Civil Engineering Services (1994) Ltd
P.O. Box 240, Te Aroha • Phone/Fax: (07) 884-8317 • Mobile: (0274) 749525 • Email: office@ces94.co.nz • Web: www.ces94.co.nz

Proposed Kaimai Windfarm

Roading and Turbine Site Earthworks

Siltation Mitigation Proposals

Introduction

In preparing this report, I have considered and incorporated the following:

1. Memorandum – Kaimai Turbine Dimensions – Rev 4; 21 May 2018: Kaimai Windfarm Ltd
2. Civil Engineering Drawings – Resource Consent Issue; Rev A; Tektus Consultants; June 2018
3. Civil Engineering Peer review; May 2018; Tiaki Consultants

Background Information

The wind farm proposal involves siting 24 wind turbines as detailed on the topographical plans 200, 200-1 to 200-7 as prepared by Tektus Consultants.
A lidar survey has provided ground contours shown at 2.0m intervals. From the above described plans a proposed roading network (comprising of approximately 18.5 km of roading), provides access to and links the proposed wind turbine sites.
The proposed roading network naturally utilises existing roads and farm tracks which comprise of approximately 13 km length of road.
The remaining 5 - 6 km of new roading traverses grassed steep to rolling farmland along ridges to the proposed wind turbine sites.
Each of the turbine sites are essentially cut into the natural ground to ensure the structures are founded appropriately. Each of the sites has an area of flat ground adjoining the actual turbine foundation that will serve as an assembly/construction platform.
A geotechnical report prepared by KGA Geotechnical provides some recommendations regarding road and turbine foundation construction and is consistent with accepted practice.

Site Preparation for Earthworks

The purpose of this report is to outline the design concepts for Siltation Mitigation methods to be carried out within the property(s) concerned and ensure the

earthworks construction phase of the proposed Kaimai Windfarm can proceed in a sensible and practical way while addressing the necessary environmental and regulatory requirements. This report may be used to support resource consent application for the project.

The use of existing stable access tracks and roads is a major benefit to this project with around 70% of these access routes already in place and having been there for normal farming practices for many years.

Another asset to the project is the good grass cover (and bush in some gullies) that exists over the entire site with significant distance of strong vegetation cover that runoff has to travel from construction areas to waterways, thus providing treatment to runoff. This in addition to the siltation mitigation measures that will be instigated within and on the margins of the earthworks sites.

We recommend that this “safety margin” is improved by some minor amendments to farming practices prior to the commencing of earthworks, whereby:

- Grazing management on areas immediately downslope of earthworks is instigated whereby stock are totally excluded with electric fencing or reduced from grazing to promote longer grass growth.

- Maintain good farming practices to ensure dense pasture growth downslope of construction sites and disturbed areas.

- Arrange farm stock rotations to fit with construction schedules

Strong project management and good planning is necessary, whereby areas of disturbance are kept to a minimum, stabilised and completed within the shortest possible period of time. Within Appendix 2, Section 1.2 is the concept of the ‘Ten Commandments of Erosion Control’ these sound guides for the management of the earth works sites will be followed.

Each proposed wind turbine site will be a discreet disturbed area during the construction phase. Each site is on a hill top or ridge making the need for ‘up slope’ runoff control negligible. As the land falls away from these sites the discharge of concentrated flows from the sites within this topography will be minimised. The concept of erosion control as the first principle when controlling sediment from a site is to be followed.

Within the construction period siltation mitigation measures most likely to be adopted on this site will be (but not be limited to) the following:

- Water cut offs

- Topsoil Bunding

- Rock check dams (including Rock in water tables)

- Silt Fences

- Sediment Pits

- Decant Ponds (with fixed or floating decant devices) with rock lined outlet protection.

- All of the above will have substantial grassed areas downslope of these devices.

Construction details of these systems and their uses are outlined in the documentation attached or referenced in appendix 2

Road Formation and Construction

The existing roading proposals have clearly been designed on the Lidar data and form a good basis for the initial road design. The Geotechnical report advises that roads are formed in cut, with little fill profile and backgrading of the surface profile to avoid runoff over the edge slope. To maintain the concept of erosion minimalization as a first principle it is important that the road over distance does not collect too much runoff and scour the road and fill. While this concept is ideal in many respects, from the perspective of avoiding the cumulative effect of significant runoff waters to deal with further downstream, the general proposal for the mitigation of large volumes of stormwater that may be potentially silt laden, is to discharge runoff waters at regular and short intervals especially in the steeper portion of the proposed roading network.

