1 June 2009
Project No. 43271059

Stockyard Hill Wind Farm Pty Ltd
Level 3, 765 Glenferrie Road, Hawthorn, VIC 3122

Attention: Peter Lausberg
Development Executive
CC : Vaughan Hulme
Development Executive

Dear Peter,

Subject: Desktop Review - Groundwater and Surface Water, Stockyard Hill Wind Farm

1.1 Introduction

This letter has been prepared by URS Australia Pty Ltd (URS) on behalf of Stockyard Hill Wind Farm Pty Ltd (SHWF) to provide further clarification in regard to the following matters that were raised during the public comment period associated with the SHWF planning application:

1. What will be the source of water requirements for the project and what are the likely impact on the source and the hydrological environment?

2. What are the potential impacts on groundwater from turbine construction?

URS understands that water requirements are temporary supply for concrete batching and dust suppression during construction phase.

This letter provides supplementary information to the URS report "*Stockyard Hill Wind Farm Desktop Review – Groundwater and Surface Water*", dated 6 November 2008.

1.2 Background Information

1.2.1 Location

The proposed wind farm is located in south-west Victoria, approximately 150km from Melbourne, and west of Ballarat. It is understood that installation of approximately 242 wind turbines and associated infrastructure including access roads, cabling and substations is proposed. The area of proposed turbines and associated infrastructure (the site) covers approximately 18,683ha and is centred around Stockyard Hill.

The local government is Pyrenees Shire Council, and the local catchment management authority is Glenelg Hopkins. The rural water authority for the site area is Southern Rural Water. The project area is zoned as farming zone by Pyrenees Shire Council Planning Scheme, with the land use consisting of freehold agricultural land.

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1.2.2 Geology

The surface geological units present within the area of the SHWF are summarised in the table below, based on the published geological maps for the area, and are shown in Figure 1. It is noted that Newer Volcanics basalt covers the majority of the area, with the St Arnaud Group outcropping to the north and Granite to the east. Swamp and lagoonal deposits generally occur in the Lake Goldsmith area and west towards Buln Gherin Swamp. Alluvial deposits occur in topographic lows and along surface water courses.

Geological Age	Lithological Unit	Description
Cambrian	St Arnaud Group	Sandstone, Shale and Mudstone (Cs)
Devonian	-	Granite, biotite granties, associated aplite and pegmatitie (Dgr)
Quaternary	Newer Volcanics	Olivine and iddingsite basalt, limburgite, scoria and minor tuff (Qvn)
	Newer Volcanics	Basalt, valley flows, stony rises (Qvh)
	-	Swamp and lagoonal deposits, silt, clay, peat, mud (Qrm)
	-	Stream alluvium, flood plain and low level terrace deposits, sand, silt, clay and gravel (Qra)

1.2.3 Hydrogeology

The site sits within Southern Rural Water's (SRW) area of jurisdiction, but is not located within a Groundwater Management Area or a Groundwater Supply Area.

Groundwater salinity beneath the site varies from <1,500 mg/L as TDS (total dissolved solids) in the area immediately west of Lake Goldsmith (corresponding to the Newer Volcanics stony rise deposits), to approximately 7,000 mg/L TDS to the north of the site.

The 1:250,000 Hydrogeological Map of Ballarat shows that inferred groundwater flow at the southern area of the site is towards the south, and at the northern area of the site inferred groundwater flow is towards the north.

1.2.4 Surface Water

Within the bounds of the project there exists two minor and several ephemeral water courses, numerous brackish lakes, and smaller swamps. The area is not registered by DSE as a designated Water Supply Protection Area.

There are a number of lakes within the site, including Lake Goldsmith and Black lake. Other water bodies exist within or close to the site including Buln Gherin Swamp (west of Lake Goldsmith) and Slate Lake (brackish lake to the south).

Two minor designated creeks, Fiery Creek and Mount Emu Creek, are present within the site. Fiery Creek flows along the northern and western bounds of the proposed wind farm. Mount Emu Creek runs to the east. These creeks have been classified as ephemeral by the Royal Australian Survey Corps.

