APPENDIX 9

Erosion and Sediment Control Plan (ESCP)

Ruakākā Energy Park Solar Farm

Prepared for Meridian Energy Ltd
Prepared by Beca Limited

28 August 2023

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Contents

Appendices

Revision History

Revision Nº	Prepared By	Description	Date
1	Curtis Blyth	Draft for Resource Consent	31.05.2023
2	Curtis Blyth	Draft for Resource Consent - updated following Meridian review	07.07.2023
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Document Acceptance

Action	Name	Signed	Date
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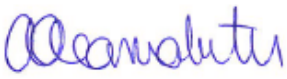
Approved by	Alex Aramakutu		28.08.2023
on behalf of	Beca Limited		

1 Introduction and Project Context

1.1 Scope and Purpose

Beca Limited (Beca) have been engaged by Meridian Energy Limited (Meridian, the Client) to provide an Erosion and Sediment Control Plan (ESCP) to support resource consent application for the proposed Ruakākā Solar Farm development ('the project').

The purpose of this document is to describe how earthworks associated with the project can be effectively managed to mitigate the risk of a potential sediment discharge and subsequent adverse impact on the environment during earthwork activities.

This plan details the principles and practices of erosion and sediment control methodology with some commentary around earthworks staging and sediment control devices that may be required in various areas of the site.

It is expected that the resource consent will require the appointed contractor to prepare a site-specific, or final, ESCP (SSESCP) which will detail design specifications of erosion and sediment control devices aligned with the finalised earthworks design, contractor's earthworks methodology and project programme.

1.2 Project and Site Overview

The project is separated into three sites owned by Meridian. Site 1 is located at Marsden Point, and Sites 2 and 3 are further south of Site 1 and located in Ruakākā, New Zealand (**Figure 1**). Surrounding the sites is predominantly agricultural land use except for a few small areas of business and residential dwellings to the east of Site 3 and the north of Site 1. Along the west side of Sites 1 and 2 is State Highway 15.

Figure 1. Site Location, Ruakākā and Marsden Point (Google Earth)

The proposed works for this project is to build a solar farm on all three sites.. Specifics for each three sites are:

- Site 1 contains the Ruakākā Energy Park's Battery Energy Storage System (BESS). The BESS is currently under construction as stage 1 of the Ruakākā Energy Park development. Construction of a solar farm forms stage 2 of the same Ruakākā Energy Park with the solar farm utilising the same operations and maintenance facility, switching station, and grid connection as the BESS. Aside from the BESS, Site 1 will host solar arrays and associated infrastructure. Site 1 also contains is an existing block of kanuka trees and a constructed wetland accompanying existing wetland areas to be retained. The BESS is located in the northern most corner of the site and has been previously consented and therefore, is not included in this report. The area of existing and constructed wetland is along Site 1's south eastern boundary and will comprise an open-water design, fed by nearby site stormwater discharges.
- Site 2 is proposed to be composed entirely of solar arrays.
- Site 3 will contain solar arrays and a constructed wetland. The wetland will be placed at the south of the site, near the existing gas lines and beneath the existing transmission lines. The rest of the site will contain solar arrays, excluding a no-build corridor for the gas pipelines. Sites 2 and 3 will be connected to the Site 1 switching station via an independent connection (not covered in this ESCP).

A general layout of the site is provided as **Figure 2**. Note that the sections labelled 'Solar Panels' contain internal and perimeter roads, small maintenance buildings, electrical inverters, and stormwater facilities as needed. Internal and perimeter roads are to be used for servicing the solar farm and will compromise an unpaved 4-8m wide roads that are to be surfaced with gravel.

The solar arrays are to be raised on platforms above the ground, with the majority of the site's surface being grassed to enable continued livestock grazing.

