Draft Earthworks Management Plan (EMP)

Puke Kapo Hau Mahinerangi Wind Farm Stage 2, Otago

RILEY

Draft Earthworks Management Plan (EMP)

Report prepared for:	Tararua Wind Power Ltd
Report prepared by:	Justin Cameron, Civil Engineer
	.....
Report reviewed by:	Luke Gordon, Principal Civil Engineer, CPEng
	.....
Report approved by:	Don Tate, Project Director, CPEng
	.....
Report reference:	240034-G
Date:	17 October 2025
Copies to:	Tararua Wind Power Ltd Electronic copy
	Riley Consultants Ltd Electronic copy

Issue	Details	Date
0.1	Draft	17 October 2025

Contents

Draft Earthworks Management Plan (EMP)

PART A Introduction

1.0 Scope and Structure of the Plan

Tararua Wind Power (TWP), a fully owned subsidiary of Mercury NZ Limited, is progressing Stage 2 of the Mahinerangi Wind Farm which is to be known as "Puke Kapo Hau" ("the Project", "Puke Kapo Hau" or "MWF2").

The Stage 2 Earthworks Management Plan (EMP) provides for the environmental management, through the establishment of management procedures, for earthwork activities associated with the construction of MWF2.

The EMP is structured as follows:

- *Part A – Introduction.* This part of the EMP introduces, and establishes, the context for the Plan that follows. It also:
    - Provides an overview of the scope and structure of the Plan.
    - Establishes environmental objectives for the earthworks construction.
    - Outlines the manner in which the EMP will be implemented.
- *Part B* –outlines how adverse effects of the earthwork activities are managed to avoid, minimise or mitigate effects through the effective design and construction management processes, and specifically addresses the following areas:
    1. *Earthworks Design and Development Layout.* This part outlines the anticipated earthworks quantities to construct the MWF2 and establishes the methods to achieve the objectives of the Plan.
    2. *Surplus Fill Disposal Sites.* This part establishes the design and layout of the Surplus Fill Disposal (SFD) sites, and how they will be constructed to achieve the objectives of the Plan.
    3. *Impacts on Wetlands.* This part establishes the control measures that will be employed to avoid or minimise impacts of earthworks on wetlands.
    4. *Works within Streams and Wetlands.* This part establishes the control measures that will be employed to avoid or minimise impacts of earthworks on streams.
    5. *Erosion and Sediment Control.* This part outlines the erosion and sediment control and site rehabilitation measures that will be employed to achieve the objectives of the Plan.
    6. *Dust Control.* This part outlines the dust control measures that will be employed to achieve the objectives of the Plan.

7. ***Monitoring and Reporting.*** This part outlines the inspections and monitoring procedures for the earthworks controls (including contingency measures), plus associated reporting requirements.

2.0 Objective of the Plan

The objectives of the Stage 2 EMP set out in condition 25E(iii) as follows:

a. To minimise the overall area of disturbance, to reduce the potential impact on wetlands and streams;

b. To minimise the generation of sediment and sediment laden runoff;

c. To ensure that the earthworks are undertaken in a manner that provides for final surfaces which are suitable for rehabilitation where rehabilitation is proposed;

d. To ensure the control and/or mitigation of any potential adverse effects of dust emissions, sediment run-off or contamination of stormwater; and

e. To ensure that earthworks are undertaken in a manner that provides for compliance with relevant consent conditions in respect of water quality criteria applicable to discharge permits, and avoid, remedy or mitigate potential adverse effects on the environment.

3.0 Plan Implementation

3.1 Overview

Tararua Wind Power (TWP) as the consent holder, is responsible for ensuring the overall implementation of the EMP.

The day-to-day operation, implementation, and thus compliance with the EMP, is the responsibility of the Contractor in accordance with the construction contract. The Contractor is to ensure compliance with the resource consents administered by Otago Regional Council (ORC) and/or Clutha District Council (CDC), and the effective implementation of the EMP.

3.2 Plan Induction Procedure

All site personnel (i.e. contractor and subcontractors) at the MWF2 site, as well as visitors, are required to have completed an induction programme, where the scope is appropriate for the tasks and/or role of individual/s, covering the requirements of the EMP. The purpose of the induction programme will be to ensure that all relevant personnel play an effective role in ensuring that the requirements of the EMP are complied with.

Where visitors or other personnel to site have not completed an induction programme, they shall be accompanied at all times by personnel who have.

The induction programme is to be conducted by the Environmental Officer/s, or other personnel delegated and trained to undertake the task.

PART B Earthworks Management Plan

1.0 Earthworks Design and Development Layout

Earthworks are principally required for the formation of:

1. Access tracks to the Wind Turbine Generator (WTG) sites and Transmission Line Towers.
2. Hardstand and construction laydown areas at each WTG site.
3. Platforms for the permanent and temporary wind farm site facilities.
4. SFD's.

1.1 Access Tracks

The internal (circulation) tracks to WTG's will have a carriageway width of 5.5, with localised widening on corners (potentially up to 9.5m total width), to allow for the transportation of turbine components as well as general construction traffic. Post construction, the tracks will be narrowed to 5.5m consistent pavement width, with wider sections revegetated.

Access tracks to the transmission towers will have a 4.5m carriageway width designed for construction vehicles – including mobile crane and component deliveries.

A summary of the access track design parameters are provided in Table 1.

Table 1: Preliminary Geometric Requirements for Wind Farm Access Tracks

Parameter	Max Longitudinal Gradient	Vertical Curve Radius	Min Horizontal Curve Radius	Minimum Trafficked Width
Internal Circulation tracks (between WTG's)	15% (1)	500m	80m (2)	5.5m
Transmission Line Access Tracks	16%	200m	50m (3)	4.5m

(1) Steeper sections are permitted if tractor pulling units are utilised, and/or metalled access tracks are stabilised – generally up to maximum of 18% - excluding road to substation.

(2) Can revert to min R50m in constrained locations – track widening (up to 9.5m total width) will apply.

(3) Absolute minimum of 20m radius in constrained areas – road widening would likely be required.

The preliminary alignment of the internal circulation tracks has considered the following:

- Align along existing farm tracks where practicable and/or follow ridgelines.
- Avoid gullies and steeper terrain, where practicable.
- Maintaining a 10m setback from mapped wetlands, where practicable.

The alignment of the transmission line access tracks has considered the following:

- Access from adjacent (proposed) wind farm tracks
- Utilise (follow) existing farm tracks where practicable and generally following existing grades to minimise earthworks.
- Aligned close to fence lines (edge of paddocks), where practicable,
- Avoid gullies and steeper terrain, where practicable,
- Maintain a 10m setback from wetlands, where practicable.

1.2 Turbine Hardstands

The WTG supplier specifications determine the final hardstand and laydown area dimensions to enable crane assembly and erection for the tower, nacelle, and blade components – refer Figure 1.

