Appendix F

AIR QUALITY IMPACT ASSESSMENT

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Powering Sydney's Future
TransGrid

Potts Hill to Alexandria transmission cable project

Air Quality Impact Assessment

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Air Quality Impact Assessment

Client: TransGrid

Co. No.: 609 169 959

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Glossary, acronyms and abbreviations

Glossary

Term	Definition
Amenity	The quality of a place, its appearance, feel and sound, and the way its community experiences the place. Amenity contributes to a community's identity and its sense of place.
Bund	An embankment designed to retained fluids.
Busbar	A series of elevated metallic bars within an electrical substation which comprises a system of electrical conductors on which power is concentrated for high capacity distribution.
Cable bridges	A purpose built bridge made typically of reinforced concrete structures, through which the transmission cables are integrated for support and protection.
Cable circuit	A series of three phase alternating current transmission cables which make up an electrical circuit to carry an electrical current. A single circuit transmission cable typically comprises a minimum of three cables per circuit.
Community	A group of people living in a specific geographical area or with mutual interests that could be affected by the project.
Conduit	A protective tube or pipe system for individual electric cables. Sometimes referred to as a 'duct'.
Construction	Includes all physical work required to construct the project and also includes construction planning such as the development of construction management plans.
Construction laydown areas	Areas required for temporarily storing materials, plant and equipment and providing space for other ancillary facilities, such as project offices, during construction. Some construction laydown areas would be used for stockpiling.
Demolition	Any activity involved with the removal of an existing structure (or structures).
Deposited dust/dust soiling	Dust that has fallen out of suspension in the air and which has settled onto a surface.
Detailed design	The stage of the project following concept design where the design is refined, and plans, specifications and estimates are produced, suitable for construction.
Dust	Solid particles that are suspended in air or have settled out onto a surface after having been suspended in air. The terms dust and particulate matter (PM) are often used interchangeably. In this report the term 'dust' has been used to include the particles that give rise to soiling, and to human health and ecological effects.
Earthworks	All operations involved in loosening, excavating, placing, shaping and compacting soil or rock.
Easement	A 'right of way' around infrastructure that allows access to authorised personnel for inspections, repairs and maintenance. The establishment of an easement also restricts certain activities on the land that could endanger members of the public or impact on the safe operation of the infrastructure.
Effects	The consequences of the changes in airborne concentrations and/or dust deposition for a receptor.

Term	Definition
Egress	Exit.
Embankment	An artificially raised structure (usually an earthen or gravel wall) used especially to hold back water (to prevent flooding) or to carry a roadway/rail line (across low-lying or wet areas).
Erosion	A natural process where wind or water detaches a soil particle and provides energy to move the particle.
Fill	The material placed in an embankment
Frac-out	A release of drill slurry at a fracture zone which has occurred on the surface through the building up of pressure in the bore hole.
Hazard	A source of potential harm that can cause injury/loss of human life and/or damage to the environment or property.
Impact	Influence or effect exerted by a project or other activity on the natural, built and community environment.
Infiltration	The downward movement of water into soil and rock. It is largely governed by the structural condition of the soil, the nature of the soil surface (including presence of vegetation) and the antecedent moisture content of the soil.
inner Sydney	Includes the Sydney Central Business District (CBD) and eastern suburbs.
Joint bay	An enlarged section of excavated trench in which cables are joined together.
PM_{10}	Airborne particulate matter with an aerodynamic diameter of less than 10 µm.
$PM_{2.5}$	Airborne particulate matter with an aerodynamic diameter of less than 2.5 µm.
Pre-construction	All work prior to, and in respect of the state significant infrastructure, that is excluded from the definition of construction.
Project area	The project area comprises the overall potential area of direct disturbance by the project, which may be temporary (for construction) or permanent (for operational infrastructure) and extend below the ground surface. The project area includes the location of operational infrastructure and construction work sites for: • the transmission cable route (including the entire road reserve of roads traversed); • special crossings of infrastructure or watercourses; • substation sites requiring upgrades (noting that all works would be contained within the existing site boundaries); and • construction laydown areas.
Road reserve	The area comprising roads, footpaths, nature strips and public transport infrastructure (including indented bus bays, bus shelters and bus stop signage).
Risk	The likelihood of an adverse event occurring.
Secretary's Environmental Assessment Requirements (SEARs)	Requirements and specifications for an environmental assessment prepared by the Secretary of the NSW Department of the Planning and Environment under section 5.16 of the *Environmental Planning and Assessment Act 1979* (NSW).
Sediment	Material, both mineral and organic, that is being or has been moved from its site of origin by the action of wind, water or gravity and comes to rest either above or below water level.

Term	Definition
Sensitive receiver/receptor	Includes residences, educational institutions (including preschools, schools, universities, TAFE colleges), healthcare providers (including nursing homes, hospitals), religious facilities (including churches), child care centres, passive recreation areas (including outdoor grounds used for teaching), active recreation areas (including parks and sports grounds), commercial premises (including film and television studios, research facilities, entertainment spaces, temporary accommodation such as caravan parks and camping grounds, restaurants, office premises, retail spaces and industrial premises).
state significant infrastructure (SSI)	Infrastructure projects for which approval is required under Division 5.2 of the NSW *Environmental Planning and Assessment Act 1979*.
Switch bay	Part of a substation within which the switch and control equipment relating to a given circuit are contained.
Transmission cable	An insulated wire that conducts an electrical current at voltages greater than 132 kV.
Trackout	The transport of dust and dirt from the construction/demolition site onto the public road network, where it may be deposited and then re-suspended by vehicles using the network.
Underboring	This is a trenchless method for installing cables involving passing the conduits under infrastructure (such as a road or railway corridor) or a watercourse. Underboring could be via thrust boring (also known as micro tunnelling) or horizontal directional drilling.
Warning tape	Tape that is buried directly above underground services to provide visual warning during subsequent excavation.
Work site	A specific section of the project area for carrying out project construction activities such as trenching and excavation, establishment of a joint bay or installing a cable bridge. The work site would be fenced off from public access and may include associated activities such as traffic management measures.

Abbreviations and acronyms

Abbreviation/ Acronym	Definition
µm	Micrometres
ACT	Australian Capital Territory
AQMP	Air Quality Management Plan
BoM	Bureau of Meteorology
CEMP	Construction Environmental Management Plan
CO	Carbon monoxide
CO_2	Carbon dioxide
DECC	NSW Department of Climate Change (now OEH)
DPE	NSW Department of Planning and Environment
EIS	Environmental Impact Statement
EP&A Act	*Environmental Planning and Assessment Act 1979* (NSW)
EPA	Environment Protection Authority
H_2S	Hydrogen sulfide
IAQM	(UK) Institute of Air Quality Management
kV	Kilovolt
LFG	Landfill gas
LGA	Local Government Area
PPM	Parts per million
NSW	New South Wales
OCE	Odour Control Enclosure
OEH	Office of Environment and Heritage (Formerly DECCW)
Ou	Odour Units
TSP	Total suspended particulate (matter)
UK	United Kingdom

Executive summary

TransGrid is the manager and operator of the major high-voltage electricity transmission network in New South Wales (NSW) and the Australian Capital Territory (ACT). TransGrid is seeking approval under Division 5.2 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) for the construction and operation of a new 330 kilovolt (kV) transmission cable circuit between the existing Rookwood Road substation in Potts Hill and the Beaconsfield West substation in Alexandria (the project).

An air quality impact assessment of the construction works associated with the project was undertaken by means of a qualitative risk assessment. The assessment was undertaken in accordance with the NSW Approved Methods (NSW, 2016), in terms of pollutant criteria and general approach. However, due to the linear progression of the work sites and the relatively short periods of construction at any given point along the transmission cable route, a quantitative air dispersion modelling assessment in accordance with the Approved Methods was not deemed necessary to show compliance with air quality criteria.

Potential dust emissions from the project were assessed using the methodology provided in the UK Institute of Air Quality Management (IAQM) guideline, *Guidance on the assessment of dust from demolition and construction* (IAQM, 2014). A ‘worst case’ dust emission scenario was defined for assessment using the IAQM guideline method. A pre-mitigation dust impact risk rating of Medium was determined for dust soiling and Medium for human health impacts. This rating was based on the potential dust emission magnitude from the project, sensitivity of nearby receptors, proximity of receptors, and the sensitivity of the project area as a whole to both dust soiling and human health impacts. The ratings are considered to be applicable to the entire project area. Residual impacts once appropriate dust mitigation measures are implemented were considered to be not significant, in accordance with the post-mitigation reassessment guidance provided in the IAQM guideline.

In addition to dust, potential odour impacts during excavation activities were identified at several locations along the transmission cable route, including Camdenville Park, St Peters, and Sydney Park, Alexandria, due to possible presence of landfill gas. However, only small amounts of landfill gas are expected to be encountered and excavation works in any single area would likely be short term and temporary in nature, so potential odour impacts are not expected to be significant. A range of site-specific odour mitigation measures were identified. The implementation of these measures during the project is considered sufficient to minimise the potential for off-site odour impacts.

1.0 Introduction

TransGrid is the manager and operator of the major high-voltage electricity transmission network in New South Wales (NSW) and the Australian Capital Territory (ACT). TransGrid is seeking approval under Division 5.2 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) for the construction and operation of a new 330 kilovolt (kV) underground transmission cable circuit between the existing Rookwood Road substation in Potts Hill and the Beaconsfield West substation in Alexandria (the project).

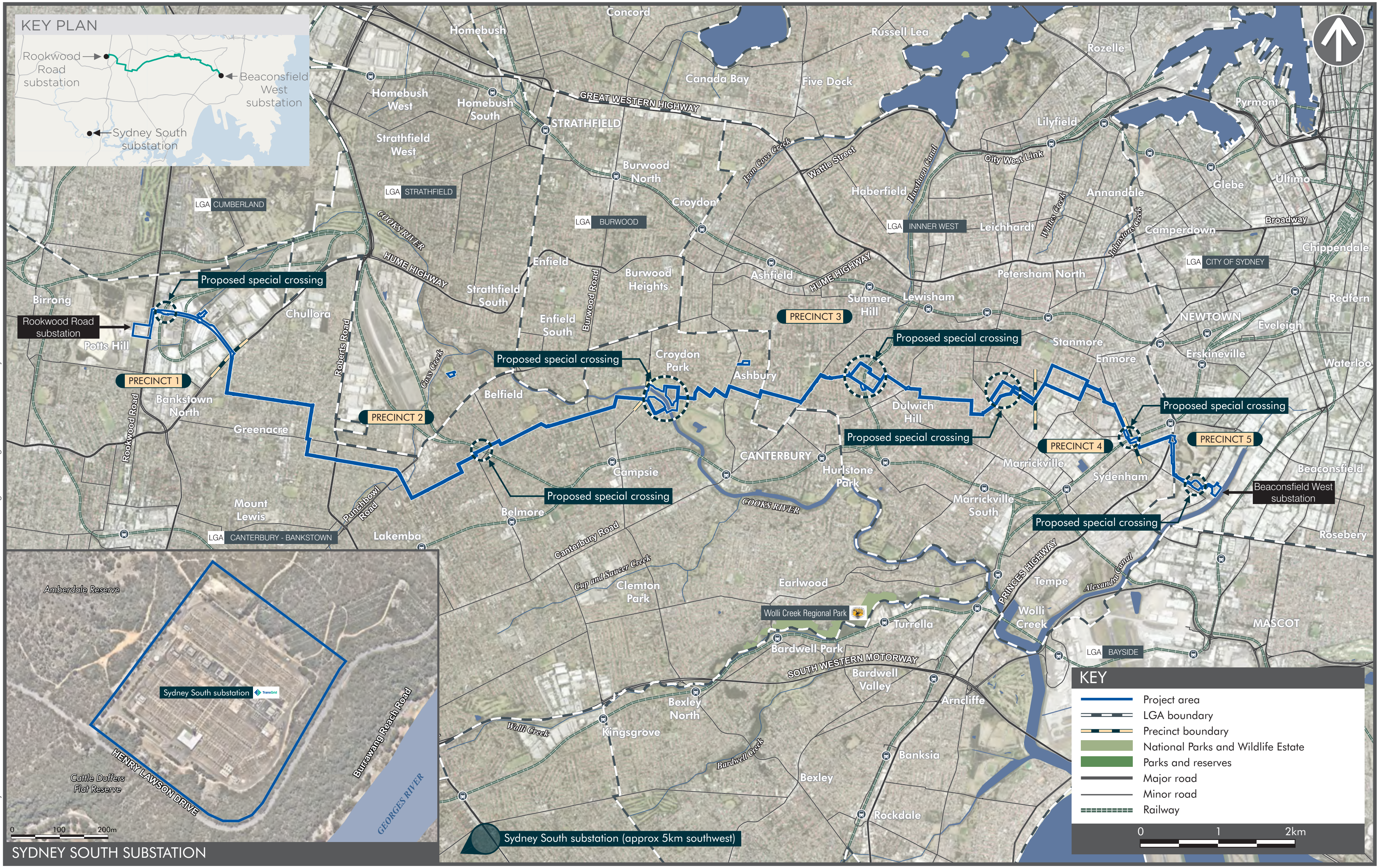
The project has been identified as a solution to address existing issues in the electricity supply network for inner Sydney, which is characterised by ageing and deteriorating electricity infrastructure and forecast increases in consumer demand.

As the project is state significant infrastructure under section 5.12 of the EP&A Act, an Environmental Impact Statement (EIS) has been prepared to assess the impacts of the project. This technical report has been developed in support of the EIS.

1.1 Project overview

The transmission cable circuit would be about 20 kilometres long and would generally be located within existing road reserves, at existing electrical infrastructure sites, within public open space and on previously disturbed areas as shown in **Figure 1-1**. The project would comprise the following key components:

- cable works connecting Rookwood Road substation with the Beaconsfield West substation;
- special crossings of infrastructure or watercourses;
- upgrade works at the Rookwood Road and Beaconsfield West substations;
- conversion works at the Beaconsfield West and Sydney South substations; and
- temporary construction laydown areas to facilitate construction of the project.



