**Independent Expert Report**

**Gabriel da Silva**

**HVO Open Cut Coal Continuation Project (SSD-11826621 & SSD-11826681)**

## 1 Qualification and Experience

1. I, Dr. Gabriel da Silva, of The University of Melbourne, Parkville, Victoria 3010, Australia, am the author of this report.
2. I acknowledge having read Division 2 of Part 31 of the *Uniform Civil Procedure Rules 2005*, and the Expert Witness Code of Conduct, and having agreed to abide by them.
3. I am an Associate Professor in Chemical Engineering at the University of Melbourne, Australia.
4. I hold a Ph.D. and B. Eng. (Hons I) in Chemical Engineering, from the University of Newcastle, Australia.
5. I completed a postdoctoral research fellowship in Chemistry and Environmental Science at New Jersey Institute of Technology, USA.
6. My experience is detailed in my resume (Appendix A). I have published over 150 peer reviewed scientific papers and am considered an expert in atmospheric chemistry and air pollution science. I have significant training and experience in mineral processing and mining technology.
7. As an undergraduate and then graduate engineer I worked as a Research Assistant for BHP Billiton Minerals Technology, developing technology for the leaching of base metals.
8. My Ph.D. dissertation was on the formulation of ammonium nitrate based explosives for the mining industry, involving work at the laboratories of Orica Australia.
9. My postdoctoral research focused on modelling the chemistry of combustion. This included research on particulate matter and $NO_x$ formation from combustion reactions.
10. As a teaching and research academic at the University of Melbourne I have supervised 17 former or current PhD students and directed a wide range of research projects. My research program focuses on studying the chemistry of reactive gases, with an emphasis on air pollution. We approach these problems by combining theoretical models grounded in quantum and statistical mechanical theories with synchrotron-based experiments. My teaching focuses on air pollution and emissions, chemical thermodynamics, and process control, in the Masters of Chemical Engineering program.

## 2 Brief

11. I have been briefed by the Environmental Defenders Office (**EDO**) on behalf of the Lock the Gate Alliance to review documents relating to the HVO Open Cut Coal Continuation Project **(The Project)**, as set out in the Brief to Expert dated 29 April 2026 and the Amended Brief to Expert dated 22 June 2026 (Appendix B). I acknowledge having reviewed these and other relevant documents as footnoted in this report, which include in particular:
    - The Hunter Valley Operations Continuation Project Environmental Impact Statement, December 2022 (**The EIS**).
    - The Hunter Valley Operations Continuation Project Submissions Report, November 2023 (**The Submissions Report**).
    - The Hunter Valley Operations Continuation Project Amendment Report, August 2025 (**The Amendment Report**).
    - The Hunter Valley Operations Continuation Report State Significant Development Assessment Report, June 2026 (**The SSD Report**).
    - The HVO North and HVO South Recommended Conditions of Consent (**The Conditions of Consent**).
12. I have been briefed by the EDO to prepare a written expert report and give oral evidence addressing the issues set out in the brief to expert (Appendix B), specifically relating to air quality issues arising from the Project.

## 3 Summary of Opinions

13. Continuation of coal mining at HVO to 2045 would contribute to unhealthy air across the Upper Hunter region. In my opinion the most concerning air pollutant from the Project is particulate matter less than 2.5 μm in diameter (**PM2.5**), both directly emitted from mining activities and formed through secondary reactions of other pollutants in the atmosphere.
14. The Upper Hunter region has historically experienced PM2.5 pollution at levels known to be damaging to human health and in exceedance of daily and annual national air quality standards.
15. Continued mining at HVO out to 2045 will continue to add a significant cumulative burden of PM2.5 pollution to the Upper Hunter, which includes sensitive receptors in the immediate vicinity of the mine as well as residents at the township of Camberwell and at the larger population centres of Singleton and Muswellbrook.

16. Air quality measurements at Camberwell, Singleton, and Muswellbrook reveal that all three locations regularly experience unhealthy levels of PM2.5 pollution.
17. In my opinion, air quality modelling in the EIS and the Amendment Report likely underestimates PM2.5 levels as it does not appropriately account for the major component of industrial PM2.5 in the region, which is secondary particles formed from industrial emissions. The assumed PM2.5 backgrounds used in the reports, particularly the Amendment Report, are also inadequate. Because it neglects seasonal variability it also cannot capture worst-case scenarios.
18. I disagree with the NSW EPA's finding that issues arising from deficiencies in the assumed background can be resolved through Environmental Protection Licence conditions on PM10 management, because this neglects impacts of this modelling error on annual mean PM2.5 levels.
19. As a result, the EPL needs to include measures to ensure compliance with the national annual PM2.5 standard.
20. Moreover, the NSW EPA assessment of the Project did not take into consideration the legislated national environment protection goal of keeping annual mean PM2.5 levels below 7 $\mu g/m^3$, which came into effect last year (1 January 2025).
21. When PM2.5 dispersion modelling is analysed against the 7 $\mu g/m^3$ goal using the assumed PM2.5 background from the original EIS, 91 sensitive receptors are predicted to breach this national environment protection goal in at least one of three modelled future years. Of these 91 receptors, 52 are private dwellings not subject to acquisition rights.
22. The purpose of the national environment protection goals is to "guide the formulation of strategies for the management of human activities that may affect the environment." I cannot see how this legislated goal has been used in this way in this assessment.
23. The Project and the Assessment Report contain appropriate measures to mitigate short-term exposure to mine dust. They do not contain appropriate measures to mitigate long-term exposure to fine particulate matter, which is the most concerning health impact of the Project.
24. PM2.5 emissions from the project could be reduced by requiring new diesel-powered equipment to be Tier 4 compliant. This would be consistent with the NSW EPA Climate Change Action Plan 2023 – 26. However, this is not a recommended measure at present.
25. Requiring minimum emissions standards on new equipment is unlikely to reduce PM2.5 concentrations to the levels required to satisfy the national annual PM2.5 standard and goal, due to the long timeframe for the replacement of existing heavy machinery.

26. The only feasible mechanism I see to potentially achieve compliance with the annual PM2.5 standard and goal is to approximately halve annual extraction limits from the HVO Complex.

## 4 Potential Impacts to Air Quality

27. The brief to expert requests that I consider the following issue, which I respond to in this section of the report:
    - *Summarise any potential impacts to air quality predicted to arise as a consequence of the Project.*
28. Ambient air pollution is a leading cause of disease worldwide, responsible for around 3 to 4 million deaths annually.[1]
29. Within Australia, the Burden of Disease Study[2] reported that 3,236 deaths in 2018 were attributable to air pollution, making air pollution the leading environmental risk factor.
30. Poor air quality places a burden on the nation through increased healthcare costs and loss of productivity.[3,4] As an example, a 2011 study (projected forward to 2020) from the US Environmental Protection Authority found that air quality improvements from implementation of the *Clean Air Act* carried a 30 to 1 ratio of benefits to costs.[5]
31. Unhealthy air contains a mixture of chemical pollutants specific to the local environment. These pollutants themselves react and change over time, with some pollutants being removed and other new ones being formed. Despite the chemical complexity of polluted air, there are common elements: compounds that when emitted to the atmosphere are known to degrade human health.[6]

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[1] Cohen, A. J., et al., Estimates and 25-year trends of the global burden of disease attributable to ambient air pollution: An analysis of data from the Global Burden of Diseases Study 2015, *The Lancet* 2017, 389, 1907 – 1918.
[2] Australian Institute of Health and Welfare 2021. Australian Burden of Disease Study: Impact and causes of illness and death in Australia 2018. Australian Burden of Disease Study series no. 23. Cat. No. BOD 29. Canberra: AIHW.
[3] Pages 18 – 19 of: Emerson, K.M., Keywood, M. D., Australia State of the Environment 2021: Air Quality. *Independent report to the Australian Government Minister for the Environment, Commonwealth of Australia, Canberra.*
[4] Chapter 9 of: Impact Statement for the Review of the Ambient Air Quality NEPM Standards for $SO_2$, $NO_2$ and $O_3$. *Prepared for the National Environment Protection Council*, May 2019.
[5] US EPA, Benefits and costs of the clean air act 1990-2020. Environment Protection Agency, 2011.
[6] WHO (World Health Organization), WHO global air quality guidelines: particulate matter (PM2.5 and PM10, ozone, nitrogen dioxide, sulfur dioxide, and carbon monoxide. WHO Press, 2021.

