Hunter Power Project

Consistency assessment report

Gas turbine exhaust stacks: detailed design changes

May 2022

snowyhydro

Jacobs

Revision	Date	Prepared by	Reviewed by	Endorsed by Snowy Hydro	Approved by
Draft	15/05/2022	T Colman/ M Luger	M Luger	I Smith	-
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1 Introduction

1.1 Background and Current Approval Context

The Hunter Power Project (the Project) was approved as SSI-12590060 by the then Minister for Planning and Public Spaces on 17 December 2021. The approved Project involves the development of a gas-fired power station comprising two open cycle gas turbine (OCGT) generators with a nominal capacity of up to 750 megawatts (MW), an electrical switchyard and associated supporting infrastructure.

The Project was declared by the Minister to be critical State Significant Infrastructure under section 5.13 of the NSW *Environmental Planning & Assessment Act 1979* (EP&A Act) on 16 December 2020. As such, the Proposal is considered to be "essential for the State for economic, environmental or social reasons", and is listed under section 2.15 and Schedule 5 of State Environmental Planning Policy (Planning Systems) 2021.

Snowy Hydro, as the proponent, has engaged consultants to develop the detailed design for the Project, as well as a preferred equipment supplier for the power island which includes the gas turbine exhaust stacks. The Project is approaching the final design stage, however, the final detailed design of the exhaust stacks is already known. This consistency assessment has been developed accordingly, as the final design increases the height of the exhaust stacks from 36 m above ground level (as described and assessed in the Hunter Power Project Environmental Impact Statement (Jacobs, 2021) (the Project EIS), to 60 m above ground level.

Further details of the change are provided in Section 2.1 of this consistency assessment report.

1.2 Planning context

Section 5.25(1) of the EP&A Act states that: "*Modification of an approval means changing the terms of the approval, including revoking or varying a condition of the approval or imposing an additional condition on the approval*".

Furthermore, Section 5.25(2) provides that: *The proponent may request the Minister to modify the Minister's approval for State significant infrastructure.* ***The Minister's approval for a modification is not required if the infrastructure as modified will be consistent with the existing approval under this Division****.*

Consequently, Snowy Hydro is not required to obtain the Minister's approval for modification of the Project Infrastructure Approval, if the project as modified will be consistent with the Minister's existing approval.

1.3 Purpose of consistency assessment

The purpose of this consistency assessment is to demonstrate that the Project as changed (with the proposed increase in the height of the gas turbine exhaust stacks) remains consistent with the existing Project Approval. The assessment will:

- Describe the proposed change to the Project;
- Assess the environmental impacts associated with the proposed increase in height of the turbine exhaust stacks relative to the Project Approval; and

- Demonstrate that the proposed change is consistent with the existing Project Approval and that a modification of the approval and its conditions is not required.

2 Proposed change

2.1 Description of proposed change

The Project EIS described the Project, in accordance with a concept design developed at the time of the Project EIS preparation, as comprising two gas fired generators in open cycle configuration, with the two associated turbine exhaust stacks reaching a height above ground level of approximately 36 m.

During detailed design, Snowy Hydro's equipment supplier has determined that the height of the turbine exhaust stacks needs to be increased to approximately 60 m above ground level. Other than this proposed change, the overall form of the Project remains as it was described in Chapter 2 of the Project EIS, including its location, footprint, site layout, generating capacity, construction method and schedule, and operating parameters.

Only the height of the turbine exhaust stacks would be changed under this proposal. There would be no change to the location of the stacks.

2.2 Need for the proposed change

The Project is required to operate within the noise limits set under conditions B21 through B25 of the Project Infrastructure Approval and Environmental Protection Licence 21627. To achieve this, the equipment supplier together with a recognised industry leader in stack design, has determined that the turbine exhaust stacks require additional noise mitigation (including additional silencers and increased wall thickness) to the design assumed in the preparation of the EIS.

Consequently, in order to meet the project noise limits it is necessary to install additional noise mitigation in the stacks, which in turn requires the height of the turbine exhaust stacks to be approximately 60 m above ground level.

3 Environmental assessment

3.1 Comparison of impacts

An assessment has been undertaken to compare the environmental impacts of the proposed change relative to the environmental impacts of the Approved Project. The proposed increase in the height of the turbine exhaust stacks has been assessed with reference to the topics addressed in the EIS. A summary of the assessment is provided in Table 3-1 and where relevant, more detailed assessment is provided in the text following.

Table 3-1 Summary environmental assessment

Environmental issue	Potential change in impact?	Consideration of the relative environmental impacts of the proposed change compared to the Approved Project
Biodiversity	No	Equivalent level of impact. The proposed change makes no change to the area of land potentially impacted by the Project and there would be no new impacts or changes to the impacts on flora and fauna assessed in the EIS.
Aboriginal heritage	No	Equivalent level of impact. The proposed change does not affect the area of land impacted by the Project and there would be no new impacts, or changes to the impacts on Aboriginal heritage, archaeological features or cultural values assessed in the EIS.
Non-Aboriginal heritage	No	Equivalent level of impact. The proposed change does not affect the area of land impacted by the Project and there would be no new impacts, or changes to the impacts on non-Aboriginal heritage.
Preliminary Hazard Analysis	No	Equivalent level of impact. The proposed change will not alter the Project's operating parameters, or the frequency and duration of operation or risks.
Bushfire prone land	No	Equivalent level of impact as design change does not change the surrounding land or plant layout.
Plume rise and aeronautical impact	Yes	The increase in stack height changes a number parameters relevant to plume rise, and therefore a revised plume rise assessment has been carried out and is summarised in Section 3.2 below.
Electric and magnetic fields	No	Equivalent level of impact. The increased exhaust stack height will have no impact on any electric and magnetic fields.
Soils and contamination	No	Equivalent level of impact. The proposed change makes no change to the area of land impacted by the Project and there would be no new impacts, or changes to the impacts assessed in the EIS.
Groundwater	No	Equivalent level of impact. The proposed change makes no change to the area of land potentially impacted by the Project and there would be no new impacts, or changes to the impacts on groundwater.
Surface water and aquatic ecology	No	Equivalent level of impact. The proposed change makes no change to the area of land potentially impacted by the Project and there would be no new impacts, or changes to the impacts on surface water and aquatic ecology.
Hydrology and flooding	No	Equivalent level of impact. The proposed change makes no change to the area of land potentially impacted by the Project, and no change to planned ground levels or drainage. Therefore there would be no new impacts, or changes to the impacts on flooding or hydrology.
Air quality and greenhouse gases	Yes	The increase in stack height changes a number parameters relevant to air quality. Further consideration is provided in Section 3.3.

Environmental issue	Potential change in impact?	Consideration of the relative environmental impacts of the proposed change compared to the Approved Project
Noise and vibration	No	The proposed change to the Project has been designed to achieve the noise limits set out in conditions B21 – B25 of the Project Approval. Therefore the proposed change will not result in any change to the noise impacts assessed in the Project EIS.
Traffic and transport	No	Equivalent level of impact. The proposed change makes no change to volumes of traffic likely to be generated by the Project's operation or construction, and there would be no new impacts, or changes to the impacts assessed in the EIS.
Landscape character and visual impacts	Yes	The increased stack heights will mean that these components of the Project will be visible from a greater distance. A revised landscape character and visual impact assessment has been prepared and is summarised in Section 3.4 below.
Socio-economic factors	No	Equivalent level of impact. The proposed change will not result in any changes to the Project's impacts on social or community values, access or connectivity.
Waste	No	Equivalent level of impact. The proposed change will not result in any changes to the Project's likely generation, handling or disposal of waste materials, either during construction or operation.
Cumulative impacts	No	The EIS found that the Project would have a negligible cumulative impact on surrounding projects or other planned land uses. The proposed change will result in no changes to the overall cumulative impacts.

As per Table 3-1, the environmental issues that have the potential to change as a result of the proposed change are plume rise, air quality and landscape and visual. These three issues have been assessed in detail and described below.

3.2 Revised plume rise assessment

A revised plume rise assessment has been carried out for the proposed Project change and is attached in Appendix A. Please note that the updated plume rise assessment report required by condition B19 will be provided separately. Appendix A draws on the modelling conducted for this report.

Infrastructure Approval condition B19 requires an updated plume rise assessment report based on the final generator design. Therefore, the plume rise modelling undertaken includes both the increased stack height and updated emission characteristics associated with the proposed final design. The plume rise modelling investigation has been carried out in accordance with Civil Aviation Safety Authority (CASA) Advisory Circular titled "AC 139-05v3.0 - Plume Rise Assessments (CASA, 2019). The revised assessment was conducted in accordance with Civil Aviation Authority requirements and the CSIRO's prognostic model known as TAPM (The Air Pollution Model).

Results of the assessment and modelling were presented such that the regions of space where the vertical plume velocity exceeded 4.3, 6.1 and 10.6 m/s could be determined.

The key outcome of the modelling was that the predicted maximum heights at which the plume vertical velocity falls below 6.1 m/s were 1,113 m Above Ground Level (AGL) for gas operation and 1,057 m AGL for diesel operation under the proposed final design compared to 1,144 m for the EIS. Therefore, the proposed final design is predicted to be consistent (in fact having a slightly lesser impact) with the predictions in the EIS. It is noted that while the modelled temperature and velocity has increased at the stack exit, the overall volumetric flow of the exhaust has reduced, and consequently the buoyancy of the plume has decreased.

As the plume rise modelling showed the maximum plume heights were lower than assessed in the EIS, the aviation risk is also reduced and therefore has not been re-assessed for the purposes of this Consistency Assessment.