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PROJECT OVERVIEW

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Potts Hill to Alexandria Transmission Cable Project

Note: The project area is confined to the roadway reserve with the exception of parks and existing substations

Source: Department of Finance, Services and Innovation - Spatial Services (2018), Nearmap (2018)

FIGURE 1-1

1.2 Purpose of this technical report

The purpose of this report is to identify potential air quality issues associated with the project, assess their impact on surrounding sensitive receptors, and identify appropriate mitigation and management measures to minimise pollutant concentrations at nearby sensitive receptors.

This technical report has been prepared in accordance with the revised Secretary's Environmental Assessment Requirements (SEARs) issued for the project on 20 August 2019 by the Planning Secretary of the NSW Department of Planning, Industry and Environment (DPIE).

The SEARs relevant to this technical assessment are presented in **Table 1-1**.

Table 1-1 SEARs applicable to air quality

SEARs		Section addressed
Air quality	• an assessment of the likely air quality impacts of the project in accordance with the Approved Methods for the Modelling and Assessment of Air Pollutants in NSW (EPA, 2016);	**Section 5.0**
	• demonstrated ability to comply with the relevant regulatory framework, specifically the Protection of the Environment Operations Act 1997 and the Protection of the Environment Operations (Clean Air) Regulation 2010; and	**Section 5.0**
	• details of the proposed mitigation measures to prevent the generation and emission of dust and air pollutants (including odours) during the construction of the project, particularly in relation to the use of mobile plant, stockpiles and movement of spoil.	**Section 7.2**

2.0 Description of the project

2.1 Project components

Key components of the project are listed below. A detailed description of the project is provided in **Chapter 4 Project description** of the EIS:

- cable works connecting Rookwood Road substation with the Beaconsfield West substation comprising:
  - a 330 kV underground transmission cable circuit comprising three cables installed in three conduits;
  - another set of three conduits for a possible future 330 kV transmission cable circuit if it is required;
  - four smaller conduits for carrying optical fibres;
  - around 26-30 joint bays, per circuit, where sections of cable would be joined together, located approximately every 600-800 metres along the transmission cable route;
  - link boxes and sensor boxes associated with each joint bay to allow cable testing and maintenance;
  - optical fibre cable pits for optical fibre cable maintenance;
- seven special crossings of infrastructure or watercourses including two rail lines (at Chullora and St Peters), one freight line (Enfield Intermodal rail line at Belfield), one light rail line (at Dulwich Hill), the Cooks River and its associated cycleway (at Campsie/Croydon Park), a playground (at Marrickville) and the southern wetland at Sydney Park (at Alexandria);
- upgrade works at the Rookwood Road and Beaconsfield West substations to facilitate the new 330 kV transmission cable circuit;
- conversion works at the Beaconsfield West and Sydney South substations to transition the existing Cable 41 from a 330 kV connection to a 132 kV connection; and
- five temporary construction laydown areas to facilitate construction of the project.

Associated works required to facilitate the construction of the project, such as potential utility relocations, have been considered. No major relocations are anticipated and where smaller services may need to be moved to accommodate the transmission cable circuit, this relocation would be restricted to within the project area assessed in this EIS.

The project does not include the cable pulling and jointing works for the possible future second transmission cable circuit. This activity, should it be required, would be subject to separate assessment and approval as per the requirements of the EP&A Act.

Several route options and alternative construction methods are being considered as part of the project. These are described further in **Section 2.4**.

2.2 Project location

The project would be located in the suburbs of Potts Hill, Yagoona, Chullora, Greenacre, Lakemba, Belmore, Belfield, Campsie, Croydon Park, Ashbury, Ashfield, Dulwich Hill, Marrickville, Newtown, St Peters, Alexandria and Picnic Point in the following local government areas (LGAs):

- City of Canterbury-Bankstown;
- Strathfield;
- Inner West; and
- City of Sydney.

The location of the project is shown on **Figure 1-1**.

The project would be located primarily within road reserves, at existing electrical infrastructure sites, within public open space and on previously disturbed areas. The project has been and would continue to be designed to avoid impacts to private property and open spaces where possible; however, there would be a need for both the use of public open space and easements over some private commercial properties due to significant existing constraints within the road reserve. Land uses adjacent to the road reserves in which the project would be located are mainly residential, with relatively short sections of commercial and mixed uses in the suburbs of Dulwich Hill and Petersham. The project would be located close to industrial areas at the western and eastern ends of the project around Potts Hill, Chullora, Greenacre, Marrickville, St Peters and Alexandria. The existing Sydney South substation at Picnic Point is surrounded by the George's River National Park.

The location of the proposed special crossings is provided in **Table 2-1**.

Table 2-1 Location of proposed special crossings

Location	Crossing type	Infrastructure or watercourse crossed
Muir Road, Chullora	Cable bridge	Rail line
Enfield Intermodal Terminal, Belfield	Underbore	Freight rail line
Cooks River, Campsie/Croydon Park/Ashbury	Cable bridge or underbore (preferred)	Cooks River and cycleway
Arlington Light Rail Station, Dulwich Hill	Underbore	Dulwich Hill light rail line or station
Amy Street, Marrickville	Underbore	Playground near Henson Park
Bedwin Road, St Peters	Cable bridge	Rail line
Sydney Park, Alexandria	Underbore	Wetland

2.3 The project area

The project area comprises the overall potential area of direct disturbance by the project, which may be temporary (for construction) or permanent (for operational infrastructure) and extend below the ground surface. It includes all options under consideration for the project as described in **Section 2.4**.

The project area includes the location of operational infrastructure and construction work sites for:

- the transmission cable route (including the entire road reserve[1] of roads traversed);
- special crossings of infrastructure or watercourses;
- substation sites requiring upgrades (noting that all works would be contained within the existing site boundaries); and
- construction laydown areas.

While the boundaries of the project area represent the physical extent of where project infrastructure may be located, or construction works undertaken, it does not mean that this entire area would be physically disturbed or that indirect impacts would not be experienced beyond this area. Should the project be approved, the detailed design would aim to refine the location of project infrastructure and work sites within the boundaries of the project area assessed in this EIS.

There is a possibility that to minimise impacts on other utilities or transport corridors (roads and rail), that deviations from the assessed project area may be required. In this event, specific impacts of this approach would be assessed further. Future changes to the project may require additional

[1] Road reserve is defined as the area comprising roads, footpaths, nature strips and public transport infrastructure (including indented bus bays, bus shelters and bus stop signage).

assessment and approval as described in more detail in **Chapter 5 Statutory planning and approval process** of the EIS.

The location of joint bays and the location of the transmission cable circuit within the road reserve (e.g. kerbside or non-kerbside) is yet to be determined and is subject to detailed design.

2.4 Options under consideration

The project includes route options and alternative construction methods in locations as outlined below and shown in Figure 4-6 in **Chapter 4 Project description** of the EIS. As the project design develops, a preferred option would be selected for each location. However, approval may be sought for some options where further design and engineering information is required before a preferred option can be selected.

The project options are discussed below by geographical area, from west to east.

2.4.1.1 Cooks River

There are three options for the transmission cable route in the vicinity of the Cooks River at Campsie/Croydon Park and two options for special crossing methods, including:

- Option 1: the transmission cable route travels in a south-easterly direction along Cowper Street from the intersection with Brighton Avenue, Campsie and then east on Lindsay Street. At the cul-de-sac at the end of Lindsay Street, there are two special crossing options of the Cooks River into Lees Park before the transmission cable route continues on to Harmony Street, Ashbury:
  - Option 1a: construct a cable bridge parallel to and to the north of the existing Lindsay Street pedestrian bridge; or
  - Option 1b: install the conduits under the Cooks River via underboring (this is the preferred option); or
- Option 2: the transmission cable route travels in a north-easterly direction from Byron Street at the intersection with Brighton Avenue, Campsie, through Mildura Reserve. From this parkland, the conduits would be underbored beneath the Cooks River, surfacing in Croydon Park near the cul-de-sac of Croydon Avenue in Croydon Park. The transmission cable route then travels north along Croydon Avenue, east along Dunstan Street, and south along Hay Street, before continuing east along Harmony Street; or
- Option 3: the transmission cable route travels in an easterly direction from Byron Street at the intersection with Brighton Avenue, Campsie, then in a south-easterly direction through Mildura Reserve, between residences and the Cooks River until the cul-de-sac at Lindsay Street. From here, there are two special crossing options of the Cooks River into Lees Park before the transmission cable route continues on to Harmony Street, Ashbury, which are the same for Option 1:
  - Option 3a: construct a cable bridge parallel to and to the north of the existing Lindsay Street pedestrian bridge; or
  - Option 3b: install the conduits under the Cooks River via underboring.

A description of the cable bridge and underboring methods is provided in **Section 2.5** with further detail in **Chapter 4 Project description** of the EIS.

2.4.1.2 Dulwich Hill light rail corridor

There are two options for the transmission cable route crossing of the Dulwich Hill Light Rail corridor in the vicinity of the Arlington Light Rail station, Dulwich Hill. This includes:

- Option 4a: the transmission cable route travels northeast along Windsor Road from the intersection with Arlington Street, then east on Terry Road. At the Terry Road cul-de-sac, the conduits would be underbored beneath the rail corridor, surfacing at the Hill Street cul-de-sac. From here the transmission cable route continues along Hill Street to Denison Road; or
- Option 4b: the transmission cable route travels southeast along Constitution Road from the intersection with Arlington Street, before crossing into the southern end of Johnson Park. From

here, the conduits would be underbored beneath the rail corridor near the Arlington light rail station. The transmission cable route then continues along Constitution Road and then north on Denison Road.

2.4.1.3 Henson Park

There are two options for the transmission cable route crossing in the vicinity of Henson Park, Marrickville including:

- Option 5a: the transmission cable route continues northeast on Centennial Street to a car park. From here it travels in an easterly direction through a grassed verge between the tennis courts and Henson Park oval to near the Amy Street playground. The conduits would be underbored beneath the playground, surfacing at Amy Street. The transmission cable route then turns east on to Horton Street; or
- Option 5b: the transmission cable route travels north on Sydenham Road from Centennial Street, turning northeast on to Neville Street, then southeast on Surrey Street to Amy Street before continuing along Charles Street.

2.4.1.4 Marrickville

There are two options for the transmission cable route in the vicinity of Addison Road, Marrickville. Note that the project may include one or both options at this location including:

- Option 6a: the transmission cable route travels north along Agar Street from the intersection with Illawarra Road, then east on to Newington Road and south down Enmore Road to the intersection with Scouller Street; and/or
- Option 6b: splitting the two circuits as there is insufficient space along Addison Road to accommodate both circuits. One circuit would travel along Newington Road (as for Option 6a) and one circuit would travel east on Addison Road from the intersection with Illawarra Road, then north on Enmore Road to the intersection with Scouller Street.

2.5 Construction works

Construction activities would be limited to the identified project area and include the activities summarised in **Table 2-2**. A substantial portion of the transmission cables would be installed using pre-laid conduits. The conduits would only require the excavation of short sections of trench at a time (an average of 20 metres at any one location), with backfilling occurring as soon as each section of the conduits has been installed. Depending on the overall construction program and associated number of work crews required, it is expected that trenching and excavation would occur concurrently at multiple work sites along the transmission cable route.

The project would involve the construction of seven special crossings that would involve either the installation of a cable bridge or underboring (i.e. an underground crossing). Works for these crossings would be undertaken in coordination with the relevant asset owner (e.g. road or rail authorities).

The construction of the project would require a number of work sites along the transmission cable route and at special crossings. Each work site represents an area of disturbance required to undertake the construction activity (e.g. trenching, cable bridge installation, underboring) and would be located within the project area.

Table 2-2 Summary of construction activities

Construction activity	Description
Site preparation	• implementation of traffic management changes (such as safety barriers and road signage) to facilitate access and egress to/from the work sites; • installation of environmental control measures (such as sediment barriers); • vegetation clearing and tree removal, where required; • establishing construction laydown areas and ancillary facilities including temporary offices and worker amenities, site fencing and provision of power/services; and • delivery and storage of plant and equipment at construction laydown areas and work sites.
Trenching and excavation	• clearing of surface vegetation along excavation area if required; • saw cutting of the road surface/pavement and lifting this material using a backhoe/front end loader. If rock is encountered, a rock breaker may be used to loosen the material; • removal of material down to the base of the trench using an excavator and placement of spoil directly onto trucks to be transported to a licensed facility. The trench would typically be around 3 metres wide and 1.2 metres deep but could be deeper or shallower depending on the presence of utilities; and • installation of shoring as a precaution against slump or collapse where necessary, particularly where deeper sections of trench are required (i.e. deeper than 1.4 metres).
Relocation of minor utilities/services	• use of non-destructive digging methods to expose buried services to guide the excavator; and • minor relocations, if required, would occur within the road reserve and be subject to consultation with the relevant asset owner/operator.
Conduit installation and backfilling	• laying the transmission cable conduits on plastic spacers to provide the required clearance from the side walls and bottom of the trench; • placing the optic fibre communication cable conduits into position; • backfilling the trench with engineered backfill; • laying of polymeric covers and warning tape, marked with appropriate warnings in case of accidental excavation; and • installation of the road base and temporary restoration of the road surface to allow vehicles and other road users to travel across the area.

