Genex Kidston Connection Project:
Draft Environmental Assessment Report
Powerlink Queensland

Appendix H

Noise and Vibration Technical Report

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Noise and Vibration

Genex Kidston Connection Project

Noise and Vibration

Genex Kidston Connection Project

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1.0 Introduction

AECOM Australia Pty Ltd (AECOM) has been commissioned by Powerlink to conduct a noise and vibration impact assessment for the proposed Genex Kidston Connection Project (the Project). This report describes the potential noise impacts associated with the construction, operation and decommissioning of the Project, as well as noise mitigation and management strategies. This report assesses the potential noise impacts of two draft alignment designs: Alignment A and Alignment B. The Alignments only differ significantly west of Kidston.

This assessment is intended to satisfy the requirements of the Project Terms of Reference (ToR) contained in the document *Terms of Reference for an Environmental Assessment Report Genex Kidston Connection Project* dated February 2018.

The Project Site is shown in Appendix B.

1.1 Project scope

The scope of the noise assessment is intended to satisfy the requirements of the ToR and is comprised of:

Preparation and Review

- Review relevant studies within the assessment area, including development assessment acoustic conditions for other known existing and proposed developments.
- Establish performance criteria for noise and vibration emissions:
  - Review relevant legislation and guidelines and establish suitable noise and vibration emission criteria for construction, operation and decommissioning phases, and
  - Identify noise and vibration-sensitive receptors within the study area.

Construction / Decommissioning Noise and Vibration Assessment

- Review the proposed works to be undertaken during the construction and decommissioning phases of the Project.
- Characterise noise and vibration emission data for the proposed construction/decommissioning works from Powerlink and previous acoustic studies.
- Conduct a desktop study of potential construction/decommissioning noise and vibration impacts. Determine buffer distances beyond which noise and vibration emission from construction/decommissioning activities associated with the project are forecast to be within construction noise and vibration targets.
- Overlay buffer distances onto a map of the study area, highlighting sensitive receptors which fall within the defined criteria/buffer distances.
- Recommend in-principle methods to reduce noise and vibration impacts.
- Reference will be made to Powerlink's Standard Operating Procedures.

Operational Phase Noise

- Gather noise emission data for typical operational activities from Powerlink.
- Conduct a desktop modelling study of potential operational noise impacts. Determine buffer distances beyond which noise emission from these works is forecast to be within the applicable noise criteria.
- Overlay buffer distances onto a map of the study area, highlighting sensitive receptors which fall within the defined criteria/buffer distances.
- Review the Powerlink-provided noise source data and limits for the existing powerline and substations, and assess the cumulative noise impacts from the project.

- Recommend in-principle methods to reduce noise impacts.
- Reference will be made to Powerlink's Standard Operating Procedures.

1.2 Limitations

The findings of this report are based on the information provided to date and assumptions which have been made, and may vary once design is finalised. Should the final design or equipment selections differ from that which is currently available, the impact to nearby receptors may require additional evaluation. In addition, the construction/decommissioning and operation of the Project is not envisaged to give rise to perceptible levels of vibration at nearby sensitive receptors. As vibration impacts associated with the Project are not envisaged to be perceptible at nearby receptors, this approach is considered to satisfy the Project's ToR.

Dwellings which have been identified in consultation with Powerlink within 10 km from the Project site have been considered in this report.

The assessment of noise impacts on local fauna has been excluded from this assessment.

The noise and vibration section of the Project's ToR (Section 4.16) has been reproduced in Table 1, alongside the sections of this report in which the ToR have been addressed.

Table 1 ToR requirements and relevant report sections

ToR requirement	Report Section
Describe the noise and vibration emissions (point source and general emissions) that may occur during all stages of the Project (i.e. construction, operation and decommissioning as relevant).	The construction noise and vibration emissions have been described in Section 5.1 and Section 5.5 respectively. It is expected that decommissioning will use similar equipment to the construction phase, hence decommissioning does not require any additional consideration. Noise generated by the operational phase of the Project has been considered in Section 6.1. No significant vibration-generating equipment is expected to be used during the operation of the Project.
Provide a description of the location of sensitive receptors within the study corridor.	Sensitive receptors have been identified in consultation with Powerlink. The nearest receptor is approximately 70 m north of the site and has been identified in Section 2.1 and illustrated in maps located in Appendix B
Consider the cumulative impact of noise with other known emissions of noise associated with existing development and proposed future developments.	Cumulative noise impacts have been considered for both the construction and operational phases of the Project in Sections 5.4 and 6.5 respectively.
The assessment must include reference to all performance criteria relevant to the Project under the *Environment Protection Act 1994*, Environment Protection Regulation 2008 and Environmental Protection (Noise) Policy 2008.	The relevant noise requirements of the EP Act, EP Regulation and EP (Noise) Policy have been summarised in Section 3.0 and discussed in Appendix E. The relevant vibration criteria are summarised in Section 4.0.

2.0 Existing Noise Environment

2.1 Noise sensitive receptors

Noise sensitive receptors near the Project are illustrated in Appendix B. Residential receptors which could potentially be affected by the Project surround the site in all directions, with the closest receptor located approximately 70 m to the north of the Project Site near Mount Fox and 100 m from the draft alignments. This receptor is an old tin mine which is used occasionally on the weekend as a camp.

2.2 Estimated rating background levels

Appendix A of Australian Standard 1055.2-1997 *Acoustics – 'Description and measurement of environmental noise – Part 2: Application to specific situations'* provides estimated background sound pressure level values for different areas in Australia. In lieu of noise monitoring data, conservative estimates have been used to establish background noise levels for the nearby residential receptors.

As the receptors are all rural, they are concluded to lie within Noise Area Category R1: "*Areas with negligible transportation*". The relevant background noise levels are presented below in Table 2.

Table 2 Background sound pressure levels

Noise Area Category	Description of Neighbourhood	Average background A-weighted sound pressure level, L_{A90}		
		Day 0700 - 1800	Evening 1800 - 2200	Night 2200 - 0700
Noise Area Category R1	Areas with negligible transportation	40	35	30

The noise levels provided in Table 2 have been compared to background noise levels measured by AECOM at other remote rural areas, and are considered to be generally representative of typical rural environments.

3.0 Noise Criteria

3.1 Construction/Decommissioning and Operation Noise Emission Documentation

A review of environmental noise emission criteria has been undertaken as part of this assessment and the most appropriate criteria, as outlined below, have been adopted. The criteria were derived from:

- Queensland *Environmental Protection Act 1994* (EP Act).
- Queensland *Environmental Protection Regulation 2008* (EP Regulation).
- Queensland *Environmental Protection (Noise) Policy 2008* (EPP (Noise)).
- Powerlink Queensland *SM1 Primary Systems Infrastructure Design Manual*.
- Powerlink Queensland *Standard Environmental Controls – Specification*

These documents are discussed in detail in Appendix E.

3.2 Summary of Noise Limits

Applicable noise emission limits at nearby sensitive receptors for the construction and operation of the Kidston Connection Project are outlined in Table 3 and **Table 4** respectively. The criteria adopted are the most stringent of applicable noise limits identified in the above documentation.

3.2.1 Construction noise criteria

Table 3 Construction noise criteria

Noise source	Noise Criteria	External noise limit	Time of day	Sensitive receptor
Construction equipment	EP (Noise) Policy acoustic quality objectives	$L_{Aeq,adj,1hr}$ 50 dB(A)	Daytime and evening	Residential buildings
		$L_{Aeq,adj,1hr}$ 35[1] dB(A)	Night-time	Residential buildings
		$L_{A1,adj,1hr}$ 65 dB(A)	Daytime and evening	Residential buildings
		$L_{A1,adj,1hr}$ 45[1] dB(A)	Night-time	Residential buildings

Note:

1. Noise limit includes a 5 dB correction to allow for the assessment of noise levels as measured outdoors, assuming a façade with partially open windows
2. The EP (Noise) Policy defines the following:
   Daytime means the period after 7 am on a day to 6 pm on the day;
   Evening means the period after 6 pm on a day to 10 pm on the day;
   Night-time means the period after 10 pm on a day to 7 am on the next day.

Construction works involving the use of regulated devices (assumed to be the 'worst-case noise generating equipment' used in the assessment) are restricted to the hours of 7am to 7pm, as per *General Requirement NV2*.

3.2.2 Operational noise criteria

Table 4 Operational noise criteria

Noise source	Noise Criteria	External noise limit	Time of day	Sensitive receptor
Corona discharge and operation/ maintenance of substation and transmission line	EP (Noise) Policy acoustic quality objectives	$L_{A1,1hr}$ 65 dB(A)	Daytime and evening	Residential buildings
		$L_{A1,1hr}$ 45[1] dB(A)	Night-time	Residential buildings
	EP (Noise) Policy background creep	$L_{Aeq,T}$ 45 dB(A)	Daytime	Residential buildings
		$L_{Aeq,T}$ 40 dB(A)	Evening	Residential buildings
		$L_{Aeq,T}$ 35 dB(A)	Night-time	Residential buildings

Note:

1. Noise limit includes a 5 dB correction to allow for the assessment of noise levels as measured outdoors, assuming a façade with partially open windows
2. The EP (Noise) Policy defines the following:
   Daytime means the period after 7 am on a day to 6 pm on the day;
   Evening means the period after 6 pm on a day to 10 pm on the day;
   Night-time means the period after 10 pm on a day to 7 am on the next day.

Maintenance works involving the use of regulated devices (assumed to be the 'worst-case noise generating equipment' used in the assessment) are restricted to the hours of 7am to 7pm, as per *General Requirement NV2*.

Note that although it is stated in both *General Requirement NV1* and *NV2* that "*it is not an offence to contravene a noise limit (or to cause a nuisance) where maintaining a facility for an electricity system*", maintenance activities have still been assessed to these established noise limits.

4.0 Vibration Criteria

4.1 Construction Vibration Objectives

The relevant standards and guidelines for the assessment of construction vibration are summarised in Table 5.

Table 5 Standards/guidelines used for assessing construction vibration

Item	Standard/guideline
Structural damage	German Standard DIN 4150 – Part 3 – *Structural Vibration in Buildings – Effects on Structures* (DIN 4150)
Human comfort (tactile vibration)	Transport Noise Management Code of Practice: Volume 2 – *Construction Noise and Vibration, Department of Transport and Main Roads*[1]

Note:

1. This document is based upon the guidelines contained in British Standard 5228-2:2009 *"Code of practice for noise and vibration control on construction and open sites – Part 2: Vibration* (BS 5228)

Vibration, at levels high enough, has the potential to cause damage to structures and to disrupt human comfort. Vibration and its associated effects are usually classified as continuous, impulsive or intermittent as follows.

- Continuous vibration continues uninterrupted for a defined period and includes sources such as machinery and continuous construction activities.
- Impulsive vibration is a rapid build up to a peak followed by a damped decay. It may consist of several cycles at around the same amplitude, with durations of typically less than two seconds and no more than three occurrences in an assessment period. This may include occasional dropping of heavy equipment or loading activities.
- Intermittent vibration occurs where there are interrupted periods of continuous vibration, repeated periods of impulsive vibration or continuous vibration which varies significantly in magnitude. This may include intermittent construction activity, impact pile driving, jack hammers.

4.1.1 Structural damage

At present, no Australian Standard exists for the assessment of building damage caused by vibration. The German Standard (DIN 4150) provides recommended maximum levels of vibration which reduce the likelihood of building damage caused by vibration, and these are presented in Table 6. DIN 4150 states that higher levels of vibration than the recommended limits would not necessarily result in damage at buildings exposed to vibration. In this assessment, the DIN 4150 limits have been adopted for all buildings.

Table 6 Structural damage safe limits (DIN 4150) for building vibration

Group	Type of structure	At foundation – Less than 10 Hz	At foundation - 10 Hz to 50 Hz	At foundation - 50 Hz to 100 Hz[1]	Vibration at the horizontal plane of the highest floor for all frequencies
1	Buildings used for commercial purposes, industrial buildings and buildings of similar design	20 mm/s	20 to 40 mm/s	40 to 50 mm/s	40 mm/s
2	Dwellings and buildings of similar design and/or use	5 mm/s	5 to 15 mm/s	15 to 20 mm/s	15 mm/s
3	Structures that because of their particular sensitivity to vibration, do not correspond to those listed in Lines 1 or 2 and have intrinsic value (e.g. buildings that are under a preservation order/heritage listed)	3 mm/s	3 to 8 mm/s	8 to 10 mm/s	8 mm/s

Note:

1. At frequencies above 100 Hz, the values given in this column may be used as minimum values

4.1.2 Human comfort

The assessment of human comfort to ground-borne construction vibration is outlined in the QLD Department of Transport and Main Roads *Transport Noise Management Code of Practice: Volume 2 – Construction Noise and Vibration*. The code adopts vibration levels with lower and upper limits as presented in Table 7. The lower limits are generally considered to be just perceptible whereas the upper limits are considered to cause significant annoyance if exceeded.

Table 7 Peak particle velocity human comfort limits to minimise annoyance

Building	Work Period	Resultant PPV, mm/s	
		Lower limit	Upper limit
Dwellings (including hotels, motels and mine camps)	Standard hours[1]	1.0	2.0
	Non-Standard hours – evening[1]	0.3	1.0
	Non-Standard hours – night-time[1]		

Note:

1. QLD Department of Transport and Main Roads *Transport Noise Management Code of Practice: Volume 2 – Construction Noise and Vibration* defines the following:
   Standard hours refers to Monday – Friday 7am to 6pm, Saturday 8am to 1pm;
   Non-standard hours – day/evening refers to Monday – Friday 6pm to 10pm, Saturday 1pm to 10pm;
   Non-standard hours – night-time refers to Monday – Sunday 10pm to 7am.

5.0 Construction Noise and Vibration Impact Assessment

5.1 Construction Noise Modelling Scenarios

Table 8 provides a summary of the construction stage noise modelling scenarios including the representative worst-case construction equipment and associated sound power levels. All stages have been considered, however only the worst-case construction scenarios have been assessed.

Table 8 Kidston Connection construction stages and worst case equipment

Construction stage	Worst-case noise generating equipment	Sound power level, dB(A)
Site set-out	Light vehicles	90
Flora and fauna surveys	Light vehicles	90
Installation of gates, grids, wash downs and access tracks	Roller	105
Access track construction	Excavators	98
Vegetation clearing	Mulcher	116
Benching of substation pads	Excavators	98
Benching of tower pad sites, cut/fill	Tipper truck	105
Excavation for foundations	Excavators	98
Foundations, substation electrical equipment and transmission line	Bored piling rig[1]	105
Steel assembly and erection	Cranes	98
Electrical plant erection	Cranes	98
Lines assembly	Cranes	98
Stringing	Helicopters (if heli-stringing)[2]	138
Test and commissioning	Light vehicles	90
Rehabilitation of disturbed areas (tower pads, batters including substation batters)	Excavators	98

Note:

1. It has been advised by Powerlink Queensland that impact piling is not expected, therefore bored piling has been assessed. Impact piling sound power levels would be approximately 11 dB(A) higher.
2. Assumed worst-case heli-stringing; brake and winch machines for stringing would be significantly quieter (over 40 dB(A) lower). Final chosen method will be determined based on environmental or visual sensitivity requirements.
3. The construction stages shaded light green are considered to be the worst-case construction stages given their worst-case sound power levels, location of equipment and duration.

It is assumed that decommissioning would comprise similar activities to the construction stages, hence a separate assessment is not required.

5.2 Methodology

Setback distances at which construction noise is expected to achieve the relevant criteria have been calculated for the above construction scenarios. The setback distances have been calculated from the site boundary which is assumed to be a 30 m buffer from the feeder alignment, with the exception of the heli-stringing which has been calculated from the feeder alignment itself. It is worth noting that the approach/departure of the helicopter may have a short-term impact on the residences beneath the flight path which has not been assessed in this report.

5.2.1 Propagation methodology

The CONCAWE method was originally developed for predicting the long-distance propagation of noise from petrochemical complexes. It is especially suited to predicting noise propagation over large distances because it accounts for a range of atmospheric conditions which can significantly influence the propagation of noise over large distances.

Calculations were carried out to represent ‘reasonable’ worst periods of construction works. The following features were included in the noise calculations:

- Flat ground topography.
- Ground absorption of 50%.
- Receptors.
- Worst-case construction noise sources which are conservatively assumed to operate on the site boundary.

It can be expected that there may be differences between predicted and measured noise levels due to variations in instantaneous operating conditions, plant in operation during the measurement and also the location of the plant equipment.

5.2.2 Construction calculation assumptions

The following assumptions have been made in modelling all construction noise scenarios.

- Equipment is assumed to be operating at the closest point on the site boundary to each receptor, in order to present the worst-case scenario for each receptor. In reality the equipment would only be at the closest point to each receptor for a limited period.
- 3m/s source to receptor wind with Pasquill stability category D.

5.3 Predicted Construction Noise Setback Distances

Predicted setback distances at which construction noise associated with the Project is expected to comply with the relevant limits are presented in Table 9, as well as the number of residential receptor locations at which exceedance of the noise limit is predicted to occur. Construction noise setback distance maps are provided in Appendix C and are arranged by the representative worst-case equipment.

Table 9 Predicted construction noise setback distances

Scenario	Representative worst-case equipment	Noise limit, $L_{Aeq,adj,1hr}$ dB(A)	Setback distance, (metres)	Number of exceedances	Number of exceedances
				Alignment A	Alignment B
Installation of gates, grids, wash downs and access tracks	Vibratory roller	50	250	1	1

Scenario	Representative worst-case equipment	Noise limit, $L_{Aeq,adj,1hr}$ dB(A)	Setback distance, (metres)	Number of exceedances Alignment A	Number of exceedances Alignment B
Access track construction Benching of substation pads Excavation for foundations Rehabilitation of disturbed areas (tower pads, batters including substation batters)	Excavator	50	110	1	1
Benching of tower pad sites, cut/fill	Tipper truck	50	210	1	1
Vegetation clearing	Mulcher	50	500	1	1
Foundations, substation electrical equipment and transmission line	Bored piling rig	50	220	1	1
Steel assembly and erection Electrical plant erection Lines assembly	Crane	50	120	1	1
Heli-stringing	Helicopter	50	2,400	20	13

5.3.1 Discussion of results

Setback distances which are compliant with the established daytime noise limits have been calculated. The construction activities are predicted to generally exceed the noise limits at a single sensitive receptor (the tin mine camp) across all scenarios for both alignment A and B. It is noted that this one receptor is occasionally used only during the weekend.