1.3 Works Completed for this Investigation

The information collated in the previous URS report (November, 2008) and project water supply requirements as supplied by SHWF was reviewed, with consideration of the following:

- proposed concrete batching plant locations with respect to geology and potential aquifers;
- potential for local groundwater resources to meet project requirements (including yields, chemistry) and identification of data gaps; and
- potential impacts to surrounding waters and wetlands in consideration of potential groundwater extraction locations, to infer potential implications for associated flora and fauna communities as a result of groundwater utilisation for the project (and identification of data gaps).

On 14 May 2009, Amelia O'Neill (URS Hydrogeologist) and Ross Richards (SHWF) met with Ernie Welsh (Pyrenees Shire Council) to discuss groundwater usage in the area and to gain a better understanding of likely local groundwater yields and quality. The meeting also involved an inspection of several bores and springs used by the council and/or landowners. A summary of the data collected is included in Attachment A and the sites visited are shown on Figure 1. Where possible, water levels were measured in the bores and a field measurement of electrical conductivity (indication of salinity) and pH were recorded.

1.4 Results and Discussion

What will be the source of water requirements for the project and what are the likely impact on the source and the hydrological environment?

Three temporary concrete batching plants are proposed, to be established within the staging areas. The proposed location of the concrete batching plants is shown in Figure 1 attached. SHWF have estimated that 58.4ML of water, over 45 months, will be required for use in the concrete batching plants and dust suppression during the wind farm construction phase. This equates to a temporary water supply requirement of 0.043 ML/day (0.5L/sec) over a relatively short period of time (45 months).

Water for use during the construction phase could be sourced from groundwater. The search of the DSE Groundwater Management System as part of the URS report (November. 2008) indicated that there were 109 bores registered for stock and domestic use within 20km radius of Stockyard Hill. This suggests that water is of a reasonably good quality. The site reconnaissance confirmed that groundwater in the area is readily used by both the Council and landowners for stock and domestic use. Several windmills were noted while driving through the area, and 4 operational bores and 3 springs were visited.

There are two potential groundwater targets which could be further investigated for their suitability as a source for the temporary supply requirement, including the stony rise basalts (Newer Volcanics) and deep lead sediments.

Newer Volcanics Basalt

Information collated during both the desktop study and during the meeting and subsequent site reconnaissance indicated that groundwater within the stony rise basalts has a low salinity (<500 mg/L) and appears to have the capacity to yield the required 0.5L/sec. It appears that the lower salinity water is confined to the area surrounding and immediately south of Lake Goldsmith. The

groundwater salinity appears to be higher (>5,000 mg/L as TDS) in the northern portion of the site, which may preclude its suitability for concrete batching. It is noted that one concrete batching plant is proposed in this area, and therefore other water supply options, including trucking/piping may need to be considered.

The Newer Volcanics Basalt aquifer is expected to be recharged by direct rainfall infiltration. The soils across the site are expected to include generally very porous and/or shallow soils tending to minimise surface water, as it is routed to groundwater stores (Cayley and Mc Donald, 1995).

The surface water bodies within the site, including Lake Goldsmith, Black Lake and Buln Gherin, have all been referenced as brackish lakes on the Australian Survey Corps topographic maps. These surface water bodies were dry at the time of the site reconnaissance. Given the relatively low salinity of groundwater in the area immediately south of Lake Goldsmith, groundwater is likely to be hydraulically isolated from the brackish surface water bodies. Some smaller fresh water bodies are noted in the surrounding areas but these are outside the zone of any likely potential influence from groundwater extraction for the development. The creek systems are noted to be ephemeral and are therefore likely to recharge groundwater in times of flow. The extraction of groundwater is therefore not expected to have any impact on the surface water systems and their associated ecosystems.