The Turbine permanent hardstand features a 60m by (26 to 32m) hardfill platform (~1,855m^2) on one side of a central access track, which will comprise the Turbine, main crane, and laydown areas for various Turbine components. Identified as "Turbine Permanent Hardstand Area" in Figure 1 below, this area will remain as permanent hardfill platform for ongoing maintenance activities during the life of the wind farm.

Temporary cleared areas and laydown areas of approximately 1,770m^2 make up the balance of the area and will be used for the blade laydown area, main crane boom assembly, and support crane pad. However, these additional laydown areas are temporary and will be recontoured and re-vegetated following construction and therefore are not considered part of the 'Turbine hardstand' that must be located in the Contingency Zones.

The Turbine suppliers require a gently sloping hardstand, typically with maximum 1% transverse and 1% longitudinal gradient.

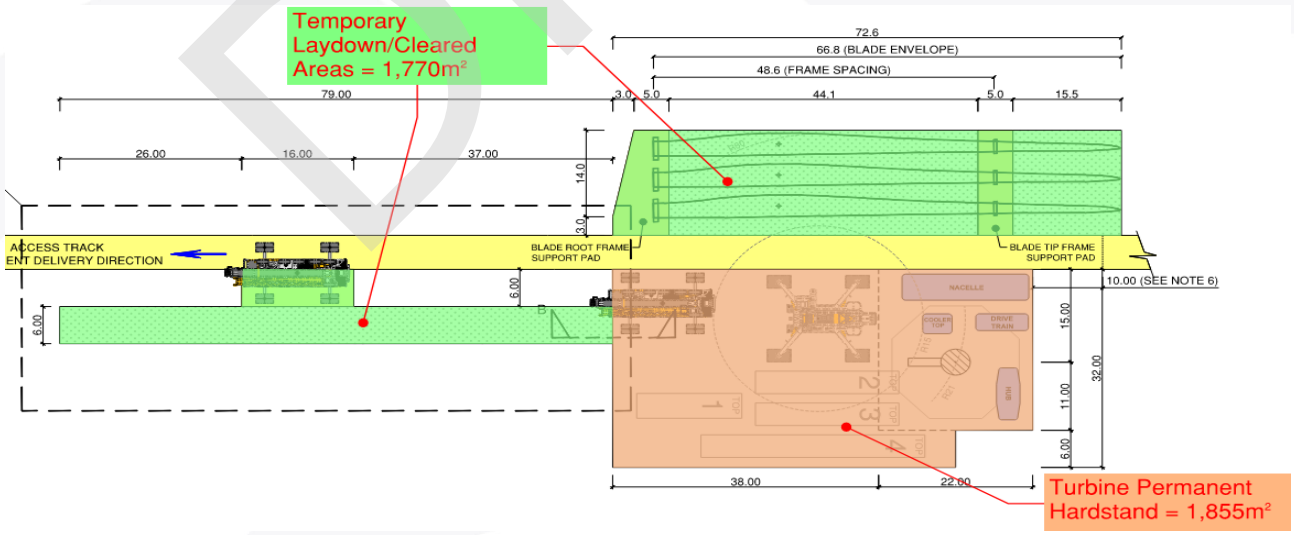


Figure 1: Indicative WTG Hardstand Configuration – 4.3MW Turbine, 136m rotor diameter, 20m ground clearance

1.3 Earthwork Quantities

A summary of the earthworks volumes and areas for the tracks and hardstands are shown in Table 2.

Table 2: Indicative Earthwork Quantities and Track Lengths

Description	Quantity
Wind Farm (access tracks and platforms)	
Number of WTG's	44
Track Length (incl. length of tracks through WTG platforms)	31km
Cut Volume (incl Rock)	530,000m^3
Rock Cut Volume	255,000m^3
Fill Volume	189,000m^3
WTG Foundation Excavation Volume	66,000m^3
WTG Foundation Backfill Volume	44,000m^3
Overall Surplus Cut Volume (excl. topsoil strip)	363,000m^3
Total Earthworks Area	55.2ha
Transmission Line – (access tracks and construction pads)	
Track length	8.8km
Cut volume	9,900m^3
Fill Volume	8,200m^3
Surplus Cut Volume (excl. topsoil)	1,700m^3
Total Earthworks Area	6.7ha

2.0 Surplus Fill Disposal

Approximately 365,000m^3 of excess material will be generated from the earthworks to form the Project Access Tracks and Hardstands. To minimise hauling distances and cost, this material will be deposited at SFD sites located within the Wind Farm Site.

The following sections outline the design and construction control measures that will be implemented to minimise adverse effects of the SFD's on the environment.

2.1 SFD Design

The design and location of the SFDs consider the following factors:

- No disposal shall take place within gullies/wetlands, SFD's to maintain a minimum 10m setback from wetland extents.

- Located on broad ridgeline features with gently to moderately sloping ground <15% gradient, with relatively easy access for construction vehicles.
- Located close to areas of cut with easy construction vehicle access
- Locate wholly within the Wind Farm Development Area as shown on the Site Development Plan.
- SFD's shall be contoured in such a way that they do not impound water nor divert runoff to adjacent wetland catchments.
- Maximise the depth of fill (to a maximum of 3m), to minimise the overall area of disturbance.

The SFD's will be 'blanket fill' type – i.e. non-engineered fill spread over the grass paddocks – typically 1-2m thick, and up to 3m max – in accordance with condition 25i) e) of the land use consent. The fill will be placed to uniform compaction, achieved by the general tracking of construction plant/vehicles. Refer Figure 2.

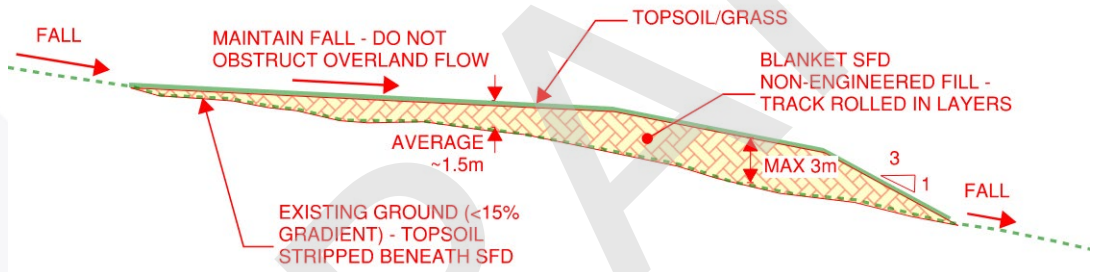


Figure 2: Blanket Type Surplus Fill Disposal Site – Typical Section

2.2 Establishment Phase

SFD's shall be located in accordance with the positions shown in the Site Development Plan, and in all cases designed in accordance with the above control measures and the conditions of consent. The final design and location of the SFD's shall be detailed in the Site Development Plan which will be submitted to Clutha District Council not less than one month prior to the commencement of any site works or construction activity as per Condition 25 of the Land Use Consent.

