

Crookwell 3 Wind Farm Geotechnical

Purpose

Coffey Geotechnics Pty Ltd was engaged to assess the potential geotechnical impacts of the proposed Crookwell 3 Wind Farm.

The purpose of the assessment was to:

- assess the geological setting and its potential impact on the type, size and location of the wind farm infrastructure;
- consider any groundwater and slope stability issues;
- consider any geotechnical constraints that could affect the construction of access roads, hardstand and lay down areas; and
- consider the potential for soil erosion and/or soil/groundwater contamination, and the electrical resistivity and thermal conductivity of soils.

Key Findings and Impacts

The site has a generally hilly topography across both Crookwell 3 East and Crookwell 3 South.

There are no major geological issues that would prevent the construction of the Crookwell 3 Wind Farm, provided the recommendations of this study are followed and further investigation is undertaken at a later stage.

The Crookwell 3 East site was found to be between RL 828 metres and RL 940 metres with ground slopes of up to 30 degrees to the horizontal.

The Geological Survey of New South Wales (1973) Goulburn map sheet indicates that the general geology of the Crookwell 3 East site comprises Ordovician siltstones, sandstones and shales with associated residual soils which are distributed over the southern part of the site and the areas of lower elevation. The northern part of the site is underlain by Ordovician siltstones, sandstones and shales as well as Tertiary basalt flows.

The Crookwell 3 South site was found to be between RL 738 metres and RL 849 metres with ground slopes of up to 40 degrees to the horizontal.

The Geological Survey of New South Wales (1973) Goulburn map sheet indicates that the general geology of the Crookwell 3 South site comprises predominantly Siluro-Devonian Granites with associated residual soils.

Stratigraphy

The results of the test pits taken from the Crookwell 3 East site found that in the areas of Tertiary age volcanics, a layer of clayey silt topsoil 0.25 metres to 0.3 metres thick is present overlying residual clay soils to between 0.5 metres and 1.3 metres below the existing surface level.

Underlying the residual soils was 'extremely to highly' weathered basalt of 'low to medium' strength.

In the areas of Ordovician Age sedimentary deposits a layer of clayey, silty topsoil of approximately 0.2 metres to 0.3 metres was encountered. This overlay contained silty clay, sandy clay and clayey sand soils to depths of between 0.9 metres and 1.4 metres below the surface. The residual soils displayed varying degrees of weathering, of siltstone, sandstone and shale of varying strengths.

Although no excavation was undertaken at the Crookwell 3 South site, the surface soils were determined as a mix of silty sands, clayey sands and sandy clays overlying granite rock.

Groundwater and drainage

The assessment found that for most of the site the permanent groundwater is likely to be at least several metres below ground surface.

Due to the generally 'hilly topography' of the site, drainage during rain events is expected to occur relatively quickly and the local creeks would be expected to rise rapidly. As a result, erosion of non-vegetated surfaces is likely to occur. However, the site is generally well vegetated.