32. Surface methods of coal mining (including open-pit / open-cut mining) produce many of the most common and significant air pollutants,[7,8] including particulate matter (**PM**), nitrogen oxides (**$NO_x$**), and volatile organic compounds (**VOCs**) such as methane. I summarise the formation and health impacts of these pollutants in the sub-sections below, followed by a consideration of air quality in the vicinity of the Project.

### 4.1 PM2.5

33. PM2.5 refers to particles of 2.5 μm or smaller that are suspended in air. These particles (or aerosols) include solids and liquids of diverse chemical composition.
34. PM2.5 particles are microscopic. At high enough levels they can be seen as haze or smog, but may be present in air at significant concentrations even when invisible to the naked eye.
35. Unlike coarser particles, PM2.5 can remain buoyant in the atmosphere for days or even weeks,[9] being transported over significant distances[10] or accumulating in stagnant plumes of air.[11]
36. Particulate matter including PM2.5 enters the atmosphere from both natural and anthropogenic sources. Material emitted to the atmosphere as particles is described as primary particulate matter.
37. Primary particulate matter includes solid particles generated through mechanical action, such as wind erosion or the crushing and grinding of rock. These particles are predominantly coarse, and are typically referred to as dust. Mechanically generated particles are almost exclusively larger than 1 μm and predominantly larger than 2.5 μm.
38. Primary particulate matter also includes particles formed in hot gases undergoing chemical reactions, which are subsequently emitted to the atmosphere. These particles are almost exclusively 2.5 μm or smaller. Particles of this type are formed predominantly through combustion, such as in wildfires and combustion engines.
39. Particulate matter is also produced directly within the atmosphere, from chemical reactions of gases at ambient conditions. These gases may be of natural or anthropogenic origin. This

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[7] Hendryx, M., The public health impacts of surface coal mining. *The Extractive Industries and Society* 2015, 2, 820 – 826.
[8] Gautam, S., et al., Characterization of PM2.5 generated from opencast coal mining operations: A case study of Sonepur Bazari Opencast Project of India. *Environmental Technology & Innovation* 2016, 6, 1 – 10.
[9] Pages 362 – 365 of: Finlayson-Pitts, B. J., Pitts, J. N., Chemistry of the Upper and Lower Atmosphere. Academic Press.
[10] Louie, P. K. K., Watson, J. G., Chow, J. C., Chen, A., Sin, D. W. M., Lau, A. K. H., Seasonal characteristics and regional transport of PM2.5 in Hong Kong. *Atmospheric Environment* 2005, 39, 1695 – 1710.
[11] Largeron, Y., Staquet, C., Persistent Inversion Dynamics and Wintertime $PM_{10}$ Air Pollution in Alpine Valleys. *Atmospheric Environment* 2016, 135, 92 – 108.

material is classified as secondary particulate matter. Secondary particles are almost exclusively 2.5 μm or smaller.

40. The processes responsible for the formation and removal of particles in the atmosphere have been broadly understood since the 1970's. They are summarised in Figure 1.[12]

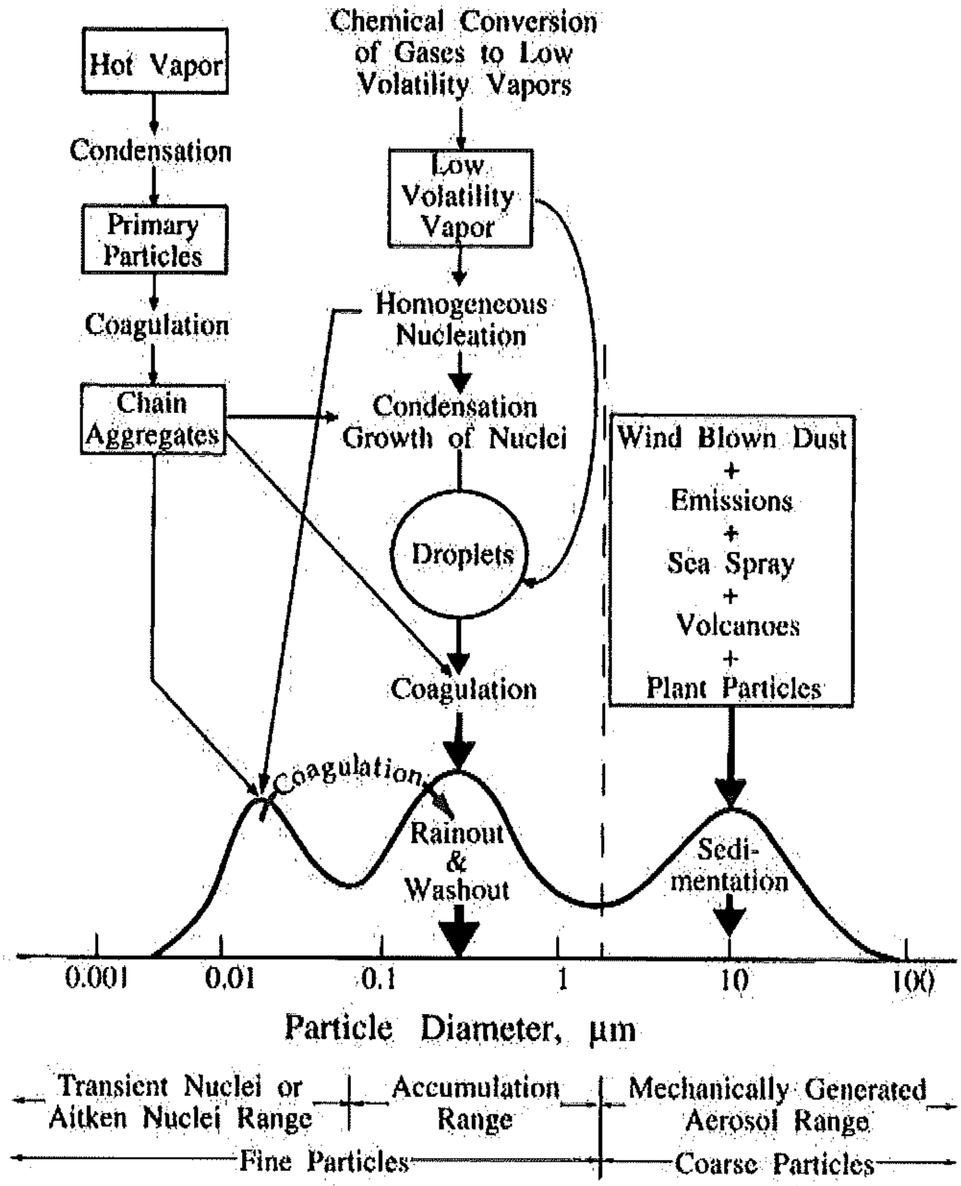


**Figure 1:** Schematic illustration of typical particulate matter distribution in the atmosphere indicating the main processes responsible for their formation and removal. From Whitby and Cantrell (1976).

41. In Figure 1, particles classified as PM2.5 are shown to the left of the vertical dashed line. These particles are almost entirely formed through chemical reactions of gases, either in combustion

[12] Whitby, K. T., Cantrell, B., Fine Particles. *Proceedings of the International Conference on Environmental Sensing and Assessment* 1976.

(primary particles) or in the atmosphere (secondary particles), after which they undergo complex further chemical transformation and growth processes.

42. Figure 1 indicates that PM2.5 particles are only removed from the atmosphere when they are collected by liquid water (rain, cloud droplets, fog, *etc.*), a process now typically referred to as wet deposition and labelled as *Rainout & Washout* in Figure 1.

43. Figure 1 also demonstrates that mechanically generated particles, shown to the right of the dashed vertical line, provide little contribution to PM2.5.

44. Secondary particle formation is complex, and only the most relevant processes are outlined here. As shown in Figure 1, effectively all particles produced in this way contribute to PM2.5.

