poorly drained*
6	Sandy clay, non-swelling clay and silty clay - slowly draining		*6*	*Medium to heavy clays - very poorly drained*
7	Swelling clay, grey clay, hardpan - poorly or non-draining			

Figure 11 - Table 6 Soil Category extracted from Auckland Council TP58

Based on the findings set out in the LGC geotechnical investigation report, the soil category at the proposed disposal site has been categorised Soil Category 3 (i.e. good drainage). For the purposes of this assessment the more conservative assumption of Category 4 has been used to determine if a larger footprint can be accommodated if required. This will be revised at detail design stage once more specific testing at the disposal location is carried out.

Using a Soil Category 4 a conservative application rate of 3.5mm/day is recommended. With a daily volume of approximately 33m^3 this equates to 9,450 m^2 (0.95ha).

TP58 recommends that for subsurface dripper lines a minimum reserve allocation area of between 33% and 100% be provided. In this instance a total area of 1.5ha has been set aside to provide in excess of the recommended 100% storage.

This combined with the conservative soil classification and the ample space available on site provides confidence that there is more than adequate space on site to provide a high performing disposal field.

The disposal field itself will be divided into sections to allow phased introduction of the site (if required) and to assist with field maintenance.

8.6 Disposal Field Location

The proposed disposal field and reserve area is shown on MCCL Drawing 1976-1-500 and 504 contained in Appendix A.

The location has been chosen as it is gently sloping, readily accessible and north facing to enhance evapotranspiration (which is not required but beneficial). It also provides large setbacks from local sensitive receiving environments.

TP58 provides guidelines on recommended minimum separation distance from the treatment plant and disposal field. The following table outlines the Project in relation to these guidelines.

Table 3 - TP58 Requirement for separations

Location	TP58 Separation Recommendation (m)	Disposal Field Separation (m)	Treatment Plant Separation (m)
Boundaries	1.5	25	100
Watercourses	15	100+	100+
Groundwater	0.6	5+	n/a
Bores	20	100+	100+
Surface Water	15	100+	100+
Buildings	1.5-3.0	100+	75+

As can be seen the proposed treatment and disposal system easily meets the guideline clearances in TP58.

8.7 On Course Toilets

There are two on course toilets proposed. These are remote from the main built formed areas treatment area, so it will be impractical to connect them to the primary treatment network. It is proposed that each of these toilets will have a standalone pre-packaged domestic wastewater treatment and pump system which will dispose to shallow wastewater pressure compensation lines.

Based on the soakage rates each toilet will only require 50m^2 of disposal field. In accordance with recommended separation distances in TP58, these individual systems will be located more than 20m from any watercourse, bore, boundary etc, hence satisfying minimum requirements.

9.0 Water Supply

The Project will require potable and non-potable water supply for day-to-day operations. There is no public water supply available to the site and hence a combination of provisions will need to be put in place to provide adequate water supply for the Project. The provision of water supply for the Project will include the following concepts:

- Water Reservoir supplied by water takes from a stream and a bore.
- Production bores for supplementary reservoir supply and potable/non-potable water supply.
- Roof water harvesting via tanks for potable/non-potable supply.
- Firefighting Supply.

9.1 Water Reservoir

The proposed golf course and practice facilities will require a significant water supply for on course irrigation purposes. To meet this demand a large water reservoir will be constructed.

The proposed water reservoir will have a storage containment volume of 140,000m^3. As previously discussed, a large earthworks operation will be required to form this reservoir. Due to the nature of the underlying soil geology (e.g., sandstone) the reservoir will likely need to be constructed with an impermeable liner (e.g. geosynthetic). Riley Consultants have recommended further geotechnical investigations are carried out in relation to the proposed spillway with further details to be confirmed at final design prior to the Building Consent stage.

The main primary water supply for the reservoir will be via a high flow take from the Raurataua Stream east of the reservoir. This will require an intake structure and pump facility to be setup. From the proposed intake location, water supply will be pumped via a pressurised pipe (e.g. HDPE pipe) into the reservoir.

A secondary water supply source will be via a production bore with pump facility located approximately 400m to the north of Muriwai Road. This bore will be constructed to provide supplementary water supply to ensure sufficient reliable supply all year round particularly during the dryer periods. This water source will pump water drawn from the bore to the water reservoir via pressurised pipe which will require a pipe crossing under Muriwai Road. This will require approval from Auckland Transport being the regulatory authority for the road corridor.

Similarly, water supply for irrigation will be distributed from the reservoir to the GPMC via a pump and pressure main. This will also require a road crossing under Muriwai Road and approval from Auckland Transport. At the GPMC a second booster pump will distribute supply to the site irrigation network.

Both water source locations and the distribution network to and from the reservoir to the golf course will require adequate pump and pressure main infrastructure to allow distribution of water supply. This infrastructure will be specifically detailed further at the future Building Consent stage.

For further information and details pertaining to the Water Supply Concepts for the Water Reservoir, refer to MCCL Drawings 1976-R1-350 - 352 & 610 – 618 – Appendix A

9.2 Lodge & Clubhouse Water Supply

A second production bore is proposed to be constructed almost adjacent to the north-eastern perimeter of the GPMC Water supply from this bore will be distributed via a pump and pressurised water reticulation main located on the southeast perimeter of the GPMC to the Lodge and Clubhouse. The water supply reticulation from the bore location will generally traverse within the private access road corridors.

This water supply infrastructure will be specifically designed in accordance with local authority (Watercare) and NZBC standards at the Building Consent stage. For further information and details pertaining to the Water Supply Concepts for the Lodge and Clubhouse, refer to MCCL Drawings 1976-1-600, 1976-L1-600 – 602 & 1976-CH1-603 - 606A – Appendix A.

9.3 Sports Academy and GPMC Water Supply

It is proposed that roof water runoff from the Sports Academy and GPMC buildings will be collected in dedicated rainwater harvesting tanks for potable and non-potable water supply.

We recommend a minimum retention (harvesting) volume of 50m^3 for the Sports Academy and 50m^3 for the maintenance facilities. Our preliminary concept for onsite harvesting indicates the provision for three tanks dedicated for each of the Sports Academy and maintenance facilities. However, we note that our recommendation for a minimum of 1 x 25,000L rainwater tank to be dedicated for each of the facilities is a minimum requirement. Extra harvesting tanks are optional and will be at the discretion of the applicant based on the operational requirements

The runoff from all future roof areas should be connected to the proposed rainwater harvesting tank/s via a sealed connection from the downpipes (i.e., syphon system if required). An overflow will be provided at the top of the retention.

We note that the rainwater harvesting tank locations and provisions for private plumbing (i.e., pumps) will be confirmed at the Building Consent stage. The installation of these tanks and private plumbing should be in accordance with the NZBC and the manufacturer's specifications and carried out by a qualified professional.

We note that there is also a proposal to provide additional reticulated water supply to the Sports Academy and GPMC from the pump house facility which is fed from production bore providing supply to the Lodge and Clubhouse.

For further information and details pertaining to the Water Supply concepts for the Sports Academy and GPMC, refer to MCCL Drawings 1976-1-600, 1976-AC1-608-610A at Appendix A.

9.4 Water Supply Demand

The on-site water supply demand for potable water is widely based on the population used for the wastewater generation volumes. This will ignore the irrigation demand for the golf course and landscaped amenities.

We have estimated the following water supply demand anticipated for the Project as follows – (refer calculations in Appendix G):

Table 4 – Development Water Supply Demand Summary

Water Supply Demand	
Lodge & Clubhouse – Production Bore Supply	
Ave Daily Demand (L/s)	0.30
Peak Daily Demand (L/s)	0.59
Peak Hourly Demand (L/s)	1.47
Daily Demand Volume (m^3/day)	25.9
Sports Academy & GPMC - (incl Ex Res Dwellings on Farm) – Water Res/Harvest)	
Ave Daily Demand (L/s)	0.13
Peak Daily Demand (L/s)	0.26
Peak Hourly Demand (L/s)	0.64
Daily Demand Volume (m^3/day)	11.0

9.5 Water Treatment

As discussed, there will be various source points to facilitate the supply for water demand on site. We envisage that water supply regardless of source will require various levels of treatment to ensure safe drinking standards. Testing the various sources proposed will provide better understand as to the level of treatment required if any. There are various proprietary systems available in the market that can be incorporated to facilitate treatment of water if deemed a requirement. This will be further detailed at the Building Consent stage.

9.6 Fire Fighting Supply

The provisions for water supply to facilitate firefighting is crucial for the Project and will require non-potable

water supply to satisfy the requirements as set out in SNZ PAS 4509:2008.

Provision of water supply for firefighting will include the following concepts:

9.6.1 Lodge and Clubhouse

As discussed in Section 9.2, a production bore will be constructed to provide potable and non-potable water supply via a pressurised reticulation networks to the Lodge and Clubhouse facilities. The Project will be to include on this reticulation water main fire hydrants at approximately 90m spacing along the private road corridors.

Although not confirmed at the time of this report, it has been assumed that the main buildings for the Lodge and Clubhouse will be provided with independent sprinkler systems. To satisfy water supply requirements in accordance with table 1 of SNZ PAS4509:2008, the main Lodge and Clubhouse buildings would generally be categorised FW2 and require 12.5L/sec of flow within 135m with an additional 12.5L/sec within 270m. Specific design by a qualified professional specialising in fire design for the sprinklers system will need to be carried out at the Building Consent stage.

Should the buildings not be sprinklered, these would generally be classified under FHC 2 with Fire Water Classification FW3. This will require 25L/sec flow within 135m and an addition 25L/sec from 270m from a maximum three hydrants if the system is to be reticulated. Should each system not be reticulated, then each building will require a minimum water storage of 180m^3 dedicated solely for firefighting purposes either by storage tank or open watercourse or reservoir. We would envisage the use of dedicated tanks for this purpose. These tanks will need to be provided with an appropriate outlet with suitable coupling for the NZ Fire Service to access and the tanks must be located within a minimum 6m clearance to the risk location and no greater than 90m away. Care will be taken to suitably locate tanks should these be plastic type tanks.

We would envisage that appropriate access and hardstanding area to satisfy the requirement of the firefighting code can be provided.

9.6.2 Sport Academy and GPMC.

As noted, the Sports Academy and GPMC will be provided with additional water supply via reticulation from proposed production bore servicing the Lodge and Clubhouse. This reticulation system will be constructed with separate hydrants each located within 135m of the buildings.

It has been assumed these buildings will not be sprinklered and hence these would generally be classified under FHC 2 with Fire Water Classification FW3. This will require 25L/sec flow within 135m and an addition 25L/sec from 270m from a maximum three hydrants if the system is to be reticulated. Should each system not be reticulated, then each building will require a minimum water storage of 180m^3 dedicated solely for firefighting purposes. The tanks dedicated for firefighting will need to be provided in accordance with SNZ PAS4509:2008 and we envisage appropriate access and hardstanding area to satisfy the requirement of the firefighting code can be provided.

Detailed design on firefighting requirements will be confirmed at the Building Consent stage.

For further information and details pertaining to the Water Supply Concepts for onsite firefighting, refer to MCCL Drawings 1976-1-600, 1976-L1-600 – 602 & 1976-CH1-603 - 606A and Drawings 1976-1-600, 1976-AC1-608-610A (Appendix A).

10.0 Utility Services

At this stage consultation with the Utility providers (Chorus and Vector) has yet to be undertaken.

Auckland Council GeoMap information indicates overhead power supply (Vector) is available along Muriwai Road which distributes power supply to the Muriwai settlement – refer Figure 11 (below). This existing overhead power supply generally traverses the Muriwai Road corridor and briefly enters the property of 697 Muriwai Road before crossing the road to traverse southwest through 610 and 670 Muriwai Road before exiting back onto Muriwai Road.

Figure 12 – Approximate Vector Overhead Power supply (Courtesy Auckland Council GeoMaps)

Information obtained from beforeUdig indicates below ground telecommunications (Chorus) is generally available within Muriwai Road corridor (refer Chorus As-built plans - Appendix C).

There is also evidence of an international telephone and fibre optic cable which traverses the lower northern and central portion of the site – (refer Telecommunications As-built plans - Appendix C). This line is no longer operational and, the utility provider has confirmed that it has no interest in the cable and agreed to removal of the easement for the cable from the title.

We envisage that suitable connections to both power and telecommunications can be made with suitable extensions into the site from Muriwai Road and discussions with the relevant utility providers will be carried out to confirm adequate capacity requirements are available. The internal supply reticulation can be provided below ground within the private access road corridors to adequately distribute supply across site. This would be subject to detailed design and installation by the individual utility service providers.

Rerouting of the existing overhead power supply below ground within the site may be considered. If this is considered as both a desirable and viable option, this again would be subject to detailed design and installation by the utility provider.

We note at the time of this report there was no evidence of any gas supply available to the site.

11.0 Safety in Design

Aspects of safety in design were considered as part of the overall design process. Areas of concern are:

- Earthworks close to the gully features and steep batters,
- Working on public arterial roads,
- Working near live services,
- Deep excavations and trenches and Confined Spaces.

Working close to the stream/wetlands and steep batters during the earthwork's operation has been considered. Other than working close to the streams and wetlands the design has been undertaken to minimise areas within the SEA area and on steep batters. Working adjacent to the streams and wetlands will be limited to a zone of safety being no machines will traverse along or into the SEA protection zones. Should work be required within this zone, this will be undertaken by an excavator reaching into the zone or smaller more mobile plant is to be used.

Working close to or within public road corridors pose many dangers and hazardous risks to onsite staff and the public. Appropriate CAR and traffic management plans will be approved by Auckland Council/Auckland Transport and implemented to ensure no adverse hazards or incidents resulting from the proposed upgrade and intersection works on Muriwai Road.

As per the PSI/DSI carried out by PDP, land contamination has been identified onsite and the removable of these will be carried out in accordance with the recommended process provided in the RAP prepared by the contamination professionals. Refer to the AEE for the relevant PSI/DSI reports (Appendix 6 of the AEE).

The proposed works will be impacted by live services in some areas. The Contractor will take all steps to locate and protect these services and consultation with the utility service providers must be carried out. Any approvals must be sought prior to works commencing. The contractor will provide all methodology around working with live services in the CEMP.

Trench depth was a consideration in the design of the Stormwater and Wastewater networks. The networks will be designed to have a minimal depth in particular the pressurised systems not requiring gravity to operate. However in some minor instances depths may exceed 1.5m. Ground water intrusion into trenches is also a concern with the trench depths exceeding 1.5m. As part of the Contractor's CEMP, it would be expected that shoring or benching of trenches over 1.5m depth and pumps on hand to remove ground water so not to impact the downstream environment (e.g wetlands).

The manholes on the stormwater and wastewater networks will generally have depths shallow depth (1-2m) and regardless of depth these are treated with caution when working inside. Excavations or manholes deeper than 2-4m should be treated as confined spaces and are to be included in the Contractor's Health and Safety Plan.
The Contractors CEMP and Health and Safety plan which forms part of the contract will need to be reviewed to ensure it complies with the resource consent conditions prior to the Contractor commencing on site to ensure that it addresses the concerns above.

12.0 Conclusion

The preliminary design for the Project presents the required infrastructure necessary for use and enjoyment of the developed facilities and confirms it will comply with relevant AUP rules and engineering standards. The preliminary design has taken into consideration the possible environmental impacts of the Project and will minimised these through the use of accepted industry engineering practices.

The Project will require bulk earthworks to form and route the golf course and to form roads, car parks building platforms, water reservoir and amenities. Earthworks for the Project will require regulatory consent and will be managed appropriately to ensure environmental risks and potential effects are either avoided or mitigated. These management processes will be documented in a certified CEMP and ESCP, and these will be implemented on site during construction.

Vehicle access and carparking can be achieved in accordance with regulatory standards. Upgrades to Muriwai Road to create intersecting access roads will be carried out in accordance with ATCoP and procedures (i.e. CAR, TMP)

The site will be managed in terms of stormwater quantity and quality in accordance with the Stormwater management Plan to be developed and will ensure minimal changes to the receiving environment. Various mitigation measures will be implemented across the Project in accordance with regulatory and NZBC standards and requirements.

The site is generally not affected by any significant overland flow path or area of inundation as development is proposed to be outside these areas. Overland flow will be managed so to match existing conditions can be mimicked where practical.

Onsite wastewater treatment and disposal will be designed, installed and maintained in accordance with Auckland Council TP58 (or current Draft GD06). Disposal and treatment for onsite waste can be achieved in accordance with the regulatory guidelines via proprietary treatment systems, private reticulation (i.e. gravity and pressure mains) for appropriate ground disposal. Specific design for onsite wastewater treatment and disposal field will be confirmed at the Building Consent stage.

Power and Telecommunications Utilities will be provided to the redevelopment by way of connection to the existing network. Some rerouting of existing services may be required and will be subject to further design and installation by the utility service provider.

APPENDIX A – ENGINEERING PLANS

- Prepared by McKenzie & Co Consultants Ltd (MCCL) - BOUND SEPARATELY

APPENDIX C – SEDIMENT RETENTION POND SUMMARY

- Prepared by MCCL

SEDIMENT RETENTION POND SPECIFICATIONS							
CATCHMENT DESCRIPTION	AREA	ADDITIONAL STORAGE (%)	BASE		CREST		VOLUME (m^3)
	(ha)		Length (m)	Width (m)	Length (m)	Width (m)	
POND 0001	5.00	20	50.0	15.3	54.8	20.1	1808
POND 0003	3.60	20	42.1	12.7	46.9	17.5	1304
POND 0004	4.09	20	45.0	13.7	49.8	18.5	1480
POND 0006	2.83	20	37.1	11.0	41.9	15.8	1027
POND 0014	4.96	20	49.8	15.3	54.6	20.1	1794
POND 0015	4.18	20	45.5	13.8	50.3	18.6	1513
POND 0016	0.85	20	34.0	10.0	38.8	14.8	872
POND 0017	1.91	20	34.0	10.0	38.8	14.8	872
POND 0018	1.96	20	34.0	10.0	38.8	14.8	872
POND 0301	3.52	20	41.6	12.5	46.4	17.3	1275
POND 0601	4.32	20	46.3	14.1	51.1	18.9	1563
POND 0602	3.43	20	41.0	12.3	45.8	17.1	1243
POND 0703	1.58	20	34.0	10.0	38.8	14.8	872
POND 0805	3.10	20	38.9	11.6	43.7	16.4	1124
POND 0902	1.18	20	34.0	10.0	38.8	14.8	872
POND 1002	4.56	20	47.6	14.5	52.4	19.3	1650
POND 1201	4.31	20	46.2	14.1	51.0	18.9	1560
POND 1302	2.88	20	37.4	11.1	42.2	15.9	1045
POND 1402	3.50	20	41.5	12.5	46.3	17.3	1268
POND 1404	2.00	20	34.0	10.0	38.8	14.8	872
POND 1406	3.83	20	43.5	13.2	48.3	18.0	1387
POND 1501	2.50	20	34.0	10.0	38.8	14.8	872
POND 1701	4.60	20	47.8	14.6	52.6	19.4	1664
POND 1801	1.30	20	34.0	10.0	38.8	14.8	872

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GD05 SEDIMENT POND SIZING - POND 0001

PROJECT NAME: MURIWAI ROAD - GOLF COURSE Created By CIM Date 18/11/2021
PROJECT Nos: 1976 Checked By Date 18/11/2021

SILT POND No: POND 0001

Design Catchment :	6	ha	+ 20% ADDITIONAL CAPACITY
Contributing Catchment :	5	ha	
Average Site Slope :	12	%	
Site Length :	250	m	

MINIMUM SEDIMENT POND SIZE

The size of the pond, in m³, is 3 % of the total contributing catchment, in m².
Pond volume = 1800 m³

PROPOSED SEDIMENT POND SIZE

Length/Width ratio = 3 :1
Pond Dimensions =

	Width	Length
@ av depth	17.3	52.0
@ spillway MH level	19.3	54.0
@ Floor level	15.3	50.0

POND DIMENSIONS	Width	Length
Crest	20.1	54.8
Floor	15.3	50

(This is the height of the dam above the outlet manhole including freeboard and 1%AEP spillway)

Surface Area = 1043 m²
Pond Depth = 2 m
Side Slopes 1vt : 1 hz

SPREADERS	
Flow Rate *l/s*	18
Number	4

Pond Volume = 1808 m³ *Av depth(spillway level * floor level)/2*

SPILLWAY DESIGN

DESIGN FOR 1% AEP RAINFALL

The Peak Flow is calculated using the Rational Method: Q = 2.78CIA

• Runoff coefficient, C

Working Area		Remaining Area		Average	
C =	0.7	C =	0.7	Cave =	0.7

• Rainfall Intensity, I

Mannings, n = 0.022
tc = 8.3 minutes *(From "A Guideline and Procedure for Hydrological Design of Urban Stormwater Systems")*

Calculate I from HIRS
I = 150 mm/hr

1% AEP flow = *1.75* *m³/s*

SPILLWAY DETAIL

Use Q = CLH3/2 to calculate the spillway height (H)

Spillway width, L =	18.1	m	
Free board =	0.1	m	
C =	1.6		*(Assume broad crested weir)*

Spillway Height = 0.25 m *(This is the height of the flow above the outlet manhole including freeboard)*

GD05 SEDIMENT POND SIZING - POND 0003

PROJECT NAME: MURIWAI ROAD - GOLF COURSE Created By CIM Date 18/11/2021
PROJECT Nos: 1976 Checked By Date 18/11/2021

SILT POND No: POND 0003

Design Catchment :	4.32	ha	+ 20% ADDITIONAL CAPACITY
Contributing Catchment :	3.6	ha	
Average Site Slope :	6.3	%	
Site Length :	270	m	