Details of such proposals will be outlined in following clauses.

With the existing roading network in place, (Roads 1,2 & 7) including well formed farm tracks traversing ridgelines (over approximately 10 km of the total 16 km proposed), existing watertabling and culverts will not be changed significantly. However regrading profiles and widening will involve extending cut batters further back into greenfield terrain and new and additional watertabling will be required. Again, the concept of 'erosion control as the first principle' when controlling sediment from a site is to be adopted. It is proposed to discharge runoff waters at regular and short intervals largely via sediment pits. This consideration is proposed as all road locations are situated with large areas of grass downslope of construction alignment.

The formation of new road sections involve initial cuts with carting of excess fill to clean-fill sites located in areas of flat or mild slope. (We note that some of these potential areas shown on the Consent version plans are considered to have a contour that is too steep for this purpose and site decisions will likely moderate the use of some of these locations). At clean-fill sites there will be silt fences with topsoil bunding behind to manage runoff and hence any silt movement from the sites. Refer to attached diagrams prepared on base plans supplied. Larger sites (> 0.3ha), in addition to silt fencing and topsoil bunding, are proposed to have sedimentation ponds constructed in accordance with WRC documentation as attached in the appendix.

Similar concepts for managing runoff from the road formations over new sections of road alignments will be adopted as per existing and upgraded alignment proposals. Temporary water cut offs may be utilised in the very early stages of new road formation with sediment pits with level overflow crests to allow discharge to grass at regular locations. Managed dispersal of such discharges to grassed surfaces downslope of new excavations will provide the necessary prevention of silt material reaching waterways.

As part of the normal earthworks and road construction, siltation mitigation methods as per the previous described methodologies will be instigated at locations considered necessary and will generally be every few hundred meters of road length and consist of : water cut offs, sediment pits, topsoil bunding, rock check dams in various configurations and other methodologies where considered necessary.

More than minor sediment control structures including Silt Fences, Decanting Earth Bunds and Sediment Retention Ponds have been identified to be required at the following locations on the proposed access roads.

Plan No	**Road**	**Approx Distance**	**Likely Device Type**	**Site Features**
200-2	1	1700	Sediment Ret Pond	Low area
200-2	1 & 7	2800 / 0	Dec Earth Bund	Intersection
200-2	2	470	Silt Fence T/S Bund	Saddle
200-2	2	1300	Sediment Ret Pond	Turbine 9
200-3	2	1770	Sediment Ret Pond	Turbine 8
200-3	2	2600	Sediment Ret Pond	Assembly Pad
200-4	2	3370	Silt Fence T/S Bund	Saddle
200-4	2	4330	Silt Fence T/S Bund	Minor Cutting
200-4	2	4940	Pond at Turbine 1	Turbine 1
200-2	3	740	Silt Fence T/S Bund	Cutting
200-1	3	1100	Pond at Turbine 14	Cutting
200-1	3	1200	Sediment Ret Pond	Turbine 14
200-3	4	700	Pond at Turbine 12	Cutting
200-3	4	1220	Sediment Ret Pond	Turbine 11
200-3	5 / 4	0	Silt Fence T/S Bund	Intersection
200-3	5	250	Sediment Ret Pond	Near Turbine 13
200-3	6 / 2	0 / 2600	Pond Assembly Area	Intersection
200-3	6	150	Silt Fence T/S Bund	Cutting
200-2	7	0	Dec Earth Bund	Saddle
200-5	7	1750 & Vicinity	Silt Fence T/S Bund	Major cutting
200-6	7	2900	Pond at Turbine 21	Cutting
200-6	7	3150	Pond at Assembly 3	Cutting
200-6	7	3350	Pond at Turbine 22	Cutting
200-6	7	3700	Pond at Turbine 23	Cutting
200-6	7	4600	Pond at Turbine 24	Turbine 24
200-7	8	550	Silt Fence T/S Bund	Cutting
200-7	8	1200 & Vicinity	Silt Fence T/S Bund	Cutting
200-1	8	2100	Pond at Turbine 15	Turbine 15