3.3 Revised air quality impact assessment

A revised Air Quality Impact Assessment (AQIA) has been carried out for the proposed Project change and is attached in Appendix B. Please note that the updated AQIA required by the Infrastructure Approval will be provided separately. Appendix B draws on the modelling conducted for that assessment.

Infrastructure Approval condition B5 requires a revised air quality impact assessment based on the detailed design of the plant and emission specifications based on manufacturer performance guarantees. Therefore, the air quality modelling undertaken includes both the increased stack height and updated emission characteristics associated with the proposed final design.

The model results clearly show that the ground-level concentrations of all the key air quality indicators will be considerably lower than presented in the EIS. This is largely due to increased dispersion as a result of the increase stack heights, higher exhaust temperatures and higher exit velocities.

It is therefore concluded that air quality impacts associated with the proposed taller stacks will be considerably lower than those that would result from the Approved Project.

3.4 Revised landscape character and visual impact assessment

A revised visual impact assessment has been undertaken for the proposed Project change and is attached in Appendix C.

The revised assessment concluded that when viewed from within the former smelter site area, that is the surrounding site being redeveloped as an industrial estate, that the proposed increase in stack height would be noticeable compared to the approved Project, however would be consistent with the expected infrastructure in that vicinity. The visual change however would not alter the level of assessed impact, and remains significantly less than the visual impact of the former Kurri Kurri aluminium smelter which had one stack of 140 m in height, two stacks at 70 m, as well as a 55 m high water tower.

The Seen Area Analysis which maps areas of theoretical visibility based solely on topography demonstrates that there would be no additional sensitive or significant viewing locations new to the Project where theoretical visibility is predicted.

The Zones of Visual Influence have demonstrated that the area within which the exhaust stacks have the potential to be a visually prominent feature in views, has increased from 500 m to 700 m. All land within this distance is within the area designated as existing or future industrial estate. There are no sensitive receptors located within 700 m of the Project.

Viewpoints L6 and T3 (refer to the Visual assessment Appendix B) are within the distance at which either 40 m or 60 m high exhaust stacks would be a noticeable element with the potential to be prominent in the landscape. The re-examination of these views undertaken considered that the levels of assessed impact for the proposed change would be consistent when compared to the approved development.

The viewshed of the Project has increased from 4.6 km for the approved Project to a distance of 6.9 km for the 60 m exhaust stacks. This increased viewshed includes the nearby townships of Gillieston Heights (viewpoint L7) and Abermain. These locations are however at such a distance that the exhaust stacks would barely be discernible

at that distance, and will in no way be a visually prominent feature in views, and consequently not alter the level of impact assessed in the EIS. Other areas within the increased viewshed mostly comprise forested areas where there would be no visibility of the site or the Project due to screening provided by existing vegetation. Where there are views in the direction of the Project, these views would include other constructed elements or visible features that are closer to the viewing location and more prominent. If the Project were visible, it would be at such a distance that the exhaust stacks would form a background element in the views.

The overall change in views and visual impact between the approved Project and the proposed change to 60 m high exhaust stacks would be Low to Negligible and consistent with the landscape character and visual impact assessment undertaken for the Project EIS. The proposed change to stack heights would not materially alter the levels of visual impact assessed for the approved Project.

4 Consistency with Project Approval conditions

4.1 Conditions of approval

Schedule 2 of the Project's Instrument of Approval sets out Administrative Conditions in Part A (approval conditions A1–A27), General Environmental Conditions in Part B (approval conditions B1–B50), and Environmental Management and Reporting Conditions in Part C (approval conditions C1–C22).

Table 4-1 provides a summary of those conditions of the Project Approval that are relevant to the proposed Project change. The table shows that the proposed change does not require any change to any of the conditions of approval and therefore demonstrates that the Project as changed will remain consistent with the existing Project Approval.

Conditions of approval that are not referenced in Table 4-1 are excluded because they are not relevant to the proposed Project change, and the proposed change will not affect the application of those conditions to the Project or the Proponent's obligations in respect of compliance with those conditions.

Table 4-1 Consistency against relevant conditions of approval

No.	Condition of Approval	Discussion	Consistent
Part A (conditions A1-A27)	Administrative conditions	The Project as changed remains consistent with all Administrative conditions under Part A of the Project Approval	Yes
B1-B11	Air Quality: Final Design Verification Conditions B5, B6	Condition B5 requires that prior to construction, the Proponent must prepare and submit a revised AQIA that is based on the Project's detailed design (refer discussion above in Section 3.3).	Yes
	Air Quality Verification Conditions B7, B8	Conditions B7 and B8 prescribe a methodology and program for monitoring and verification of the air emission performance of the Project. The proposed change will have no effect on these conditions of approval or on compliance with these conditions.	Yes
	Air Quality: discharge and monitoring Conditions B9-B11	Conditions B9-B11 set the discharge limits of key pollutants (oxides of Nitrogen; Carbon monoxide), and prescribe other pollutants/parameters that must be monitored. These conditions also identify monitoring points and monitoring conditions. The proposed change will not influence compliance with Conditions B9-B11 and no change to these conditions is required in respect of the proposed change.	Yes

No.	Condition of Approval	Discussion	Consistent
B19, B20	Aviation Safety	Conditions B19 and B20 require an updated plume rise assessment report, and all final design drawings, to be prepared and submitted to relevant authorities and stakeholders. The proposed change will not influence compliance with Conditions B19-B20 and no change to these conditions is required in respect of the proposed change.	Yes
B21-B32	Noise: ● Noise limits (B21-B25) ● Monitoring (B26-B29) ● Construction hours (B30-B32)	The proposed change is a detailed design response to achieving operational noise limits set in Approval Condition B21 (refer Section 2.2 above). The proposed change is to ensure compliance with Conditions B21-B32 and no change to these conditions is required in respect of the proposed change.	Yes

As shown in Table 4-1, the proposed change is consistent with the conditions of the Project Approval.

4.2 Permits, licenses and other approvals

The proposed change has been assessed in Table 4-2 below in relation to the relevant permit, license and other approval requirements for the Approved Project.

Table 4-2 Comparison of permits, licences and approvals requirements

Existing requirement for the Approved Project	Additional approval requirements or changes to the existing requirements as a result of the proposed change
Environmental Protection Licence (EPL 21627)	No changes would be required to the EPL as a result of the proposed increase in height of the turbine exhaust stacks.
Commonwealth Environment Protection and Biodiversity Conservation Act approval (2021-8888)	There are no impacts from the proposed change that require further MNES or Commonwealth land assessment and approval. As no changes to the State development consent are required, notification of the Department of Agriculture, Water and the Environment is not required.

4.3 Consistency questions

Table 4-3 presents a set of questions based on the Draft Environmental Impact Guideline Series, June 2017: *Modifying an Approved Project* that was intended to comprise a checklist for Proponents to determine whether a proposed change could be considered consistent with the Project Approval.

Table 4-3 Approval consistency questions

Consistency question	Discussion	Response
1. Would the proposed change result in a radical transformation to the approved project?	Refer to Sections 2 and 3. The proposed change will result in impacts that are generally equivalent to those assessed in the EIS.	No
2. Would the proposed change result in any condition of the Infrastructure Approval not being met?	Refer to Section 4. No changes to the conditions of approval would be required due to the proposed change.	No
3. Would the proposed change be 'generally in accordance' with the EIS and subsequent modifying documents?	Refer Section 3 and 5. The proposed change is minor and is generally in accordance with the Project EIS and all subsequent documents.	Yes
4. Are the works on the land or site subject to the Approval?	Yes. The proposed change will be wholly within the Proposal Site as identified in the Project EIS. Refer to Section 2.	Yes
5. Are the works within the disturbance footprint identified for the approved project?	Yes. The proposed change will be wholly within the Proposal Site as identified in the Project EIS. Refer to Section 2.	Yes
6. Would the proposed change alter the environmental impacts of the approved project?	Impacts will be equivalent to those assessed in the Project EIS. Refer to Section 3.	No
7. Are there any other approvals or licences which are required to be obtained or amended for the proposed change?	No other licences or approvals are required to be obtained or amended. Refer to Section 4.	No
8. Is the proposed change consistent with the management plans, programs and strategies?	Yes. No changes to management plans or strategies are required.	Yes
9. Has consultation occurred?	Consultation is not considered warranted in respect of the proposed change as it is consistent with the approved EIS.	No

5 Conclusion

This consistency assessment has considered the proposed increase in the height of the two turbine exhaust stacks, from approximately 36 m above ground level to 60 m above ground level, against the conditions of the Project Approval. Based on the assessment in this report, the proposed change is considered consistent with the Project Approval.

Appendix A

Revised Plume Rise Assessment

Jacobs

Hunter Power Project: Proposed increase in stack height: Plume rise modelling

Date:	20 May 2022
Project name:	Hunter Power Project
Project no:	IS354501
Attention:	Ian Smith/ Isaac Strachan
Company:	Jacobs Group (Australia) Pty Ltd.:
Prepared by:	Shane Lakmaker and Mike Luger
Document no:	Final

Jacobs Group (Australia) Pty Limited
Level 4, 12 Stewart Avenue
Newcastle West, NSW 2302
PO Box 2147
Dangar, NSW 2309
Australia
T +61 2 4979 2600
F +61 2 4979 2666
www.jacobs.com

1.1 Introduction

The Hunter Power Project (the Project) was approved as SSI-12590060 by the then Minister for Planning and Public Spaces on 17 December 2021. The approved Project involves the development of a gas-fired power station comprising two open cycle gas turbine (OCGT) generators with a nominal capacity of up to 750 megawatts (MW), an electrical switchyard and associated supporting infrastructure. The gas turbines would primarily be fired on natural gas with the use of diesel fuel as a backup. The Project will operate as a "peak load" generation facility supplying electricity at short notice when there is a requirement in the National Electricity Market (NEM).