Construction activity	Description
Excavation and establishment of joint bays	• excavation of joint bays via open trenching; • installation of erosion and stormwater flow controls and barriers; • erecting fencing or hard barriers as required; • provision for vehicle access, worker amenities and equipment storage; • temporary covering with steel plates to provide access to adjacent properties where required; and • excavation of nearby pits to facilitate the installation of link and sensor boxes.
Cable pulling and jointing	• installation of a tent or demountable building over the joint bay to provide a controlled work environment and dry work site; • pulling cables through the conduits which is fed from large drums holding 600-800 metres of cable; and • connecting sections of cables at the joint bay.
Permanent road restoration	• removing the temporary road surface; • backfilling with road base up to surface level, where required; • reinstating pavement; and • reinstating the remaining areas that were excavated with spoil or other fill material to pre-construction levels and final finishing to match existing as appropriate (e.g. footpath and/or kerb and gutter) or as otherwise agreed with the relevant roads authority.
Cable markers	• once restoration activities have been completed, cable markers would be installed along the transmission cable route to give warning of the presence of the cables and the need to make enquiries before digging; • markers may include: - small signs attached to road kerbs; - concrete marker posts (between 800-900 millimetres tall) along the transmission cable route in vegetated areas where surface markers would be difficult to see; or - flush-markers constructed of concrete that are around 50-100 millimetres thick.
Cable bridges	• establishment of the work site and access including vegetation clearing (where required); • boring and earthworks for the bridge piers; • installation of the pre-cast cable bridge and steel cage (where required) by crane; • integration with the conduits in the road reserve; and • reinstatement of the work site.
Underboring	• underboring around 4-10 metres below the ground surface by either thrust boring or horizontal directional drilling (HDD); • thrust boring would require a launch pit (at least 4 metres deep) and associated work site of around 800 square metres and a receive pit and work site of about 100 square metres; • HDD would require a work site at the drill launch area of up to 800 square metres and a receive pit for the drill exit of around 1.5 metres deep; and • work sites would be restricted to the road reserve and public open space areas where feasible and reasonable to limit the need for vegetation removal.

Construction activity	Description
Substation upgrades	• site establishment; • earthworks and excavations needed for cable entries and footings for new equipment; • installation of new infrastructure (such as switchbays and busbars); • removal of redundant infrastructure; • installation and connection of new cables; • commissioning of cables; and • demobilisation.

2.5.1 Staging and timing of construction activities

An indicative duration of construction activities is provided in **Table 2-3**. The timing is subject to detailed design and the final construction approach. For example, some works, such as trenching and excavation, would be undertaken by multiple work crews working along the transmission cable route. Staging of activities outside of certain hours would also influence the construction approach.

Should the project be approved, construction is planned to occur over 24 months, commencing in 2020. It is estimated that around 15 months would be required for civil construction works and conduit installation and about nine months for cable pulling and jointing, testing and commissioning. The transmission cable circuit is expected to be completed and commissioned in 2022/23.

Table 2-3 Indicative timing of typical construction activities

Construction activity	Indicative duration
Excavation, conduit (pipe) installation and trench backfilling	Conduits for each 600-800 metre cable section would take up to eight weeks to install (with most properties exposed to around two weeks of trench excavation activity).
Joint bay construction	Each individual joint bay would take up to three weeks to establish (in addition to trenching works). Each joint bay contains one cable circuit.
Cable pulling	Cable pulling at each joint bay for each 600-800 metre cable section would typically take up to two weeks to complete.
Cable jointing	Cable jointing would typically take up to three weeks to complete at each joint bay.
Cable bridges	Each cable bridge crossing is expected to take around 10 weeks to complete in total, however works would be staged and not continuous over the 10 week period.
Underboring	Each underbore is expected to take around eight to 10 weeks to complete in total, however works would be staged and not continuous over this period.
Substation works	Construction works at the Rookwood Road substation is expected to take around four to six months, while works at the Beaconsfield West and Sydney South substations are expected to take around six to nine months at each site.

2.5.1.1 Construction hours

Construction works would be undertaken during standard daytime construction hours as specified in the *Interim Construction Noise Guideline* (DECC, 2009) where reasonable and feasible to do so. However, it is expected that works outside standard construction hours would also be required, as described below.

Standard construction hours are:

- Monday to Friday 7am to 6pm;

- Saturday 8am to 1pm; and
- No work on Sundays and public holidays.

It is likely that construction works would be required at night time (after 10pm) due to the requirements of relevant road and rail authorities. These works could include, but are not limited to, works within major road reserves (i.e. on State and regional roads such as Rookwood Road and Old Canterbury Road), through signalised intersections, or at special crossings. Work outside standard construction hours may be required for safety reasons and/or to limit disruption to road traffic and rail services.

Cable jointing works at each joint bay would need to be undertaken continuously i.e. 24 hours. Some works at the substation sites may also need to be undertaken outside of standard construction hours due to outage constraints on the existing infrastructure (i.e. the need to maintain power supply to customers).

Cable bridges and underboring at rail corridors would be timed with other rail works to limit disruption to freight and/or passenger rail services. These works could be undertaken outside of standard construction hours including at night time or over weekends, subject to approval of the relevant rail authority.

Scheduled construction activities, work hours and duration would be further refined through consultation with relevant government agencies and would be outlined in the CEMP for the project.

2.5.2 Construction precincts

The transmission cable route has been divided into five construction precincts to aid the characterisation of the existing environment and assessment of project impacts. These precincts broadly align with similar land uses. A description of each precinct follows:

- **Precinct 1** includes the areas between the Rookwood Road substation and the Hume Highway, including the industrial area of Chullora along Muir Road;
- **Precinct 2** includes the areas between the Hume Highway and Brighton Avenue near the Cooks River including the residential areas of Greenacre, Lakemba, Belmore, Belfield and Campsie;
- **Precinct 3** includes the areas from the Cooks River to Illawarra Road including the residential areas of Croydon Park, Ashbury, Ashfield, Dulwich Hill and Marrickville;
- **Precinct 4** includes the area between Illawarra Road and the Bankstown rail line including the residential areas of Marrickville, Enmore and Newtown; and
- **Precinct 5** includes the areas between the Bankstown rail line and the Beaconsfield West substation including the residential areas of St Peters and the recreational area of Sydney Park in Alexandria.

2.5.3 Construction laydown areas

As part of the construction of the project, temporary construction laydown areas would be required to store materials, equipment, excavated spoil and provide space for other ancillary facilities such as site offices. Five locations have been investigated as potential construction laydown areas. The final number and location is subject to ongoing consultation with the relevant landowners and would be determined during detailed design.

Stockpiling of excavated spoil at the construction laydown areas would be ongoing for the duration of the civil works (around 15 months). Stockpiling would be managed by erosion and sediment controls in accordance with *Managing Urban Stormwater: Soils and Construction* (Landcom, 2004) (The Blue Book).

While it is expected that construction would require the use of transportable roadside facilities for individual work sites, provision for temporary site offices would be located within construction laydown areas for the duration of construction (up to two years).

Construction laydown areas would be fenced and would have lighting for security and to facilitate night works.

Driveways may need to be created from gravel or similar material to enable heavy vehicles to enter/exit the site. At construction laydown areas at Cooke Park and Peace Park, extended driveways would be required to access the laydown area. The construction of these driveways would require ground disturbance and potentially tree removal.

Temporary infrastructure at the construction laydown areas, including noise mitigation controls (such as hoardings), driveways and stockpile areas, would involve minimal subsurface ground disturbance (i.e. excavation) and would be removed once construction is complete.

For works at the Rookwood Road and Sydney South substation sites, sufficient space exists at each location to store materials and equipment; therefore, no additional laydown areas would be required.

The proposed locations and area required for the five potential construction laydown areas are listed in **Table 2-4**.

Table 2-4 Potential construction laydown areas

Potential construction laydown area	LGA	Potential area (hectares)
12 Muir Road, Chullora	City of Canterbury-Bankstown	0.48
Cooke Park, Belfield	Strathfield	0.37
Peace Park, Ashbury	Inner West Council	0.45
Camdenville Park, St Peters	Inner West Council	0.18
Beaconsfield West substation, Alexandria	City of Sydney	0.85

2.6 Cable operation and maintenance

Once the transmission cables have been installed, generally only visual inspections would be required. This would involve regularly driving along the transmission cable route to check for hazards or activities (such as excavation works in the vicinity) that could impact the underground cables or cable bridges. Ongoing physical access to the transmission cables is not required however ongoing monitoring of the cable for damage (missing/worn cable markers) and outages would occur. This would be through access to the link boxes and sensor boxes located near the joint bays. Optical fibre cables installed alongside the transmission cables would be monitored at the optical fibre cable pits.

Pits for link and sensor boxes and optical fibre cables would generally be located in the footpath/road verge but in some cases where there is insufficient space, they may be required in the roadway. Roadway access would be managed with standard traffic controls.

Regular checks of the pits would ensure they are accessible and that the pit does not contain water or tree roots. Cable bridge structures would be inspected to ensure structural integrity and aesthetics are being maintained.

2.7 Other relevant technical information

2.7.1 Plant and equipment

The following typical plant and equipment are likely to be used during construction of the project:

- chainsaws;
- diamond saws;
- jackhammers;
- rock breakers;
- hand tools;
- hydraulic excavators;
- drill rig;
- spoil haulage trucks;
- mobile cranes and elevated working platforms;
- piling rigs;
- concrete trucks;
- winch trucks;
- low loaders;

- vacuum tankers/trucks;
- light vehicles;
- temporary generators;
- compressors;
- backhoes/front-end loaders;
- mixing plant;
- road millers;
- asphalt machine; and
- heavy rollers

2.7.2 Site access and traffic movements

Access for heavy vehicles would be required throughout the project area. The standard of access along the transmission cable route would be sufficient to permit passage of excavators, spoil haulage trucks, concrete trucks, low loaders and mobile cranes. The estimated vehicle movements required for construction is outlined in **Table 2-5**. The vehicle numbers estimated do not include private vehicles used by the workforce to arrive at the work site, or traffic management vehicles. The vehicle numbers for the 'transmission cable route' assume four work crews operating concurrently at multiple locations within the project area. The final number of work crews, materials and vehicle movements would be determined during detailed design and construction planning.

Table 2-5 Anticipated vehicle movements

Location	Activity	Number of vehicle movements per day
Construction laydown areas	Delivery/pickup of plant and materials, spoil transfer (at relevant sites)	Vehicle movements per construction laydown area, per day: • Light: 3-4 • Heavy: 12
Transmission cable route – trenching and joint bay excavation	Delivery of plant and materials, removal of spoil, general construction	Vehicle movements for four work sites, per day: • Light: 16 • Heavy: 96
Special crossings	Delivery of plant and materials, removal of spoil, general construction	• Light: 10-12 • Heavy: 8-10
Substation upgrade – Rookwood Road	Delivery of plant and materials, removal of spoil	• Light: 3-4 • Heavy: 4
Substation upgrade – Beaconsfield West	Delivery of plant and materials, removal of spoil	• Light: 3-4 • Heavy: 4
Substation upgrade – Sydney South	Delivery of plant and materials, removal of spoil	• Light: 5-6 • Heavy: 6

Equipment and materials would be held in storage at the laydown areas until needed and delivered to the relevant work sites. Larger plant and cable materials may be delivered at night to avoid disrupting daytime traffic. Materials such as the cable drums may be temporarily stored near the trench and would be securely stored and barricaded.

Where the trench intersects another road or access to properties is required to enable construction works, vehicle and pedestrian passage would be restored as soon as possible after excavation has passed the intersection or access point.

3.0 Assessment methodology

3.1 Study area

For the purpose of this air quality assessment, the study area comprises a 350 meter buffer around the project area. The study area is presented in **Figure 3-1**.

3.2 Statutory context, policy and guidelines

3.2.1 Protection of the Environment Operations Act 1997

Air quality in NSW is regulated under the *Protection of the Environment Operations Act 1997*. The objective of the act is to achieve the protection, restoration and enhancement of the quality of the environment. The *Protection of the Environment Operations (Clean Air) Regulation 2010* (POEO Regulations) contains provision to regulate air emissions in NSW.

The POEO Regulations requires that air pollutant impact assessments for activities and plant be conducted in accordance with the *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (Approved Methods) (NSW EPA, 2016).

3.2.2 NSW EPA Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales

The Approved Methods apply to stationary sources of air pollutants and describes the statutory methods for modelling and assessing emissions from these sources. The Approved Methods specify air quality criteria which represent maximum allowable pollution levels at sensitive receptors.

The assessment criteria relevant to dust emissions for the project are presented in **Table 3-1**.

Table 3-1 NSW EPA impact assessment criteria for pollutants of potential concern

Pollutant	Averaging period	Concentration
Particles as PM_{10}	24 hours	50 µg/m^3
	Annual	25 µg/m^3
Total Suspended Particulates (TSP)	Annual	90 µg/m^3
Deposited dust (dust soiling)	Annual	2 g/m^2/month[a] 4 g/m^2/month[b]