2.3 Construction Phase

Construction of SFD's shall be generally phased as follows:

1. Construct diversion bunds (in accordance with GD05) to direct clean stormwater runoff away from the fill disposal/stockpile sites as works progress. Where practicable, the diversion bunds will follow close to the existing contours to prevent significant channel erosion. Stormwater collected will be directed to safe discharge points and may require a haybale barrier/staggering at the outlets to dissipate flow rates.

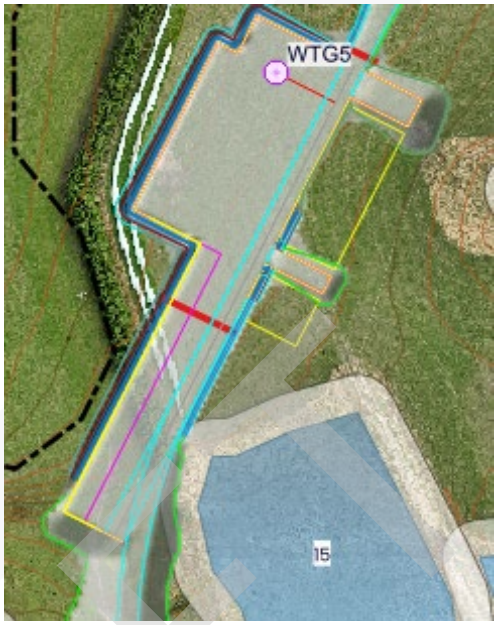
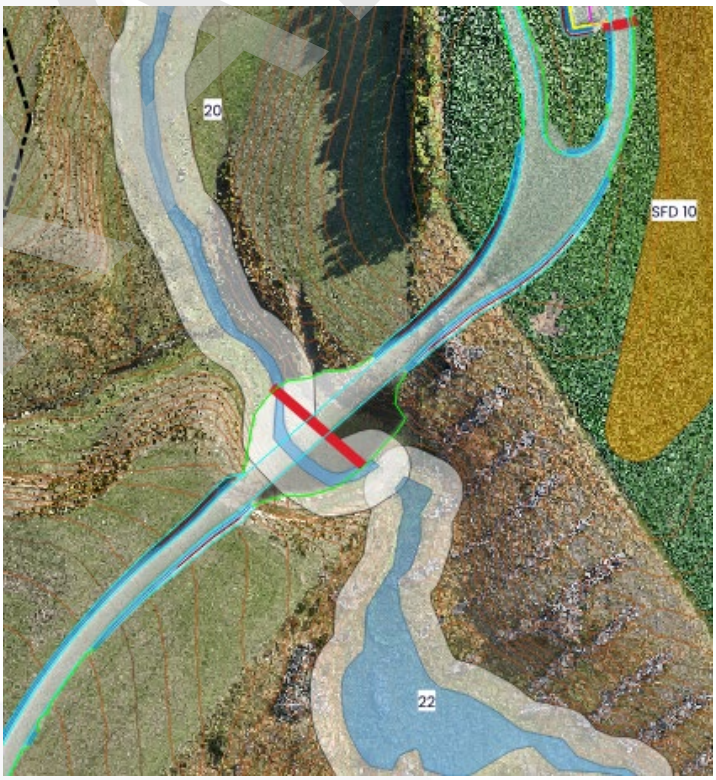
2. Construct sediment retention ponds/earth decant bunds that will provide adequate retention of sediment laden runoff from the fill disposal/stockpile sites (including access tracks into the sites). The pond/earth decants shall be positioned to ensure the diversion bunds intercepting sediment laden runoff can be adequately graded into the structures. The sediment retention ponds/earth decants will be designed in accordance with GD05. Where catchments are less than 0.5ha, earth decants are preferred over sediment retention ponds.
3. Construct diversion bunds (in accordance with GD05) to intercept sediment laden runoff and divert flows to the sediment retention pond. If the gradient of the diversion bunds exceeds 5%, the channel should be stabilised with suitable materials to provide erosion protection (i.e. lined with geotextile fabric).
4. At the entry/exit point of the fill disposal/stockpile sites, construct a rock lined stabilised construction entrance.
5. Undertake vegetation clearance, strip topsoil and organic material from the footprint of the SFD and place in stockpiles adjacent to the SFD. Install silt fences downslope of stockpiles. Cut benches into the subgrade (where ground slope > 1v:3h) and install subsoil drainage at the base of the gully features (where shown on the drawings).
6. Construct engineered-fill buttress toe (for shoulder and gully-type fills), under the supervision of a suitably qualified civil or geotechnical engineer. Once the structural bund is complete, commence bulk filling of the non-engineered fill behind the toe – placing material in layers starting from the toe and working back up the slope.
7. Once the SFD design level and finished surface profile is achieved, respread stockpiled topsoil and organic material, and grass seed (seed selection to be in accordance with the rehabilitation management plan). This shall occur within 12 months of the SFD site strip, to make the use of the next planting season (in accordance with the rehabilitation management plan).
8. Remove sediment control measures once all disturbed areas have established 80% grass coverage.