45. In the atmosphere, $NO_x$ and $SO_2$ oxidise to nitric acid ($HNO_3$) and sulfuric acid ($H_2SO_4$). These acids can be taken up by water to form acidic aqueous aerosols. Combination of these acids with bases can lead to the generation of crystalline PM2.5 particles. One example is the reaction of nitric acid and ammonia to make ammonium nitrate.

46. VOCs can be transformed into secondary particles in the atmosphere, via oxidation to organic acids and other low-volatility compounds. Reactions with $NO_x$ can also produce organic nitrate particulate matter.

47. PM2.5 are well-understood to be harmful to human health. Because of their small size, these particles can be inhaled deep into the lungs and transfer into the bloodstream, allowing them to impact almost every bodily system. The health impacts of PM2.5 are a result of their small size, and not their specific chemical composition, although some particles may contain compounds that are harmful in their own right, such as metals or metalloids.

48. Exposure to PM2.5 is linked to a host of diseases affecting the respiratory and cardiovascular systems such as heart disease, stroke, and lung cancer. The scientific understanding of these negative health impacts of PM2.5 has advanced significantly in the last 10 to 20 years.

49. Research from the mid to late 1990's revealed strong links between exposure to particulate matter and increased mortality. These negative health outcomes were specifically linked to increased exposure to the PM2.5 size fraction. This work is reviewed in the 2002 analysis of Schwartz *et al.*[13]

50. Schwartz *et al.* constructed a concentration-response diagram showing the increased probability in deaths from annual PM2.5 exposure. This diagram is reproduced here as Figure 2.

[13] Schwartz, J., Laden, F., Zanobetti, A., The Concentration-Response Relation Between PM2.5 and Daily Deaths. *Environmental Health Perspectives* 2002, 110, 1025 – 1029.

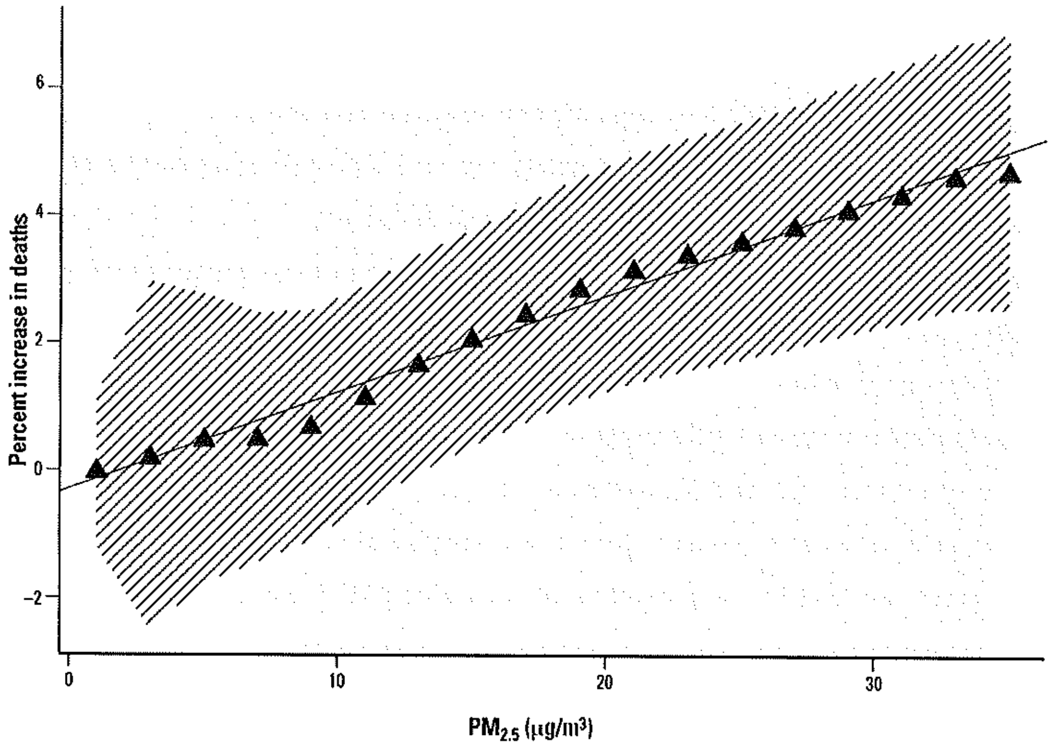

**Figure 2:** Concentration – response function for mortality from PM2.5 exposure, taken from Schwartz *et al.* (2002). The shaded area represents a 95 % confidence interval.

51. Figure 2 shows that exposure to higher atmospheric levels of PM2.5 leads to worse health outcomes for a population, following an approximately linear relationship. Importantly, this Figure also reveals that there is no lower limit, or threshold, below which PM2.5 exposure is safe.
52. Early studies on the health risks of PM2.5 were limited by an absence of data at low exposure levels, approaching that of the unpolluted background. This gap was exacerbated because studies naturally focused on polluted urban environments.
53. This is borne out by Figure 2. At an exposure level of 20 $\mu g/m^3$, for instance, the shaded area (a 95 % confidence interval) always corresponds to a health risk above zero. From exposure levels of around 10 $\mu g/m^3$ and above there was, in 2002, a high degree of certainty that increased exposure leads to increased mortality. At lower exposure levels the mortality predictions were less certain at the time.
54. Responding to these and other studies, the World Health Organization (**WHO**) recommended a yearly mean PM2.5 exposure limit of 10 $\mu g/m^3$ in 2005.[14] The yearly mean exposure is the average concentration of a pollutant recorded in a given location across a 12-month period, and recognises that PM2.5 health impacts arise from long term exposure to this pollutant.

[14] Air Quality Guidelines Global Update 2005, World Health Organization.

55. Following the WHO recommendations, international jurisdictions began to tighten their PM2.5 exposure standards. For instance, the US lowered the National Ambient Air Quality Standard (**NAAQS**) for annual PM2.5 exposure in 2012/2013 from 15 $\mu g/m^3$ (first set in 1997) to 12 $\mu g/m^3$.[15]

56. In Australia, PM2.5 performance standards were installed in 2016,[16] at 8 $\mu g/m^3$ for annual mean exposure. These air quality standards are a component of the National Environment Protection Measure for Ambient Air Quality (**Air NEPM**).

57. Scientific data has continued to accumulate on the negative health impacts of PM2.5 exposure at low concentrations, through studies of less polluted environments. Studies early this decade were still unable to determine a threshold below which exposure to PM2.5 is safe,[17,18] with higher confidence of increased mortality at annual exposure below the WHO recommendation (at the time) of 10 $\mu g/m^3$.

58. A more recent concentration – response curve for the mortality risk of PM2.5 exposure is shown in Figure 3, taken from phase 2 of a Canadian study: Mortality-Air Pollution Associations in Low Exposure Environments (MAPLE).[19,20] At the lowest PM2.5 levels encountered in the study, around 2.5 $\mu g/m^3$, the risk ratio converges towards a baseline value of 1, although with some remaining uncertainty around if and where a threshold may exist. Similar concentration – response curves were also returned by parallel investigations in the US and Europe (not shown here).[21]

59. Figure 3 demonstrates that there is now a high degree of certainty that exposure to mean PM2.5 levels of 5 $\mu g/m^3$ and above presents an elevated risk of mortality. The risk ratio at these exposure levels is approximately 1.05, which corresponds to a 5 % increase in mortality from PM2.5 exposure, compared to a zero-exposure scenario.

[15] Environmental Protection Agency, National Ambient Air Quality Standards for Particulate Matter, January 15 2013.

[16] These same levels were first set as advisory reporting standards in Australia in 2003.

[17] Orellano, P., Reynoso, J., Quaranta, N., Bardach, A., Ciapponi, A., Short-term exposure to particulate matter (PM10 and PM2.5), nitrogen dioxide ($NO_2$), and ozone ($O_3$) and all-cause and cause-specific mortality: Systematic review and meta-analysis. *Environment International* 2020, 105876.

[18] Chen, J., Hoek, G., Long-term exposure to PM and all-cause and cause-specific mortality: A systematic review and meta-analysis. *Environment International* 2020, 105974.