Notes:

a. Maximum increase in deposited dust level

b. Maximum total deposited dust level

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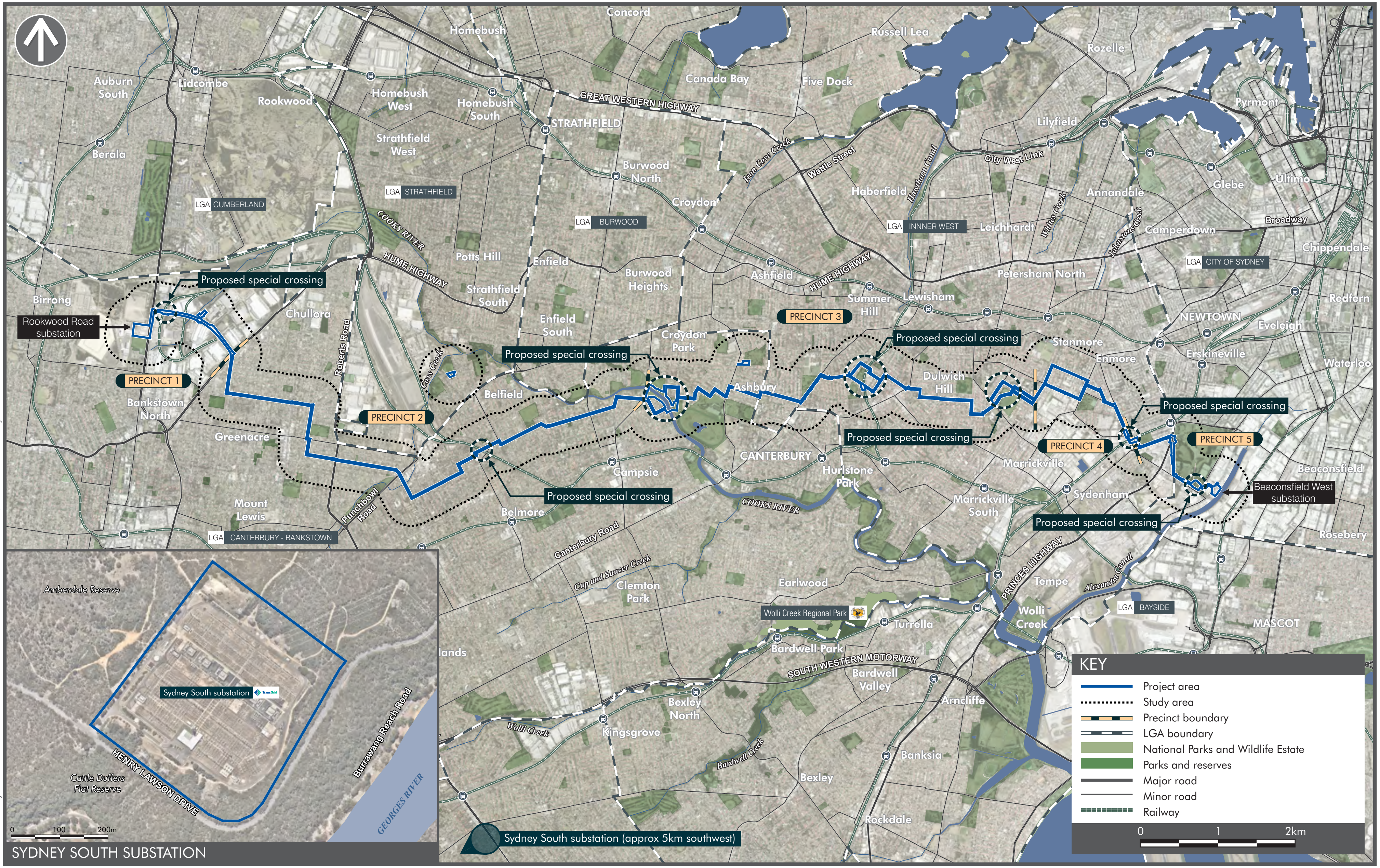

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STUDY AREA RELEVANT TO AIR QUALITY

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Note: The project area is confined to the roadway reserve with the exception of parks and existing substations
Source: Department of Finance, Services and Innovation - Spatial Services (2018), Nearmap (2018)

FIGURE 3-1

Odour concentration is measured in terms of odour units (OU). A concentration of 1 OU of a given air sample represents the concentration at which 50% of a population can detect an odour. This is referred to as an ‘odour threshold’. Typically, an odour concentration of 1 OU would not be strong enough to be recognised as a specific odour, only that an odour is present.

The NSW EPA’s odour assessment criteria for complex mixtures of odorous air pollutants (NSW EPA, 2016) are shown in **Table 3-2**. These criteria consider individual sensitivity to odour in the community and use a statistical approach for determining the appropriate criterion for a particular site based on the size of the surrounding population. As population size increases, the likelihood of sensitive individuals being within that population also increases. As such, areas with larger populations (including the study area for the project) require more stringent criteria. An odour assessment criterion of 2 OU was adopted for this assessment due to the urban nature of the area surrounding the project area.

Table 3-2 NSW EPA impact assessment criteria – complex odours

Population	Criteria (OU)[a]
Urban (> ~2000) and/or schools and hospitals	2
~ 500	3
~ 125	4
~ 30	5
~ 10	6
Single residence (< ~2)	7

Notes:

a. 99^{th} percentile 1-hour average

Due to the linear progression of the work sites and the relatively short periods of construction at any given point along the transmission cable route, a quantitative air dispersion modelling assessment in accordance with the Approved Methods was not deemed necessary to show compliance with air quality criteria.

3.2.3 UK Institute of Air Quality Management Guidance on the assessment of dust from demolition and construction

The UK Institute of Air Quality Management (IAQM) guideline: *Guidance on the assessment of dust from demolition and construction* (IAQM, 2014) provides a framework for the assessment of the risk of construction. The IAQM guideline uses a four-step process to assess risk of dust impacts by considering magnitude of the potential impact and the sensitivity of receptors. This methodology was adopted for the project and is described in more detail in **Section 3.3.1**.

3.3 Approach and methodology

3.3.1 Suspended particulate matter and deposited dust

During construction, the primary pollutants of concern for the project would be suspended particulate matter and deposited dust. Dust would be generated by any activities that disturb the soil, resulting in suspended particulates (dust suspended in the air) and deposited dust (dust settled on surfaces). Activities with the greatest potential to generate dust are those requiring excavation such as trenching and the construction of joint bays.

Particulate matter refers to the many types and sizes of particles suspended in the air we breathe. Particulate matter can be emitted from natural sources (bushfires, dust storms and pollens) or by human activities such as combustion activities (motor vehicle emissions, power generation and incineration), excavation works, bulk material handling, crushing operations, wheels on unpaved roads and use of wood heaters.

Particulate matter is often classified according to the following size fractions:

- Total suspended particulates (TSP). Particles with an aerodynamic diameter of less than or equal to 30 micrometres (µm) are collectively referred to as TSP; and
- Particles with an aerodynamic diameter less than or equal to ten µm (referred to as PM_{10}).

PM_{10} tends to remain suspended in the air for longer periods than larger particles and can penetrate into human lungs. Exposure to particulate matter has been linked to a variety of adverse health effects, including respiratory problems (e.g. aggravated asthma, chronic bronchitis) and heart attacks. If the particulates contain contaminants such as heavy metals (lead, cadmium, zinc) or live organisms (bacteria or fungi) there is the potential for health effects from the inhalation of the dust (depending on exposure levels).

For the project, particulate matter would be emitted from several construction activities including disturbance of soil and rock, movement of plant on exposed areas of earth, movement of fill materials and wind-blown dust from exposed surfaces. Dust generation would generally be higher as the quantity of soil disturbed increases, when the soil is dry, or during windy conditions.

Particles with a diameter of less than 2.5 µm (referred to as $PM_{2.5}$) are typically associated with combustion emissions and are not produced in significant amounts by mechanical disturbance of materials such as excavation, which would be the primary source of dust generation for the project. As there would be only be very minor combustion emissions due to the project (refer to **Section 3.3.3**), $PM_{2.5}$ was not assessed further.

Deposited dust (dust soiling) refers to dust particles of all sizes that have settled on exposed surfaces. Deposited dust causes aesthetic impacts associated with coarse particles settling on surfaces, which causes soiling and discolouration.

The methodology employed for the dust assessment (discussed in the next section) focuses on deposited dust and PM_{10}. The larger size fraction of TSP (> 10 µm) tends to fall out of suspension quickly as deposited dust. The finer size fraction of TSP (<10 µm) are effectively PM_{10}. Based on this, the TSP emissions are generally accounted for when focusing only on deposited dust and PM_{10}. In addition, assessment of TSP is generally concerned with impacts to amenity, whereas the assessment of PM_{10} is usually more concerned with health impacts. Based on this, TSP is not strictly considered in the IAQM guideline methodology and therefore was not considered further.

Dust assessment methodology

As discussed in **Section 1.2**, the SEARs for the project reference the NSW Approved Methods with respect to air quality impact assessment. The modelling and assessment methodology outlined in the Approved Methods apply to stationary industrial sources as stated in Section 1.1 of the Approved Methods (EPA, 2017). The project is not a stationary industrial emission source and air quality impacts associated with the project would be confined almost entirely to the construction phase. Furthermore, most construction activities would occur in a progressive linear manner (with the exception of construction laydown areas, special crossings and substation works) with receptors likely exposed to relatively short periods of construction at any given point along the transmission cable route.

The construction laydown areas, special crossings and substation works would occur at fixed locations; however, dust-generating activities would be less intensive than along the transmission cable route and therefore impacts are generally not expected at receptors nearby these locations (refer to a description of the dust emission scenarios assessed in **Section 5.1.1**). The excavation of the launch and receive underbore pits would be the highest dust generating stage of underboring and is expected to take up to a week.

Given this, quantitative modelling under the Approved Methods was not considered applicable to the project. Air quality impacts associated with the project have been assessed qualitatively, based on a risk-based approach focusing on construction emissions and standard mitigation measures to minimise amenity and nuisance impacts at surrounding receptors. Relevant air pollutant criteria and the general approach to assessment (e.g. inclusion of background air quality and meteorology) have been applied, which is consistent with the Approved Methods.

The assessment of potential dust impacts resulting from the construction of the project was based on the methodology described in the IAQM guideline (IAQM, 2014), as this guideline provides a framework for assessing potential risk from construction dust emissions and is a method accepted by NSW government authorities. The IAQM assesses the risk of 'dust soiling' (equivalent to dust deposition) and this term has been used hereafter. The risk of dust soiling and human health impacts resulting from the generation of suspended particulate matter (PM_{10}) on surrounding areas were determined based on the scale of activities and proximity to sensitive receptors.

Ecological effects due to dust soiling are also discussed in the IAQM guideline. However, impacts on ecological receptors are unlikely to be significant, as soil deposition rates would need to be significantly higher than the deposited dust assessment criteria used for this assessment before impacting on plants or animals. Therefore, if dust impacts were to occur above the deposited dust criteria, they would be noticeable, and appropriate measures would be implemented, prior to impacting ecological receptors. Ecological receptors were therefore not considered further in this assessment.

The IAQM guideline uses a four-step process to assess dust impacts:

- Step 1 (discussed in **Section 5.1.2**): Screening based on distance to nearest sensitive receptors. If any sensitive receptors are within a certain distance, then continuing to Step 2 is required;
- Step 2 (discussed in **Section 5.1.3**): Assess risk of dust impacts from project activities based on:
  - Scale and nature of the works, which determines the potential dust emission magnitude;
  - Sensitivity of the surrounding area;
- Step 3 (discussed in **Section 5.1.4**): Determine site-specific mitigation for dust-emitting activities; and
- Step 4 (discussed in **Section 5.1.5**): Reassess risk of dust impacts after mitigation has been considered.

A worst case dust emission scenario was identified for the transmission cable route. How the scenario was determined and applied to the project is described in **Section 5.1**.

3.3.2 Odour

Several locations with potential landfill gas (LFG) have been identified in the Preliminary Site Investigation –Soils and Contamination technical report of the EIS (Appendix K). There is the potential that LFG may be encountered during excavation in Arlington Oval Park (Precinct 3), Marrickville Park (Precinct 3), Henson Park (Precinct 3), Camdenville Park (Precinct 5) and Sydney Park (Precinct 5). LFG is also potentially present at the construction laydown areas Cooke Park (Precinct 2) and Peace Park (Precinct 3).

Landfill gas is primarily composed of methane and carbon dioxide, which are not odorous compounds, and which are not covered by environmental air quality criteria in NSW as priority pollutants. Emissions of methane and carbon dioxide have therefore not been considered further in this assessment. However, LFG typically contains small amounts of other compounds, such as hydrogen sulfide, which can be odorous, even at low concentrations. Odour from hydrogen sulfide, therefore has the potential to impact on nearby receptors if LFG is encountered during excavation activities. Odour impacts typically manifest as annoyance, which is described as the negative reaction that a person may experience when exposed to an unpleasant odour. Continued annoyance may impact health by causing a build-up of stress (Horton et. al. 2009).

Odour assessment methodology

Odour impacts from industry are usually assessed in NSW according to the *Technical Framework: Assessment and Management of Odour from Stationary Sources in NSW*. However, the Technical Framework applies to new or modified stationary odour sources. The odour source of concern for the project is legacy LFG, which the project does not contribute to. As such, the framework is not relevant to the assessment of potential odour impacts from the project.

LFG concentrations near the transmission cable route through Camdenville Park and Sydney Park are not expected to be high. Potential odour impacts due to LFG were therefore assessed qualitatively, rather than by means of a quantitative air dispersion model in accordance with the NSW Approved Methods (EPA, 2017). To assist in the qualitative assessment, previous reports for Camdenville Park and Sydney Park were reviewed. The assessment is detailed in **Section 5.2**.

3.3.3 Combustion emissions

A small number of mobile plant and light vehicles (refer to **Section 2.6**) would be required to undertake construction of the project and operational maintenance. It is unlikely that more than one or two mobile plant would be operational at any given time near any given receptor, and as such combustion emissions (e.g. $PM_{2.5}$, nitrogen dioxide, carbon monoxide) from plant are not expected to be significant and are unlikely to impact on surrounding sensitive receptors. Combustion emissions due to mobile plant and other vehicles were therefore not included in this assessment. However, as a precautionary measure, standard mitigation measures for combustion emissions have been identified and included in **Section 7.2**.

4.0 Description of the existing environment

4.1 Sensitive receptors

There are a large number of sensitive receptors[2] within the study area, mainly along the transmission cable route, including private residences, commercial businesses, and community facilities such as schools, childcare centres, healthcare providers and parks/recreation areas. Many of these receptors are located within about 20 metres of the project area and as a result are most likely to be impacted due to their proximity. Only minor impacts are expected at receptors beyond this distance, or at receptors shielded from the works by other buildings. However, all receptors within the study area (i.e. within 350 metres) have been considered for the purpose of assessment, as specified in the IAQM guideline.

The Sydney South substation is located in bushland on a bend of the Georges River at Picnic Point. There are no sensitive receptors within 350 metres of works to be undertaken at the substation.

A summary of the approximate number of sensitive receptors within the study area by precinct are presented in **Table 4-1** as per the IAQM guideline.