The heli-stringing construction scenario has 20 receptors which are located within the setback distance of 2.4km for Alignment A and 13 receptors for Alignment B. This difference is attributed to the close proximity of Alignment A towards the receptors in Kidston. Whilst there are a significant number of exceedances associated with heli-stringing, this is over the entire extent of the Project. The duration of the predicted exceedance at any one receptor would be limited. Furthermore, it is expected that heli-stringing is a much more accelerated process when compared with conventional stringing methods which would be quieter but may have a longer term impact.

5.4 Cumulative Construction Noise Impacts

Cumulative construction noise from the Kidston Renewable Energy Hub has been considered. It is anticipated that there may be an overlap of construction time frames between the Project and the Kidston Renewable Energy Hub which may lead to a cumulative construction noise impact. However specific construction timeframes and methodology are not available at this point for either project. No other significant, concurrent construction activities (existing and possible future developments) have been identified.

5.5 Construction Vibration Assessment

The only significant vibration-intensive works expected to take place during the proposed works would be pile boring and the use of vibratory rollers. Safe working distances to minimise disturbance to occupants of nearby buildings have been recommended and are based on the British Standards *BS 6472 'Evaluation of human exposure to vibration in buildings'* and *BS 7385 'Evaluation and measurement for vibration in buildings'*. In lieu of similar Australian guidelines, the following safe working distances for vibration-intensive equipment listed in Table 10 below have been adopted.

Table 10 Recommended safe working distances for vibration-intensive plant

Plant	Rating/Description	Safe Working Distance, metres	
		Cosmetic Damage	Human Response
Pile Boring	≤ 800 mm	2 m (nominal)	N/A
Vibratory Roller	< 50 kN (Typically 1-2 tonnes)	5 m	20 m
	< 100 kN (Typically 2-4 tonnes)	6 m	40 m
	< 200 kN (Typically 4-6 tonnes)	12 m	100 m
	< 300 kN (Typically 7-13 tonnes)	15 m	100 m
	> 300 kN (Typically 13-18 tonnes)	20 m	100 m
	> 300 kN (>18 tonnes)	25 m	100 m

There are no vibration-sensitive receptors within these structural damage safe working distances for pile boring rigs and vibratory rollers. However there is a single receptor (the tin mine camp) which is located within the maximum human response safe working distance for vibratory rollers with a rating of greater than 100kN. Vibration setback distances have not been included in the maps as only a single receptor is located within the human response safe working distance; all other receptors are located over 100 m from this.

Nevertheless, care should be taken during the construction stage as to not encroach on the safe working distances as specified. These safe working distances should also be used to guide the plant selection for the construction of the project.

5.6 Construction Noise Mitigation Measures

5.6.1 Powerlink – Standard Environmental Controls – Specification

All construction activities associated with the Project will be subject to the standard noise mitigation measures described in Powerlink Queensland's *Standard Environmental Controls – Specification Document*.

5.6.2 General construction noise mitigation measures

The contractor should, where risk assessment deem necessary apply best-practice noise mitigation measures including the following.

- Appropriate plant and equipment to be selected for each task to minimise the noise contributions.
- Plant to be turned off when not in use.
- Plant is to be regularly maintained, and repaired or replaced if it becomes noisier.
- Emphasis should be placed during driver training and site induction sessions on the potential adverse impact of reversing alarms and exhaust brakes and the need to minimise their use.
- Wherever feasible, turning circles to be created at the end points of vehicle work legs, which should allow trucks to turn and avoid the need for reversing.
- Non-tonal reversing alarms to be used where practicable.

- Although *General Requirement NV1* limits work hours to 6.30am to 6.30pm it is recommended that works that generate substantial noise should commence from 7am as to not encroach on the night-time period. Works between 6:30am and 7am should include setting up site, toolbox talks and any other works that do not generate a significant level of noise. Furthermore as *NV2* limits the use of regulated devices to 7am to 7pm, it is recommended that the operation of all significant noise generating equipment is restricted to this time period.
- Coordinate with users of the tin mine camp to schedule significant noise generating construction scenarios to occur during weekdays when the tin mine camp is unoccupied.

6.0 Operational Noise Assessment

6.1 Operational Noise Sources

A list of operational noise sources obtained from Powerlink and research papers is presented in Table 11 below. It is assumed that the Project will be operational at all hours, every day of the year. Maintenance activities are expected to occur during daytime hours only for corrective and preventative maintenance activities. Hence the daytime noise limits have been used in the operational maintenance acoustic assessment and the night-time noise limits have been used for the operation of the Project.

The assessed items of equipment are presumed to be steady noise sources, as such the L_{Aeq} and L_{A1} noise levels are assumed to be equivalent.

Table 11 Kidston Connection operational noise sources

Scenario	Equipment	SWL, dB(A)	Quantity	Description
Operation	Substation shunt reactor	Mount Fox: 90[1] Kidston: 95[1,2]	2	One reactor per substation as advised by Powerlink.
	Corona discharge	83[2]	-	Continuous along the transmission line length.
Maintenance	Helicopter	138	1	For the inspection of powerlines and associated infrastructure.
	Mulcher	116	1	Vegetation clearing as part of regular maintenance.

Notes

1. This level has a 5 dB(A) tonal penalty added as required by the Powerlink Queensland *SM1 Primary Systems Infrastructure Design Manual* for the determination of noise levels at the Powerlink substation property boundary to account for low frequency noise. This 5 dB(A) tonal penalty has also been used in the calculation of the noise-compliant setback distance.
2. The proposed Kidston substation has only been modelled for Draft Alignment B; Draft Alignment A will connect to a substation which is part of the Kidston Renewable Energy Hub Project hence it has not been assessed in this report.
3. Sound power level derived from L_{10} sound pressure level measurements of a 1000 kV powerline in rainy weather documented in research paper *Audible Noise Performance of Conductor Bundles Based on Cage Test Results and Comparisons with Long Term Data* (Baoquan Wan 2017), therefore the assessment is considered conservative.

6.1.1 Corona discharge

Noise associated with the power lines themselves is primarily due to corona discharge. The intensity of the corona discharge and the resulting noise is dependent on meteorological conditions (such as humidity, rain, fog and wind), the concentration of airborne particles (dust, ash) and the state of the conductor surface. As the power lines are primarily to be located in sparsely-populated rural areas and the 275kV line is to be designed as a twin conductor set, the acoustic effect of corona discharge is expected to be minimal on nearby sensitive receptors. In addition line fittings (such as hardware corona rings) and insulator arrangements are to be designed to minimise corona discharge.

Transmission line audible noise (corona discharge) is typically represented by L_{50} sound pressure level values. This value represents an average noise level present during rainy or otherwise wet conditions. Higher noise levels corresponding to L_{10} or L_5 sound pressure level values can be calculated, however these values typically coincide with higher rain rates when background ambient noise is higher, and does not necessarily coincide with maximum annoyance at the noise receptor.

It is also noted in the Powerlink *Transmission Line Design – Guideline* that annoyance can still occur during fog conditions, hence the sound power level of a corona discharge in this assessment was conservatively derived using available measured L_{10} sound pressure level values with the assumption of heavy fog conditions which is indicative of lower background noise levels hence providing a conservative approach.

6.2 Methodology

Noise compliant setback distances have been calculated for the above operational equipment. The setback distances have been calculated from the substation and the feeder alignment itself. As with the construction noise assessment, the CONCAWE method was used for the operational noise predictions.

Calculations were carried out to represent ‘reasonable’ worst-case periods of operation and maintenance. It can be expected that there may be differences between predicted and measured noise levels due to variations in instantaneous operating conditions, plant in operation during the measurement and also the location of the plant equipment.

6.2.1 Operational calculation assumptions

The following assumptions have been made in assessing all operational noise scenarios.

- All operational equipment would be operating simultaneously with the exception of maintenance activities.
- Only shunt reactors have been assessed within the substations as they are the dominant noise source as advised by Powerlink Queensland. Sound power levels have been provided by Powerlink Queensland.
- 3m/s source to receptor wind with Pasquill stability category D. It is noted that noise due to corona discharge has been calculated using this worst-case noise propagation meteorological condition. The meteorological condition conducive to the occurrence of corona discharge may not be conducive to noise propagation; therefore this is considered a conservative assumption.

6.3 Predicted Operational Noise Setback Distances

Predicted compliant operational noise setback distances associated with the Project are presented in Table 12. Operational noise setback distance maps are provided in Appendix D and are arranged by the representative worst-case equipment.

Table 12 Predicted operational noise setback distances

Scenario	Representative worst-case equipment	External noise limit, $L_{Aeq,adj,1hr}$, dB(A)	Setback distance, (metres)	Number of exceedances	Number of exceedances
				Alignment A	Alignment B
Operation	Substation shunt reactors	Day: 45	Mount Fox: 80[1]	0	0
			Kidston: 150	-	
		Night: 35	Mt Fox: 250	0	0
			Kidston: 380		
		Substation property boundary: 55	Mt Fox: 25[1]	0	0
			Kidston: 45[1]		
	Corona discharge	Day: 45	35[1]	0	0
		Night: 35	110	1	1
Maintenance activities – Transmission line and infrastructure inspection	Helicopter	Day: 45[2]	3,400	80	80

Scenario	Representative worst-case equipment	External noise limit, $L_{Aeq,adj,1hr}$, dB(A)	Setback distance, (metres)	Number of exceedances	Number of exceedances
				Alignment A	Alignment B
Maintenance activities – Vegetation clearing	Mulcher	45[1]	710	1	1

Note:

1. The CONCAWE method has not been validated at ranges below 100m, hence this distance has been determined via geometric spreading calculations.
2. It is assumed that inspection and routine maintenance activities will be restricted to daytime hours only due to safety and practical considerations; hence it has been assessed against the daytime criteria.

6.4 Discussion of Results

Setback distances at which the most stringent established noise limits are expected to be achieved have been calculated. The operational activities are predicted to comply with the established noise limits at nearby sensitive receptors across all operational scenarios with the exception of maintenance activities involving the inspection of the transmission line and infrastructure associated with the Project using a helicopter.

The inspection activities are expected to be completed only during the daytime and on average twice per year with the possibility of additional inspections due to emergency repairs. Whilst there are a significant number of exceedances associated with inspection activities with a helicopter, this is over the entire extent of the Project, which means the duration of the predicted exceedance at any one receptor would be limited. Therefore; the overall impact of inspection activities is limited.

There is also a single exceedance of the night-time noise limit for Alignment A and B associated with corona discharge. This single exceedance is associated with the tin mine camp which lies 10m within the calculated night-time setback distance. At the distance considered, this approximately equates to a <1 dB(A) exceedance. A difference of up to 2 dB(A) is generally considered to be imperceptible. Also the conservative approach used in the calculation of corona discharge noise will mean that actual noise levels will typically be lower than what has been calculated. To further minimise the impacts, additional mitigation measures could be applied by Powerlink Queensland such as additional line fittings and insulator arrangements, designed for the purpose of further minimising corona discharge in the vicinity of the tin mine camp.

The operation of a mulcher during vegetation clearing maintenance activities is predicted to result in an exceedanc at one receptor for both alignments. This exceedance means that this maintenance activity only exceeds the relevant criterion at a single particular location along the transmission line alignment (and for a limited duration), hence the overall impact is limited.

Setback distances at which the L_{Aeq} 55 dB(A) noise limit can be achieved has also been calculated for both substations. It is understood at the time of writing this report that Powerlink was discussing property acquisition and subdivisions, hence the lot boundary for the substations was not known. If the final lot boundaries for the substations lie within the calculated L_{Aeq} 55 dB(A) setback distance, noise enclosures around individual noise generating equipment, particularly the reactors, may be required.

6.5 Cumulative Operational Noise Impact

Cumulative operational noise from the Kidston Renewable Energy Hub has been considered; maintenance activities (use of helicopter for inspections) have not been considered as they are only expected to occur twice a year. The closest noise-sensitive receptors for the Project to the Kidston Renewable Energy Hub are over one kilometre to the east. The operational noise contribution of the Project to these receptors is predicted to be greater than 10 dB(A) below the applicable daytime and night-time operational noise limits, therefore cumulative noise impacts are unlikely to be an issue as the total noise levels from the two projects combined will not increase to higher than the Kidston Renewable Energy Hub project alone.

No other significant noise generating developments/activities (existing and possible future developments) have been identified, hence a cumulative operational noise impact assessment is not warranted.

6.6 Operational Vibration Assessment

No significant vibration-generating equipment is expected to be used during the operation of the Project hence an assessment is not required.

6.7 Operational Noise Mitigation Measures

Although it is stated in both *General Requirement NV1* and *NV2* that "*it is not an offence to contravene a noise limit (or to cause a nuisance) where maintaining a facility for an electricity system*", it is recommended by AECOM to minimise the overall noise generated by maintenance activities.

All operational activities associated with the Project will be subject to the standard noise mitigation measures described in Powerlink Queensland's *Standard Environmental Controls – Specification Document* which has been listed in Section 5.6 of this report.

Additional mitigation measures proposed include:

- Appropriate plant and equipment to be selected for each task to minimise the noise contributions.
- Plant to be turned off when not in use.
- Plant is to be regularly maintained, and repaired or replaced if it becomes noisier.
- Emphasis should be placed during driver training and site induction sessions on the potential adverse impact of reversing alarms and the need to minimise their use.
- Non-tonal reversing alarms to be used where practicable.
- Although *General Requirement NV1* limits work hours to 6.30am to 6.30pm and *NV2* limits the use of regulated devices to 7am to 7pm, it is proposed that the operation of significant noise generating maintenance equipment is restricted to the daytime hours as defined in the EP (noise) Policy (7am to 6pm).
- Although *General Requirement NV1* limits work hours to 6.30am to 6.30pm it is recommended that works that generate substantial noise should commence from 7am as to not encroach on the night-time period. Maintenance works between 6:30am and 7am should include setting up site, toolbox talks and any other works that do not generate a significant level of noise. Furthermore as *NV2* limits the use of regulated devices to 7am to 7pm, it is recommended that the operation of all significant noise generating equipment is restricted to this time period..

To minimise the noise impact of routine inspections, the use of unmanned aircraft systems (drones) for the inspection of the transmission lines and associated infrastructure is recommended to be considered.

The Powerlink Queensland *SM1 Primary Systems Infrastructure Design Manual* also states that, where the calculated noise levels at the Powerlink substation property boundary is greater than L_{Aeq} 55 dB(A), noise enclosures may need to be installed around individual noise sources.

7.0 Conclusion

This report presents the results of an assessment of the potential noise and vibration impacts of the proposed Genex Kidston Connection Project for two draft alignment designs. AECOM has prepared this acoustic assessment of the construction / decommissioning and operational noise and vibration associated with the establishment of the Project in support of an Environmental Assessment Report (EAR) to satisfy the requirements of the Project Terms of Reference (ToR).

Construction / decommissioning noise and vibration

The construction and decommissioning activities have been assessed against the established noise limits. Compliant setback distances have been calculated based on these.

The construction scenarios assessed are predicted to exceed the noise limit at a single sensitive receptor across all scenarios for both alignment A and B. It is noted that this receptor is only occasionally used during the weekend. The heli-stringing construction scenario has 20 receptors within the associated calculated setback distance for alignment A and 13 receptors for alignment B. The 7 additional exceedances are from the receptors in Kidston. Whilst there are a significant number of exceedances associated with heli-stringing, this is over the entire extent of the Project, and therefore the duration of the predicted exceedance at any one receptor would be limited. As a detailed construction programme is not available at this stage of the Project, the noise and vibration duration impact of construction / decommissioning works can only be addressed qualitatively.

Vibration-intensive works are expected to take place well within safe working distances for building damage. However a single receptor is located within the maximum human comfort safe working distance for a vibratory roller with a rating of greater than 100 kN. It is recommended that these safe working distances be used to guide the plant selection for the construction of the project.

Standard noise mitigation measures have been recommended, which are based on Powerlink Queensland's *Standard Environmental Controls – Specification*.

Operational noise and vibration

Results show that the majority of noise-sensitive receptors are beyond the predicted operational noise setback distances from the Project and comply with the most stringent operational noise limits across the Project. The operational activities are predicted to comply with the established noise limits at nearby sensitive receptors across all operational scenarios with the exception of maintenance activities involving the inspection of the transmission line and infrastructure associated with The Project using a helicopter. The inspection activities are expected to be completed only during the daytime and on average twice per year, with the possibility of additional inspections due to emergency repairs. Whilst there are a significant number of exceedances associated with inspection activities with a helicopter, this is over the entire extent of the Project and therefore the duration of the predicted exceedance at any one receptor would be limited. There is also a single exceedance of the night-time noise limit for alignment A and B associated with corona discharge. This single exceedance is associated with the tin mine camp which lies 10m within the calculated night-time setback distance. At the distance considered, this approximately equates to a <1 dB(A) exceedance. A difference of up to 2 dB(A) is generally considered to be imperceptible. To further minimise the impacts, additional mitigation measures could be applied by Powerlink Queensland such as additional line fittings and insulator arrangements designed for the purpose of minimising corona discharge in the vicinity of the tin mine camp.

The operation of a mulcher during vegetation clearing maintenance activities is predicted to result in an exceedance at one receptor for both alignments. This exceedance means that this maintenance activity only exceeds the relevant criterion at a single particular location along the transmission line alignment (and for a limited duration), hence the overall impact is limited.

Setback distances around the substations at which the L_{Aeq} 55 dB(A) noise limit can be achieved have also been calculated. If the final lot boundary of the substations lies within this setback distance, noise enclosures may need to be installed around individual noise generating equipment.

The cumulative noise impacts from the Kidston Renewable Energy Hub and the Project have been considered, and the noise contribution of the Project to the Hub's receptors is negligible, therefore cumulative noise impacts are unlikely to be an issue.

It is recommended that the substations and transmission line are properly maintained to ensure that the noise emission from the Project is not adversely affected by wear and tear on operational items of plant.

Appendix A

Acoustic Terminology

Appendix A Acoustic Terminology

The following is a brief description of acoustic terminology used in this report.