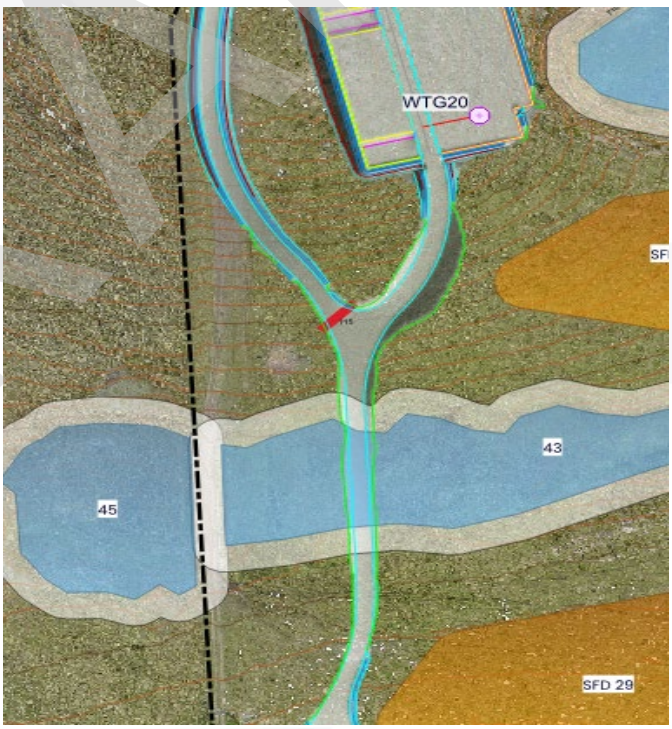
3.0 Works within Streams and Wetlands

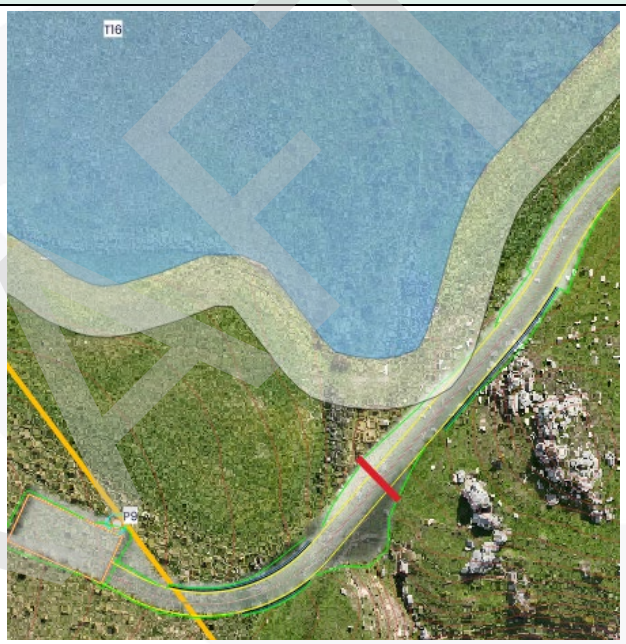
3.1 Introduction

Proposed works within, or within 10m of, streams and wetlands are outlined in Table 3. There are seven locations/instances where works will be located within 10m of a wetland, and two locations where physical works are required within wetlands.

Table 3: Details of Access Tracks and Hardstands within Wetlands or Within 10m of a Wetland

Location	Description	Site Map
Wind Farm Access Tracks and Platforms		
Wetland 15, south of Turbine 5	Proposed Track is located within the 10m wetland buffer. Area of earthworks within the wetland = **0m²**. Area of earthworks within 10m of wetland = **103m²**	
Wetland 20 - Lee Stream Tributary Crossing	An existing culvert and farm track crossing will be replaced with a new culvert and track crossing located approximately 25m to the north-west. The new culvert will be approximately 33.5m long. The existing farm track crossing will be removed and area rehabilitated once the new track crossing is completed. Area of earthworks within the wetland = **154m²**. Area of earthworks within 10m of wetland = **771m²**	

Location	Description	Site Map
Wetland 37 - North of Turbine 20	Turbine 20 Auxiliary Crane platform fill batter located within the Wetland 10m buffer. Area of earthworks within the wetland = **0m²**. Area of earthworks within 10m of wetland = **112m²**	
Wetland 43 - South of Turbine 20	An existing farm track is to be replaced with a new track crossing through (and perpendicular) to the wetland, approximately 45m to the east of the existing crossing. The new crossing position is at the crest point of the wetland, so no culvert is required. Once the new track is constructed, the existing farm track crossing will be removed and area rehabilitated. Area of earthworks within the wetland = **322m²**. Additional area within 10m of wetland = **194m²**	

Location	Description	Site Map
Wetland 68 and 69 - Access Track between Turbines 25 and 26	Proposed Track is located within the Wetlands 10m buffer. Area of earthworks within the wetlands = **0m²**. Area of earthworks within 10m of wetlands = **317m²**	
Transmission Line Access Tracks		
Wetland T16	Proposed access track has a very minor encroachment within 10m of wetland T16. Area of earthworks within the wetland = **0m²**. Area of earthworks within 10m of wetland = **15m²**	

Location	Description	Site Map
Wetland T26, T27, T28	Proposed access track follows existing farm track alignment, located within 10m wetland buffers. Area of earthworks within the wetlands = **0m²**. Area of earthworks within 10m of wetlands = **220m²**	
Wetland T30	Proposed access track follows existing farm track alignment, located within 10m wetland buffer. Area of earthworks within the wetlands = **0m²**. Area of earthworks within 10m of wetland = **250m²**	

The following sections outline the construction control measures that will be implemented at the wetland crossings, and where works are required within 10m of wetlands, to minimise adverse effects of the works on the wetland/stream.

3.2 Establishment Phase

- Detailed Erosion and Sediment Control Plans for each site to be prepared and certified by the relevant council(s).
- Wetland buffer areas to be clearly marked on-site in accordance with the procedures outlined in the ECMP.
- The extent of stream culvert/s, track fill embankments, earthwork batters to be clearly set out on-site by a suitably qualified surveyor.

- Team Supervisor or Environmental Officer to prepare site-specific task analyses and brief the site team on the procedures and controls to be followed for construction works within each of the wetlands buffer areas (toolbox talk).

3.3 Construction Phase

3.3.1 All Earthworks Within 10m of Wetlands

- Construct sediment control measures in accordance with the approved plans
- Follow the monitoring and reporting procedures outlined in Section 6.0 of the EMP but increase frequency of inspections of sediment controls to daily.
- Team Supervisor to monitor construction to ensure works and plant/equipment do not extend beyond designated areas.

3.3.2 Wetland 20 (Lee Stream Tributary) Crossing

Riley Drawings 240034-287 (Phase 1 – Works within Stream) and 240034-288 (Phase 2 – Works Adjacent to Stream) present the construction phasing. The expected duration of Phase 1 (Works within the Stream) is two weeks. The sequence within each phase is as follows:

Phase 1 (Works within Stream):

1. As far as is practical undertake works during dry/low flow periods where no significant rain is forecasted.
2. Construct diversion bunds to divert cleanwater runoff away from the working area.
3. Construct non-erodible dams (using sand-bags or similar) at the upstream and downstream end of the culvert. Form temporary/isolated stream diversions to direct stream flow around bunded areas. Downstream dam to feature a T-bar decant to drain the works area if required to keep the area dry from groundwater/water leakage.
4. Offline from stream - install precast culverts and wingwalls, pour in-situ concrete baffles and aprons, place culvert infill material and form low flow channel as per design.
5. Place and compact backfill material around the culvert to half height (minimum).
6. Remove diversion bunds, and upstream and downstream dams - allowing flows to pass through the new culvert.

Phase 2 (Works Adjacent to Stream):

1. Install silt fences around the base of the track fill embankment.
2. Continue with backfill over the culvert and forming of the fill embankment.
3. Form sediment control measures for approach tracks (e.g. drop out pits) and commence earthworks to form the tracks.
4. Existing farm track crossing and culvert to be removed and area remediated (undertake works during low-flow dry period).
5. Stabilize the earthworks area and remove sediment controls.

The Lee Stream Tributary Water Quality Monitoring Plan (prepared by SLR Consulting) includes sampling to be undertaken relating to works within the stream:

> '*Sampling during works activities will be undertaken at a time when activities have progressed to the extent that sediment control measures would be required (i.e. sampling is to demonstrate whether control measures were working effectively).*'

And;

> '*Once works have been completed, sampling will be undertaken following removal of all equipment and control measures from the watercourse, and stabilisation of areas of bare earth.*'

The Fish Recovery Plan (prepared by SLR Consulting), notes '*there will be localised stream channel dewatering associated with the culvert installation, which triggers the requirement for salvage to avoid adverse effects on the resident fish*'

Reference shall be made to the Water Quality Management Plan and Fish Recovery Plan for further details on specific management procedures to be followed during works within the Lee Stream Tributary.