Table 4-1 Summary of sensitive receptors

Precincts and Sydney South substation	Approximate number of sensitive receptors within the study area
Precinct 1	~50 mostly commercial
Precinct 2	>100 mostly residential[a]
Precinct 3	>100 mostly residential[a]
Precinct 4	>100 mostly residential[a]
Precinct 5	>100 mixed residential and commercial[a]
Sydney South substation	None

Notes:
a. The highest number of receptors category is listed as “>100” in the IAQM guideline

4.2 Meteorology

4.2.1 Project area excluding Sydney South substation

The nearest meteorological weather station operated by the Bureau of Meteorology (BoM) is at Canterbury Park Racecourse, less than 200 metres from the project area in Precinct 3. Wind characteristics measured at Canterbury Park Racecourse are generally considered to be representative of winds across the project area. To determine prevailing wind conditions within the project area, annual and seasonal data were observed for the years 1995 to 2017. Long term wind roses for this period are presented in **Figure 4-1**. The wind roses show the frequency of occurrence of winds by direction and strength. The bar at the top of each wind rose diagram represents winds blowing from the north (i.e. northerly winds) and so on. The length of the bar represented frequency of occurrence of winds from that direction. The widths of the bars correspond to wind speed categories, the narrowest representing the lightest winds.

The following is a summary of winds observed at Canterbury Park Racecourse:

- night-time and early morning winds are represented by the 9:00 am wind roses. Daytime and afternoon winds are represented by the 3 pm wind roses;

[2] Sensitive receptors include residences, educational institutions (including preschools, schools, universities, TAFE colleges), healthcare providers (including nursing homes, hospitals), religious facilities (including churches), child care centres, passive recreation areas (including outdoor grounds used for teaching), active recreation areas (including parks and sports grounds), commercial premises (including film and television studios, research facilities, entertainment spaces, temporary accommodation such as caravan parks and camping grounds, restaurants, office premises, retail spaces and industrial premises).

- summer (January) morning winds are typically light with winds from the north and south most common. Winds are calm (0 km/h) for 5% of the time;
- summer afternoons are dominated by strong north east to south east winds with very few (<0.5%) calm conditions;
- winter (July) morning winds are typically light with dominant north west and west components. Winds are calm for 7% of the time; and
- winds on winter afternoons are stronger than the morning but also more variable, with winds from the north west, west, south, and south east most common. Calm conditions are experienced 3% of the time.

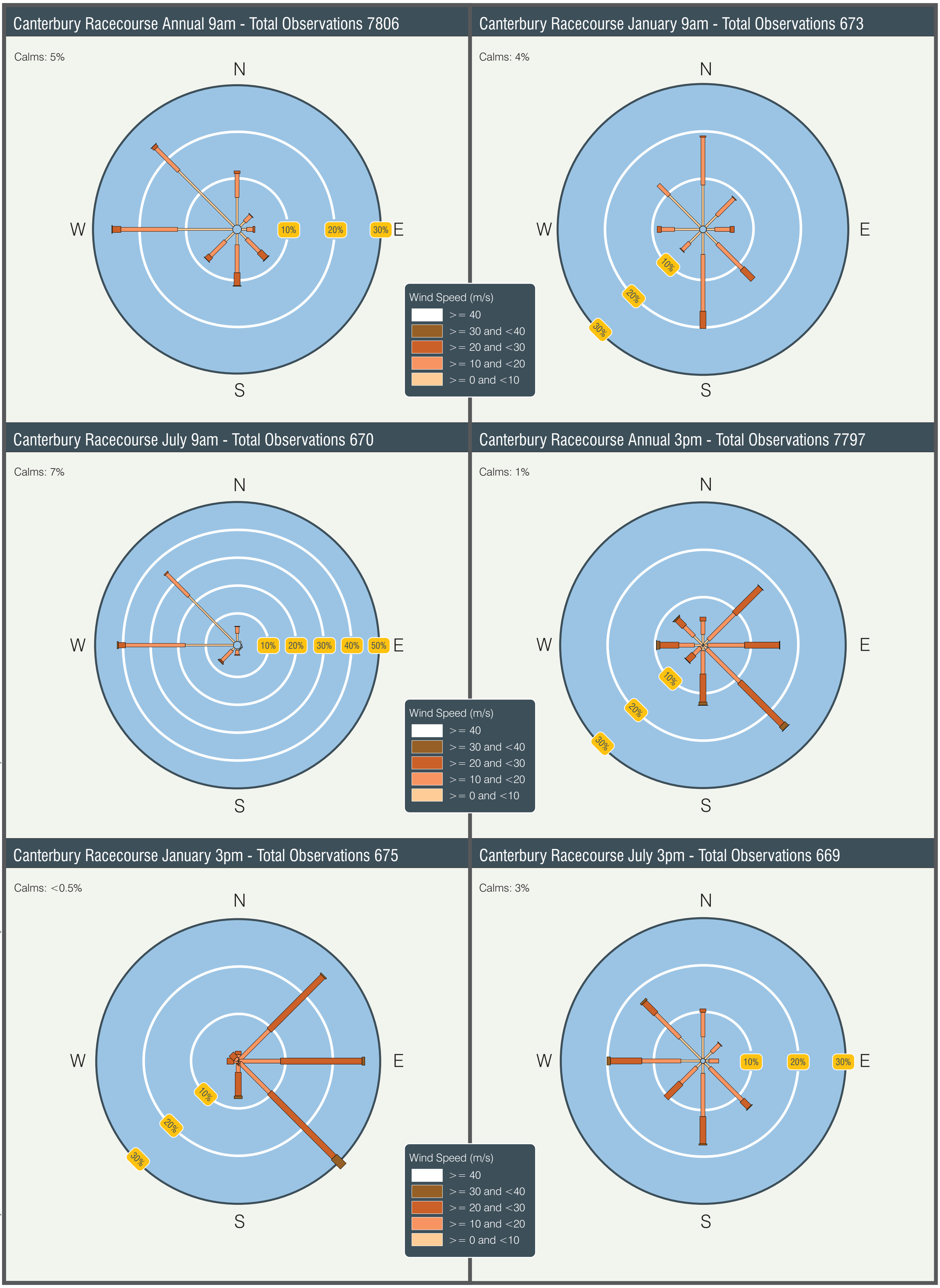
Typically, summer afternoons would be most favourable to rapid dispersion of air pollutants due to strong winds and a low percentage of calm conditions. Winter mornings would be least favourable to the dispersion of air pollutants due to the lower wind speeds and higher percentage of calm conditions.

4.2.2 Sydney South substation

The nearest BoM station to Sydney South substation is at Holsworthy Aerodrome, approximately 5.5 kilometres to the southwest, however long-term weather data is not available for this site. Long term wind roses are available for the Holsworthy Control Range BoM site, which is about 8 kilometres west of Sydney South substation. The Canterbury Park Racecourse site is about 12 kilometres northeast from the substation. Winds at Sydney South substation are expected to be consistent with both Holsworthy Control Range and Canterbury Park Racecourse, as all sites are located in the Sydney basin. The following is a summary of winds observed at Holsworthy Control Range for the period 1998 to 2014:

- night-time and early morning winds are represented by the 9:00 am wind roses. Daytime and afternoon winds are represented by the 3:00 pm wind roses;
- summer (January) morning winds are typically light with no predominant wind direction. Winds are calm for 3% of the time;
- summer afternoons are dominated by strong east and south east winds with very few (<0.5 %) calm conditions;
- winter (July) morning winds are typically light with dominant west and southwest components. Winds are calm for 4% of the time; and
- winds on winter afternoons are stronger than the morning but also more variable, with winds from the west most common. Calm conditions are experienced 2% of the time.

Typically, summer afternoons would be most favourable to rapid dispersion of air pollutants due to strong winds and a low percentage of calm conditions. Winter mornings would be least favourable to the dispersion of air pollutants due to the lower wind speeds and higher percentage of calm conditions.



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WIND ROSES FOR BUREAU OF METEOROLOGY CANTERBURY RACECOURSE WEATHER STATION - 1995 TO 2017

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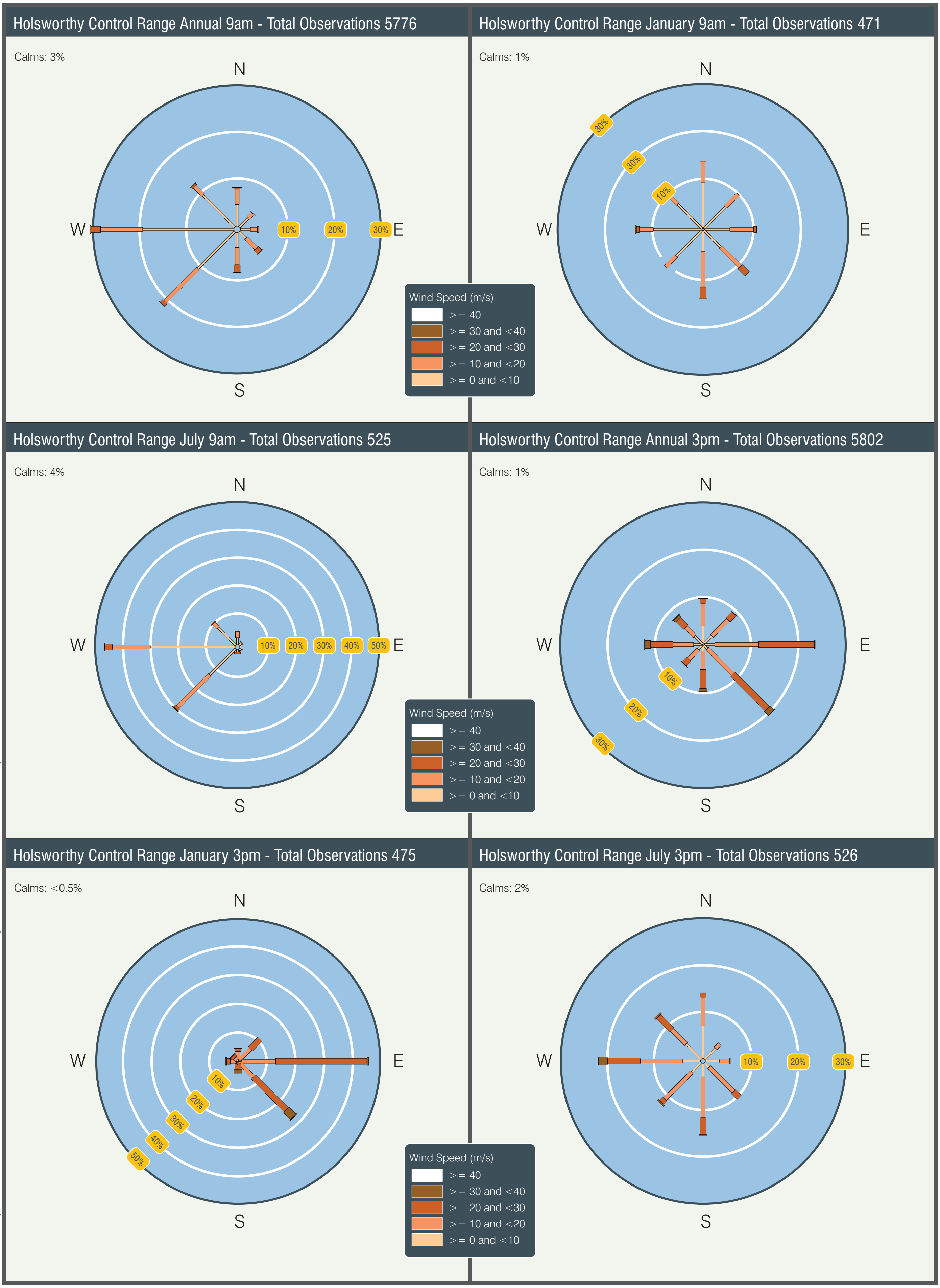
FIGURE 4-1



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WIND ROSES FOR BUREAU OF METEOROLOGY HOLSWORTHY CONTROL RANGE WEATHER STATION - 1998 TO 2014

Powering Sydney's Future
Potts Hill to Alexandria Transmission Cable Project

FIGURE 4-2

4.3 Terrain and land use

Terrain along the transmission cable route, including Potts Hill and Beaconsfield West substations, is mostly flat with elevation ranging from about 5 metres above sea level in Precinct 5 at the eastern end to about 50 metres above sea level in Precinct 3 in the middle and in Precinct 1 at the western end. Due to the low and regular nature of the terrain (i.e. without deep valleys and prominent peaks that may strongly influence local meteorology), it does not have a significant effect on wind speed and direction along the transmission cable route.

Land use along the transmission cable route is a combination of medium-density residential, commercial, and public use parkland. Air flow at ground level would be most affected by taller buildings that block winds particularly in areas where there are continuous buildings on both sides of the road. This creates an urban canyon effect wherein airflow would be directed along the road and may affect pollutant dispersion at street level.

The construction laydown areas are all located within about one kilometre of the transmission cable route and share similar terrain and land use features (i.e. mostly flat). They are located primarily in parks and vacant space and are surrounded by a mix of residential and commercial land use. Wind flow would be slightly less affected compared with the transmission cable route, due to the open parkland and generally lower buildings surrounding the parks.

The Sydney South substation is located on a hill above the Georges River at an elevation of about 55 meters above sea level. The area surrounding the substation is hilly with the Georges River Valley running west to east to the immediate south of the substation. Winds are likely to be directed along the flow of the Georges River Valley. The substation is completely surrounded by forest with the nearest residential areas about 400-500 metres away.

Arlington Oval, Marrickville Park, Henson Park and two of the construction laydown areas (Cooke Park and Peace Park) are formerly filled brick pits. In a 2012 survey conducted by GHD, methane was detected in high concentrations in boreholes in Camdenville Park, showing the presence of LFG (GHD, 2013). No methane (major LFG constituent) was detected in an LFG screening program at six locations in Sydney Park wherein one location is within the project area located near the Sydney Park car park adjacent to Princes Highway (Douglas Partners, 2017). Negligible detections of carbon dioxide were identified during the screening program, suggesting that LFG could be present. No landfilling activities have been undertaken for more than 30 years in Sydney Park.

4.4 Existing air quality

The NSW Office of Environment and Heritage (OEH) operate an air quality monitoring network across the state. The nearest monitoring stations to the project are Rozelle (approximately 3.5 kilometres to the north), Chullora (immediately adjacent to the western end of the transmission cable route), and Earlwood (about 2 kilometres to the south of the transmission cable route). The Rozelle and Earlwood sites are located in predominately residential areas. The Chullora site is located in a mixed residential and commercial area. All three sites are considered representative of particulate concentrations expected along the transmission cable route.