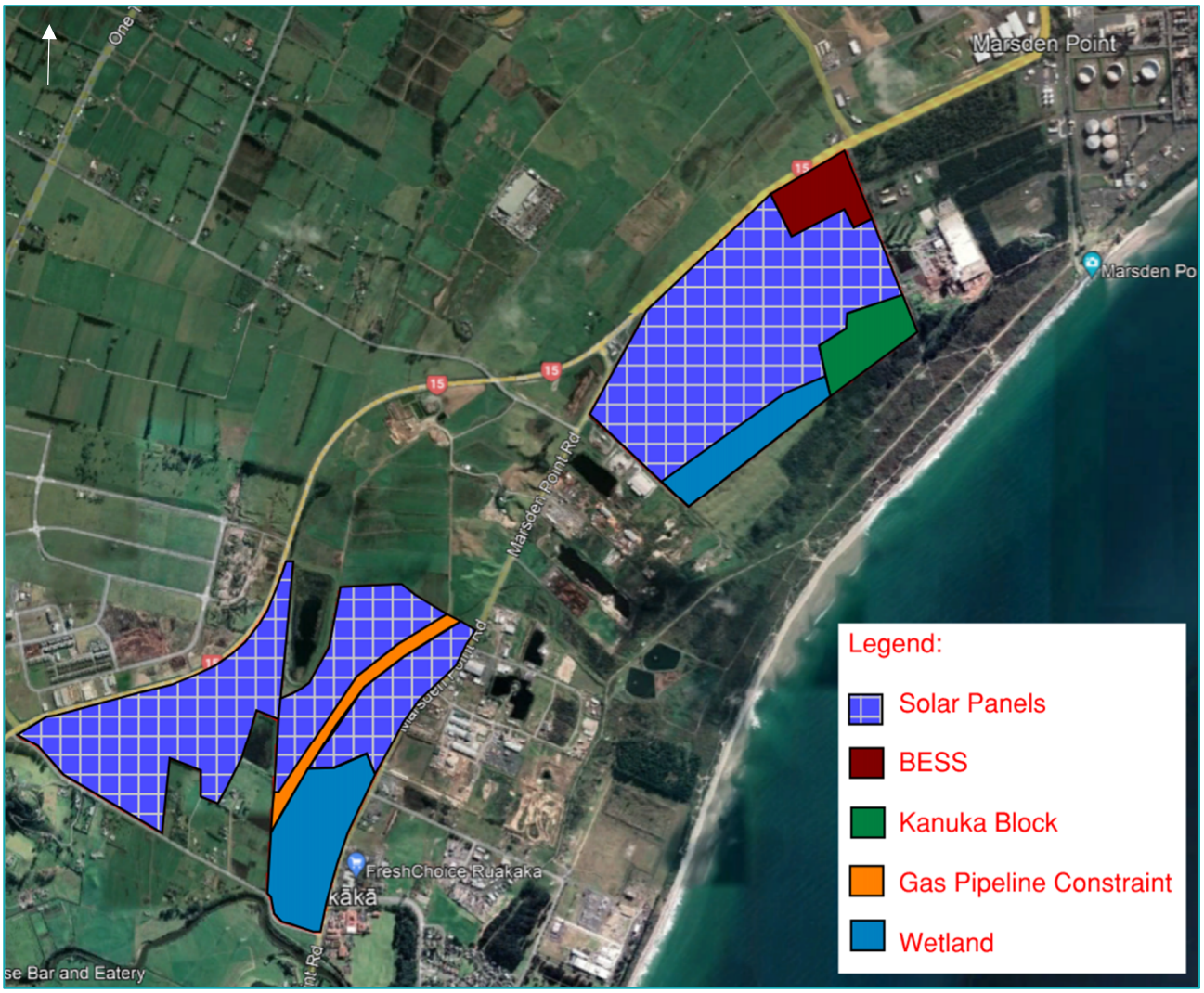


Figure 2. General Design Site Layout (Preliminary Design Stage)

1.2.1 Project Earthworks

Shallow earthworks are needed across all sites to re-grade the contour to obtain a slight northwards tilt (maximising solar gain). In most areas, this equates to cut/fill of less than 1m deep given the site's flat topography, however some localised mounds and hollows will require deeper earthworks.

Linear earthworks are also required throughout the site for all internal roads, with trenching also required for DC and MV electrical cabling. The proposed stormwater network will rely on open swales/drains with culverted sections.

Deeper earthworks are associated with the constructed wetlands in Site 1 and Site 3.

The cumulative area of the three sites is large (**Table 1**). Earthworks across this area is associated with re-grading the majority of the site to enable development, and deeper earthworks required for the two wetlands.

Table 1. Indicative earthworks/land disturbance areas (Civil Design Report – For Resource Consent)

Location	Area (m²)
Site 1	937,600
Site 2	415,500
Site 3	553,400
Total	1,906,400

Earthworks will be staged to minimize the open earthworks area at any given time. The final staging will be determined by the appointed contractor and detailed in their Site-Specific ESCP. For the purposes of this ESCP for resource consent, staging has been determined by each site's specific earthworks and design, enabling the most appropriate erosion and sediment control methodology to be provided.

1.3 Proposed Construction Methodology

The final construction methodology will be determined by the appointed contractor, aligning with their programme and the detailed design. An indicative construction sequence is provided here only, which is applicable to all three sites.

