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ENGINEERING & INFRASTRUCTURE REPORT

Client: DARFIELD SOLAR AND ENERGY LTD

Project Site: 1352 Homebush Road, Darfield

APPLICATION PRÉCIS

CLIENT	New Zealand Clean Energy
SITE LOCATION	1352 Homebush Road, Darfield
LEGAL DESCRIPTION	Lot 2 DP 60325, Lot 1 DP 434071
TERRITORIAL AUTHORITY	Selwyn District Council

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1.0 Introduction

CKL has been engaged by Darfield Solar and Energy Ltd (DSE) to prepare an Engineering & Infrastructure Report in support of a resource consent application for a proposed Agrivoltaic Development at 1352 Homebush Road, Darfield.
The scope of this report details the following:

- Earthworks including erosion and sediment control
- Roading and access
- Stormwater management
- Wastewater reticulation and disposal
- Water supply and utility services

Preliminary civil engineering design has also been undertaken for the purposes of resource consent to detail the required engineering works for the proposed development.

2.0 Background

2.1 Existing Site

The site is situated on 154 ha of agricultural land at 1352 Homebush Road, approximately1.5km north of Darfield. The site is directly adjacent to the eastern side of the Fonterra Kimberley Factory. The application site is currently grazed with sheep, which will continue post construction. The subject land and surrounding areas lie within the General Rural Zone under the Selwyn District Council Partially Operative District Plan (PODP).

A portion of the site (Approx 5ha) with access directly off Homebush Road has residential buildings with various other farm sheds and ancillary buildings. This area of the site will be excluded from the development.

In general, the site is flat gently sloping towards the southern boundary of the site, with approximately 17m fall over the entire length of the site. The length of the site is approximately 2400m from northern corner to southern corner.

An existing open drain enters the property from Auchenflower Road at the north running south through the site before exiting the southern boundary along Homebush Road.

2.2 Proposed Development

The proposal entails to establish an approximately 148ha Agrivoltaic development, also known as a solar farm, within the subject site. The project is a utility scale 117 MW renewable energy project. It will consist of 117 MW of Solar plus 106MW / 200-400 MWH of battery energy storage. This project will include erecting solar panels (photovoltaic modules), inverters, transformers, battery energy storage system (BESS), a substation, and a site office.

Site works associated with the construction of the development, including earthworks, tree and vegetation removal, will also be required to enable the Agrivoltaic development to be established. This will also include the construction of internal access routes, a designated site parking, and a laydown area.

Furthermore, it is proposed to build hardstand areas specifically for the substation and BESS units. The proposal includes the construction of three internal culvert crossings to allow access across the existing open drain.

New site entrances are to be constructed from both Homebush Road and Loes Road, as per the site plan. The proposed site plan is attached in Appendix 1.

3.0 Earthworks and Erosion & Sediment Control

3.1 Earthworks

The site earthworks are limited to the removal of topsoil, to form the internal access tracks along with hard stand areas. The total area of topsoil strip is likely to be an area of approximately 7.55 ha for the internal access roads and 2.07 ha for the hard stand areas. Topsoil volumes are based on an assumed topsoil depth of 300mm.The total estimated earthworks volumes associated with the development are presented in Table 1 : ESTIMATED EARTHWORKS VOLUMES below.

Table 1 : ESTIMATED EARTHWORKS VOLUMES

Earthworks	Volume (m^3)
Topsoil Strip – Access Tracks	22,600m^3
Topsoil Strip – Hardstand areas	6,200m^3
Cable Trenching	8,000m^3

All estimated earthworks volumes are solid measure quantities. This shall be confirmed at detailed design stage.

Calculation of Access Tracks

Total length of access tracks is approximately 15,100m. Width of access tracks is to be 5.0m with a stripped depth of approximately 300mm of topsoil removal. This gives an approximate volume of **22,600m^3** of topsoil that will be spread adjacent to the track clear of any structures or water courses. The excess topsoil will be spread over a 5m – 10m width and then grassed.
The approximate total area for the tracks is **75,500m^2** which will be confined to smaller individual areas as the access track works is to be carried out as a cut and cover operation. The maximum length of track stripped (at any one time) will be 50m. This will allow the topsoil to be stripped and spread locally then the pavement metal imported and placed as 300mm – 500mm compacted layer of Blue/Brown rock.