200-5	9	370	Silt Fence T/S Bund	Saddle
200-6	10	0	Silt Fence T/S Bund	Saddle
200-6	10	330	Pond at Turbine 20	Turbine 20
200-7	11	0 - 200	Pond at Assembly 2	Turbine 17
200-6	12	40	Sediment Ret Pond	Substation

Construction at Turbine Sites

Excavations at turbine sites are necessary to achieve appropriate foundations for the proposed structures.
As most of the turbine sites are on ridges or knolls, it is expected that hard ground or rock will be encountered within the upper 3 – 5m depth (the geotechnical report covers this in more detail). It is expected that such rocky fill will be able to be utilised in the sub base and possibly surfacing of the access roads. Turbine sites adjoining existing roads will tend to be excavated first to potentially supply roading fill material at an early stage.

The diagrams in Appendix 1 indicate the construction staging of a typical Turbine site (including assembly construction area) and the sediment retention and control concepts to be adopted.

Temporary ponds within the generally 120m x 20 m Turbine sites can be excavated to serve as sediment retention and control structures and progressively be reduced in size as the area is completed and stabilised.

All turbine sites (including assembly construction areas) are considered likely to require the construction of Sediment Retention Ponds in various formats in a similar manner to a quarry situation.

Deposition areas as per the example in Appendix 1 will be in low impact locations away from areas where natural runoff is concentrated. These deposition sites will be required at various locations within approximately 500 m of areas of significant cuts. Many of the areas of significant cut are expected to yield harder brown rock that is intended to be used as sub base and basecourse road fill, so only the finer grained excavation material will be placed in the deposition areas.

These areas will be topsoiled and grassed on completion.

Design and Implementation of Siltation Mitigation Devices

The design and Implementation of Silt retaining devices is well documented and this report need not repeat or expand on such details.

The following publication “Erosion and Sediment Control” shall form part of the proposals and are attached in Appendix 2 of this report along with the attached PDF documents issued by the Waikato Regional Council.

Appendix 1

Kaimai Windfarm (sheets P01 – P08) prepared by Tektus Consultants detail the Roading and Turbine site locations.