Since the Project's approval, a main equipment supplier has been engaged by Snowy Hydro and the detailed design has progressed. The main equipment supplier and their specialist stack designer and manufacturer have determined that 60 m high turbine exhaust stacks are required to comply with the project noise criteria specified in the Infrastructure Approval conditions and Environment Protection Licence 21627.

The purpose of this Memorandum is to assess the plume rise impact associated with the proposed increase in the height of the exhaust stacks from approximately 36 m (as described and assessed in the *Hunter Power Project Environmental Impact Sta*tement (Jacobs 2021) (the Project EIS), to 60 m above ground level. Note that Infrastructure Approval condition B19 requires an updated plume rise assessment report based on the final generator design. Therefore the plume rise modelling undertaken for this Memorandum includes both the increased stack height and updated emission characteristics associated with the proposed final design. The plume rise modelling investigation has been carried out in accordance with Civil Aviation Safety Authority (CASA) Advisory Circular titled "AC 139-05v3.0 - Plume Rise Assessments (CASA, 2019).

1.2 Assessment Methodology

1.2.1 Background

Aviation authorities have established that wind gusts with vertical velocity exceeding 4.3 metres per second (m/s) may cause damage to an aircraft airframe or otherwise upset an aircraft flying at low levels. The CASA has subsequently required that proponents of a facility where the vertical velocity of exhaust plumes exceeds the critical plume velocity (CPV) of 4.3 m/s or 10.6 m/s at an aerodrome Obstacle Limitation Surface (OLS), or at 110 metres above ground level anywhere else, must undertake plume rise modelling to assess the potential hazard to aircraft operations. Requirements of the plume rise modelling were original outlined in CASA's Advisory Circular (AC 139-5(0)) titled "Guidelines for conducting plume rise assessments" (CASA, 2004).

The CASA then updated their guidelines in 2012 to reflect an interim assessment phase whereby the proponent submits a "Form 1247" for CASA review prior to completion of detailed plume rise modelling, see CASA's Advisory Circular (AC 139-5(1)) titled "Plume Rise Assessment" (CASA, 2012). In 2019 the CASA again revised their plume rise assessment guidelines and now apply a critical plume velocity of 6.1 m/s instead of 4.3 m/s which formed part of their original guidance with respect to plume rise impacts (CASA 2019).

1.2.2 Requirements

Plume rise assessments are typically based around the use of the CSIRO's prognostic model known as TAPM (The Air Pollution Model). TAPM is a prognostic model which has the ability to generate meteorological data for any location in the world based on synoptic information determined from global simulation models such as the Global Forecast System (GFS). TAPM is further discussed in the model's user manual (Hurley, 2008).

The requirements of CASA, when conducting plume rise modelling and assessment, can be summarised as follows:

- Modelling using TAPM version 2.0 or higher;
- At least five years of continuous meteorological data modelled;
- Horizontal displacement of the plume centreline evaluated as a function of height;
- Plume spread about the centreline evaluated as a function of height;
- Consideration of "average" and "peak" vertical plume velocities for each height;
- Wind speed evaluated as a function of height; and
- Probability of vertical velocity exceeding the CPV of 6.1 or 10.6 m/s.

The approach to the assessment was to follow the CASA requirements.

1.3 Plume Rise Modelling

TAPM (version 4.0.5) modelling was undertaken in accordance with the CASA requirements. The simulation period was 2015 to 2019 inclusive. **Table 1** provides a summary of TAPM inputs and settings for this assessment used in the Plume Rise Model (Appendix G of the Project EIS, Jacobs, 2021) for the approved Project, as well as those used in the proposed final design.

Table 1. Summary of TAPM modelling parameters

Parameter	EIS	Proposed final design
TAPM version	4.0.5	4.0.5
Number of grids (spacing)	3 (30 km, 10 km, 3 km)	3 (30 km, 10 km, 3 km)
Number of grid points	25 x 25 x 25	25 x 25 x 25
Simulation period	Jan 2015 to Dec 2019 inclusive	Jan 2015 to Dec 2019 inclusive
Terrain information	AUSLIG 9 second DEM data	AUSLIG 9 second DEM data
Centre of analysis	32°47'S, 151°29'E	32°47'S, 151°29'E
Local data assimilation	None	None
Mode	Meteorology and pollution mode	Meteorology and pollution mode

The stack emission characteristics used in the modelling during the EIS and for the proposed final design are shown in **Table 2**. Note that in the EIS it was determined that operating on gas resulted in higher plume heights than operating on diesel and therefore in this memorandum the proposed final design is only compared against the EIS operating on gas.

Table 2. Stack emission characteristics

Parameter	EIS (operating on gas)		Proposed final design (operating on gas)		Proposed final design (operating on diesel)	
Stack ID	OCGT1	OCGT2	OCGT1	OCGT2	OCGT1	OCGT2
Easting (m)	357520	357510	357519	357509	357519	357509
Northing (m)	6371470	6371401	6371474	6371405	6371474	6371405
Height (m)	36	36	60	60	60	60

Parameter	EIS (operating on gas)		Proposed final design (operating on gas)		Proposed final design (operating on diesel)	
Base elevation (m)	14	14	14	14	14	14
Stack tip diameter (m)	9.8	9.8	7.5	7.5	7.5	7.5
Temperature (C)	635	635	650	650	525	525
Velocity (m/s)	25	25	40	40	39	39

For emissions from multiple stacks (i.e. 2 x gas turbines) there is the possibility that merged, overlapping hot plumes may interact with one another, resulting in a single, higher buoyancy plume. This process is referred to as buoyancy enhancement.

The buoyancy enhancement factor (N_E) is defined (Hibberd *et al*, 2005) as follows:

Equation 1

$$N_E = \left[\frac{n+S}{1+S}\right]$$

Where *n* is the number of stacks and *S* is a dimensionless separation factor, defined as:

Equation 2

$$S = 6 \times \left[\frac{(n-1).\Delta s}{n^{\frac{1}{3}}.\Delta z}\right]^{\frac{3}{2}}$$

Where Δs is the stack separation and Δz is the rise of an individual plume. It should be noted that this approach is relevant to stack emissions of similar physical and emission characteristics, such as a group of gas turbine stacks separated by equal distances.

To determine relevant buoyancy enhancement factors, TAPM was run twice in pollution mode. The first run was used to predict the final rise of an individual plume. The second run included groups of "like" stack emissions, with the calculated buoyancy enhancement, and was used for the final analysis. The "like" stack emissions in this instance were the two gas turbine sources.

Statistics on the final rise of individual plumes, after modelling all stack emissions with no buoyancy enhancement, are shown below in **Table 3**. Buoyancy enhancement for the two sources has been determined.

The data from **Table 3** show that the maximum final plume rise of individual plumes will be approximately 1,551 m above ground-level (proposed final design operating on gas). The final rise is the height above ground at which the vertical velocity falls to zero. The buoyancy enhancement factor (BEF) of 1.96 was determined from the maximum final rise of individual plumes, which is a conservative approach.

Table 3. Final rise of individual plumes and buoyancy enhancement factors

Scenario	Maximum final rise of individual plumes (m)	Average final rise of individual plumes (m)	Buoyancy enhancement of stack configuration
EIS (operating on gas)	1,556	550	1.96
Proposed final design (operating on gas)	1,551	562	1.96
Proposed final design (operating on diesel)	1,530	546	1.96

While the new stack heights are higher (60 metres vs. 36 metres), plume rise is less because the volumetric flows are less (with plume rise due to momentum being less).

TAPM has a limitation in that only one value of the BEF can be used for the entire model simulation. In reality, the BEF will vary from hour to hour, due to variations in meteorology.

1.4 Model Results

TAPM generates output gradual plume rise data for every hour in the five year simulation period for each stack. Gradual plume rise data includes vertical velocity, plume height and plume dimensions from the time

of release to the time of final plume height. Statistics were generated from this data by interpolating to selected heights above ground.

An analysis of plume rise data was undertaken to determine the heights at which the plume vertical velocity exceeded the velocities of 4.3, 6.1 and 10.6 m/s. Results of this analysis for various percentile bands are shown in **Table 4**. Over the five year modelling period the predicted maximum heights at which the plume vertical velocity falls below 6.1 m/s for the proposed final design were 1,113 m AGL for gas operation and 1,057 m AGL for diesel operation. These results demonstrate that the maximum plume heights for the proposed final design are slightly lower than that predicted in the EIS.