3.3.3 Rehabilitation Phase

Refer to procedures outline in Section 4.1.3 below.

Earthwork areas within 10m of wetlands to be stabilised immediately upon completion, and prior to the continuation of earthworks within adjacent catchments.

4.0 Erosion and Sediment Control Plan

The following procedures shall be followed to ensure the discharge of sediment into waterbodies is minimised through the provision of control and retention devices:

4.1.1 Establishment Phase

Establishment phase management procedures, which are to be completed prior to earthworks commencing for any new stage/area of the site are as follows:

A. Planning of erosion and sediment control measures shall occur prior to any earthworks commencing. The measures shall ensure that:
   - sediment mobilisation beyond the immediate earthworks site is minimised; and
   - all sediment from site earthworks, where mobilised by stormwater or vehicles, is managed and treated, prior to discharge to the environment.

B. Such planning is to be carried out for each stage/area of earthworks. Detailed Erosion and Sediment Control Plans shall be prepared and form part of the final EMP – to be approved by Council.

C. Provide advance notice to Council of intended start dates for each staged component of earthworks.

D. The following techniques are examples of the sediment control measures that are to be used, these techniques are in accordance with GD05. If a more suitable approach is identified during this planning phase, which is not identified below, it may be used provided it meets the purpose of this EMP. The selection criteria for selection of sediment control measures to be implemented for each stage of earthworks is identified in Table 4.

Cut and Cover

For sections of access track that follow close to existing grade or are in cut (and can therefore be completed and stabilised rapidly), and located >10m from a wetland; a cut and cover technique will be employed as follows:

A. As the track is formed, the excavated material will be loaded directly onto a dumper and transported to the nearest SFD as indicated on the drawings.

B. The trackside v-drains and cut batter will be rapidly stabilised with hydroseed or rock lined (for v-drain with gradient >5%)

C. The v-drain will then convey clean water runoff to culverts or discharge points.

The length of access track that is left exposed will depend on the dry weather window and the timeframes for earthworks and stabilisation. Cuts shall be stabilised prior to significant wet weather.

Stabilised Construction Entrance

A stabilised pad of aggregate on a filter cloth base will be located at site entrances (and entrances to the SFD's – dependent on construction staging) where construction traffic will be entering and leaving. This will prevent the entrance from becoming a sediment source and minimise dust generation and tracking of soil onto the adjacent environments.

Wheel Wash

A wheel wash adjacent to the stabilised construction entrance may be provided if required (dependent on cleanliness of vehicles exiting the site). If required, the wheel wash will consist of a temporary mobile chamber or a shallow pit (stabilised with roading aggregates or hotmix) and will be filled/maintained with water from an adjacent water tank or water cart. The purpose of the wash is to clean the earthmoving truck tyres, and therefore, reduce the amount of sediment being tracked onto public roads. The wheel wash will maintain a pool depth of 400mm to 500mm, and water will be replenished regularly (dirty water to be pumped and removed from site or overflow directed to sediment pond/decanting structures).

Surface Roughening

Surface roughening is a temporary erosion control method involving the deliberate disturbance of bare soil surfaces, typically by creating grooves or using construction equipment to track the surface. Its main purpose is to increase surface roughness, promote water infiltration, reduce sediment runoff, and aid vegetation establishment by trapping seeds and moisture in the soil.

While effective as a short-term measure on slopes prone to sediment discharge, surface roughening is not a substitute for permanent stabilization and should be used alongside other erosion control methods during the stabilisation period. Proper implementation includes diverting water away from the area, filling existing rills, and ensuring cleat marks are left parallel to the contour to create micro sediment traps without over-compacting the soil

Figure 3: Surface Roughening of a Slope (Figure 39 from GD05)

Drop Out Pits

Drop out pits may be used on steep sections of access tracks to ensure sediment laden water is slowed down and silt is deposited out at regular intervals. Drop out pits may also be installed within dirty water diversion channels to allow heavier sediment particles to drop out before they enter the sediment retention device, reducing the load on the device; and at termination points of roadside open drains - prior to discharge across grass fields. Drop out pits are approximately 500mm to 1,000mm deep and 1000m wide. The pits will be maintained regularly with contained sediment being removed and disposed of appropriately.

Where the drop out pit is located near to a wetland, a silt fence should also be installed as a secondary measure to filter overflow from the drop out pits.

Drop out pits may be used at the gently sloping turbine platforms in areas of cut. Runoff will be directed to and collected in the pit/sump where the heavier sediment to settle out before water is pumped (via floating offtake) to a turkeys nest and/or grassed area, which will provide further filtration.

Runoff Diversion Channels/Bunds and Clean Water Diversion Bunds

Runoff diversion channels or bunds will be used to intercept and detain silt laden runoff and divert into drop-out pits, earth decant structures, or sediment ponds where specified. The channels shall be sized for the 5% AEP rainfall storm event and generally include a 0.3m freeboard, where practicable. Dewatering may also be required at times for runoff not draining away in low gradient dirty water diversion bunds, particularly around turbine platforms. In this instance, a mobile turkey's nest can be constructed and used for dewatering if 100mm of clarity cannot be achieved. For an example of a mobile 'turkeys nest' used for dewatering, see figure 107 from GD05.

Clean water diversion bunds are to be constructed to intercept overland flow from upper catchments and divert around the earthwork sites. The diversion bunds are sized to accommodate the 5% AEP rainfall storm event and, generally, include a 0.3m freeboard, where practicable.

The channels and bunds, generally, have longitudinal gradients less than 2%. Where the grade exceeds this, or flow velocities are high, the channels shall be lined with either rocks or geotextile fabric to prevent erosion of the underlying soils. The collected and diverted clean stormwater runoff will be disposed at safe locations in order to prevent erosion of the receiving environment.

Stormwater Inlet Protection

It is proposed to excavate around the inlet of the culverts in the track side v-drains to form a sump (small drop-out pit) to allow settlement of suspended material. During construction, geotextile fabric may also be wrapped around the inlet of the culvert to intercept sediment laden runoff collected by the v-drain.

Temporary Culverts

Temporary culverts are to be installed across tracks, haul roads, and platforms, where required to maintain hydrological connectivity between segregated sections of wetlands, and/or to direct runoff to sediment control devices; until such time that the permanent culverts can be installed (generally relates to cut earthworks).