- Site Establishment
  - Set up stabilised entrances off on Marsden Point Road (Site 1 and Site 3), McCathie Road (Site 2)
  - Establish temporary laydown area for construction and storage of equipment
  - Construct all erosion and sediment control devices as shown in the approved Contractor's ESCP
  - Set up a workshop, site office and facilities and site perimeter fencing with signage, locks and security systems
  - Construct internal haul roads to facilitate earth moving and culvert stream crossings with temporary culverts
  - Set up additional stabilised site entries off Rama Road (Site 1) and an internal road between Sites 2 and 3.
- Undertake site clearance activities including removal of trees and buildings.
- Perform earth moving activities to achieve the bulk earthwork profile for the site (staged in accordance with final contractor's programme). Dependent on the area of site, earthworks will either involve re-grading (i.e. localised cut to fill) or, in areas of surplus cut, cut to waste operations will be undertaken. Offsite disposal locations, if required, will be consented separately.
- Undertake earthworks to construct wetlands in Site 1 and Site 3, and landscape.
- Construct internal roads, open drains, culverts.
- Construct hardstands and concrete pads and/or piles for the inverter power stations. Install power conduits and/or cables under roads, as required.
- Solar array construction
  - Install piles for solar panels.
  - Install solar panels, inverter power stations and weather stations.
  - Run DC cables from combiner boxes to Inverter Power Stations.
  - Run AC cables from Inverter Power Station to cable/overhead line transition pole and terminate to 33kV switchgear in BESS facility (Sites 1 and 3) or the inverter power station ring main unit (Site 2)
- Disestablish the erosion and sediment control measures once the site is stabilised and open the site.
- Plant site perimeters where required.

2 Site Environmental Setting

Site 1

Site 1 has a relatively flat terrain across the entire site with small rolling dunes (contours displayed on **Figure 3**). An open drain for stormwater runs through the centre for the entire length of Site 1 and catches the runoff from the south of the site. This drain flows towards Bream Bay Substation and then to Mair Road in the north, before discharging to the open sea near the end of Mair Road.

Site 1 contains existing wetlands scattered throughout the entirety of the site, with a block of Kanuka trees in the corner towards the east which will be retained. The contours of the existing Site 1 terrain can be seen in **Figure 3**.

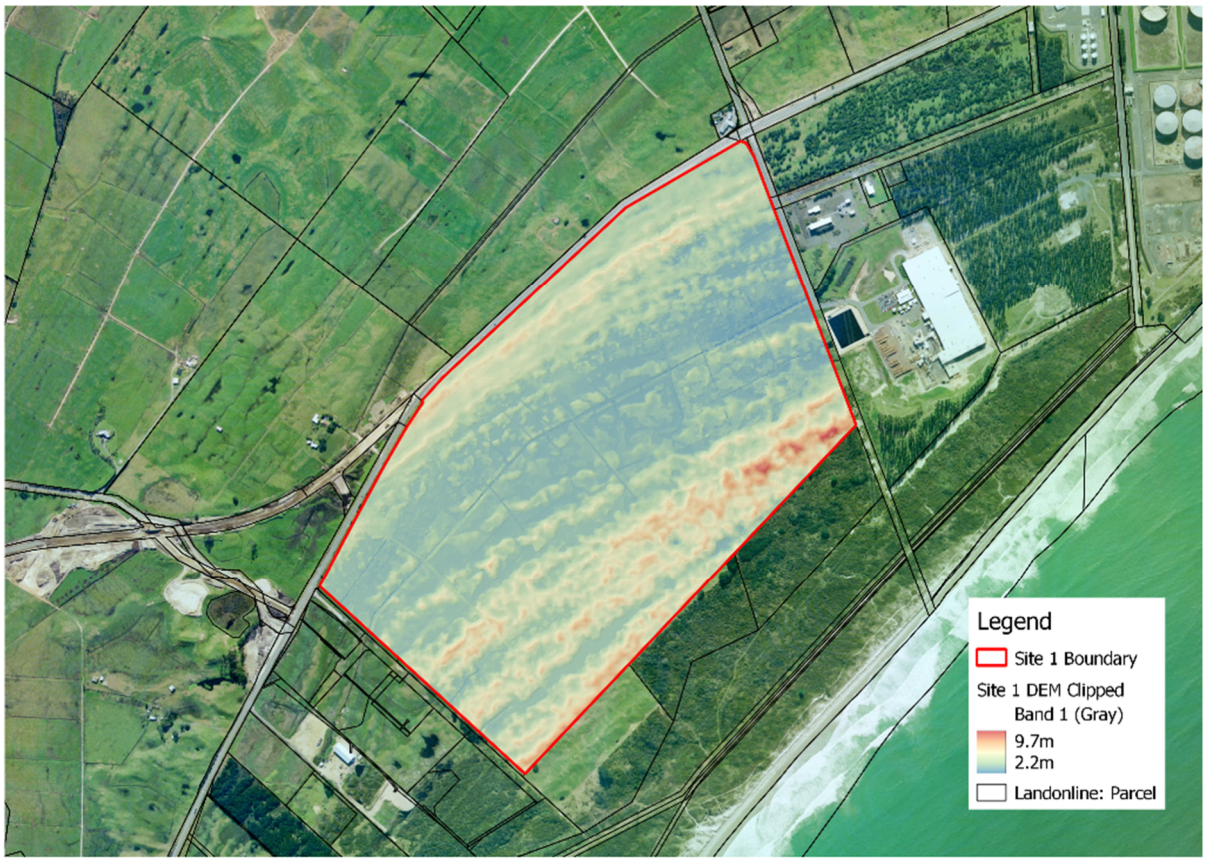


Figure 3. Site 1 Existing Terrain (Preliminary Civil Design)

Site 2

The existing terrain for Site 2 is relatively flat with the lowest point of the site being along the eastern boundary (contours displayed on **Figure 4)**. There are two existing stormwater retention ponds immediately adjacent the site's eastern boundary (outside the site).