Sound power level	The total sound emitted by a source.
Sound pressure level	The amount of sound at a specified point.
Decibel dB	The measurement unit of sound.
A Weighted decibels, dB(A)	The A weighting is a frequency filter applied to measured noise levels to represent how humans hear sounds. The A-weighting filter emphasises frequencies in the speech range (between 1kHz and 4 kHz) which the human ear is most sensitive to, and places less emphasis on low frequencies at which the human ear is not so sensitive. When an overall sound level is A-weighted it is expressed in units of dB(A).
Decibel scale	The decibel scale is logarithmic in order to produce a better representation of the response of the human ear. A 3 dB increase in the sound pressure level corresponds to a doubling in the sound energy. A 10 dB increase in the sound pressure level corresponds to a perceived doubling in volume. Examples of decibel levels of common sounds are as follows:

0dB(A)	Threshold of human hearing
30dB(A)	A quiet country park
40dB(A)	Whisper in a library
50dB(A)	Open office space
70dB(A)	Inside a car on a freeway
80dB(A)	Outboard motor
90dB(A)	Heavy truck pass-by
100dB(A)	Jackhammer/Subway train
110 dB(A)	Rock Concert
115dB(A)	Limit of sound permitted in industry
120dB(A)	747 take off at 250 metres

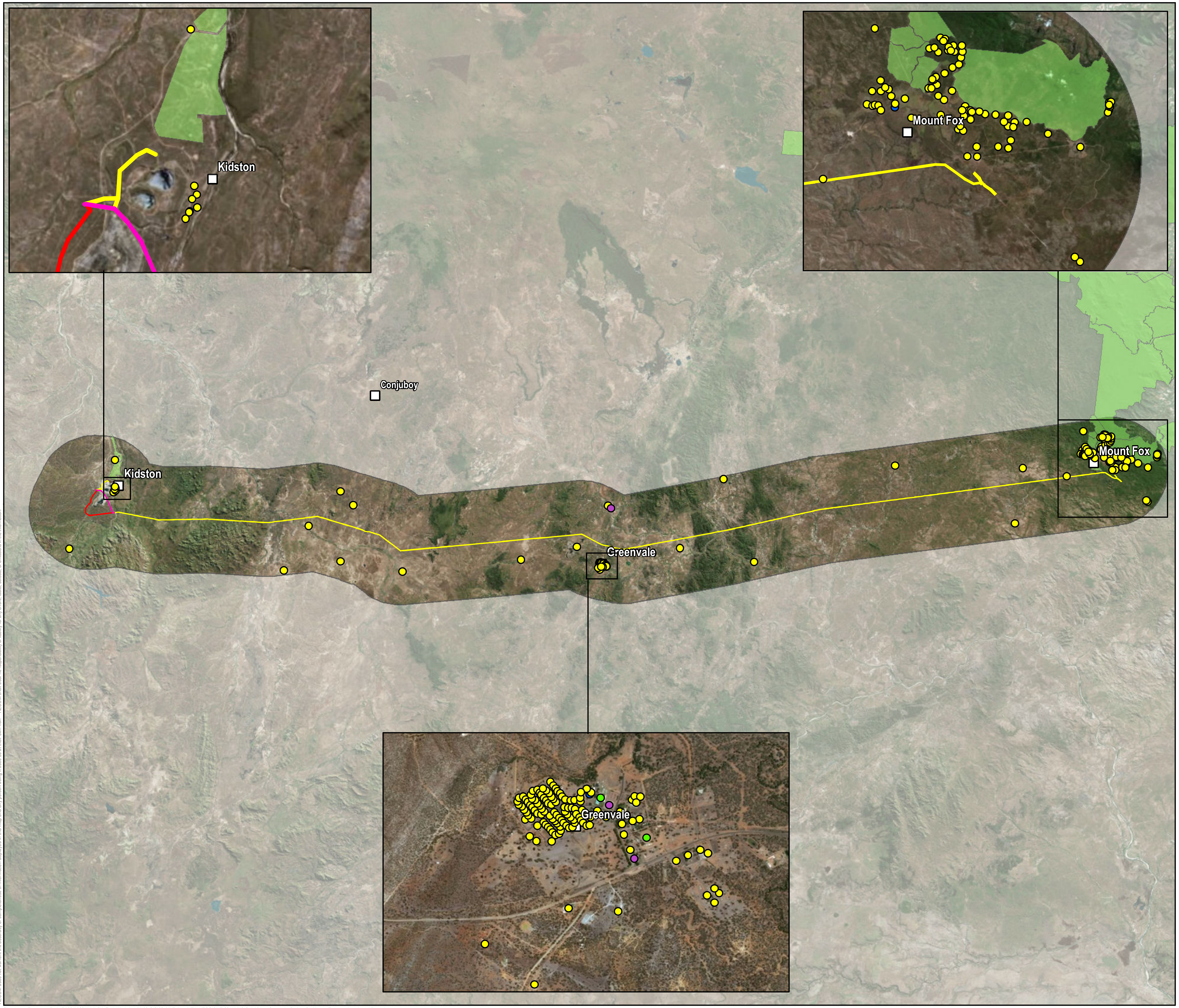
Frequency	The repetition rate of the cycle measured in Hertz (Hz). The frequency corresponds to the pitch of the sound. A high frequency corresponds to a high pitched sound and a low frequency to a low pitched sound.
Equivalent continuous sound level, L_{eq}	The constant sound level which, when occurring over the same period of time, would result in the receptor experiencing the same amount of sound energy.
L_{max}	The maximum sound pressure level measured over the measurement period.
L_{min}	The minimum sound pressure level measured over the measurement period.
L_1	The sound pressure level exceeded for 1% of the measurement period. For 1% of the measurement period it was louder than the L_1.
L_{10}	The sound pressure level exceeded for 10% of the measurement period. For 10% of the measurement period it was louder than the L_{10}.

L_{90}	The sound pressure level exceeded for 90% of the measurement period. For 90% of the measurement period it was louder than the L_{90}.
Ambient noise	The all-encompassing noise at a point composed of sound from all sources near and far.
Background noise	The underlying level of noise present in the ambient noise when extraneous noise (such as transient traffic and dogs barking) is removed. The L_{90} sound pressure level is used to quantify background noise.
Traffic noise	The total noise resulting from road traffic. The L_{eq} sound pressure level is used to quantify traffic noise.

*Definitions of a number of terms have been adapted from Australian Standard AS1633:1985 "Acoustics – Glossary of terms and related symbols"

Appendix B

Kidston Connection Site Map and Receptor Locations



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N

Coordinate System: GDA 1994 MGA Zone 55
Projection: Transverse Mercator
0 2 4 6 8
Kilometers

1:650,000 (when printed at A3)

Legend

- Commercial and Retail Activity
- Dwellings and Accommodation
- Educational facility
- Outdoor Recreational Area
- Point Of Interest
- Protected Area
- Draft Alignment
- Draft Alignment A
- Draft Alignment B

Data sources:
DCDB, Roads, Watercourses - DNRM 2017
Site Features and Layout - AECOM 2018
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Kidston Connection Project

Sensitive Receptors
Powerlink Queensland

Site Map and Receptor Locations

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LAST MODIFIED:	CFS - 17-Sep-18
VERSION:	1

Figure B-1

A3 size

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Appendix C

Construction Noise Setback Distance Maps

Appendix C Construction Noise Setback Distance Maps - Roller

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N

Coordinate System: GDA 1994 MGA Zone 55
Projection: Transverse Mercator

0 2 4 6 8
Kilometers

1:170,000 (when printed at A3)

Legend

- Commercial and Retail Activity
- Dwellings and Accommodation
- Educational facility
- Outdoor Recreational Area
- Point Of Interest
- Protected Area
- Proposed substation
- Alignment
- Solar-hydro transmission line
- buffer_roller_250m

Data sources:
DCDB, Roads, Watercourses - DNRM 2017
Site Features and Layout - AECOM 2018
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Kidston Connection Project

Kidston - Alignment A
Construction - Vibratory roller
Powerlink Queensland

Noise compliant setback distance map

PROJECT ID:	60577456	Figure
CREATED BY:	JB	C1.1
LAST MODIFIED:	PD - 18/09/2018	
VERSION:	1	

A3 size

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N

Coordinate System: GDA 1994 MGA Zone 55
Projection: Transverse Mercator

0 2 4 6 8
Kilometers

1:170,000 (when printed at A3)

Legend

- Commercial and Retail Activity
- Dwellings and Accommodation
- Educational facility
- Outdoor Recreational Area
- Point Of Interest
- Protected Area
- Proposed substation
- Alignment
- Solar-hydro transmission line
- buffer_roller_250m

Data sources:
DCDB, Roads, Watercourses - DNRM 2017
Site Features and Layout - AECOM 2018
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Kidston Connection Project

Kidston - Alignment B
Construction - Vibratory roller
Powerlink Queensland

Noise compliant setback distance map

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LAST MODIFIED:	PD - 18/09/2018	
VERSION:	1	

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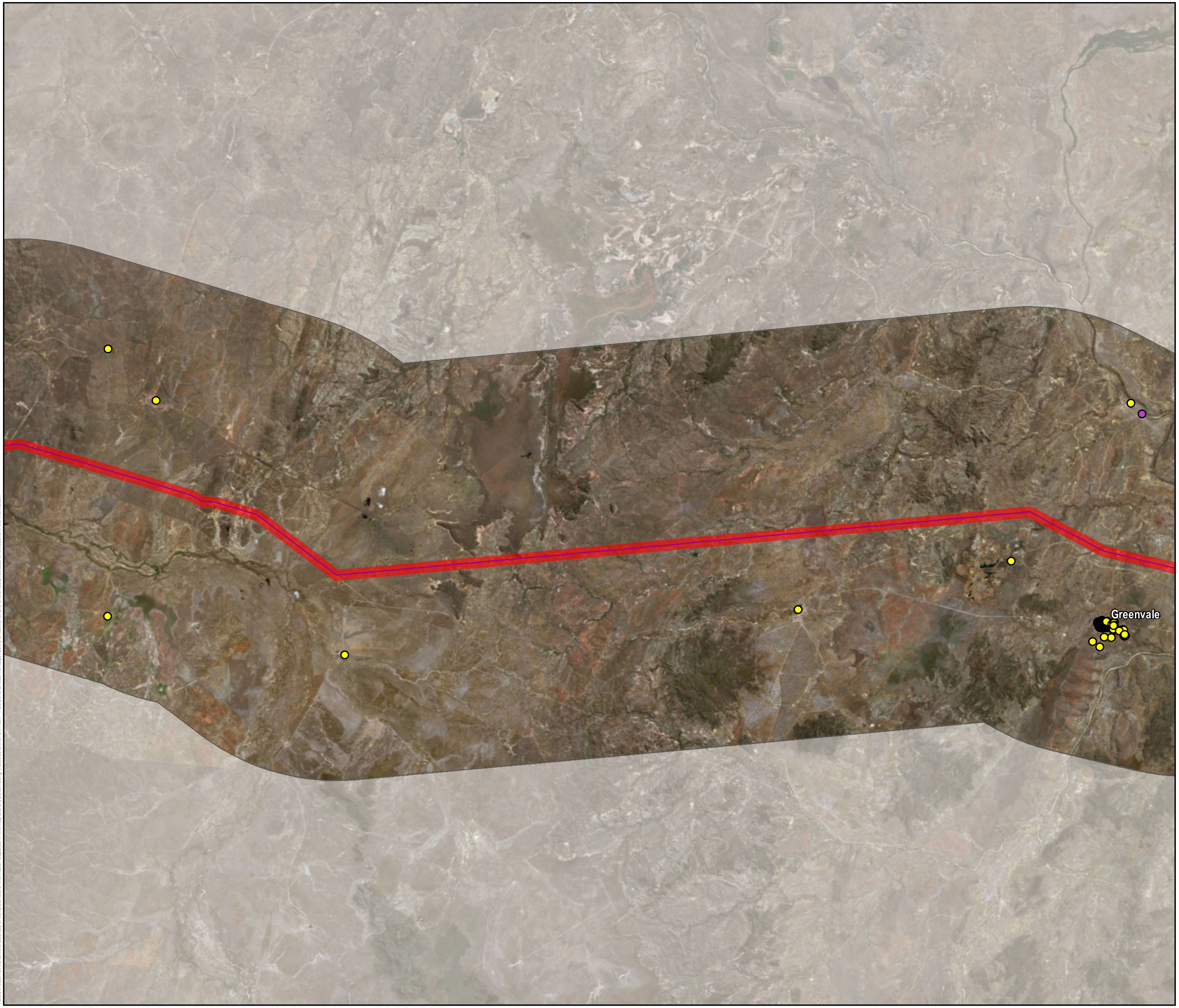

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N

Coordinate System: GDA 1994 MGA Zone 55
Projection: Transverse Mercator

0 2 4 6 8
Kilometers
1:170,000 (when printed at A3)

Legend

- Commercial and Retail Activity
- Dwellings and Accommodation
- Educational facility
- Outdoor Recreational Area
- Point Of Interest
- Protected Area
- Proposed substation
- Alignment
- buffer_roller_250m

Data sources:
DCDB, Roads, Watercourses - DNRM 2017
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Kidston Connection Project

Conjaboy
Construction - Vibratory roller
Powerlink Queensland

Noise compliant setback distance map

PROJECT ID:	60577456	Figure
CREATED BY:	JB	C1.2
LAST MODIFIED:	PD - 13/09/2018	
VERSION:	1	

A3 size

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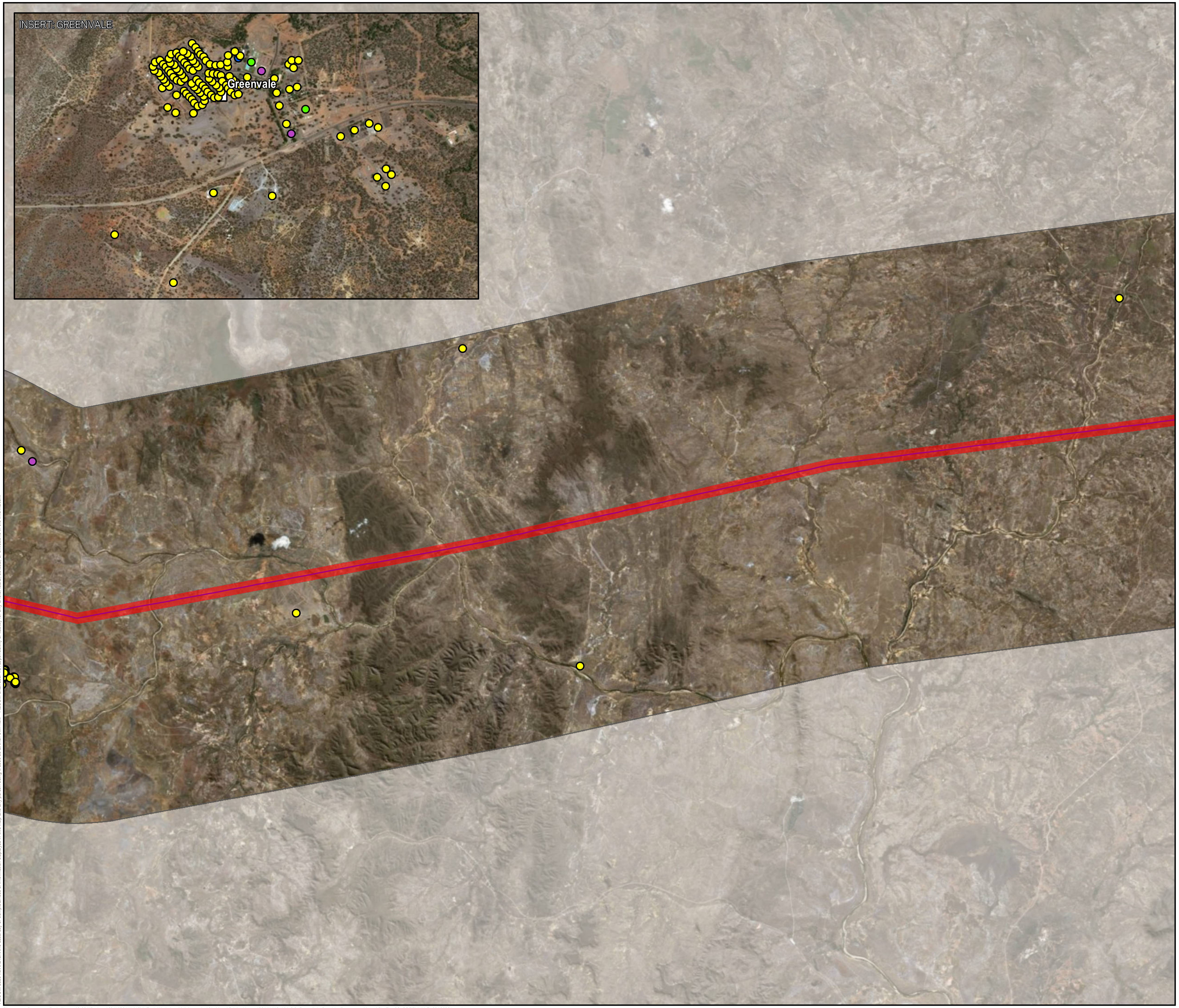

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N

Coordinate System: GDA 1994 MGA Zone 55
Projection: Transverse Mercator

0 2 4 6 8
Kilometers

1:170,000 (when printed at A3)

Legend

- Commercial and Retail Activity
- Dwellings and Accommodation
- Educational facility
- Outdoor Recreational Area
- Point Of Interest
- Protected Area
- Proposed substation
- Alignment
- buffer_roller_250m

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DCDB, Roads, Watercourses - DNRM 2017
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Kidston Connection Project

Greenvale
Construction - Vibratory roller
Powerlink Queensland

Noise compliant setback distance map

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VERSION: 1

Figure C1.3

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Coordinate System: GDA 1994 MGA Zone 55
Projection: Transverse Mercator

0 2 4 6 8
Kilometers

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Legend

- Commercial and Retail Activity
- Dwellings and Accommodation
- Educational facility
- Outdoor Recreational Area
- Point Of Interest
- Protected Area
- Proposed substation
- Alignment
- buffer_roller_250m

Data sources:
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Kidston Connection Project

Mount Fox
Construction - Vibratory roller
Powerlink Queensland

Noise compliant setback distance map

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VERSION: 1

Figure
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Appendix C Construction Noise Setback Distance Maps - Excavator

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N

Coordinate System: GDA 1994 MGA Zone 55
Projection: Transverse Mercator

0 2 4 6 8
Kilometers

1:170,000 (when printed at A3)

Legend

- Commercial and Retail Activity
- Dwellings and Accommodation
- Educational facility
- Outdoor Recreational Area
- Point Of Interest
- Protected Area
- Proposed substation
- Alignment
- Solar-hydro transmission line
- buffer_excavator_110m

Data sources:
DCDB, Roads, Watercourses - DNRM 2017
Site Features and Layout - AECOM 2018

Kidston Connection Project

Kidston - Alignment A
Construction - Excavator
Powerlink Queensland

Noise compliant setback distance map

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VERSION:	1	

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N

Coordinate System: GDA 1994 MGA Zone 55
Projection: Transverse Mercator

0 2 4 6 8
Kilometers

1:170,000 (when printed at A3)

Legend

- Commercial and Retail Activity
- Dwellings and Accommodation
- Educational facility
- Outdoor Recreational Area
- Point Of Interest
- Protected Area
- Proposed substation
- Alignment
- Solar-hydro transmission line
- buffer_excavator_110m