These culverts will be sized for the 5% AEP rainfall event in accordance with GD05 – refer Table 4 for max catchment areas for the respective pipe sizes. Rainfall data has been taken from the NIWA database (HIRDS), and flow rates calculated using the Rational Method (NZBC E1/VM1) assuming bare soils (earthwork) ground cover. Flow rates have then been correlated to the maximum pipe capacities, assuming inlet control, to give a required pipe size, which exceeds this capacity.

The temporary culverts will be removed once the permanent culverts are in place. The temporary culverts will likely be HDPE pipes which have the advantage of being lightweight and high strength. It is intended the temporary culverts will be reused across the site as the earthworks progress.

Table 4: Temporary Culvert Sizing – Earthworks Phase

Culvert Diameter (mm)	Max Flow (L/s)	Max Catchment Area (ha)
300	50	0.33
375	120	0.79
450	190	1.25
525	280	1.84
600	400	2.63

Silt Fences

Silt fences may be used at various areas and times during construction. The silt fences will detain flows from the construction area so deposition of transported silt can occur through settlement.

Silt fences may be utilised at low gradient sites or for confined areas where the contributing catchment is small, such as downslope of temporary stockpiles. Silt fences may be used to limit disturbance of a more sensitive area where diversion and earth bunds are not practical to construct, such as around watercourses and wetlands. 2m returns will require to be constructed on steeper slopes where the silt fence cannot follow the existing contours. Silt fences may, generally, be utilised for slope lengths up to 40m (for slopes less than 10%), or up to 15m for steeper fill batter slopes.

Figure 4: Example Silt Fence – Isolated Earthworks Area Adjacent to a Watercourse

Decanting Earth Bund

It is proposed that earth decanting bunds will be used to provide treatment of sediment laden runoff, contributed from small catchments such as turbine platforms and fill disposal sites.

The earth bunds will be used to intercept sediment laden runoff and minimise the amount of sediment leaving the site through settlement. The earth-bunds will include forebays and be fitted with a floating T-bar decant structure, similar to that used in a sediment pond, to increase settlement time and improve sediment removal efficiency of the device.

The maximum catchment area contributing to the earth bund structures is 0.5ha. The bund will be sized to have a volume of approximately 2 to 3% of the typically 0.5ha contributing catchment area and provide an adequately sized spillway to pass a 1% AEP storm event. Position the decant inlet to provide 50% live storage volume with a minimum distance of 5m from the inlet.

Outlets from the bunds shall disperse flow overland, and not direct to water bodies.

Figure 5: Example Decanting Earth Bund – Adjacent to a Construction Platform

Sediment Retention Ponds

Sediment retention ponds (SRPs) will be used to treat sediment laden runoff and reduce the volume of sediment leaving the site. SRPs may be used at the fill disposal sites or platforms, where large areas of earthworks will remain exposed to erosion during the construction period, i.e. where catchment sizes exceed the capacity of a DEB.

The sediment retention ponds are to be positioned at a convenient collection point for the sediment laden runoff. This position should also allow for easy access to carry out routine maintenance of the structure. Sediment ponds shall be excavated into natural ground and embankments formed with engineered fill. The sediment retention ponds require specifically designed spillway arrangements to ensure overtopping of embankments does not occur during storm events.

The contributing catchment area for the sediment retention pond should be restricted to less than 3ha per pond. The minimum capacity of the pond should be 300m^3 for each hectare of contributing catchment (3% of the contributing catchment) where an additional 10% of this volume is used as a sediment forebay. However, the minimum capacity may be reduced to 200m^3 for each hectare of contributing catchment where the earthwork slopes are less than 10%. Sediment retention ponds will be constructed and maintained in general accordance with GD05 guidelines.

Outlets from the pond shall disperse flow overland, and not direct to water bodies.

Figure 6: Example Sediment Retention Pond on a Hilly Site

Chemical Treatment

A Draft Chemical Treatment Management Plan (CTP) has been prepared by EnviroCo Ltd. The CTP outlines methodologies for the application of chemical treatment for the SRP's and DEB's – via rain activated and passive systems. Coagulants (e.g. Alum/PAC) and Cationic PAM's (flocculants) will not be considered for the project, due to their toxic properties and risk of changes to pH levels in the receiving streams and wetlands. On the other hand, Anionic PAM's are widely used in New Zealand and are generally considered safe and non-toxic to aquatic life at approved doses.

Bench testing of representative soil samples (collected from three locations around the site) was undertaken using a range of flocculant products. Findings from the bench testing concluded that there was not one stand out product, with each sample reacting differently to the chemicals. It was also observed that for each sample, the sediment settled out of the water within 24hrs without any chemical treatment. Therefore, it was concluded that rain activated treatment may not be necessary for this site, subject to the monitoring of turbidity and total suspended sediment of the water column in the devices during the early stages of earthworks.

As per Enviroco's recommendation, as a minimum, chemical products shall be available on-site during earthworks as a back-up (contingency measure) to facilitate flocculant dosed treatment, for example, products that can be implemented into sediment laden discharges via passive or controlled dosing systems. In general, chemical treatment will be considered for sediment control devices located within 50m of a wetland, or if the sediment control device is servicing a catchment > 1.5ha.

The selection approach, when planning, for sediment control measures, are identified in Table 5.

Table 5: Application Criteria for Sediment and Erosion Control Devices

Order of Selection	Sediment and Erosion Control Method	Criteria for Application	General Purpose
1	Cut and Cover technique	Where earthworks will not adversely affect the downstream environment (can be completed and stabilised rapidly), such as: sections of access track that follow close to existing grade or are in cut and located >10m from a wetland. Apply cut and cover techniques to limit time of exposure.	N/A
	Surface Roughening	While awaiting grass strike, surface roughening can be used on bare soil to slow water runoff and thus reduce erosion.	The series of mound and hollow features that are created using this process act as mini sediment traps. This process also promotes the growth of grass by trapping seed and moisture to promote establishment of vegetation.
	Stabilised Construction Entrance	At the main entrance to the site and fill disposal sites	Prevent the entrance from becoming a sediment source, minimise dust generation and tracking of soil onto the adjoining environments.

Order of Selection	Sediment and Erosion Control Method	Criteria for Application	General Purpose
	Wheel wash	At the main entrance	Prevent the entrance from becoming a sediment source, minimise dust generation and tracking of soil onto the adjoining environments – to be installed if trafficking of sediment onto public roads is likely to become an issue.
	Clean water diversion bunds	Where the surrounding topography contributes to the catchment area of the earthworks.	Intercepts and diverts clean water and reduces the contributing catchment area affecting the earthworks.
2	Stormwater inlet protection and inlet sump	At the inlets of culverts collecting and diverting flows from the v-drains.	Provide additional storage capacity where suspended materials can settle out and water can soak into the natural ground.
3	Diversion bunds/open drains	To intercept and detain sediment laden runoff from earthwork areas, and direct to sediment capture device where specified.	Intercept, attenuate sediment laden runoff from exposed earthwork surfaces.
4	Rock line open drains	Where the gradient of the excavated v-drain exceeds 5%.	Provides erosion protection where increased flow velocities may cause erosion.
	Geotextile lined diversion channels/bunds	Where the gradients of the diversion channels/bunds exceed 2%.	Provides erosion protection where increased flow velocities may cause erosion.
5	Drop-out pits	Installed at outlet of diversion drains and culverts, to be combined with a silt fence where servicing larger catchments, such as platforms, or where close to sensitive receiving environments. Turbine platforms in cut – used as a sump for dewatering drains – in combination with floating offtake pump and turkeys nest at discharge point.	Promote settlement of suspended materials prior to discharge to downstream receiving environment, through interception and attenuation.
6	Temporary Culverts	Installed beneath access tracks, haul roads, and platforms, to temporarily direct clean or dirty water to downstream water bodies or sediment control devices	Maintain hydrological connectivity to downstream water bodies during earthworks construction, avoid areas of ponding within earthworks catchments.