No OEH monitoring station is located nearby Sydney South substation. The Chullora monitoring station is the closest, approximately 10 kilometres to the north of the substation. Particulate concentrations at Sydney South substation are likely to be similar to those monitored at Rozelle, Chullora and Earlwood as concentrations throughout the Sydney Basin are typically similar. The data presented below can therefore be considered representative of concentrations at Sydney South substation.

A summary of PM_{10} monitoring data for the period 2013 to 2018 at Rozelle, Chullora and Earlwood are presented in **Table 4-2**. Observations from the monitoring stations identified:

- exceedances of the 24-hour NSW EPA criterion at all three sites in 2013, 2015, 2016, 2017, and 2018. The highest 24-hour PM_{10} concentrations measured at the three stations in 2018 were all recorded on 22 November 2018 when a state wide dust storm occurred (NSW OEH 2018);

- no exceedances of the annual average NSW EPA criterion at any of the sites across all six years. The highest annual average PM_{10} concentration of 21.9 µg/m^3 was measured in 2018 at Chullora; and
- the study area can be subject to elevated short-term particulate impacts; for example, when smoke from bushfires and/or hazard reduction burn events affects the Sydney basin.

Table 4-2 Summary of existing PM_{10} concentrations at nearby air quality monitoring sites

Averaging period	NSW EPA impact assessment criteria	Year	PM_{10} concentration (µg/m^3)		
			Rozelle	Chullora	Earlwood
Maximum 24-hour Average	50	2013	58.5	69.4	63.1
		2014	43.8	40.0	45.2
		2015	60.3	64.6	66.5
		2016	58.8	63.5	42.9
		2017	54.1	63.0	59.8
		2018	88.3	90.7	86.5
Annual Average	25	2013	18.3	18.3	19.9
		2014	17.9	18.1	18.3
		2015	16.7	17.5	17.2
		2016	16.8	18.1	17.6
		2017	18.1	20.1	18.0
		2018	18.5	21.9	19.8

Odour is a complex pollutant, and cumulative sources of different odours are not necessarily additive and may actually mask each other. For this reason, only odours with similar character can be assessed cumulatively. There are no other known sources of odour with similar character to LFG near Camdenville Park or Sydney Park. Based on this, no background odour was considered for this assessment.

5.0 Assessment of potential construction impacts

5.1 Dust

5.1.1 Selection of emissions scenario

To assess the potential magnitude of dust emissions from the construction of the project, a worst case dust emission scenario was defined and volumes of earthworks, construction and trackout (dust from trucks and other vehicles moving from site) were estimated. The IAQM guideline methodology is largely based on expected volumes of dusty material (generally soil and concrete) that are produced as part of a construction project. The worst case dust emission scenario for the project was therefore developed based on consideration of which of the construction activities (identified in **Section 2.5.1**) are likely to have the highest volumes of material. The various works involved in the project are discussed in the following sections.

5.1.1.1 Transmission cable route – trenching, excavating and stockpiling

The construction activities that would produce the most dust in relation to the transmission cable route would be trenching and excavation, excavation of pits for underboring and excavation and establishment of joint bays, including associated stockpiling. Excavation volumes along the length of the transmission cable route are expected to be essentially identical, and as such the dust emission scenario was developed as a generic case which could be applied across the entire transmission cable route.

As stated in **Section 2.5.1**, works may be undertaken concurrently in two or more 600-800 metre drum length sections of the alignment. It is possible that these works may be carried out concurrently in immediately adjacent drum length sections, and that construction activities in both drum length sections may impact on a single given sensitive receptor.

Considered in the worst case dust emission scenario were two adjacent drum length sections. There is the possibility that at least one of the two sections would be split into two routes; each requiring its own trench. This may be necessary if existing infrastructure does not allow enough space for both sets of conduits to be placed along the same alignment. One of the two sections included in the worst case dust emission scenario therefore included duplication of trenching and other associated infrastructure (joint bays, link boxes, etc.).

While it is possible that three adjacent drum length sections may be worked on at one time, the distance between the sections would be sufficient to present a low risk of cumulative impacts at individual receptors and as such this scenario has not been considered.

A single thrust boring location has been considered for the worst case dust emission scenario. Excavation and restoration of a launch and receive pit as well as stockpiling of excavated spoil at nearby laydown areas are included. Horizontal Directional Drilling (HDD) (if required) would require a significantly smaller volume of earthworks compared with thrust boring. Based on this, HDD was not included in the worst case scenario and the outcome of the assessment can be considered conservative for HDD.

The worst case scenario for two adjacent drum length sections, one of which is duplicated, consisted of:

- 2,400 metres of cable trench (800 metres for one section, 1,600 metres for duplicated section);
- one thrust bore special crossing;
- six joint bays;
- six link box pits;
- six sensor boxes;
- two nearby construction laydown areas;
- two stockpiling sites; and
- permanent restoration of trenched surfaces.

The scenario is defined and summarised in **Table 5-1**.

Table 5-1 Description of worst case dust emission scenario

Works component	Description
Trenching and excavation of transmission cable route	Total length: 2,400 metres (1 x 800 metre section, 1 x 1,600 metre duplicated section) Dimensions: 2,400 metres long x 3 metres wide x 1.5 metres deep = 10,800 m^3 Notes: • excavation and backfilling would be completed at a rate of about 20 metres per day; and • trench depth may vary depending on the location.
Thrust boring	• 1 x launch pit: 10 m deep x 10 m wide x 15 m long = 1,500 m^3; and • 1 x receive pit: 10 m deep x 10 m wide x 15 m long = 1,500 m^3.
Excavation of joint bays	• quantity per section: 2 x joint bays, separated by about 15 metres; and • dimensions: 10 metres long x 3 metres wide x 2 metres deep x 6 joint bays = 360 m3
Excavation of link box pits	• quantity per section: 2 (1 link box pit per joint bay); and • dimensions: 1.4 metres long x 1.5 metres wide x 1 metres deep x 6 link boxes = 12.6 m^3.
Excavation of sensor box pit	• quantity per section: 2 (1 sensor box pit per joint bay); and • dimensions: 1.4 metres long x 1.5 metres wide x 1 metre deep x 6 sensor boxes = 12.6 m^3.
Construction laydown areas	• 2 construction laydown areas; and • Dimensions: 10,300 m^2 (assumes the largest realistic combination of two construction laydown areas - Camdenville Park and Beaconsfield West substation).
Stockpiling	2 x stockpiling sites Dimensions: Total maximum stockpiled volume per day would be approximately: • trenching and excavation 270 m^3 per day (at a trenching and excavation rate of about 20 metres per day x 3 sections (including duplicate route) = 20 metres long x 3 metres wide x 1.5 metres deep x 3 sections = 270 m^3 per day); • thrust bore pits: 175 m^3 per day (assumes an hourly excavation rate of 25 m^3 x seven hours actual work time per day); • joint bays: 60 m^3 per day (assumes that a single joint bay could be excavated in a day); • link boxes: 8.4 m^3 per day; • sensor box pit: 8.4 m^3 per day; and • total maximum stockpiling volume is approximately 522 m^3 per day for two stockpiling sites. Typical stockpiling rates are likely to be lower than this.
Cable bridge excavation	Quantity per section: assumed one cable bridge for the purposes of the assessment, up to three in total may be required. Notes: • considered the construction of bridge piers at each end of the cable bridge; and • bridge structure to be precast off-site.
Permanent restoration of surfaces	Total length: 2,400 metres (1 x 800 metre section, 1 x 1,600 metre duplicated section) Dimensions: 2,400 metres long x 3 metres wide = 7,200 m^2 Notes: • includes backfilling and road surface restoration; and • works would be completed at a rate of between 5-50 metres per day, depending on the type of surface.

Works component	Description
Vehicle movements	• there would be approximately 48 heavy vehicle movements and 8 light vehicle movements per day at the transmission cable route, including for trenching, bridges and major infrastructure crossings and joint bay excavation; • there would be approximately 4 heavy vehicle movements and 3-4 light vehicle movements per day at each construction laydown area; and • there would be approximately 14 heavy vehicle movements per day for the stockpiling at laydown areas.

A summary of total area, construction volumes, and duration are presented in **Table 5-2**.

Table 5-2 Summary of totals for worst case dust emissions scenario

Works component	Description	Area/volume
Total area for scenario	Trenching and excavation and restoration of surfaces	~ 7,200 m^2
	Thrust bore	~800 m^2 (launch pit) ~ 100 m^2 (receive pit)
	Excavation and establishment of joint bays	~ 180 m^2
	Construction laydown areas:	10,300 m^2
	Area subtotal	~ 18,580 m^2
Total earthworks volume for scenario	Trenching and excavation	~ 10,800 m^3
	Thrust bore	~ 3,000 m^3
	Excavation and establishment of joint bays:	~ 360 m^3
	Backfilling	< 13,800 m^3
	Total earthworks	~ 27960 m^3 (44,736 tonnes @ 1.6 tonnes/m^3 bulk density)
Total construction duration for scenario	Trenching and excavation: excavate, install conduit and backfill trench for one section	~ 20 metres of trenching per day - 8 weeks
	Excavation and establishment of joint bays	Up to 4 weeks of excavation and then 6 weeks for establishment
	Construction laydown areas	24 months
	Special crossings (thrust boring)	Up to 10 weeks
	Permanent road restoration	Up to 6 months
	Total	Up to 24 months

5.1.1.2 Substation upgrades

The substation upgrade works would include earthworks and excavations needed for cable entries and footings for new equipment at the Rookwood Road, Beaconsfield West and Sydney South substations.

The worst case dust emission scenario identified above in **Table 5-1** for the transmission cable route includes trenching and excavation activities that would also occur at Rookwood Road and Beaconsfield West substations. Based on this, the scenario can be applied to the Rookwood Road and Beaconsfield West substations and represents a worst case scenario at these two locations.

Works at the Sydney South substation would include substation upgrade works only. In terms of total volume of earthworks and construction, the South Sydney substation works are expected to be significantly less than the transmission cable route, based on activities to occur and the area of the substation site. Therefore, the worst case dust emissions scenario can also be conservatively applied to works at the Sydney South substation.

5.1.1.3 Construction laydown areas

No significant earthworks are planned at the construction laydown areas, however minor ground disturbance and temporary stockpiling of excavated spoil would occur, i.e. at times when landfills and other waste facilities are not open. Other dust generating activities at the construction laydown areas would likely be limited to movement of light vehicles on unsealed ground, and movement of materials and supplies that may have dust on them.

If stockpiling is managed appropriately dust emissions are not expected to impact on surrounding sensitive receptors. Stockpiling is proposed to occur at all five construction laydown areas; 12 Muir Road, Cooke Park, Peace Park, Camdenville Park and Beaconsfield West substation. As shown in **Table 5-1**, the maximum daily stockpiling rate at two stockpiling sites would be 522 m^3 and actual stockpiling rates are likely be lower than this as the activities included in the worst case scenario will likely not occur simultaneously. The estimated daily rate of spoil delivery would require 8-9 trucks per day to deliver the spoil (30 tonnes per truck) to each stockpiling site.

Other potential dust emissions would primarily be due to wheel generated dust from delivery and removal of materials and spoil. As shown in **Table 2-5**, a maximum total of 12 heavy vehicle movements daily are estimated to be required at each construction laydown area. Short sections of unsealed driveways and tracks may be required at the construction laydown areas. Based on the small number of trucks and the short sections of unsealed tracks significant dust emissions are not expected. If managed appropriately according to management measures listed in **Section 7.2** , no significant impacts to surrounding sensitive receptors are expected.

5.1.1.4 Summary of emissions scenario

The project works with the highest volume of earthworks, construction and trackout, were identified as being for the construction of the transmission cable circuit. The worst case dust emission scenario was therefore based on activities involved with the transmission cable route. This includes stockpiling activities at the relevant construction laydown areas. Other works such as substation upgrades would not have as high a potential dust emission magnitude as the works involved with the transmission cable route. As such, outcomes of the IAQM guideline assessment for the transmission cable route can be applied conservatively to the substation upgrades.

The four-step assessment of the worst case dust emission scenario according to IAQM guideline is described in the following sections.

5.1.2 Step 1 - screening assessment

The IAQM guideline recommends further assessment of dust impacts for construction works where sensitive receptors are located closer than:

- 350 metres from the boundary of a site; and
- 50 metres from the route used by construction vehicles on public roads up to 500 metres from a site entrance.

As there are a number of sensitive receptors located within 350 metres of the transmission cable route, construction laydown areas, and the Rookwood Road and Beaconsfield West substations, further assessment was deemed necessary. The assessment is described in the following sections.

No sensitive receptors are located within 350 metres of the works to be undertaken at Sydney South substation, and no receptors are located within 50 metres of roads up to 500 metres from the site entrance. No further assessment of these works is therefore necessary. However, as a precautionary measure, dust management measures described in **Section 7.0** are still recommended to be implemented during construction works at Sydney South substation.

5.1.3 Step 2 – risk assessment

Step 2 in the IAQM guideline is a risk assessment tool designed to appraise the potential for dust impacts due to unmitigated dust emissions from a construction project. The key components of the risk assessment are defining the dust emission magnitudes (Step 2A), the sensitivity of the area (Step 2B), and then combining these in a risk matrix (Step 2C) to determine an overall risk of dust impacts.

5.1.3.1 Step 2A - dust emission magnitude

Dust emission magnitudes are estimated according to the scale of works being undertaken and other considerations such as meteorology, types of material being used, or general demolition methodology. The IAQM guideline provides examples to aid classification, as presented in the excerpt from the IAQM guideline (note that only sections relevant to the project are included – i.e. demolition is excluded) presented in **Table 5-3**.