Table 4. Height at which plume vertical velocity falls below 4.3, 6.1 and 10.6 m/s

Percent exceedance	Height at which plume vertical velocity falls below 4.3 m/s (m AGL)			Height at which plume vertical velocity falls below 6.1 m/s (m AGL)			Height at which plume vertical velocity falls below 10.6 m/s (m AGL)		
Scenario	EIS	Proposed final design (gas)	Proposed final design (diesel)	EIS	Proposed final design (gas)	Proposed final design (diesel)	EIS	Proposed final design (gas)	Proposed final design (diesel)
0%	1509	1480	1418	1144	1113	1057	291	302	276
0.05%	1316	1307	1260	938	917	873	255	264	240
0.1%	1258	1241	1181	853	841	778	239	251	228
0.2%	1162	1147	1098	766	755	702	225	229	214
0.3%	1096	1086	1040	718	706	656	214	226	203
0.5%	1024	1013	954	656	647	601	201	210	191
1%	888	872	822	557	555	514	177	189	176
2%	743	736	691	456	456	425	155	167	153
3%	650	647	604	402	405	376	140	152	140
4%	587	585	544	361	364	339	132	141	137
5%	540	539	502	332	338	313	124	138	127
6%	502	502	469	312	316	294	115	127	125
7%	474	474	441	294	300	279	112	126	115
8%	449	450	419	280	286	267	110	117	114
9%	428	430	401	267	273	254	101	114	114
10%	410	412	383	256	262	245	99	114	113
20%	298	302	282	190	198	186	85	101	90
30%	245	251	235	159	168	159	74	89	89
40%	212	219	206	141	149	141	62	88	88
50%	191	198	187	126	137	130	61	78	78
60%	175	183	173	115	128	121	61	77	77
70%	161	169	160	106	120	113	60	77	77
80%	147	158	149	99	112	106	50	77	76
90%	133	144	138	87	104	98	49	76	76
100%	82	99	98	53	80	80	47	74	74

Table 5 shows the frequency of time that the plume vertical velocity was predicted to fall below 4.3, 6.1 and 10.6 m/s for a range of heights above local ground-level. Again, these results demonstrate that the plume heights for the proposed final design are not significantly higher than that predicted in the EIS.

Table 5. Frequency of plume vertical velocity exceeding 4.3, 6.1 and 10.6 m/s in height bands

Height above ground level (m AGL)	Frequency of plume vertical velocity exceeding 4.3 m/s at each height (%)			Frequency of plume vertical velocity exceeding 6.1 m/s at each height (%)			Frequency of plume vertical velocity exceeding 10.6 m/s at each height (%)		
Scenario	EIS	Proposed final design (gas)	Proposed final design (diesel)	EIS	Proposed final design (gas)	Proposed final design (diesel)	EIS	Proposed final design (gas)	Proposed final design (diesel)
50	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	71.67%	100.00%	100.00%
100	99.26%	100.00%	99.92%	79.07%	93.41%	89.79%	9.16%	20.46%	18.36%
150	77.25%	85.43%	79.36%	34.10%	39.24%	34.14%	2.28%	3.43%	2.53%
200	45.06%	48.69%	42.55%	17.94%	19.59%	16.83%	0.51%	0.77%	0.40%
300	19.56%	20.28%	17.37%	6.62%	7.00%	5.69%	0.00%	0.00%	0.00%
400	10.51%	10.71%	9.03%	3.02%	3.10%	2.46%	0.00%	0.00%	0.00%
500	6.05%	6.06%	5.04%	1.48%	1.47%	1.13%	0.00%	0.00%	0.00%
600	3.74%	3.64%	3.03%	0.73%	0.70%	0.50%	0.00%	0.00%	0.00%
800	1.55%	1.48%	1.14%	0.14%	0.13%	0.10%	0.00%	0.00%	0.00%
1000	0.55%	0.52%	0.38%	0.03%	0.02%	0.01%	0.00%	0.00%	0.00%
1200	0.14%	0.13%	0.09%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1400	0.01%	0.01%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1600	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1800	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

1.5 Conclusions

Plume rise modelling was conducted using TAPM in accordance with the requirements of CASA and results were presented such that the regions of space where the vertical plume velocity exceeded 4.3, 6.1 and 10.6 m/s could be determined.

The key outcome of the modelling was that the predicted maximum heights at which the plume vertical velocity falls below 6.1 m/s were 1,113 m AGL for gas operation and 1,057 m AGL for diesel operation under the proposed final design compared to 1,144 m for the EIS. Therefore the proposed final design is predicted to be consistent (in fact having a slightly lower impact) with the predictions in the EIS.

1.6 References

Civil Aviation Safety Authority (2004) "Guidelines for Conducting plume Rise Assessment". Advisory Circular, AC 139-05(0), Civil Aviation Safety Authority, Australian Government, June 2004.

Civil Aviation Safety Authority (2012) "Plume Rise Assessment". Advisory Circular, AC 139-5(1), Civil Aviation Safety Authority, Australian Government, 2012.

Civil Aviation Safety Authority (2019) "Plume Rise Assessments". Advisory Circular, AC 139-05v3.0, Civil Aviation Safety Authority, Australian Government, January 2019.

Hibberd M, Hurley P, Edwards M, Luhar A, Galbally I and Bentley S (2005) "Meteorological and Dispersion Modelling using TAPM for Wagerup, Phase 3A: HRA Concentration Modelling – Current Emission Scenario", CSIRO Atmospheric Research Final Report.

Hurley (2008) "TAPM v.4. User Manual". CSIRO Marine and Atmospheric Research Internal Report No. 5. October 2008.

Appendix B

Revised Air Quality Assessment

Hunter Power Project: Proposed increase in stack height: air quality modelling

Date:	20 May 2022
Project name:	Hunter Power Project
Project no:	IS354501
Attention:	Ian Smith/ Isaac Strachan
Company:	Jacobs Group (Australia) Pty Ltd.:
Prepared by:	Shane Lakmaker and Mike Luger
Document no:	Final

Jacobs Group (Australia) Pty Limited
Level 4, 12 Stewart Avenue
Newcastle West, NSW 2302
PO Box 2147
Dangar, NSW 2309
Australia
T +61 2 4979 2600
F +61 2 4979 2666
www.jacobs.com

1.1 Introduction

The Hunter Power Project (the Project) was approved as SSI-12590060 by the then Minister for Planning and Public Spaces on 17 December 2021. The approved Project involves the development of a gas-fired power station comprising two open cycle gas turbine (OCGT) generators with a nominal capacity of up to 750 megawatts (MW), an electrical switchyard and associated supporting infrastructure. The gas turbines would primarily be fired on natural gas with the use of diesel fuel as a backup. The Project will operate as a "peak load" generation facility supplying electricity at short notice when there is a requirement in the National Electricity Market (NEM).

Since the Project's approval, a main equipment supplier has been engaged by Snowy Hydro and the detailed design has progressed. The main equipment supplier and their specialist stack designer and manufacturer have determined that 60 m high turbine exhaust stacks are required to comply with the project noise criteria specified in the Infrastructure Approval conditions and Environment Protection Licence 21627.

The purpose of this Memorandum is to assess the potential air quality impact associated with the proposed increase in the height of the exhaust stacks from approximately 36 m (as described and assessed in the *Hunter Power Project Environmental Impact Sta*tement (Jacobs, 2021a) (the Project EIS), to 60 m above ground level. Note that Infrastructure Approval condition B5 requires an updated air quality assessment report based on the final generator design. Therefore, the air quality modelling undertaken for this Memorandum includes both the increased stack height and updated emission characteristics associated with the proposed final design. The air quality modelling has been carried out in accordance with EPA's "Approved Methods for the Modelling and Assessment of Air Pollutants in NSW" (EPA, 2016).

1.2 Assessment Methodology

The potential air quality impacts of the Project were determined from results of computer-based dispersion modelling which followed the guidance of the:

- "Approved Methods for the Modelling and Assessment of Air Pollutants in NSW" (EPA, 2016) hereafter referred to as the "Approved Methods" and
- "Generic Guidance and Optimum Model Settings for the CALPUFF Modeling System for Inclusion into the 'Approved Methods for the Modeling and Assessments of Air Pollutants in NSW, Australia' (Barclay and Scire for NSW Office of Environment and Heritage (2011))

The methodology and model settings are fully described in the air quality impact assessment for the Environmental Impact Statement (EIS) (Jacobs, 2021b). Emissions characteristics have been updated to reflect the proposed final design of the Project and the differences in the modelled Project contributions have been evaluated. **Table 1** shows the stack emission characteristics used in the EIS modelling and for the proposed final design.

Table 1. Stack emission characteristics

Parameter	EIS (operating on gas)		Proposed final design (operating on gas)		EIS (operating on diesel)		Proposed final design (operating on diesel)	
Stack ID	OCGT1	OCGT2	OCGT1	OCGT2	OCGT1	OCGT2	OCGT1	OCGT2
Easting (m)	357520	357510	357519	357509	357520	357510	357519	357509
Northing (m)	6371471	6371402	6371474	6371405	6371471	6371402	6371474	6371405
Base elevation (m)	13	13	14.4	14.8	13	13	14.4	14.8
Height (m)	36	36	60	60	36	36	60	60
Stack tip diameter (m)	9.80	9.80	7.50	7.50	9.8	9.8	7.50	7.50
Temperature (C)	635	635	650	650	524	524	525	525
Velocity (m/s)	25.0	25.0	40.8	40.8	22.1	22.1	39.3	39.3
In-stack concentrations, based on dry flue gas at 15 vol% O_2 (mg/Nm^3 except where noted)								
NO_x	51.0	51.0	51.3	51.3	86.0	86.0	86.2	86.2
SO_2	1.7 ppmvd	1.7 ppmvd	1.65 ppmvd	1.65 ppmvd	0.25 ppmvd	0.25 ppmvd	0.24 ppmvd	0.24 ppmvd
CO	12.5	12.5	7.0	7.0	63.0	63.0	63.0	63.0
PM_{10}	5.0	5.0	5.0	5.0	10.0	10.0	10.0	10.0
Mass emission rates (g/s)								
NO_x	34	34	35.3	35.3	49.4	49.4	58.6	58.6
SO_2	2.61	2.61	3.2	3.2	0.36	0.36	0.5	0.5
CO	8.3	8.3	4.8	4.8	35.8	35.8	42.8	42.8
PM_{10}	3.3	3.3	3.4	3.4	5.7	5.7	6.8	6.8

1.3 Model Results

Table 2 shows the modelled maximum ground-level concentrations of key air quality indicators due to the estimated emissions from the Project. The results clearly show that the potential contributions of the Project will be lower than the ground-level concentrations presented in the EIS. This is largely due to increased dispersion as a result of the increased stack heights, higher exhaust temperatures and higher exit velocities.