Two existing open drains which capture the majority of the site's stormwater within the site flow along the site's eastern boundary and southern boundary (along McCathie Road), converging in the southeast and discharging through a culvert beneath McCathie Road to Ruakākā River. Ruakākā River subsequently flows south – south east towards the open sea. An additional farm drain is present in the western portion of the site which discharges south, under McCathie Road, towards Ruakākā River.

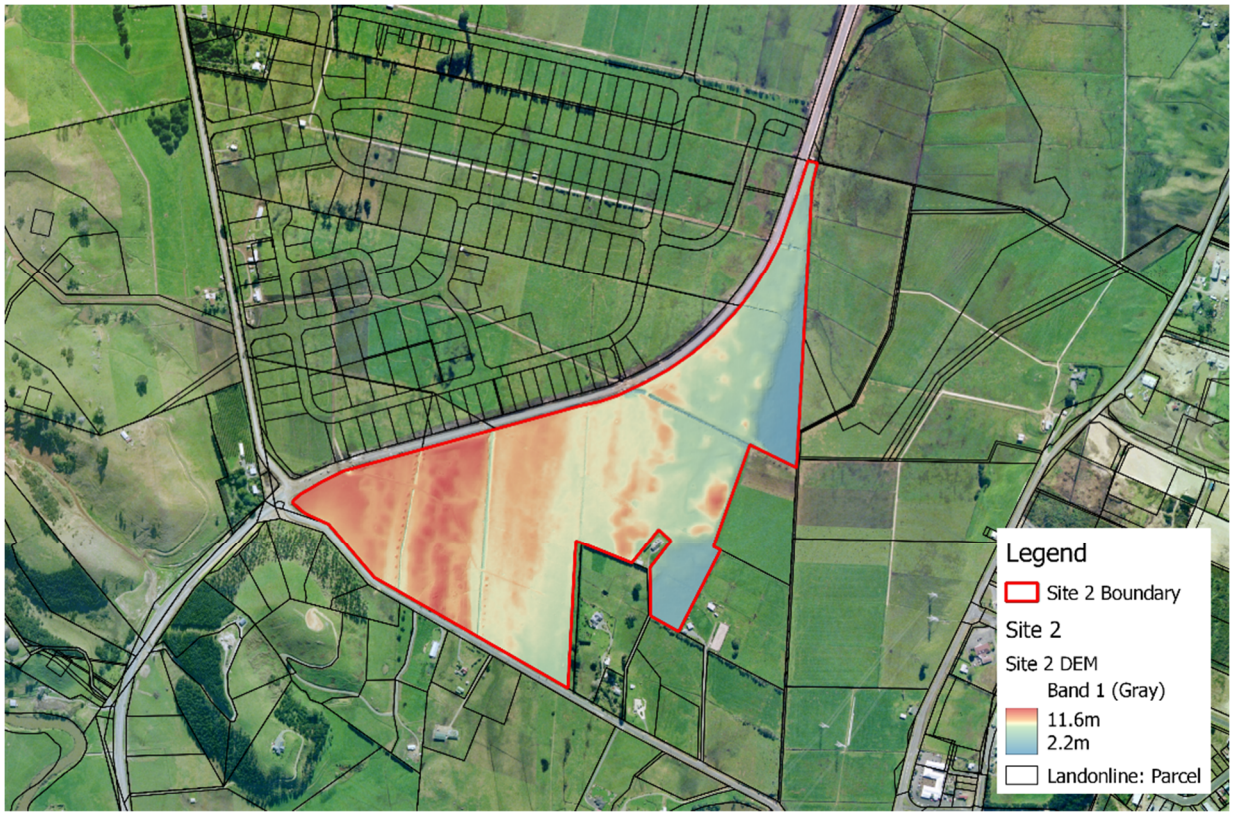


Figure 4. Site 2 Existing Terrain (Preliminary Civil Design)

Site 3

Site 3 is relatively flat throughout, with a slight raise along the site's eastern boundary with Marsden Point Road (contours displayed on **Figure 5**). The lowest point of the site is to the southwest, where site stormwater discharges to the same open drain as Site 2, which flows south towards the Ruakākā River. There are two existing stormwater retention ponds immediately adjacent to the site's western boundary (outside the site).

Within Site 3 is a First Gas pipeline exclusion corridor and Transpower transmission lines, of which several pylons need protecting (as detailed in the design).