Calculation of Hardstand Area

The final layout of the hardstand area will be confirmed at detailed design stage. For this reporting and stage of design, we have identified an area that could potentially be stripped of topsoil and replaced with a metalled surface. This area could increase or reduce depending on the final layout.
The area identified is approximately **2.07ha** requiring all topsoil to be removed and then replaced with a compacted layer of 300mm – 500mm Blue/Brown rock. The topsoil will be respread locally or used

to create bunds onsite. Depending on final volumes, during detailed design phase, the location of what material goes where will be defined.
Based on 2.07ha would result in approximately **6,200m³** of topsoil being respread.

The stripped topsoil from the Hardstand area will be spread locally over the existing paddocks to disperse the material over a large area. These areas will then be stabilised with mulch & grass. No topsoil will be spread adjacent to the existing open drain. All topsoil stripping and spreading is to be at least 3.0m clear of the drain edge.
Excess topsoil will be utilised to construct bunds around and within the BESS area as required.

No other earthworks are assumed to be required due to the nature of solar panel construction (methodology proposes piling of the solar panel supporting structures). There will be no excavation associated with installation of the piles.

Cabling will be run in underground ducts in a network trench. The exact location and layout of the trenches is yet to be detailed. The trenches will be backfilled with the excavated material and the surface topsoiled / grassed immediately after. Trench volume is estimated to be 8,000m³ based 0n 15,000m of trenching.

New materials will be imported to site for the construction of civil works including access track pavements and hard stand areas. This will include mostly metal aggregates and concrete required for strip footings under the Battery Energy Storage System (BESS) units.

3.2 Erosion & Sediment Control

3.2.1 General

In accordance with industry best practice and resource consent requirements, implementation of erosion and sediment controls during the earthworks operation will be undertaken during the construction works.

Erosion and sediment control and site stabilisation during earthworks will be undertaken in accordance with the methodologies of Environment Canterbury Regional Council (ECAN) “Erosion and Sediment Control Toolbox for Canterbury”.

Earthworks undertaken in accordance with these guidelines will act to minimise and/or mitigate any adverse environmental effects of sediment discharge during the works through appropriate use and design of erosion and sediment control techniques and measures.

The proposed erosion and sediment control methodology is detailed in the following sections. It is noted that the methodology may be subject to change depending on the Contractor’s construction operation and phasing, which will be discussed with Council at the time of works.

3.2.2 Proposed Controls

The proposed erosion and sediment controls are as follows:

- Silt Fences/Filter Socks
  Silt fences will be installed around the hard stand perimeter to control any sediment discharges from the site and will be retained until sufficient stabilisation is achieved over the site.
- Super Silt Fences
  Super silt fences will be installed if required where high risk areas are involved.
- Stabilised Construction Access
  A stabilised construction access will be installed as a primary access point to the site. The position will be confirmed onsite with the Contractor at the time of works. Facilities to enable wash down of vehicles i.e., water blaster as a minimum, may be used to ensure vehicles' tyres are cleaned down prior to exiting the site onto the adjacent roads to ensure sediment is not transported offsite.
- Retention of Existing Vegetated Areas
  Where possible, existing vegetation will be maintained over the site to minimise the amount of bare earth exposed or to provide a buffer/filtration strip.
- Diversion Bunds
  Clean water diversion drains will be installed if required to divert any clean water away from work areas.
- Decanting Earth Bunds
  Decanting Earth Bunds will be installed if required for areas that are identified as requiring a higher level of treatment. A decanting earth bund (DEB) is an impoundment area formed by a temporary bund to provide an area where ponding can occur, and sediment can settle before runoff is discharged from site.
- Site Stabilisation
  Once the subgrade levels are achieved, progressive site stabilisation will be undertaken and shall comprise:
  - Re-topsoiling in conjunction with grass seeding to establish grass cover over disturbed areas.
  - Where necessary, areas will be stabilised by applying straw mulch in conjunction with topsoiling and grass seeding.
  - Roading aggregates will be placed over Access Tracks, hardstand areas and accessway areas as soon as practicable.