Table 2. Modelled maximum ground level concentrations due to the Project

Air quality indicator and averaging time	EIS (operating on gas)	Proposed final design (operating on gas)	EIS (operating on diesel)	Proposed final design (operating on diesel)
Maximum 1-hour average CO (µg/m^3)	60.6	15.8	315.2	138.6
Maximum 8-hour average CO (µg/m^3)	7.8	2.0	42.0	17.6
Maximum 1-hour average NO_2 (µg/m^3)	25.7	11.6	42.9	18.9
Annual average NO_2 (µg/m^3)	0.21	0.18	0.40	0.34
Maximum 1-hour average SO_2 (µg/m^3)	19.8	10.6	3.2	1.5
Maximum 24-hour average SO_2 (µg/m^3)	1.1	0.5	0.1	0.1
Annual average SO_2 (µg/m^3)	0.02	0.02	<0.01	<0.01
Maximum 24-hour average PM_{10} (µg/m^3)	1.5	0.5	2.3	1.1
Annual average PM_{10} (µg/m^3)	0.02	0.02	0.05	0.04

1.4 Conclusions

The EIS concluded that the Project is unlikely to cause adverse air quality impacts based on modelling that showed compliance with the EPA's ambient air quality impact assessment criteria. The air quality modelling has now been updated to reflect the proposed final design of the Hunter Power Project. Results from the updated modelling showed that the potential contributions of the Project to ground-level concentrations of key air quality indicators will be lower than those presented in the EIS. This is largely due to increased dispersion as a result of the increased stack heights, higher exhaust temperatures and higher exit velocities. It follows that the conclusions of the EIS are still valid and in fact the proposed final design will likely lead to a lower potential for adverse air quality impacts than previously predicted.

1.5 References

EPA (2016) “Approved Methods for the Modelling and Assessment of Air Pollutants in NSW”. NSW Environment Protection Authority.

Jacobs (2021a) “Hunter Power Project – Environmental Impact Statement”, Rev 0, 22 April 2021. Prepared for Snowy Hydro.

Jacobs (2021b) “Hunter Power Project – Air Quality Impact Assessment” Revision 1, 22 July 2021. Prepared for Snowy Hydro.

Appendix C

Revised Landscape Character and Visual Impact Assessment

Hunter Power Station: Proposed increase in stack height : Landscape character and visual impact assessment

Date:	20 May 2022
Project name:	Hunter Power Project
Project no:	IS354501
Attention:	Ian Smith/ Isaac Strachan
Company:	Jacobs Group (Australia) Pty Ltd.
Prepared by:	Hayden Burge, Brigitte Walsh and Mike Luger
Document no:	Final

Jacobs Group (Australia) Pty Limited
Level 4, 12 Stewart Avenue
Newcastle West, NSW 2302
PO Box 2147
Dangar, NSW 2309
Australia
T +61 2 4979 2600
F +61 2 4979 2666
www.jacobs.com

1.1 Introduction

The Hunter Power Project (the Project) was approved as SSI-12590060 by the then Minister for Planning and Public Spaces on 17 December 2021. The approved Project involves the development of a gas-fired power station comprising two open cycle gas turbine (OCGT) generators with a nominal capacity of up to 750 megawatts (MW), an electrical switchyard and associated supporting infrastructure. The gas turbines would primarily be fired on natural gas with the use of diesel fuel as a backup. The Project will operate as a "peak load" generation facility supplying electricity at short notice when there is a requirement in the National Electricity Market (NEM).

Since the Project's approval, a main equipment supplier has been engaged by Snowy Hydro and the detailed design has progressed. The main equipment supplier and their specialist stack designer and manufacturer have determined that 60 m high turbine exhaust stacks are required to comply with the project noise criteria specified in the Infrastructure Approval conditions and Environment Protection Licence 21627.

The purpose of this Memorandum is to assess the landscape character and visual impact associated with the proposed increase in the height of the exhaust stacks from approximately 36 m (noting that stacks of 40m were assessed in the visual assessment supporting the *Hunter Power Project Environmental Impact Statement* (Jacobs, 2021a) (the Project EIS), to 60 m above ground level.

1.2 Background

A landscape character and visual impact assessment (LCVIA) was undertaken for the Project EIS (Jacobs, 2021b) to assess the potential visual impacts of the Project. The LCVIA described the existing and proposed visual environment, and assessed the significance of potential operational visual impacts from sensitive receivers. Mitigation measures were limited to lower-level infrastructure and treatments to building facades. The levels of assessed impacts did not appear to warrant mitigation measures.

The assessment determined the overall visual impact of the Project to be low-negligible. This was due partly to the Project being consistent and compatible with the land use provisions for the area in which the Project was proposed, which is either existing or planned industrial use, and partly to views from the public and private realm either being screened or filtered by mature vegetation and localised topography, or views are from such a distance that the Project would be a small element in the background of views.

Contextually and as described in the EIS, the former Kurri Kurri aluminium smelter is the site upon which the Project is located. When the smelter was in operation there was one stack of 140 m in height, two stacks at 70 m, as well as a 55 m high water tower.

2. Proposed Changes

2.1 Approved development

The approved development allows for the construction of the following.

- Industrial frame gas turbines in Open Cycle configuration as described above, with turbine exhaust stack heights of approximately 36 m;
- 132 kV electrical switchyard;
- Water storage tanks and other water management infrastructure;
- Fire water storage tanks and firefighting equipment such as hydrants and pumps;
- Maintenance laydown areas;
- Diesel fuel storage tank(s) and truck unloading facilities;
- Site access roads and car parking; and
- Office/administration, amenities, workshops/storage areas.

Indicative elevations that show the layout, appearance and heights of the Project's infrastructure are shown below in Figure 2-1.

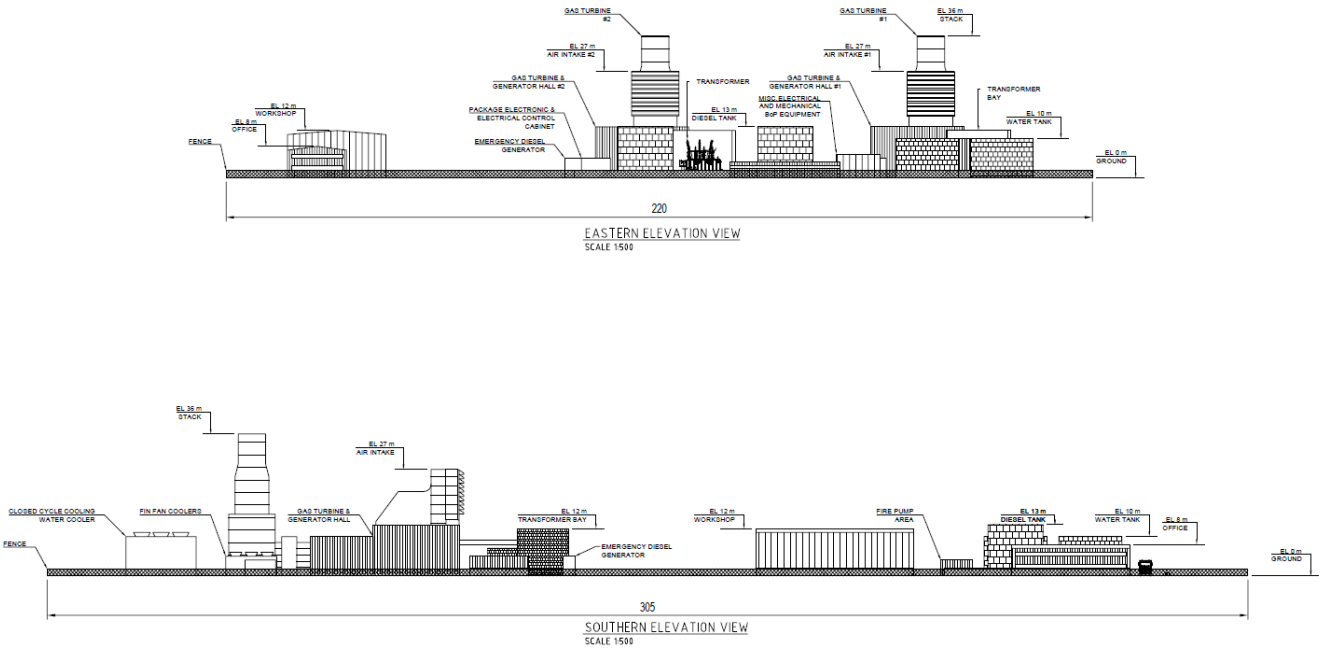


Figure 2-1: Cross section of Approved Project

2.2 Description of the proposed changes

The Project would remain entirely within the footprint of the approved Project, which includes the former location of the electrical switchyard that serviced the Hydro Aluminium Kurri Kurri aluminium smelter. The overall layout and form of the Project would remain largely similar as that which was assessed in the Project EIS.

Based on the above, the only change in views relevant to the assessment of visual impacts is the proposed increase in height of the exhaust stacks from 40 m to 60 m above natural ground.