[19] Brauer, M., et al., Mortality – air pollution associations in low-exposure environments (MAPLE): Phase 1. *Research Reports: Health Effects Institute* 2019.

[20] Brauer, M., et al., Mortality – air pollution associations in low-exposure environments (MAPLE): Phase 2. *Research Reports: Health Effects Institute* 2022.

[21] Boogaard et al., Assessing adverse health effects of long-term exposure to low levels of ambient air pollution: The HEI experience and what's next? *Environmental Science and Technology* 2024, 58, 12767 – 12783.

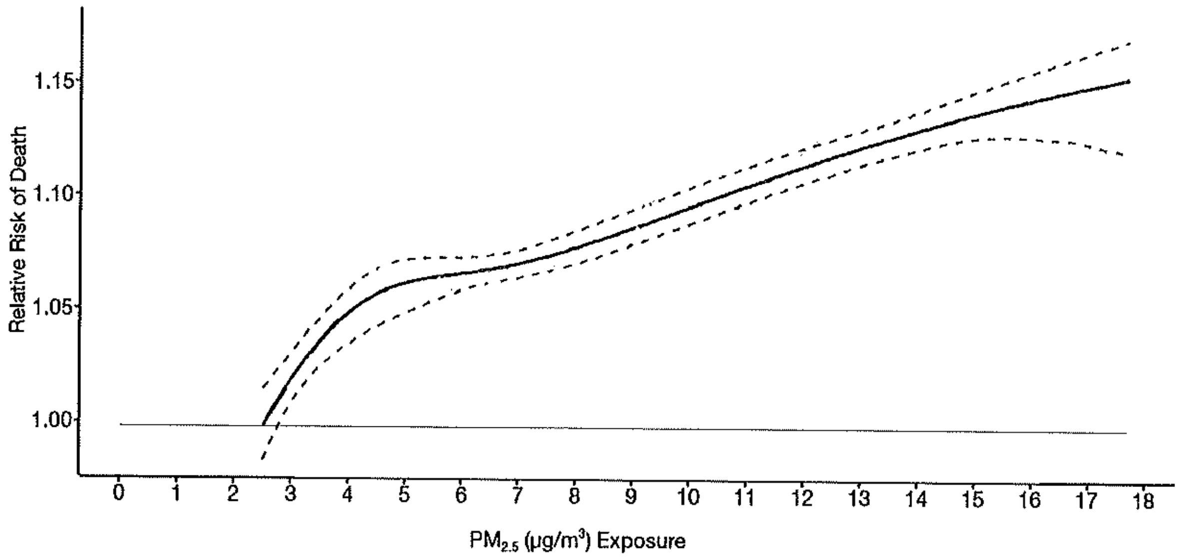


**Figure 3:** Concentration – response function for mortality from PM2.5 exposure, taken from Brauer et al. (2022).

60. In 2021, upon consideration of the latest scientific evidence, the WHO halved their annual air quality guideline for PM2.5 exposure from 10 to 5 µg/m³. The evidence that the WHO relied upon[22] indicates that consistent exposure to PM2.5 at 5 µg/m³ still presents negative health effects, and that maintaining PM2.5 levels below 5 µg/m³ will have public health benefits.

61. International jurisdictions that have responded to the latest science on the health impacts of PM2.5 this decade include the US, which lowered the NAAQS for annual PM2.5 exposure from 12 µg/m³ to 9 µg/m³ in 2024,[23] and the European Union (**EU**),[24] which began phasing in a 10 µg/m³ standard from 2024 (down from 25 µg/m³, introduced in 2008).

62. So as to continue to align Australia's air quality with the evolving science the 2021 amendment to the Air NEPM introduced a national environment protection goal of 7 µg/m³ for annual mean PM2.5 exposure, effective from 1 January 2025.[25]

63. The main source of primary PM2.5 emissions at HVO are expected to be in combustion emissions, including diesel tail-pipe emissions and blasting fumes.

64. Operations at HVO are also expected to produce pre-cursors to PM2.5, which can subsequently form secondary particulate matter in the atmosphere. The most significant pre-cursor is $NO_x$, which is addressed in Section 4.3 below.

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[22] Pages 74 to 89 of the 2021 WHO Guidelines and references therein.
[23] Environmental Protection Agency, Reconsideration of the National Ambient Air Quality Standards for Particulate Matter, March 6 2024.
[24] Directive (EU) 2024/2881 of the European Parliament and of the Council of 23 October 2024 on ambient air quality and cleaner air for Europe (recast).
[25] Section 6 of the National Environment Protection (Ambient Air Quality) Measure 2021.

65. Open-cut coal mining also produces substantial quantities of mechanically generated particulate matter, or dust. As shown in Figure 1, these particles are predominantly larger than 2.5 µm, and therefore contribute more to PM10 than to PM2.5 (where the next section of this report addresses PM10 pollution). Note, however, that the large quantity of dust generated by mining means that it does still contribute a component of the total PM2.5 pollution,[26] alongside combustion-generated and secondary particulate matter.

### 4.2 PM10

66. PM10 refers to particles of 10 µm or smaller that are suspended in air. Because PM10 includes all particles below 10 µm, it incorporates PM2.5.[27] This means that PM10 levels in the atmosphere are always greater than or equal to those of PM2.5.

67. The fraction of PM in the 2.5 to 10 µm range is sometimes reported as PM10 minus PM2.5. PM10 minus PM2.5 provides an indication of coarse particle (or dust) levels. This is why it is useful to measure both PM10 and PM2.5. This section focuses on the dust component of PM10 which is not addressed in section 4.1 on PM2.5 (*i.e.*, PM10 minus PM2.5).

68. Unlike PM2.5, dust is predominantly removed from the atmosphere by gravitational settling (*sedimentation*; see Figure 1). Dust is therefore not transported as far as fine particles in the atmosphere, and is more likely to impact those close to the emission source.

69. Open cut mining has the potential to generate significant quantities of dust. Activities that will produce dust and/or cause it to become suspended in the atmosphere include: the removal of overburden; blasting; crushing and grinding of rock; and the handling and transport of mined material.

70. Dust has negative impacts on human health and the environment. Dust aggravates the eyes and airways, and is particularly harmful to those with asthma and other respiratory conditions. [28]

71. Dust causes reduced visibility and will accumulate on solid surfaces. It can impact growth of plants and reduce the performance of solar cells. When dust particles contain harmful components, such as heavy metals, they provide a means of dispersing them in the environment.

[26] Duran, Z., Erdem, B., Modeling of Particulate Matter Concentrations from Hauling Operations in Quarries using Decision Tree Approach. *Air Quality, Atmosphere & Health* 2026, 19:31.
[27] Pages 21 – 25 of: Finlayson-Pitts, B. J., Pitts, J. N., Chemistry of the Upper and Lower Atmosphere. Academic Press.
[28] Section 3.3 of 2021 WHO guidelines.

72. In 2006 the WHO installed an annual mean PM10 guideline of 20 μg/m$^3$. This was updated in 2021 to 15 μg/m$^3$.

73. In Australia, an annual PM10 standard was implemented in 2016 at 25 μg/m$^3$, and it has remained at this level since. The significantly higher value set for PM10 *vs.* PM2.5 exposure reflects the heightened health risk of very fine particulate matter as opposed to coarser dust particles in the 2.5 to 10 μm range.

74. Practical measures exist to control exposure to mine dust. Water spray on high dust generating activities, for instance, is an effective control and is standard practice at open-cut mines.

75. Exposure of nearby residents to mine dust can be controlled by limiting dust generating activities on days with adverse meteorological conditions. Again, this is standard practice at open-cut coal mines in close proximity to residential areas.

76. Because the activities that generate mine dust are largely distinct from those that create the fine particles associated with PM2.5, and because dust particles are not disseminated as widely in the atmosphere as PM2.5, dust suppression measures will have little impact on PM2.5 emissions and atmospheric concentrations, even if they are effective at reducing short-term PM10 emissions. In fact, there is some evidence that water spray can enhance secondary PM2.5 chemistry,[29] and these control measures may be inadvertently increasing PM2.5 pollution.