Information on the sustainable yield from the aquifer is more difficult to determine, and the yield from an individual bore is dependent on the degree of fracturing and vesicularity of the basalt, and the extent to which these secondary porosity features are connected. Anecdotal evidence indicates that yields are likely to be in the order of 0.5-1 L/sec (*pers comm*., Ernie Welsh, 14 May 2009). The GMS data indicates that yields could be up to 10 L/sec, however this is considered to be an exception.

URS has visited an artesian bore located on a landowner's property near the corner of Beaufort-Carranballac Rd and Mt William Road (refer to Figure 1), as part of another project. Information collated at that time indicated that this bore was approximately 20m deep with a free flow yield of 12.5L/sec and a salinity of 1,000 mg/L TDS.

Groundwater is noted at several locations within the stony rise basalts at surface (springs). The proposed concrete batching plant locations do not appear to be in close proximity to any of the springs observed during the site reconnaissance. These springs are utilised by a number of landowners for stock and domestic use. Three springs were visited as part of the site reconnaissance and salinity tested at <500mg/L (as TDS). These springs are considered to be groundwater discharge or "exit" points. The springs most likely occur as a result of permeable portions of the Newer Volcanics outcropping, which allows groundwater to discharge to the surface. The presence of rocky basalt outcrops and the low salinity groundwater also suggests that this area is a zone of preferential rapid recharge into the aquifer.

The utilisation of the Newer Volcanics basalt as a water supply for the SHWF could lower the water table and therefore potentially lead to a reduction in flow within springs and/or available yields from landowner bores installed in this aquifer. However, considering the low extraction rates estimated (0.5L/sec) and the relatively short time period for extraction (45 months), the water table is likely to be only depressed in a local area around the production bore and no significant impact on the regional water table is expected. Aquifer testing would need to be completed to confirm the sustainable yield.

Deep Lead Sedimentary Aquifer

A buried palaeovalley (deep lead) may be present beneath the basalts beneath and/or in the near vicinity of the site. A paper recently published in Journal of Hydrology "*Strontium isotopes to delineate aquifer interactions and the influence of rainfall in basalt plains of southeastern Australia*", Raiber et al. 2009, discusses the interaction between the basalt aquifer and the underlying deep lead.

The deep lead sediments reportedly cover an approximate area of 2,500 km^2 and consist of several tributaries running from Ararat in the north to somewhere east of Mt Fyans in the south. These buried sediments are thought to be the stratigraphic equivalent of the Eastern View Formation, which is of late Miocene to Palaeocene age, and a sub-catchment of the Otway Basin. The deep lead sediments are most likely recharged by leakage from the overlying basalt.

There was no indication of bores installed in the deep lead sediments during the site reconnaissance. However, the GMS database indicates that bore 62734 located to the south west of Lake Goldsmith encountered course sands between 106 and 115m depth. There is no available quality or yield information on the database for these deposits in the study area. However, the deep lead sediments are expected to have a similar salinity to the overlying basalts and could have the potential to yield significant volumes.

Utilising the deep lead sediments as a water supply is unlikely to have any significant impacts on surface water bodies, springs or existing bores, given that water would be sourced from a different and somewhat hydraulically isolated aquifer. However, the following should also be noted with regard to pursuing the deep lead sediments for temporary groundwater supply:

- Greater cost of installing a production bore given the greater depth involved. This is likely to be significant (more than double the costs of a bore targeting the basalt); and
- The thickness and extent of the deep lead sediments beneath the site are not well understood and therefore there is a risk that they will not be encountered.

What are the potential impacts on groundwater from turbine construction?

The potential impacts on groundwater from turbine construction are expected to be minimal and could be mitigated through appropriate construction management processes, including the management of water and sediment run-off. EPA Publication 628 "The Environmental Guidelines for the Concrete Batching Industry", dated June 1998, states that a concrete batching plants must be located in areas where they will not pose a hazard to the environment or the amenity of the local community. These guidelines suggest the following measures to ensure contaminated wastewater is not discharged from the concrete batching plant to surface waters, groundwater or land:

- Minimise the area of the site which generates contaminated stormwater runoff.
- Provide a separate dedicated drainage system to discharge clean stormwater from the site.
- Drain all contaminated stormwater and process wastewater to a collection pit for recycling.
- Regularly clean out solids that accumulate in the pit.
- The wastewater recycling system must be able to store the contaminated runoff generated by 20mm of rain in 24hours.
- Use wastewater stored in the recycling system at the earliest opportunity.