MINIMUM SEDIMENT POND SIZE

The size of the pond, in m³, is 3 % of the total contributing catchment, in m².
Pond volume = 1296 m³

PROPOSED SEDIMENT POND SIZE

Length/Width ratio = 3 :1
Pond Dimensions =

	Width	Length
@ av depth	14.7	44.1
@ spillway MH level	16.7	46.1
@ Floor level	12.7	42.1

POND DIMENSIONS	Width	Length
Crest	17.5	46.9
Floor	12.7	42

(This is the height of the dam above the outlet manhole including freeboard and 1%AEP spillway)

Surface Area = 770 m²
Pond Depth = 2 m
Side Slopes 1vt : 1 hz

SPREADERS	
Flow Rate *l/s*	12.96
Number	3

Pond Volume = 1304 m³ *Av depth(spillway level * floor level)/2*

SPILLWAY DESIGN

DESIGN FOR 1% AEP RAINFALL

The Peak Flow is calculated using the Rational Method: Q = 2.78CIA

• Runoff coefficient, C

Working Area		Remaining Area		Average	
C =	0.7	C =	0.7	Cave =	0.7

• Rainfall Intensity, I

Mannings, n = 0.022
tc = 9.7 minutes *(From "A Guideline and Procedure for Hydrological Design of Urban Stormwater Systems")*

Calculate I from HIRS
I = 150 mm/hr

1% AEP flow = *1.26* *m³/s*

SPILLWAY DETAIL

Use Q = CLH3/2 to calculate the spillway height (H)

Spillway width, L =	15.5	m	
Free board =	0.1	m	
C =	1.6		*(Assume broad crested weir)*

Spillway Height = 0.24 m *(This is the height of the flow above the outlet manhole including freeboard)*

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GD05 SEDIMENT POND SIZING - POND 0004

PROJECT NAME: MURIWAI ROAD - GOLF COURSE Created By CIM Date 18/11/2021
PROJECT Nos: 1976 Checked By Date 18/11/2021

SILT POND No: POND 0004

Design Catchment :	4.908	ha	+ 20% ADDITIONAL CAPACITY
Contributing Catchment :	4.09	ha	
Average Site Slope :	6.3	%	
Site Length :	230	m	

MINIMUM SEDIMENT POND SIZE

The size of the pond, in m³, is 3 % of the total contributing catchment, in m².
Pond volume = 1472 m³

PROPOSED SEDIMENT POND SIZE

Length/Width ratio = 3 :1
Pond Dimensions =

	Width	Length
@ av depth	15.7	47.0
@ spillway MH level	17.7	49.0
@ Floor level	13.7	45.0

POND DIMENSIONS	Width	Length
Crest	18.5	49.8
Floor	13.7	45

(This is the height of the dam above the outlet manhole including freeboard and 1%AEP spillway)

Surface Area = 866 m²
Pond Depth = 2 m
Side Slopes 1vt : 1 hz

SPREADERS	
Flow Rate *l/s*	14.724
Number	4

Pond Volume = 1480 m³ *Av depth(spillway level * floor level)/2*

SPILLWAY DESIGN

DESIGN FOR 1% AEP RAINFALL

The Peak Flow is calculated using the Rational Method: Q = 2.78CIA

• Runoff coefficient, C

Working Area		Remaining Area		Average	
C =	0.7	C =	0.7	Cave =	0.7

• Rainfall Intensity, I

Mannings, n = 0.022
tc = 9.2 minutes *(From "A Guideline and Procedure for Hydrological Design of Urban Stormwater Systems")*

Calculate I from HIRS
I = 150 mm/hr

1% AEP flow = *1.43* *m³/s*

SPILLWAY DETAIL

Use Q = CLH3/2 to calculate the spillway height (H)

Spillway width, L =	16.5	m	
Free board =	0.1	m	
C =	1.6		*(Assume broad crested weir)*

Spillway Height = 0.24 m *(This is the height of the flow above the outlet manhole including freeboard)*

GD05 SEDIMENT POND SIZING - POND 0006

PROJECT NAME: MURIWAI ROAD - GOLF COURSE Created By CIM Date 18/11/2021
PROJECT Nos: 1976 Checked By Date 18/11/2021

SILT POND No: POND 0006

Design Catchment :	3.396	ha	+ 20% ADDITIONAL CAPACITY
Contributing Catchment :	2.83	ha	
Average Site Slope :	4.8	%	
Site Length :	230	m	

MINIMUM SEDIMENT POND SIZE

The size of the pond, in m³, is 3 % of the total contributing catchment, in m².
Pond volume = 1019 m³

PROPOSED SEDIMENT POND SIZE

Length/Width ratio = 3 :1
Pond Dimensions =

	Width	Length
@ av depth	13.0	39.1
@ spillway MH level	15.0	41.1
@ Floor level	11.0	37.1

POND DIMENSIONS	Width	Length
Crest	15.8	41.9
Floor	11.0	37

(This is the height of the dam above the outlet manhole including freeboard and 1%AEP spillway)

Surface Area = 618 m²
Pond Depth = 2 m
Side Slopes 1vt : 1 hz

SPREADERS	
Flow Rate *l/s*	10.188
Number	3

Pond Volume = 1027 m³ *Av depth(spillway level * floor level)/2*

SPILLWAY DESIGN

DESIGN FOR 1% AEP RAINFALL

The Peak Flow is calculated using the Rational Method: Q = 2.78CIA

• Runoff coefficient, C

Working Area		Remaining Area		Average	
C =	0.7	C =	0.7	Cave =	0.7

• Rainfall Intensity, I

Mannings, n = 0.022
tc = 9.7 minutes *(From "A Guideline and Procedure for Hydrological Design of Urban Stormwater Systems")*

Calculate I from HIRS
I = 150 mm/hr

1% AEP flow = *0.99* *m³/s*

SPILLWAY DETAIL

Use Q = CLH3/2 to calculate the spillway height (H)

Spillway width, L =	13.8	m
Free board =	0.1	m
C =	1.6	*(Assume broad crested weir)*

Spillway Height = 0.23 m *(This is the height of the flow above the outlet manhole including freeboard)*

GD05 SEDIMENT POND SIZING - POND 0014

PROJECT NAME: MURIWAI ROAD - GOLF COURSE Created By CIM Date 18/11/2021
PROJECT Nos: 1976 Checked By Date 18/11/2021

SILT POND No: POND 0014

Design Catchment :	5.952	ha	+ 20% ADDITIONAL CAPACITY
Contributing Catchment :	4.96	ha	
Average Site Slope :	5.15	%	
Site Length :	330	m	

MINIMUM SEDIMENT POND SIZE

The size of the pond, in m³, is 3 % of the total contributing catchment, in m².
Pond volume = 1786 m³

PROPOSED SEDIMENT POND SIZE

Length/Width ratio = 3 :1
Pond Dimensions =

	Width	Length
@ av depth	17.3	51.8
@ spillway MH level	19.3	53.8
@ Floor level	15.3	49.8

POND DIMENSIONS	Width	Length
Crest	20.1	54.6
Floor	15.3	50

(This is the height of the dam above the outlet manhole including freeboard and 1%AEP spillway)

Surface Area = 1035 m²
Pond Depth = 2 m
Side Slopes 1vt : 1 hz

SPREADERS	
Flow Rate *l/s*	17.856
Number	4

Pond Volume = 1794 m³ *Av depth(spillway level * floor level)/2*

SPILLWAY DESIGN

DESIGN FOR 1% AEP RAINFALL

The Peak Flow is calculated using the Rational Method: Q = 2.78CIA

• Runoff coefficient, C

Working Area		Remaining Area		Average	
C =	0.7	C =	0.7	Cave =	0.7

• Rainfall Intensity, I

Mannings, n = 0.022
tc = 10.7 minutes *(From "A Guideline and Procedure for Hydrological Design of Urban Stormwater Systems")*

Calculate I from HIRS
I = 150 mm/hr

1% AEP flow = *1.74* *m³/s*

SPILLWAY DETAIL

Use Q = CLH3/2 to calculate the spillway height (H)

Spillway width, L =	18.1	m	
Free board =	0.1	m	
C =	1.6		*(Assume broad crested weir)*

Spillway Height = 0.25 m *(This is the height of the flow above the outlet manhole including freeboard)*

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GD05 SEDIMENT POND SIZING - POND 0015

PROJECT NAME: MURIWAI ROAD - GOLF COURSE Created By CIM Date 18/11/2021
PROJECT Nos: 1976 Checked By Date 18/11/2021

SILT POND No: POND 0015

Design Catchment :	5.016	ha	+ 20% ADDITIONAL CAPACITY
Contributing Catchment :	4.18	ha	
Average Site Slope :	1.5	%	
Site Length :	330	m	

MINIMUM SEDIMENT POND SIZE

The size of the pond, in m^3, is 3 % of the total contributing catchment, in m^2.
Pond volume = 1505 m^3

PROPOSED SEDIMENT POND SIZE

Length/Width ratio = 3 :1
Pond Dimensions =

	Width	Length
@ av depth	15.8	47.5
@ spillway MH level	17.8	49.5
@ Floor level	13.8	45.5

POND DIMENSIONS	Width	Length
Crest	18.6	50.3
Floor	13.8	46

(This is the height of the dam above the outlet manhole including freeboard and 1%AEP spillway)

Surface Area = 883 m^2
Pond Depth = 2 m
Side Slopes 1vt : 1 hz

SPREADERS	
Flow Rate *l/s*	15.048
Number	4

Pond Volume = 1513 m^3 *Av depth(spillway level * floor level)/2*

SPILLWAY DESIGN

DESIGN FOR 1% AEP RAINFALL

The Peak Flow is calculated using the Rational Method: Q = 2.78CIA

• Runoff coefficient, C

Working Area		Remaining Area		Average	
C =	0.7	C =	0.7	Cave =	0.7

• Rainfall Intensity, I

Mannings, n = 0.022
tc = 13.8 minutes *(From "A Guideline and Procedure for Hydrological Design of Urban Stormwater Systems")*

Calculate I from HIRS
I = 150 mm/hr

1% AEP flow = *1.46* *m^3/s*

SPILLWAY DETAIL

Use Q = CLH3/2 to calculate the spillway height (H)

Spillway width, L =	16.6	m
Free board =	0.1	m
C =	1.6	*(Assume broad crested weir)*

Spillway Height = 0.24 m *(This is the height of the flow above the outlet manhole including freeboard)*

GD05 SEDIMENT POND SIZING - POND 0016

PROJECT NAME:	MURIWAI ROAD - GOLF COURSE	Created By	CIM	Date	18/11/2021
PROJECT Nos:	1976	Checked By		Date	18/11/2021

SILT POND No: POND 0016

Design Catchment :	1.02	ha	+ 20% ADDITIONAL CAPACITY
Contributing Catchment :	0.85	ha	
Average Site Slope :	2.5	%	
Site Length :	110	m	

MINIMUM SEDIMENT POND SIZE

The size of the pond, in m^3, is 2 % of the total contributing catchment, in m^2.

Pond volume = 204 m^3

PROPOSED SEDIMENT POND SIZE

Length/Width ratio = 3 :1

Pond Dimensions =

	Width	Length
@ av depth	12.0	36.0
@ spillway MH level	14.0	38.0
@ Floor level	10.0	34.0

POND DIMENSIONS	Width	Length
Crest	14.8	38.8
Floor	10.0	34

(This is the height of the dam above the outlet manhole including freeboard and 1%AEP spillway)

Surface Area = 532 m^2

Pond Depth = 2 m

Side Slopes 1vt : 1 hz

SPREADERS	
Flow Rate *l/s*	3.06
Number	1

Pond Volume = 872 m^3 *Av depth(spillway level * floor level)/2*

SPILLWAY DESIGN

DESIGN FOR 1% AEP RAINFALL

The Peak Flow is calculated using the Rational Method: Q = 2.78CIA

• Runoff coefficient, C

Working Area		Remaining Area		Average	
C =	0.7	C =	0.7	Cave =	0.7

• Rainfall Intensity, I

Mannings, n = 0.022

tc = 8.6 minutes *(From "A Guideline and Procedure for Hydrological Design of Urban Stormwater Systems")*

Calculate I from HIRS

I = 150 mm/hr

1% AEP flow = *0.30* *m^3/s*

SPILLWAY DETAIL

Use Q = CLH3/2 to calculate the spillway height (H)

Spillway width, L =	12.8	m
Free board =	0.1	m
C =	1.6	*(Assume broad crested weir)*

Spillway Height = 0.16 m *(This is the height of the flow above the outlet manhole including freeboard)*

GD05 SEDIMENT POND SIZING - POND 0017

PROJECT NAME:	MURIWAI ROAD - GOLF COURSE	Created By	CIM	Date	18/11/2021
PROJECT Nos:	1976	Checked By		Date	18/11/2021

SILT POND No: POND 0017

Design Catchment :	2.292	ha	+ 20% ADDITIONAL CAPACITY
Contributing Catchment :	1.91	ha	
Average Site Slope :	4.2	%	
Site Length :	166	m	

MINIMUM SEDIMENT POND SIZE

The size of the pond, in m³, is 2 % of the total contributing catchment, in m².

Pond volume = 458 m³

PROPOSED SEDIMENT POND SIZE

Length/Width ratio = 3 :1

Pond Dimensions =

	Width	Length
@ av depth	12.0	36.0
@ spillway MH level	14.0	38.0
@ Floor level	10.0	34.0

POND DIMENSIONS	Width	Length
Crest	14.8	38.8
Floor	10.0	34

(This is the height of the dam above the outlet manhole including freeboard and 1%AEP spillway)

Surface Area = 532 m²

Pond Depth = 2 m

Side Slopes 1vt : 1 hz

SPREADERS	
Flow Rate *l/s*	6.876
Number	2

Pond Volume = 872 m³ *Av depth(spillway level * floor level)/2*

SPILLWAY DESIGN

DESIGN FOR 1% AEP RAINFALL

The Peak Flow is calculated using the Rational Method: Q = 2.78CIA

• Runoff coefficient, C

Working Area		Remaining Area		Average	
C =	0.7	C =	0.7	Cave =	0.7

• Rainfall Intensity, I

Mannings, n = 0.022

tc = 8.9 minutes *(From "A Guideline and Procedure for Hydrological Design of Urban Stormwater Systems")*

Calculate I from HIRS

I = 150 mm/hr

1% AEP flow = *0.67* *m³/s*

SPILLWAY DETAIL

Use Q = CLH3/2 to calculate the spillway height (H)

Spillway width, L =	12.8	m
Free board =	0.1	m
C =	1.6	*(Assume broad crested weir)*

Spillway Height = 0.20 m *(This is the height of the flow above the outlet manhole including freeboard)*

GD05 SEDIMENT POND SIZING - POND 0018

PROJECT NAME: MURIWAI ROAD - GOLF COURSE Created By CIM Date 18/11/2021
PROJECT Nos: 1976 Checked By Date 18/11/2021

SILT POND No: POND 0018

Design Catchment :	2.352	ha	+ 20% ADDITIONAL CAPACITY
Contributing Catchment :	1.96	ha	
Average Site Slope :	1.6	%	
Site Length :	190	m	

MINIMUM SEDIMENT POND SIZE

The size of the pond, in m^3, is 2 % of the total contributing catchment, in m^2.
Pond volume = 470 m^3

PROPOSED SEDIMENT POND SIZE

Length/Width ratio = 3 :1
Pond Dimensions =

	Width	Length
@ av depth	12.0	36.0
@ spillway MH level	14.0	38.0
@ Floor level	10.0	34.0

POND DIMENSIONS	Width	Length
Crest	14.8	38.8
Floor	10.0	34

(This is the height of the dam above the outlet manhole including freeboard and 1%AEP spillway)

Surface Area = 532 m^2
Pond Depth = 2 m
Side Slopes 1vt : 1 hz

SPREADERS	
Flow Rate *l/s*	7.056
Number	2

Pond Volume = 872 m^3 *Av depth(spillway level * floor level)/2*

SPILLWAY DESIGN

DESIGN FOR 1% AEP RAINFALL

The Peak Flow is calculated using the Rational Method: Q = 2.78CIA

• Runoff coefficient, C

Working Area		Remaining Area		Average	
C =	0.7	C =	0.7	Cave =	0.7

• Rainfall Intensity, I

Mannings, n = 0.022
tc = 11.3 minutes *(From "A Guideline and Procedure for Hydrological Design of Urban Stormwater Systems")*

Calculate I from HIRS
I = 150 mm/hr

1% AEP flow = *0.69* *m^3/s*

SPILLWAY DETAIL

Use Q = CLH3/2 to calculate the spillway height (H)

Spillway width, L =	12.8	m
Free board =	0.1	m
C =	1.6	*(Assume broad crested weir)*

Spillway Height = 0.20 m *(This is the height of the flow above the outlet manhole including freeboard)*

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GD05 SEDIMENT POND SIZING - POND 0301

PROJECT NAME: MURIWAI ROAD - GOLF COURSE Created By CIM Date 18/11/2021
PROJECT Nos: 1976 Checked By Date 18/11/2021

SILT POND No: POND 0301

Design Catchment :	4.224	ha	+ 20% ADDITIONAL CAPACITY
Contributing Catchment :	3.52	ha	
Average Site Slope :	6.75	%	
Site Length :	385	m	

MINIMUM SEDIMENT POND SIZE

The size of the pond, in m³, is 3 % of the total contributing catchment, in m².
Pond volume = 1267 m³

PROPOSED SEDIMENT POND SIZE

Length/Width ratio = 3 :1
Pond Dimensions =

	Width	Length
@ av depth	14.5	43.6
@ spillway MH level	16.5	45.6
@ Floor level	12.5	41.6

POND DIMENSIONS	Width	Length
Crest	17.3	46.4
Floor	12.5	42

(This is the height of the dam above the outlet manhole including freeboard and 1%AEP spillway)

Surface Area = 754 m²
Pond Depth = 2 m
Side Slopes 1vt : 1 hz

SPREADERS	
Flow Rate *l/s*	12.672
Number	3

Pond Volume = 1275 m³ *Av depth(spillway level * floor level)/2*

SPILLWAY DESIGN

DESIGN FOR 1% AEP RAINFALL

The Peak Flow is calculated using the Rational Method: Q = 2.78CIA

• Runoff coefficient, C

Working Area		Remaining Area		Average	
C =	0.7	C =	0.7	Cave =	0.7

• Rainfall Intensity, I

Mannings, n = 0.022
tc = 10.7 minutes *(From "A Guideline and Procedure for Hydrological Design of Urban Stormwater Systems")*

Calculate I from HIRS
I = 150 mm/hr

1% AEP flow = *1.23* *m³/s*

SPILLWAY DETAIL

Use Q = CLH3/2 to calculate the spillway height (H)

Spillway width, L =	15.3	m
Free board =	0.1	m
C =	1.6	*(Assume broad crested weir)*

Spillway Height = 0.24 m *(This is the height of the flow above the outlet manhole including freeboard)*

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GD05 SEDIMENT POND SIZING - POND 0601

PROJECT NAME:	MURIWAI ROAD - GOLF COURSE	Created By	CIM	Date	18/11/2021
PROJECT Nos:	1976	Checked By		Date	18/11/2021

SILT POND No: POND 0601

Design Catchment :	5.18	ha	+ 20% ADDITIONAL CAPACITY
Contributing Catchment :	4.32	ha	
Average Site Slope :	22.3	%	
Site Length :	220	m	

MINIMUM SEDIMENT POND SIZE

The size of the pond, in m^3, is 3 % of the total contributing catchment, in m^2.