  Site stabilisation will reduce the time bare earth is exposed to erosive forces and ability for generation of sediment laden runoff. Perimeter controls will remain in place until adequate stabilisation is achieved over the site.

3.2.3 Access Track

As the site is predominantly flat and has free draining stoney soils no silt fences or bunds will be installed as part of the cut & cover operation. The maximum exposed length of 50m needs to be complied with along with leaving an existing grassed width of 3.0m minimum between any water course and topsoil removal or spreading. The 50m length can be increased if ECAN agree with additional temporary exposed ground.

3.2.4 Hardstand Area

As the hard stand area to be stripped is generally isolated and could either be stripped all at once or carried out as a cut and cover operation, a perimeter silt fence is to be installed to contain the area. In practical terms either a silt fence or a temporary topsoil bund would be sufficient to contain the works. The hard stand area is flat with free draining gravelly soils which makes any other control device impractical to construct.

A stabilised construction entrance is to be installed in this area to allow entry and provide a raised barrier connecting with the proposed silt fence.

3.3 Earthworks and Erosion & Sediment Control Methodology

It is expected that the main earthworks/site works operation will be undertaken over approximately 3-4 months, noting that these works will involve both the access tracks and hard stand areas. (Note: installation of the solar panels will take longer than this and expected to take place after the establishment of all the internal roading). The erosion and sediment control methodology during the proposed works will be confirmed by the Contractor on site prior to commencement of site works. However, the methodology will generally comprise the following:

1. Install the stabilised construction entrance(s) to the site. Install silt fences as necessary on site including around the proposed hard stand areas.
2. Strip topsoil and complete minor earthworks to construct the access tracks.
3. Strip topsoil and complete minor earthworks to construct hard stand areas for site office, Laydown area, BESS units and Substation.
4. Where possible, respread topsoil to completed areas and mulch out.
5. Once all working areas are sufficiently stabilised, decommission all erosion and sediment control devices and reinstate these areas to complete final works.

3.4 USLE Calculations

The calculation of the net sediment yield from the earthwork's operation has not been undertaken for this site due to the earthworks being limited to generally topsoil strip only.

3.5 Earthworks Risk Assessment

The soil types on site are generally well draining and comprise silty loam over sandy gravels. Given the nature of the soils, the flat topography and lack of natural surface water on site, overall risk and potential effects of sediment laden runoff are relatively low.

The following risks and proposed mitigation are detailed in Table 2 : EARTHWORKS RISKS AND MITIGATION

Table 2 : EARTHWORKS RISKS AND MITIGATION

Factor	Risk	Mitigation
Proximity to existing open drain	Sediment laden runoff enters existing open drain.	Closely monitor discharge points to check any presence of sediment plumes. Maintain vegetative buffer strips. Ensure minimum 3.0m width from track works and no disturbance to the existing grass along both banks of the water race.
Poor erosion and sediment controls and lack of maintenance	Poor implementation or under performance of erosion and sediment controls may contribute to increased sediment yield or non-control of runoff.	Undertake regular monitoring and maintenance on a daily basis/prior to forecast inclement weather to ensure all controls are in place and operating efficiently. Rectify issues promptly.
Works duration	Increased construction period may raise net sediment yield where earthworks areas are exposed for longer than anticipated	Maximise productivity to minimise time sites are open. Progressively stabilise completed earthworks areas with topsoil/grass and subgrades with metal as soon as practicable.
Construction Dust	Dust generation from construction actives	Watering of Haul roads and manoeuvring areas during dry and/or windy periods. Suspension of operations should the weather conditions become unfavourable.

3.6 Monitoring and Maintenance

Monitoring of the erosion and sediment control measures will typically be undertaken by the Contractor's site project manager/ foreman with compliance monitoring undertaken by the Council Site EMA. It is expected that monitoring will also be undertaken by the Consultant project manager. Monitoring and maintenance will typically include:

- Inspection of all perimeter controls including the silt fences followed by removal of any sediment accumulations and repair to silt fences where required.
- Review of weather forecasts to programme/stage the works around any forecast inclement weather i.e., minimise area of stripping/excavation and subsequent basecourse preparation where poor weather is forecast, and make the site safe prior to rain.