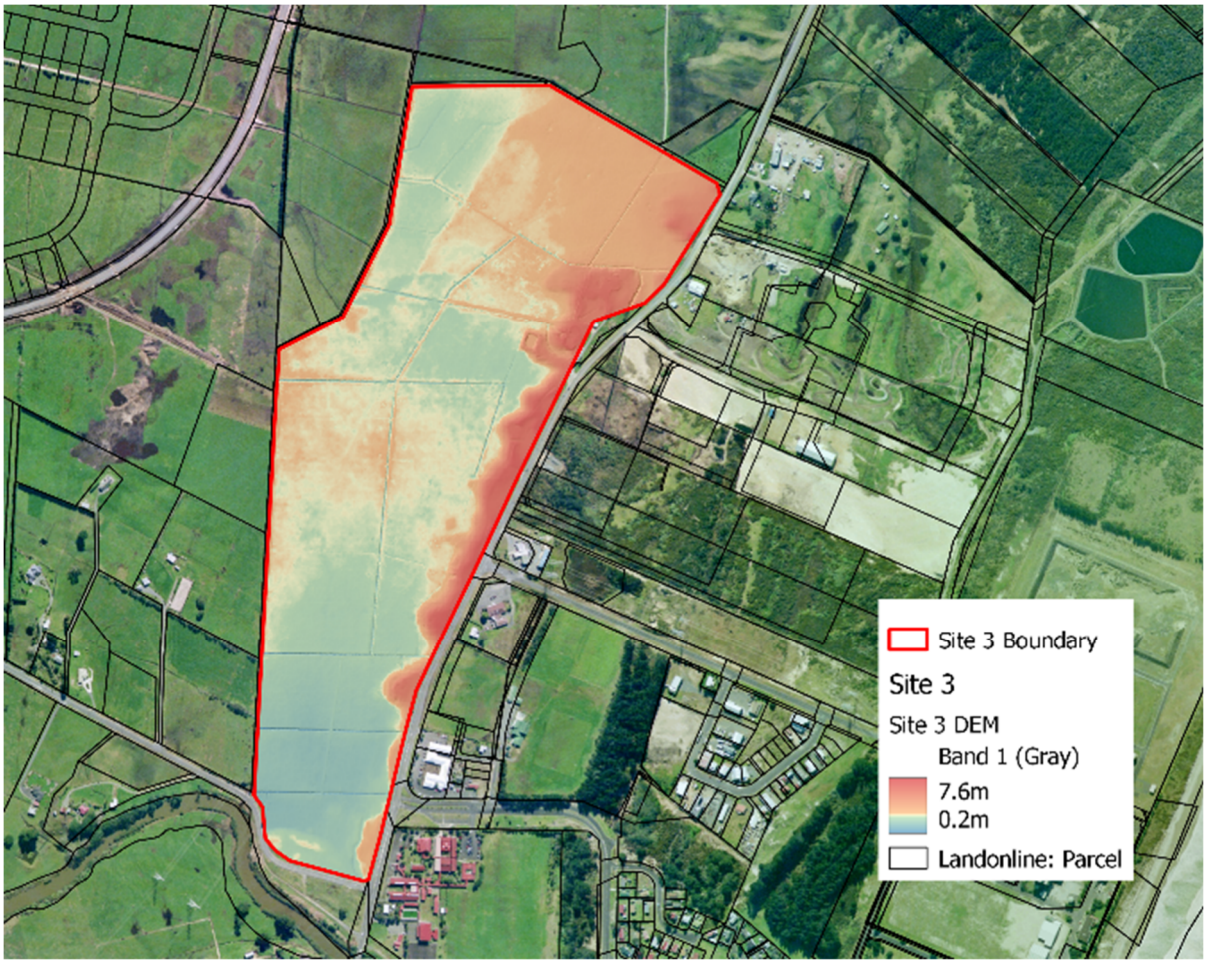


Figure 5. Site 3 Existing Terrain (Preliminary Civil Design)

2.1 Potential Receiving Environment Effects

All receiving aquatic environments have the potential to be affected by sediment runoff during construction works. Sediment suspended in water can clog fish gills within the stream or limit light penetration, affecting various plant or algal species. Once settled, additional sediment loading can smother benthic organisms or coat plant leaves.

3 Principles of Erosion and Sediment Control

The key principles to be employed for an ESCP are to undertake land disturbing activities in a manner that reduces the potential for erosion of bare soils to occur (erosion control) and to employ treatment devices to treat all sediment laden water prior to discharging from the site (sediment control).