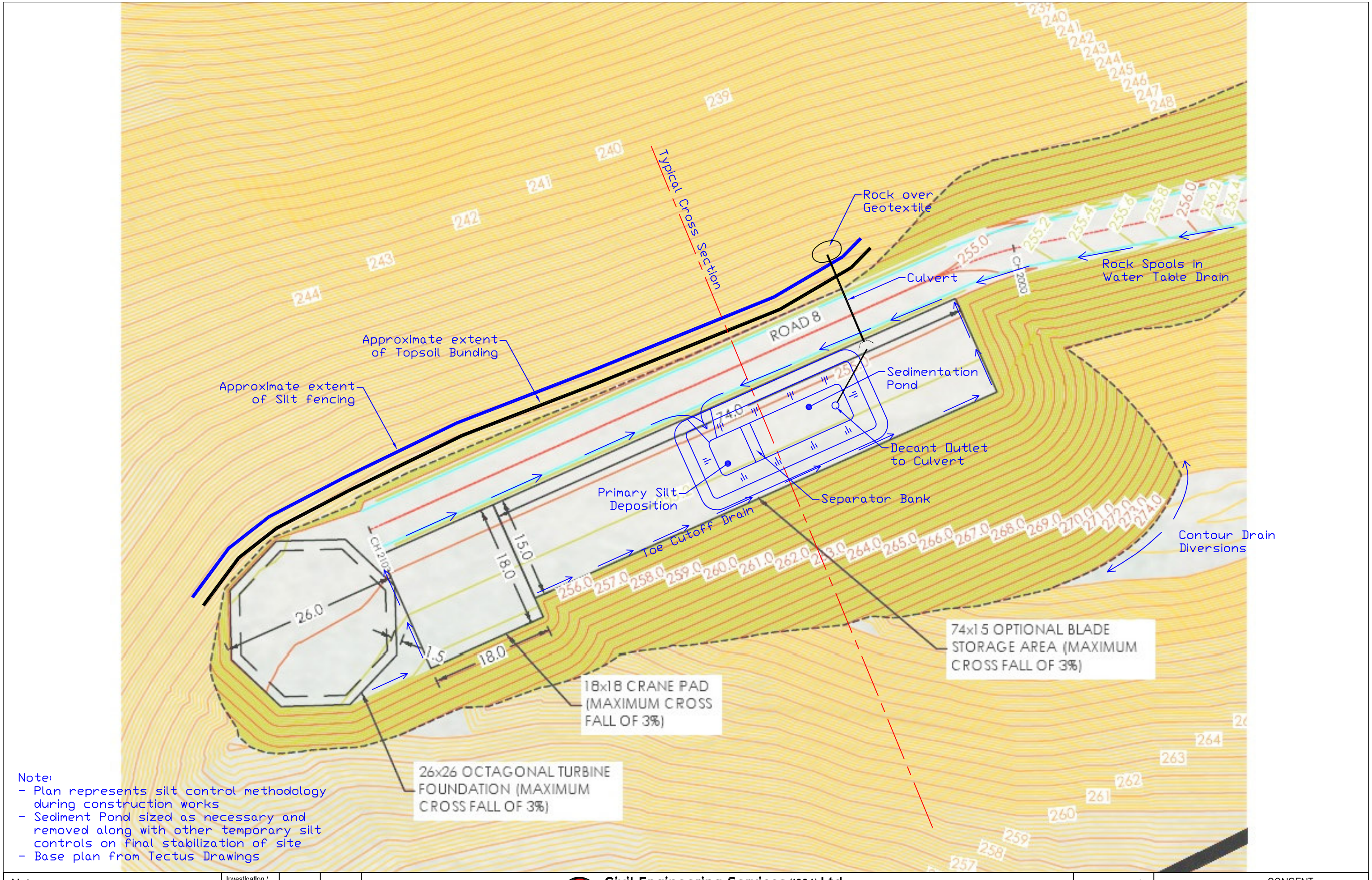
Appendix 2

Attached publications showing generic erosion control methodologies to be adopted as necessary.

Appendix 3

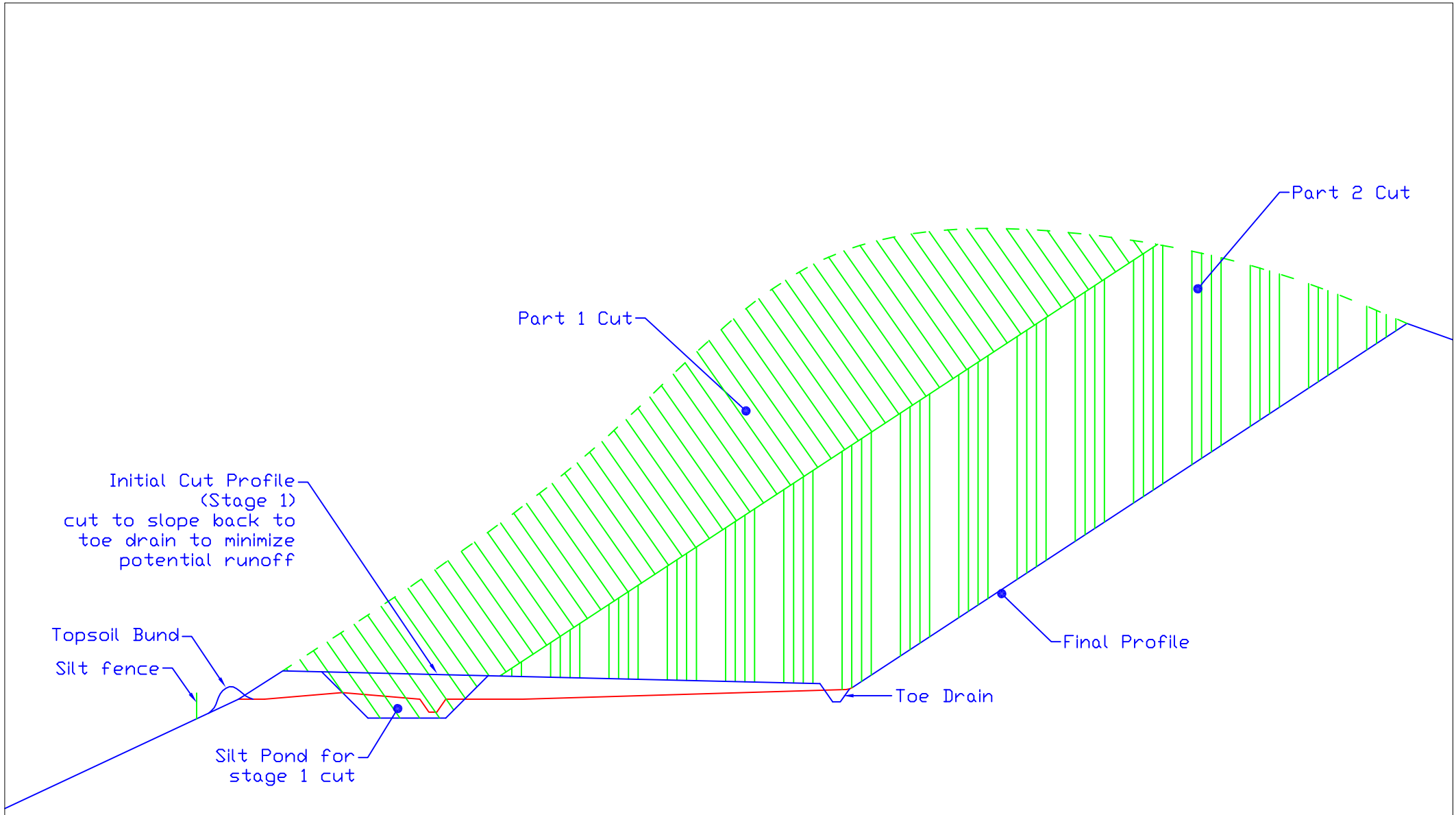
CES Plans and diagrams detail typical site construction methodologies.