Order of Selection	Sediment and Erosion Control Method	Criteria for Application	General Purpose
7	Silt Fence	To limit disturbance of a sensitive area where diversion and earth bunds are not practical to construct. The slope angle of the surrounding topography exceeds 18. Length of fill batters is less than 15m and the chainage of fills are short. Can be used in conjunction with drop-out pits as per above.	Intercept sheet flows from fill batters and provide treatment of sediment laden runoff prior to entering the downstream environment.
8	Earth decanting bunds (DEB)	Where embankment structures cross gully features. To intercept sediment laden runoff from cut surfaces where the contributing catchment of the exposed earthworks exceeds 1,000m^2 but is less than 3,000-5000m^2. Where excessive quantities of sediment laden runoff will degrade the downstream environment.	Intercept, attenuate and provide treatment of sediment laden runoff from exposed earthwork surfaces.
9	Sediment Retention Pond	At fill disposal sites and concrete batching plant. Generally for contributing catchments areas ranging between 0.5ha and 3ha.	Provide attenuation and treatment of sediment laden runoff from large areas of earthworks that may be exposed to erosion for long periods of time.
10	Chemical Treatment	Rain-activated chemical treatment to be considered for DEB's and SRP's, if located within nominal 50m distance of a wetland, or SRP's servicing a catchment > 1.5ha. Chemical treatment may not be necessary for this site, subject to the monitoring of turbidity and total suspended sediment of the water column in the devices during the early stages of earthworks. Refer to the CTP.	Increase sediment removal efficiency of the device where located in close proximity to sensitive water receiving environments.

4.1.2 Activity Phase

Activity phase management procedures, which are to take place throughout any earthworks activity, are as follows:

A. Establishment of a truck wash down station at the site entrance. This is to be established in conjunction with the stabilised construction entrance and include water spray units. All vehicles entering and exiting the site are to be cleaned at this location to remove sediment. The runoff from this facility is to be directed to a suitable sediment treatment device as outlined in the section above.

B. Installation of the planned erosion and sediment control measures at the commencement of each staged component of the earthworks. Once installed, the erosion and sediment control will need to be checked, as-builts prepared and certified by an engineer or other suitably qualified person.

C. Weekly inspection of the control measures and surrounding vicinity to confirm that the measures are achieving their purpose, plus additional inspections pre and post trigger rainfall events. This includes determining visually that discharges to water bodies are substantially free from sediment. As a general rule, a minimum 100mm water clarity and a pH range of 5.5 to 8.5 shall be achieved within temporary water impoundment devices before discharge (to ground) is permitted, and no conspicuous adverse change in the colour of the watercourse beyond 20metres downstream of the mixing zone.

D. If following inspection, or at any other time, it is evident that the control measures are not working appropriately, immediately undertake any necessary maintenance and/or other appropriate measure (e.g. temporarily raise decants). If the erosion and sediment control measures need to be modified (such as implementing batch dosing), these will need to be reviewed and approved by the Environmental Officer or other suitably qualified person, both prior to and after the installation of the measures. Until the control measure/s has been rectified, no additional areas of soil disturbance within the contributing catchment shall be created.

In the event of heavy rain forecasts, stabilise the earthworks and control measures as far as practicable. Also, if necessary, cease work during such events.

4.1.3 Rehabilitation Phase

Rehabilitation phase management procedures are to be undertaken upon the completion of each stage earthwork activity. These procedures can be undertaken either progressively as each staged earthworks proceeds and/or at the completion of the staged earthworks, as appropriate, but in accordance with the establishment phase planning. The management procedures are:

A. Following earthworks, general disturbance areas and fill batters will be stabilised by respreading locally stockpiled topsoil (stockpiled for a duration < 12 months) to a minimum depth of 300mm and applying grass seed (or hydro seed) - using non-invasive grass species such as brown top or rye grass. Hydro mulch may be required for highly exposed areas where wind and heavy rain may otherwise wash away the grass seed.

B. The steeper cut batters (in soils) may be stabilised with hydro seed (no topsoil), including polymer additives for erosion control where required.

C. Hydroseed or hydro mulch will also be considered for areas requiring rapid stabilisation such as adjacent to watercourses – e.g. Lee Stream Tributary crossing.

D. Rock cut batters will be left in their natural state – i.e. no stabilisation measures are required.

E. Once 80% grass strike has been achieved (in accordance with GD05), erosion and sediment control measures can be decommissioned, ensure that the areas affected by the decommissioning of the sediment control measures are rehabilitated as appropriate.

F. Refer to the Rehabilitation Management Plan (included separately with the application) for details of remedial planting to be undertaken following the earthworks stabilisation works.

5.0 Dust Control

To ensure dust does not become a nuisance beyond the site boundaries, the following procedures shall be followed:

5.1 Establishment Phase

Establishment phase management procedures, which are to be completed prior to any earthworks commencing are as follows:

A. Planning of dust control measures shall occur prior to any earthworks commencing. The measures shall ensure that all potential sources of dust nuisance are identified, and measures put in place and/or contingency measures identified, so that dust does not become a nuisance. Such planning is to be carried out for each staged component of the earthworks.

B. A supply of water and access to water trucks for dampening of potentially dusty surfaces is to be identified and sufficient water storage provided, such that if climatic conditions do result in a potential dust nuisance, then water spraying can occur immediately.

5.2 Activity Phase

Activity phase management procedures, which are to take place throughout any earthworks activity, on an as necessary and appropriate basis, are as follows:

A. Ensure the track surface remains in a damp condition utilising water trucks as necessary until exposed earthworks are stabilised.

B. Limit site traffic speed to a level to reduce the production of dust into the atmosphere.

C. Stage earthworks during construction in order to isolate and reduce the area of exposed earthworks and re-vegetate exposed surfaces as soon as practical.

D. Stabilised entrance at the entry/exit points of the windfarm site and fill disposal sites and provide a wheel wash at the main entrance.

