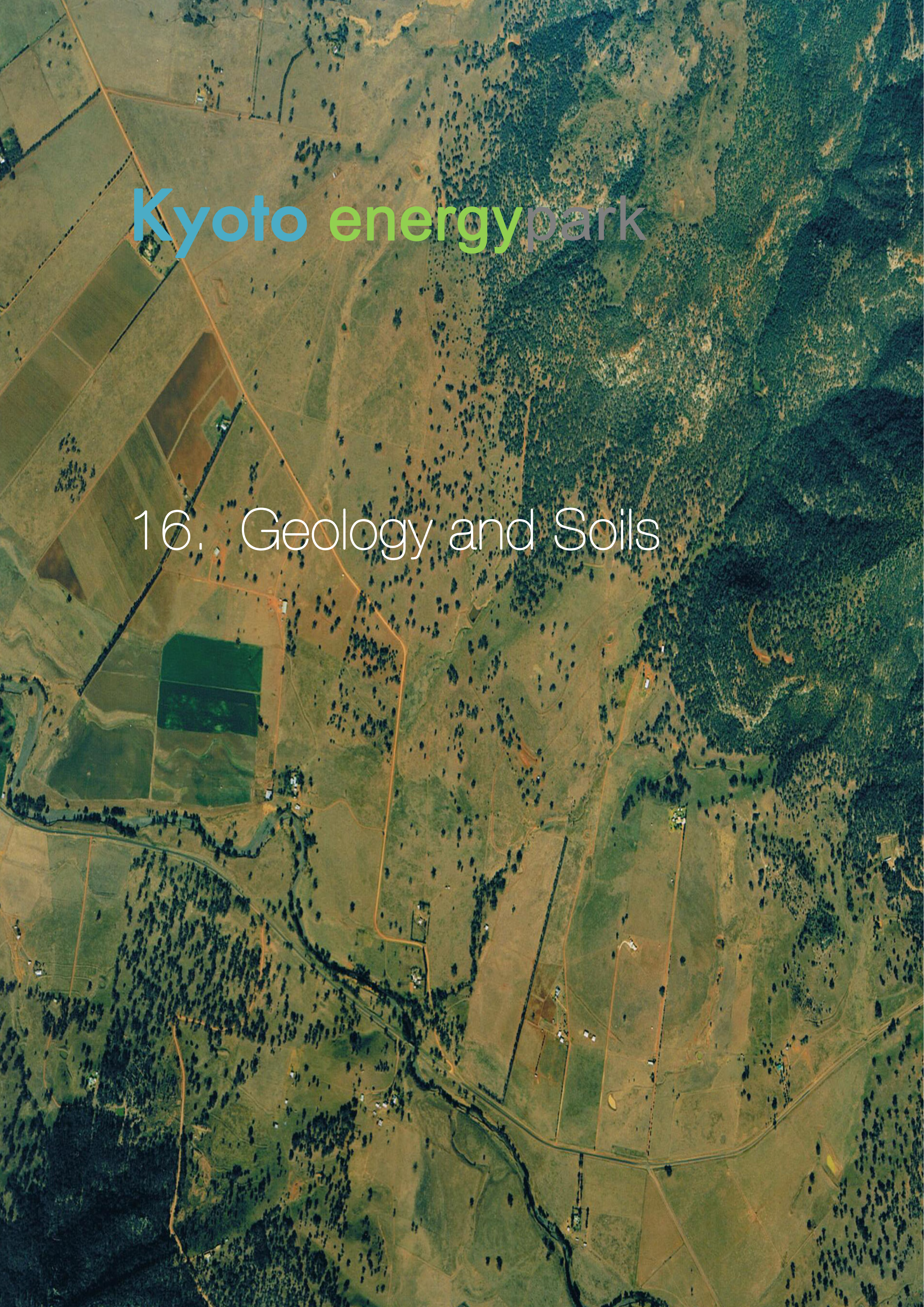

Kyoto energypark

16. Geology and Soils

16.0 GEOLOGY AND SOILS

This component of the Environmental Assessment was undertaken with the assistance of the Department of Land and Water Conservation and the Department of Natural Resources. HDB Town Planning Pty Ltd initially completed a desktop survey and an inspection to clarify soil and geology profiles for both sites.