- There must be no dry weather wastewater discharge at the site.
- Monitor wet weather discharge for pH and suspended solids. Retain the records.

Groundwater salinity is variable beneath the site. However, it is expected that any groundwater extracted for use in the concrete batching plant would have a salinity less than 1,000mg/L. If this water is also utilised for dust suppression, it is unlikely to have any negative impacts on flora and fauna.

1.5 Summary and Conclusion

The desktop study and site reconnaissance have indicated that groundwater beneath the site, particularly in the southern portion, is likely to be suitable for use in the concrete batching plant.

As discussed above, if groundwater is utilised as a water supply for the concrete batching plants, there is not expected to be any significant impacts on the regional water table given the low volumes required. Significant impacts to the springs, which potentially support wetlands in the area, are not expected based on the temporary yields required, the distance from proposed concrete batching plants to springs which were identified, and in the context of current apparent utilisation of the Newer Volcanics aquifer.

Creeks and surface water bodies are likely to act generally as groundwater recharge zones and are therefore considered unlikely to be impacted by additional groundwater extraction from the basalt and/or deep lead aquifer. The brackish nature of lakes in the site area indicates that those lakes are not likely to be in hydraulic connection with groundwater, and as such would not be affected by groundwater extraction.

It is therefore considered reasonable to infer that flora and fauna associated with surface water environments are unlikely to be impacted by the temporary extraction of groundwater for the proposed windfarm, based on this desktop assessment.

Site works would be required to collate site specific data to confirm the groundwater suitability, and to provide supporting information that impacts of the temporary groundwater extraction would be minimal. Site works would include, but not be necessarily limited to:

- Drilling and installation of a test production bore in the near vicinity of one or all of the concrete batching plant locations (Note a bore construction licence would be required from SRW);
- Pumping and recovery test on any installed bores to provide an estimate of sustainable yield; and
- Water quality sampling to test whether the water chemistry is suitable for concrete mixing.

It should be noted that any proposal to extract groundwater would require an Extraction Licence from SRW. It is likely that SRW would require a more detailed hydrogeological assessment to be completed prior to the issue of the Extraction Licence, in accordance with SRW's requirements for licensing attached as Attachment B.

1.6 Statement of Limitations

URS Australia Pty Ltd (URS) has prepared this report in accordance with the usual care and thoroughness of the consulting profession for the use of Stockyard Hill Wind Farm Pty Ltd and only those third parties who have been authorised in writing by URS to rely on the report. It is based on generally accepted practices and standards at the time it was prepared. No other warranty, expressed or implied, is made as to the professional advice included in this report. It is prepared in accordance with the scope of work and for the purpose outlined in the Proposal dated 24 April 2009..

The methodology adopted and sources of information used by URS are outlined in this report. URS has made no independent verification of this information beyond the agreed scope of works and URS assumes no responsibility for any inaccuracies or omissions. No indications were found during our investigations that information contained in this report as provided to URS was false.

This report was prepared in May 2009 and is based on the conditions encountered and information reviewed at the time of preparation. URS disclaims responsibility for any changes that may have occurred after this time.

This report should be read in full. No responsibility is accepted for use of any part of this report in any other context or for any other purpose or by third parties. This report does not purport to give legal advice. Legal advice can only be given by qualified legal practitioners.

This report contains information obtained by inspection, sampling, testing or other means of investigation. This information is directly relevant only to the points in the ground where they were obtained at the time of the assessment. The borehole logs indicate the inferred ground conditions only at the specific locations tested. The precision with which conditions are indicated depends largely on the frequency and method of sampling, and the uniformity of conditions as constrained by the project budget limitations. The behaviour of groundwater and some aspects of contaminants in soil and groundwater are complex. Our conclusions are based upon the analytical data presented in this report and our experience. Future advances in regard to the understanding of chemicals and their behaviour, and changes in regulations affecting their management, could impact on our conclusions and recommendations regarding their potential presence on this site.