Report Prepared by
Civil Engineering Services June 2018

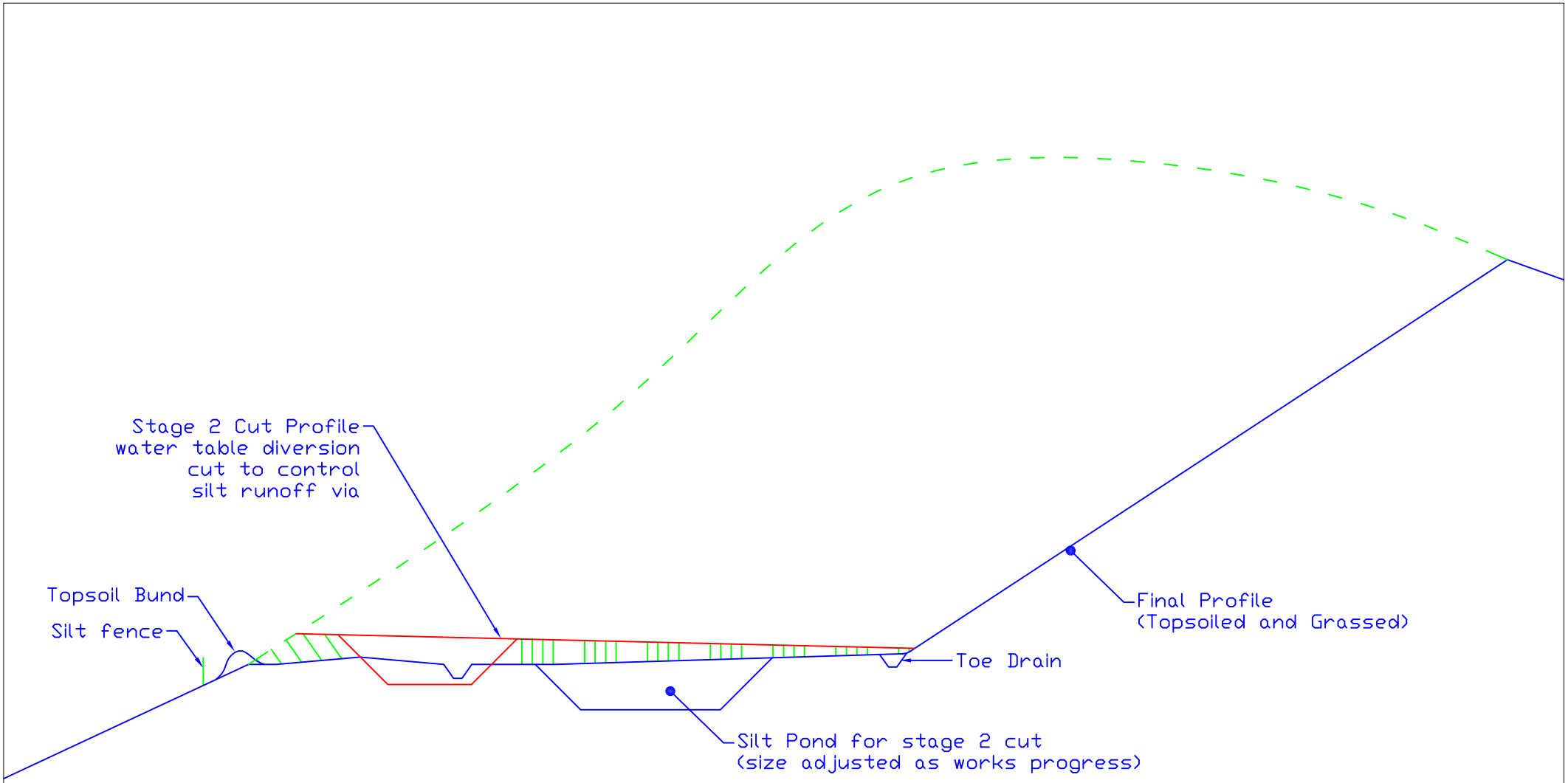


Note:
- Plan represents silt control methodology during construction works
- Sediment Pond sized as necessary and removed along with other temporary silt controls on final stabilization of site
- Base plan from Tectus Drawings

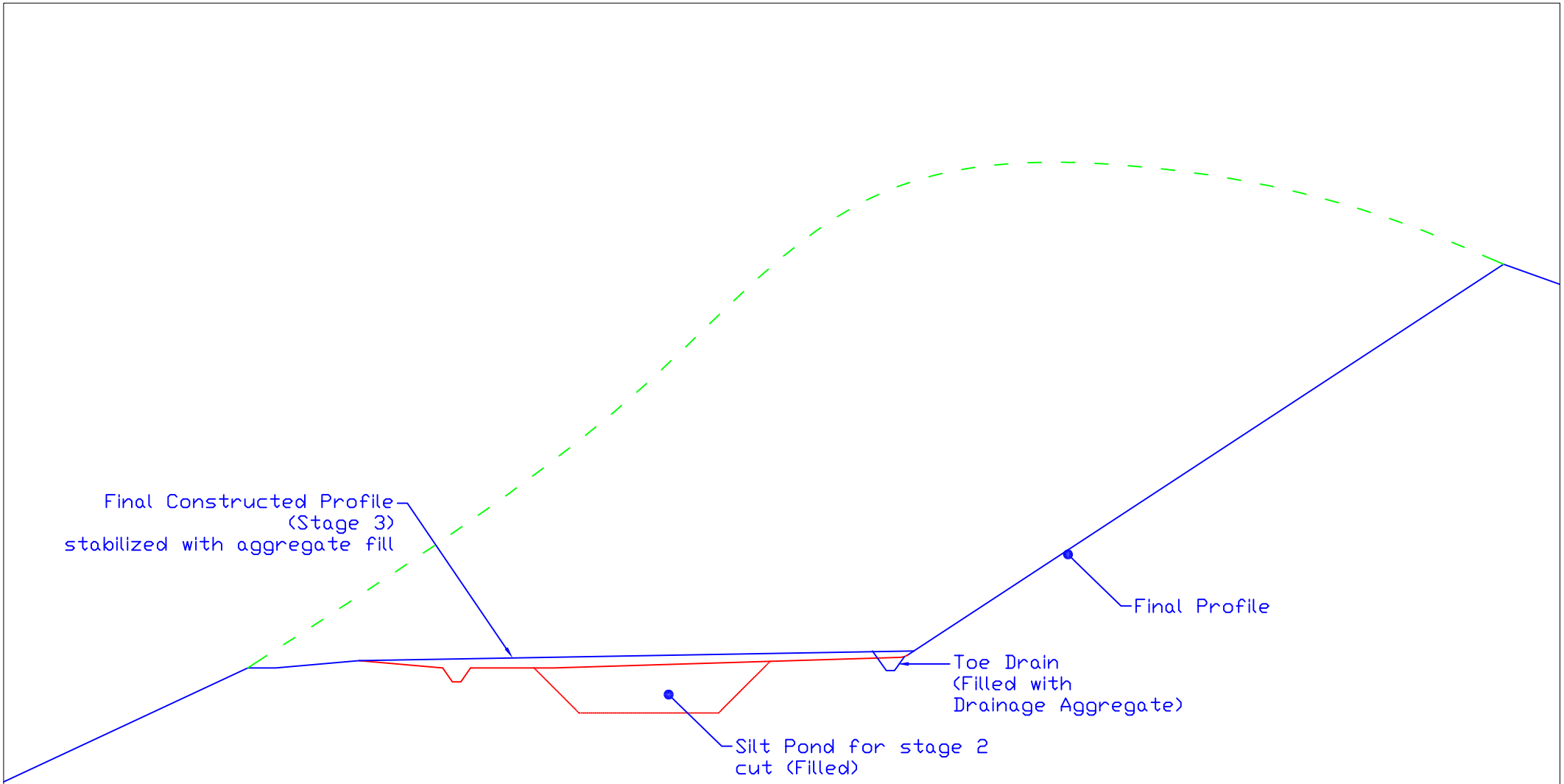
Notes:	Investigation / Surveyed			Email • office@ces94.co.nz • Web • www.ces94.co.nz	**Civil Engineering Services (1994) Ltd**	Phone (office) • (07) 8848317 • Postal • P.O. Box 240. Te Aroha	Client Ref 1174/2	Drawing Revision: CONSENT
	Draughted / CAD	S. LALA	10/2017	Typical Silt Control Measures at Turbine Locations for Kaimai Wind Farm			Scale: Diagram Only Not to Scale	Drawing No. 17/1174/2/01
	Design / Proposal	M J PRESTON	10/2017					
	Checked / Reviewed	M J PRESTON	10/2017					Sheet No. 01