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Kidston Connection Project

Kidston - Alignment B
Construction - Excavator
Powerlink Queensland

Noise compliant setback distance map

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VERSION:	1	

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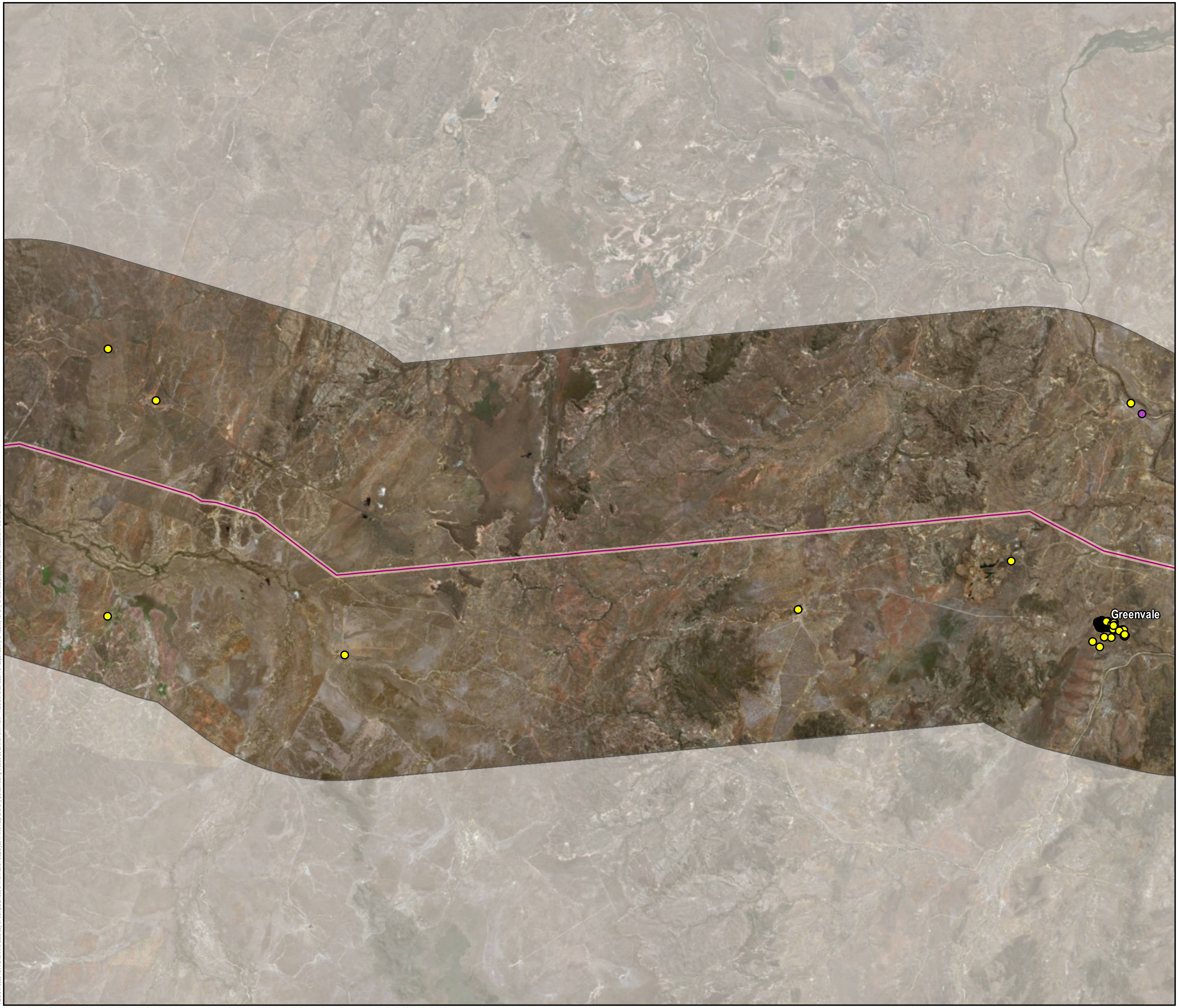

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N

Coordinate System: GDA 1994 MGA Zone 55
Projection: Transverse Mercator
0 2 4 6 8
Kilometers
1:170,000 (when printed at A3)

Legend

- Commercial and Retail Activity
- Dwellings and Accommodation
- Educational facility
- Outdoor Recreational Area
- Point Of Interest
- Protected Area
- Proposed substation
- Alignment
- buffer_excavator_110m

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Conjaboy
Construction - Excavator
Powerlink Queensland

Noise compliant setback distance map

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VERSION: 1

Figure C2.2

A3 size

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Projection: Transverse Mercator

0 2 4 6 8
Kilometers

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Legend

- Commercial and Retail Activity
- Dwellings and Accommodation
- Educational facility
- Outdoor Recreational Area
- Point Of Interest
- Protected Area
- Proposed substation
- Alignment
- buffer_excavator_110m

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Kidston Connection Project

Greenvale
Construction - Excavator
Powerlink Queensland

Noise compliant setback distance map

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VERSION:	1	

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A3 size

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N

Coordinate System: GDA 1994 MGA Zone 55
Projection: Transverse Mercator

0 2 4 6 8
Kilometers

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Legend

- Commercial and Retail Activity
- Dwellings and Accommodation
- Educational facility
- Outdoor Recreational Area
- Point Of Interest
- Protected Area
- Proposed substation
- Alignment
- buffer_excavator_110m

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Kidston Connection Project

Mount Fox
Construction - Excavator
Powerlink Queensland

Noise compliant setback distance map

PROJECT ID: 60577456
CREATED BY: JB
LAST MODIFIED: PD - 13/09/2018
VERSION: 1

Figure
C2.4

A3 size

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Appendix C Construction Noise Setback Distance Maps - Tipper Truck

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N

Coordinate System: GDA 1994 MGA Zone 55
Projection: Transverse Mercator

0 2 4 6 8
Kilometers

1:170,000 (when printed at A3)

Legend

- Commercial and Retail Activity
- Dwellings and Accommodation
- Educational facility
- Outdoor Recreational Area
- Point Of Interest
- Protected Area
- Proposed substation
- Alignment
- Solar-hydro transmission line
- buffer_tippertruck_210m

Data sources:
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Site Features and Layout - AECOM 2018
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Kidston Connection Project

Kidston - Alignment A
Construction - Tipper Truck
Powerlink Queensland

Noise compliant setback distance map

PROJECT ID: 60577456
CREATED BY: JB
LAST MODIFIED: PD - 18/09/2018
VERSION: 1

Figure
C3.1

A3 size

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N

Coordinate System: GDA 1994 MGA Zone 55
Projection: Transverse Mercator

0 2 4 6 8
Kilometers

1:170,000 (when printed at A3)

Legend

- Commercial and Retail Activity
- Dwellings and Accommodation
- Educational facility
- Outdoor Recreational Area
- Point Of Interest
- Protected Area
- Proposed substation
- Alignment
- Solar-hydro transmission line
- buffer_tippertruck_210m

Data sources:
DCDB, Roads, Watercourses - DNRM 2017
Site Features and Layout - AECOM 2018

Kidston Connection Project

Kidston - Alignment B
Construction - Tipper Truck
Powerlink Queensland

Noise compliant setback distance map

PROJECT ID:	60577456
CREATED BY:	JB
LAST MODIFIED:	PD - 18/09/2018
VERSION:	1

Figure C3.1

A3 size

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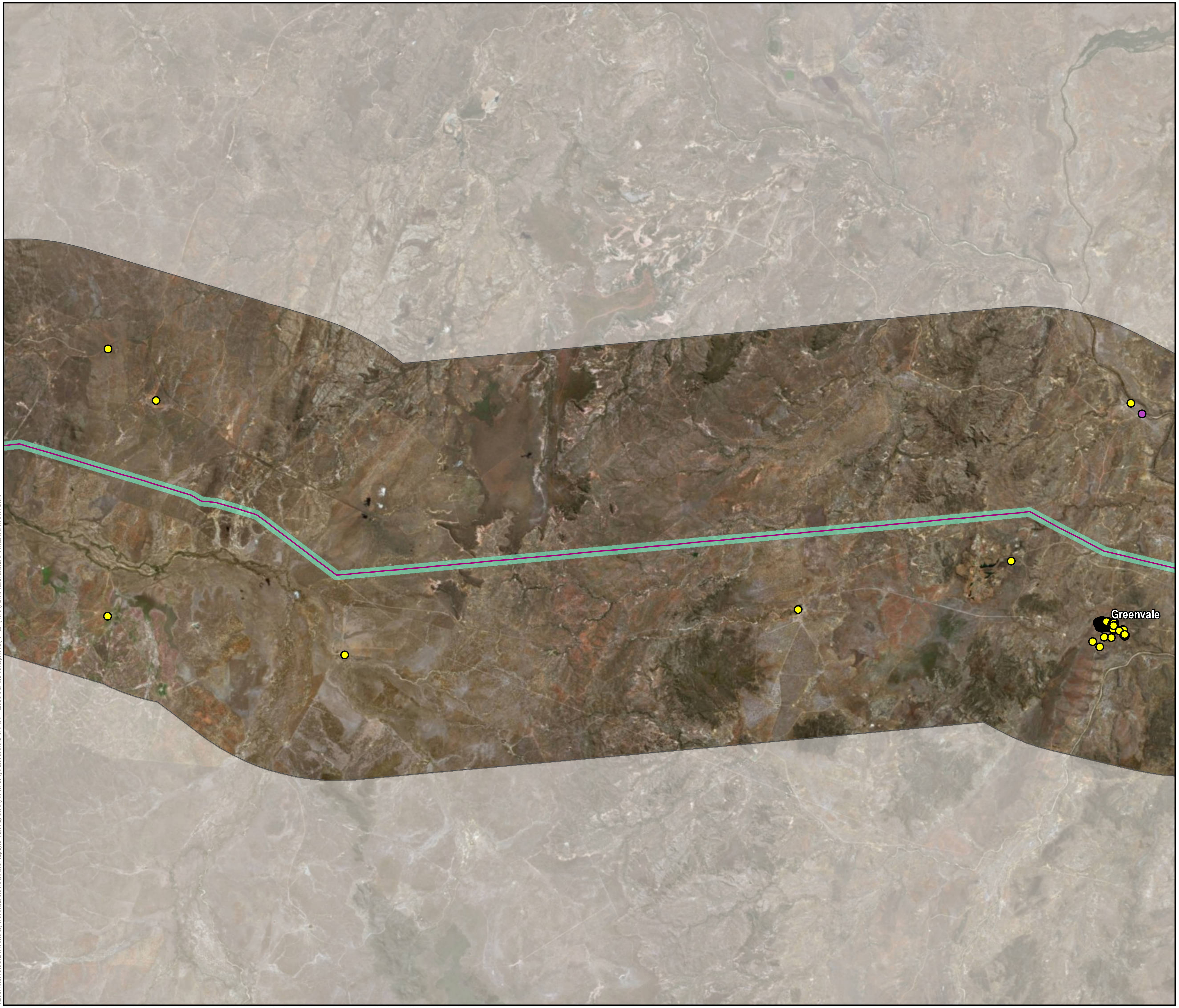

AECOM
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N

Coordinate System: GDA 1994 MGA Zone 55
Projection: Transverse Mercator

0 2 4 6 8
Kilometers

1:170,000 (when printed at A3)

Legend

- Commercial and Retail Activity
- Dwellings and Accommodation
- Educational facility
- Outdoor Recreational Area
- Point Of Interest
- Protected Area
- Proposed substation
- Alignment
- buffer_tippertruck_210m

Data sources:
DCDB, Roads, Watercourses - DNRM 2017
Site Features and Layout - AECOM 2018

Kidston Connection Project

Conjaboy
Construction - Tipper Truck
Powerlink Queensland

Noise compliant setback distance map

PROJECT ID:	60577456	Figure
CREATED BY:	JB	C3.2
LAST MODIFIED:	PD - 13/09/2018	
VERSION:	1	

A3 size

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AECOM
www.aecom.com

N

Coordinate System: GDA 1994 MGA Zone 55
Projection: Transverse Mercator
0 2 4 6 8
Kilometers
1:170,000 (when printed at A3)

Legend

- Commercial and Retail Activity
- Dwellings and Accommodation
- Educational facility
- Outdoor Recreational Area
- Point Of Interest
- Protected Area
- Proposed substation
- Alignment
- buffer_tippertruck_210m

Data sources:
DCDB, Roads, Watercourses - DNRM 2017
Site Features and Layout - AECOM 2018

Kidston Connection Project

Greenvale
Construction - Tipper Truck
Powerlink Queensland

Noise compliant setback distance map

PROJECT ID: 60577456
CREATED BY: JB
LAST MODIFIED: PD - 13/09/2018
VERSION: 1

Figure
C3.3

A3 size

AECOM
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N

Coordinate System: GDA 1994 MGA Zone 55
Projection: Transverse Mercator

0 2 4 6 8
Kilometers

1:170,000 (when printed at A3)

Legend

- Commercial and Retail Activity
- Dwellings and Accommodation
- Educational facility
- Outdoor Recreational Area
- Point Of Interest
- Protected Area
- Proposed substation
- Alignment
- buffer_tippertruck_210m

Data sources:
DCDB, Roads, Watercourses - DNRM 2017
Site Features and Layout - AECOM 2018
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Kidston Connection Project

Mount Fox
Construction - Tipper Truck
Powerlink Queensland

Noise compliant setback distance map

PROJECT ID: 60577456
CREATED BY: JB
LAST MODIFIED: PD - 13/09/2018
VERSION: 1

Figure **C3.4**

A3 size

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Appendix C Construction Noise Setback Distance Maps - Mulcher

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N

Coordinate System: GDA 1994 MGA Zone 55
Projection: Transverse Mercator

0 2 4 6 8
Kilometers

1:170,000 (when printed at A3)

Legend

- Commercial and Retail Activity
- Dwellings and Accommodation
- Educational facility
- Outdoor Recreational Area
- Point Of Interest
- Protected Area
- Proposed substation
- Alignment
- Solar-hydro transmission line
- buffer_mulcher_500m

Data sources:
DCDB, Roads, Watercourses - DNRM 2017
Site Features and Layout - AECOM 2018
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Kidston Connection Project

Kidston - Alignment A
Construction - Mulcher
Powerlink Queensland

Noise compliant setback distance map

PROJECT ID:	60577456
CREATED BY:	JB
LAST MODIFIED:	PD - 18/09/2018
VERSION:	1

Figure
C4.1

A3 size

Filename: Document Path: \\autsv1fp001\Projects\605X\60577456\4. Tech Work Area\4.7 Acoustics\05_Maps\Original layout\60577456_NV_2.1_Powerlink_SensitiveReceptors_Map_A3L_Fig_2_KIDSTON_20180905_A.mxd

AECOM
www.aecom.com

N

Coordinate System: GDA 1994 MGA Zone 55
Projection: Transverse Mercator
0 2 4 6 8
Kilometers
1:170,000 (when printed at A3)

Legend

- Commercial and Retail Activity
- Dwellings and Accommodation
- Educational facility
- Outdoor Recreational Area
- Point Of Interest
- Protected Area
- Proposed substation
- Alignment
- Solar-hydro transmission line
- buffer_mulcher_500m

Data sources:
DCDB, Roads, Watercourses - DNRM 2017
Site Features and Layout - AECOM 2018
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Kidston Connection Project

Kidston - Alignment B
Construction - Mulcher
Powerlink Queensland

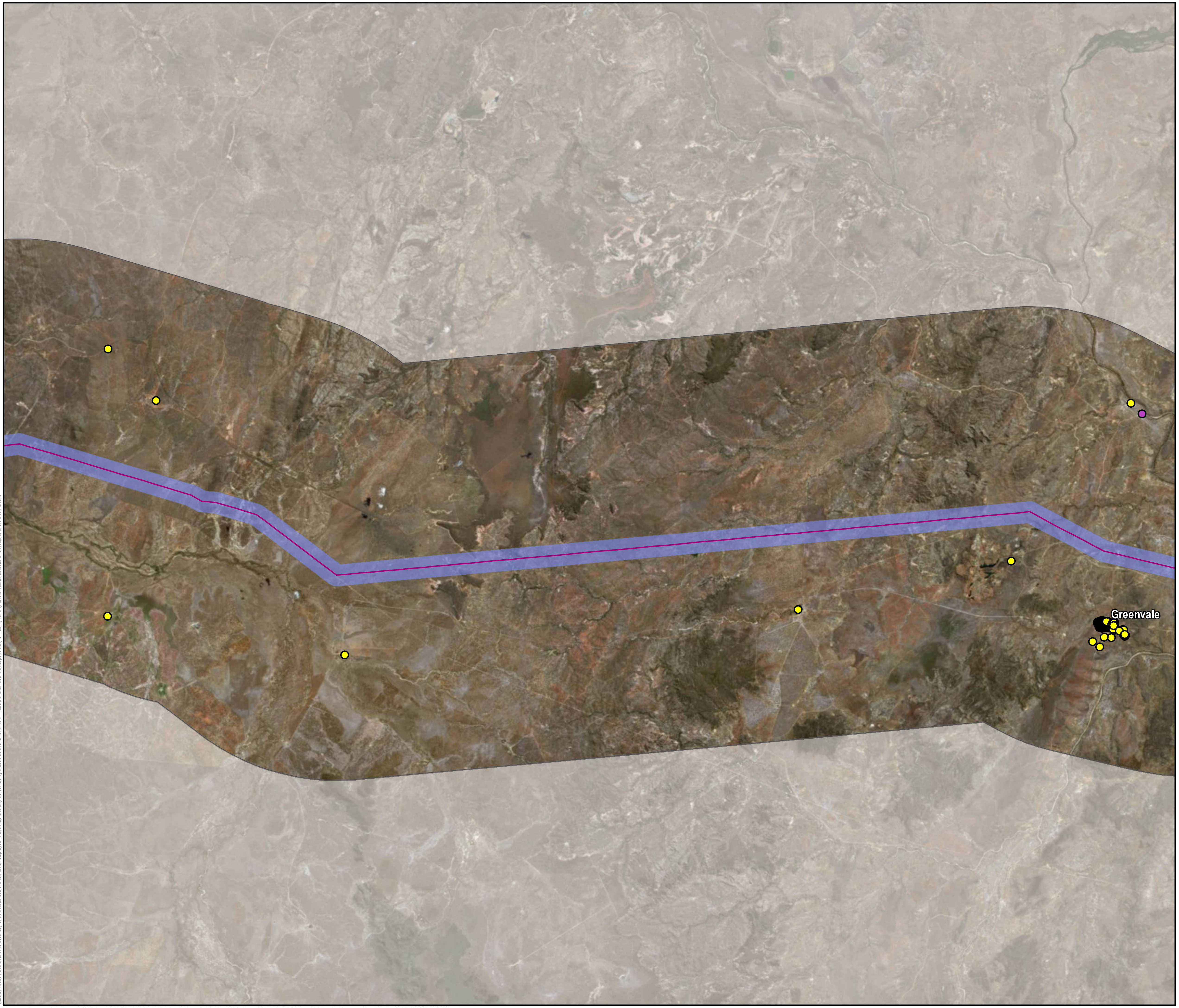
Noise compliant setback distance map

PROJECT ID: 60577456
CREATED BY: JB
LAST MODIFIED: PD - 18/09/2018
VERSION: 1

Figure C4.1

A3 size

Filename: Document Path: \\AUTSV1FP001\Projects\605X\60577456\4. Tech Work Area\4.7 Acoustics\05_Maps\Original layout\60577456_NV_2.1_Powerlink_SensitiveReceptors_Map_A3L_Fig_2_KIDSTON_20180905_B.mxd