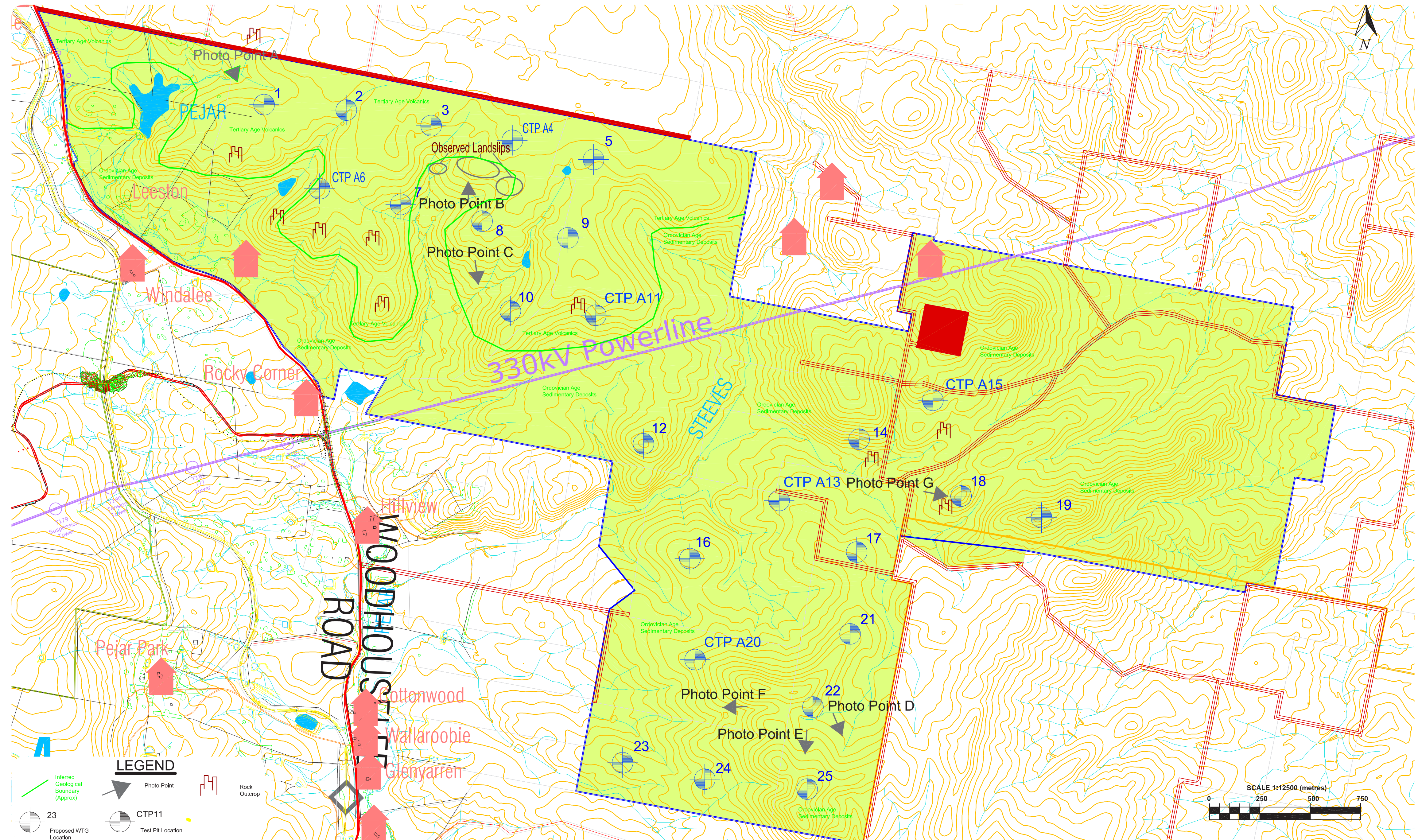


Figure 1: Geotechnical Investigation - Crookwell 3 East

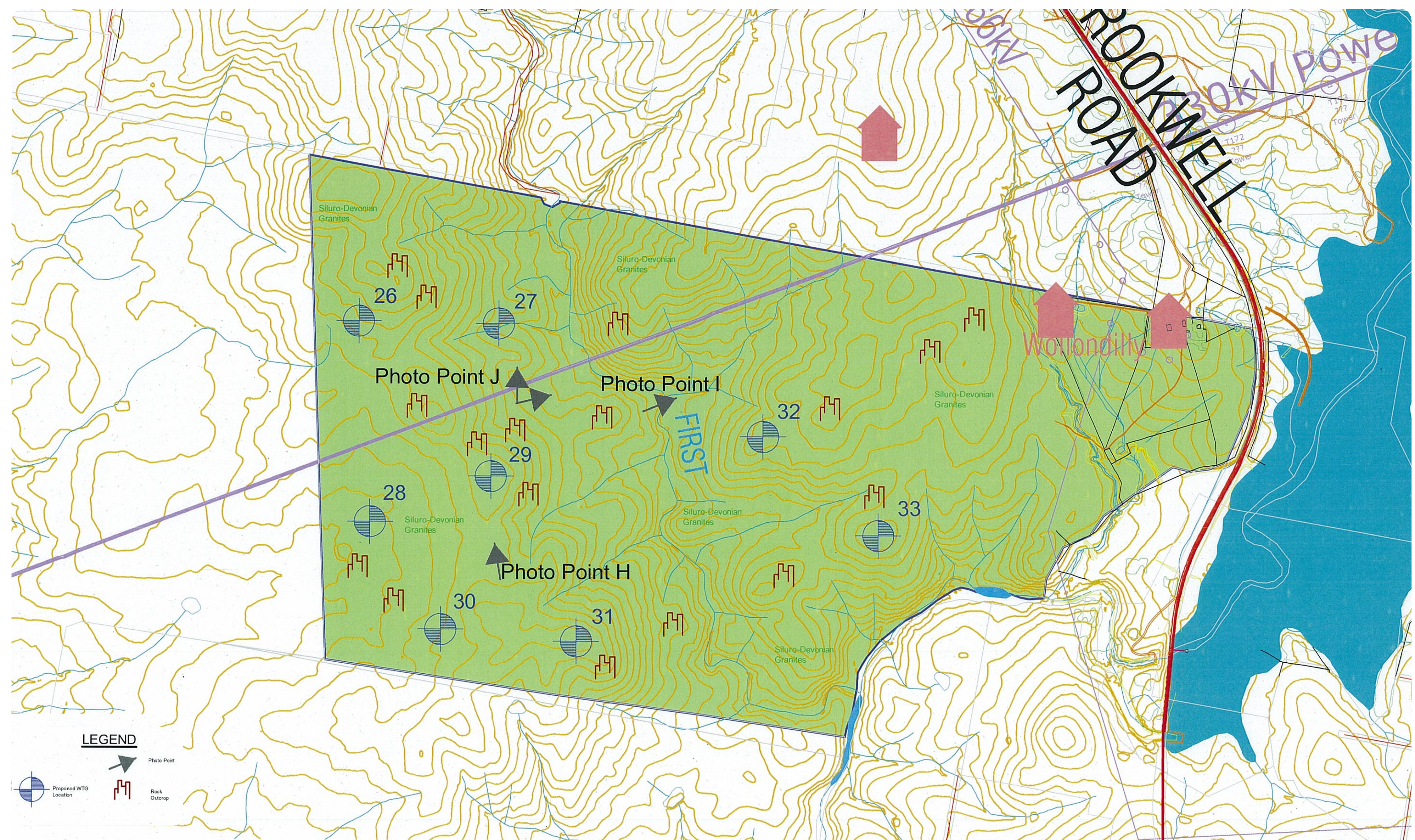


Figure 2: Geotechnical Investigation - Crookwell 3 South

Note: The geotechnical investigations were based on the initial proposed layout of 33 turbines. 3 turbines have since been removed in response to community concerns.

Footing Systems

Two main footing systems are available to be utilised for the wind turbine generators in this project. These consist of:

- gravity footings; and
- anchored footings.

The use of these different types of footings would largely rely on localised conditions at each individual turbine and economic factors.

The reinforced concrete gravity footings of the wind turbines are generally expected to be founded 1.5 metres to 3 metres below the ground surface.

Anchored footings involve a smaller pad footing restrained by subsurface anchors into rock.

The main parameter governing anchor design will be the allowable bond stress at the rock to grout interface.

Based on previous experience with wind farms, it would be expected that anchors may be constructed to a depth of about 12 metres.

Soil Erosion

A number of ancient landslides are present at Crookwell 3 East. The cause of the landslips was presumed to be associated with the contact between the Tertiary age basalts and the underlying Ordovician age sediments. However, no evidence of recent instability was observed during the Crookwell 3 East site investigation.

No evidence of natural slope instability beyond surface erosion was observed at the Crookwell 3 South site during the site walkover.

Response to Findings

The following recommendations and measures are proposed to mitigate any adverse geotechnical impacts:

- Further geotechnical investigations should be undertaken to provide information for the design of footings, access roads and other infrastructure;
- Further geotechnical investigations at the turbine sites to depths of about 20m are recommended to allow footing designs;
- Reduce clearing of natural vegetation and surface water runoff in the construction areas to reduce the likelihood of erosion along drainage channels on the site; and
- Drainage channels may require protection by rock beaching or similar.