Pond volume = 1555 m^3

PROPOSED SEDIMENT POND SIZE

Length/Width ratio = 3 :1

Pond Dimensions =

	Width	Length
@ av depth	16.1	48.3
@ spillway MH level	18.1	50.3
@ Floor level	14.1	46.3

POND DIMENSIONS		
	Width	Length
Crest	18.9	51.1
Floor	14.1	46

(This is the height of the dam above the outlet manhole including freeboard and 1%AEP spillway)

Surface Area = 910 m^2

Pond Depth =	2	m
Side Slopes 1vt :	1	hz

SPREADERS	
Flow Rate *l/s*	15.552
Number	4

Pond Volume = 1563 m^3 *Av depth(spillway level * floor level)/2*

SPILLWAY DESIGN

DESIGN FOR 1% AEP RAINFALL

The Peak Flow is calculated using the Rational Method: Q = 2.78CIA

• Runoff coefficient, C

Working Area		Remaining Area		Average	
C =	0.7	C =	0.7	Cave =	0.7

• Rainfall Intensity, I

Mannings, n =	0.022		
tc =	7.0	minutes	*(From "A Guideline and Procedure for Hydrological Design of Urban Stormwater Systems")*
Calculate I from	HIRS		
I =	150	mm/hr	

1% AEP flow = *1.51* *m^3/s*

SPILLWAY DETAIL

Use Q = CLH3/2 to calculate the spillway height (H)

Spillway width, L =	16.9	m	
Free board =	0.1	m	
C =	1.6		*(Assume broad crested weir)*

Spillway Height = 0.25 m *(This is the height of the flow above the outlet manhole including freeboard)*

GD05 SEDIMENT POND SIZING - POND 0602

PROJECT NAME: MURIWAI ROAD - GOLF COURSE Created By CIM Date 18/11/2021
PROJECT Nos: 1976 Checked By Date 18/11/2021

SILT POND No: POND 0602

Design Catchment :	4.12	ha	+ 20% ADDITIONAL CAPACITY
Contributing Catchment :	3.43	ha	
Average Site Slope :	7.9	%	
Site Length :	215	m	

MINIMUM SEDIMENT POND SIZE

The size of the pond, in m^3, is 3 % of the total contributing catchment, in m^2.
Pond volume = 1235 m^3

PROPOSED SEDIMENT POND SIZE

Length/Width ratio = 3 :1
Pond Dimensions =

	Width	Length
@ av depth	14.3	43.0
@ spillway MH level	16.3	45.0
@ Floor level	12.3	41.0

POND DIMENSIONS	Width	Length
Crest	17.1	45.8
Floor	12.3	41

(This is the height of the dam above the outlet manhole including freeboard and 1%AEP spillway)

Surface Area = 736 m^2
Pond Depth = 2 m
Side Slopes 1vt : 1 hz

SPREADERS	
Flow Rate *l/s*	12.348
Number	3

Pond Volume = 1243 m^3 *Av depth(spillway level * floor level)/2*

SPILLWAY DESIGN

DESIGN FOR 1% AEP RAINFALL

The Peak Flow is calculated using the Rational Method: Q = 2.78CIA

• Runoff coefficient, C

Working Area		Remaining Area		Average	
C =	0.7	C =	0.7	Cave =	0.7

• Rainfall Intensity, I

Mannings, n = 0.022
tc = 8.6 minutes *(From "A Guideline and Procedure for Hydrological Design of Urban Stormwater Systems")*
Calculate I from HIRS
I = 150 mm/hr

1% AEP flow = *1.20* *m^3/s*

SPILLWAY DETAIL

Use Q = CLH3/2 to calculate the spillway height (H)

Spillway width, L =	15.1	m
Free board =	0.1	m
C =	1.6	*(Assume broad crested weir)*

Spillway Height = 0.23 m *(This is the height of the flow above the outlet manhole including freeboard)*

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GD05 SEDIMENT POND SIZING - POND 0703

PROJECT NAME: MURIWAI ROAD - GOLF COURSE Created By CIM Date 18/11/2021
PROJECT Nos: 1976 Checked By Date 18/11/2021

SILT POND No: POND 0703

Design Catchment :	1.90	ha	+ 20% ADDITIONAL CAPACITY
Contributing Catchment :	1.58	ha	
Average Site Slope :	18.5	%	
Site Length :	195	m	

MINIMUM SEDIMENT POND SIZE

The size of the pond, in m^3, is 3 % of the total contributing catchment, in m^2.
Pond volume = 569 m^3

PROPOSED SEDIMENT POND SIZE

Length/Width ratio = 3 :1
Pond Dimensions =

	Width	Length
@ av depth	12.0	36.0
@ spillway MH level	14.0	38.0
@ Floor level	10.0	34.0

POND DIMENSIONS	Width	Length
Crest	14.8	38.8
Floor	10.0	34

(This is the height of the dam above the outlet manhole including freeboard and 1%AEP spillway)

Surface Area = 532 m^2
Pond Depth = 2 m
Side Slopes 1vt : 1 hz

SPREADERS	
Flow Rate *l/s*	5.688
Number	2

Pond Volume = 872 m^3 *Av depth(spillway level * floor level)/2*

SPILLWAY DESIGN

DESIGN FOR 1% AEP RAINFALL

The Peak Flow is calculated using the Rational Method: Q = 2.78CIA

• Runoff coefficient, C

Working Area		Remaining Area		Average	
C =	0.7	C =	0.7	Cave =	0.7

• Rainfall Intensity, I

Mannings, n = 0.022
tc = 7.0 minutes *(From "A Guideline and Procedure for Hydrological Design of Urban Stormwater Systems")*

Calculate I from HIRS
I = 150 mm/hr

1% AEP flow = *0.55* *m^3/s*

SPILLWAY DETAIL

Use Q = CLH3/2 to calculate the spillway height (H)

Spillway width, L =	12.8	m
Free board =	0.1	m
C =	1.6	*(Assume broad crested weir)*

Spillway Height = 0.19 m *(This is the height of the flow above the outlet manhole including freeboard)*

GD05 SEDIMENT POND SIZING - POND 0805

PROJECT NAME: MURIWAI ROAD - GOLF COURSE Created By CIM Date 18/11/2021
PROJECT Nos: 1976 Checked By Date 18/11/2021

SILT POND No: POND 0805

Design Catchment :	3.72	ha	+ 20% ADDITIONAL CAPACITY
Contributing Catchment :	3.1	ha	
Average Site Slope :	12.4	%	
Site Length :	210	m	

MINIMUM SEDIMENT POND SIZE

The size of the pond, in m^3, is 3 % of the total contributing catchment, in m^2.
Pond volume = 1116 m^3

PROPOSED SEDIMENT POND SIZE

Length/Width ratio = 3 :1
Pond Dimensions =

	Width	Length
@ av depth	13.6	40.9
@ spillway MH level	15.6	42.9
@ Floor level	11.6	38.9

POND DIMENSIONS	Width	Length
Crest	16.4	43.7
Floor	11.6	39

(This is the height of the dam above the outlet manhole including freeboard and 1%AEP spillway)

Surface Area = 671 m^2
Pond Depth = 2 m
Side Slopes 1vt : 1 hz

SPREADERS	
Flow Rate *l/s*	11.16
Number	3

Pond Volume = 1124 m^3 *Av depth(spillway level * floor level)/2*

SPILLWAY DESIGN

DESIGN FOR 1% AEP RAINFALL

The Peak Flow is calculated using the Rational Method: Q = 2.78CIA

• Runoff coefficient, C

Working Area		Remaining Area		Average	
C =	0.7	C =	0.7	Cave =	0.7

• Rainfall Intensity, I

Mannings, n = 0.022
tc = 7.8 minutes *(From "A Guideline and Procedure for Hydrological Design of Urban Stormwater Systems")*

Calculate I from HIRS
I = 150 mm/hr

1% AEP flow = *1.09* *m^3/s*

SPILLWAY DETAIL

Use Q = CLH3/2 to calculate the spillway height (H)

Spillway width, L =	14.4	m
Free board =	0.1	m
C =	1.6	*(Assume broad crested weir)*

Spillway Height = 0.23 m *(This is the height of the flow above the outlet manhole including freeboard)*

GD05 SEDIMENT POND SIZING - POND 0902

PROJECT NAME: MURIWAI ROAD - GOLF COURSE Created By CIM Date 18/11/2021
PROJECT Nos: 1976 Checked By Date 18/11/2021

SILT POND No: POND 0902

Design Catchment :	1.42	ha	+ 20% ADDITIONAL CAPACITY
Contributing Catchment :	1.18	ha	
Average Site Slope :	10	%	
Site Length :	150	m	

MINIMUM SEDIMENT POND SIZE

The size of the pond, in m³, is 3 % of the total contributing catchment, in m².
Pond volume = 425 m³

PROPOSED SEDIMENT POND SIZE

Length/Width ratio = 3 :1
Pond Dimensions =

	Width	Length
@ av depth	12.0	36.0
@ spillway MH level	14.0	38.0
@ Floor level	10.0	34.0

POND DIMENSIONS	Width	Length
Crest	14.8	38.8
Floor	10.0	34

(This is the height of the dam above the outlet manhole including freeboard and 1%AEP spillway)

Surface Area = 532 m²
Pond Depth = 2 m
Side Slopes 1vt : 1 hz

SPREADERS	
Flow Rate *l/s*	4.248
Number	1

Pond Volume = 872 m³ *Av depth(spillway level * floor level)/2*

SPILLWAY DESIGN

DESIGN FOR 1% AEP RAINFALL

The Peak Flow is calculated using the Rational Method: Q = 2.78CIA

• Runoff coefficient, C

Working Area		Remaining Area		Average	
C =	0.7	C =	0.7	Cave =	0.7

• Rainfall Intensity, I

Mannings, n = 0.022
tc = 7.3 minutes *(From "A Guideline and Procedure for Hydrological Design of Urban Stormwater Systems")*

Calculate I from HIRS
I = 150 mm/hr

1% AEP flow = *0.41* *m³/s*

SPILLWAY DETAIL

Use Q = CLH3/2 to calculate the spillway height (H)

Spillway width, L =	12.8	m	
Free board =	0.1	m	
C =	1.6		*(Assume broad crested weir)*

Spillway Height = 0.17 m *(This is the height of the flow above the outlet manhole including freeboard)*

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GD05 SEDIMENT POND SIZING - POND 1002

PROJECT NAME: MURIWAI ROAD - GOLF COURSE Created By CIM Date 18/11/2021
PROJECT Nos: 1976 Checked By Date 18/11/2021

SILT POND No: POND 1002

Design Catchment :	5.47	ha	+ 20% ADDITIONAL CAPACITY
Contributing Catchment :	4.56	ha	
Average Site Slope :	9.5	%	
Site Length :	380	m	

MINIMUM SEDIMENT POND SIZE

The size of the pond, in m³, is 3 % of the total contributing catchment, in m².
Pond volume = 1642 m³

PROPOSED SEDIMENT POND SIZE

Length/Width ratio = 3 :1
Pond Dimensions =

	Width	Length
@ av depth	16.5	49.6
@ spillway MH level	18.5	51.6
@ Floor level	14.5	47.6

POND DIMENSIONS	Width	Length
Crest	19.3	52.4
Floor	14.5	48

(This is the height of the dam above the outlet manhole including freeboard and 1%AEP spillway)

Surface Area = 957 m²
Pond Depth = 2 m
Side Slopes 1vt : 1 hz

SPREADERS	
Flow Rate *l/s*	16.416
Number	4

Pond Volume = 1650 m³ *Av depth(spillway level * floor level)/2*

SPILLWAY DESIGN

DESIGN FOR 1% AEP RAINFALL

The Peak Flow is calculated using the Rational Method: Q = 2.78CIA

• Runoff coefficient, C

Working Area		Remaining Area		Average	
C =	0.7	C =	0.7	Cave =	0.7

• Rainfall Intensity, I

Mannings, n = 0.022
tc = 10.0 minutes *(From "A Guideline and Procedure for Hydrological Design of Urban Stormwater Systems")*

Calculate I from HIRS
I = 150 mm/hr

1% AEP flow = *1.60* *m³/s*

SPILLWAY DETAIL

Use Q = CLH3/2 to calculate the spillway height (H)

Spillway width, L =	17.3	m
Free board =	0.1	m
C =	1.6	*(Assume broad crested weir)*

Spillway Height = 0.25 m *(This is the height of the flow above the outlet manhole including freeboard)*

GD05 SEDIMENT POND SIZING - POND 1201

PROJECT NAME: MURIWAI ROAD - GOLF COURSE Created By CIM Date 18/11/2021
PROJECT Nos: 1976 Checked By Date 18/11/2021

SILT POND No: POND 1201

Design Catchment :	5.17	ha	+ 20% ADDITIONAL CAPACITY
Contributing Catchment :	4.31	ha	
Average Site Slope :	5.2	%	
Site Length :	500	m	

MINIMUM SEDIMENT POND SIZE

The size of the pond, in m³, is 3 % of the total contributing catchment, in m².
Pond volume = 1552 m³

PROPOSED SEDIMENT POND SIZE

Length/Width ratio = 3 :1
Pond Dimensions =

	Width	Length
@ av depth	16.1	48.2
@ spillway MH level	18.1	50.2
@ Floor level	14.1	46.2

POND DIMENSIONS	Width	Length
Crest	18.9	51.0
Floor	14.1	46

(This is the height of the dam above the outlet manhole including freeboard and 1%AEP spillway)

Surface Area = 908 m²
Pond Depth = 2 m
Side Slopes 1vt : 1 hz

SPREADERS	
Flow Rate *l/s*	15.516
Number	4

Pond Volume = 1560 m³ *Av depth(spillway level * floor level)/2*

SPILLWAY DESIGN

DESIGN FOR 1% AEP RAINFALL

The Peak Flow is calculated using the Rational Method: Q = 2.78CIA

• Runoff coefficient, C

Working Area		Remaining Area		Average	
C =	0.7	C =	0.7	Cave =	0.7

• Rainfall Intensity, I

Mannings, n = 0.022
tc = 12.3 minutes *(From "A Guideline and Procedure for Hydrological Design of Urban Stormwater Systems")*

Calculate I from HIRS
I = 150 mm/hr

1% AEP flow = *1.51* *m³/s*

SPILLWAY DETAIL

Use Q = CLH3/2 to calculate the spillway height (H)

Spillway width, L =	16.9	m
Free board =	0.1	m
C =	1.6	*(Assume broad crested weir)*

Spillway Height = 0.25 m *(This is the height of the flow above the outlet manhole including freeboard)*

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GD05 SEDIMENT POND SIZING - POND 1302

PROJECT NAME: MURIWAI ROAD - GOLF COURSE Created By CIM Date 18/11/2021
PROJECT Nos: 1976 Checked By Date 18/11/2021

SILT POND No: POND 1302

Design Catchment :	3.46	ha	+ 20% ADDITIONAL CAPACITY
Contributing Catchment :	2.88	ha	
Average Site Slope :	3.65	%	
Site Length :	385	m	

MINIMUM SEDIMENT POND SIZE

The size of the pond, in m³, is 3 % of the total contributing catchment, in m².
Pond volume = 1037 m³

PROPOSED SEDIMENT POND SIZE

Length/Width ratio = 3 :1
Pond Dimensions =

	Width	Length
@ av depth	13.1	39.4
@ spillway MH level	15.1	41.4
@ Floor level	11.1	37.4

POND DIMENSIONS	Width	Length
Crest	15.9	42.2
Floor	11.1	37

(This is the height of the dam above the outlet manhole including freeboard and 1%AEP spillway)

Surface Area = 628 m²
Pond Depth = 2 m
Side Slopes 1vt : 1 hz

SPREADERS	
Flow Rate *l/s*	10.368
Number	3

Pond Volume = 1045 m³ *Av depth(spillway level * floor level)/2*

SPILLWAY DESIGN

DESIGN FOR 1% AEP RAINFALL

The Peak Flow is calculated using the Rational Method: Q = 2.78CIA

• Runoff coefficient, C

Working Area		Remaining Area		Average	
C =	0.7	C =	0.7	Cave =	0.7

• Rainfall Intensity, I

Mannings, n = 0.022
tc = 12.1 minutes *(From "A Guideline and Procedure for Hydrological Design of Urban Stormwater Systems")*

Calculate I from HIRS
I = 150 mm/hr

1% AEP flow = *1.01* *m³/s*

SPILLWAY DETAIL

Use Q = CLH3/2 to calculate the spillway height (H)

Spillway width, L =	13.9	m	
Free board =	0.1	m	
C =	1.6		*(Assume broad crested weir)*

Spillway Height = 0.23 m *(This is the height of the flow above the outlet manhole including freeboard)*

GD05 SEDIMENT POND SIZING - POND 1402

PROJECT NAME: MURIWAI ROAD - GOLF COURSE Created By CIM Date 18/11/2021
PROJECT Nos: 1976 Checked By Date 18/11/2021

SILT POND No: POND 1402

Design Catchment :	4.20	ha	+ 20% ADDITIONAL CAPACITY
Contributing Catchment :	3.5	ha	
Average Site Slope :	5.8	%	
Site Length :	310	m	

MINIMUM SEDIMENT POND SIZE

The size of the pond, in m³, is 3 % of the total contributing catchment, in m².
Pond volume = 1260 m³

PROPOSED SEDIMENT POND SIZE

Length/Width ratio = 3 :1
Pond Dimensions =

	Width	Length
@ av depth	14.5	43.5
@ spillway MH level	16.5	45.5
@ Floor level	12.5	41.5

POND DIMENSIONS	Width	Length
Crest	17.3	46.3
Floor	12.5	41

(This is the height of the dam above the outlet manhole including freeboard and 1%AEP spillway)

Surface Area = 750 m²
Pond Depth = 2 m
Side Slopes 1vt : 1 hz

SPREADERS	
Flow Rate *l/s*	12.6
Number	3

Pond Volume = 1268 m³ *Av depth(spillway level * floor level)/2*

SPILLWAY DESIGN

DESIGN FOR 1% AEP RAINFALL

The Peak Flow is calculated using the Rational Method: Q = 2.78CIA

• Runoff coefficient, C

Working Area		Remaining Area		Average	
C =	0.7	C =	0.7	Cave =	0.7

• Rainfall Intensity, I

Mannings, n = 0.022
tc = 10.3 minutes *(From "A Guideline and Procedure for Hydrological Design of Urban Stormwater Systems")*

Calculate I from HIRS
I = 150 mm/hr

1% AEP flow = *1.23* *m³/s*

SPILLWAY DETAIL

Use Q = CLH3/2 to calculate the spillway height (H)

Spillway width, L =	15.3	m	
Free board =	0.1	m	
C =	1.6		*(Assume broad crested weir)*

Spillway Height = 0.24 m *(This is the height of the flow above the outlet manhole including freeboard)*

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GD05 SEDIMENT POND SIZING - POND 1404

PROJECT NAME: MURIWAI ROAD - GOLF COURSE Created By CIM Date 18/11/2021
PROJECT Nos: 1976 Checked By Date 18/11/2021

SILT POND No: POND 1404

Design Catchment :	2.40	ha	+ 20% ADDITIONAL CAPACITY
Contributing Catchment :	2	ha	
Average Site Slope :	5.333	%	
Site Length :	225	m	

MINIMUM SEDIMENT POND SIZE

The size of the pond, in m³, is 3 % of the total contributing catchment, in m².
Pond volume = 720 m³

PROPOSED SEDIMENT POND SIZE

Length/Width ratio = 3 :1
Pond Dimensions =

	Width	Length
@ av depth	12.0	36.0
@ spillway MH level	14.0	38.0
@ Floor level	10.0	34.0

POND DIMENSIONS	Width	Length
Crest	14.8	38.8
Floor	10.0	34

(This is the height of the dam above the outlet manhole including freeboard and 1%AEP spillway)

Surface Area = 532 m²
Pond Depth = 2 m
Side Slopes 1vt : 1 hz

SPREADERS	
Flow Rate *l/s*	7.2
Number	2

Pond Volume = 872 m³ *Av depth(spillway level * floor level)/2*

SPILLWAY DESIGN

DESIGN FOR 1% AEP RAINFALL

The Peak Flow is calculated using the Rational Method: Q = 2.78CIA

• Runoff coefficient, C

Working Area		Remaining Area		Average	
C =	0.7	C =	0.7	Cave =	0.7

• Rainfall Intensity, I

Mannings, n = 0.022
tc = 9.4 minutes *(From "A Guideline and Procedure for Hydrological Design of Urban Stormwater Systems")*

Calculate I from HIRS
I = 150 mm/hr

1% AEP flow = *0.70* *m³/s*

SPILLWAY DETAIL

Use Q = CLH3/2 to calculate the spillway height (H)

Spillway width, L =	12.8	m
Free board =	0.1	m
C =	1.6	*(Assume broad crested weir)*

Spillway Height = 0.21 m *(This is the height of the flow above the outlet manhole including freeboard)*

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GD05 SEDIMENT POND SIZING - POND 1406

PROJECT NAME: MURIWAI ROAD - GOLF COURSE Created By CIM Date 18/11/2021
PROJECT Nos: 1976 Checked By Date 18/11/2021

SILT POND No: POND 1406

Design Catchment :	4.60	ha	+ 20% ADDITIONAL CAPACITY
Contributing Catchment :	3.83	ha	
Average Site Slope :	5.71	%	
Site Length :	210	m	

MINIMUM SEDIMENT POND SIZE

The size of the pond, in m³, is 3 % of the total contributing catchment, in m².
Pond volume = 1379 m³

PROPOSED SEDIMENT POND SIZE

Length/Width ratio = 3 :1
Pond Dimensions =

	Width	Length
@ av depth	15.2	45.5
@ spillway MH level	17.2	47.5
@ Floor level	13.2	43.5

POND DIMENSIONS	Width	Length
Crest	18.0	48.3
Floor	13.2	43

(This is the height of the dam above the outlet manhole including freeboard and 1%AEP spillway)

Surface Area = 815 m²
Pond Depth = 2 m
Side Slopes 1vt : 1 hz

SPREADERS	
Flow Rate *l/s*	13.788
Number	4

Pond Volume = 1387 m³ *Av depth(spillway level * floor level)/2*

SPILLWAY DESIGN

DESIGN FOR 1% AEP RAINFALL

The Peak Flow is calculated using the Rational Method: Q = 2.78CIA

• Runoff coefficient, C

Working Area		Remaining Area		Average	
C =	0.7	C =	0.7	Cave =	0.7

• Rainfall Intensity, I

Mannings, n = 0.022
tc = 9.1 minutes *(From "A Guideline and Procedure for Hydrological Design of Urban Stormwater Systems")*

Calculate I from HIRS
I = 150 mm/hr

1% AEP flow = *1.34* *m³/s*

SPILLWAY DETAIL

Use Q = CLH3/2 to calculate the spillway height (H)

Spillway width, L =	16.0	m	
Free board =	0.1	m	
C =	1.6		*(Assume broad crested weir)*

Spillway Height = 0.24 m *(This is the height of the flow above the outlet manhole including freeboard)*

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GD05 SEDIMENT POND SIZING - POND 1501

PROJECT NAME: MURIWAI ROAD - GOLF COURSE Created By CIM Date 18/11/2021
PROJECT Nos: 1976 Checked By Date 18/11/2021

SILT POND No: POND 1501

Design Catchment :	3.00	ha	+ 20% ADDITIONAL CAPACITY
Contributing Catchment :	2.5	ha	
Average Site Slope :	3.63	%	
Site Length :	165	m	