**4.3 $NO_x$**

77. The nitrogen oxides (NO and $NO_2$, or $NO_x$) are free radical species that react in the atmosphere to produce secondary pollutants, including tropospheric ozone and PM2.5. $NO_2$ is also a harmful air pollutant in its own right.

78. In the atmosphere, NO and $NO_2$ rapidly convert back and forth, on the timescale of seconds to minutes. It is therefore practical to consider them together (as $NO_x$).[30] Because it is usually more convenient to measure $NO_2$ than NO, air quality standards often relate only to $NO_2$, as a proxy for total $NO_x$.

79. Mining at HVO will result in substantial emissions of $NO_x$ to the atmosphere.

80. Combustion at high temperatures converts $N_2$ in air into $NO_x$. Diesel engines are particularly prone to $NO_x$ formation.

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[29] Knight, W. L., Fraser, M. P., Herckes, P. Impact of Misting Systems on Local Particulate Matter (PM) Levels. *Aerosol and Air Quality Research* 2021, 200431.

[30] Section 6.6 of: Seinfeld, J. H., Pandis, S. N., Atmospheric Chemistry and Physics: From Air Pollution to Climate Change, 3rd Edition. Wiley 2016.

81. Open-pit mining uses large quantities of ammonium nitrate ($NH_4NO_3$) based explosives. Incomplete oxidation of ammonium nitrate during mining blasts results in the formation of $NO_x$.[31]

82. Long-term exposure to $NO_2$ can impact lung function and trigger symptoms of asthma. Short-term exposure to high levels of this gas can result in acute respiratory symptoms.[32]

83. The Air NEPM first set a mean annual exposure limit of 30 ppb (*ca.* 60 $\mu g/m^3$) for $NO_2$. This limit was halved in 2021 to 15 ppb (*ca.* 30 $\mu g/m^3$).

84. In 2021 the WHO dramatically reduced their recommended annual mean limit for $NO_2$ exposure from 40 down to 10 $\mu g/m^3$. This was not a response to direct health effects of $NO_2$, but was instead directed at reducing secondary PM2.5. To quote from their guideline: "$NO_2$ is the main source of nitrate aerosols, which form an important fraction of PM2.5".[33]

85. The large gap between the Air NEPM annual $NO_2$ standard of *ca.* 30 $\mu g/m^3$ and the current WHO recommendation of 10 $\mu g/m^3$ reflects the different philosophies of controlling $NO_2$ to reduce direct health impacts *vs.* mitigating indirect harm from secondary PM2.5 formation.

**4.3 VOCs**

86. The term VOCs refers to all gaseous organic air pollutants. Typically these compounds are hydrocarbons released to the atmosphere when vaporised from the liquid state or released from confinement.[34]

87. VOCs typically demonstrate similar behaviour in air, and are therefore lumped together as a single class of air pollutant. Note that the VOC methane is also a significant greenhouse gas.

88. Open cut coal mining will release a range of VOCs into the atmosphere, through the use of hydrocarbon fuels, solvents, and from the release of coal seam gas.

89. The Project uses substantial quantities of diesel fuel, which is comprised of VOCs. VOCs will be released into the atmosphere from the use of diesel, both as fugitive emissions and as unburned exhaust gases. Combustion also produces toxic polycyclic aromatic hydrocarbons.

90. A range of organic solvents are typically employed in coal mining, including in the maintenance of equipment. Evaporation of these solvents would contribute to VOC emissions from HVO.

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[31] Onederra, I., Bailey, V., Cavanough, G., Torrance, A., Understanding main causes of nitrogen oxide fumes in surface blasting. *Transactions of the Institutions of Mining and Metallurgy: Section A* 2012, 121, 151-159.
[32] Section 3.5 of 2021 WHO guidelines.
[33] World Health Organization Ambient (Outdoor) Air Pollution Guidelines, 2020.
[34] Pages 18 – 20 of: Finlayson-Pitts, B. J., Pitts, J. N., Chemistry of the Upper and Lower Atmosphere. Academic Press.

91. Volatile hydrocarbons trapped within coal are released during mining, as coal seam gas. Predominantly this is methane (the most volatile hydrocarbon), but it will also include non-methane hydrocarbons like ethane and propane.[35]

92. A number of VOCs are classified as air toxics,[36] such as the aromatic hydrocarbons identified above. Benzene is carcinogenic, as are most polycyclic aromatics. Aromatic compounds typically react in the atmosphere within a day, and therefore local residents and mine workers are those most likely to be exposed.

93. The majority of VOCs do not have direct health impacts. However, they contribute to air pollution through their atmospheric chemical reactions. Oxidation of VOCs in air contributes to ozone formation, which is a harmful air pollutant. VOC oxidation products include organic nitrates and acids, both of which contribute to secondary PM2.5 formation.[37]

### 4.4 Air Quality in the HVO Complex Region

94. The HVO North and South mines are in the Upper Hunter Valley, situated around 10 km west of the village of Camberwell. The towns of Singleton and Muswellbrook are located approximately 20 to 30 km to the south-east and north-north-west, respectively, of HVO. Each of these towns is home to over 10,000 people.

95. The Upper Hunter Air Quality Monitoring Network (**UHAQMN**) was established to provide comprehensive air pollutant measurements for the Upper Hunter because of the air quality issues that this region faced. The UHAQMN has provided PM2.5 recordings for Camberwell, Singleton, and Muswellbrook since 2012. PM10, $NO_2$, and $SO_2$ readings are also made at these sites and at around a dozen other locations across the Upper Hunter.

96. This report focuses on air quality at Camberwell, Singleton, and Muswellbrook, because of the availability of PM2.5 data for these locations and their proximity to the Project.

97. The Upper Hunter hosts intensive open-cut and underground coal mining. As described above, coal mining (particularly surface mining) produces primary air pollutants that include PM2.5, PM10, and $NO_x$. Coal mining also provides precursors for secondary PM2.5 formation including VOCs and $NO_x$.

[35] What is Unconventional Gas? CSIRO, October 28, 2021. https://www.csiro.au/en/research/environmental-impacts/fuels/What-is-unconventional-gas
[36] National Environment Protection (Air Toxics) Measure.
[37] Section 6.8 of: Seinfeld, J. H., Pandis, S. N., Atmospheric Chemistry and Physics: From Air Pollution to Climate Change, 3rd Edition. Wiley 2016.

98. The Bayswater coal fired power station is located in the Upper Hunter. Bayswater releases emissions that include $SO_2$, $NO_x$, VOCs, and PM2.5.[38]

99. Agriculture is an important industry for the Upper Hunter, with the farming of plants and animals, wineries, and horse studs. Ammonia is an inevitable agricultural emission and a key precursor to secondary PM2.5.[39]

100. In winter, wood fire heating is a major pollution source across the Upper Hunter.[40] Wood burning produces particulate matter and VOCs. Despite their negative air quality impacts, domestic wood heaters have proven difficult to phase out across NSW and Australia.

101. The Upper Hunter region has all the ingredients necessary for poor air quality. There are multiple significant sources of primary PM2.5 (coal mining, wood heating), alongside precursor chemicals for secondary PM2.5 such as $NO_x$ from diesel trucks and mining blasts, $SO_2$ from coal fired power stations, ammonia from farms, and sea salt from the Pacific Ocean. Drought and bushfire events are also known to intermittently bring dust and smoke particulate matter.

102. The UHAQMN has air quality stations in the townships of Muswellbrook and Singleton, and in the small village of Camberwell (*ca.* 5 km east of the HVO complex). Camberwell is about 6 km away from both the North and South HVO pits, but has a small population. Muswellbrook is around 20 km north of the HVO North pit, whereas Singleton is less than 20 km east of the HVO South pit.

103. Mean annual PM2.5 levels at these three stations are provided in Table 1, showing that each station has frequently recorded annual PM2.5 levels in excess of 8 $\mu g/m^3$ (the current standard), and that they are usually in excess of 7 $\mu g/m^3$ (the current goal). Only one measurement is below the WHO recommended limit of 5 $\mu g/m^3$ (Camberwell in 2022, a year of exceptionally high rainfall). Air quality at these locations, which encircle the HVO complex, have consistently demonstrated air quality at levels known to have negative health impacts.