Table 5-3 Excerpt from IAQM guideline– dust emission magnitude examples by activity

Activity	Dust emission magnitude
Earthworks: Earthworks would primarily involve excavating material, haulage, tipping and stockpiling. This may also involve levelling the site and landscaping.	*Example definitions for earthworks are:* • *Large: Total site area >10,000 m^2, potentially dusty soil type (e.g. clay, which would be prone to suspension when dry due to small particle size), >10 heavy earth moving vehicles active at any one time, formation of bunds >8 metres in height, total material moved >100,000 tonnes;* • *Medium: Total site area 2,500-10,000 m^2, moderately dusty soil type (e.g. silt), 5-10 heavy earth moving vehicles active at any one time, formation of bunds 4-8 metres in height, total material moved 20,000-100,000 tonnes; and* • *Small: Total site area <2,000 m^2 – soil type with large grain size, e.g. sand, <5 heavy earth moving vehicles at one time, formation of bunds <4 metres in height, total material moved <20,000 tonnes, earthworks during wetter months.*
Construction: The key issues when determining the potential dust emission magnitude during the construction phase include the size of the building(s)/infrastructure, method of construction, construction materials, and duration of build.	*Example definitions for construction are:* • *Large: Total building volume >100, 000 m^3, on-site concrete batching, sandblasting;* • *Medium: Total building volume 25,000-100,000 m^3, potentially dusty construction material (e.g. concrete), on-site concrete batching; and* • *Small: Total building volume <25,000 m^3, construction material with low potential for dust release (e.g. metal cladding or timber).*
Trackout: Factors which determine the dust emission magnitude are vehicle size, vehicle speed, vehicle numbers, geology and duration. As with all other potential sources, professional judgement must be applied when classifying trackout into one of the dust emission magnitude categories.	*Example definitions for trackout are:* • *Large: >50 truck (>3.5 tonne) outward movements in any one day, potentially dusty surface material (e.g. high clay content), unpaved road length >100 metres;* • *Medium: 10-50 truck (>3.5 tonne) outward movements in any one day, moderately dusty surface material (e.g. high clay content), unpaved road length 50-100 metres; and* • *Small: <10 truck (>3.5 tonne) outward movements in any one day, surface material with low potential for dust release, unpaved road length <50 metres."*

Source: *Guidance on the assessment of dust from demolition and construction* (IAQM, 2014)

For the project, earthworks are defined as all excavations (such as for cable trenches, joint bays and underboring pits) and backfilling. Construction is defined as all other non-excavation activities, such as restoration of surfaces and cable bridge installation. Trackout is defined as dust generated by the movement of vehicles from the project area, including between transmission cable route work sites and construction laydown areas. There are no demolition activities associated with the project worst case scenario.

Potential dust emission magnitudes for the worst case dust emission scenario (defined in **Section 5.1.1**) were estimated based on the IAQM guideline. Justification and the factors used in determining the magnitudes for the worst case dust emission scenario used in this assessment are presented in **Table 5-4**. Note that works at Sydney South substation were not included in this scenario as there are no nearby sensitive receptors (refer to **Section 5.1.2**). Overall dust emission magnitudes were small, mostly due to the relatively small volumes of work to be undertaken.

Table 5-4 Maximum dust emission magnitudes for the worst case dust emission scenario in accordance with IAQM guideline

Activity	Potential dust emission magnitude	Justification
Demolition	Nil	• no demolition activities proposed.
Earthworks	Medium	• total site area ~8,280 m^2 (does not include construction laydown areas where no earthworks would be undertaken); • <5 heavy earth moving vehicles at any one time: 1 x excavator and 1 x backhoe/front-end loader, <3 spoil trucks at any given time at each work site; • no bunds, or bunds <4 metres in height; • total material excavated and backfilled approximately 44,740 tonnes (refer to **Table 5-2**); • most surplus excavated material to be trucked from site immediately without stockpiling; and • stockpiling of excavated material at construction laydown areas, up to 522 m^3/day.
Construction	Small	• total construction volume <25,000 m^3; • no on-site crushing or concrete batching; and • cable bridges would be pre-built using precast sections.
Trackout	Medium	• up to 48 outward heavy vehicle movements per day for the transmission cable route movements (refer to **Table 2-5**); and • unpaved road length <50 metres.

5.1.3.2 Step 2B - sensitivity of the surrounding area

The IAQM guideline classifies sensitivity of an area to dust soiling and human health impacts due to PM_{10} as high, medium, or low. Factors used to determine the sensitivity of the surrounding area are described as follows:

- receptor sensitivity (for individual receptors in the area):
  - High sensitivity – locations where members of the public are likely to be exposed for eight hours or more in a day. For example, private residences, healthcare providers, schools, or aged care homes;
  - Medium sensitivity - places of work where exposure is likely to be eight hours or more in a day;
  - Low sensitivity – locations where exposure is transient – i.e. one or two hours maximum. For example, parks, footpaths, commercial areas, playing fields;
- annual mean PM_{10} concentration (only applicable to the human health impact matrix);
- number of receptors of each sensitivity type in the area; and
- distance from source.

The matrix table in the IAQM guideline for determining the sensitivity of the area to dust deposition is presented in **Figure 5-1**, and for human health impacts in **Figure 5-2**. The sensitivity for the area for dust soiling and human health impacts were selected from these two tables.

Receptor Sensitivity	Number of Receptors	Distance from the Source(m)[c]			
		<20	<50	<100	<350
High	>100	High	High	Medium	Low
	10-100	High	Medium	Low	Low
	1-10	Medium	Low	Low	Low
Medium	>1	Medium	Low	Low	Low
Low	>1	Low	Low	Low	Low

[A] The sensitivity of the area should be derived for each of the four activities: demolition, construction, earthworks and trackout. See **STEP 2B**, **Box 6** and **Box 9**

[B] Estimate the total number of receptors within the stated distance. Only the *highest level* of area sensitivity from the table needs to be considered. For example, if there are 7 high sensitivity receptors <20m of the source and 95 high sensitivity receptors between 20 and 50m, then the total of number of receptors <50m is 102. The sensitivity of the area in this case would be high.

[C] For trackout, the distances should be measured from the side of the roads used by construction traffic. Without site-specific mitigation, trackout may occur from roads up to 500m from large sites, 200m from medium sites and 50m from small sites, as measured from the site exit. The impact declines with distance from the site, and it is only necessary to consider trackout impacts up to 50m from the edge of the road.

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EXTRACT FROM THE IAQM GUIDELINE SHOWING THE MATRIX FOR DETERMINING THE SENSITIVITY OF THE AREA TO DUST DEPOSITION

(IAQM, 2014)

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FIGURE 5-1

Receptor Sensitivity	Annual Mean PM_{10} concentration[C]	Number of Receptors[D]	Distance from the Source(m)[E]				
			<20	<50	<100	<200	<350
High	>32 ug/m^3 (>18 ug/m^3 in Scotland)	>100	High	High	High	Medium	Low
		10-100	High	High	Medium	Low	Low
		1-10	High	Medium	Low	Low	Low
	28-32 ug/m^3 (16-18 ug/m^3 in Scotland)	>100	High	High	Medium	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	High	Medium	Low	Low	Low
	24-28 ug/m^3 (14-16 ug/m^3 in Scotland)	>100	High	Medium	Low	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	Medium	Low	Low	Low	Low
	24-28 ug/m^3 (14-16 ug/m^3 in Scotland)	>100	Medium	Low	Low	Low	Low
		10-100	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
Medium	>32 ug/m^3 (>18 ug/m^3 in Scotland)	>10	High	Medium	Low	Low	Low
		1-10	Medium	Low	Low	Low	Low
	28-32 ug/m^3 (16-18 ug/m^3 in Scotland)	>10	Medium	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
	24-28 ug/m^3 (14-16 ug/m^3 in Scotland)	>10	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
	<24 ug/m^3 (<14 ug/m^3 in Scotland)	>10	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
Low	-	>1	Low	Low	Low	Low	Low

[A] The sensitivity of the area should be derived for each of the four activities: demolition, construction, earthworks and trackout. See **STEP 2B**, **Box 7** and **Box 9**

[B] Estimate the total number of receptors within the stated distance (e.g. The total within 350m and not the number between 200 and 350m), noting that only the **highest level** of area sensitivity from the table needs to be considered. For example, if there are 7 high sensitivity receptors <20m of the source and 95 high sensitivity receptors between 20 and 50m, then the total of number of receptors <50m is 102. If the annual mean PM_{10} concentration is 29 ug/m^3, the sensitivity of the area would be high.

[C] Most straightforwardly taken from the national background maps, but should also take into account of local sources. The values are based on 32ug/m^3 being the annual mean concentration at which an exceedance of the 24-hour objective is likely in England, Wales and Northern Ireland. In Scotland there is an annual mean obejective of 18ug/m^3.

[D] In the case of high sensitivity receptors with high occupancy (such as schools or hospitals) approximate the number of people likely to be present. In the case of residential dwellings, just include the number of properties.

[E] For trackout, the distances should be measured from the side of the roads used by construction traffic. Without site-specific mitigation, trackout may occur from roads up to 500m from large sites, 200m from medium sites and 50m from small sites, as measured from the site exit. The impact declines with distance from the site, and it is only necessary to consider trackout impacts up to 50m from the edge of the road.

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EXTRACT FROM THE IAQM GUIDELINE SHOWING THE MATRIX FOR DETERMINING THE SENSITIVITY OF THE AREA TO HUMAN HEALTH IMPACTS (IAQM, 2014)

The overall sensitivity of the area is determined by selecting the highest relevant sensitivity classification from the matrix tables (there may be more than one classification depending on the number of receptors of each sensitivity types in the area).

Based on this approach, the highest sensitivity of the area to dust soiling was classified as High, and the overall sensitivity to human health impacts was classified as Medium. Justifications for these classifications and factors used in the IAQM guideline matrix tables are presented in **Table 5-5**.

Table 5-5 Sensitivity of the area in accordance with IAQM guideline

Potential impact	Sensitivity of the area	Justification
Dust soiling	High	• receptor sensitivity: High (residences); • number of receptors: >100 per 1,800 metre length of transmission cable route; and • distance from source: <20 metres of transmission cable route area.
Human health (PM_{10})	Medium	• receptor sensitivity: High (residences); • annual average PM_{10} concentration: <24 µg/m^3 (refer to **Table 4-2**); • number of receptors: >100 per 1,800 metre length of transmission cable route; and • distance from source: <20 metres of transmission cable route area.

5.1.3.3 Step 2C - unmitigated risks of impacts

The potential dust emission magnitude classification for each activity (earthworks, construction or trackout), as identified in **Table 5-4**, was combined with the sensitivity of the area, as identified in **Table 5-5**, to determine the risk of dust related impacts, with no mitigation applied. The IAQM guideline provides a risk matrix to aid in making this determination, as presented in **Figure 5-3**.

EARTHWORKS AND CONSTRUCTION

Sensitivity of Area	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Medium Risk	Low Risk
Low	Low Risk	Low Risk	Negligible

TRACKOUT

Sensitivity of Area	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Low Risk	Negligible
Low	Low Risk	Low Risk	Negligible

G:\ENV\GIS\Projects\605\60558835 Rookwood to Beaconsfield EIS\FIGURES\2019\AQ\60558835 F5.3 Extract from the IAQM Matrix Sensitivity 30 05 2019

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EXTRACT FROM THE IAQM GUIDELINE SHOWING THE MATRIX FOR DETERMINING THE RISK OF DUST IMPACTS FOR EARTHWORKS & CONSTRUCTION (TOP) AND TRACKOUT (BOTTOM) (IAQM, 2014)

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FIGURE 5-3

The risk of dust impacts due to the worst case dust emission scenario were assigned according to the IAQM guideline risk matrix above and are summarised in **Table 5-6**.

Table 5-6 Summary of "worst case" drum length section dust risks without mitigation

Potential impact	Risk of dust impacts on sensitive receptors – without mitigation		
	Earthworks	**Construction**	**Trackout**
Dust soiling	Medium	Low	Medium
Human health (PM_{10})	Medium	Low	Low

The outcome of the qualitative air quality risk assessment shows that the project is considered to pose a Medium Risk of dust soiling, and a Medium Risk of human health impacts. This outcome is based on the worst case dust emission scenario defined in **Section 5.1.1**, and is representative of all construction precincts along the transmission cable route and includes the Rookwood Road and Beaconsfield West substation and construction laydown areas.

As discussed in **Section 5.1.2**, the outcomes described here are not relevant to South Sydney substation due to its distance from sensitive receptors. A risk rating of negligible can be assumed to apply to the works at Sydney South substation.

5.1.4 Step 3 – management strategies

The outcome of Step 2C is used to determine the level of management that is required to ensure that dust impacts on surrounding sensitive receptors are minimised. A high or medium-level risk rating means that suitable management measures must be implemented during the construction works to minimise nuisance/noticeable dust impacts. As the outcomes of Step 2 of the assessment reported a Medium Risk of dust soiling and a Medium Risk of human health impacts, suitable management measures would need to be implemented during construction of the project.

Recommended site-specific and in-principle management measures are described below in **Section 7.2**. With the implementation of these measures there should be minimal risk of nuisance dust impacts on surrounding receptors due to project construction.

5.1.5 Step 4 – reassessment

The final step of the IAQM guideline is to determine whether there are significant residual impacts, post mitigation, arising from a proposed development. The guidance states: "*For almost all construction activity, the aim should be to prevent significant effects on receptors through the use of effective mitigation*". Experience shows that this is normally possible. Hence the residual effect would normally be "not significant".

It is anticipated that the project would not constitute an atypical case; as it involves standard construction methodologies for an urban linear construction project. With implementation of the proposed mitigation measures (described in **Section 7.2**) the residual effect (impacts) would be "not significant" in all precincts for dust soiling and human health impacts.

5.2 Odour

As discussed in **Section 3.3.2**, there is potential for LFG to be encountered during excavation at several locations through the project area. Should LFG be encountered, odorous constituents of the gas may disperse from the excavation towards nearby sensitive receptors. LFG may impact receptors by causing annoyance and potential for stress.

Previous studies have identified the presence of LFG constituents (methane and/or carbon dioxide) at Camdenville Park and Sydney Park, and further assessment of these locations is presented in the following sections.