16.1 Geology

Carboniferous and Devonian sediments form the rolling hills and lower slopes immediately to the west and east of the New England Highway at Scone. These include the coal bearing Singleton measures. Jurassic sediments, predominately sandstone and shale form the steeper ground of Mt Moobi Plateau (Mountain Station).

Tertiary basalts overlie much of the higher ground including the underlying basalt rock on both sites. Quaternary alluvium and colluvium sediments occur under the river floodplain forming the valley floor.

The Middlebrook Station site is underlain by:
- The Permian aged Singleton Coal Measures Group; and
- The Cainozoic Aged Quaternary Group.

The Mountain Station site is underlain by:
- Cainozoic Aged Tertiary Group;
- Triastic Aged Narrabeen Group; and
- Permian Aged Singleton Coal Measures Group.

The site area is also edged by the Cainozoic Aged Quaternary Group, generally comprising gravel, sand, silt and clay.

16.2 Soils

Early intensive cultivation of the area has resulted in widespread sheet, rill and gully erosion in many areas. Past farming practices have caused substantial increases in catchment runoff and gully erosion, which occurs along most major drainage lines. Heavy stocking rates in the early days of settlement, has caused widespread sheet and rill erosion on the poorer soils in the Parkville Valley, which are susceptible to erosion and topsoil degradation. In these areas, ground cover is severely reduced, soil organic matter and infiltration are low, and topsoils are hardsetting. The highly aggregated black soils on basalt of the Merriwa Plateau are very susceptible to gully erosion risk. While these soils are well-structured, concentrated flows can easily dislodge individual pads, causing the profile to erode like sand.

The sites of the proposed Kyoto Energy Park are located at the junction of the Merriwa Plateau and Parkville Valley physiographic regions.

The Merriwa Plateau terrain is Tertiary basalt overlaying Triassic sediments. This terrain includes the hills, mountains, fans and occasional foot slopes. The Merriwa Plateau is characterised by rich dark Vertisols with a uniform profile of well structured clay soil which is generally black, dark red or dark brown in colour. They are reasonably fertile soils and generally do not have trace element deficiencies. Black earths show considerable erodibility if poorly managed even on gentle to moderate slopes. The Merriwa Plateau physiographic region includes, Cranbourne (ce), Erin (er), Tinagroo (tg) and Wingen Maid (wx) soil landscapes.

The Euchrozem group of soils also occur on the slopes to the west and east of the New England Highway. Euchrozems are gradational red and red brown clay soils grading from a clay loam or light clay to medium textured at depth. They are moderately fertile and the erodibility of these soils is highly variable, reflecting the complexities of the underlying geology. Under pasture they are considered stable but may be subject to severe erosion when exposed if adequate soil conservation measures are not employed.

Solodic soils are also associated with the hilly and rugged land. These soils are red in well drained locations and yellow where the water table is high. They have low fertility and are highly susceptible to erosion when disturbed.

The Wingen Maid soil type on the slopes and steep land contains acid soils of low plant available waterholding capacity, stoniness and high permeability, localised high organic matter content and hardsetting surfaces. It is characterised by steep slopes, rock outcrops, high rockfall hazard, mass movement hazard, high runoff, shallow soils and engineering hazards. On the lower slopes it has localised high run-on, high erosion risk and non-cohesive soils.

The Parkville Valley terrain consists of undulating to rolling hills, foot slopes and drainage plains on Permiam marine sediments. The alluvial soils of the flood plain and lower reaches of the Hunter River and its tributaries occur as a result of sedimentations from still or moving water. These sediments range from fine and medium textured soils to gravels in the upper reaches of the creeks. In general, these alluvial soils are fertile. The erosion potential is low due to the low gradients on which the soils are developed. However, where sodic or unstable subsoils are exposed, such as in the Parkville Valley, moderate and active gully erosion occurs. The Parkville Valley physiographic region includes, Parkville (pv), Tinagroo (tg) and Thomsons Creek (tc) soil landscapes.

Parkville Valley soils on the floodplain and low lying areas, when disturbed, are also susceptible to erosion and topsoil degradation. In these areas, ground cover is severely reduced, soil organic matter and infiltration are low, and topsoils are hardsetting.

The soil landscapes of the Merriwa Plateau and Parkville Valley area are defined in Table 16.0.