[38] Environment Protection Licence 779: Bayswater Power Station. *Environment Protection Authority – NSW.* January 24, 2023.

[39] Sections 2.3 and 8.3 of: Seinfeld, J. H., Pandis, S. N., Atmospheric Chemistry and Physics: From Air Pollution to Climate Change, 3rd Edition. Wiley 2016.

[40] Hibberd, M. F., Selleck, P. W., Keywood, M. D., Cohen, D. D., Stelcer, E., and Atanacio, A. J., Upper Hunter Particle Characterisation Study, CSIRO, Australia.

**Table 1:** Mean annual PM2.5 levels (μg/m³) at the Muswellbrook, Singleton, and Camberwell air quality stations.

| | Muswellbrook | Singleton | Camberwell |
|---|---|---|---|
| 2011 | 9.1 | 7.6 | - |
| 2012 | 10.1 | 8.0 | 7.5 |
| 2013 | 9.4 | 7.9 | 8.2 |
| 2014 | 9.7 | 7.8 | 7.8 |
| 2015 | 8.7 | 7.6 | 7.2 |
| 2016 | 8.4 | 7.9 | 7.5 |
| 2017 | 9.4 | 8.2 | 7.4 |
| 2018 | 9.4 | 8.1 | 8.4 |
| 2019* | 12.2 | 10.9 | 10.5 |
| 2020 | 9.3 | 8.4 | 7.5 |
| 2021 | 7.3 | 6.3 | 5.7 |
| 2022 | 6.2 | 5.1 | 4.8 |
| 2023 | 7.5 | 6.7 | 6.1 |
| 2024 | 7.1 | - | 5.9 |

*Substantially bushfire impacted measurements.

104. Chemical analysis of PM2.5 collected in the Upper Hunter region provides information on the origins of these particles.[41] At Muswellbrook, 36 % of PM2.5 could be assigned to secondary sources (secondary sulfate, industry aged sea salt, and secondary nitrate). A further 8 % was assigned to vehicle/industry, which would include primary diesel PM2.5 emissions, with 11 % characterised as soil, including coal dust.

105. Predictive models of PM2.5 pollution in the Upper Hunter arising from industrial activity need to include estimates of primary PM2.5 emission rates as well as secondary PM2.5 formation rates, which themselves are a function of pre-cursor emission rates and atmospheric chemical reactions. Models that do not include secondary PM2.5 formation will be unable to describe what is empirically known to be a large component of the PM2.5 particulate matter.

106. The ongoing importance of secondary particulate matter as a contributor to PM2.5 in the Upper Hunter is supported by recent $NO_2$ measurements in the region. The 2022 - 2024 reviews of the UHAQMN reported that in each of these years Muswellbrook was the station experiencing the highest annual $NO_2$ level in the region, at 7 ppb (2022), 8 ppb (2023), and 6 ppb (2024). Although these values are below the Air NEPM standard of 15 ppb, they do each exceed the WHO recommended limit of 10 μg/m³ (5.3 ppb at room temperature). Note that the WHO threshold is specifically set with the intention of limiting secondary PM2.5

[41] Hibberd, M. F., Selleck, P. W., Keywood, M. D., Cohen, D. D., Stelcer, E., and Atanacio, A. J., Upper Hunter Particle Characterisation Study, CSIRO, Australia.

formation. All of this is to say that $NO_x$ levels in the vicinity of HVO, although perhaps not a direct health risk to the general public, are known to be at concentrations that promote substantial secondary PM2.5 formation.

## 5 Air Quality Assessment and Cumulative Impacts

107. In this section I respond to the following questions from the brief to expert:

- *In your opinion, was the Proponent's air quality assessment of the potential impacts on air quality appropriate and sufficient?*
- *In your opinion, have the Proponent's air quality assessments adequately considered any cumulative impacts arising from the Project?*

108. The Air Quality and Greenhouse Gas Assessment (**The Assessment**) provided as Appendix H of the 2022 EIS, and the Air Quality Impact Assessment (**The AQIA**) provided as Appendix F of the 2025 Amendment Report both include dispersion modelling aimed at predicting air pollutant levels in the immediate vicinity of the Project. The modelling tools used in both are similar, and appear to be conventional.

109. Based on modelling performed for the original EIS (see Table ES1 of the EIS), it is argued that compliance with annual average PM2.5 air quality criteria is expected to be largely achieved for sensitive receptors, and that the contribution of the project to annual average PM2.5 concentrations to these receivers is predicted to be low and on the order of 1 to 2 $\mu g/m^3$.

110. I do not consider 1 to 2 $\mu g/m^3$ of annual PM2.5 to be low. This amounts to a very substantial individual contribution to the total annual PM2.5 standard of 8 $\mu g/m^3$ and goal of 7 $\mu g/m^3$, particularly when one considers background PM2.5 from both natural and anthropogenic sources.

111. Updated modelling for the 2025 Amendment Report is used to argue that the amended project "is unlikely to affect air quality" and that it "poses a lower air quality risk than the original Project ... due largely to the significantly (approximately 23%) lower quantities of material to be moved in each year."[42] I show below that these statements are incorrect.

112. Figure 20 of the Amendment Report AQIA shows that sensitive receptors would receive "no more than 2 $\mu g/m^3$" annual average PM2.5 from HVO. This is on the same order as the concentrations predicted for the original project, and is inconsistent with the stated lower air quality risk. I show below that the main source of the reduction in PM2.5 predictions is the

[42] Table ES1 of the Amendment Report.

assumed background PM2.5 concentration, which is a substantial deficiency of both the original and amendment project assessments.

113. The original EIS attempts to predict annual PM2.5 levels at sensitive receptors by modelling dispersion of primary PM2.5 emissions from HVO and adding the results to an assumed background of all other PM2.5 in the region. Below I calculate this background to be around 6 $\mu g/m^3$.

114. Neither the original assessment nor the Amendment Report AQIA attempt to evaluate the performance of the dispersion model at reproducing known PM2.5 levels, due to a lack of empirical data. I am of the opinion that the dispersion model would substantially underpredict PM2.5 levels because of an absence of detailed secondary particle formation chemistry. Note that this is less of an issue for PM10 modelling, because of a much lower contribution from secondary *vs.* primary particles to PM10, due to their different formation mechanisms. The assumed background concentrations for PM2.5 are derived in the original assessment and amendment AQIA as a fraction of supposedly representative PM10 concentrations.

115. Furthermore, a fixed assumed background cannot reproduce annual variability in air pollutant levels, and therefore does not provide a conservative or worst-case scenario estimate. Measured PM2.5 levels presented in Table 1 show substantial year-on-year variability. For instance, annual PM2.5 levels are typically lower in years with high rainfall (*e.g.*, 2022) and higher in drought-affected years (*e.g.*, 2019), due to the importance of wet deposition on PM2.5 removal from the atmosphere. Without incorporating this variability into the model uncertainty the predictions can never provide worst-case estimates.

116. Climate modelling carried out for the NSW and Australian Regional Climate Modelling (NARCliM) project predicts that global warming will result in the Hunter region experiencing *ca.* 7 to 9 % less rainfall in the 2030 – 2049 period.[43] These climate impacts will increase PM2.5 levels in the region over the life of the HVO project, and is another reason that I expect the air quality modelling to provide underestimates.[44]

117. The modelling described in the Assessment does not include detailed secondary particle formation chemistry. Secondary PM2.5 particle formation is challenging to predict, but characterisation of particles from the Upper Hunter region show that it is an essential component of the PM2.5 mix.[14] The Assessment does refer to the Upper Hunter Fine Particle Characterisation Study, but only in the context of the contribution of wood smoke to PM2.5.

[43] NARCliM Hunter Climate Change Snapshot, *NSW Department of Climate Change, Energy, the Environment and Water,* November 2025.

[44] Section 4 of the Amendment Report AQIA adopts a long-term average of 695 mm of rainfall for the local environment, and uses this to attempt to argue for 2024 being a representative year.