It is expected that the Contractor will generally undertake daily inspections of the erosion and sediment controls as part of operation of the site with increased monitoring undertaken prior to inclement weather. Where monitoring identifies any further controls, coordination of such works will be undertaken between the Contractor and Contract Engineer in liaison with the Council Site Representative/EMA to ensure that sufficient controls are being implemented throughout the earthworks/site works operation.

3.7 Construction Aspects

Construction aspects include the following:

- Construction access and traffic safety: It can be expected that there will be an increase in construction traffic during works with increased use of Homebush Road due to both construction traffic and workers and during removal of any surplus materials offsite. This will only be temporary in nature and will employ traffic management controls as appropriate throughout the course of the construction to minimise adverse impacts on adjacent landowners.
- Vehicle movements: Plant will be brought to and from site for construction activities as well as deliveries of construction materials, which are difficult to quantify. However, the majority of works will be contained within the site, and it is noted that adjacent dwellings are very limited.
- Machinery refuelling: It is expected that mobile tanker machinery refuelling will be undertaken as per common practice rather than having an onsite refuelling station/tank. Typically, it can be expected that refuelling will occur within the works areas, thus any spillages can be contained by the sediment controls. Should any soils become exposed to spilt fuel, these will duly be removed to an appropriate offsite disposal facility.
- Site depot/storage: A designated site depot and storage area will be confirmed onsite in consultation/agreement with the appointed Contractor. It is expected that machinery and materials will be stored in this designated area.

- **Dust management:** Given the proximity to existing residential properties and public roads, precautions will be taken to prevent dust nuisances. Such methods will include the watering of haul roads and manoeuvring areas during dry and/or windy periods. Precautions will also include that should weather conditions create a dust nuisance, operations will be suspended until favourable weather conditions return. Once each phase of earthworks is completed, exposed earth will be stabilised with topsoil to ensure clay subgrades are covered in a timely manner to manage the risk of them drying out and creating a dust nuisance.
- Noise: The effects from noise are expected to be negligible and generally in accordance with Operative Plan criteria. Construction noise will typically be associated with the construction phase and is therefore only temporary during the works.
- Hours of operation: The hours of operation are expected to be as per Selwyn District Council Partially Operative District Plan (PODP) criteria for construction activites.
    - 7:30am to 6pm Monday to Friday
    - 7:30am to 6pm Saturday to Sunday

4.0 Roading and Access

4.1 Existing

The site is fronted by Homebush Road to the south, Loes Road to the east and a smaller frontage to the north along Auchenflower Road. Two existing vehicle crossings are located off Homebush Road immediately adjacent to each other.

4.2 Proposed

New roading and access will be constructed as part of the development and shall comprise the following:

- Internal access tracks running around the perimeter of the site and north south tracks through the internal portion of the site. The access tracks will be 5.0m wide with a metalled pavement consisting of approximately 300mm – 500mm thick metalled layers.
- New vehicle crossing / entrance off both Homebush Road & Loes Road to be constructed to council specifications. Location to be confirmed by traffic engineer.
- Hard stand area for Carparking, site office, construction laydown, substation, BESS area

Refer to Traffic engineer report for further information.

4.3 Fire Fighting Access

Access for emergency vehicles will be via the two new entrances. These will be further discussed in the Traffic engineers report. The internal access tracks will therefore need to be constructed to allow for the operational requirements of fire appliances to manoeuvre around the site. This will require tracking curves to be looked at for each intersection and crossing point to ensure sufficient clearance from panels and other structures. This will be addressed at detailed design.

5.0 Stormwater Management Strategy

5.1 Existing Stormwater System

The site does not have a stormwater reticulation system other than the existing open drain which flows from north to south. The site is relatively flat and any stormwater runoff is dispersed overland on existing paddocks soaking to ground, due to the nature of the soil substrata.

5.2 Proposed Stormwater System

5.2.1 Site Drainage

As the site generally provides for good infiltration, water will generally soak to ground, with compacted areas able to discharge to areas adjacent. Therefore, given the buffers and setbacks in place between the solar arrays and site boundaries, runoff of stormwater beyond site boundaries will be generally avoided, or there will be sufficient area for the installation of any possible soakage swales. The only areas that will require (possible) drainage is the BESS area, carparking and laydown area. Given the flat nature of the site it is envisaged the flows will runoff to existing grassed areas and discharge the runoff through the soil substrata.