Notes:	Investigation / Surveyed			Email • office@ces94.co.nz • Web • www.ces94.co.nz **Civil Engineering Services (1994) Ltd** Phone (office) • (07) 8848317 • Postal • P.O. Box 240, Te Aroha	Client Ref 1174/2	Drawing Revision: CONSENT	
	Draughted / CAD	S. LALA	10/2017	Typical Silt Control Measures at Turbine Locations for Kaimai Wind Farm	Scale: Diagram Only Not to Scale		Drawing No. 17/1174/2/02
	Design / Proposal	M J PRESTON	10/2017				
	Checked / Reviewed	M J PRESTON	10/2017				Sheet No. 02



Notes:	Investigation / Surveyed			Email • office@ces94.co.nz • Web • www.ces94.co.nz **Civil Engineering Services (1994) Ltd** Phone (office) • (07) 8848317 • Postal • P.O. Box 240, Te Aroha	Client Ref 1174/2	Drawing Revision: CONSENT	
	Draughted / CAD	S. LALA	10/2017	Typical Silt Control Measures at Turbine Locations for Kaimai Wind Farm	Scale: Diagram Only Not to Scale		Drawing No. 17/1174/2/03
	Design / Proposal	M J PRESTON	10/2017				
	Checked / Reviewed	M J PRESTON	10/2017				Sheet No. 03



Notes:

Investigation / Surveyed			
Draughted / CAD	S. LALA	10/2017	
Design / Proposal	M J PRESTON	10/2017	
Checked / Reviewed	M J PRESTON	10/2017	

Email • office@ces94.co.nz • Web • www.ces94.co.nz
Civil Engineering Services (1994) Ltd
Phone (office) • (07) 8848317 • Postal • P.O. Box 240, Te Aroha