Where conditions encountered at the site are subsequently found to differ significantly from those anticipated in this report, URS must be notified of any such findings and be provided with an opportunity to review the recommendations of this report.

Whilst to the best of our knowledge information contained in this report is accurate at the date of issue, subsurface conditions, including groundwater levels can change in a limited time. Therefore this document and the information contained herein should only be regarded as valid at the time of the investigation unless otherwise explicitly stated in this report.

We trust this letter has adequately addressed the matters that were raised during the public comment period associated with the SHWF planning application. If you require any additional information, please do not hesitate to contact the undersigned on 03 8699 7500.

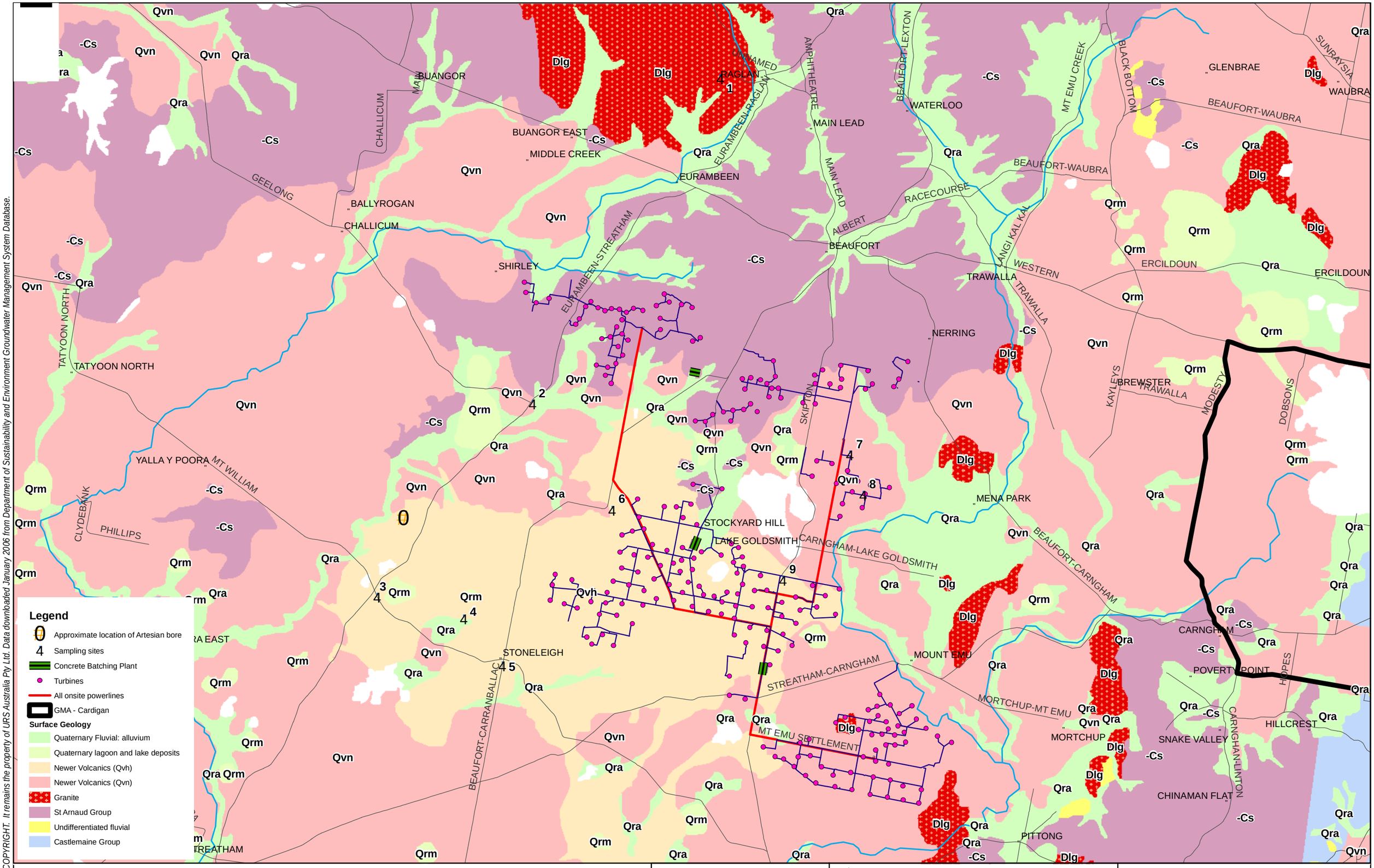
Yours sincerely
URS Australia Pty Ltd

Amelia O'Neill
Associate Hydrogeologist

Phillip Bayne
Principal Hydrogeologist

Attachments

Attachment A Notes from Site Reconnaissance
Attachment B Southern Rural Water requirements for Groundwater Extraction Approval
Figure 1 Site Layout with Surface Geology and Sample Sites



Legend

- Approximate location of Artesian bore
- Sampling sites
- Concrete Batching Plant
- Turbines
- All onsite powerlines
- GMA - Cardigan

Surface Geology

- Quaternary Fluvial: alluvium
- Quaternary lagoon and lake deposits
- Newer Volcanics (Qvh)
- Newer Volcanics (Qvn)
- Granite
- St Arnaud Group
- Undifferentiated fluvial
- Castlemaine Group

0 1.25 2.5 5 7.5 10 km

Client: STOCKYARD HILL WINDFARM PTY LTD	Project: PROPOSED STOCKYARD HILL WINDFARM DESKTOP STUDY			Title: **SITE LAYOUT WITH SURFACE GEOLOGY AND SAMPLE SITES**	
URS	Designed: AON	Checked:	Date: May 2009	Job No.: 43271059	Rev. A
	Drawn: LLB	Approved:	Status: FInal	File No.: Site Layout.mxd	A3
				Figure 1	

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13 October 2009
Project No. 43271059

Origin Energy
Level 3, 765 Glenferrie Road,
Hawthorn, VIC 3122

Attention: Vaughan Hulme
Development Executive

Dear Vaughan,

Subject: Desktop Review - Groundwater and Surface Water, Stockyard Hill Wind Farm