MINIMUM SEDIMENT POND SIZE

The size of the pond, in m³, is 2 % of the total contributing catchment, in m².
Pond volume = 600 m³

PROPOSED SEDIMENT POND SIZE

Length/Width ratio = 3 :1
Pond Dimensions =

	Width	Length
@ av depth	12.0	36.0
@ spillway MH level	14.0	38.0
@ Floor level	10.0	34.0

POND DIMENSIONS	Width	Length
Crest	14.8	38.8
Floor	10.0	34

(This is the height of the dam above the outlet manhole including freeboard and 1%AEP spillway)

Surface Area = 532 m²
Pond Depth = 2 m
Side Slopes 1vt : 1 hz

SPREADERS	
Flow Rate *l/s*	9
Number	2

Pond Volume = 872 m³ *Av depth(spillway level * floor level)/2*

SPILLWAY DESIGN

DESIGN FOR 1% AEP RAINFALL

The Peak Flow is calculated using the Rational Method: Q = 2.78CIA

• Runoff coefficient, C

Working Area		Remaining Area		Average	
C =	0.7	C =	0.7	Cave =	0.7

• Rainfall Intensity, I

Mannings, n = 0.022
tc = 9.2 minutes *(From "A Guideline and Procedure for Hydrological Design of Urban Stormwater Systems")*

Calculate I from HIRS
I = 150 mm/hr

1% AEP flow = *0.88* *m³/s*

SPILLWAY DETAIL

Use Q = CLH3/2 to calculate the spillway height (H)

Spillway width, L =	12.8	m	
Free board =	0.1	m	
C =	1.6		*(Assume broad crested weir)*

Spillway Height = 0.22 m *(This is the height of the flow above the outlet manhole including freeboard)*

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GD05 SEDIMENT POND SIZING - POND 1701

PROJECT NAME: MURIWAI ROAD - GOLF COURSE Created By CIM Date 18/11/2021
PROJECT Nos: 1976 Checked By Date 18/11/2021

SILT POND No: POND 1701

Design Catchment :	5.52	ha	+ 20% ADDITIONAL CAPACITY
Contributing Catchment :	4.6	ha	
Average Site Slope :	6.05	%	
Site Length :	380	m	

MINIMUM SEDIMENT POND SIZE

The size of the pond, in m³, is 3 % of the total contributing catchment, in m².
Pond volume = 1656 m³

PROPOSED SEDIMENT POND SIZE

Length/Width ratio = 3 :1
Pond Dimensions =

	Width	Length
@ av depth	16.6	49.8
@ spillway MH level	18.6	51.8
@ Floor level	14.6	47.8

POND DIMENSIONS	Width	Length
Crest	19.4	52.6
Floor	14.6	48

(This is the height of the dam above the outlet manhole including freeboard and 1%AEP spillway)

Surface Area = 965 m²
Pond Depth = 2 m
Side Slopes 1vt : 1 hz

SPREADERS	
Flow Rate *l/s*	16.56
Number	4

Pond Volume = 1664 m³ *Av depth(spillway level * floor level)/2*

SPILLWAY DESIGN

DESIGN FOR 1% AEP RAINFALL

The Peak Flow is calculated using the Rational Method: Q = 2.78CIA

• Runoff coefficient, C

Working Area		Remaining Area		Average	
C =	0.7	C =	0.7	Cave =	0.7

• Rainfall Intensity, I

Mannings, n = 0.022
tc = 10.9 minutes *(From "A Guideline and Procedure for Hydrological Design of Urban Stormwater Systems")*

Calculate I from HIRS
I = 150 mm/hr

1% AEP flow = *1.61* *m³/s*

SPILLWAY DETAIL

Use Q = CLH3/2 to calculate the spillway height (H)

Spillway width, L =	17.4	m
Free board =	0.1	m
C =	1.6	*(Assume broad crested weir)*

Spillway Height = 0.25 m *(This is the height of the flow above the outlet manhole including freeboard)*

GD05 SEDIMENT POND SIZING - POND 1801

PROJECT NAME: MURIWAI ROAD - GOLF COURSE Created By CIM Date 18/11/2021
PROJECT Nos: 1976 Checked By Date 18/11/2021

SILT POND No: POND 1801

Design Catchment :	1.56	ha	+ 20% ADDITIONAL CAPACITY
Contributing Catchment :	1.3	ha	
Average Site Slope :	13.9	%	
Site Length :	165	m	

MINIMUM SEDIMENT POND SIZE

The size of the pond, in m³, is 3 % of the total contributing catchment, in m².
Pond volume = 468 m³

PROPOSED SEDIMENT POND SIZE

Length/Width ratio = 3 :1
Pond Dimensions =

	Width	Length
@ av depth	12.0	36.0
@ spillway MH level	14.0	38.0
@ Floor level	10.0	34.0

POND DIMENSIONS	Width	Length
Crest	14.8	38.8
Floor	10.0	34

(This is the height of the dam above the outlet manhole including freeboard and 1%AEP spillway)

Surface Area = 532 m²
Pond Depth = 2 m
Side Slopes 1vt : 1 hz

SPREADERS	
Flow Rate *l/s*	4.68
Number	2

Pond Volume = 872 m³ *Av depth(spillway level * floor level)/2*

SPILLWAY DESIGN

DESIGN FOR 1% AEP RAINFALL

The Peak Flow is calculated using the Rational Method: Q = 2.78CIA

• Runoff coefficient, C

Working Area		Remaining Area		Average	
C =	0.7	C =	0.7	Cave =	0.7

• Rainfall Intensity, I

Mannings, n = 0.022
tc = 7.0 minutes *(From "A Guideline and Procedure for Hydrological Design of Urban Stormwater Systems")*

Calculate I from HIRS
I = 150 mm/hr

1% AEP flow = *0.46* *m³/s*

SPILLWAY DETAIL

Use Q = CLH3/2 to calculate the spillway height (H)

Spillway width, L =	12.8	m	
Free board =	0.1	m	
C =	1.6		*(Assume broad crested weir)*

Spillway Height = 0.18 m *(This is the height of the flow above the outlet manhole including freeboard)*

APPENDIX B – TELECOMMUNICATION AS-BUILT PLANS (BEFOREUDIG)

CHORUS

WARNING: Buried services are widespread and it should be assumed that they are present until it is proven otherwise.
Cables should be expected to be found at ANY depth. In most instances Chorus plans do NOT show house service feeds on private property.
Refer to cover letter provided with your request for additional information - use all plans provided in conjunction with each other
You are responsible for interpreting the information provided and should refer to Worksafe.govt.nz for the 'Guide for safety with underground services'
For assistance contact Chorus Network Protection on 0800 822 003 or if you suspect damage has occurred contact 0800 463 896 opt 2

N

Plan Name	ZQ301
Plan ID	100612
Version	GA
Current at	19/10/2021

APPENDIX D – STORMWATER CATCHMENT ASSESSMENT WETLANDS – TP108 CALCULATIONS

- Prepared by MCCL

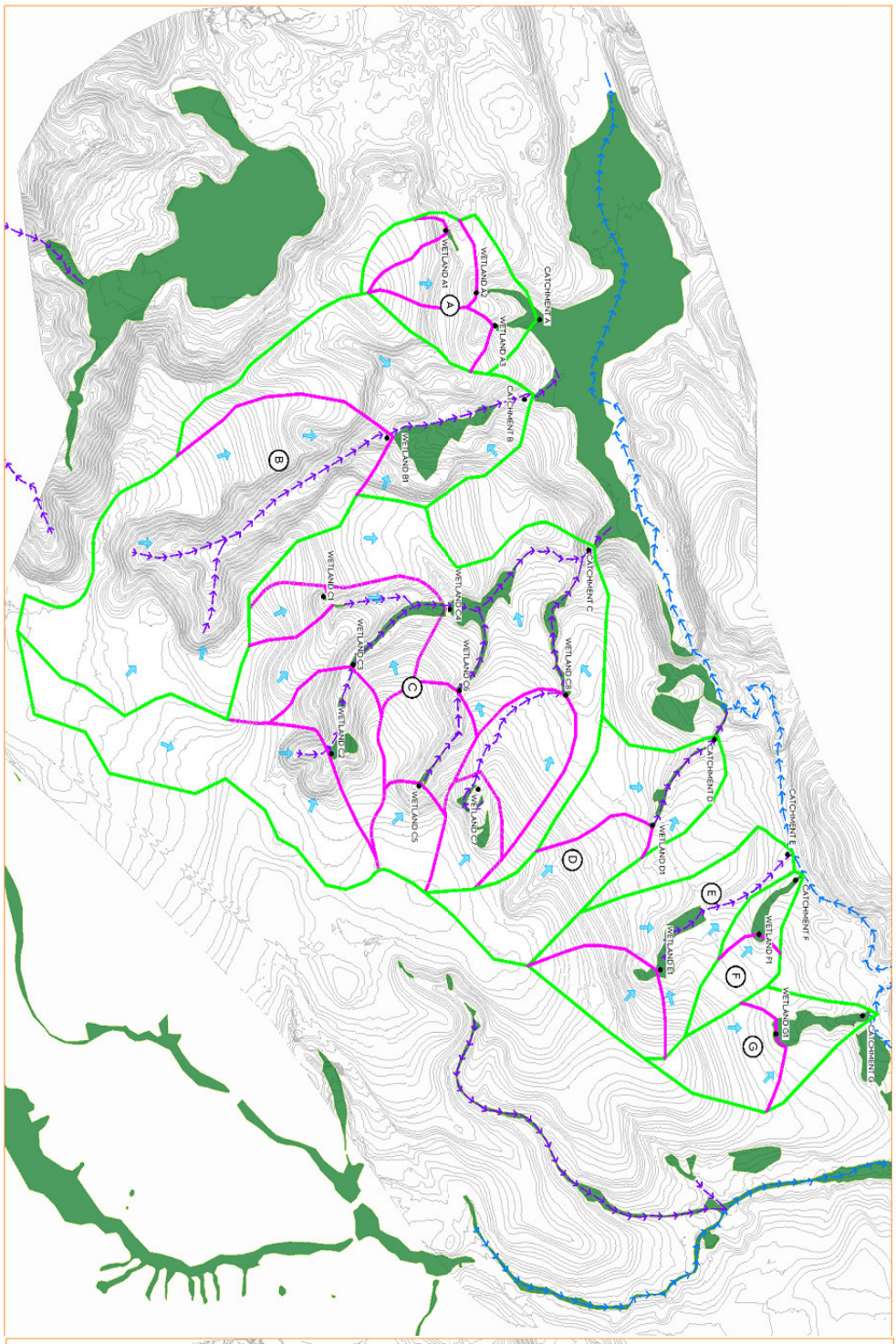
PRE DEVELOPMENT CATCHMENT INFO

24-hour rainfall Depth (mm)	Imperviousness (%)	SCS Curve No. (mm)														
175	0%	74														
Description	Catchment Area (ha)	Contributing Catchments	Total Catchment Area (ha)	Catchment Slope (m/m)	Catchment Length (km)	Channelisation C	Imperviousness (%)	q* Approx.	Weighted curve number	Storage (S)	Ia weighted (mm)	c*=(P24-2Ia)/(P24-2Ia+2S)	tc	Peak Q100 Flow (m3/s)	Q24 (mm)	V24 (m3)
Wetland A1	0.90	A1	0.90	0.128	0.21	1.00	0%	0.121	74.0	89.2	5.00	0.48	0.17	0.19	111.5	1003.30
Wetland A2	1.88	A1+A2	2.78	0.116	0.34	1.00	0%	0.121	74.0	89.2	5.00	0.48	0.17	0.59	111.5	3099.10
Wetland A3	1.43	A3	1.43	0.168	0.27	1.00	0%	0.121	74.0	89.2	5.00	0.48	0.17	0.30	111.5	1594.14
Catchment A	1.77	A1+A2+A3+A	5.98	0.113	0.47	1.00	0%	0.120	74.0	89.2	5.00	0.48	0.18	1.26	111.5	6666.40
Wetland B1	19.57	B1	19.57	0.105	0.82	1.00	0%	0.107	74.0	89.2	5.00	0.48	0.27	3.66	111.5	21816.31
Catchment B	10.44	B1+B	30.01	0.090	1.09	1.00	0%	0.098	74.0	89.2	5.00	0.48	0.34	5.15	111.5	33454.64
Wetland C1	1.20	C1	1.20	0.204	0.17	1.00	0%	0.121	74.0	89.2	5.00	0.48	0.17	0.25	111.5	1337.74
Wetland C2	9.05	C2	9.05	0.073	0.67	1.00	0%	0.109	74.0	89.2	5.00	0.48	0.26	1.73	111.5	10088.79
Wetland C3	2.83	C2+C3	11.88	0.069	0.83	1.00	0%	0.102	74.0	89.2	5.00	0.48	0.31	2.12	111.5	13246.97
Wetland C4	5.30	C1+C2+C3+C4	18.38	0.063	1.04	1.00	0%	0.095	74.0	89.2	5.00	0.48	0.37	3.06	111.5	20493.06
Wetland C5	1.83	C5	1.83	0.129	0.20	1.00	0%	0.121	74.0	89.2	5.00	0.48	0.17	0.39	111.5	2040.05
Wetland C6	2.80	C5+C6	4.63	0.106	0.39	1.00	0%	0.121	74.0	89.2	5.00	0.48	0.17	0.98	111.5	5156.99
Wetland C7	2.06	C7	2.06	0.111	0.24	1.00	0%	0.121	74.0	89.2	5.00	0.48	0.17	0.44	111.5	2296.45
Wetland C8	8.88	C7+C8	10.94	0.092	0.48	1.00	0%	0.118	74.0	89.2	5.00	0.48	0.20	2.26	111.5	12195.73
Catchment C	12.27	C4+C6+C8+C	46.22	0.072	1.37	1.00	0%	0.090	74.0	89.2	5.00	0.48	0.42	7.28	111.5	51524.16
Wetland D1	1.72	D1	1.72	0.098	0.46	1.00	0%	0.119	74.0	89.2	5.00	0.48	0.19	0.36	111.5	1917.43
Catchment D	2.88	D1+D	4.60	0.089	0.66	1.00	0%	0.110	74.0	89.2	5.00	0.48	0.25	0.89	111.5	5128.00
Wetland E1	2.85	E1	2.85	0.167	0.24	1.00	0%	0.121	74.0	89.2	5.00	0.48	0.17	0.60	111.5	3177.13
Catchment E	5.92	E1+E	8.77	0.091	0.57	1.00	0%	0.117	74.0	89.2	5.00	0.48	0.22	1.80	111.5	9781.11
Wetland F1	1.29	F1	1.29	0.108	0.23	1.00	0%	0.121	74.0	89.2	5.00	0.48	0.17	0.27	111.5	1432.50
Catchment F	0.94	F1+F	2.23	0.087	0.35	1.00	0%	0.121	74.0	89.2	5.00	0.48	0.17	0.47	111.5	2480.39
Wetland G1	2.89	G1	2.89	0.127	0.21	1.00	0%	0.121	74.0	89.2	5.00	0.48	0.17	0.61	111.5	3221.72
Catchment G	2.04	G1+G	4.93	0.094	0.38	1.00	0%	0.121	74.0	89.2	5.00	0.48	0.17	1.04	111.5	5495.88
	102.74															

POST DEVELOPMENT CATCHMENT INFO

24-hour rainfall Depth (mm)	Imperviousness (%)	SCS Curve No. (mm)														
175	0%	74														
Description	Catchment Area (ha)	Contributing Catchments	Total Catchment Area (ha)	Catchment Slope (m/m)	Catchment Length (km)	Channelisation C	Imperviousness (%)	q* Approx.	Weighted curve number	Storage (S)	Ia weighted (mm)	c*=(P24-2Ia)/(P24-2Ia+2S)	tc	Peak Q100 Flow (m3/s)	Q24 (mm)	V24 (m3)
Wetland A1	0.87	A1	0.87	0.129	0.21	1.00	0%	0.122	74.0	89.2	5.00	0.48	0.17	0.19	111.5	969.86
Wetland A2	1.87	A1+A2	2.74	0.110	0.34	1.00	0%	0.122	74.0	89.2	5.00	0.48	0.17	0.58	111.5	3054.51
Wetland A3	1.40	A3	1.40	0.156	0.27	1.00	0%	0.122	74.0	89.2	5.00	0.48	0.17	0.30	111.5	1560.70
Catchment A	1.77	A1+A2+A3+A	5.91	0.109	0.47	1.00	0%	0.118	74.0	89.2	5.00	0.48	0.19	1.22	111.5	6588.37
Wetland B1	19.35	B1	19.35	0.105	0.82	1.00	0%	0.108	74.0	89.2	5.00	0.48	0.27	3.66	111.5	21571.05
Catchment B	11.09	B1+B	30.44	0.090	1.09	1.00	0%	0.098	74.0	89.2	5.00	0.48	0.34	5.22	111.5	33934.00
Wetland C1	1.25	C1	1.25	0.172	0.17	1.00	0%	0.122	74.0	89.2	5.00	0.48	0.17	0.27	111.5	1393.48
Wetland C2	8.57	C2	8.57	0.073	0.67	1.00	0%	0.109	74.0	89.2	5.00	0.48	0.26	1.63	111.5	9553.69
Wetland C3	2.95	C2+C3	11.52	0.069	0.83	1.00	0%	0.101	74.0	89.2	5.00	0.48	0.31	2.04	111.5	12842.30
Wetland C4	5.88	C1+C2+C3+C4	18.65	0.073	1.04	1.00	0%	0.097	74.0	89.2	5.00	0.48	0.35	3.17	111.5	20790.71
Wetland C5	1.73	C5	1.73	0.129	0.20	1.00	0%	0.122	74.0	89.2	5.00	0.48	0.17	0.37	111.5	1928.57
Wetland C6	2.83	C5+C6	4.56	0.106	0.39	1.00	0%	0.122	74.0	89.2	5.00	0.48	0.17	0.97	111.5	5083.41
Wetland C7	2.16	C7	2.16	0.107	0.24	1.00	0%	0.122	74.0	89.2	5.00	0.48	0.17	0.46	111.5	2402.36
Culvert 17	0.57	C7+culvert 17	2.73	0.096	0.34	1.00	0%	0.122	74.0	89.2	5.00	0.48	0.17	0.58	111.5	3037.78
Wetland C8	7.71	C7+C8	10.44	0.072	0.60	1.00	0%	0.110	74.0	89.2	5.00	0.48	0.25	2.01	111.5	11637.22
Catchment C	10.94	C4+C6+C8+C	44.59	0.077	1.28	1.00	0%	0.091	74.0	89.2	5.00	0.48	0.40	7.10	111.5	49707.07
Wetland D1	1.65	D1	1.65	0.128	0.19	1.00	0%	0.122	74.0	89.2	5.00	0.48	0.17	0.35	111.5	1839.39
Catchment D	3.04	D1+D	4.69	0.097	0.38	1.00	0%	0.122	74.0	89.2	5.00	0.48	0.17	1.00	111.5	5232.79
Wetland E1	2.86	E1	2.86	0.167	0.24	1.00	0%	0.122	74.0	89.2	5.00	0.48	0.17	0.61	111.5	3188.28
Wetland E2	4.93	E+E1	7.79	0.167	0.24	1.00	0%	0.122	74.0	89.2	5.00	0.48	0.17	1.66	111.5	8684.16
Culvert 16		E+E1	7.79	0.09	0.24	1.00	0%	0.122	74.0	89.2	5.00	0.48	0.17	1.66	111.5	8684.16
Catchment E	1.34	E+E1+E2	9.13	0.091	0.45	1.00	0%	0.118	74.0	89.2	5.00	0.48	0.19	1.88	111.5	10174.63
Wetland F1	1.25	F1	1.25	0.108	0.23	1.00	0%	0.122	74.0	89.2	5.00	0.48	0.17	0.27	111.5	1393.48
Catchment F	0.96	F1+F	2.21	0.087	0.57	1.00	0%	0.112	74.0	89.2	5.00	0.48	0.23	0.43	111.5	2465.79
Wetland G1	2.89	G1	2.89	0.127	0.21	1.00	0%	0.122	74.0	89.2	5.00	0.48	0.17	0.62	111.5	3221.72
Catchment G	2.04	G1+G	4.93	0.094	0.38	1.00	0%	0.122	74.0	89.2	5.00	0.48	0.17	1.05	111.5	5495.88
	101.90															

