APPENDIX D

SITE INVESTIGATION METHODOLOGY

Stantec

Memo

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SITE INVESTIGATION METHODOLOGY MEMO

Stantec Australia Pty Ltd (Stantec) intends on conducting a geotechnical investigation at the proposed Bookham Windfarm at Bookham, NSW. This memo outlines methodology Stantec intends to follow to undertake borehole drilling and excavation of test pits.

Heritage and environmental consideration
Stantec will not undertake any fieldwork until environmental considerations such as heritage and ecology have allowed the fieldwork to occur with these requirements provided by Squadron Energy Services Pty Ltd (SQE).

Access tracks
Intended access tracks will be communicated to SQE prior to mobilising to investigation locations. Noting the site conditions, it is likely the floats/flatbed trucks will be driven as far as possible toward investigation locations prior to unloading. Unloading away from the investigation may be required due to insufficient grade and gate access for floats or creek crossings the trucks are unable to pass. Access will also be undertaken along existing roads/farm tracks as far as feasibility possible prior to moving toward investigation locations. No clearing of material to gain access is proposed.

Underground service clearance
Prior to any ground disturbance, Stantec will undertake due diligence regarding underground services which includes performing a BYDA search. A qualified service locator will search and clear if any test location that is within 200m of existing roads or house, or if any services present on retrieved BYDA plans.General review of site area for the potential presence of services will be undertaken prior to breaking ground. Following underground service checks, an internal permit to dig will be completed by theStantec site geotechnical engineer.

Drilling of Boreholes
Stantec intends on drilling boreholes using a Hanjin D&B 8D tracked drill rig. The following methodology describes the process;

- Drill rig is tracked off back of flatbed truck by driller using a remote controlling device.
- Drill rig is positioned at borehole location and outriggers are deployed for stability. Ground needs to be relatively level and suitable enough to safely support the drill rig, which will be assessed by the site geotechnical engineer and driller during setup.
- Drill rig mask is lifted so that it is 90 degrees to the ground.
- Coring barrels, augers, extension tubes and other accessories are typically stored on the drill rig
- Drilling of boreholes typically starts with solid flight auguring. Maximum auger hole size for this project will be 150mm diameter.
    - A continuous flight auger is used to drill the ground and is lifted by a mechanism fixed on the mask or by winches also on the mask.
    - Stantec geotechnical engineer assesses cuttings from the auger and auger can be lifted using a winch or the drilling mechanism to obtain soil samples.
    - Driller communicates drilling resistance with Stantec geotechnical engineer.
- A SPT test is undertaken at intervals at the discretion of Stantec Engineer, but typically every 1.5m which involves removing auger from the hole
    - SPT spoon is inserted to the current drill depth of the borehole on the end of a rod which extends to just above ground level. The SPT hammer is lowered onto the top of the rod and an automatic safety hammer fully enclosed within the SPT device begins to hammer the SPT splitspoon into the ground. Typical penetration depth is 450mm, however this may not be achieved due to encountering hard soil or rock.

    - Number of blows per 150mm are recorded which are used to determine the soils engineering properties.
    - SPT spoon is removed and split open by the driller/drillers offsider for Stantec geotechnical engineer to assess and store sample
- Coring is undertaken when confidence that rock depth has been achieved which involves;
    - Placing a 'mud tank' next to borehole which cycles water used to flush the hole while drilling, typically 300-500L in volume. Water is carried in IBC tanks on a ute and/or on the flatbed truck. A pump is located on the drill rig which pumps water from the tank into the drill rigs internal water system and 'mud tank' or is alternatively gravity fed.
    - A casing tube is drilled into the ground which gives the hole stability and creates a seal so water can be returned to the mud tank.
    - A coring barrel that includes a diamond impregnated drill bit lowers into the hole using winch on drill rig.
    - Coring barrel spins at high speed and cuts into the rock in the ground, water is injected through the core barrel and returns through the casing and into the mud tank.
    - Segments of up to 3m can be advanced before the core barrel has to be removed from the hole via winch, and placed onto a rack.
    - The drill bit is removed, and water pump is used to push an inner split tube out of the core barrel.
    - Stantec geotechnical engineer removes core from split tube and places into a core box. Core may need to be broken in sections in order to fit into the box.
- Apon target drill depth, the water in the mud tank is sprayed and spread evenly to dry. If required for environmental purposes the used water can be retuned into the IBC tank, however the current intention is to spread the water evenly around the borehole area.
- All attachments used are typically placed back onto the drill rig to reduce manual labour involved.
- Mast is lowered before outriggers are retracted.
- Drill rig either tracks to next location or is trafficked back onto the flatbed truck.
- Hole is backfilled with drill cuttings, or groundwater well is installed. Groundwater well install involves feeding various PVC blank and screen pipes in to the borehole, backfilling the hole with clean sand and sealing the top with bentonite.

Photo 1: Drill rig on truck. Photo credit: Drill Wise Services Pty Ltd (Drill Wise)

Photo 2: Drill rig in operation, Photo credit: Drill Wise Services Pty Ltd (Drill Wise)

Photo 3: Core removed from core barrel. Photo Credit: Stantec

Testpit Excavation

Stantec intends on using a 14T excavator to excavate test pits. The following methodology describes the process:

- Excavator is tracked off flatbed truck or float trailer by operator.
- Excavator typically uses various bucket types with toothed buckets for excavation and a wide 'mud' bucket to push stockpiled material from the test pit around or back in to the test pit in completed. Test pit area will be maximum 1m wide by 3m long.
- Soil is typically placed adjacent to test pit hole in stockpiles ordered in sequence of material type as it is removed from the test pit.

- Stantec geotechnical engineer assesses soil as it is removed from the hole and collects appropriate samples.
- During test pitting operations, the Stantec geotechnical engineer will also undertake Dynamic Cone Penetrometer (DCP) testing which involves manually lift and dropping a 9kg weight 510mm to test penetration resistance in the subsurface, with testing proposed to be completed to 3m depth.
- Excavator operator communicates digging resistance with Stantec geotechnical engineer
- Bucket may need to be swapped to a ripper as ground becomes harder or weathered rock is encountered however this will typically result in completion/refusal of the test pit.
- Apon refusal or target depth, Stantec geotechnical engineer places survey staff into test pit and takes relevant photos of the profile as well as the excavation material
- Excavator backfills test pit with the material in the same sequence it came out (ie material from the bottom goes back in first) and levels ground around location to remove trip hazards or potential for holes as the test pit backfill settles.
- Excavator is tracked to next location or is tracked back onto float or flatbed truck by operator.

Photo 4: Excavator on float. Photo Credit Yass Earth Movers

Photo 5: 14T excavator using ripping bucket in approx. 3m deep test pit Photo credit: Stantec

Photo 6: 5T excavator with mud (wide) bucket and toothed bucket (attached to excavator arm) Photo credit: Stantec

Photo 7: photo of completed test pit with survey staff Photo Credit: Stantec

Yours sincerely,

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