The following section will review the changes to the extent of the viewshed and zones of visual influence, before re-examining land-uses and sensitive receptors in proximity to the Project.

3. Viewshed

The LCVIA defined the theoretical extent of the study area as the distance at which the stack would occupy 0.5° in the vertical field of view when visible in full, and not screened by topography, vegetation, or buildings. That is, the stacks would occupy less than 1° in the vertical viewing plane.

3.1 Zones of visual influence

The LCVIA also relied upon Zones of Visual Influence (ZVI) to assist in the consideration of visual prominence of vertical structures over varying distances. The calculations used to determine the viewshed or study area were used to determine ZVI. ZVI are one criteria that contributes to the overall assessment of views and visual impact.

Table 1 compares the theoretical extent of the Viewshed or study area and Zones of Visual Influence between the assessed exhaust stack heights of 40 m and the proposed increase to 60 m.

Table 1: Zones of visual influence of the approved Project and the proposed change

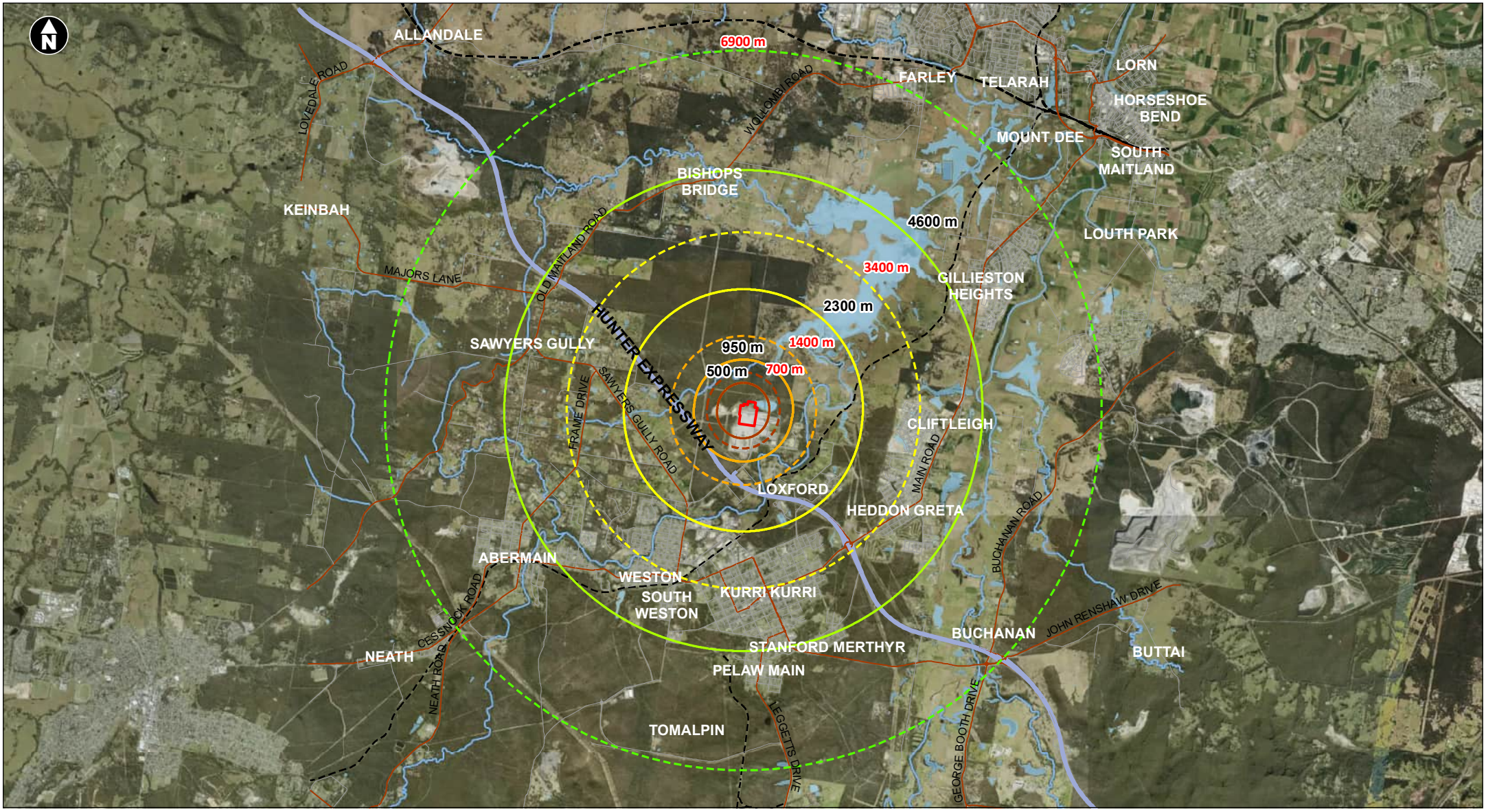
Vertical angle of view	Zones of Visual Influence	*Approved Project* *Distance from the gas turbine exhaust stack (approx. height 40 m)*	Proposed Change Distance from the gas turbine exhaust stack (approx. height 60 m)
<0.5	Visually insignificant – Extent of the Project viewshed A very small element in the viewshed, which is difficult to discern and will be invisible in some lighting or weather circumstances.	>4.6 km	>6.9 km
0.5-1.0	Noticeable, but will not be prominent in the landscape The degree of visual intrusion will depend on the landscape sensitivity and the sensitivity of the viewer; however, the Project will not dominate the landscape.	2.3 km - 4.6 km	3.4 km – 6.9 km
1.0-2.5	Noticeable and can be prominent in the landscape The degree of visual intrusion will depend on the landscape sensitivity and the sensitivity of the viewer.	950 m - 2.3 km	1.4 km – 3.4 km
2.5-5.0	Highly visible and will usually be prominent in the landscape The degree of visual intrusion will depend on the Project's visibility in views from the landscape and factors such as foreground screening.	500 m – 950 m	700 m – 1.4 km
>5.0	Will always be visually prominent in the landscape Dominates the landscape in which it is sited.	<500 m	<700 m

The theoretical extent of the study, or distance at which the exhaust stacks would occupy 0.5° in the vertical field of view will extend from 4.6 km for the approved Project to 6.9 km for the proposed increased stack height. That is, if the stacks were visible in full, and not screened by topography, vegetation, or buildings, they would be less than 1° in the vertical viewing plane.

The area, or distance at which the exhaust stacks have the potential to be a visually prominent feature in views, would only increase from 500 m to 700 m. All land within this radius is situated within the existing industrial estate or is designated as future industrial estate.

Figure 3-1 shows the extent of the viewshed or visual study area in green, with the zones of visual influence in yellow, orange and red for the approved Project (in solid lines) and proposed change (in dashed lines).

The following section will re-examine the study area and nearby land-uses.



Project site

ZVI buffers (m) - LCVIA assessment
- 500
- 950
- 2300
- 4600 (Approved project viewshed)

ZVI buffers (m) - Proposed change assessment
- 700
- 1400
- 3400
- 6900 (Proposed change viewshed)

- Motorway
- Main roads
- Roads
- Railway
- Waterbodies

0 2 4 km

1:100,000 at A4
Coordinate System: GDA2020 MGA Zone 56

Data sources:
Jacobs 2020
Metromap (Aerometrex) 2020
NSW Spatial Services

Figure 3-1 Proposal Viewshed and Zones of Visual Influence

Date: 11/05/2022 Path: J:\IE\Projects\04_Eastern\IS354500\22_Spatial\GIS\Directory\Templates\Figures\KurriKurriEIS\Specialists\VisualAssessment\HunterPowerModificationAssessment\IS354501_KKOCGT_MA_VA_F001_ZVI_R1.mxd
Created by : AA | QA by : KI

4. Existing land-use and sensitive receptors

The approved Project is located in Loxford in the Hunter Valley region and the Cessnock City Council local government area (LGA).

Kurri Kurri is approximately 3.0 km to the southwest and is the closest township to the Project. The following section will review existing land uses and sensitive receptors relevant to views and visual impact of the proposed change. These have not changed since the LCVIA, but are repeated here for context.

Approved development site

- The approved Project is within a brownfield site, extensively disturbed by past industrial development.
- Existing land use zoning is Rural Landscape zone which allows for sustainable primary industry production, extensive agriculture, and the preservation of the agricultural, mineral and extractive production potential of the land.
- Although the underlying zoning is Rural Landscape, the former and designated future land use is for industrial facilities.
- The Proposed change would remain entirely within the approved development footprint which includes part of the former Kurri Kurri aluminium smelter.

Nearby residential areas

- The closest residential dwellings to the Project are located along Dawes Avenue, Loxford. These dwellings are in areas zoned Rural Landscape, approximately 1.25 km to the south and south-east of the approved Project.
- The closest residential zoned land is the suburban areas of Kurri Kurri approximately 3 km south and south-west of the approved development.

Other land use

- The areas immediately south of the Project site include the former Kurri Kurri aluminium smelter and the M15 Hunter Expressway.

Vegetation, topography, and hydrology

- Existing vegetation in the areas to the north, east, and west comprise native vegetation. This vegetation will partially screen or filter views in the direction of the approved Project and the proposed change.
- Land further east and north of the project site comprises low-lying cleared farming land. These areas are not considered to be sensitive to visual change.
- Waterways include swamp Creek, Black Waterholes Creek and the Swamp Creek wetlands to the east and north, and Black Waterholes Creek to the northeast.
- Nearby waterbodies to the north-east of the approved development include constructed wetlands established as part of the former Kurri Kurri aluminium smelter site.