118. Deficiencies in the assumed PM2.5 background are identified in the NSW EPA's 6 March 2023 advice on the EIS[45] requesting additional information on how the background was calculated and how it compared to measured PM2.5 levels.

119. The Amendment Report AQIA selected a new, lower, PM2.5 background of around 5 $\mu g/m^3$. As shown below it is this lower assumed background that results in the biggest reduction in estimated annual PM2.5 levels at sensitive receptors in the amended *vs.* initial proposal, and not "the significantly ... lower quantities of material to be moved in each year".[46]

120. The NSW EPA again point out deficiencies in the assumed PM2.5 background, arguing in their 25 September 2025 advice on the Amendment Report that "the adjusted background underpredicts the background air quality and is not site-representative".[47]

121. In the 15 December 2025 advice on additional information to the Amendment Report,[48] the NSW EPA find:

> *The Air Quality Letter Report did not revise the modelled background air quality data as previously requested by the EPA (DOC25/735725-12). Although the Air Quality Letter Report may show some good agreement between the measured and modelled particulate matter concentrations using the modelling methodology, and was done to avoid double counting, the approach is not supported by the Approved Methods.*

122. I am in agreement with the above statement in relation to background air quality data, as argued above, and also believe that the modelled air quality data should be revised.

123. The Department of Planning, Housing and Infrastructure (**The Department**) requested in their 30 January 2026 request for additional information[49] that the proponent list average background concentrations of annual cumulative PM2.5 at sensitive receptors predicted to exceed 8 $\mu g/m^3$.

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[45] Point 5 (bottom of page 3) in: Advice on EIS – EPA. March 6, 2023. https://majorprojects.planningportal.nsw.gov.au/prweb/PRRestService/mp/01/getContent?AttachRef=PAE-54033709%2120230306T044009.691+GMT

[46] Executive Summary and Conclusions of the Amendment Report.

[47] Advice on Amendment Report – EPA. September 25, 2025. https://majorprojects.planningportal.nsw.gov.au/prweb/PRRestService/mp/01/getContent?AttachRef=PAE-92196456%2120250925T015549.252+GMT

[48] Advice on Amendment Report – EPA (Air and Noise). December 15, 2025. https://majorprojects.planningportal.nsw.gov.au/prweb/PRRestService/mp/01/getContent?AttachRef=PAE-100283460%2120251215T044016.000+GMT

[49] Request for Additional Information – Air Quality Impact Assessment. January 30, 2026. https://majorprojects.planningportal.nsw.gov.au/prweb/PRRestService/mp/01/getContent?AttachRef=SSD-11826621%2120260206T005431.789%20GMT

124. The 27 February 2026 response to this request, from Airen Consulting, does not list the requested background PM2.5 concentrations (see Table 2 of the response).[50] Instead it includes the annual average PM2.5 concentrations modelled from all non-HVO sources. These values include the background concentrations and contributions from other modelled sources (such as other nearby mines). This precludes one from determining the contribution of HVO to any predicted exceedances relative to other nearby polluters.

125. I have myself revised the Amendment Report annual PM2.5 modelling using the more reasonable assumed background of the original EIS. My methodology is explained below.

126. The Air Quality and Greenhouse Gas Assessment (Appendix H) prepared by Jacobs Group for the original EIS provides modelled annual average PM2.5 concentrations for 228 sensitive receptors in four individual years for 2029, 2033, and 2040 (as well as 2025 and 2044, which I will omit from this analysis).[51] This provides 684 different annual PM2.5 datapoints with both cumulative and project-only PM2.5 predictions.

127. For each of the above annual PM2.5 concentrations I have calculated the individual background contribution as the difference between the cumulative and project-only values. The resultant concentrations are listed in Appendix C as the "Jacobs" dataset.

128. The average non-HVO (or background) PM2.5 contribution across the three evaluated years is 6.2 $\mu g/m^3$, predicted to peak at an average of 6.4 $\mu g/m^3$ in 2029 and 2033 then decline to 5.7 $\mu g/m^3$ in 2041. The lowest individual background value used is 5.3 $\mu g/m^3$ for a number of receptors in 2040.

129. Similar data is listed in the Air Quality Impact Assessment (Appendix F) prepared by Airen Consulting for the Amendment Report,[52] for which I have carried out the same analysis. Resultant values are again provided in Appendix C, as the "Airen" dataset, now for the prediction years 2029, 2034, and 2041.

130. The average non-HVO PM2.5 contribution across the three evaluated years in the Amendment Report AQIA is 5.0 $\mu g/m^3$, averaging 5.4 $\mu g/m^3$ in 2029 and 2034, then declining to 4.4 $\mu g/m^3$ in 2041. The lowest individual background value used is 4.1 $\mu g/m^3$.

131. Annual background PM2.5 levels as low as 4.1 $\mu g/m^3$ have not been seen in UHAQMN measurements across the region over many years, and are inconsistent with the local environment (*cf.* Table 1).

[50] Re: Request for Additional Information – Air Quality Impact Assessment. February 27, 2026. https://majorprojects.planningportal.nsw.gov.au/prweb/PRRestService/mp/01/getContent?AttachRef=SSD-11826681%2120260302T004701.486+GMT

[51] True page numbers 168 – 170 of Appendix H of the EIS.

[52] True page numbers 99 – 101 of Appendix F of the Amendment Report.

132. I have recalculated the AQIA annual PM2.5 concentrations at sensitive receptors for 2029 – 2040/41 using the more-reasonable background values from the original assessment. These calculations use the Jacobs background values for the years 2033 and 2040 as background values for the years 2034 and 2041, respectively. The resultant values are provided in Appendix C as the "Revised Airen" dataset.

133. Table 2 lists sensitive receptors predicted to have annual PM2.5 exceedances above 8 $\mu g/m^3$ in at least one year across the future predictions from the Jacobs, Airen, and Revised Airen datasets. Where at least one of the exceedances would not have occurred without the HVO project contributions to PM2.5 it is marked as being "HVO-attributed". Otherwise it is labelled as "Background", and here the HVO emissions contribution is responsible for exacerbating the annual PM2.5 exceedance(s).

134. The original Jacobs modelling predicts that 35 of the 228 modelled receptors would experience at least one year where the annual PM2.5 standard is not met. Of these 35 receptors, 12 are predicted to experience an exceedance because of the cumulative impact of the HVO operation (*i.e.*, the background would otherwise be below 8 $\mu g/m^3$) and the other 23 are predicted to have their non-compliant air quality exacerbated by HVO.

135. The Airen modelling for the Amendment Report predicts that 14 of the modelled sensitive receptors would experience at least one exceedance of the annual PM2.5 standard, where 3 of these receptors have an annual exceedance that would be solely attributable to HVO.

136. The Revised Airen modelling returns essentially the same results as those provided in the original project EIS: 35 receptors with exceedances of the national PM2.5 standard, 12 of which are predicted to be the result of the HVO operation. This leads me to form the opinion that the improved PM2.5 air quality predicted in the Amendment Report is not a consequence of modifications to the project, as claimed in the Amendment Report (see paragraph 111 above), and instead can almost entirely be attributed to the selection of a new assumed background that is not unsupported.