AECOM
www.aecom.com

N

Coordinate System: GDA 1994 MGA Zone 55
Projection: Transverse Mercator

0 2 4 6 8
Kilometers

1:170,000 (when printed at A3)

Legend

- Commercial and Retail Activity
- Dwellings and Accommodation
- Educational facility
- Outdoor Recreational Area
- Point Of Interest
- Protected Area
- Proposed substation
- Alignment
- buffer_mulcher_500m

Data sources:
DCDB, Roads, Watercourses - DNRM 2017
Site Features and Layout - AECOM 2018
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Kidston Connection Project

Conjaboy
Construction - Mulcher
Powerlink Queensland

Noise compliant setback distance map

PROJECT ID:	60577456	Figure C4.2
CREATED BY:	JB	
LAST MODIFIED:	PD - 13/09/2018	
VERSION:	1	

A3 size

Filename: Document Path: \\autsv1fp001\Projects\605X\60577456\4. Tech Work Area\4.7 Acoustics\05_Maps\Original layout\60577456_NV_2.2_Powerlink_SensitiveReceptors_Map_A3L_Fig_02_CONJABOY_20180905.mxd

AECOM
www.aecom.com

N

Coordinate System: GDA 1994 MGA Zone 55
Projection: Transverse Mercator

0 2 4 6 8
Kilometers

1:170,000 (when printed at A3)

Legend

- Commercial and Retail Activity
- Dwellings and Accommodation
- Educational facility
- Outdoor Recreational Area
- Point Of Interest
- Protected Area
- Proposed substation
- Alignment
- buffer_mulcher_500m

Data sources:
DCDB, Roads, Watercourses - DNRM 2017
Site Features and Layout - AECOM 2018
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Kidston Connection Project

Greenvale
Construction - Mulcher
Powerlink Queensland

Noise compliant setback distance map

PROJECT ID: 60577456
CREATED BY: JB
LAST MODIFIED: PD - 13/09/2018
VERSION: 1

Figure
C4.3

A3 size

Filename: Document Path: \\autsv1fp001\Projects\605X\60577456\4. Tech Work Area\4.7 Acoustics\05_Maps\Original layout\60577456_NV_2.3_Powerlink_SensitiveReceptors_Map_A3L_Fig_02_GREENVALE_20180905.mxd

AECOM
www.aecom.com

N

Coordinate System: GDA 1994 MGA Zone 55
Projection: Transverse Mercator
0 2 4 6 8
Kilometers
1:170,000 (when printed at A3)

Legend

- Commercial and Retail Activity
- Dwellings and Accommodation
- Educational facility
- Outdoor Recreational Area
- Point Of Interest
- Protected Area
- Proposed substation
- Alignment
- buffer_mulcher_500m

Data sources:
DCDB, Roads, Watercourses - DNRM 2017
Site Features and Layout - AECOM 2018
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Kidston Connection Project

Mount Fox
Construction - Mulcher
Powerlink Queensland

Noise compliant setback distance map

PROJECT ID:	60577456	Figure
CREATED BY:	JB	C4.4
LAST MODIFIED:	PD - 13/09/2018	
VERSION:	1	

A3 size

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Appendix C Construction Noise Setback Distance Maps - Bored piling rig

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N

Coordinate System: GDA 1994 MGA Zone 55
Projection: Transverse Mercator
0 2 4 6 8
Kilometers
1:170,000 (when printed at A3)

Legend

- Commercial and Retail Activity
- Dwellings and Accommodation
- Educational facility
- Outdoor Recreational Area
- Point Of Interest
- Protected Area
- Proposed substation
- Alignment
- Solar-hydro transmission line
- buffer_piling_220m

Data sources:
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Site Features and Layout - AECOM 2018
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Kidston Connection Project

Kidston - Alignment A
Construction - Bored piling rig
Powerlink Queensland

Noise compliant setback distance map

PROJECT ID:	60577456
CREATED BY:	JB
LAST MODIFIED:	PD - 18/09/2018
VERSION:	1

Figure C5.1

A3 size

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AECOM
www.aecom.com

N

Coordinate System: GDA 1994 MGA Zone 55
Projection: Transverse Mercator

0 2 4 6 8
Kilometers

1:170,000 (when printed at A3)

Legend

- Commercial and Retail Activity
- Dwellings and Accommodation
- Educational facility
- Outdoor Recreational Area
- Point Of Interest
- Protected Area
- Proposed substation
- Alignment
- Solar-hydro transmission line
- buffer_piling_220m

Data sources:
DCDB, Roads, Watercourses - DNRM 2017
Site Features and Layout - AECOM 2018

Kidston Connection Project

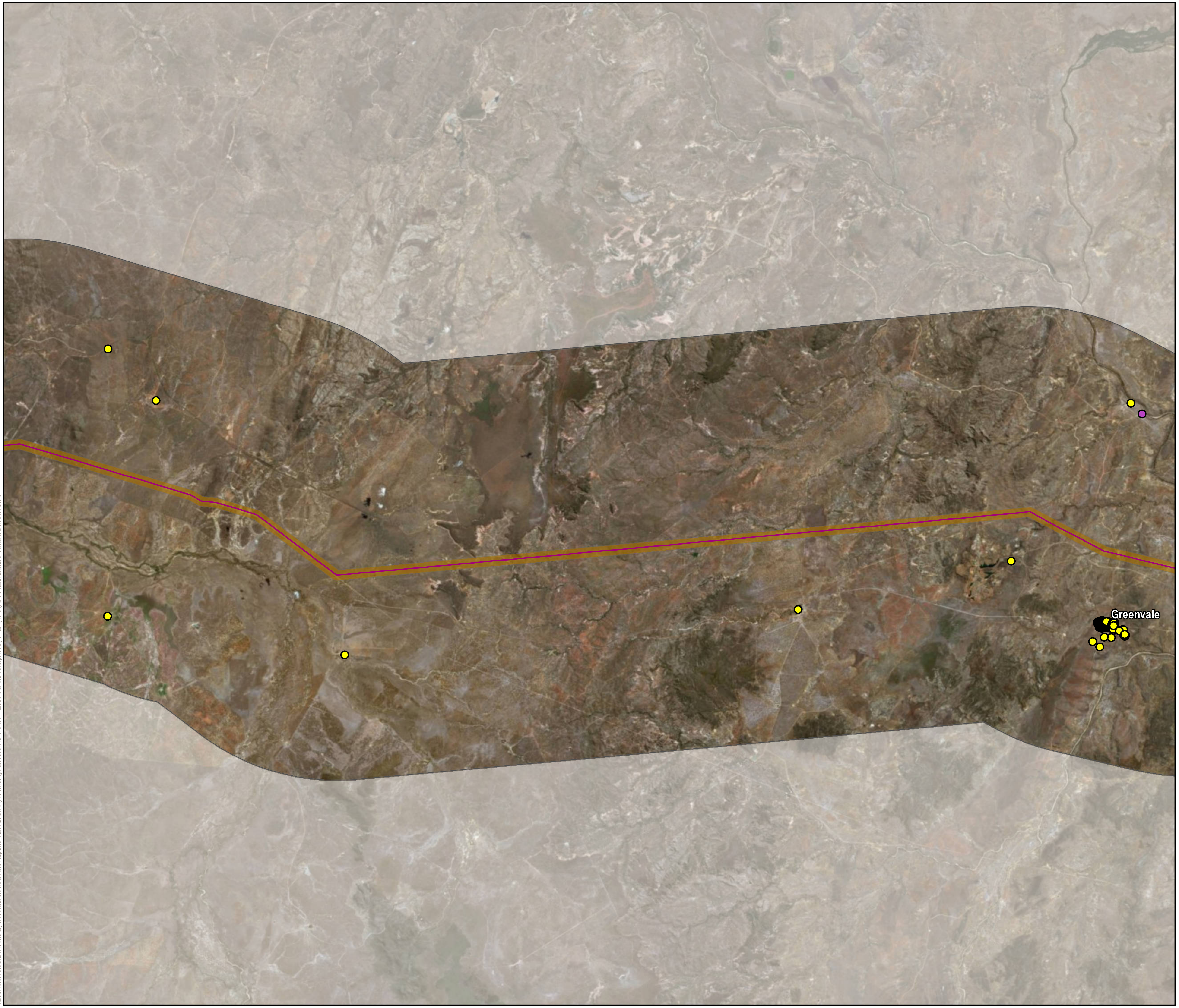
Kidston - Alignment B
Construction - Bored piling rig
Powerlink Queensland

Noise compliant setback distance map

PROJECT ID: 60577456
CREATED BY: JB
LAST MODIFIED: PD - 18/09/2018
VERSION: 1

Figure C5.1

A3 size



AECOM
www.aecom.com

N

Coordinate System: GDA 1994 MGA Zone 55
Projection: Transverse Mercator

0 2 4 6 8
Kilometers

1:170,000 (when printed at A3)

Legend

- Commercial and Retail Activity
- Dwellings and Accommodation
- Educational facility
- Outdoor Recreational Area
- Point Of Interest
- Protected Area
- Proposed substation
- Alignment
- buffer_piling_220m

Data sources:
DCDB, Roads, Watercourses - DNRM 2017
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Kidston Connection Project

Conjaboy
Construction - Bored piling rig
Powerlink Queensland

Noise compliant setback distance map

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VERSION:	1

Figure
C5.2

A3 size

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N

Coordinate System: GDA 1994 MGA Zone 55
Projection: Transverse Mercator

0 2 4 6 8
Kilometers

1:170,000 (when printed at A3)

Legend

- Commercial and Retail Activity
- Dwellings and Accommodation
- Educational facility
- Outdoor Recreational Area
- Point Of Interest
- Protected Area
- Proposed substation
- Alignment
- buffer_piling_220m

Data sources:
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Greenvale
Construction - Bored piling rig
Powerlink Queensland

Noise compliant setback distance map

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LAST MODIFIED:	PD - 13/09/2018	
VERSION:	1	

A3 size

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N

Coordinate System: GDA 1994 MGA Zone 55
Projection: Transverse Mercator

0 2 4 6 8
Kilometers

1:170,000 (when printed at A3)

Legend

- Commercial and Retail Activity
- Dwellings and Accommodation
- Educational facility
- Outdoor Recreational Area
- Point Of Interest
- Protected Area
- Proposed substation
- Alignment
- buffer_piling_500m

Data sources:
DCDB, Roads, Watercourses - DNRM 2017
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Kidston Connection Project

Mount Fox
Construction - Bored piling rig
Powerlink Queensland

Noise compliant setback distance map

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VERSION: 1

Figure **C5.4**

A3 size

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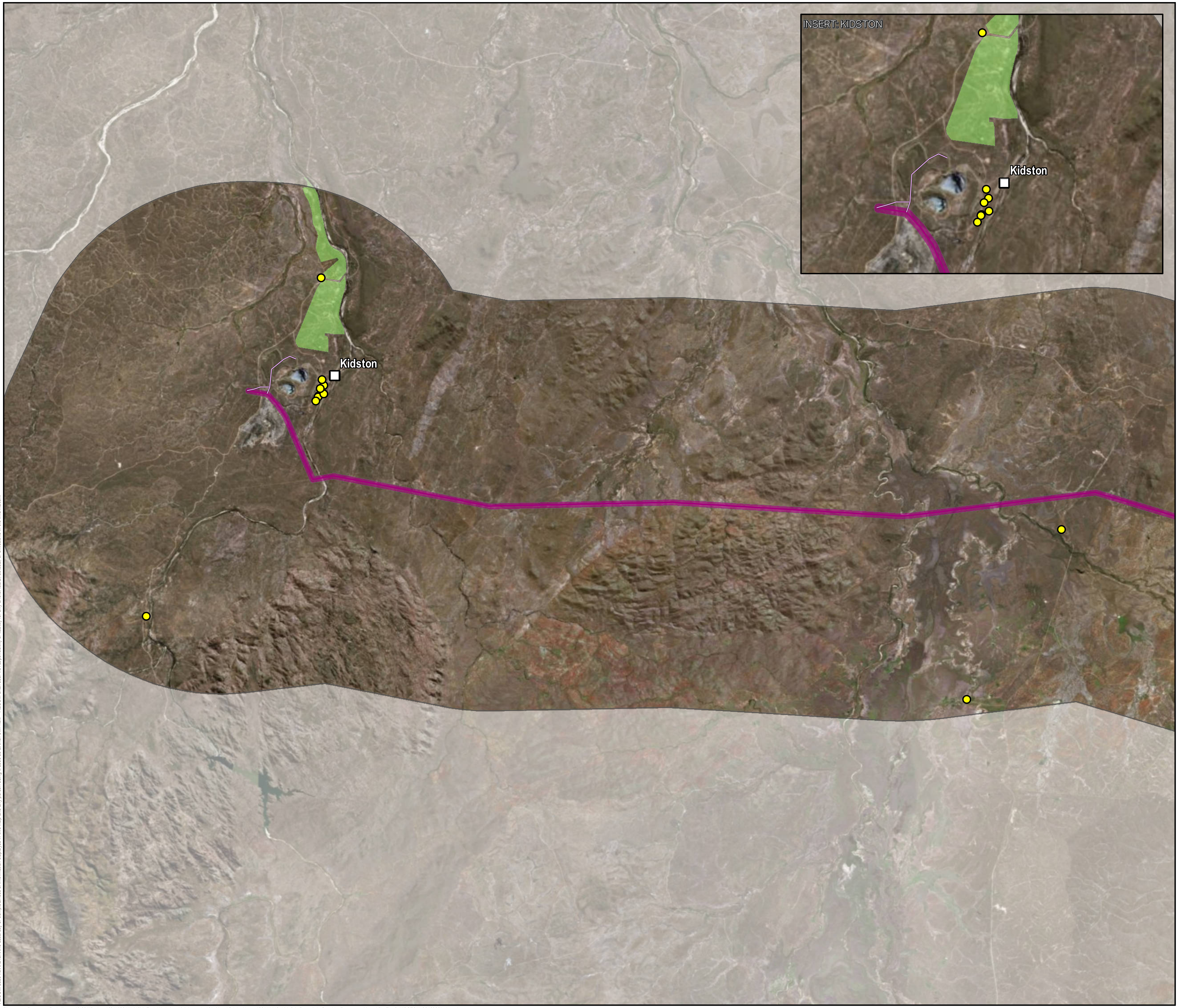
Appendix C Construction Noise Setback Distance Maps - Crane



AECOM
www.aecom.com

N

Coordinate System: GDA 1994 MGA Zone 55
Projection: Transverse Mercator

0 2 4 6 8
Kilometers

1:170,000 (when printed at A3)

Legend

- Commercial and Retail Activity
- Dwellings and Accommodation
- Educational facility
- Outdoor Recreational Area
- Point Of Interest
- Protected Area
- Proposed substation
- Alignment
- Solar-hydro transmission line
- buffer_crane_120m

Data sources:
DCDB, Roads, Watercourses - DNRM 2017
Site Features and Layout - AECOM 2018
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Kidston Connection Project

Kidston - Alignment A
Construction - Crane
Powerlink Queensland

Noise compliant setback distance map

PROJECT ID: 60577456
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LAST MODIFIED: PD - 18/09/2018
VERSION: 1

Figure
C6.1

A3 size

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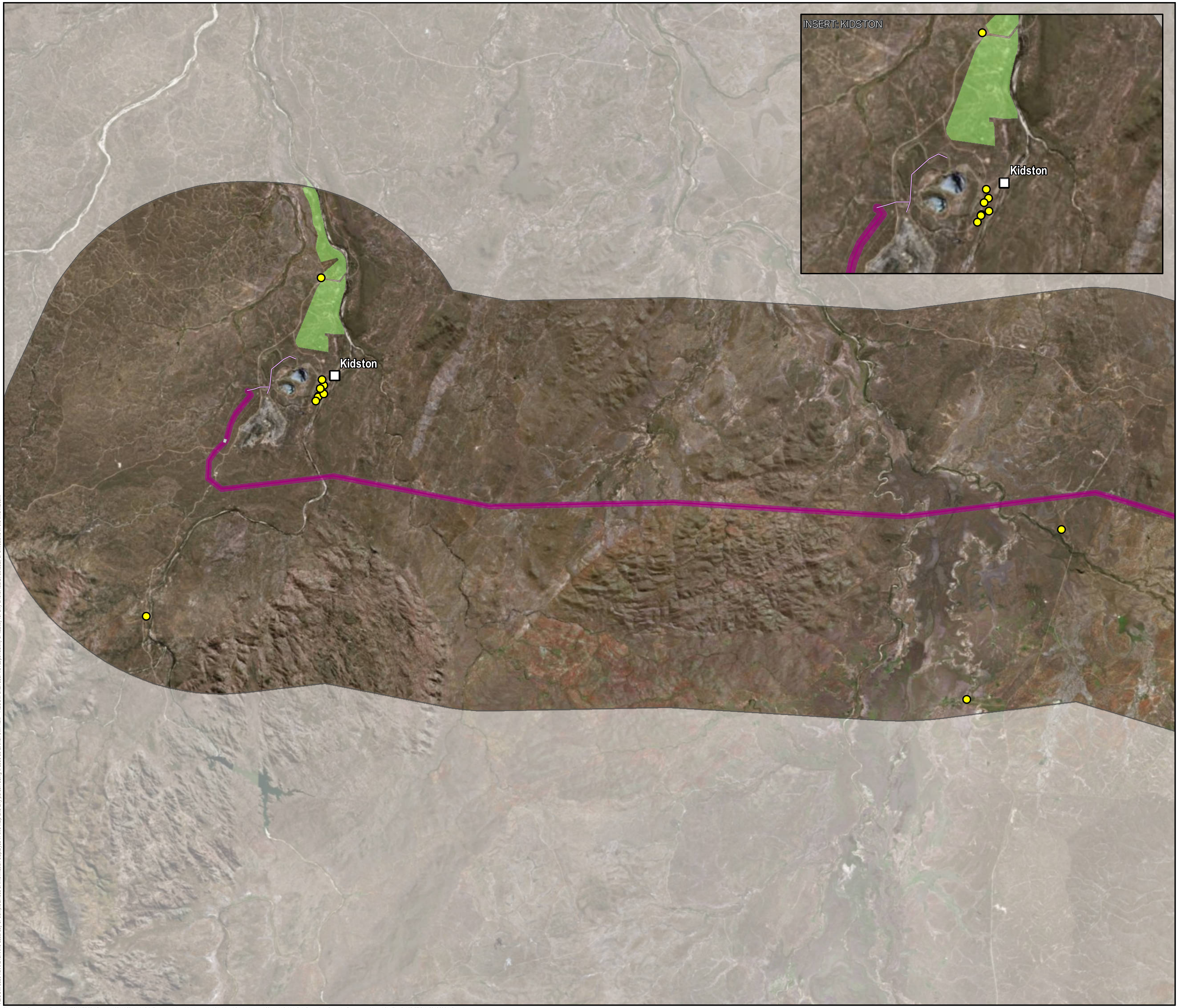