Table 16.0 – Kyoto Energy Park Soil Landscapes

Underlying Geology	Soil Landscape Name	Defining Landform Features
Tertiary – Basalt (Tc, Tb)	Cranbourne (ce)	Level to undulating plateau and broad benches of the Merriwa Plateau.
Triassic – Narabeen Group, lithic and quartz-lithic sandstones and conglomerate (RN, Rnd, Rns)	Erin (er) Wingen Maid (wx)	Long foot slopes of the Merriwa Plateau rugged steep to very steep (25% - 80%) hills. Steep benched sideslopes with cliffs, broken scarps and boulders.
Quaternary – Alluvium (Qa)	Thompson's Creek (Tc)	Floodplains draining the Merriwa Plateau and Parkville lowlands.

16.2.1 General Soil Qualities and Limitations

Soil qualities and soil limitations are properties that can be assessed on an individual soil basis. They can affect the viability and sustainability of land uses proposed for them.

Final design of all structures and buildings will include provisions for soil testing and analysis of the various soil types that occur over the two sites. This will include presence of engineering hazards, subsurface testing, presence of acid sulphate soils and soil testing and analysis.

The soils limitation analysis for the dominant soil types are presented in Table 16.1

The table below indicates that only a portion of the Parkville soils, are highly erodable and that the Wingen Maid soil is not.

The highly aggregated black soils on basalt are very susceptible to gully erosion risk. While these soils are well-structured, concentrated flows can easily dislodge individual pads, causing the profile to erode like sand. Where sodic or unstable subsoils are exposed moderate and active gully erosion can occur.

Steep slopes and rock outcrops are susceptible to high rockfall hazard, mass movement hazard, high runoff, shallow soils and engineering hazards.

Localised high run-on (on the lower slopes) can also present high erosion risk and non-cohesive soils. The amount of weathering and fracturing of the substrate has major effects on site stability, water movement and plant growth. Rock outcrops and boulders can impede excavations, construction work, access and water runoff from the site, and also reduce the site's capacity for effluent disposal.

Typically, the movement of heavy vehicles and equipment on site can be a cause of major soil disturbance, and methods including restricting movement over non-essential areas; use of broad or multiple tyres or bulldozer type tracks which spread weight over a larger surface area can assist in minimising the areas of disturbance.

Table 16.1 Kyoto Energy Park Soils Limitation Analysis

Soil Limitations Analysis

Soil Material Code	High Plasticity	Low Wet Bearing Strength	High Shrink Swell	Organic Matter	Stoniness	Sodicity/Dispersion	High Erodibility	Hardsetting Surfaces	Permeability – High	Permeability – Low	Acidity	Alkalinity	Salinity	Low Fertility	Low Plant Available Waterholding Capacity
Parkville															
pv1				L	L	L		W	L		W				L
pv2					W	L	W				L		L		L
pv3			L		L	W				W			L	L	
pv4						W				W					
Wingen Maid				W	L			L	W		W			W	L
wx1					W				L		L			W	W
wx2															

W = Widespread occurrence; L = Localised occurrence

16.3 Excavation works

Foundation works would require excavation of topsoil and rock material for construction of:

- Foundations for wind turbines and solar frames;
- Slab construction for all facilities;
- Site works, access tracks, trenches and hardstand areas

Wind Turbine Foundations

The site inspection and geological analysis suggest that conditions are suitable to support large wind turbine structures. Based on visual inspection of the site, footings would occur along the ridges and plateaus where the presence of underlying basalts exist which are capable of supporting the turbine footings. Turbine footings would be either gravity or reinforced anchored design based on final design parameters including geotechnical strength of the underlying fractured rock. Final sizing and dimensions of the footings would be subject to a detailed geotechnical investigation and design.

Slab constructions

The depth of the substation foundation will be based on the overall bearing strength of the subsurface material, which will be determined during final design stages of the project. The overall depth of footing will be less than 1m below final design surface level of the substation slab.

The nature of the geology and soils characteristic of the sites are suitable to allow any ancillary works associated with the project. Any local variations to soil and geology can be allowed for in the design of individual footings. Slabs for building facilities will be sized during final design of the building structures.

Access Tracks, trenches and hardstand areas

Road base material sourced in the locality may be used to prepare subgrade foundations, strengthen existing access tracks, and hardstand areas for erection of components. The use of compacted road base material will provide all weather access, minimise maintenance and reduce erosion potential. Erosion and Sedimentation measure will also be adopted to satisfy design requirements.

Trench construction would be staged to avoid fouling the trench but also to reduce potential for sedimentation especially on slopes.