1.1 Introduction

URS Australia Pty Ltd (URS) has been asked by Origin Energy to provide further clarification in regard to the nature and extent of potential impacts on the local aquifer(s) from the turbine construction of the Stockyard Hill Wind Farm (SHWF).

It has understood that concern over this issue was raised during the public comment period associated with the planning application.

This letter provides supplementary information and should be read in conjunction with:

- URS's letter dated 1 June 2009; and
- URS Report "Stockyard Hill Wind Farm Desktop Review – Groundwater and Surface Water", dated 6 November 2008.

1.2 Objective

The purpose of this letter is to provide a further assessment on the potential impacts to groundwater from turbine construction, specially the installation of foundations. URS have not considered in this letter the impacts from road construction or extraction for water supply.

The following broad category of impacts to the groundwater system have been considered:

- reduction in rainfall recharge to the aquifer from "capping" of outcrop;
- change/modification in the groundwater flow path from foundations; and
- change in the physical and/or chemical properties of the aquifer.

1.3 Turbine Construction

URS have been provided with a preliminary design for the turbine foundations by Origin Energy (refer to Attachment A). The design plans show that the turbine foundations will be constructed as a concrete slab to a maximum depth of 2.4 metre below ground surface. It is noted that the design is generic and that there will need to be some modification at each site based on specific geotechnical properties encountered. However, for the purpose of this assessment any

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modification from this general design is unlikely to be significant in regards to impacts to groundwater.

The design aspect assumes that the concrete foundations will sit above the water table and that no dewatering will be required as part of the foundation construction. This assumption is considered to be valid, given that turbine construction is on topographic highs, where depth to water is typically greatest.