PRE DEVELOPMENT				POST DEVELOPMENT					
Description	**Contributing Catchments**	**Total Catchment Area (ha)**	**Peak Q100 Flow (m3/s)**	**Description**	**Contributing Catchments**	**Total Catchment Area (ha)**	**Peak Q100 Flow (m3/s)**	**Change in Flow (m3/s)**	**Change in area (%)**
Wetland A1	A1	0.90	0.19	Wetland A1	A1	0.87	0.19	0.00	-3%
Wetland A2	A1+A2	2.78	0.59	Wetland A2	A1+A2	2.74	0.58	0.00	-1%
Wetland A3	A3	1.43	0.30	Wetland A3	A3	1.40	0.30	0.00	-2%
Catchment A	A1+A2+A3+A	5.98	1.26	Catchment A	A1+A2+A3+A	5.91	1.22	-0.04	-1%
Wetland B1	B1	19.57	3.66	Wetland B1	B1	19.35	3.66	-0.01	-1%
Catchment B	B1+B	30.01	5.15	Catchment B	B1+B	30.44	5.22	0.07	1%
Wetland C1	C1	1.20	0.25	Wetland C1	C1	1.25	0.27	0.01	4%
Wetland C2	C2	9.05	1.73	Wetland C2	C2	8.57	1.63	-0.09	-5%
Wetland C3	C2+C3	11.88	2.12	Wetland C3	C2+C3	11.52	2.04	-0.08	-3%
Wetland C4	C1+C2+C3+C4	18.38	3.06	Wetland C4	C1+C2+C3+C4	18.65	3.17	0.11	1%
Wetland C5	C5	1.83	0.39	Wetland C5	C5	1.73	0.37	-0.02	-5%
Wetland C6	C5+C6	4.63	0.98	Wetland C6	C5+C6	4.56	0.97	-0.01	-1%
Wetland C7	C7	2.06	0.44	Wetland C7	C7	2.16	0.46	0.02	5%
Wetland C8	C7+C8	10.94	2.26	Wetland C8	C7+C8	10.44	2.01	-0.25	-5%
Catchment C	C4+C6+C8+C	46.22	7.28	Catchment C	C4+C6+C8+C	44.59	7.10	-0.18	-4%
Wetland D1	D1	1.72	0.36	Wetland D1	D1	1.65	0.35	-0.01	-4%
Catchment D	D1+D	4.60	0.89	Catchment D	D1+D	4.69	1.00	0.12	2%
Wetland E1	E1	2.85	0.60	Wetland E1	E1	2.86	0.61	0.01	0%
Catchment E	E1+E	8.77	1.80	Catchment E	E+E1+E2	9.13	1.88	0.09	4%
Wetland F1	F1	1.29	0.27	Wetland F1	F1	1.25	0.27	-0.01	-3%
Catchment F	F1+F	2.23	0.47	Catchment F	F1+F	2.21	0.43	-0.04	-1%
Wetland G1	G1	2.89	0.61	Wetland G1	G1	2.89	0.62	0.01	0%
Catchment G	G1+G	4.93	1.04	Catchment G	G1+G	4.93	1.05	0.01	0%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WETLAND A2
WETLAND A3
CATCHMENT A
A
WETLAND B1
CATCHMENT B
B
WETLAND C1
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WETLAND C3
WETLAND C4
WETLAND C5
WETLAND C6
CATCHMENT C
C
WETLAND D1
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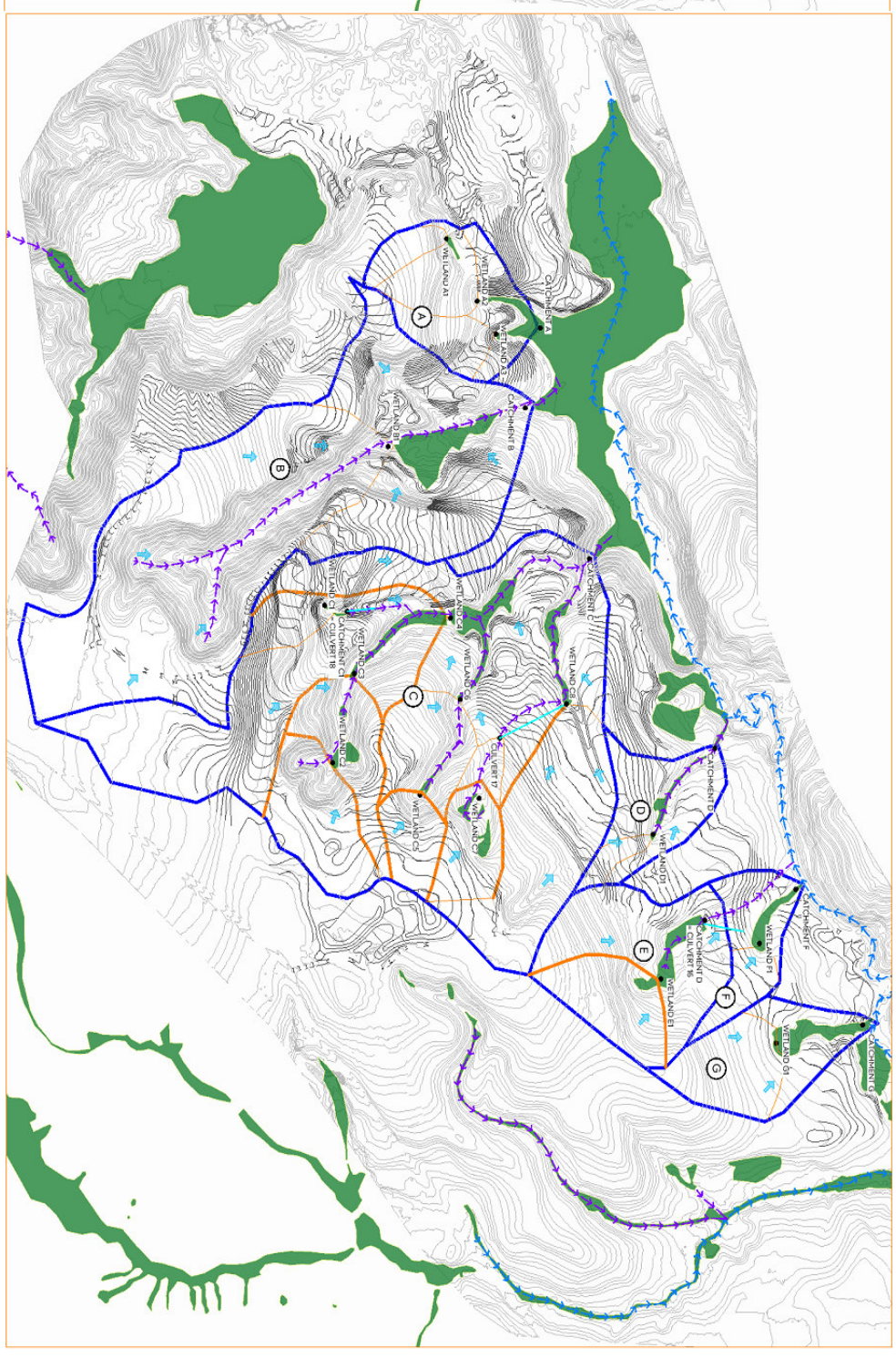
WETLAND A1
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CATCHMENT A
A
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CATCHMENT B
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WETLAND C4
WETLAND C5
WETLAND C6
CULVERT 17
CATCHMENT C
C
WETLAND D1
CATCHMENT D
D
WETLAND E1
CATCHMENT E
E
WETLAND F1
CATCHMENT F
F
WETLAND G1
CATCHMENT G
G

http://www.aucklandcity.govt.nz/council/documents/technicalpublications/TP108%20Part%20B.pdf

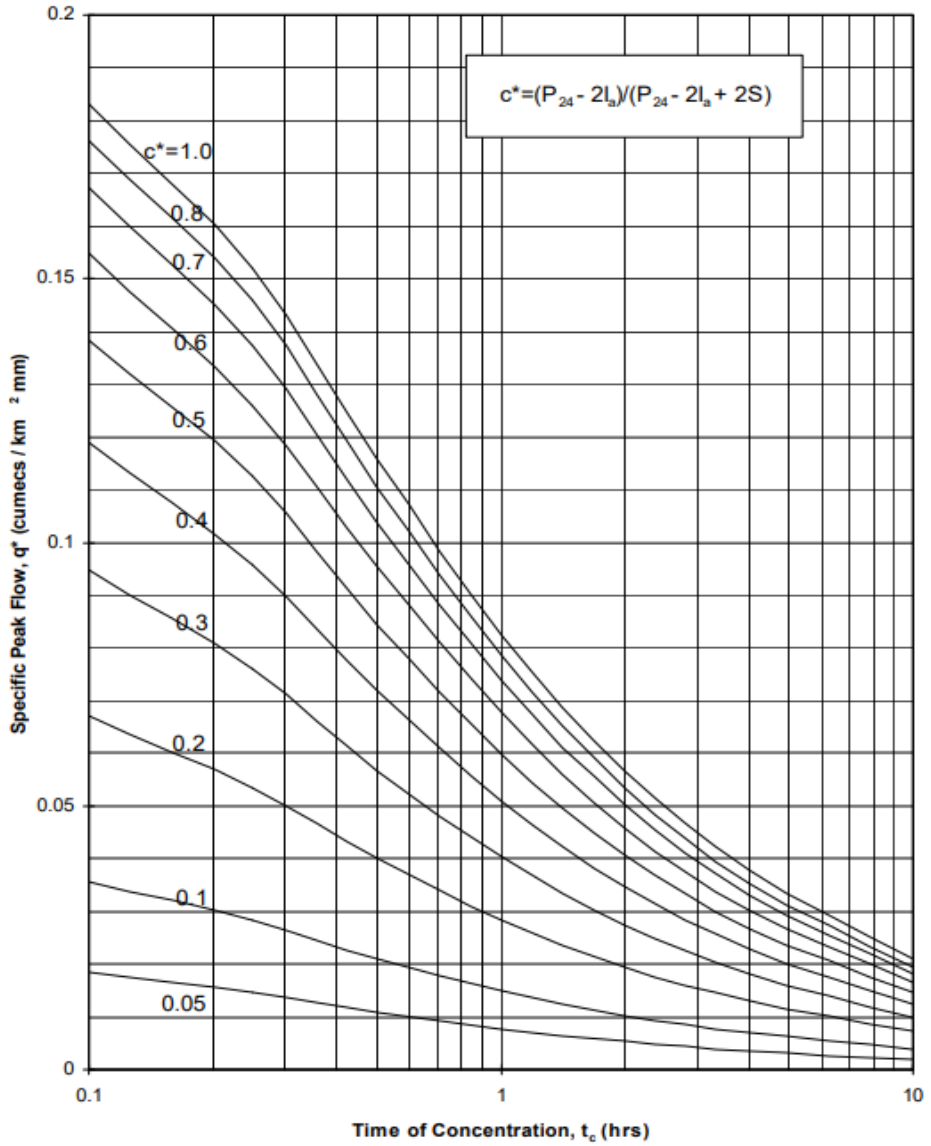


Figure 5.1 - Specific Peak Flow Rate

Rainfall depths (mm) :: RCP2.6 for the period 2031-2050

ARI	AEP	10m	20m	30m	1h	2h	6h	12h	24h	48h	72h	96h	120h
1.58	0.633	11.7	15.0	17.6	23.0	30.2	45.5	57.9	72.2	87.4	96.3	102	107
2	0.500	12.7	16.4	19.2	25.1	33.0	49.7	63.3	78.9	95.6	105	112	117
5	0.200	16.2	21.0	24.5	32.2	42.3	64.0	81.5	102	123	136	145	151
10	0.100	18.8	24.3	28.4	37.4	49.1	74.3	94.8	118	144	159	169	176
20	0.050	21.4	27.7	32.4	42.6	56.0	84.9	108	135	164	182	193	202
30	0.033	22.9	29.6	34.7	45.6	60.0	91.1	116	145	177	195	208	217
40	0.025	24.0	31.0	36.3	47.8	62.9	95.6	122	152	185	205	218	228
50	0.020	24.8	32.1	37.6	49.5	65.2	99.0	126	158	192	213	226	236
60	0.017	25.5	33.0	38.7	50.9	67.0	102	130	163	198	219	233	243
80	0.012	26.6	34.4	40.3	53.1	69.9	106	136	170	207	229	243	254
100	0.010	27.4	35.5	41.6	54.8	72.2	110	140	175	214	236	252	263
250	0.004	30.7	39.8	46.6	61.5	81.1	124	158	198	241	267	284	297

PRE DEVELOPMENT SUB-CATCHMENT INFO

24-hour rainfall Depth (mm)	Imperviousness (%)	SCS Curve No. (mm)															
175	0%	74															
Description	**Catchment Area (ha)**	**Contributing Catchments**	**Total Catchment Area (ha)**	**Catchment Slope (m/m)**	**Catchment Length (km)**	**Channelisation C**	**Imperviousness (%)**	**q* Approx.**	**Weighted curve number**	**Storage (S)**	**Ia weighted (mm)**	**c*=(P24-2Ia)/(P24-2Ia+2S)**	**tc**	**Peak Q100 Flow (m3/s)**	**Q24 (mm)**	**V24 (m3)**
Catchment A	1.44	A	1.44	0.077	0.60	1.00	0%	0.110	74.0	89.2	5.00	0.48	0.24	0.28	111.5	1600.83
Catchment B	1.96	B	1.96	0.084	0.28	1.00	0%	0.120	74.0	89.2	5.00	0.48	0.17	0.41	111.5	2184.97
Catchment C	5.00	C	5.00	0.065	0.40	1.00	0%	0.116	74.0	89.2	5.00	0.48	0.19	1.01	111.5	5570.57
Catchment D	3.57	D	3.57	0.067	0.27	1.00	0%	0.120	74.0	89.2	5.00	0.48	0.17	0.75	111.5	3979.78
Catchment E	6.22	E	6.22	0.108	0.47	1.00	0%	0.116	74.0	89.2	5.00	0.48	0.19	1.26	111.5	6933.95
Catchment F	2.99	F	2.99	0.038	0.20	1.00	0%	0.120	74.0	89.2	5.00	0.48	0.17	0.63	111.5	3333.20
Catchment G	10.58	G	10.58	0.040	0.60	1.00	0%	0.103	74.0	89.2	5.00	0.48	0.29	1.91	111.5	11794.41
	31.75															

*** All catchments shown are localised areas contributing to adjacent streams. Calculations have been provided to show a snapshot of the PRE & POST areas affected which only portrays a small percentage of the overall catchment areas contributing to the local waterways.

POST DEVELOPMENT SUB-CATCHMENT INFO

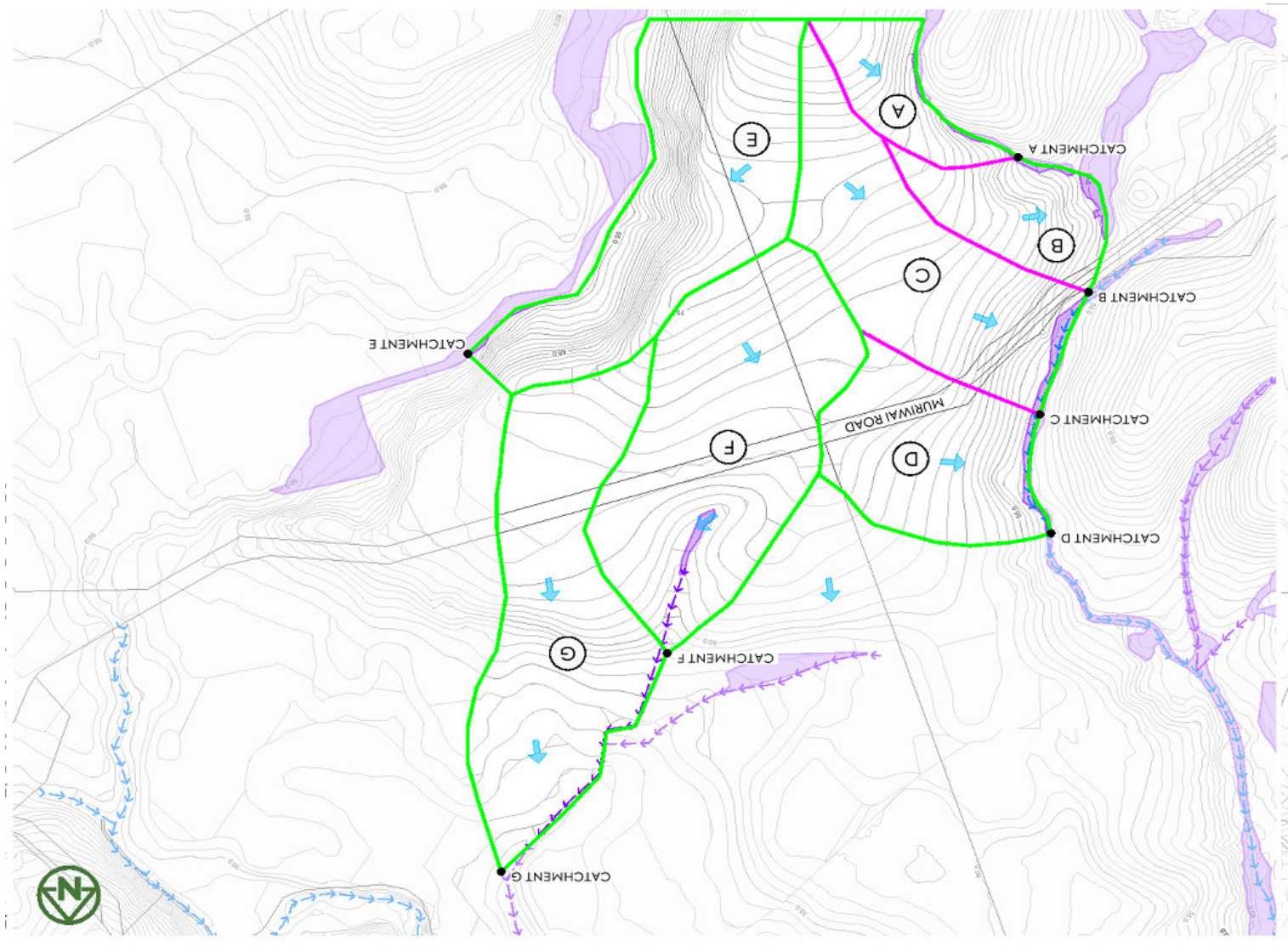
24-hour rainfall Depth (mm)	Imperviousness (%)	SCS Curve No. (mm)															
175	0%	74															
Description	**Catchment Area (ha)**	**Contributing Catchments**	**Total Catchment Area (ha)**	**Catchment Slope (m/m)**	**Catchment Length (km)**	**Channelisation C**	**Imperviousness (%)**	**q* Approx.**	**Weighted curve number**	**Storage (S)**	**Ia weighted (mm)**	**c*=(P24-2Ia)/(P24-2Ia+2S)**	**tc**	**Peak Q100 Flow (m3/s)**	**Q24 (mm)**	**V24 (m3)**
Catchment A	2.45	A	2.45	0.077	0.30	1.00	0%	0.120	74.0	89.2	5.00	0.48	0.17	0.51	111.5	2731.22
Catchment B	7.43	B	7.43	0.059	0.39	1.00	0%	0.125	74.0	89.2	5.00	0.48	0.20	1.63	111.5	8282.84
Catchment C	1.86	C	1.86	0.130	0.33	1.00	0%	0.120	74.0	89.2	5.00	0.48	0.17	0.39	111.5	2073.50
Catchment D	3.30	D	3.30	0.100	0.23	1.00	0%	0.120	74.0	89.2	5.00	0.48	0.17	0.69	111.5	3678.78
Catchment E	6.44	E	6.44	0.120	0.22	1.00	0%	0.120	74.0	89.2	5.00	0.48	0.17	1.35	111.5	7179.20
Catchment F	2.99	F	2.99	0.041	0.33	1.00	0%	0.125	74.0	89.2	5.00	0.48	0.20	0.65	111.5	3333.20
Catchment G	7.28	G	7.28	0.040	0.55	1.00	0%	0.105	74.0	89.2	5.00	0.48	0.28	1.34	111.5	8115.62
	31.75															

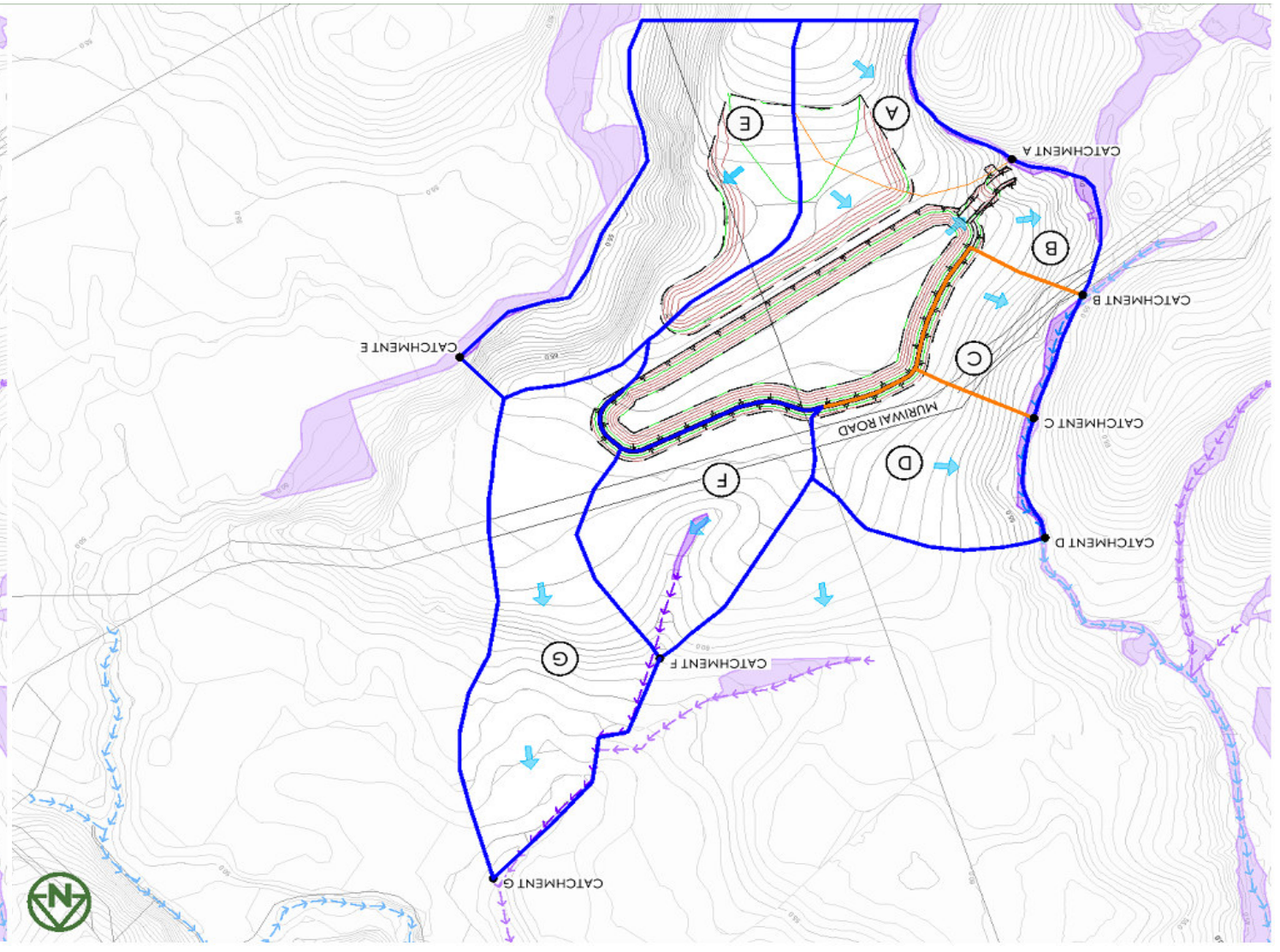
*** All catchments shown are localised areas contributing to adjacent streams. Calculations have been provided to show a snapshot of the PRE & POST areas affected which only portrays a small percentage of the overall catchment areas contributing to the local waterways.