The site office roof runoff will discharge to ground via overflow from the rainwater tank with a dispersal unit to ensure erosion is avoided at the point of discharge to ground.

5.2.2 Existing Culverts

The site has various existing culverts to provide farm access across the existing (operational) open drain. The open drain enters and exits the site through 225mmØ culverts with all internal existing culverts in the wet operational drain being 225mmØ with one 300mmØ. The existing disused dry drain has abandoned culverts ranging from 150mm to 300mm.

Two new culverts will be installed to create two independent crossing points separate from the existing farm crossings. It is anticipated that new pipes and wingwalls will be constructed along with compacted suitable fill over the pipes to form an embankment crossing.

5.3 Stormwater Management and Flood Risk Assessment

Refer to the CKL Stormwater Management and Flood Risk Assessment Report for further details on flood modelling and management assessment.

6.0 Wastewater Disposal

6.1 Existing Wastewater System

The subject site does not have an existing connection to any wastewater network. The existing dwellings utilise septic tanks for treatment and disposal to a dedicated area.

6.2 Proposed Wastewater System

The proposed site office will require some form of wastewater system for any anticipated kitchen facilities and toilets.

Water supply for the office will be via an installed rainwater tank which will collect water from the roof. Details are provided in following section.

Toilet facilities will be provided via a portable toilet that is serviced monthly or as required depending on staff numbers. Alternatively, wastewater will be held in a holding tank and disposed off-site.

Should a kitchen be provided then wastewater will be collected, in much the same options as the toilet facilities via a holding tank for removal

7.0 Water Supply and Utility Services

7.1 Water Supply

No public water supply is available. Rainwater tanks will be used to collect roof water to supply the site office for potable and non-potable purposes. Treatment of water will occur through a “packaged treatment system” prior to consumption.

7.2 Fire Fighting and Panel Cleaning

Additional static water tanks will be required around the site for panel cleaning maintenance to be carried out along with firefighting capacity. The proposal is to provide dual 30,000 litre tanks positioned around the site in optimal locations to allow firefighting services to reach all areas. The area will be equipped with a hardstand to provide access for a fire appliance to connect to the tanks and be clear of the access track. The tanks will be interconnected with a 100mm pipe along with a FENZ 100mm female suction coupling at the outlet.

The tanks will need to be filled by water tankers brought to site or filled via some other source. This is yet to be decided. Any depletion of the tanks supply will require immediate refill after each event.

7.3 Utility Services

Power and telecommunication lines are located within the road reserve adjacent to the site and will be extended to serve the site office as required.

The main substation is located immediately adjacent on the west boundary within the Fonterra site and will form the connection between the Agrivoltaic facility and main power network substation.

8.0 Summary

DSE is proposing a Agrivoltaic Facility within the site that requires the installation of solar panels, internal roading, service area containing parking, site office, laydown area and BESS units.

The earthworks on site are limited to topsoil stripping to construct access tracks and hardstand areas. To prevent and mitigate any adverse environmental effects during the earthwork's operation, erosion and sediment controls will be implemented in accordance with ECAN guidelines.

The site is relatively flat, and any stormwater runoff is dispersed overland onto existing paddocks soaking to ground.

Wastewater management & water supply are limited to the site office with options available for a portable toilet or on-site holding tanks along with rain tanks for water collection and use.

Firefighting storage capacity will be supplied via multiple dual water tanks located across the site with suitable access for emergency vehicles. The tanks will also be used for panel maintenance when the panels require washing. Tanks will require immediate refill after each event.

New utility services will be installed to service the site as required, and access to these services are within the immediate vicinity of the stie and location for the demand.

9.0 Limitations

This report has been prepared solely for the benefit of our client with respect of the particular brief and it may not be relied upon in other contexts for any other purpose without the express approval by CKL. Neither CKL nor any employee or sub-consultant accepts any responsibility with respect to its use, either in full or in part, by any other person or entity. This disclaimer shall apply notwithstanding that the report may be made available to other persons including Council for an application for permission, approval or to fulfil a legal requirement.

APPENDIX 1

Engineering Plan