- The increased viewshed or study area associated with the proposed change would include the nearby townships of Gillieston Heights and Abermain. These locations are approximately 5 km from the Project. At this distance, if visible, the exhaust stacks would not be a visually prominent feature in views.

Other areas and land uses within the increased viewshed comprise heavily vegetated forested areas where there would be no visibility of the Project or the proposed change due to screening provided by existing vegetation.

Where there are views in the direction of the Project, these views would include other constructed elements or visible features that are closer to the viewing location and more visually prominent. If the proposed change to

the project were visible, it would be at such a distance that the stacks would form a background element in the views.

The following section will review the change in theoretical Project visibility for the proposed change, in the areas surrounding the Project.

5. Seen area analysis

A Seen Area Analysis (SAA) identifies locations where the Project may be visible from the surrounding areas. However, visibility of the Project depends on a number of factors not considered by SAA. Additional considerations include potential intervening vegetation, existing structures or minor topographic changes that may filter or screen views of the Project.

The SAA for the Project has been revised for the proposed change to 60 m tall exhaust stacks. Areas modelled for potential visibility have been offset an additional 1.8 m to represent the height of an average person standing in the landscape.

The SAA demonstrates that there would be no additional sensitive or significant locations with a view to the Project where theoretical visibility is predicted. The areas where the proposed change would be potentially visible are limited to areas where the approved Project was already theoretically visible. This is due partly to the Project being in a low-lying area, and generally flat terrain of the areas surrounding the Project. The SAA and broad areas of theoretical visibility are shown for the approved Project and proposed change in Figure 5-1 below.

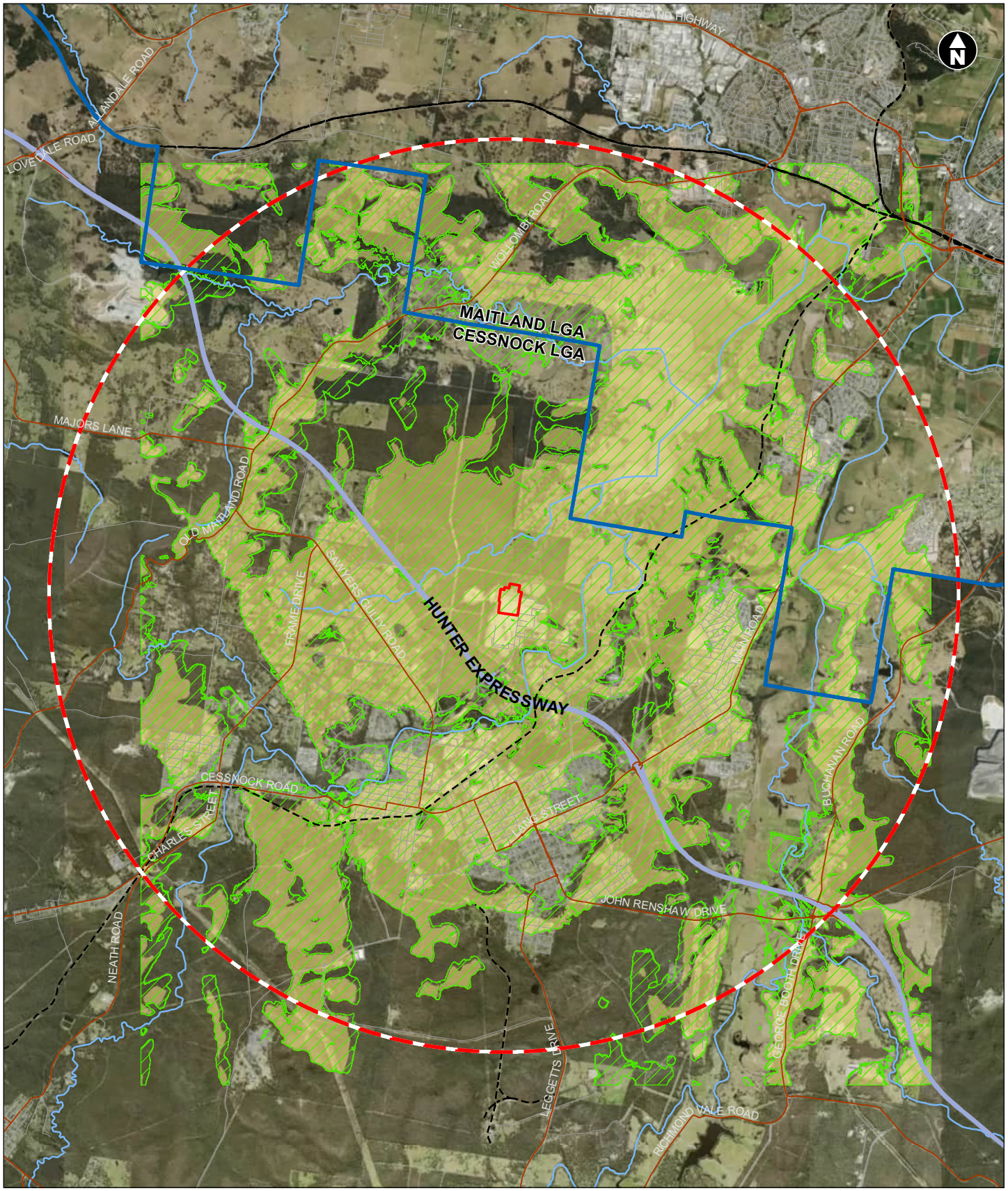


Figure 5-1 Seen Area Analysis

The areas which will retain partial visibility include Kurri Kurri township, areas within Sawyers Gully, Gillieston Heights, Heddon Greta, and other areas within the rural landscape which were considered in the LCVIA prepared for the Project EIS.

Gillieston Heights to the north east is in an area where there is little to no predicted visibility of the proposed increased stack height. Abermain to the south west is towards the outer extent of the study area. From this location, the project would be in the background of views that include built form and visual modifications in Kurri Kurri.

The following section will review the proposed increase in stack heights through selected views where theoretical visibility of the Project was predicted.

6. Viewpoint assessment

Section 9 of the LCVIA (Jacobs, 2021b) outlined the potential visual impact on the approved Project from a range of key locations within the public realm. Table 2 below summarises the visual impact of the approved Project as identified in the LCVIA. Viewpoints considered in this Memo are highlighted in green.

Table 2: Viewpoint assessment of the approved Project

Viewpoint	Visual impact of the approved Project (Stack height of 40 m)
Major Road Viewpoints	
VP M1 – Cessnock Road	Nil-Negligible
Local Road Viewpoints	
VP L1 – Hart Road	Negligible-Low
VP L2 – McLeod Road	Low-Moderate
VP L3 – Metcalfe Lane / Sawyers Gully Road	Low-Moderate
VP L4 – Bowditch Avenue	Low
VP L5 – Ravensfield Lane	Negligible
VP L6 – Sawyers Gully Road	Negligible
VP L7 – Cartwright Street	Low
Township Viewpoints	
VP T1 – Mitchell Avenue/Lang Street	Low
VP T2 – Lang Street/Heddon Street	Low
VP T3 – Mitchell Avenue/Northcote Street	Low
VP T4 – Centre Oval	Nil
VP T5 – Bill Squires Park	Nil-Negligible

As the SAA identified that the theoretical visibility of previously identified areas has merely expanded, the viewpoints assessed in the approved LCVIA will remain an acceptable representation of views from publicly accessible viewpoints within the Project viewshed. This means that there would be no additional sensitive or significant viewing locations to the Project where theoretical visibility is predicted. As such, no new viewpoint locations have been identified.

This section will review the change in views and visual impact from four viewpoints assessed in the LCVIA. The first viewpoint (L1) is near to the approved Project within the existing industrial estate. Although this location is not sensitive, this view was supported by a photomontage in the LCVIA. A comparative photomontage has been prepared from this location to consider the qualitative change in views from other locations.

Two additional views (L6 and T3) have been included from locations in proximity to the Project that are sensitive to visual change. As the viewshed of the Project has increased, the nearby township of Gillieston Heights has more theoretical visibility than before. Viewpoint L7 is indicative of views from the edge of the residential development in Gillieston Heights.

Views from these locations are examined below.

6.1 Viewpoint L1 – Hart Road

This viewpoint is located near the end of Hart Road, Loxford, near to the Project site. A photomontage has been prepared from this viewpoint.

At this viewpoint, the recently demolished Kurri Kurri aluminium smelter site exists directly adjacent to the west. The aluminium smelter site to the west of Hart Road has been cleared of most infrastructure, while to the east of Hart Road the Hydro Aluminium offices, some large sheds, many smaller structures, stockpiles of materials and water tank remain.

The landscape character at this location is predominately industrial and utility, due to the expansive brownfield aluminium smelter site and the presence of high voltage transmission lines which surround the western and northern perimeter and join a large transmission corridor to the south.

The Project site is located approximately 500 m north of this viewpoint. Figure 6-1 below shows the view looking north toward the Project site.

Figure 6-1: VP L1 – Hart Road looking north toward the Project site

Hart Road to the south is largely surrounded by forested areas. The Kurri Kurri aluminium smelter site is largely filtered from view until entering the clearing near the site. This land is part of the area designated by Cessnock City Council as a proposed future industrial precinct.

Hart Road joins Dickson Road, which is the connecting road for those visiting the Kurri Kurri Speedway, which is located approximately 650 m to the east. Otherwise, there are currently no other businesses or points of interest that require public access to this area, until it is eventually redeveloped.

A photomontage of the approved Project is shown in Figure 6-2 below.