AECOM
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N

Coordinate System: GDA 1994 MGA Zone 55
Projection: Transverse Mercator

0 2 4 6 8
Kilometers

1:170,000 (when printed at A3)

Legend

- Commercial and Retail Activity
- Dwellings and Accommodation
- Educational facility
- Outdoor Recreational Area
- Point Of Interest
- Protected Area
- Proposed substation
- Alignment
- Solar-hydro transmission line
- buffer_crane_120m

Data sources:
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Kidston Connection Project

Kidston - Alignment B
Construction - Crane
Powerlink Queensland

Noise compliant setback distance map

PROJECT ID:	60577456	Figure
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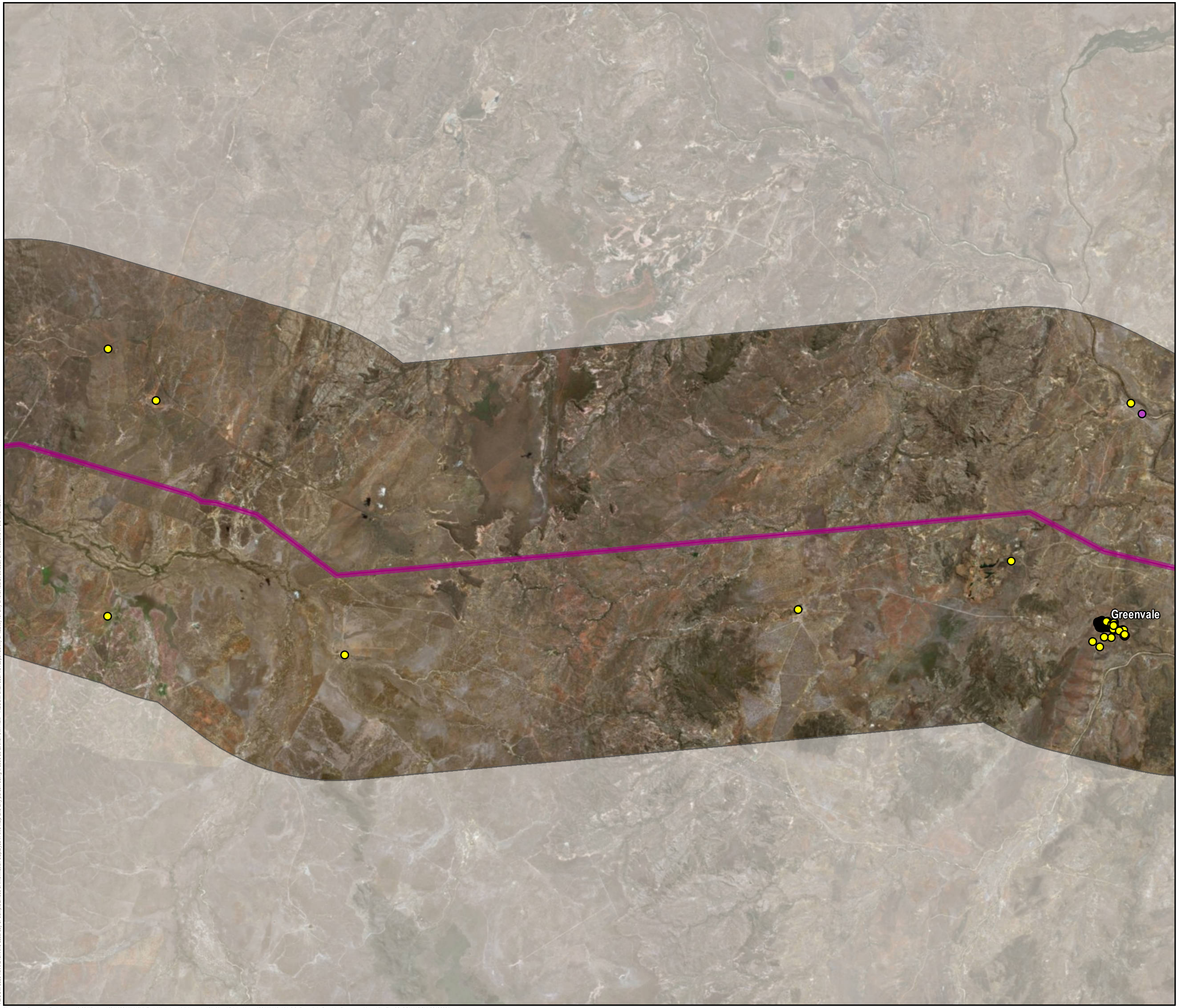
LAST MODIFIED:	PD - 18/09/2018	
VERSION:	1	

A3 size



AECOM
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N

Coordinate System: GDA 1994 MGA Zone 55
Projection: Transverse Mercator

0 2 4 6 8
Kilometers

1:170,000 (when printed at A3)

Legend

- Commercial and Retail Activity
- Dwellings and Accommodation
- Educational facility
- Outdoor Recreational Area
- Point Of Interest
- Protected Area
- Proposed substation
- Alignment
- buffer_crane_120m

Data sources:
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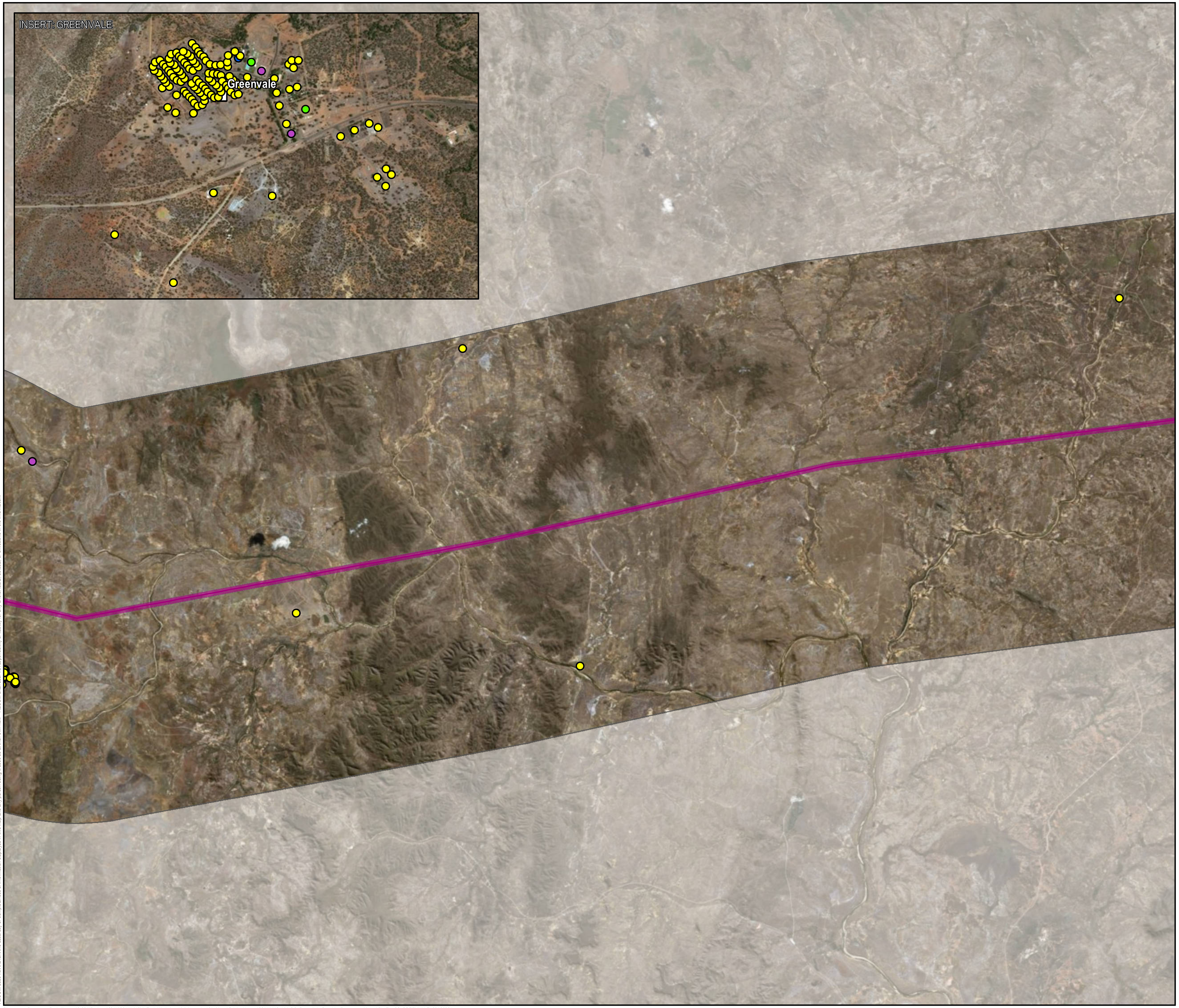
Conjaboy
Construction - Crane
Powerlink Queensland

Noise compliant setback distance map

PROJECT ID:	60577456	Figure
CREATED BY:	JB	C6.2
LAST MODIFIED:	PD - 13/09/2018	
VERSION:	1	

A3 size



AECOM
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N

Coordinate System: GDA 1994 MGA Zone 55
Projection: Transverse Mercator

0 2 4 6 8
Kilometers

1:170,000 (when printed at A3)

Legend

- Commercial and Retail Activity
- Dwellings and Accommodation
- Educational facility
- Outdoor Recreational Area
- Point Of Interest
- Protected Area
- Proposed substation
- Alignment
- buffer_crane_120m

Data sources:
DCDB, Roads, Watercourses - DNRM 2017
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Greenvale
Construction - Crane
Powerlink Queensland

Noise compliant setback distance map

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LAST MODIFIED:	PD - 13/09/2018	
VERSION:	1	

Filename: Document Path: \\autsv1fp001\Projects\605X\60577456\4. Tech Work Area\4.7 Acoustics\05_Maps\Original layout\60577456_NV_2.3_Powerlink_SensitiveReceptors_Map_A3L_Fig_02_GREENVALE_20180905.mxd

A3 size

AECOM
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N

Coordinate System: GDA 1994 MGA Zone 55
Projection: Transverse Mercator

0 2 4 6 8
Kilometers

1:170,000 (when printed at A3)

Legend

- Commercial and Retail Activity
- Dwellings and Accommodation
- Educational facility
- Outdoor Recreational Area
- Point Of Interest
- Protected Area
- Proposed substation
- Alignment
- buffer_crane_120m

Data sources:
DCDB, Roads, Watercourses - DNRM 2017
Site Features and Layout - AECOM 2018

Kidston Connection Project

Mount Fox
Construction - Crane
Powerlink Queensland

Noise compliant setback distance map

PROJECT ID:	60577456
CREATED BY:	JB
LAST MODIFIED:	PD - 13/09/2018
VERSION:	1

Figure C6.4

A3 size

Appendix C Construction Noise Setback Distance Maps - Helicopter

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N

Coordinate System: GDA 1994 MGA Zone 55
Projection: Transverse Mercator

0 2 4 6 8
Kilometers

1:170,000 (when printed at A3)

Legend

- Commercial and Retail Activity
- Dwellings and Accommodation
- Educational facility
- Outdoor Recreational Area
- Point Of Interest
- Protected Area
- Proposed substation
- Alignment
- Solar-hydro transmission line
- buffer_helicopter_2400m

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Kidston Connection Project

Kidston - Alignment A
Construction - Helicopter
Powerlink Queensland

Noise compliant setback distance map

PROJECT ID:	60577456
CREATED BY:	JB
LAST MODIFIED:	PD - 18/09/2018
VERSION:	1

Figure C7.1

A3 size

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AECOM
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N
Coordinate System: GDA 1994 MGA Zone 55
Projection: Transverse Mercator
0 2 4 6 8
Kilometers
1:170,000 (when printed at A3)

Legend
- Commercial and Retail Activity
- Dwellings and Accommodation
- Educational facility
- Outdoor Recreational Area
- Point Of Interest
- Protected Area
- Proposed substation
- Alignment
- Solar-hydro transmission line
- buffer_helicopter_2400m

Data sources:
DCDB, Roads, Watercourses - DNRM 2017
Site Features and Layout - AECOM 2018
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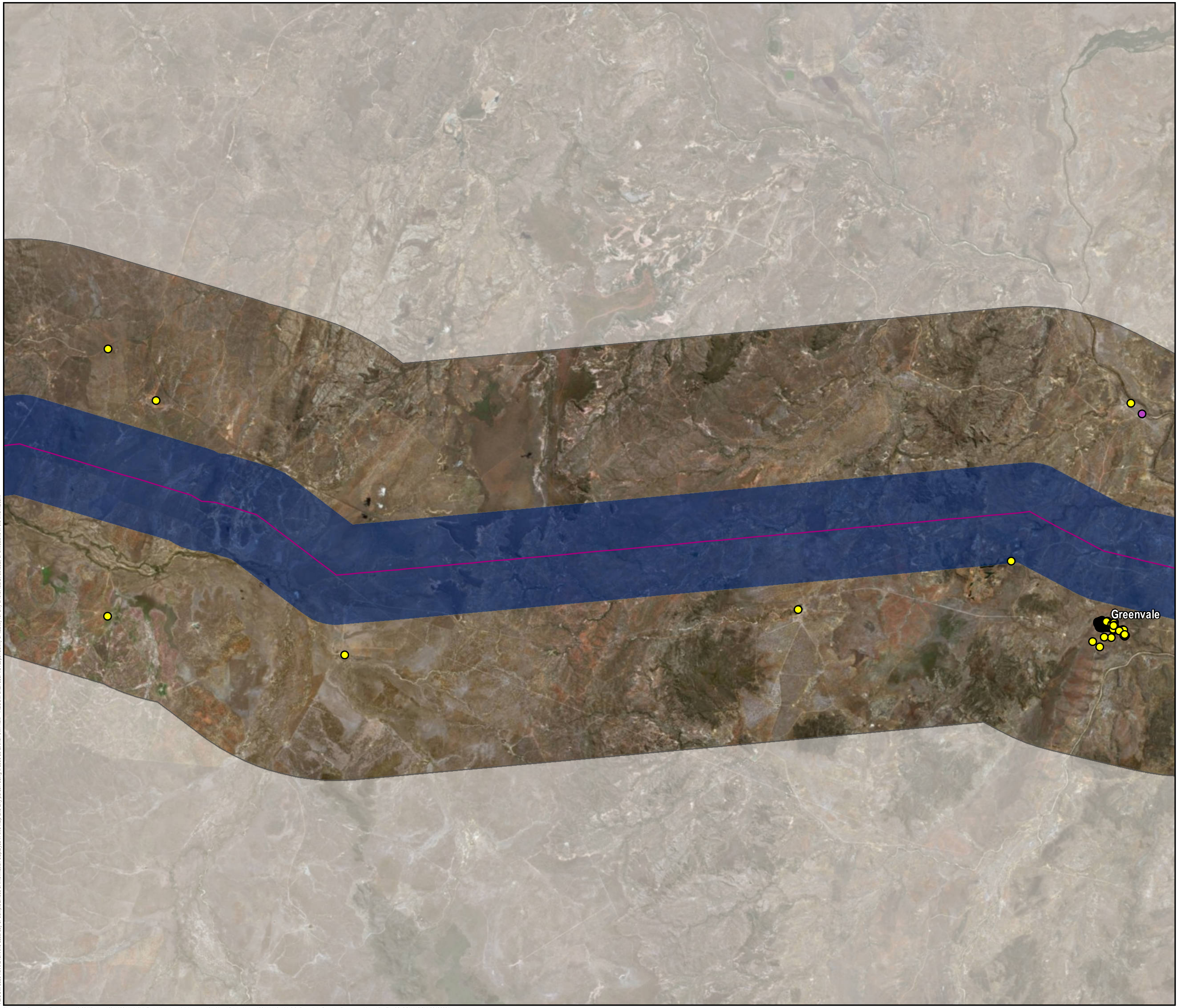
Kidston Connection Project
Kidston - Alignment B
Construction - Helicopter
Powerlink Queensland

Noise compliant setback distance map

PROJECT ID:	60577456	Figure
CREATED BY:	JB	C7.1
LAST MODIFIED:	PD - 18/09/2018	
VERSION:	1	



AECOM
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N

Coordinate System: GDA 1994 MGA Zone 55
Projection: Transverse Mercator

0 2 4 6 8
Kilometers

1:170,000 (when printed at A3)

Legend

- Commercial and Retail Activity
- Dwellings and Accommodation
- Educational facility
- Outdoor Recreational Area
- Point Of Interest
- Protected Area
- Proposed substation
- Alignment
- buffer_helicopter_2400m

Data sources:
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Kidston Connection Project

Conjaboy
Construction - Helicopter
Powerlink Queensland

Noise compliant setback distance map

PROJECT ID:	60577456	Figure
CREATED BY:	JB	C7.2
LAST MODIFIED:	PD - 13/09/2018	
VERSION:	1	

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A3 size

AECOM
www.aecom.com

N

Coordinate System: GDA 1994 MGA Zone 55
Projection: Transverse Mercator

0 2 4 6 8
Kilometers

1:170,000 (when printed at A3)

Legend

- Commercial and Retail Activity
- Dwellings and Accommodation
- Educational facility
- Outdoor Recreational Area
- Point Of Interest
- Protected Area
- Proposed substation
- Alignment
- buffer_helicopter_2400m