16.4 Erosion and Sedimentation Risks and Mitigation Measures

The differing soil types that occur on site range in erosion potential from low, to very high as defined in the Soils Limitations Analysis. As such, managing potential erosion and associated landform stability and sediment mobilization impacts are serious issues during the construction and decommissioning phase. Soil compaction and soil erosion are likely to occur during all excavation works, upgrading to access tracks and the transport of road base and machinery. There is also a risk of potential soil contamination from the use of hydrocarbon fuels and toilet facilities during construction of the turbines.

Impacts of the proposal to the local soils and landforms are considered manageable. Soil testing during final design stages for the sites will aid in the design and planning of proper erosion and sediment control measures for protection of exposed works areas. Analysis of soil profiles for the sites will aid in the design and planning of proper erosion and sediment control measures for protection of exposed works areas.

Pamada's Statement of Commitments identifies the need for a detailed Construction Environmental Management Plan (CEMP) and an Operations Environmental Management Plan (OEMP) in relation to ongoing maintenance, monitoring and remediation works. Pamada is committed to ensuring that all works involving disturbance of the ground will be undertaken in accordance with best practice guidelines to ensure the minimum disturbance of the soil surface and appropriate sedimentation and erosion controls are put in place.

Mitigation strategies that would be employed during construction to manage the potential for adverse environmental impacts are outlined below.

Erosion and sediment control measures are aimed at minimizing the area and length of time soil is exposed to erosion and provision for the collection and containment of sediment. Erosion and Sedimentation risks have been identified in Table 16.2 with best practice mitigation measures for soils as defined.

Table 16.2 Kyoto Energy Park – Erosion and Sedimentation Risks and Measures

Erosion & Sed[m] Risks	Project Stages				Mitigation Measures
	Final Design	Construction	Operation	De-commissioning	
Protect drainage lines and gullies		✓	✓		• Install sediment structures along drainage lines to limit sediment loss from works areas and avoid potential downslope contamination • Maintain soil stockpiles away from drainage lines and depressions. • Erosion and sedimentation structures shall be used around stockpiles and works areas (e.g. silt fencing)
Stabilise works area		✓	✓		• Minimize exposed works areas. • Access routes and tracks would be confined to already disturbed areas, where possible. • Disturbance of soil and vegetation should be kept to a minimum. • All completed works areas are to stabilized and restored
Erosion control measures ***Erosion control measures (cont)***	✓	✓	✓	✓	Erosion control measures shall include: • ***Site management practices*** - o appropriate scheduling of construction sequence and erosion control measures o restriction of access to non-essential areas o monitoring and maintenance of erosion control measures o use of broad or multiple tyres or bulldozer type tracks which spread weight over a larger surface area can also assist in minimising the areas of disturbance. • ***Diversion banks and channels*** – these intercept and divert "clean" run-on water away from disturbed ground and dispose of it safely below the site. Perimeter banks are low temporary structures, which may be used on small scale operations; • ***Graded banks and channels*** – these are designed to intercept and direct sediment-laden runoff from within the disturbed site to an appropriate sediment basin or trap. They also reduce the effective length of slope and hence, the velocity and erosive power of the water flow; • ***Cross banks and drains*** – as above, but are applied to small disturbed sites such as across unsealed tacks; • ***Vegetation and other ground cover*** – these serve to shield soil from erosive water (and wind) impacts; reduce the velocity and erosive power of water (and air) flow, and reduce the volume of water runoff by intercepting rainwater and improving soil permeability. The cover may be temporary or permanent. Temporary cover provides short-term stabilization over sites with high erosion hazard, where subsequent reworking will be necessary (e.g., on soil stockpiles) or prior to the establishment of permanent vegetation.