E. If necessary, earthwork activities may be limited in specific areas during periods of high wind.

Further, it should be noted that stockpiled material has the potential to create dust nuisance. Dust can also be generated when material is added to or excavated from a stockpile. The following methods, as appropriate, are proposed to control dust from stockpiles.

A. Wet suppression via water trucks.

B. Covered storage in more sensitive locations, where practicable.

C. Reduced/controlling stockpile height and slopes (reduce wind entrainment).

D. In the extreme event that remedial measures are found to be ineffective for the control of dust, works are to be suspended as a precautionary measure until conditions are suitable for resumption.

5.3 Rehabilitation Phase

Rehabilitation phase management procedures are to be undertaken upon the completion of each stage earthwork activity. The management procedures are:

A. Until such time as vegetation cover is re-established on earthwork areas, these areas shall continue to be monitored for dust generation, and control measures implemented as required and in accordance with Section 5.2 above.

6.0 Monitoring and Reporting

6.1 Site Inspections

- Routine site inspections shall be undertaken during installation and post installation of the Erosion and Sediment Controls (E&SC) devices. There should be a specific focus on ensuring that anti-seep collars, level spreaders and T-bars have been installed and are operating correctly.
- Once rainfall-activated chemical treatment is in effect i.e. after the first rainfall event following construction of the E&SC devices, inspections should be carried out to ensure that all E&SC devices are performing well and that the chemical treatment is adequate based on the resulting quality discharged water.
- Following this, the inspection programme should consist of weekly site walkovers to inspect all E&SC devices and measures, plus additional inspections prior to and following rainfall trigger events.
- Sediment retention devices (SRPs and DEBs) will be cleaned of sediment once accumulated sediment reaches 20% of the storage volume.
- Monitoring and maintenance of the chemical treatment system (if implemented) will be carried out in accordance with the CTP.
- Regular clarity, temperature, and pH monitoring should also be carried out for outflows from sediment retention devices (at the mixing points with natural water bodies).

- Monitoring data shall be collected at monthly intervals and be made available to council on request.
- Ongoing monitoring of the commissioned stormwater systems shall be carried out post earthworks, in accordance with the ECMP.

6.2 Reporting

An internal audit should be conducted weekly. This will identify any maintenance actions required, and where practical, these maintenance actions should be undertaken that day.

Following rainfall trigger events, a report should be produced that summarises how well the SRPs, DEBs and the overall E&SC system have performed during the rainfall event. This should include a summary of the total rainfall and intensity, and results from clarity, temperature and pH monitoring.

If it is identified that the water quality discharge thresholds were exceeded, the extent of this and the actions that were taken to mitigate the effects of this trigger event should be included in the report. If the overall E&SC performance has been compromised, then this should also be recorded, along with the mitigation measures that were carried out to address this.

A monthly report should also be compiled that summarises the results of all the inspections and monitoring that was carried out.

6.3 Weather Monitoring and Response Measures

During construction, weather forecasts should be checked daily. If forecasts predict more rainfall or snowfall than a threshold rainfall trigger event, appropriate site works need to be implemented. A rainfall trigger event is >20mm rainfall forecast over 24 hours.

Pre trigger event procedures will include:

- Inspections of the overall E&SC system, with a particular focus on SRPs and DEBs to ensure that these devices are performing adequately to mitigate the negative effects of a trigger rainfall event. Additional E&SC measures may also be required during these trigger events.
- Depending on the site-specific circumstances and ECS controls in place, consider limiting or ceasing earthwork activities ahead of trigger events.
- As far as practicable, stabilize disturbed areas. Employ additional short-term measures such as track rolling and install of temporary contour drains.

6.4 Contingencies

There is potential for unforeseen events to occur resulting in urgent action being required. The types of events specific to the earthworks activities for the project are identified as follows:

- Natural hazards including floods and seismic events.
- Extreme rainfall and snow events.

- Extreme wind events.
- Operational errors.
- Failure of earthwork and sediment controls.

The potential outcomes of these events include:

- Discharges of sediment to surface water.
- Discharges to air of nuisance dust emissions or contaminants.
- Mud or silt on public roads.

6.4.1 Discharges of Sediment

The most likely reason for the discharge of sediment into surface water is the failure of DEBs, SRPs, clean water and dirty water diversion drains, or silt fences to operate correctly due to an extreme rainfall or snowfall event or lack of maintenance.

Should this occur, all practical steps to improve the quality of the discharge or to stop the discharge will be undertaken. This may include the following:

- Unblocking floating decant outlet structures from earth bunds and sediment ponds, which may be clogged from debris or snowfall.
- Blocking off the outlet pipe or raising floating decants to stop the discharge.
- Survey and assess the failed structure to determine if it requires repair or needs to be redesigned.
- If water is overtopping the earth bund, use pump truck to reduce the water level and discharge at an appropriate site.
- Increase the size of the decanting earth bunds.
- Implement chemical flocculation systems to inflows of DEBs and SRPs in accordance with the FMP.
- Improve diversion of clean water away from disturbed land.
- As far as practicable, stabilise exposed areas.

Furthermore, when decommissioning the DEBs and SRPs, the quality of any retained water shall be assessed by visual (or other means), prior to releasing downstream. If the quality is not deemed sufficient for release (e.g. water clarity is poor) then water quality shall be improved by means of flocculation, in accordance with the CTP.

Failures of sediment control measures shall be reported to the site's Environmental Officer in the first instance.

6.4.2 Dust Discharges

In the event of unacceptable levels of dust being discharged into the air beyond the project site, the first option will be to stop or reduce the discharge. This will be achieved by wetting disturbed areas or covering the source of the dust (stockpiles). Where necessary, traffic movement will be stopped until a road is dampened down.

Once the discharge is stopped or reduced, action will be taken to avoid, mitigate or eliminate the risk or re-occurrence. Such actions may include limiting site traffic speeds or limiting areas of exposed earthworks during periods of high winds.

6.4.3 Mud and Silt on Roads

Should the tracking of mud and silt become a common occurrence and not adequately dealt with by the provisions of stabilised entrance and wheel wash, then additional controls may need to be implemented at the site entrance. Such controls may include manually washing down construction vehicles prior to exiting on to the public roads.

6.5 Review

Immediately following any event requiring contingency actions to be carried out, the Environmental Officer shall establish the causes of the event and review the effectiveness of the response. Based upon the outcome of the review, the EMP may be updated.

7.0 Limitation

This report has been prepared for Tararua Wind Power, to inform the Expert Consenting Panel's consideration of Contact's application for approvals under the Fast-track Approvals Act 2024 and any subsequent regulatory processes.

The reliance by other parties on the information or opinions contained in the report shall, without our prior review and agreement in writing, be at such parties' sole risk.

AUCKLAND
4 Fred Thomas Drive, Takapuna
riley@riley.co.nz
CHRISTCHURCH
22 Moorhouse Avenue, Addington
rileychch@riley.co.nz

riley.co.nz