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Kidston Connection Project

Greenvale
Construction - Helicopter
Powerlink Queensland

Noise compliant setback distance map

PROJECT ID: 60577456
CREATED BY: JB
LAST MODIFIED: PD - 13/09/2018
VERSION: 1

Figure C7.3

A3 size

Filename: Document Path: \\autsv1fp001\Projects\605X\60577456\4. Tech Work Area\4.7 Acoustics\05_Maps\Original layout\60577456_NV_2.3_Powerlink_SensitiveReceptors_Map_A3L_Fig_02_GREENVALE_20180905.mxd

AECOM
www.aecom.com

N

Coordinate System: GDA 1994 MGA Zone 55
Projection: Transverse Mercator

0 2 4 6 8
Kilometers

1:170,000 (when printed at A3)

Legend

- Commercial and Retail Activity
- Dwellings and Accommodation
- Educational facility
- Outdoor Recreational Area
- Point Of Interest
- Protected Area
- Proposed substation
- Alignment
- buffer_helicopter_2400m

Data sources:
DCDB, Roads, Watercourses - DNRM 2017
Site Features and Layout - AECOM 2018

Kidston Connection Project

Mount Fox
Construction - Helicopter
Powerlink Queensland

Noise compliant setback distance map

PROJECT ID: 60577456
CREATED BY: JB
LAST MODIFIED: PD - 18/09/2018
VERSION: 1

Figure
C7.4

A3 size

Appendix D

Operational Noise Setback Distance Maps

Appendix D Operational Noise Setback Distance Maps - Corona discharge and substation (day)

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N

Coordinate System: GDA 1994 MGA Zone 55
Projection: Transverse Mercator

0 2 4 6 8
Kilometers

1:170,000 (when printed at A3)

Legend

- Commercial and Retail Activity
- Dwellings and Accommodation
- Educational facility
- Outdoor Recreational Area
- Point Of Interest
- Protected Area
- Proposed substation
- Alignment
- Solar-hydro transmission line
- buffer_operation_day

Data sources:
DCDB, Roads, Watercourses - DNRM 2017
Site Features and Layout - AECOM 2018
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Kidston Connection Project

Kidston - Alignment A
Operation - Corona discharge & substation (day)
Powerlink Queensland

Noise compliant setback distance map

PROJECT ID:	60577456
CREATED BY:	JB
LAST MODIFIED:	PD - 18/09/2018
VERSION:	1

Figure
D1.1

A3 size

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N

Coordinate System: GDA 1994 MGA Zone 55
Projection: Transverse Mercator

0 2 4 6 8
Kilometers

1:170,000 (when printed at A3)

Legend

- Commercial and Retail Activity
- Dwellings and Accommodation
- Educational facility
- Outdoor Recreational Area
- Point Of Interest
- Protected Area
- Proposed substation
- Alignment
- Solar-hydro transmission line
- buffer_operation_day

Data sources:
DCDB, Roads, Watercourses - DNRM 2017
Site Features and Layout - AECOM 2018

Kidston Connection Project

Kidston - Alignment B
Operation - Corona discharge & substation (day)
Powerlink Queensland

Noise compliant setback distance map

PROJECT ID: 60577456
CREATED BY: JB
LAST MODIFIED: PD - 18/09/2018
VERSION: 1

Figure
D1.1

A3 size

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N

Coordinate System: GDA 1994 MGA Zone 55
Projection: Transverse Mercator

0 2 4 6 8
Kilometers

1:170,000 (when printed at A3)

Legend

- Commercial and Retail Activity
- Dwellings and Accommodation
- Educational facility
- Outdoor Recreational Area
- Point Of Interest
- Protected Area
- Proposed substation
- Alignment
- buffer_operation_day

Data sources:
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Kidston Connection Project

Conjaboy
Operation - Corona discharge & substation (day)
Powerlink Queensland

Noise compliant setback distance map

PROJECT ID:	60577456
CREATED BY:	JB
LAST MODIFIED:	PD - 13/09/2018
VERSION:	1

Figure
D1.2

A3 size

AECOM
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N

Coordinate System: GDA 1994 MGA Zone 55
Projection: Transverse Mercator

0 2 4 6 8
Kilometers

1:170,000 (when printed at A3)

Legend

- Commercial and Retail Activity
- Dwellings and Accommodation
- Educational facility
- Outdoor Recreational Area
- Point Of Interest
- Protected Area
- Proposed substation
- Alignment
- buffer_operation_day

Data sources:
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Kidston Connection Project

Greenvale
Operation - Corona discharge & substation (day)
Powerlink Queensland

Noise compliant setback distance map

PROJECT ID:	60577456
CREATED BY:	JB
LAST MODIFIED:	PD - 13/09/2018
VERSION:	1

Figure D1.3

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A3 size

AECOM
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N

Coordinate System: GDA 1994 MGA Zone 55
Projection: Transverse Mercator
0 2 4 6 8
Kilometers
1:170,000 (when printed at A3)

Legend
- Commercial and Retail Activity
- Dwellings and Accommodation
- Educational facility
- Outdoor Recreational Area
- Point Of Interest
- Protected Area
- Proposed substation
- Alignment
- buffer_operation_day

Data sources:
DCDB, Roads, Watercourses - DNRM 2017
Site Features and Layout - AECOM 2018

Kidston Connection Project
Mount Fox
Operation - Corona discharge & substation (day)
Powerlink Queensland

Noise compliant setback distance map

PROJECT ID:	60577456
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VERSION:	1

Figure
D1.4

Filename: Document Path: \\AUTSV1FP001\Projects\605X\60577456\4. Tech Work Area\4.7 Acoustics\05_Maps\Original layout\60577456_NV_2.4_Powerlink_SensitiveReceptors_Map_A3L_Fig_02_MOUNTFOX_20180905.mxd

A3 size

Appendix D Operational Noise Setback Distance Maps - Corona discharge and substation (night)

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N

Coordinate System: GDA 1994 MGA Zone 55
Projection: Transverse Mercator

0 2 4 6 8
Kilometers

1:170,000 (when printed at A3)

Legend

- Commercial and Retail Activity
- Dwellings and Accommodation
- Educational facility
- Outdoor Recreational Area
- Point Of Interest
- Protected Area
- Proposed substation
- Alignment
- Solar-hydro transmission line
- buffer_operation_night

Data sources:
DCDB, Roads, Watercourses - DNRM 2017
Site Features and Layout - AECOM 2018

Kidston Connection Project

Kidston - Alignment A
Operation - Corona discharge & substation (night)
Powerlink Queensland

Noise compliant setback distance map

PROJECT ID:	60577456	Figure
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LAST MODIFIED:	PD - 18/09/2018	
VERSION:	1	

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N

Coordinate System: GDA 1994 MGA Zone 55
Projection: Transverse Mercator

0 2 4 6 8
Kilometers

1:170,000 (when printed at A3)

Legend

- Commercial and Retail Activity
- Dwellings and Accommodation
- Educational facility
- Outdoor Recreational Area
- Point Of Interest
- Protected Area
- Proposed substation
- Alignment
- Solar-hydro transmission line
- buffer_operation_night

Data sources:
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Kidston Connection Project

Kidston - Alignment B
Operation - Corona discharge & substation (night)
Powerlink Queensland

Noise compliant setback distance map

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VERSION: 1

Figure **D2.1**

A3 size

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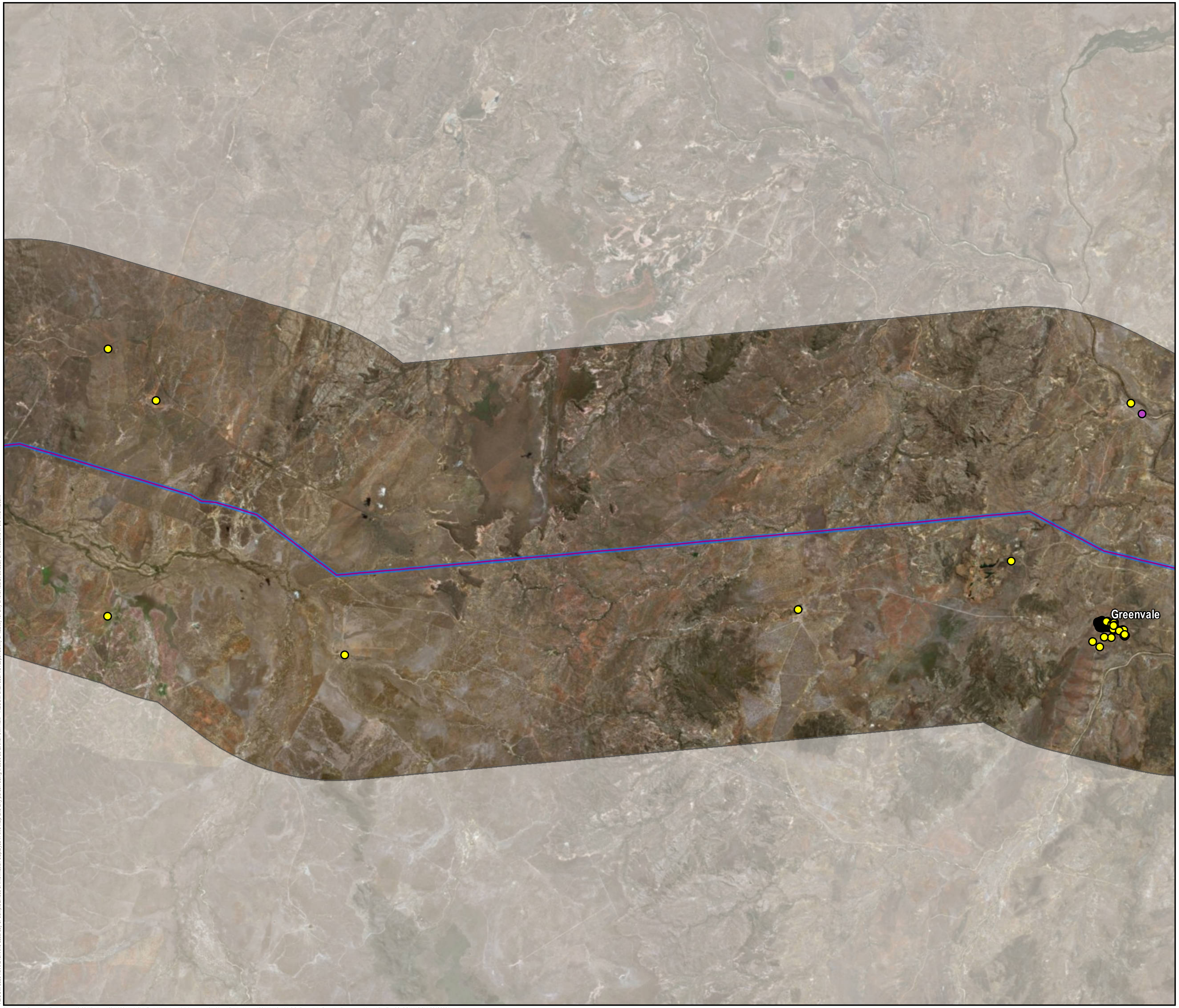

AECOM
www.aecom.com

N

Coordinate System: GDA 1994 MGA Zone 55
Projection: Transverse Mercator

0 2 4 6 8
Kilometers

1:170,000 (when printed at A3)

Legend

- Commercial and Retail Activity
- Dwellings and Accommodation
- Educational facility
- Outdoor Recreational Area
- Point Of Interest
- Protected Area
- Proposed substation
- Alignment
- buffer_operation_night

Data sources:
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Kidston Connection Project

Conjaboy
Operation - Corona discharge & substation (night)
Powerlink Queensland

Noise compliant setback distance map

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A3 size

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N

Coordinate System: GDA 1994 MGA Zone 55
Projection: Transverse Mercator

0 2 4 6 8
Kilometers

1:170,000 (when printed at A3)

Legend

- Commercial and Retail Activity
- Dwellings and Accommodation
- Educational facility
- Outdoor Recreational Area
- Point Of Interest
- Protected Area
- Proposed substation
- Alignment
- buffer_operation_night

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Kidston Connection Project

Greenvale
Operation - Corona discharge & substation (night)
Powerlink Queensland

Noise compliant setback distance map

PROJECT ID:	60577456	Figure
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LAST MODIFIED:	PD - 13/09/2018	
VERSION:	1	

A3 size

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AECOM
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N

Coordinate System: GDA 1994 MGA Zone 55
Projection: Transverse Mercator

0 2 4 6 8
Kilometers

1:170,000 (when printed at A3)

Legend

- Commercial and Retail Activity
- Dwellings and Accommodation
- Educational facility
- Outdoor Recreational Area
- Point Of Interest
- Protected Area
- Proposed substation
- Alignment
- buffer_operation_night

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Kidston Connection Project

Mount Fox
Operation - Corona discharge & substation (night)
Powerlink Queensland

Noise compliant setback distance map

PROJECT ID:	60577456	Figure
CREATED BY:	JB	D2.4
LAST MODIFIED:	PD - 13/09/2018	
VERSION:	1	

A3 size

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Appendix D Operational Noise Setback Distance Maps - Helicopter inspections

AECOM
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N

Coordinate System: GDA 1994 MGA Zone 55
Projection: Transverse Mercator
0 2 4 6 8
Kilometers
1:170,000 (when printed at A3)

Legend

- Commercial and Retail Activity
- Dwellings and Accommodation
- Educational facility
- Outdoor Recreational Area
- Point Of Interest
- Protected Area
- Proposed substation
- Alignment
- Solar-hydro transmission line
- buffer_helicopter_3400m

Data sources:
DCDB, Roads, Watercourses - DNRM 2017
Site Features and Layout - AECOM 2018

Kidston Connection Project

Kidston - Alignment A
Operation - Helicopter inspections
Powerlink Queensland

Noise compliant setback distance map

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CREATED BY: JB
LAST MODIFIED: PD - 18/09/2018
VERSION: 1

Figure
D3.1

A3 size

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AECOM
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N

Coordinate System: GDA 1994 MGA Zone 55
Projection: Transverse Mercator

0 2 4 6 8
Kilometers

1:170,000 (when printed at A3)

Legend

- Commercial and Retail Activity
- Dwellings and Accommodation
- Educational facility
- Outdoor Recreational Area
- Point Of Interest
- Protected Area
- Proposed substation
- Alignment
- Solar-hydro transmission line
- buffer_helicopter_3400m

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Kidston Connection Project

Kidston - Alignment B
Operation - Helicopter inspections
Powerlink Queensland

Noise compliant setback distance map

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VERSION: 1

Figure **D3.1**

A3 size

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AECOM
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N

Coordinate System: GDA 1994 MGA Zone 55
Projection: Transverse Mercator

0 2 4 6 8
Kilometers

1:170,000 (when printed at A3)

Legend

- Commercial and Retail Activity
- Dwellings and Accommodation
- Educational facility
- Outdoor Recreational Area
- Point Of Interest
- Protected Area
- Proposed substation
- Alignment
- buffer_helicopter_3400m

Data sources:
DCDB, Roads, Watercourses - DNRM 2017
Site Features and Layout - AECOM 2018

Kidston Connection Project

Conjaboy
Operation - Helicopter inspections
Powerlink Queensland

Noise compliant setback distance map

PROJECT ID:	60577456
CREATED BY:	JB
LAST MODIFIED:	PD - 13/09/2018
VERSION:	1

Figure
D3.2

A3 size

AECOM

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N

Coordinate System: GDA 1994 MGA Zone 55
Projection: Transverse Mercator

0 2 4 6 8

Kilometers

1:170,000 (when printed at A3)

Legend

- Commercial and Retail Activity
- Dwellings and Accommodation
- Educational facility
- Outdoor Recreational Area
- Point Of Interest
- Protected Area
- Proposed substation
- Alignment
- buffer_helicopter_3400m

Data sources:
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Kidston Connection Project

Greenvale
Operation - Helicopter inspections
Powerlink Queensland

Noise compliant setback distance map

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LAST MODIFIED:	PD - 13/09/2018	
VERSION:	1	

A3 size

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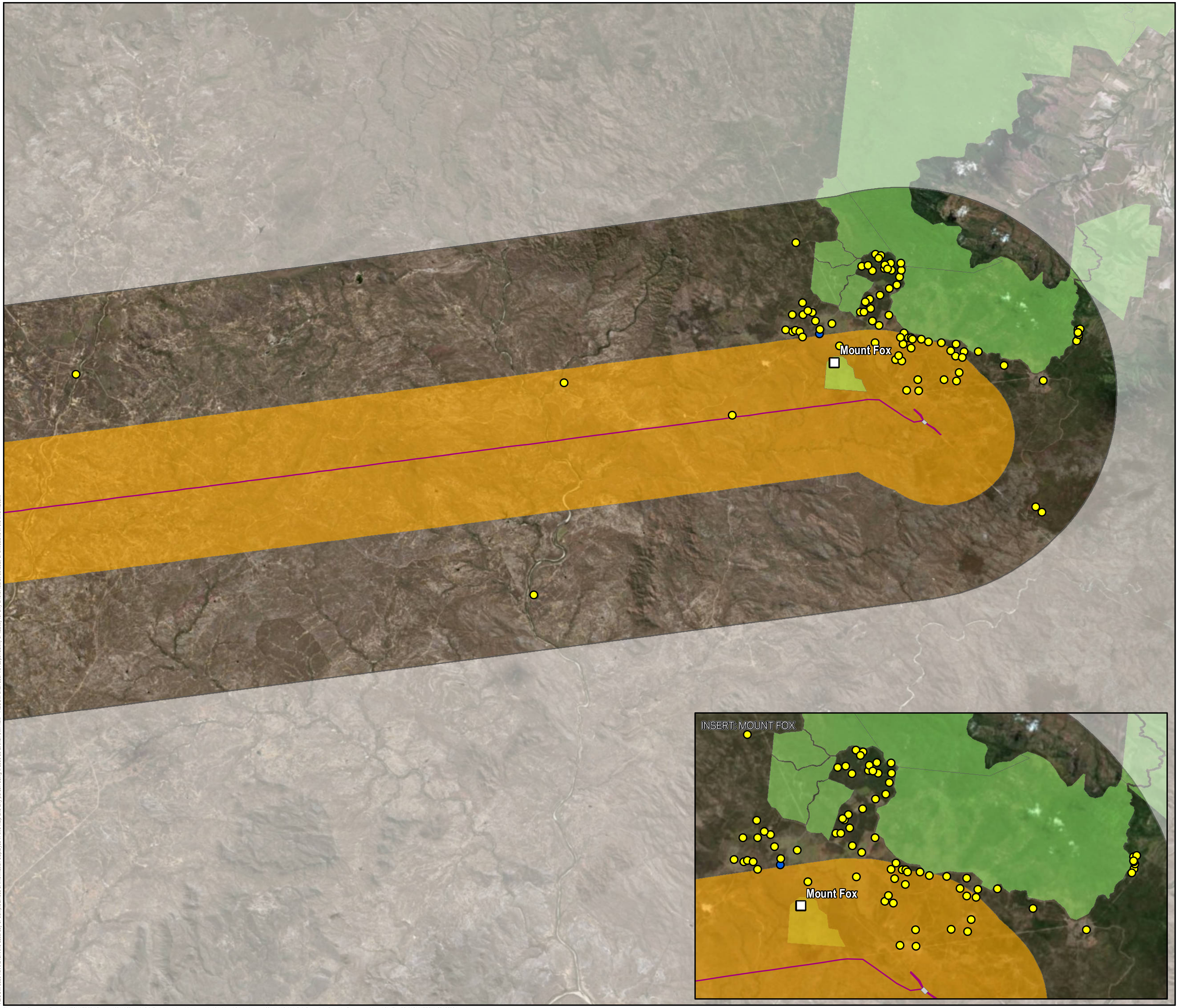