The 10 basic principles of erosion and sediment control taken from Auckland Council's Guidance Document 005: *Erosion and Sediment Control* ('*GD05*', 2016) will be applied to each of the defined scenarios (as applicable) and are outlined for completeness as follows:

- **Minimise Disturbance:** Only work those areas required for construction to take place.
- **Stage Construction:** Carefully plan works to minimise the area of disturbance at any one time.
- **Protect steep slopes:** Where steep slopes exist within the works area, ensure that these are protected as steep slopes are prone to erosion.
- **Protect Watercourses:** Map all water bodies before works commence.
- **Stabilise** exposed areas rapidly with sowing new seed or mulch cover.
- **Install perimeter controls:** Divert clean water away from areas of disturbance and divert runoff from areas disturbed to sediment control measures.
- **Employ detention devices:** Treat runoff by methods that allow sediment to settle out.
- **Make sure the ESCP evolves:** As construction progresses and the nature of land disturbing activities change, the ESCP needs to be modified to reflect the changing conditions on the site.
- **Assess and adjust:** Inspect, monitor and maintain control measures.
- **Use trained** and experienced contractors.

Any Site-Specific Erosion and Sediment Control Plan (SSESCP) prepared by the Contractor or their delegate as a requirement of any future conditions of consent will be developed and maintained in accordance with Auckland Council's GD05.

4 Erosion Controls

4.1 Timing of Earthworks and Staging

The sandy nature of the site will likely permit earthworks year-round without presenting additional erosion risk over winter (such as with clay soils). Given the size of the earthwork areas, Northland Regional Council (NRC) may require a winter works approval process, if required, by a condition of consent. Based on the scale and demand of works, it is likely this project will be undertaken over the winter months.

Staging will be restricted to the catchment of sediment retention devices, with internal bunds and cut-offs enabling a single retention device to be retained and treat multiple catchments in a staged manner. This staged construction will limit the active works area to a single catchment and allow for the safe management of the site. This staging will allow for progressive completion and stabilisation to be undertaken, predominantly re-grassing the site prior to infrastructure associated with the solar panel array and internal roads being constructed.

4.2 Site Access Points and Construction Laydowns

Stabilised entranceways will be installed at the access points to laydown/construction yards and are to be constructed and maintained in accordance with GD05.

These access points have been identified for each site as:

- Site 1 –Access 1: Established off Marsden Point Road, near the GAS station.
  - Access 2: Will be established off Rama Road on the site's northern boundary, opposite the Bream Bay Substation.
  - BESS Operational Access: Will be maintained as currently consented.
- Site 2 – Primary access established off McCathie Road on the site's southern boundary.
  - Secondary access likely via Site 3 adjoining eastern boundary, dependent on staging.
- Site 3 – Primary access established off Marsden Point Road.
  - Secondary access likely via Site 2 adjoining western boundary, dependent on staging.

Any construction laydown areas will be stabilised with aggregate underlain by suitable geofabric to prevent erosion and becoming a source of sediment. Laydown areas and sizes shown in the plan are indicative only and will be confirmed in the Contractor's SSESCP. These areas have been shown indicatively as ~7,000m^2 to allow a large enough area for vehicle parking and turning, equipment and material, and offices.

Should any tracking of sediment to public roads occur as a result of the works, this will be removed as required using dry methods (e.g., sweeper, or broom and shovel). The contractor will assess whether a wheel wash system is required during earthworks should continued sediment losses to public roads occur.

4.3 Minimise Exposed Areas

A number of best practice measures will be employed to minimise the area of land exposed to erosive forces at any one time. Vegetation clearance will be limited to those areas where soil disturbance will be undertaken, with as much existing grassed ground cover being retained as possible. Staging of earthworks and progressive stabilisation of the site will be undertaken to ensure effective management of the open earthwork areas. Temporary stabilisation with the use of pinned geofabrics, hay mulch or soil stabilisers will also be used for small, isolated areas where required.

4.4 Stabilisation and Reinstatement

Exposed areas will be progressively stabilised as works are completed to reduce erosion. The methodology of permanent stabilisation employed is dependent on the specific area of the site.

All re-graded areas of the site involving broad, shallow earthworks, will be stabilised via the placement of topsoil and reseeding grass.

Once the design grade is obtained, all internal roads will be stabilised with their designed aggregate.

The stormwater network works involve cut open swales/drains with culverts installed for access routes. These sections will be constructed within the catchment of a wider sediment control device, but will be largely undertaken as isolated linear works adopting a progressive stabilisation approach where the swale will be restabilised with mulch and grass seed once a section is complete. Monitoring and programming of works will be required to ensure new swales/drains are not connected to existing drains before the catchment is stabilised or the drain protected.

Pinned geofabrics, soil stabilisers, aggregate or hay mulch may be required in isolated areas to achieve temporary stabilisation during construction.

4.5 Dust Control

Dust will be controlled during earthworks by water spray as required. Water for dust control and construction purposes will be sourced from public supply or retained stormwater onsite. Any water take for dust control purposes will need to comply with relevant district and regional rules. Resource consents for water takes are included in the resource consent application.