Erosion & Sed^{m} Risks	Project Stages				Mitigation Measures
	Final Design	Construction	Operation	De-commissioning	
					• ***Channel flow control structures*** – these structures are designed to reduce the velocity and erosive power of water flow within a channel or waterway. They include o check dams (to obstruct normal flow) o rough channel linings o grade stabilizing structures o outlet protection structures such as outfall aprons o stormwater detention basins (which serve to temporarily store and delay stormwater runoff o level spreader outlets (designed to convert channel flow into less erosive sheet flow) • Stockpiles generated as a result of construction activities would be bunded with silt fencing, (hay bales or similar) to reduce the potential for runoff from these areas.
Sedimentation control measures	✓	✓	✓	✓	• Sediment control involves the interception and retention of eroded soil material on-site, preventing its release to off-site areas. The most important strategy in sediment control is the implementation of effective erosion control measures. • Manage water flow onto and through the site. Control measures aim to reduce the flow volume, control the flow path and reduce flow velocity. • Sedimentation structures including • ***Sediment basins*** – special dams with water outlets at their base designed to intercept large volumes of sediment laden runoff from a site, typically receiving waters from channels and waterways. Suspended soil material settles out of the water and is periodically removed. • ***Sediment traps*** – generally, small temporary structures used in small catchments to trap sediment runoff before it enters stormwater pipes or channels. They require regular clean out of sediment; • ***Sediment filters*** – these function by intercepting and filtering out sediment from small volumes of water flow, which is generally in the form of sheet flow rather than concentrated flow.
Dust suppression		✓		✓	• Utilise local road base material to strengthen existing access tracks, provide all weather access, minimal maintenance and reduce erodibility. • Dust suppression of all exposed works areas with water truck
Revegetation works		✓	✓		Revegetation of disturbed areas as soon as possible upon completion of works; • Site clearing and topsoil handling – clearing and disturbance to existing vegetation should be kept to a minimum. For parts of the site undergoing greatest disturbance, the stripping and appropriate stockpiling of topsoil should be undertaken. Stockpiles

Erosion & Sed[m] Risks	Project Stages: Final Design	Construction	Operation	De-commissioning	Mitigation Measures
					must be adequately protected from wind and water erosion. • Plant species selection – should be made on the basis of whether temporary or long-term cover is required, the climate and soil conditions of the site, the season of growth (e.g., spring or summer), the availability of plant seed or seedlings and ecological considerations. For permanent long-term vegetative cover, native grasses, shrubs and trees will often be more appropriate, especially those indigenous to the site. • Site preparation – good surface preparation is essential to the success of a revegetation program. This involves such measures as the ripping and/or cultivation of any hard set or compacted surfaces and; the respreading of topsoil to a minimum depth of 50mm, with the organic layer at the top.
Maintenance of Erosion and Sed[m] structures		✓	✓		• Access tracks would be graded to enhance their stability. • Sedimentation structures to be regularly inspected and maintained • All measures must be properly monitored for their effectiveness and maintained throughout the functional life of the use.
Sediment and Erosion Control Plan (CEMP and OEMP)	✓	✓	✓		• Sediment and erosion would be controlled as part of a formal Sediment and Erosion Control Plan, as a sub plan of the CEMP and OEMP. • Soil and water management practices would be guided by the Best Practice guidelines contained within *Soils and Construction Vol. 1* (Landcom 2004).
Spill Control Plan	✓	✓	✓		The contractor would prepare and implement a **Spill Control Plan**, as a sub-plan of the **Construction Environmental Management Plan**. • Identify persons responsible for implementing the plan if a spill of a dangerous or hazardous chemical/waste should occur. • Material Safety Data Sheets (MSDS) for all chemical inventories would be located on site and readily available. • Where chemicals are used, their application and disposal would comply with manufacturers recommendations. • Any spill that occurs, regardless of size or type of spill, would be reported to the Construction Manager. • The event and clean up processes would be recorded. Information that would be recorded in the event of spill would include time and date of spill, type of chemical or waste spilt, approximate volume spilt, general area in which the spill occurred, corrective actions applied, and disposal of spilt material. • Spill protocols in the plan would dictate when the EPA would be notified. • Chemical/fuel storage areas would be identified, and be bunded to prevent loss of

Erosion & Sed^m Risks	Project Stages				Mitigation Measures
	Final Design	Construction	Operation	De-commissioning	
					any pollutants. • Hydrocarbon spill kits would be stored at the site. A number of site staff are to be trained in the use of the spill kits. • Maintenance or re-fuelling of machinery would be carried out on hard-stand area within the laydown area. The concrete hardstand area would include bunding and flush pits for collecting and safe disposal of hydrocarbons materials. • Concrete wash would be deposited in an excavated area, below the level of the topsoil, or in an approved landfill site. Where possible, waste water and solids would be reused onsite.
Site Restoration Plan					• A **Site Restoration Plan** would be part of the Construction Environmental Management Plan. This would set out protocols for restoration works including Site preparation

Kyoto Energy Park Scone is wholly an Australian Enterprise. The Management is 100% Australian.
The funding of this proposal and report is 100% Australian.
An Australian Project

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