UPPER-CATCHMENT INFO

Description	Catchment Area (ha)	Contributing Catchments	Total Catchment Area (ha)
Catchment EX1	209.07	A+B+C+D	212.35
Catchment EX2	23.76	F+G	20.47

PRE DEVELOPMENT SUB-CATCHMENT				POST DEVELOPMENT SUB CATCHMENT				
Description	**Contributing Catchments**	**Total Catchment Area (ha)**	**Peak Q100 Flow (m3/s)**	**Description**	**Contributing Catchments**	**Total Catchment Area (ha)**	**Peak Q100 Flow (m3/s)**	**Change in area (%)**
Catchment A	A	1.44	0.28	Catchment A	A	2.45	0.51	
Catchment B	B	1.96	0.41	Catchment B	B	7.43	1.63	
Catchment C	C	5.00	1.01	Catchment C	C	1.86	0.39	
Catchment D	D	3.57	0.75	Catchment D	D	3.30	0.69	
Total Catchment	**A-D**	**11.96**	**2.45**	**Total Catchment**	**A-D**	**15.04**	**3.22**	**31%**
Catchment E	E	6.22	1.26	Catchment E	E	6.44	1.35	
Catchment F	F	2.99	0.63	Catchment F	F	2.99	0.65	
Catchment G	G	10.58	1.91	Catchment G	G	7.28	1.34	
Total Catchment	**F-G**	**13.57**	**2.53**	**Total Catchment**	**F-G**	**10.27**	**1.99**	**-21%**


A
B
C
D
E
F
G
CATCHMENT A
CATCHMENT B
CATCHMENT C
CATCHMENT D
CATCHMENT E
CATCHMENT F
CATCHMENT G
MURIWAI ROAD


A
B
C
D
E
F
G
CATCHMENT A
CATCHMENT B
CATCHMENT C
CATCHMENT D
CATCHMENT E
CATCHMENT F
CATCHMENT G
MURIWAI ROAD

http://www.aucklandcity.govt.nz/council/documents/technicalpublications/TP108%20Part%20B.pdf

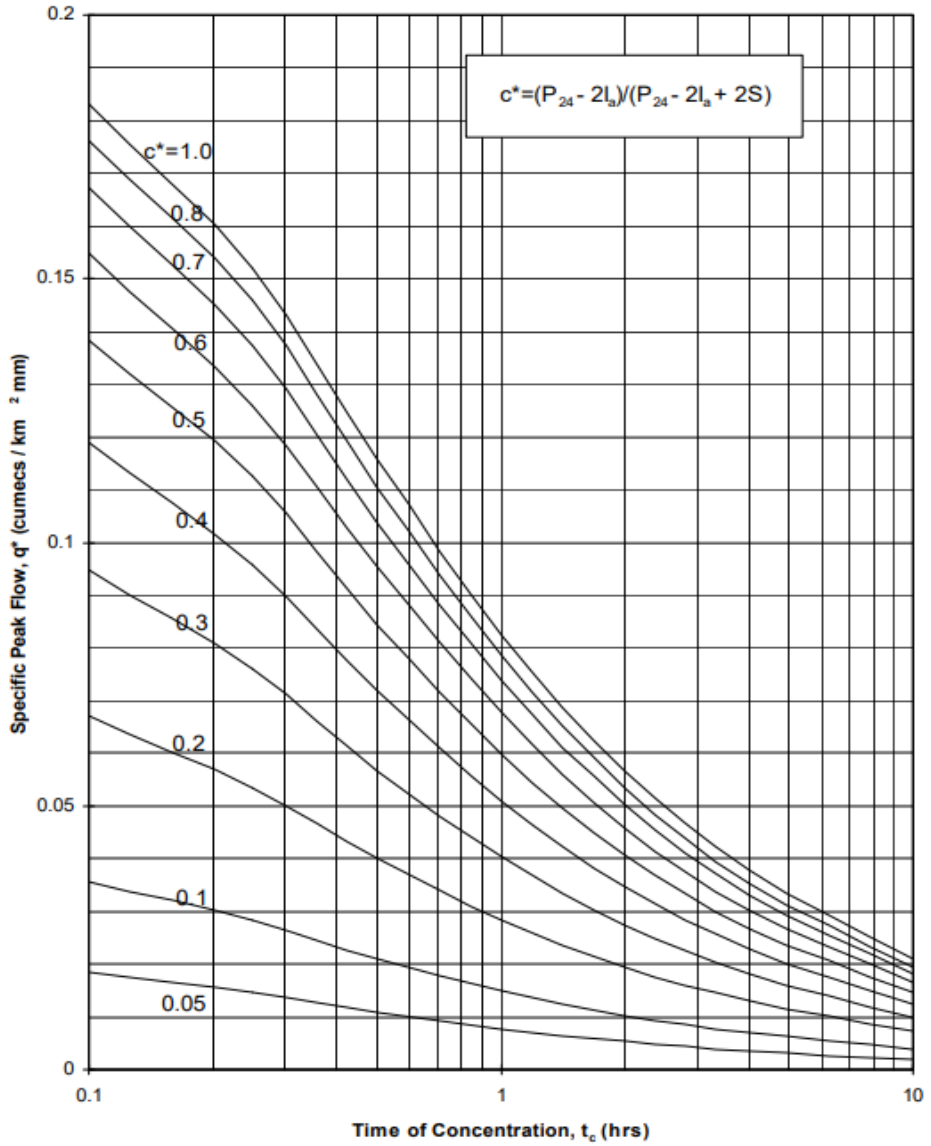


Figure 5.1 - Specific Peak Flow Rate

Rainfall depths (mm) :: RCP2.6 for the period 2031-2050

ARI	AEP	10m	20m	30m	1h	2h	6h	12h	24h	48h	72h	96h	120h
1.58	0.633	11.7	15.0	17.6	23.0	30.2	45.5	57.9	72.2	87.4	96.3	102	107
2	0.500	12.7	16.4	19.2	25.1	33.0	49.7	63.3	78.9	95.6	105	112	117
5	0.200	16.2	21.0	24.5	32.2	42.3	64.0	81.5	102	123	136	145	151
10	0.100	18.8	24.3	28.4	37.4	49.1	74.3	94.8	118	144	159	169	176
20	0.050	21.4	27.7	32.4	42.6	56.0	84.9	108	135	164	182	193	202
30	0.033	22.9	29.6	34.7	45.6	60.0	91.1	116	145	177	195	208	217
40	0.025	24.0	31.0	36.3	47.8	62.9	95.6	122	152	185	205	218	228
50	0.020	24.8	32.1	37.6	49.5	65.2	99.0	126	158	192	213	226	236
60	0.017	25.5	33.0	38.7	50.9	67.0	102	130	163	198	219	233	243
80	0.012	26.6	34.4	40.3	53.1	69.9	106	136	170	207	229	243	254
100	0.010	27.4	35.5	41.6	54.8	72.2	110	140	175	214	236	252	263
250	0.004	30.7	39.8	46.6	61.5	81.1	124	158	198	241	267	284	297

HY-8 Culvert Analysis Report

Crossing Discharge Data

Discharge Selection Method: User Defined

Table 1 - Summary of Culvert Flows at Crossing: HOLE 17 CULVERT

Headwater Elevation (m)	Discharge Names	Total Discharge (cms)	Culvert 1 Discharge (cms)	Roadway Discharge (cms)	Iterations
61.61	10 Year	0.25	0.25	0.00	1
62.76	100 Year	0.58	0.53	0.05	21
62.75	Overtopping	0.53	0.53	0.00	Overtopping

Rating Curve Plot for Crossing: HOLE 17 CULVERT

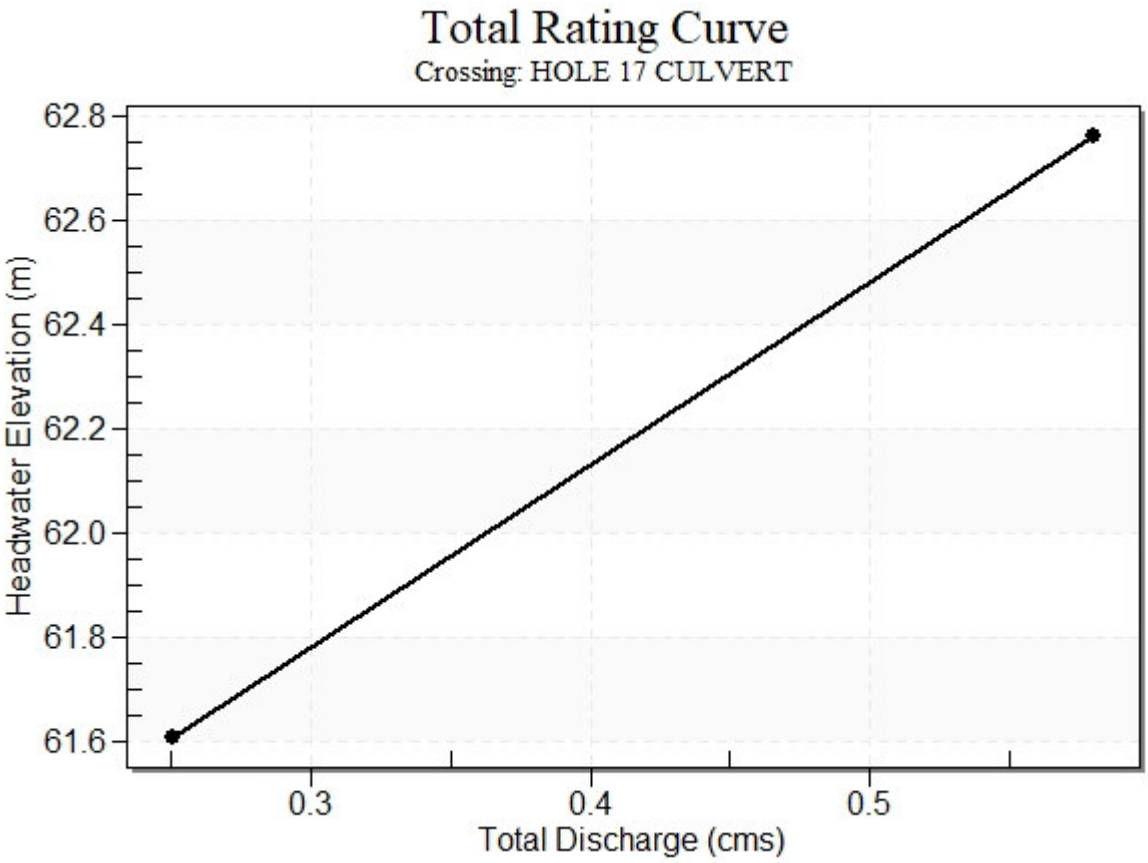


Table 2 - Culvert Summary Table: Culvert 1

Discharge Names	Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth (m)	Outlet Control Depth (m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
10 Year	0.25	0.25	61.61	0.609	0.0*	5-S2n	0.176	0.352	0.176	0.264	4.350	1.195
100 Year	0.58	0.53	62.76	1.763	0.0*	5-S2n	0.273	0.450	0.273	0.362	5.254	1.475

* Full Flow Headwater elevation is below inlet invert.

****

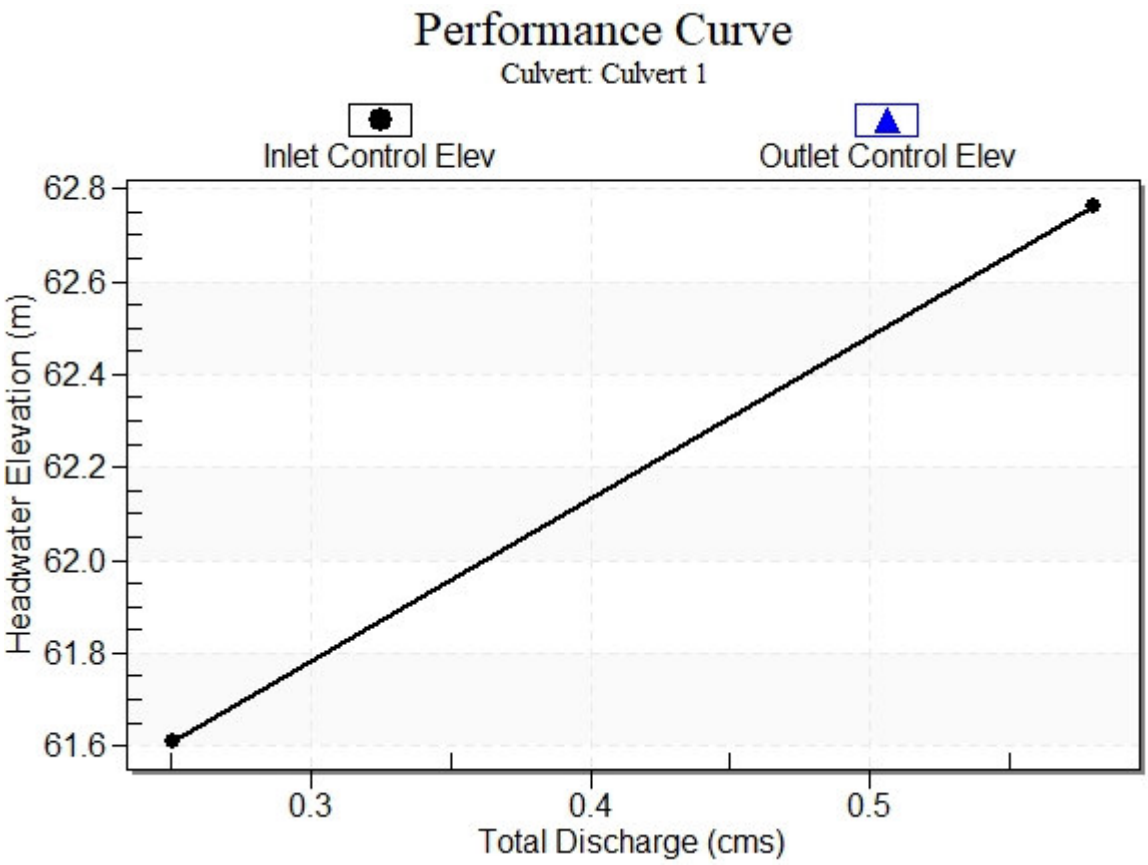
Straight Culvert

Inlet Elevation (invert): 61.00 m, Outlet Elevation (invert): 53.28 m

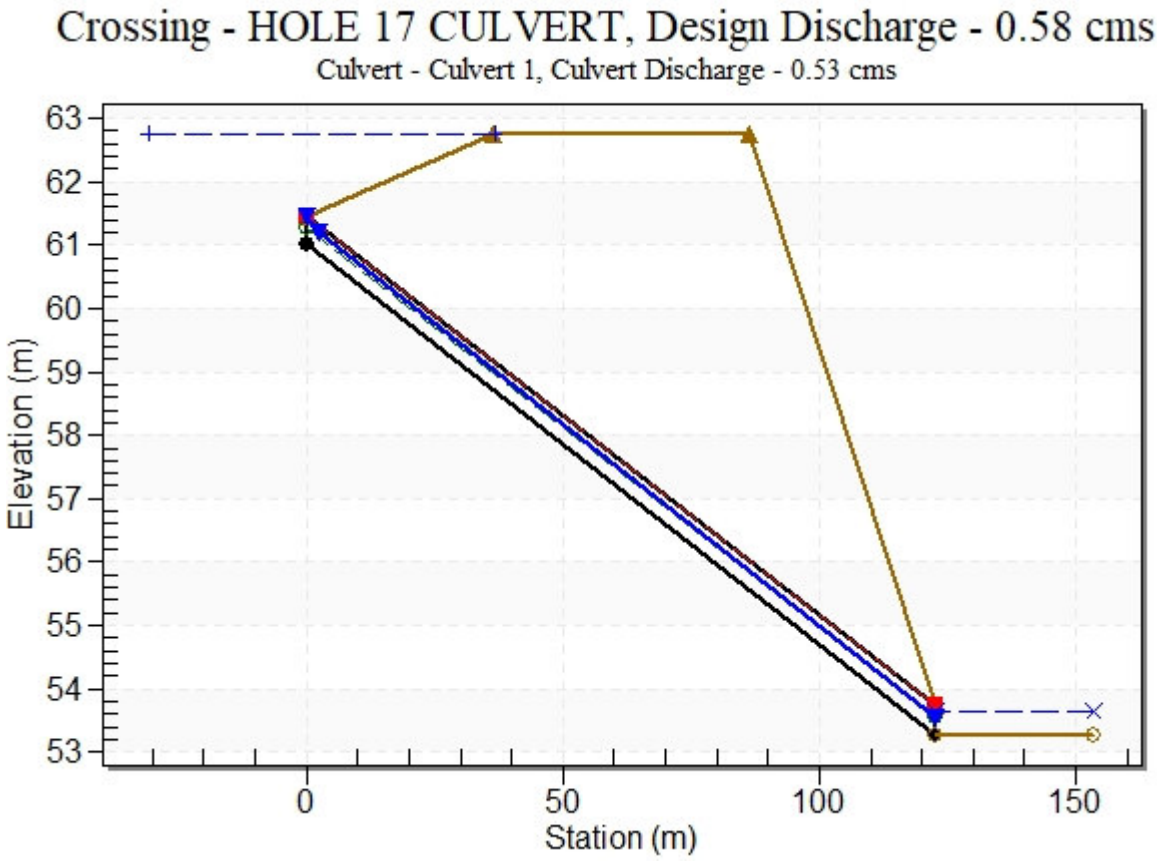
Culvert Length: 122.99 m, Culvert Slope: 0.0629

****

Culvert Performance Curve Plot: Culvert 1



Water Surface Profile Plot for Culvert: Culvert 1



Site Data - Culvert 1

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 m

Inlet Elevation: 61.00 m

Outlet Station: 122.75 m

Outlet Elevation: 53.28 m

Number of Barrels: 1

Culvert Data Summary - Culvert 1

Barrel Shape: Circular

Barrel Diameter: 450.00 mm

Barrel Material: Concrete

Embedment: 0.00 mm

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Square Edge with Headwall

Inlet Depression: None

Table 3 - Downstream Channel Rating Curve (Crossing: HOLE 17 CULVERT)

Flow (cms)	Water Surface Elev (m)	Depth (m)	Velocity (m/s)	Shear (Pa)	Froude Number
0.25	53.54	0.26	1.20	147.52	1.05
0.58	53.64	0.36	1.48	202.26	1.11

Tailwater Channel Data - HOLE 17 CULVERT

Tailwater Channel Option: Triangular Channel

Side Slope (H:V): 3.00 (_:1)

Channel Slope: 0.0570

Channel Manning's n: 0.0500

Channel Invert Elevation: 53.28 m

Roadway Data for Crossing: HOLE 17 CULVERT

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 20.00 m

Crest Elevation: 62.75 m

Roadway Surface: Paved

Roadway Top Width: 50.00 m

Crossing Discharge Data

Discharge Selection Method: User Defined

Table 4 - Summary of Culvert Flows at Crossing: HOLE 16 CULVERT

Headwater Elevation (m)	Discharge Names	Total Discharge (cms)	Culvert 2 Discharge (cms)	Roadway Discharge (cms)	Iterations
45.93	10 Year	1.03	1.03	0.00	1
46.46	100 Year	1.66	1.66	0.00	1
50.00	Overtopping	3.65	3.65	0.00	Overtopping

Rating Curve Plot for Crossing: HOLE 16 CULVERT

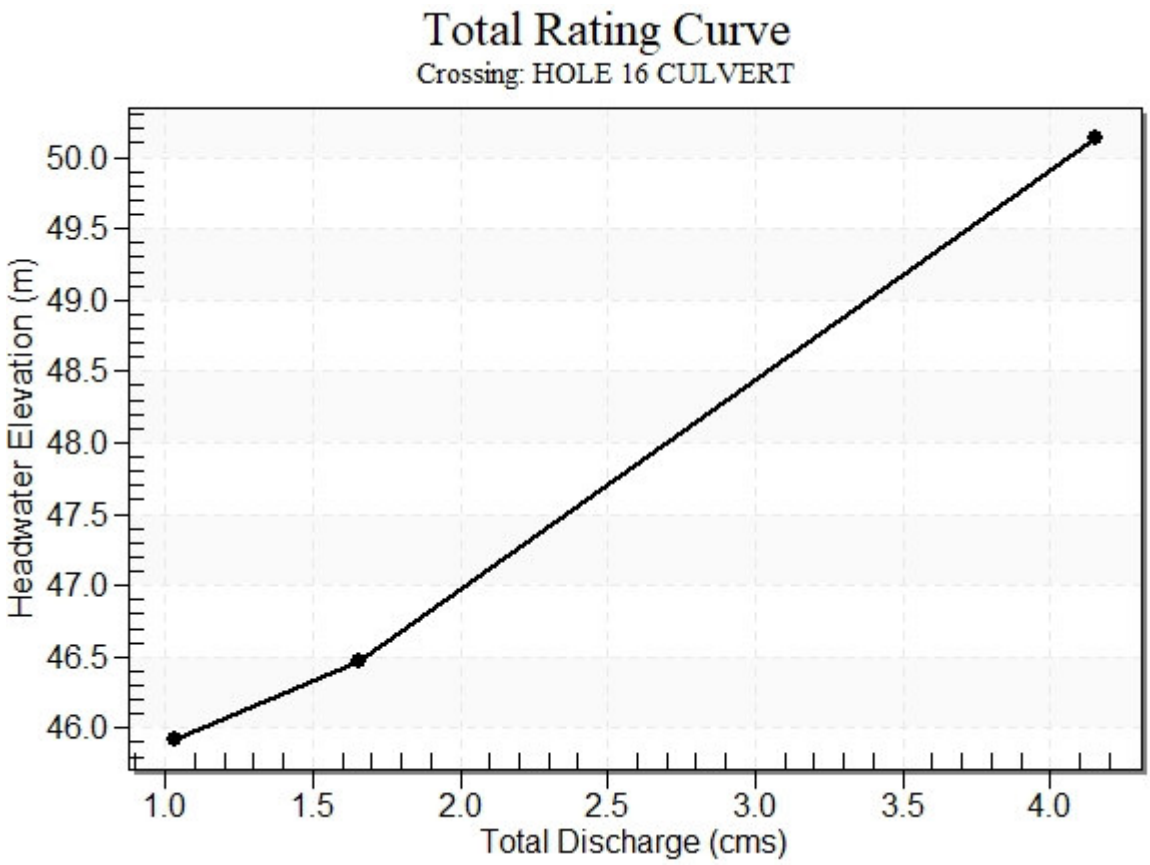


Table 5 - Culvert Summary Table: Culvert 2

Discharge Names	Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth (m)	Outlet Control Depth (m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
10 Year	1.03	1.03	45.93	0.928	0.0*	5-S2n	0.296	0.600	0.296	0.379	5.639	2.385
100 Year	1.66	1.66	46.46	1.462	0.0*	5-S2n	0.383	0.756	0.383	0.454	6.424	2.688

* Full Flow Headwater elevation is below inlet invert.