Typical Silt Control Measures at Turbine Locations for Kaimai Wind Farm

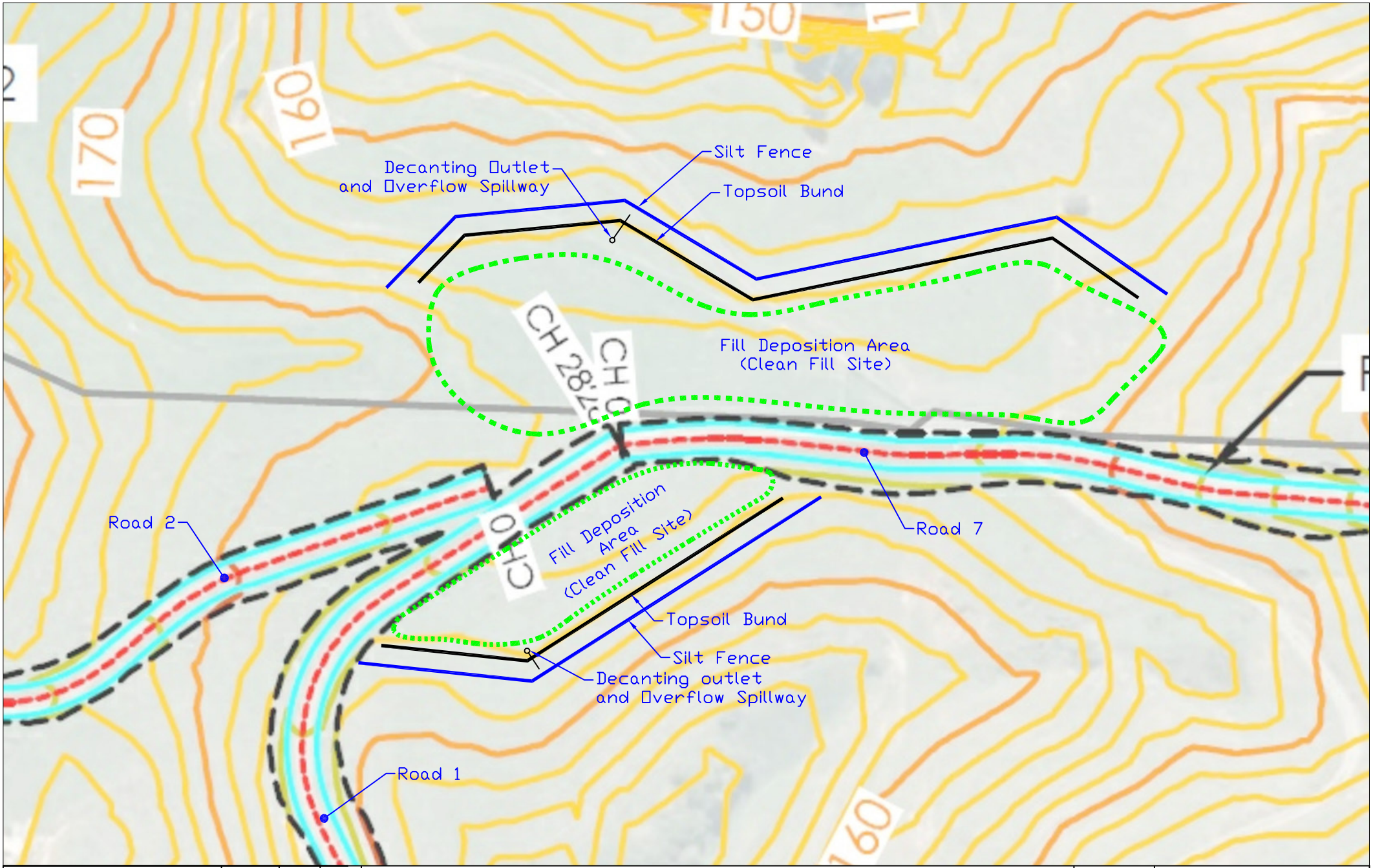
Client Ref 1174/2

Drawing Revision: CONSENT

Scale: Diagram Only Not to Scale

Drawing No. 17/1174/2/04

Sheet No. 04



Notes:	Investigation / Surveyed			Email • office@ces94.co.nz • Web • www.ces94.co.nz **Civil Engineering Services (1994) Ltd** Phone (office) • (07) 8848317 • Postal • P.O. Box 240, Te Aroha	Client Ref 1174/2	Drawing Revision: CONSENT	
	Draughted / CAD	S. LALA	10/2017	Typical Silt Control Measures at Turbine Locations for Kaimai Wind Farm	Scale: Diagram Only Not to Scale		Drawing No. 17/1174/2/05
	Design / Proposal	M J PRESTON	10/2017				
	Checked / Reviewed	M J PRESTON	10/2017				Sheet No. 05