Figure 6-2: Viewpoint L1 - Photomontage showing the 40 m exhaust stacks of the approved Project

For the purposes of comparative analysis, this photomontage has been revised to show the change in views between the approved Project and the proposed change of stack heights to 60 m. A photomontage showing the modified exhaust stack height is shown in Figure 6-3 below.

Figure 6-3: Viewpoint L1 - Photomontage showing the 60 m exhaust stacks of the proposed change

The initial photomontage prepared from this viewpoint shows that the approved Project's exhaust stacks and air intake units are visible over the security fencing in this view. The comparative photomontage showing the 60 m stack height shows that the proposed change would be a noticeable. The visual change however would not alter the level of assessed impact.

At this viewpoint, the Project would be clearly visible. Recognising that this area is scheduled to become developed with warehouses and other industries, built form may screen some views to the Project. At this distance, the proposed 60 m exhaust stacks would form a prominent element in an industrial landscape, which would not be out of character with the former or future use of this landscape.

The approved Project includes landscape screening along the eastern perimeter, which would soften views toward the Project from the extension of Hart Road.

There are no sensitive receptors, such as dwellings or public open space in this area.

Recognising that the former and future landscape character of this area is predominately industrial in nature, and the viewer numbers are relatively low, the proposed change will not bring about an unacceptable visual impact or change to the landscape character at this location despite being a prominent element in the landscape.

The visual impact at this location would be Negligible-Low.

VP L1 – Hart Road		
Distance to Project	500 m north	Highly visible and will be prominent the landscape
Landscape Unit	Landscape Unit 6	Low sensitivity
Viewer Numbers	Local Road	Low viewer numbers
OVERALL VISUAL IMPACT	**NEGLIGIBLE – LOW**	

6.2 Viewpoint L6 – Sawyers Gully Road

This viewpoint is located along Sawyers Gully Road where the road exits a stretch of enclosed vegetation. The Project Site is located approximately 2.5 km to the east. Figure 6-4 shows the view looking east toward the Project Site.

Figure 6-4: VP L6 – Sawyers Gully Road looking east toward the Project Site

This landscape is characterised as rural living (forested flats and gullies). Residential dwellings and small farm properties exist in a relatively patchwork forested setting.

Vegetation exists in large patches and corridors along property boundaries and roadsides.

Journeys along this road are largely within a vegetated corridor, which restricts views to the direction of travel.

At this location, the Project would sit behind roadside vegetation in this view and would not be visible. Road users may catch glimpses of the Project's exhaust stacks as they travel toward Kurri Kurri, but these views are scarce due to vegetation.

The assessed level of visual impact would not change as a result of the proposed increase in stack height. This is because the distance from the Project stays the same, and the nearby screening vegetation would remain.

A photomontage of the proposed change has not been prepared for the view from this location, as the exhaust stacks at a height of 60 m above ground level would not be clearly visible in this view.

The visual impact at this location is Negligible.

VP L6 – Sawyers Gully Road		
Distance to Project	2.5 km east	Noticeable, and can be prominent in the landscape
Landscape Unit	Landscape Unit 2a	Moderate sensitivity
Viewer Numbers	Local Road	Low viewer numbers
OVERALL VISUAL IMPACT	**NEGLIGIBLE**	

6.3 Viewpoint L7 – Cartwright Street

This viewpoint is located along Cartwright Street, at the edge of residential development in Gillieston Heights.

The nearest Project boundary is approximately 4.8 km to the southwest. At the time the LCVIA was prepared, this viewpoint was located just outside the edge of the Project viewshed. However, due to the proposed increase in stack height, the viewshed has expanded to encompass viewpoint L7.

Figure 6-5 below shows the view looking southwest toward the Project site.

Figure 6-5: VP L7 – Cartwright Street looking southwest toward the Project site

At this location, the landscape character is a mix of the edge of suburban residential development to the east (Gillieston Heights), which overlooks some farmland and in some locations the floodplain valley. The presence of residential dwellings heightens the sensitivity at this location.

The topography at this location is relatively raised, as the street reaches a crest. This crest allows some views to distant landscape features, filtered through vegetation.

Vegetation at this location is found within private gardens, the paddocks to the south and west contain emerging shrubs. The vegetation in the foreground largely filters or screens views toward the Project site, but glimpses toward the Project site may be permitted at some locations.

Due to the elevated nature of some residential dwellings along this road, they may allow views above the surrounding foreground vegetation toward the Project site. Views to the Project will further be filtered or screened by the forested areas that surround the Project site. The proposed 60 m exhaust stacks may be visible in these views, above the surrounding vegetation. Although potentially partially visible, the Project will be at such a distance that it will not be a prominent feature in the landscape.

A photomontage of the proposed change has not been prepared for the view from this location, as the exhaust stacks at a height of 60 m above ground level would not be clearly visible in this view.

The visual impact at this location will be Low.

VP L7 – Cartwright Street		
Distance to Project	4.8 km southwest	Noticeable, but will not be prominent in the landscape
Landscape Unit	Landscape Unit 1	Moderate sensitivity
Viewer Numbers	Local Road	Low viewer numbers
OVERALL VISUAL IMPACT	**LOW**	

6.4 Viewpoint T3 – Mitchell Avenue / Northcote Street

This viewpoint is located at the roundabout at Mitchell Avenue and Northcote Street. At this location, the B68 Highway diverts left from Mitchell Avenue to Northcote Street towards Cessnock.

This viewpoint is located approximately 2.5 km south of the nearest Project site boundary.

Figure 6-6 below shows the view looking north toward the Project site.

Figure 6-6: Mitchell Avenue / Northcote Street looking north toward the Project site

This viewpoint is located along a main thoroughfare through town and would expect moderate-high viewer numbers.

Views to the north from this location are orientated toward the Project site. These views include the industrial area of Kurri Kurri, which sits in front of a background of vegetation that extends toward the Hunter Expressway and the Project site. Foreground views include several elevated built features, including two types of transmission poles.

To the south is the edge of residential areas in Kurri Kurri. The presence of residential dwellings heightens the sensitivity of the area, which is balanced by the views toward industrial and utility elements.

The landscape character of this viewpoint is a mix of township and industrial landscape elements.

At this location, the Project site is located behind the hardware warehouse in the foreground of this view, and the vegetation behind this in the background. The proposed 60 m exhaust stacks may be partially visible above these features.

In the context of this landscape, the proposed 60 m exhaust stacks would not be out of character with the relatively built-up, industrial setting.

A photomontage of the proposed change has not been prepared for the view from this location, as the exhaust stacks at a height of 60 m above ground level would not be clearly visible in this view.

In this context, the visual impact of the proposed change would be low.

VP T3 – Mitchell Avenue / Northcote Street		
Distance to Project	2.5 km north	Noticeable, and can be prominent in the landscape
Landscape Unit	Landscape Unit 1 / 6	Low-Moderate sensitivity
Viewer Numbers	Main road	Moderate-High viewer numbers
OVERALL VISUAL IMPACT	**LOW**	

7. Conclusion

The preceding analysis has determined that the change in views and visual impact between the approved Project comprising exhaust stacks up to 40 m in height, and the proposed increase in height to 60 m, would be low to negligible. This conclusion is based on the following:

- The Project is located within an area that is zoned for large scale industry and uses that are recognised as contributing to offsite amenity impacts including views and visual impact.
- The former Kurri Kurri aluminium smelter is the site upon which the Project is located. When the smelter was in operation there was one stack of 140 m in height, two stacks at 70 m, as well as a 55 m high water tower.
- The photomontage viewed from within the former smelter site area has shown that the proposed increase in stack height from the approved Project. The visual change however would not alter the level of assessed impact.
- The Seen Area Analysis (SAA) which maps areas of theoretical visibility based solely on topography demonstrates that there would be no additional sensitive or significant viewing locations new to the Project where theoretical visibility is predicted.
- The Zones of Visual Influence have demonstrated that the area within which the exhaust stacks have the potential to be a visually prominent feature in views, has increased from 500 m to 700 m. All land within this distance is within the area designated as existing or future industrial estate. There are no sensitive receptors located within 700 m of the Project.
- Viewpoints L6 and T3 are within the distance at which either 40 m or 60 m high exhaust stacks would be a noticeable element with the potential to dominate the landscape. The re-examination of these views undertaken in Section 4 has considered that there would be no material change in the levels of assessed impact for the approved development and the proposed change.
- The viewshed of the Project has increased from 4.6 km for the approved Project to a distance of 6.9 km for the 60 m exhaust stacks.
    - This increased viewshed includes the nearby townships of Gillieston Heights (viewpoint L7) and Abermain. These locations are however at such a distance that the exhaust stacks would not be a visually prominent feature in views.
    - Other areas within the increased viewshed mostly comprise forested areas where there would be no visibility of the site or the Project due to screening provided by existing vegetation.
    - Where there are views in the direction of the Project, these views would include other constructed elements or visible features that are closer to the viewing location and more prominent.
    - If the Project were visible, it would be at such a distance that the exhaust stacks would form a background element in the views.

The overall change in views and visual impact between the approved Project and the proposed change to 60 m high exhaust stacks would be **Low to Negligible** and consistent with the approved LCVIA. The proposed change to stack heights would not materially alter the levels of visual impact assessed for the approved Project.

References

Jacobs (2021a) Hunter Power Project Environmental Impact Statement. Prepared for Snowy Hydro Limited. 22 April 2021.

Jacobs (2021b) Hunter Power Project Landscape Character and Visual Impact Assessment. Prepared for Snowy Hydro Limited. 01 April 2021.