****

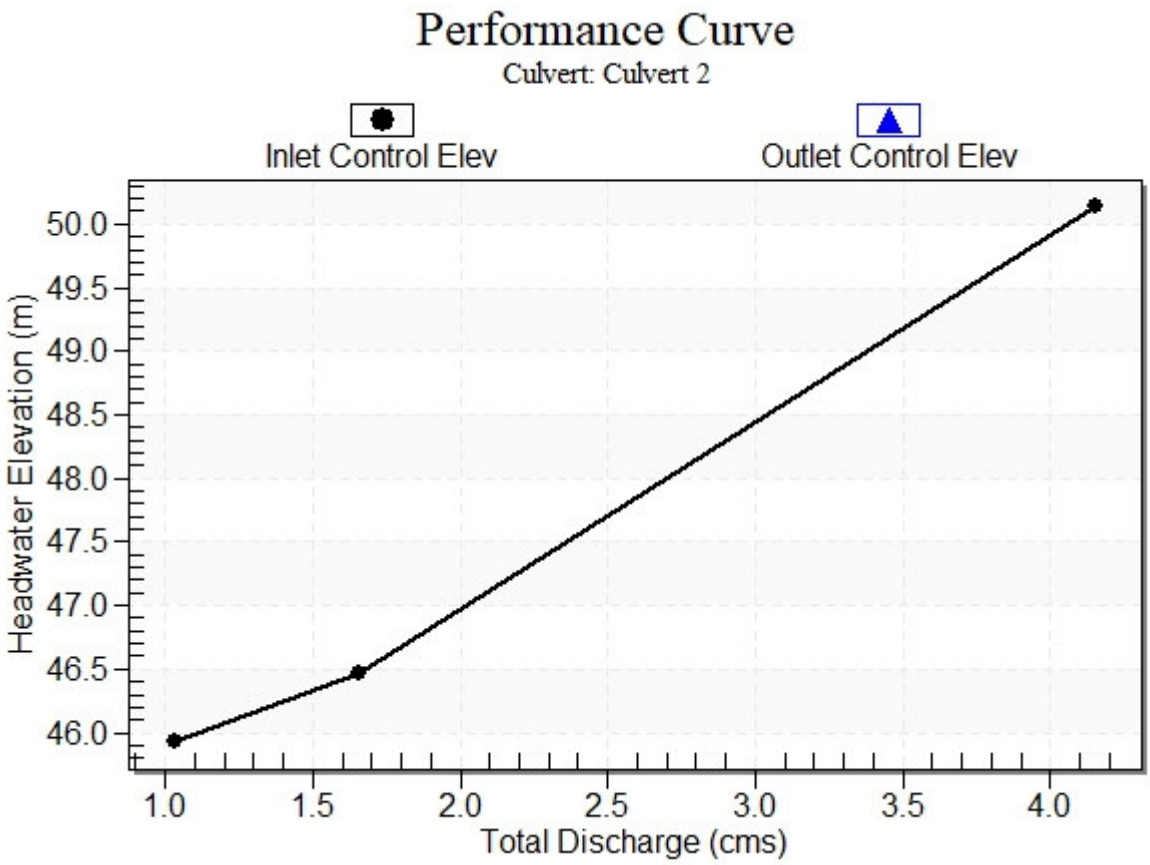
Straight Culvert

Inlet Elevation (invert): 45.00 m, Outlet Elevation (invert): 40.29 m

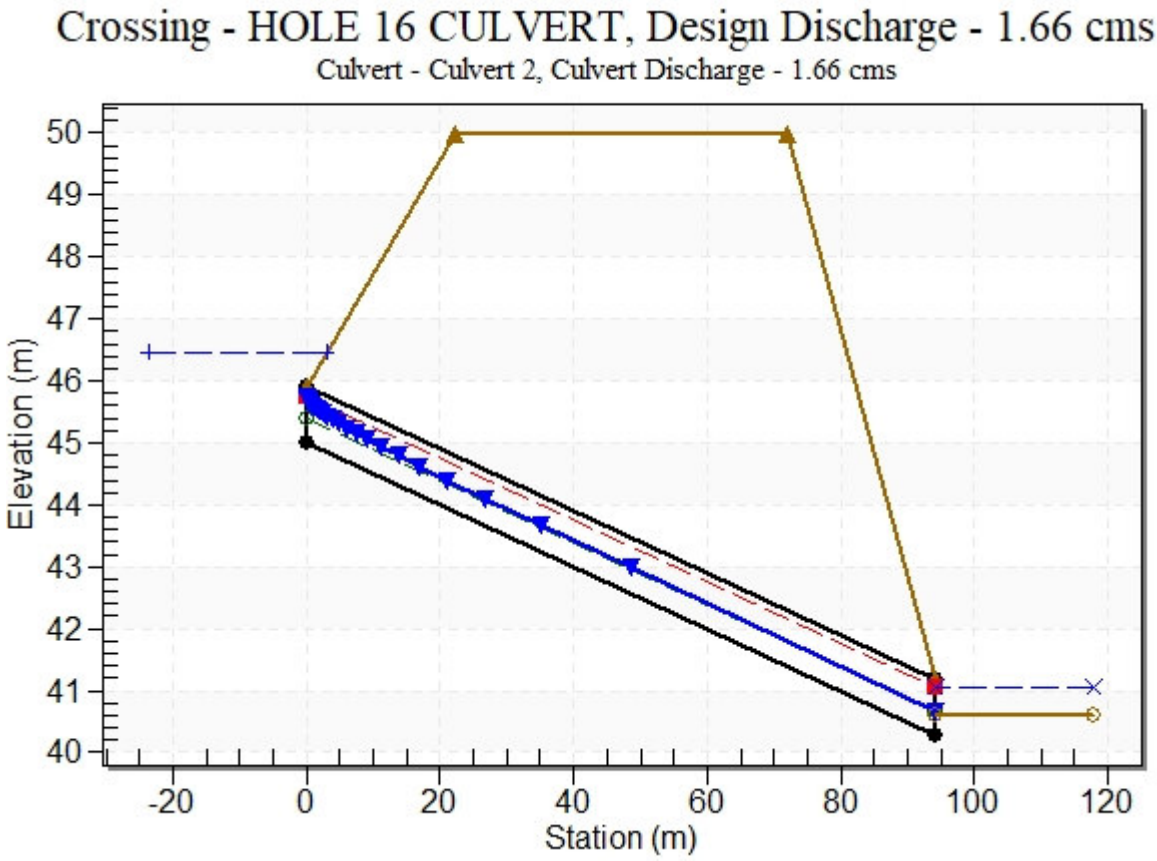
Culvert Length: 94.42 m, Culvert Slope: 0.0499

****

Culvert Performance Curve Plot: Culvert 2



Water Surface Profile Plot for Culvert: Culvert 2



Site Data - Culvert 2

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 m

Inlet Elevation: 45.00 m

Outlet Station: 94.30 m

Outlet Elevation: 40.29 m

Number of Barrels: 1

Culvert Data Summary - Culvert 2

Barrel Shape: Circular

Barrel Diameter: 900.00 mm

Barrel Material: Concrete

Embedment: 0.00 mm

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Square Edge with Headwall

Inlet Depression: None

Table 6 - Downstream Channel Rating Curve (Crossing: HOLE 16 CULVERT)

Flow (cms)	Water Surface Elev (m)	Depth (m)	Velocity (m/s)	Shear (Pa)	Froude Number
1.03	40.97	0.38	2.39	520.63	1.75
1.66	41.04	0.45	2.69	622.67	1.80

Tailwater Channel Data - HOLE 16 CULVERT

Tailwater Channel Option: Triangular Channel

Side Slope (H:V): 3.00 (_:1)

Channel Slope: 0.1400

Channel Manning's n: 0.0500

Channel Invert Elevation: 40.59 m

Roadway Data for Crossing: HOLE 16 CULVERT

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 5.00 m

Crest Elevation: 50.00 m

Roadway Surface: Paved

Roadway Top Width: 50.00 m

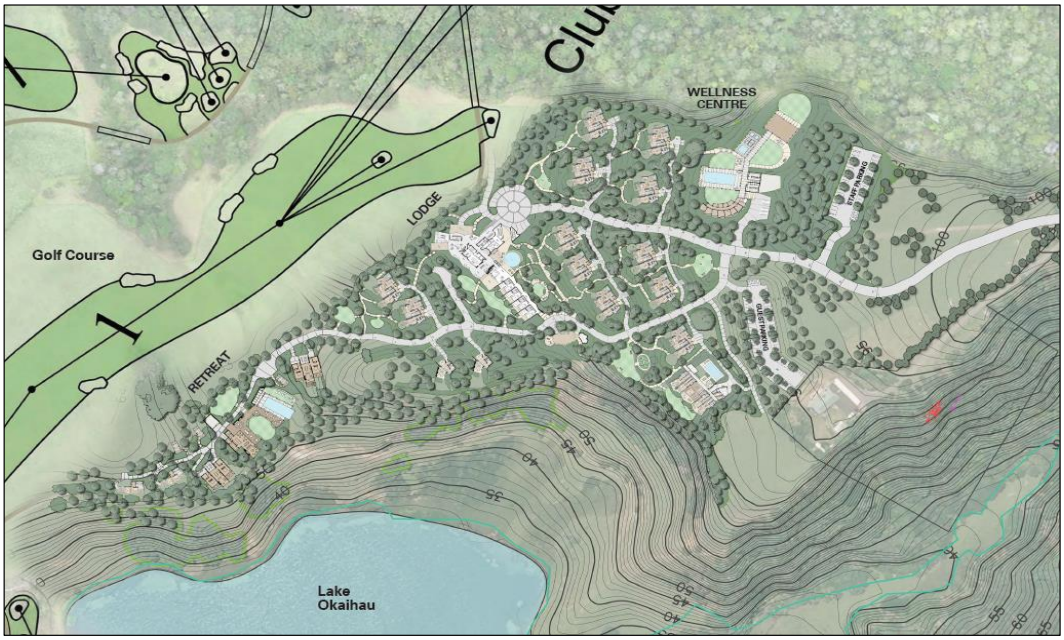
APPENDIX E – ONSITE WATER SUPPLY DEMAND CALCULATIONS

- Prepared by MCC

PROJECT NAME:	Muriwai Downs Resort	CREATED BY:	CGH	DATE:	8/12/2021
PROJECT No:	1976	CHECKED BY:	SM	DATE:	8/12/2021

SUMMARY OF ASSESSMENT - WATER SUPPY FOR LODGE. WELLNESS & CLUBHOUSE FACILITY

Catchment Area selected for Water Supply Assessment



DESIGN CRITERIA

Residential

			Assumption
Per Capita Demand (PCD)	220	person	(Table 5.1.2)
Peak Daily Factor (PF=2.0 <2000 POPULATION)	2	person	(Table 5.1.2)
Peak Hourly Factor	2.5	person	(Table 5.1.2)
People per dwelling (1 bedroom):	2	L/p/d	(WSL CoP 5.3.5.1.1/Table 5.1.1)
People per dwelling (2 to 4 bedrooms):	3	L/s	(WSL CoP 5.3.5.1.1/Table 5.1.1)
People per dwelling (5 bedrooms):	8	L/s	(WSL CoP 5.3.5.1.1/Table 5.1.1)

Accomodation & Retail

			Assumption
Per Capita Demand (PCD) - Hotel Guests	200	L/room/d	(WSL CoP 6.3.5.6-Table 6.1b)
Per Capita Demand (PCD) - Hotel Staff	50	L/staff/d	(WSL CoP 6.3.5.6-Table 6.1b)
Wet Retail-(food & beverage preperation)	15	l/d/m^2	(WSL CoP 6.3.5.6-Table 6.1c)
Office & dry where toilets for staff only	1	person/50m^2	(WSL CoP 6.3.5.6-Table 6.1c)
	65	l/p/d	
Office & dry retail	1	person/15m	(WSL CoP 6.3.5.6-Table 6.1c)
	65	l/p/d	
Peak Daily Factor	2		(WSL CoP 6.3.5.3) - Dev Assessmt Form
Peak Hourly Factor	2.5		(WSL CoP 6.3.5.3) - Dev Assessmt Form

EXISTING WATER DEMAND

Residential

			Remarks
No. of existing (assumed with 3 bedrooms each):	0		Ignore existing dwelling on our
No. of people:	0	person	development site demolished)
Avg Daily Demand (L/s)	**0.00**	**L/s**	
Peak Daily Demand (L/s)	**0.00**	**L/s**	
Peak Hourly Demand (L/s)	**0.00**	**L/s**	

PROPOSED DEVELOPMENT WATER DEMAND

Total Lodge, Wellness & Clubhouse

Avg Daily Demand (L/s)	**0.29**	**L/s**	
Peak Daily Demand (L/s)	**0.59**	**L/s**	
Peak Hourly Demand (L/s)	**1.47**	**L/s**	

TOTAL - POST DEVELOPMENT WATER DEMAND

Avg Daily Demand (L/s)	**0.295**	**L/s**	Lodge/Well =18,275L/d & GCH=7,188L/d
Peak Daily Demand (L/s)	**0.59**	**L/s**	
Peak Hourly Demand (L/s)	**1.47**	**L/s**	Excl landscape,swimming pools & spa supply

MURIWAI DOWNS DEVELOPMENT PLANNING ASSESSMENT - ONSITE WATER DEMAND CALCULATIONS

WATER SUPPLY

SITE:	Muriwai Downs Golf Resort	Prepared By:	CGH
PROJECT #:	1976	Reviewed By:	SM
DATE	8/12/2021	Page No:	2 of 4

Assumptions

Design Criteria - Lodge

Residential

			Assumption
Per Capita Demand (PCD)	220	L/p/d	(WSL CoP 6.3.5.6) - WS Dev Assessmt Form
Peak Daily Factor (PF=2.0 <2000 POPULATION)	2		(WSL CoP 6.3.5.3) - Dev Assessmt Form
Peak Hourly Factor	2.5		(WSL CoP 6.3.5.3) - Dev Assessmt Form
People per dwelling (1 bedroom):	2	person	(WSL Ws CoP Table 6.1a)
People per dwelling (2 to 4 bedrooms):	3	person	(WSL Ws CoP Table 6.1a)
People per dwelling (5 bedrooms):	8	person	(WSL Ws CoP Table 6.1a)

Commercial/Retail/Accomodation

			Assumption
Accomodation (Hotel)			
Per Capita Demand (PCD) - Hotel Guests	200	L/room/d	(WSL CoP 6.3.5.6-Table 6.1b)
Per Capita Demand (PCD) - Hotel Staff	50	L/staff/d	(WSL CoP 6.3.5.6-Table 6.1b)
Wet Retail-(food & beverage preperation)	15	l/d/m^2	(WSL CoP 6.3.5.6-Table 6.1c)
Office & dry where toilets for staff only	1	person/50m^2	(WSL CoP 6.3.5.6-Table 6.1c)
	65	l/p/d	
Office & dry retail	1	person/15m^2	(WSL CoP 6.3.5.6-Table 6.1c)
	65	l/p/d	
Peak Daily Factor	2		(WSL CoP 6.3.5.3) - Dev Assessmt Form
Peak Hourly Factor	2.5		(WSL CoP 6.3.5.3) - Dev Assessmt Form

Existing Development

Residentilal - Dwelling

			Remark
No. of dwelling:	0		Existing rural dwellings ignored
No. of people:	0		
Avg Daily Demand (L/s)	0.00	L/s	
Peak Daily Demand (L/s)	0.00	L/s	
Peak Hourly Demand (L/s)	0.00	L/s	

Proposed Development

Main Lodge - Lodge Suites

			Remark
No. of unit rooms (65m2)	4	200L/room/d	4 room in main building
Avg Daily Demand (L/s)	0.01	L/s	4 units x 200L/unit/d = 800 L/d
Peak Daily Demand (L/s)	0.02	L/s	
Peak Hourly Demand (L/s)	0.05	L/s	

Lodge External Guest Rooms - Extrenal accomodatio - Lodge Res, Challets, Cabins & Bunk Rooms

			Remark
No. of new dwellings rooms	26	200L/room/d	external self standing accomodation
Avg Daily Demand (L/s)	0.06	L/s	26units x 200L/unit/d = 5,200 L/d
Peak Daily Demand (L/s)	0.12	L/s	
Peak Hourly Demand (L/s)	0.30	L/s	

Lodge & Welness Staff: - Lodge

			Remark
No Staff	30	persons	staff for office, kitchen & lodge
Avg Daily Demand (L/s)	0.02	L/s	30 persons x 50L/d = 1,500 L/d
Peak Daily Demand (L/s)	0.03	L/s	
Peak Hourly Demand (L/s)	0.09	L/s	

Café/Resturant/Bar: - Lodge Amenities (GFA = 2,000m^2)

			Remark
Floor Area	600	m^2	kitchen/Café/Bar/dining (Assume 30% GFA)
Avg Daily Demand (L/s)	0.10	L/s	600m2 x 15L/m2/d = 9,000 L/d
Peak Daily Demand (L/s)	0.21	L/s	
Peak Hourly Demand (L/s)	0.52	L/s	

Total Site Demand Lodge

			Remark
Avg Daily Demand (L/s)	0.19	L/s	16,500 L/d
Peak Daily Demand (L/s)	0.38	L/s	
Peak Hourly Demand (L/s)	0.95	L/s	

MURIWAI DOWNS DEVELOPMENT PLANNING ASSESSMENT – ONSITE WATER DEMAND CALCULATIONS

WATER SUPPLY

SITE:	Muriwai Downs Golf Resort	Prepared By:	CGH
PROJECT #:	1976	Reviewed By:	SM
DATE	8/12/2021	Page No:	3 of 4

Assumptions

Design Criteria - Meeting/Yoga and Wellness Facilities

Residential

			Assumption
Per Capita Demand (PCD)	220	L/p/d	(WSL CoP 6.3.5.6) - WS Dev Assessmt Form
Peak Daily Factor (PF=2.0 <2000 POPULATION)	2		(WSL CoP 6.3.5.3) - Dev Assessmt Form
Peak Hourly Factor	2.5		(WSL CoP 6.3.5.3) - Dev Assessmt Form
People per dwelling (1 bedroom):	2	person	(WSL Ws CoP Table 6.1a)
People per dwelling (2 to 4 bedrooms):	3	person	(WSL Ws CoP Table 6.1a)
People per dwelling (5 bedrooms):	8	person	(WSL Ws CoP Table 6.1a)