4.6 Stockpiling

Stockpiling of topsoil will be undertaken for reuse on site where appropriate. All unsuitable spoil is likely to be cut to waste and removed from site to reduce the extent of stockpiling required. All topsoil stockpiles are to be positioned in the catchment of retention device or temporarily stabilised with pinned geofabric or hay mulch as required to avoid becoming a source of dust or material runoff.

Backfill materials (aggregate and sand) will be stored in stockpiles in construction yards. These are unlikely to become a source of sediment runoff but will be monitored throughout construction.

Isolated bunding or silt fencing will adequately protect stockpiles outside the catchment of a retention device, if required.

5 Sediment Controls

Emphasis on mitigating erosion of the site should be considered priority as opposed to the reliance on sediment control devices. At the same time, the following sediment control mechanisms will be implemented throughout the site to provide treatment capacity of sediment laden discharge from the site.

5.1 Clean Water Diversions

Diverting clean water minimises the erosion of worked areas and allows sediment retention devices to specifically retain dirty water which increases the efficiency of the device.

Given the proposed staged construction methodology, clean water diversions are likely to involve retaining existing farm drains, perimeter roadside swales and overland flow paths to divert any upgradient clean stormwater and separate earthwork zones. Clean water flow paths will be identified prior to earthworking any new area and clean water diversions established in accordance with GD05 as required.

5.2 Sediment Retention Ponds and Decanting Earth Bunds

Sediment retention devices will be installed in low points of the site, with site perimeter bunds allowing the capture and direction of dirty water to these devices. Given the flat nature and dominant sandy soils of the site there is a low erosion risk, however, the bulk earthworks across large areas will need a device to adequately retain dirty water discharges and allow sedimentation onsite.

Sediment retention ponds (SRPs) or decanting earth bunds (DEBs) will be installed by the Contractor to provide treatment of earthwork areas. All SRPs and DEBs will be designed in accordance with GD05, with a minimum volume equivalent to 2% of the contributing catchment area, include floating T-Bar decants and stabilised emergency spillways and discharge points.

Indicative locations of SRPs have been provided in a draft ESCP as **Appendix A** for each site. The final location and size of any device installed will be provided in the Contractor's SSESCP as is heavily dependent on their preferred construction staging, programme and detailed design. For the purposes of this draft ESCP, SRPs have been shown to treat a maximum 5ha catchment with a 2% retention capacity. Specification of these SRPs are provided in **Appendix B.**

5.2.1 Flocculation

Chemical flocculation will be used in all SRPs and DEBs to improve their sediment removal efficiency. This flocculation will be with a rain or flow activated dosing system.

All flocculation methodology and dosing rates will be detailed in a Flocculation Management Plan (FMP), if required by condition of consent. This approach will allow the appointed contractor to size their flocculation devices specifically to their constructed devices, as detailed in their SSESCP.

5.3 Silt Fences and Super Silt Fences

Silt fences or super silt fences will be installed across the contour to slow sheet flow and impound sediment from limited catchment areas. Any silt fence will be installed in accordance with GD05, including the adequate number of returns, and will remain in place until 80% stabilisation is achieved within their contributing catchment.

Heavy machinery operation and earthworks will not occur on the downhill side of silt fences unless it is undertaken following a strict cut and cover methodology for small work areas only.

5.4 Wetland Construction Areas

Both constructed wetlands in Sites 1 and 3 are intended for wetland-offsets associated with the development and are not intended to act as permanent stormwater treatment devices. Given the proposed excavation depths associated with wetland construction across a wide area, these areas will be ideal for the temporary capture of construction related stormwater discharges, allowing onsite sedimentation and prevention of sediment related discharges offsite.

Both wetland's comprise large areas of ~9ha (Site 1) and ~13ha (Site 3). These areas will have perimeter bunds established to enable internal excavation (cut to waste) of what will form large stormwater impoundment areas. No outlets will be constructed until the wetland configuration and grade is obtained. This methodology will allow all dirty water associated with the wetland construction to be contained, with water being controlled via dewatering mechanisms (outlined in Section 6).

These large wetland excavation areas can be adopted by the contractor for dirty water retention from the wider earthworks site via pumping from active earthwork areas, or channeling/drains (if the contour enables it).

A temporary T-bar outlet can be constructed within the wetland retention areas to enable some control of water levels. Any detail of this outlet device would be provided in the final ESCP and incorporate specification outlined in GD05 (i.e. live and dead storage heights of T-bars).

6 Dewatering

It is likely that areas throughout the construction zone will become inundated with stormwater and may require dewatering to enable construction to continue.

Clean water (>150mm clarity measured with a Secchi or Black Disk) may be discharged offsite directly, under close management. Any dirty water dewatering will be passed through a dewatering treatment device such as a dewatering bag, turkey's nest, baffled bin, or lamella clarifier (e.g. 'Silt Buster'). This device will be set up in an area that allows the passive discharge of treated water to a nearby watercourse. Alternatively, dewatering can be directed to an established sediment retention device onsite to enable sedimentation and passive discharge through the device's constructed outlet. Examples of these dewatering devices are provided in **Figure 6** below. Any dewatering undertaken will be closely monitored to ensure adequate treatment.