AECOM
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N

Coordinate System: GDA 1994 MGA Zone 55
Projection: Transverse Mercator

0 2 4 6 8
Kilometers

1:170,000 (when printed at A3)

Legend

- Commercial and Retail Activity
- Dwellings and Accommodation
- Educational facility
- Outdoor Recreational Area
- Point Of Interest
- Protected Area
- Proposed substation
- Alignment
- buffer_helicopter_3400m

Data sources:
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Kidston Connection Project

Mount Fox
Operation - Helicopter inspections
Powerlink Queensland

Noise compliant setback distance map

PROJECT ID:	60577456	Figure
CREATED BY:	JB	D3.4
LAST MODIFIED:	PD - 13/09/2018	
VERSION:	1	

A3 size

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Appendix D Operational Noise Setback Distance Maps - Mulcher

AECOM
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N

Coordinate System: GDA 1994 MGA Zone 55
Projection: Transverse Mercator

0 2 4 6 8
Kilometers

1:170,000 (when printed at A3)

Legend

- Commercial and Retail Activity
- Dwellings and Accommodation
- Educational facility
- Outdoor Recreational Area
- Point Of Interest
- Protected Area
- Proposed substation
- Alignment
- Solar-hydro transmission line
- buffer_op_mulcher_710m

Data sources:
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Kidston Connection Project

Kidston - Alignment A
Operation - Mulcher
Powerlink Queensland

Noise compliant setback distance map

PROJECT ID:	60577456
CREATED BY:	JB
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VERSION:	1

Figure D4.1

A3 size

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AECOM
www.aecom.com

N

Coordinate System: GDA 1994 MGA Zone 55
Projection: Transverse Mercator

0 2 4 6 8
Kilometers

1:170,000 (when printed at A3)

Legend

- Commercial and Retail Activity
- Dwellings and Accommodation
- Educational facility
- Outdoor Recreational Area
- Point Of Interest
- Protected Area
- Proposed substation
- Alignment
- Solar-hydro transmission line
- buffer_op_mulcher_710m

Data sources:
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Site Features and Layout - AECOM 2018
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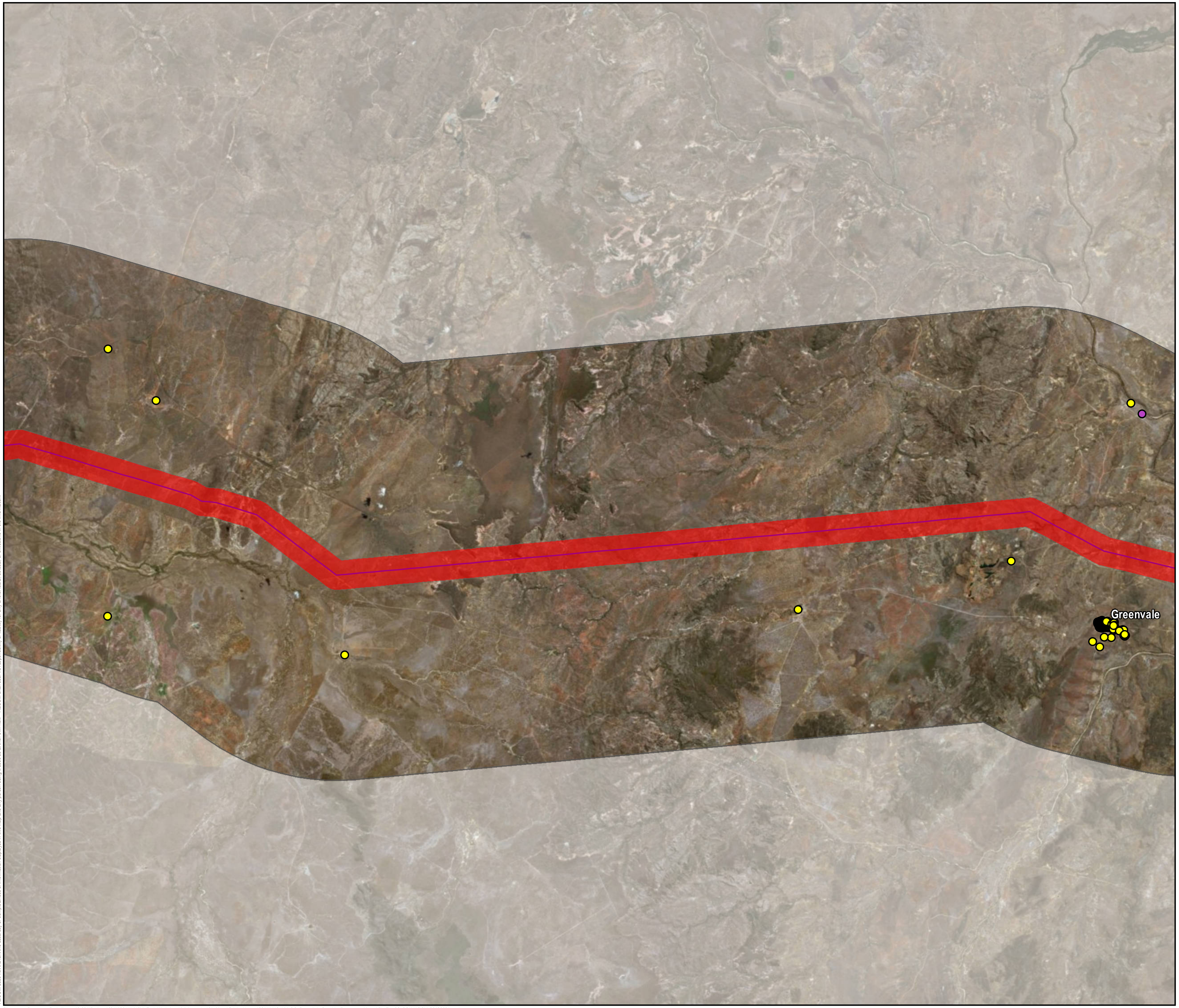
Kidston Connection Project

Kidston - Alignment B
Operation - Mulcher
Powerlink Queensland

Noise compliant setback distance map

PROJECT ID:	60577456	Figure
CREATED BY:	JB	D4.1
LAST MODIFIED:	PD - 18/09/2018	
VERSION:	1	

A3 size



AECOM
www.aecom.com

N

Coordinate System: GDA 1994 MGA Zone 55
Projection: Transverse Mercator

0 2 4 6 8
Kilometers

1:170,000 (when printed at A3)

Legend

- Commercial and Retail Activity
- Dwellings and Accommodation
- Educational facility
- Outdoor Recreational Area
- Point Of Interest
- Protected Area
- Proposed substation
- Alignment
- buffer_op_mulcher_710m

Data sources:
DCDB, Roads, Watercourses - DNRM 2017
Site Features and Layout - AECOM 2018
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Kidston Connection Project

Conjaboy
Operation - Mulcher
Powerlink Queensland

Noise compliant setback distance map

PROJECT ID:	60577456	Figure
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LAST MODIFIED:	PD - 13/09/2018	
VERSION:	1	

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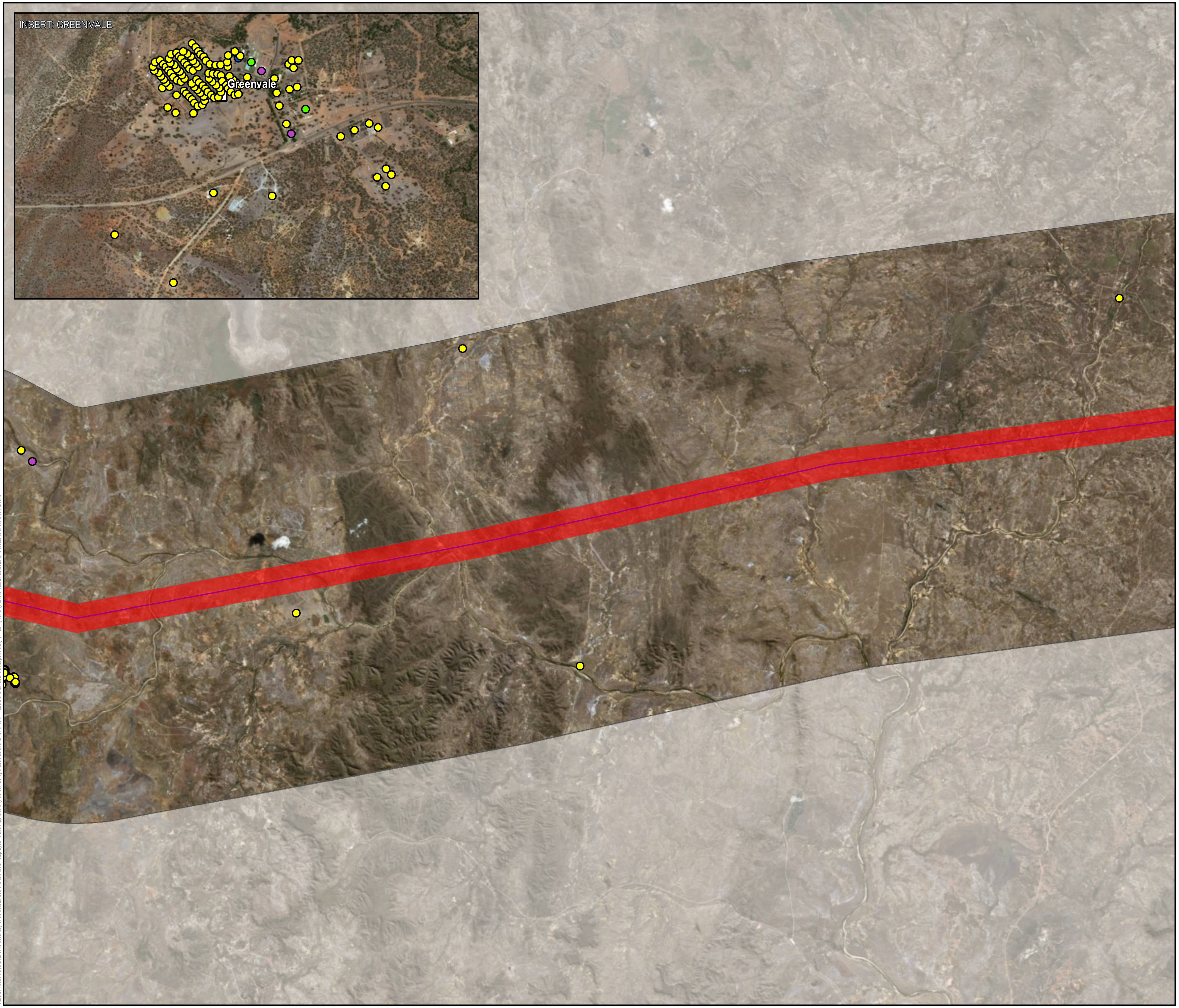

AECOM
www.aecom.com

N

Coordinate System: GDA 1994 MGA Zone 55
Projection: Transverse Mercator

0 2 4 6 8
Kilometers

1:170,000 (when printed at A3)

Legend

- Commercial and Retail Activity
- Dwellings and Accommodation
- Educational facility
- Outdoor Recreational Area
- Point Of Interest
- Protected Area
- Proposed substation
- Alignment
- buffer_op_mulcher_710m

Data sources:
DCDB, Roads, Watercourses - DNRM 2017
Site Features and Layout - AECOM 2018
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Kidston Connection Project

Greenvale
Operation - Mulcher
Powerlink Queensland

Noise compliant setback distance map

PROJECT ID:	60577456	Figure
CREATED BY:	JB	D4.3
LAST MODIFIED:	PD - 13/09/2018	
VERSION:	1	

A3 size

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N

Coordinate System: GDA 1994 MGA Zone 55
Projection: Transverse Mercator

0 2 4 6 8
Kilometers

1:170,000 (when printed at A3)

Legend

- Commercial and Retail Activity
- Dwellings and Accommodation
- Educational facility
- Outdoor Recreational Area
- Point Of Interest
- Protected Area
- Proposed substation
- Alignment
- buffer_op_mulcher_710m

Data sources:
DCDB, Roads, Watercourses - DNRM 2017
Site Features and Layout - AECOM 2018

Kidston Connection Project

Mount Fox
Operation - Mulcher
Powerlink Queensland

Noise compliant setback distance map

PROJECT ID:	60577456
CREATED BY:	JB
LAST MODIFIED:	PD - 13/09/2018
VERSION:	1

Figure D4.4

A3 size

Appendix E

Relevant legislation and guidelines

Appendix E Relevant legislation and guidelines

Environmental Protection Act 1994

The key piece of legislation in Queensland for assessing potential environmental impacts associated with development is the *Environmental Protection Act 1994* (EP Act). Under the Act, a person must not carry out any activity that causes, or is likely to cause, environmental harm unless the person takes all reasonable and practicable measures to prevent or minimise the harm (the general environmental duty). Failure to do this is an offence under the Act. The acoustic objectives of the EP Act are achieved through the Environmental Protection Regulation 2008 and the Environmental Protection (Noise) Policy 2008

Environmental Protection Regulation 2008

The noise objective of the Environmental Protection Regulation 2008 (EP Regulation) is to protect the environmental values of the acoustic environment. The Regulation lists two performance outcomes:

1. Sound from the activity is not audible at a sensitive receptor.
2. The release of sound to the environment from the activity is managed so that adverse effects on environmental values including health and wellbeing and sensitive ecosystems are prevented or minimised.

These environmental values are addressed in the Environmental Protection (Noise) Policy 2008

Environmental Protection (Noise) Policy 2008

The purpose of the Environmental Protection (Noise) Policy (EP (Noise) Policy) is to achieve the objectives of the EP Act in relation to the acoustic environment. The purpose of this policy is achieved by:

- Identifying environmental values to be enhanced or protected; and
- Stating acoustic quality objectives for enhancing or protecting the environmental values; and
- Providing a framework for making consistent, equitable and informed decisions in relation to the acoustic environment.

Environmental values to be enhanced or protected under this policy that are relevant to this assessment are:

> *"the qualities of the acoustic environment that are conducive to human health and wellbeing, including by ensuring a suitable acoustic environment for individuals to do any of the following:*
>
> - *sleep*
> - *study or learn*
> - *be involved in recreation, including relaxation and conversation*
> - *the qualities of the acoustic environment that are conducive to protecting the amenity of the community"*

Acoustic quality objectives

Schedule 1 of the EP (Noise) Policy details acoustic quality objectives. The applicable objectives to dwellings are summarised in Table 13. These limits are designed to be long-term noise limits and are not applied to any individual project or enterprise. They can, however, inform the decision-making process around the limits and can assist in identifying whether the environmental values are protected.

Table 13 EP (Noise) Policy acoustic quality objectives

Sensitive receptor	Time of day	Acoustic quality objectives, dB(A)			Environmental value
		$L_{Aeq,adj,1hr}$	$L_{A10,adj,1hr}$	$L_{A1,adj,1hr}$	
Dwelling (for outdoors)	Daytime and evening	50	55	65	Health and wellbeing
Dwelling (for indoors)	Daytime and evening	35	40	45	Health and wellbeing
Dwelling (for indoors)	Night-time	30	35	40	Health and wellbeing, in relation to the ability to sleep

Note:
The EP (Noise) Policy defines the following:

Daytime means the period after 7 am on a day to 6 pm on the day;
Evening means the period after 6 pm on a day to 10 pm on the day;
Night-time means the period after 10 pm on a day to 7 am on the next day.

The acoustic quality objectives have been adopted as noise limits for construction noise and the night time $L_{A1,adj,1hr}$ acoustic quality objectives have also been adopted for the assessment of sleep disturbance due to operational noise.

In addition to the Acoustic Quality objectives, the EPP (Noise) provides a hierarchy for the management of activities involving noise; reproduced below:

Part 4 Avoiding, minimising or managing noise

9 Management hierarchy for noise

1. *This section states the management hierarchy for an activity involving noise*
2. *To the extent that it is reasonable to do so , noise must be dealt with in the following order of preference:*
   a. *Firstly – avoid:*
      Example for paragraph (a)
      Locating an industrial activity in an area that is not near a sensitive receptors
   b. *Secondly – minimise, in the following order of preference –*
      i. *Firstly-orientate an activity to minimise noise*
         Example for subparagraph (i)- Facing a part of an activity that makes noise away from a sensitive receptors
      ii. *Secondly – use best available technology*
   c. *Thirdly-manage*
      Example for paragraph (c) - using heavy machinery only during business hours

Background creep

EP (Noise) Policy states:

(1) This section states the management intent for an activity involving noise.

Note—

See section 51 of the Environmental Protection Regulation 2008.

(2) To the extent that it is reasonable to do so, noise from an activity must not be—

(a) for noise that is continuous noise measured by $L_{A90,T}$—more than nil dB(A) greater than the existing acoustic environment measured by $L_{A90,T}$; or

(b) for noise that varies over time measured by $L_{Aeq,adj,T}$—more than 5dB(A) greater than the existing acoustic environment measured by $L_{A90,T}$.

Background creep noise criteria have been adopted for use in the assessment of only operational noise due to the constant nature of noise expected to be generated.

Powerlink Queensland SM1 Primary Systems Infrastructure Design Manual

The Powerlink Queensland *SM1 Primary Systems Infrastructure Design Manual* states that, where the calculated noise levels at the Powerlink substation property boundary is greater than L_{Aeq} 55 dB(A), noise enclosures may need to be installed around individual noise sources.

Appendix F

References

Appendix F References

Baoquan Wan, Wangling He, Chunming Pei, Xiaorui Wu, Yuchao Chen, Yemao Zhang. "Audible Noise Performance of Conductor Bundles." *Energies*, 2017: 1-12.