Commercial/Retail/Accomodation

			Assumption
Accomodation (Hotel)			
Per Capita Demand (PCD) - Hotel Guests	200	L/room/d	(WSL CoP 6.3.5.6-Table 6.1b)
Per Capita Demand (PCD) - Hotel Staff	50	L/staff/d	(WSL CoP 6.3.5.6-Table 6.1b)
Wet Retail-(food & beverage preperation)	15	l/d/m^2	(WSL CoP 6.3.5.6-Table 6.1c)
Office & dry where toilets for staff only	1	person/50m^2	(WSL CoP 6.3.5.6-Table 6.1c)
	65	l/p/d	
Office & dry retail	1	person/15m^2	(WSL CoP 6.3.5.6-Table 6.1c)
	65	l/p/d	
Peak Daily Factor	2		(WSL CoP 6.3.5.3) - Dev Assessmt Form
Peak Hourly Factor	2.5		(WSL CoP 6.3.5.3) - Dev Assessmt Form

Existing Development

Residential

			Remark
No. of dwelling:	0		Existing rural dwellings ignored
No. of people:	0		
Avg Daily Demand (L/s)	0.00	L/s	
Peak Daily Demand (L/s)	0.00	L/s	
Peak Hourly Demand (L/s)	0.00	L/s	

Proposed Development

Meeting/Yoga — MEETING, YOGA AND CENTRAL FITNESS FACILTIES

			Remark
Floor Area	260	m^2	Office/meeting/studio/change room
Avg Daily Demand (L/s)	0.004	L/s	5 persons x 65 L/d = 325 L/d
Peak Daily Demand (L/s)	0.01	L/s	
Peak Hourly Demand (L/s)	0.02	L/s	

Welness Centre — Reception,Office, treatment, change room, storage (GFA 1,414m2)

			Remark
Floor Area	990	m^2	Assume 70% GFA
Avg Daily Demand (L/s)	0.015	L/s	20 persons x 65 L/d =1,300 L/d
Peak Daily Demand (L/s)	0.03	L/s	
Peak Hourly Demand (L/s)	0.07	L/s	

Welness Centre — Staff

			Remark
No Staff	3	persons	Wellnes Staff
Avg Daily Demand (L/s)	0.002	L/s	3 persons x 50 L/d = 150 L/d
Peak Daily Demand (L/s)	0.00	L/s	
Peak Hourly Demand (L/s)	0.01	L/s	

Total Site Demand Lodge

			Remark
Avg Daily Demand (L/s)	0.021	L/s	1,775 L/d
Peak Daily Demand (L/s)	0.04	L/s	
Peak Hourly Demand (L/s)	0.10	L/s	

MURIWAI DOWNS DEVELOPMENT PLANNING ASSESSMENT – ONSITE WATER DEMAND CALCULATIONS

WATER SUPPLY

SITE:	Muriwai Downs Golf Resort	Prepared By:	CGH
PROJECT #:	1976	Reviewed By:	SM
DATE	8/12/2021	Page No:	4 of 4

Assumptions

Design Criteria – Clubhouse Gross Floor Area 2294.0m^2

Residential

			Assumption
Per Capita Demand (PCD)	220	L/p/d	(WSL CoP 6.3.5.6) - WS Dev Assessmt Form
Peak Daily Factor (PF=2.0 <2000 POPULATION)	2		(WSL CoP 6.3.5.3) - Dev Assessmt Form
Peak Hourly Factor	2.5		(WSL CoP 6.3.5.3) - Dev Assessmt Form
People per dwelling (1 bedroom):	2	person	(WSL Ws CoP Table 6.1a)
People per dwelling (2 to 4 bedrooms):	3	person	(WSL Ws CoP Table 6.1a)
People per dwelling (5 bedrooms):	8	person	(WSL Ws CoP Table 6.1a)

Commercial/Retail/Accomodation

			Assumption
Accomodation (Hotel)			
Per Capita Demand (PCD) - Hotel Guests	200	L/room/d	(WSL CoP 6.3.5.6-Table 6.1b)
Per Capita Demand (PCD) - Hotel Staff	50	L/staff/d	(WSL CoP 6.3.5.6-Table 6.1b)
Wet Retail-(food & beverage preperation)	15	l/d/m^2	(WSL CoP 6.3.5.6-Table 6.1c)
Office & dry where toilets for staff only	1	person/50m^2	(WSL CoP 6.3.5.6-Table 6.1c)
	65	l/p/d	
Office & dry retail	1	person/15m^2	(WSL CoP 6.3.5.6-Table 6.1c)
	65	l/p/d	
Peak Daily Factor	2		(WSL CoP 6.3.5.3) - Dev Assessmt Form
Peak Hourly Factor	2.5		(WSL CoP 6.3.5.3) - Dev Assessmt Form

Existing Development

Residential

			Remark
No. of dwelling:	0		Existing rural dwellings ignored
No. of people:	0		
Avg Daily Demand (L/s)	**0.00**	L/s	
Peak Daily Demand (L/s)	**0.00**	L/s	
Peak Hourly Demand (L/s)	**0.00**	L/s	

Proposed Development

Club house Office/Pro-shop/Change Rooms/Lounge/staff lunch room

Floor Area	1145	m^2	reception,/office assume 50% GFA
Avg Daily Demand (L/s)	**0.017**	L/s	23 persons x 65 L/d =1,495 L/d
Peak Daily Demand (L/s)	**0.03**	L/s	
Peak Hourly Demand (L/s)	**0.09**	L/s	

Clubhouse Guests: Clubhouse Golfers and Patrons

			Remark
No Staff	30	persons	Guusets using amenities
Avg Daily Demand (L/s)	**0.017**	L/s	30 persoons x 50l/d - = 1,500L/d
Peak Daily Demand (L/s)	**0.03**	L/s	
Peak Hourly Demand (L/s)	**0.09**	L/s	

Clubhouse Cafe/Bar Clubhouse bar/kitchen/resturant dining

			Remark
Floor Area	230	m^2	Kitchen/bar/resturant assume 10% GFA
Avg Daily Demand (L/s)	**0.040**	L/s	230m2 x 15L/m2/d = 3,450 L/d
Peak Daily Demand (L/s)	**0.08**	L/s	
Peak Hourly Demand (L/s)	**0.20**	L/s	

On Course Toilets 2 x separate toilet bld locations (Combined GFA = 50m^2)

			Remark
No Persons	50	person	assume 50p/d (30% of total rounds)
Avg Daily Demand (L/s)	**0.009**	L/s	50 persons x 15 L/p/d = 750 L/d
Peak Daily Demand (L/s)	**0.02**	L/s	
Peak Hourly Demand (L/s)	**0.04**	L/s	

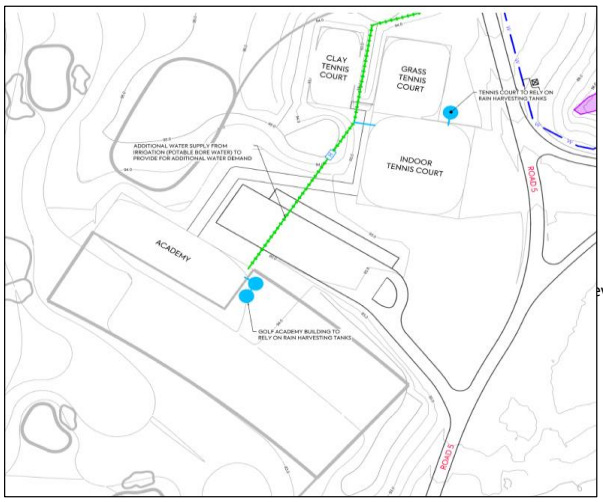
Total Site Demand Lodge

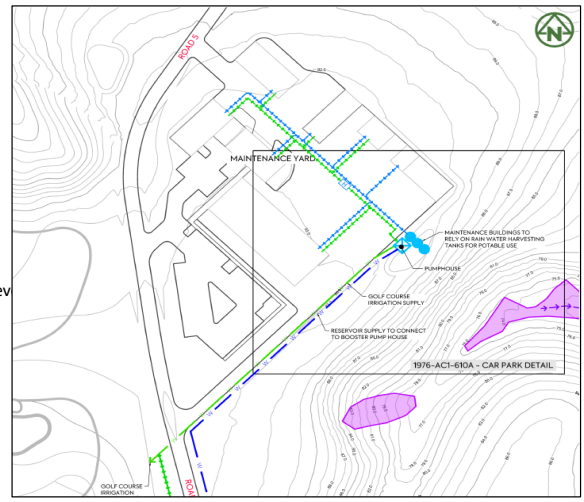
			Remark
Avg Daily Demand (L/s)	**0.0832**	L/s	7,189 L/d
Peak Daily Demand (L/s)	**0.17**	L/s	
Peak Hourly Demand (L/s)	**0.42**	L/s	

PROJECT NAME:	Muriwai Downs Resort	CREATED BY:	CHG	DATE:	8/12/2021
PROJECT No:	1976	CHECKED BY:	SM	DATE:	8/12/2021

SUMMARY OF ASSESSMENT - WATER SUPPLY ACADEMY & MAINTENANCE FACILITY

Catchment Area selected for Water Supply Assessment





Golf Academy **Maintenance facility**

0

DESIGN CRITERIA

Residential

			Assumption
Per Capita Demand (PCD)	220	person	(Table 5.1.2)
Peak Daily Factor (PF=2.0 <2000 POPULATION)	2	person	(Table 5.1.2)
Peak Hourly Factor	2.5	person	(Table 5.1.2)
People per dwelling (1 bedroom):	2	L/p/d	(WSL CoP 5.3.5.1.1/Table 5.1.1)
People per dwelling (2 to 4 bedrooms):	3	L/s	(WSL CoP 5.3.5.1.1/Table 5.1.1)
People per dwelling (5 bedrooms):	8	L/s	(WSL CoP 5.3.5.1.1/Table 5.1.1)

Academy & Maintenance (Office, Meeting Rooms and Lunchroom)

			Assumption
Per Capita Demand (PCD) - Hotel Guests	200	L/room/d	(WSL CoP 6.3.5.6-Table 6.1b)
Per Capita Demand (PCD) - Hotel Staff	50	L/staff/d	(WSL CoP 6.3.5.6-Table 6.1b)
Wet Retail-(food & beverage preparation)	15	l/d/m^2	(WSL CoP 6.3.5.6-Table 6.1c)
Office & dry retail	1	person/15m^2	(WSL CoP 6.3.5.6-Table 6.1c)
	65	l/p/d	
Peak Daily Factor	2		(WSL CoP 6.3.5.3) - Dev Assessment Form
Peak Hourly Factor	2.5		(WSL CoP 6.3.5.3) - Dev Assessment Form

EXISTING WATER DEMAND

Residential - Farm Dwellings

			Remarks
No. of existing (assumed with 3 bedrooms each):	0		Exclude existing farm dwellings on
No. of people:	0	person	development site
Avg Daily Demand (L/s)	**0.00**	**L/s**	
Peak Daily Demand (L/s)	**0.00**	**L/s**	
Peak Hourly Demand (L/s)	**0.00**	**L/s**	

PROPOSED DEVELOPMENT WATER DEMAND

Total Academy & Maintenance Facilities

Avg Daily Demand (L/s)	**0.13**	**L/s**	
Peak Daily Demand (L/s)	**0.26**	**L/s**	
Peak Hourly Demand (L/s)	**0.64**	**L/s**	

TOTAL - POST DEVELOPMENT WATER DEMAND

Avg Daily Demand (L/s)	**0.128**	**L/s**	GA= 8,500L/d & MCF=2,460L/d
Peak Daily Demand (L/s)	**0.26**	**L/s**	
Peak Hourly Demand (L/s)	**0.64**	**L/s**	Excl landscape, golf course irrigation and operation supply

MURIWAI DOWNS DEVELOPMENT PLANNING ASSESSMENT – ONSITE WATER DEMAND CALCULATIONS

WATER SUPPLY

SITE:	Muriwai Downs Golf Resort	CALCS BY:	CGH
PROJECT #:	1976	CHECKED BY:	SM
DATE	8/12/2021	Page No:	2 of 3

Assumptions

Design Criteria – Golf Academey Roof Area 1,550m^2 assume building 80%

Residential

			Assumption
Per Capita Demand (PCD)	220	L/p/d	(WSL CoP 6.3.5.6) - WS Dev Assessmt Form
Peak Daily Factor (PF=2.0 <2000 POPULATION)	2		(WSL CoP 6.3.5.3) - Dev Assessmt Form
Peak Hourly Factor	2.5		(WSL CoP 6.3.5.3) - Dev Assessmt Form
People per dwelling (1 bedroom):	2	person	(WSL Ws CoP Table 6.1a)
People per dwelling (2 to 4 bedrooms):	3	person	(WSL Ws CoP Table 6.1a)
People per dwelling (5 bedrooms):	8	person	(WSL Ws CoP Table 6.1a)

Commercial/Retail/Accomodation

			Assumption
Accomodation (Hotel)			
Per Capita Demand (PCD) - Hotel Guests	200	L/room/d	(WSL CoP 6.3.5.6-Table 6.1b)
Per Capita Demand (PCD) - Hotel Staff	50	L/staff/d	(WSL CoP 6.3.5.6-Table 6.1b)
Wet Retail-(food & beverage preperation)	15	l/d/m^2	(WSL CoP 6.3.5.6-Table 6.1c)
Office & dry where toilets for staff only	1	person/50m^2	(WSL CoP 6.3.5.6-Table 6.1c)
	65	l/p/d	
Office & dry retail	1	person/15m^2	(WSL CoP 6.3.5.6-Table 6.1c)
	65	l/p/d	
Peak Daily Factor	2		(WSL CoP 6.3.5.3) - Dev Assessmt Form
Peak Hourly Factor	2.5		(WSL CoP 6.3.5.3) - Dev Assessmt Form

Existing Development

Residential

			Remark
No. of dwelling:	0		Exclude existing farm dwellings on our development
No. of people:	0		
Avg Daily Demand (L/s)	**0.00**	L/s	
Peak Daily Demand (L/s)	**0.00**	L/s	
Peak Hourly Demand (L/s)	**0.00**	L/s	

Proposed Development

Golf Academy Building Office (incl NZ Golf), Treatment room, Lunch room, Fittnes room, Lockers, hitting bays

Floor Area	595	m^2	Changeroom/office/ assume 67% GFA
Avg Daily Demand (L/s)	**0.009**	L/s	10 persons x 65 L/d = 650L/d
Peak Daily Demand (L/s)	**0.018**	L/s	
Peak Hourly Demand (L/s)	**0.045**	L/s	

Golf Academty Staff: Extra 25 x NZ Golf Staff + 9x Café Staff

			Remark
No Staff	34	persons	Academy staff and NZ Golf
Avg Daily Demand (L/s)	**0.020**	L/s	34 persons x 50 L/d = 1,700 L/d
Peak Daily Demand (L/s)	**0.039**	L/s	
Peak Hourly Demand (L/s)	**0.098**	L/s	

Golf Academy Building Cafe - kitchen and dinning

			Remark
Floor Area	290	m^2	Cafe/bar/resturant assume 33% GFA
Avg Daily Demand (L/s)	**0.050**	L/s	15L/d/m^2 = 4,350 L/d
Peak Daily Demand (L/s)	**0.101**	L/s	
Peak Hourly Demand (L/s)	**0.252**	L/s	

Tennis Court Building Tennis Bld (2,025m^2 GFA)

			Remark
No of persons	20	persons	Toilets Intermitent use (15L/p/d)
Avg Daily Demand (L/s)	**0.003**	L/s	20 person x 15 L/d = 300 L/d
Peak Daily Demand (L/s)	**0.007**	L/s	
Peak Hourly Demand (L/s)	**0.017**	L/s	

Golf Academey Academy Guests/Users

			Remark
No Staff	30	persons	Using physio, golf lessons etc
Avg Daily Demand (L/s)	**0.02**	L/s	30persons x 50 L/d = 1,500L/d
Peak Daily Demand (L/s)	**0.03**	L/s	
Peak Hourly Demand (L/s)	**0.09**	L/s	

Total Site Demand Lodge

			Remark
Avg Daily Demand (L/s)	**0.0998**	L/s	8, 500 L/d
Peak Daily Demand (L/s)	**0.20**	L/s	
Peak Hourly Demand (L/s)	**0.50**	L/s	

MURIWAI DOWNS DEVELOPMENT PLANNING ASSESSMENT – ONSITE WATER DEMAND CALCULATIONS

WATER SUPPLY

SITE:	Muriwai Downs Golf Resort	CALCS BY:	CGH
PROJECT #:	1976	CHECKED BY:	SM
DATE	8/12/2021	Page No:	3 of 3

Assumptions

Design Criteria – GOLF MAINTENANCE FACILITY

Residential

			Assumption
Per Capita Demand (PCD)	220	L/p/d	(WSL CoP 6.3.5.6) - WS Dev Assessmt Form
Peak Daily Factor (PF=2.0 <2000 POPULATION)	2		(WSL CoP 6.3.5.3) - Dev Assessmt Form
Peak Hourly Factor	2.5		(WSL CoP 6.3.5.3) - Dev Assessmt Form
People per dwelling (1 bedroom):	2	person	(WSL Ws CoP Table 6.1a)
People per dwelling (2 to 4 bedrooms):	3	person	(WSL Ws CoP Table 6.1a)
People per dwelling (5 bedrooms):	8	person	(WSL Ws CoP Table 6.1a)

Commercial/Retail/Accomodation

			Assumption
Accomodation (Hotel)			
Per Capita Demand (PCD) - Hotel Guests	200	L/room/d	(WSL CoP 6.3.5.6-Table 6.1b)
Per Capita Demand (PCD) - Hotel Staff	50	L/staff/d	(WSL CoP 6.3.5.6-Table 6.1b)
Wet Retail-(food & beverage preperation)	15	l/d/m^2	(WSL CoP 6.3.5.6-Table 6.1c)
Office & dry where toilets for staff only	1	person/50m^2	(WSL CoP 6.3.5.6-Table 6.1c)
	65	l/p/d	
Office & dry retail	1	person/15m^2	(WSL CoP 6.3.5.6-Table 6.1c)
	65	l/p/d	
Peak Daily Factor	2		(WSL CoP 6.3.5.3) - Dev Assessmt Form
Peak Hourly Factor	2.5		(WSL CoP 6.3.5.3) - Dev Assessmt Form

Existing Development

Ex Residential

			Remark
No. of dwelling:	0		Exclude existing farm dwellings on our development
No. of people:	0		
Avg Daily Demand (L/s)	0.00	L/s	
Peak Daily Demand (L/s)	0.00	L/s	
Peak Hourly Demand (L/s)	0.00	L/s	

Proposed Development

GCM Office — GCM office (250m^2 GFA)

Floor Area	250	m^2	Change room/office/staff kitchen
Avg Daily Demand (L/s)	0.004	L/s	5 persons= 325 L/d
Peak Daily Demand (L/s)	0.008	L/s	
Peak Hourly Demand (L/s)	0.019	L/s	

GCM Staff: On course Staff

			Remark
No Staff	25	persons	Golf Cource Maint Staff use GCM
Avg Daily Demand (L/s)	0.014	L/s	25 persons x 50 L/d = 1,250 L/d
Peak Daily Demand (L/s)	0.029	L/s	
Peak Hourly Demand (L/s)	0.072	L/s	

Maint Wshop and Equip — Golf Maintenace Equipment Storage & Workshop (1,000m2 GFA)

			Remark
Floor Area	150	m^2	Assume 15% GFA for Workshop
Avg Daily Demand (L/s)	0.002	L/s	3 person x 65L/d = 195 L/d
Peak Daily Demand (L/s)	0.005	L/s	
Peak Hourly Demand (L/s)	0.011	L/s	

Operations Building — Golf Opps Office Bld (300m^2 GFA)

			Remark
Floor Area	300	m^2	Offices - Golf Opps
Avg Daily Demand (L/s)	0.005	L/s	6 persons x 65L/d = 390 L/d
Peak Daily Demand (L/s)	0.009	L/s	
Peak Hourly Demand (L/s)	0.023	L/s	

Staff: Extra Laundry Staff opperate out of Golf Opps Building

			Remark
No Staff	6	persons	Laundry staff at 6 staff /shift
Avg Daily Demand (L/s)	0.00	L/s	6 persons x 50L/d = 300 L/d
Peak Daily Demand (L/s)	0.01	L/s	
Peak Hourly Demand (L/s)	0.02	L/s	

Total Site Demand Lodge

			Remark
Avg Daily Demand (L/s)	0.0285	L/s	2,460 L/d
Peak Daily Demand (L/s)	0.06	L/s	
Peak Hourly Demand (L/s)	0.14	L/s	

Muriwai Wastewater

Activity	No People	Est daily use (L)	total Daily use (L)	cu.m/day	Area totals
Club Rooms					
Guests	50	75	3750	3.75	
Staff[4]	18	40	720	0.72	
Caddies[5]	28	75	2100	2.1	
Office					
Staff	25	40	1000	1	
Maintenance Facility					
Staff	23	40	920	0.92	
Operation building					
Staff	30	40	1200	1.2	**9.69**
Sports Academy					
Academy					
Staff[2]	15	40	600	0.6	
Golf NZ	25	40	1000	1	
Guests	30	40	1200	1.2	
Café					
Staff[3]	7	40	280	0.28	
Guests	100	75	7500	7.5	**10.58**
The Lodge					
Main Lodge building					
Staff	30	60	1800	1.8	
Guests[1]	52	150	7800	7.8	
Meeting Yoga House					
Guests	10	40	400	0.4	
Wellness Centre					
Guests	20	40	800	0.8	
Accomodation (26)					
Guests[1]	52	40	2080	2.08	**12.88**
golf course toilets					
Toilets	2	250	500	0.5	**0.5**

[1] Guests of lodge are also staying in accomodation

[2] Café staff 9 over week assessed as 75% total on any day

[3] Academy staff 12 over week assessed as 75% total on any day

[4] Club house staff 25 over week assessed as 75% total on any day

[5] Club house 40 caddies over week assessed as 75% total on any day