Figure 6: Example dewatering devices, clockwise from top left: turkey's nest, baffled skip bins, small dewatering bag, lamella clarifier.

7 ESC Monitoring and Maintenance

The monitoring and maintenance activities shown in **Table 2** below are recommended as a minimum for the site. This table provides several aspects of ESC that the Site Manager or delegate will assess regularly so that the ESC measures are optimised. Final maintenance and monitoring will be detailed in the Contractor's SSESCP.

Table 2. General Inspection and Maintenance Requirements

Control Type	Inspection and Maintenance Requirements	Frequency
Weather Forecast	• Check forecast provider for rainfall forecasts • Undertake a pre-check of the site controls prior to any large rainfall events.	Daily during operations
Silt fences	• Check that silt fences are toed in correctly. • Check for tears and other damage – fix if required. • Any areas of collapse, decomposition or ineffectiveness are to be replaced immediately. • Remove silt build ups when bulges develop or when deposition reaches 20% of the silt fence height.	Weekly
Sediment Retention Devices	• Check catchment of device is sized correctly for device's capacity. • Check T-bar system is operational to emergency spillway height and T-bar levels are set at appropriate levels. • Check spillway and discharge outlet is stabilised, free of debris and not becoming a source of erosion. • Check forebay has capacity and undertake maintenance if 20% capacity lost. • Check flocculation system is operational (in accordance with approved FMP or CTMP).	Weekly and prior any rainfall events
Monitoring of Sediment Discharge	• Check whether erosion and sediment devices are operating as designed via checking water clarity in devices and/or receiving waterways. • Inspect areas of earthworks and identify whether additional erosion and sediment control measures are necessary. • Determine whether excessive sediment is discharging to roadways, land, or watercourses and remediate immediately.	Prior and during rainfall events and weekly
Stabilised Entranceways and Laydowns	• Inspect the stabilised accessway and top up with clean aggregate if required. • Inspect surfaces at exit points are not having sediment tracked onto them – sweep if required. • Inspect any structure used to trap sediment from the stabilised entranceway.	Daily during operations
Stabilising Areas	• Check that all stabilised areas have at least 80% cover before removing control devices. • Identify areas that require stabilisation and remedy.	Daily during operations.

8 ESC Summary

- The appointed contractor will prepare a finalised ESCP once appointed, as required by a condition of consent, allowing the inclusion of the final project programme, earthworks staging and methodology, and detailed design.
- All ESC works are to be undertaken in accordance with Auckland Council's Guidance Document 005: Erosion and Sediment Control ('GD05', 2016), as adopted by NRC.
- Earthworks are to be undertaken across the entirety of all three sites to regrade each surface flat and enable construction of the solar panel arrays and associated infrastructure (internal roads, stormwater and electrical connections).
- Earthworks require relatively minor depths of cut and fill given the site's relatively flat, hummocky nature, however, do encompass a large area.
- Staging of earthwork areas is proposed as the primary method in minimising erosion risk. Staging will allow earthwork catchment areas to be defined and treated via the implementation of sediment retention ponds and water diversions.
- SRPs will be constructed in low areas of each site, designed to treat a maximum 5ha site (i.e. max 1000m^3 capacity). Bunds will be established around working areas to enable dirty water treatment via the bund, and act as clean water diversions from surrounding unworked areas upgradient.
- Staged earthworks will allow areas to be contained, earthworked, and then stabilised, with a moving sequence of work areas allowing dirty water to be directed to the SRPs as required via relocating catchment perimeter controls (bunds and channels).
- Monitoring of SRP catchment areas will be required to ensure each SRP is not treating any excess catchment area beyond the designed capacity.
- Silt fences, super silt fences and DEBs will be constructed in smaller catchments where dirty water cannot be directed to the primary SRPs.
- All SRPs and DEBs will be chemically flocculated in accordance with a Flocculation Management Plan, likely required as a condition of consent.
- The constructed wetland areas within Site 1 and Site 3 may be utilised for the dirty water impoundment areas and controlled via dewatering or implementation of a T-bar outlet.
- Stabilised entranceways and laydown areas will be constructed early to prevent the site works becoming a source of sediment to public roads and receiving environs.
- All ESC will be monitored and maintained regularly to ensure operational efficiency.

Staging earthwork areas, constructing ESC in accordance with GD05 and incorporating sediment retention devices will adequately prevent exacerbated erosion and sediment discharges from construction works and thus minimise potential environmental effects associated with construction-related sediment loss.

A

Appendix A – ESCP Mark-ups

B

Appendix B – SRP Specifications