The presence and extent of LFG at Arlington Oval Park, Marrickville Park and Henson Park are unknown and may require further assessment. Assessment would need to be undertaken prior to the commencement of construction as part of site investigations. Site investigations would include assessment for the presence and risk of subsurface landfill gas by sampling ground gas following the *Guidelines for the Assessment and Management of Sites Impacted by Hazardous Ground Gases* (NSW EPA, 2012).

Two of the construction laydown areas, Cooke Park (Precinct 2) and Peace Park (Precinct 3) may also contain potential former landfills and were identified in the Preliminary Site Investigation –Soils and Contamination technical report of the EIS (Appendix K) as having potential for LFG. Only minor ground disturbance is proposed at Cooke Park and Peace Park and therefore it is unlikely that LFG would be encountered. Given this, no further assessment of potential odour impacts was undertaken for these construction laydown areas.

Although odour impacts are not considered likely, precautionary measures would be adopted. LFG would be monitored to assess the presence of odour by means of a portable LFG analyser during excavation works at any locations that may potentially have LFG, to allow for early on-site detection.

5.2.1 Camdenville Park

In a 2012 survey conducted by GHD, methane was detected in high concentrations in boreholes in Camdenville Park, showing the presence of LFG (GHD, 2013). However, the bulk of the high detections were concentrated along the northern and eastern boundaries of the park, away from the transmission cable route. Detections of methane near the transmission cable route were typically below the NSW EPA subsurface monitoring criterion of 1.25% v/v (NSW EPA, 2012). Methane is non-odorous, but its presence suggests that other odorous components of LFG may also be present in concentrations above their respective odour thresholds.

Air flow rates in the bores monitored in the 2012 survey were generally low, with flow rates typically below 0.2 litres per hour (GHD, 2013). This indicates that there may be little pressure within the body of LFG, and migration of LFG through the subsoil is unlikely. Should a pocket of LFG be encountered during excavation, further infiltration of LFG from surrounding areas is also unlikely. Additionally, trenching would be undertaken at a rate of about 20 metres per day meaning that any given 20 metre section would be excavated and covered again within a day. Potential odour impacts due to LFG would therefore be short in duration and it is not likely to lead to continued annoyance and potential stress to people at nearby sensitive receptors or in the park. As a precautionary measure, management of potential odour impacts would be implemented during construction activities in Camdenville Park.

Applicable management strategies for odour in Camdenville Park are discussed in **Section 5.2.3**. With implementation of these strategies, odour impacts are not considered likely at nearby sensitive receptors outside of the Camdenville Park, or to people using the park.

5.2.2 Sydney Park

A map of the transmission cable route through Sydney Park, and approximate locations of the historical landfill (based on previous studies) are presented in **Figure 5-4**. If LFG is encountered during excavations in Sydney Park, it is most likely to be on the southern or western side of the park where the transmission cable route passes through or alongside areas of historic landfill. However, LFG can migrate underground and there is also the potential for LFG to be encountered at the location of the underboring pits near the wetland. Excavation works involved with trenching and underboring would both be deep enough to potentially encounter LFG, should it be present. Sections of trench (20 metres long) would be excavated and covered again within a day, while underboring would take up to 8 to 10 weeks (see **Table 2-3**). As both activities require excavation of the subsurface, the likelihood of encountering LFG is similar for trenching and underboring. However, due to the longer duration of works compared with trenching, underboring may present a higher likelihood of odour impacts, as the excavation would be open to air for a longer period. For both activities, appropriate mitigation measures should be applied as required to minimise the potential for odour impacts.

No methane (major LFG constituent) was detected in an LFG screening program at six locations in Sydney Park wherein one location is within the project area located near the Sydney Park car park adjacent to Princes Highway (Douglas Partners, 2017). Negligible detections of carbon dioxide were identified during the screening program, suggesting that LFG could be present. No landfilling activities have been undertaken however for more than 30 years in this park. Based on this, the likelihood of encountering significant pockets of LFG during project excavation activities in Sydney Park is low. Additionally, should any LFG be encountered, it is not likely to be widespread (based on the non-detection of methane in the LFG screening program), and any odour emissions would be short in duration and not likely to lead to continued annoyance and potential stress to people at nearby sensitive receptors or in the park. As a precautionary measure, management measures for short-term odour impacts would be implemented during excavation activities (trenching and underboring) in Sydney Park.

Applicable management strategies for odour in Sydney Park are discussed in **Section 5.2.3**. With implementation of these strategies, odour impacts are not considered likely at nearby sensitive receptors outside of the Sydney Park, or to people using the park.

5.2.3 Management of odour

Although odour impacts are not considered likely, precautionary measures have been adopted. LFG would be monitored to assess the presence of odour by means of a portable LFG analyser during excavation works at Camdenville Park and Sydney Park, or any of the other locations that may have LFG, to allow for early on-site detection of LFG should it be encountered.

If LFG is detected by the portable LFG analyser at levels such as methane >0.1 % v/v or hydrogen sulfide >1 ppm[3] then additional measures would be implemented, such as slowing the pace of works, covering excavations and visually observing wind speed and direction (refer to **Table 7-1**). Should these additional measures be ineffectual and odour complaints are received, then the use of an Odour Control Enclosure (OCE)[4] with filtered air extraction should be considered, where reasonable and feasible.

[3] H_2S is typically odorous at concentrations much lower than 1 ppm. However, 1 ppm is a typical limit of detection for portable LFG analysers. Concentrations lower than 1 ppm are therefore not easily measurable on a continuous basis.

[4] An OCE is essentially a tent that is maintained under negative pressure with all air within the tent vented via a single vent stack. Controlling emissions through a single vent stack allows for better dispersion of potential odour and reduces the risk of impacts.

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G:\ENV\GIS\Projects\605\60558835 Rookwood to Beaconsfield EIS\FIGURES\2019\60558835 F9.1 Project Area and Approximate Locations of Landfill 01 10 2019

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PROJECT AREA AND APPROXIMATE LOCATIONS OF LANDFILL IN SYDNEY PARK

Powering Sydney's Future
Potts Hill to Alexandria Transmission Cable Project

FIGURE 5-4

Note: The project area is confined to the roadway reserve with the exception of parks and existing substations
Source: Douglas Partners (2017), Nearmap (2018)

6.0 Assessment of potential operational impacts

All ground surfaces disturbed during construction would be returned to a condition similar to their original state (or as agreed with relevant road authority or local council) post-construction. Based on this, dust emissions are not anticipated during operation of the project except during maintenance activities or emergency works along the transmission cable route or at the substations, which would generally involve visual inspections and potentially small amounts of excavation. If this occurred, the dust emission magnitude would likely be less than that described in **Section 5.1.3.1** for construction activities, and as such any emissions could be managed by the measures identified in **Section 7.2**.

The cable conduits through locations with LFG present would be designed such that no preferential migration pathway for LFG exists. Based on this there would be no sources of odour emissions anticipated during operation of the project. Again, if emergency works are required then potential odour emissions would be managed according to measures identified in **Section 7.2**.

7.0 Environmental management and mitigation measures

7.1 Management objectives

Management of air quality throughout the construction of the project would be undertaken with the aim of reducing impacts on nearby sensitive receptors in accordance with the IAQM guideline.

The main objective of the air quality management measures would be to minimise dust and odour emissions to maintain amenity at nearby sensitive receptors. The secondary objective would be to ensure that no complaints regarding air quality issues are received for the duration of the project.

7.2 Environmental management and mitigation measures

A range of site-specific and in-principle dust management and mitigation measures have been identified for the project. These measures are considered sufficient to adequately minimise dust emissions and are applicable across all five project precincts, construction laydown areas and works being undertaken at the three substations. The management and mitigation measures identified to prevent dust migrating off-site are outlined in **Table 7-1**.

A range of site-specific and in-principle odour management and mitigation measures have been identified for the project in Camdenville Park and Sydney Park. These measures are considered sufficient to adequately minimise odour emissions. The management and mitigation measures identified are outlined in **Table 7-1**.

Performance of air quality management measures would be assessed through a combination of visual monitoring and development of a complaints register. No visible dust or detectable odour migrating off-site and no dust or odour related complaints would indicate successful achievement of the management objectives.

Table 7-1 Environmental management and mitigation measures

No.	Impact/issue	Environmental management and mitigation measures	Timing
AQ1	General dust and odour impacts	Prepare an Air Quality Management Plan (AQMP) for the project, as part of the project's Construction Environmental Management Plan (CEMP). The AQMP will identify the measures to be undertaken during construction of the project and document the complaints management process.	Construction
AQ2	Dry surfaces	Regularly water all exposed surfaces at construction laydown areas (excluding stockpiles) or special crossing work sites when conditions are dry and dusty, through the use of water sprays, sprinkler systems, a water cart or other suitable methods. Frequency would be determined by how quickly the surface dries out again, with higher frequency watering required on hot, dry, windy days.	Construction
AQ3	Adverse weather	On days where forecast weather conditions (e.g. high winds) may result in high dust emissions, dust generating work activities may need to be rescheduled or modified. The forecast weather conditions will be included in daily tool box talks and construction planning.	Construction
AQ4	Stockpiles	Spoil stockpiles will be covered.	Construction
AQ5	Drop heights	Minimise drop heights from excavators when placing spoil into trucks or onto stockpiles to reduce the potential for dust-generation.	Construction

No.	Impact/issue	Environmental management and mitigation measures	Timing
AQ6	Exposed surfaces	Progressively rehabilitate exposed areas at work sites to limit dust generation.	Construction
AQ7	Generation of dust from vehicles and plant	Ensure that all vehicles transporting spoil, rock, other materials or waste, are covered when entering or exiting the work site.	Construction
AQ8	Generation of dust from vehicles and plant	Vehicle and plant will be free of excessive soil, where required to reduce soil tracking onto public roadways.	Construction
AQ9	Generation of dust from vehicles and plant	Provide stabilised site access (where existing site is unsealed) and access points as required.	Construction
AQ10	Generation of dust from vehicles and plant	Construction vehicles and mobile plant will use designated haulage and access routes, where practicable, and traffic speeds at work sites will be restricted to limit the generation of dust from vehicle movements.	Construction
AQ11	Migration of dust off-site	If dust is seen to be migrating off-site, the source of the dust will be identified and additional management and mitigation measures implemented (such as rescheduling the works or water spraying), where required.	Construction
AQ12	Landfill gas	Site-specific landfill gas management plans will be prepared for works at locations with landfill gas (including Camdenville Park and Sydney Park) prior to any trenching and excavation. Further site investigations will be undertaken within the project area closest to Arlington Oval and Marrickville Park and where the project traverses Henson Park in accordance with the *Guidelines for the Assessment and Management of Sites Impacted by Hazardous Ground Gases* (NSW EPA, 2012) to assess the presence and risk of landfill gas. If landfill gas is detected, a site-specific landfill gas management plan will be developed for any excavation works in these areas (also refer to CT9). The plans will be prepared by a suitably qualified landfill gas management specialist. The management plans will include mitigation measures to prevent human health exposure and explosive risks posed by landfill gas and nuisance odours from exposed leachate or landfill wastes. The plans will detail the type and frequency of monitoring required during the works and will outline the triggers that could stop works or require a step up in controls. Controls may include the use of odour suppressant mists and foams and other measures deemed suitable for the local conditions of the site.	Detailed design and construction
AQ13	Plant exhaust emissions	Construction vehicles and mobile plant will be maintained in good working condition. Engines will be switched off when not in use.	Construction

Notes:

1 H_2S is typically odorous at concentrations much lower than 1 ppm. However, 1 ppm is a typical limit of detection for portable LFG analysers. Concentrations lower than 1 ppm are therefore not easily measurable on a continuous basis.

2 An OCE is essentially a tent that is maintained under negative pressure with all air within the tent vented via a single vent stack. Controlling emissions through a single vent stack allows for better dispersion of potential odour and reduces the risk of impacts.

8.0 Conclusion

An air quality impact assessment of the construction works associated with the project was undertaken by means of a qualitative risk assessment for the identified primary pollutants of concern, dust and odour. Potential sources of dust were identified as excavation and construction activities that require physical disturbance of material, such as earthworks associated with trenching and joint bay excavation. Landfill gas from areas of former landfill in Camdenville Park and Sydney Park were identified as potential sources of odour.

The existing environment in the study area was described in terms of sensitive receptors, terrain and land use, climate and air quality. The linear nature of the project and the urban location in inner Sydney meant that a large number of sensitive receptors, mainly residential dwellings, are located within 20 metres of the project area. There were no sensitive receptors identified within 500 metres from the Sydney South substation. A review of existing air quality data showed a small number of days of elevated background PM_{10} concentrations in the project area, likely due to bushfires or hazard reduction burns.

A worst case dust emissions scenario was identified for the project, based on construction activities associated with the transmission cable route activities. Potential dust impacts were assessed by means of the methodology provided in the IAQM *Guidance on the assessment of dust from demolition and construction* (2014). A pre-mitigation dust impact risk rating of Medium was determined for dust soiling and Medium for human health impacts for the worst case dust emissions scenario. This rating was based on the potential dust emission magnitude from the project, sensitivity of nearby receptors, proximity of receptors, and the sensitivity of the area as a whole to both dust soiling and human health impacts. Residual impacts once appropriate dust mitigation measures are implemented were “not significant”, in accordance with the post-mitigation reassessment guidance provided in the IAQM guideline.

Potential odour impacts were identified in several locations along the transmission cable route, including Camdenville Park and Sydney Park, due to possible encounters with landfill gas during excavation activities. Odour impacts typically manifest as annoyance, which is described as the negative reaction that a person may experience when exposed to an unpleasant odour. Continued annoyance may impact health by causing a build-up of stress. A range of in-principle and site-specific odour mitigation measures were identified to manage these impacts and reduce the potential for annoyance and stress. The implementation of the management and mitigation measures during the project was considered sufficient to minimise the potential for off-site odour impacts.

An AQMP would be prepared for the project to manage potential dust and odour impacts during construction. The AQMP would include a range of measures such as watering of exposed surfaces and monitoring of landfill gas.

9.0 References

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