1.4 Geology and Hydrogeology

The uppermost geological units present within the area of the SHWF are summarised in the table below, based on the published geological maps for the area, and are shown in Figure 1.

It is noted that Newer Volcanics basalt covers the majority of the area, with the St Arnaud Group outcropping to the north and Granite to the east. Swamp and lagoonal deposits generally occur in the Lake Goldsmith area and west towards Buln Gherin Swamp. Alluvial deposits occur in topographic lows and along surface water courses.

Geological Age	Lithological Unit	Description
Cambrian	St Arnaud Group (basement)	Sandstone, Shale and Mudstone (Cs)
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	-	Swamp and lagoonal deposits, silt, clay, peat, mud (Qrm)
	-	Stream alluvium, flood plain and low level terrace deposits, sand, silt, clay and gravel (Qra)

The main aquifers within the SHWF area are expected to occur within the St Arnaud Group (basement), Devonian aged granites, Newer Volcanics basalt and recent aged alluvial sequences:

Basement

The northern section of the SHWF sits on the basement formation of the St Arnaud Group. Aquifers of the basement typically have a low transmissivity and salinities which reduce the beneficial use to some limited stock watering (>5,000 mg/L - Total Dissolved Solids). The depth to water varies with topography but is expected to be greater than 5 metres below ground surface (mbgs).

Devonian Granites

No turbines are proposed in the area to the east or north where the granite formation outcrops. Therefore there is no potential impact to the granite aquifer(s) from turbine construction.

Newer Volcanics

The majority of the turbines sit on the Newer Volcanics basalt. The hydrogeological characteristics of the basalt aquifer(s) are highly variable and dependent on the extent of fracturing. The Stony Rise sequence of the Newer Volcanics is present on the surface in the southern part of the site and groundwater is likely to have a relatively high beneficial use, due to high yield potential and low salinity. It has been noted that this basalt sequence is the primary target in the area for stock and domestic use, via windmills, springs and/or groundwater bores.

The Stony Rise sequence occurs at the surface as a distinctive rocky basalt ridgeline and is typically an important zone of local recharge to the underlying aquifer units. Groundwater beneath these areas can have low salinity (<1,000 mg/L TDS) such as seen in the southern area of SHWF.

Recent Alluvial

All the alluvial sequences in the SHWF are within the base of gullies and low lying wetland/swamps areas, and as such are some distance from any of the turbines. Therefore there is no potential impact to the alluvial aquifer(s) from turbine construction.

Regional Groundwater Flow Directions

The 1:250,000 Hydrogeological Map of Ballarat shows that inferred groundwater flow at the southern area of the site is towards the south, and at the northern area of the site inferred groundwater flow is towards the north.

1.5 Discussion of Potential Impacts

The potential impacts on the aquifers and groundwater from turbine construction are expected to be minimal, given that the foundations will sit above the water table.

Reduction in Recharge

The turbine construction is not expected to have any observable impacts on the amount of recharge to the various aquifer systems. Although there is likely to be some very small portion of the recharge zone that will be “capped” by the turbine and its base, any rainfall will run-off the concrete surface and directly into the subsurface immediately adjacent without any material change in the coefficient of infiltration.

Change in Groundwater Flow

There is not expected to be any change or restriction in the groundwater flow path, within any of the various aquifers across SHWF, as no aspect of the foundation is anticipated to intercept the water table. The entire foundation will sit within the unsaturated zone.

Change in the Physical and Chemical Characteristics

No impact to the aquifer properties is expected from the turbine construction. The excavation works could theoretically cause localised increased fracturing if a rock breaker is used, however this is not expected to have any negative impacts.

It is assumed that the introduction of concrete into the surface will be managed in such a way as to prevent the loss of grout into the aquifer system.

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Yours sincerely
URS Australia Pty Ltd

Amelia O'Neill
Associate Hydrogeologist

Bryan Chadwick
Senior Principal

Attachments

Attachment A Preliminary Foundation Design
Figure 1 Site Layout with Surface Geology