**Table 2:** Sensitive Receptors included in the air quality modelling with at least one predicted mean annual PM2.5 exceedance of 8 μg/m³. Background exceedances marked with an x are those receptors with at least one year of background concentrations above 8 μg/m³ and no years of HVO-Attributed exceedances. HVO-Attributed exceedances marked with an x are those receptors with at least one year predicted to cross the 8 μg/m³ threshold because of HVO emissions.

| | Jacobs | | Airen | | Revised Airen | |
|---|---|---|---|---|---|---|
| Receptor | Background | HVO-Attributed | Background | HVO-Attributed | Background | HVO-Attributed |
| 102 | x | - | x | - | x | - |
| 167 | - | - | - | - | - | x |
| 264 | x | - | x | - | x | - |
| 308 | - | x | - | - | - | x |
| 310 | - | x | - | - | - | x |
| 463 | - | x | - | - | - | x |
| 471 | - | x | - | - | - | x |
| 499 | - | x | - | - | - | x |
| 507 | x | - | x | - | x | - |
| 511 | - | x | - | - | - | x |
| 592 | x | - | - | - | x | - |
| 596 | x | - | x | - | x | - |
| 598 | x | - | - | - | x | - |
| 599 | x | - | - | - | x | - |
| 613 | x | - | - | - | x | - |
| 614 | x | - | - | - | x | - |
| 619 | x | - | - | - | x | - |
| 621 | - | x | x | - | - | x |
| 623 | x | - | - | - | x | - |
| 624 | x | - | - | - | x | - |
| 626 | x | - | x | - | x | - |
| 627 | x | - | - | x | x | - |
| 628 | x | - | - | x | x | - |
| 629 | x | - | - | - | x | - |
| 735 | - | x | - | - | - | x |
| 797 | x | - | - | - | x | - |
| 799 | x | - | - | - | x | - |
| 800 | x | - | - | - | x | - |
| 830 | - | x | - | x | - | x |
| 833 | - | x | x | - | - | x |
| 860 | x | - | x | - | x | - |
| 861 | x | - | x | - | x | - |
| 862 | x | - | x | - | x | - |
| 863 | x | - | x | - | x | - |
| 869 | - | x | - | - | - | - |
| 870 | - | x | - | - | - | x |

## 6 The Department's Assessment of Air Quality Impacts

137. In this section I respond to questions posed in the Brief to Expert relating to the Department's assessment of air quality impacts.

138. The Brief to Expert includes the following questions, which I answer together:

- *Are there any propositions or statements in the Department's analysis of air quality impacts contained within the assessment report that you disagree with, and if so, why?*
- *In your opinion does the Department's assessment report adequately consider the project's individual and cumulative impacts on air quality?*

139. As put forth in the previous section, I am in agreement with the NSW EPA that air quality modelling in the original project EIS and in the Amendment Report are deficient, through selection of an unreasonably low PM2.5 background and neglect of secondary particulate matter sources. The NSW EPA concludes in the 15 December 2025 letter referenced above that the assume background approach "is not supported by the Approved Methods".

140. It follows that the I disagree with the SSD Report (at page v) where it states that "Air quality was assessed in accordance with the EPA's *Approved Methods* ... using worst-case future scenarios".

141. When grappling with the inappropriate assumed background, the NSW EPA state in their 15 December 2025 Advice on Additional Information to the Amendment Report:[53]

> *However, as the project requires a Trigger Action Response Plan that must use actual measured PM10 concentrations to manage impacts for compliance, the EPA considers this issue can be resolved through including conditions in an Environment Protection Licence (EPL), should the project be approved.*

142. I disagree with the above statement that the issue of a deficient assumed background can be resolved through EPL conditions. Conditions in an Environment Protection Licence may be able to use contemporaneously measured PM10 levels to manage daily PM10 exceedances through, for example, proactive and reactive measures. However, these measures cannot manage annual PM2.5 exceedances, which are the result of cumulative emissions and not exceptional one-off events which may be avoided.

143. In years where sensitive receptors are already on track to exceed the annual PM2.5 air quality standard through cumulative HVO emissions, the only feasible measure to avoid an air quality

[53] Advice on Amendment Report – EPA (Air and Noise). December 15, 2025. https://majorprojects.planningportal.nsw.gov.au/prweb/PRRestService/mp/01/getContent?AttachRef=PAE-100283460%2120251215T044016.000+GMT

violation attributable to the project are to scale back or suspend activities at the mine. Realistically, managing annual PM2.5 compliance using measured PM2.5 levels is not operationally feasible.

144. The most appropriate measures to ensure compliance with the annual PM2.5 standard are those that reduce cumulative PM2.5 emissions from the project, which are predicted to amount to atmospheric levels of 1 to 2 $\mu g/m^3$ at sensitive receptors. Substantially reduced annual extraction limits are one such measure. For instance, halving annual extraction limits from the HVO complex would be reasonably expected to reduce predicted annual PM2.5 contributions to 1 $\mu g/m^3$ and below for sensitive receptors, which would likely bring them close to satisfying the Air NEPM annual PM2.5 standard and, perhaps, goal.

145. Another feasible measure to help achieve compliance with the annual PM2.5 standard, addressed later in this report, is to reduce the PM2.5 and $NO_x$ emissions intensity of diesel-fuelled engines. However, this measure alone is unlikely to achieve compliance.

146. As well as prescribing conditions to tackle daily PM10 exceedances, the Department needs to address likely annual exceedances of PM2.5 arising from acknowledged deficits in the original EIS and Amendment Report AQIS dispersion modelling.

147. The NSW EPA and Department of Planning, Housing and Infrastructure assessment of the project applies the annual mean PM2.5 exposure standard of 8 $\mu g/m^3$. It appears to me that they have not turned their mind to the more stringent national environment protection goal of 7 $\mu g/m^3$ which is now in effect.

148. The purpose of the national environment protection goals, as written in legislation, is to set goals that "relate to the desired environmental outcomes" and "guide the formulation of strategies for the management of human activities that may affect the environment."[54]

149. The Department appear to have not taken the opportunity to use the 7 $\mu g/m^3$ annual mean PM2.5 goal to assess the air quality impacts of the project out to 2040 and beyond. I cannot see where they have considered the desired environmental outcome of annual mean PM2.5 levels that do not exceed 7 $\mu g/m^3$, nor can I see how they have used this legislated environment protection goal to guide the project's management of air quality.

150. I have repeated the exercise from the previous section of my report to predict annual mean PM2.5 exceedances at sensitive receptors, now applying the 7 $\mu g/m^3$ national environment protection goal. Table 3 lists sensitive receptors predicted to have annual PM2.5 exceedances above 7 $\mu g/m^3$ in at least one of the future modelled years in the Jacobs, Airen, or Revised Airen datasets of Appendix C.

[54] Paragraph 4 of the National Environment Protection (Ambient Air Quality) Measure.

**Table 3:** Sensitive Receptors included in the air quality modelling with at least one predicted mean annual PM2.5 exceedance of 7 µg/m³. Background exceedances marked with an **x** are those receptors with at least one year of background concentrations above the 7 µg/m³ and no years of HVO-Attributed exceedances. HVO-Attributed exceedances marked with an **x** are those receptors with at least one year predicted to cross the of 7 µg/m³ threshold because of HVO emissions.

| | Jacobs | | Airen | | Revised Airen | |
|---|---|---|---|---|---|---|
| Receptor | Background | HVO-Attributed | Background | HVO-Attributed | Background | HVO-Attributed |
| 102 | x | - | x | - | x | - |
| 120 | - | x | - | - | - | x |
| 121 | - | x | - | - | - | x |
| 122 | - | x | - | - | - | x |
| 123 | - | x | - | - | - | x |
| 124 | - | x | - | - | - | x |
| 126 | - | x | - | - | - | x |
| 127 | - | x | - | - | - | x |
| 128 | - | x | - | - | - | x |
| 130 | - | - | - | - | - | x |
| 160 | - | x | - | - | - | x |
| 161 | - | x | - | - | - | x |
| 162 | - | x | - | - | - | x |
| 163 | - | x | - | - | - | x |
| 167 | - | - | - | - | - | x |
| 244 | - | x | - | - | - | x |
| 245 | - | x | - | - | - | x |
| 246 | - | x | - | - | - | x |
| 247 | - | x | - | - | - | x |
| 256 | - | x | - | - | - | x |
| 258 | - | x | - | - | - | x |
| 260 | - | x | - | - | - | x |
| 261 | - | x | - | - | - | x |
| 262 | - | x | - | - | - | x |
| 264 | x | - | x | - | x | - |
| 308 | - | x | - | - | - | x |
| 310 | - | x | - | - | - | x |
| 311 | - | x | - | - | - | x |
| 317 | - | x | - | - | - | x |
| 321 | - | x | - | - | - | x |
| 322 | - | - | - | - | - | x |
| 324 | - | x | - | - | - | x |
| 360 | - | - | - | - | - | x |
| 361 | - | - | - | - | - | x |
| 362 | - | - | - | - | - | x |
| 363 | - | - | - | - | - | x |
| 391 | - | - | - | - | - | x |
| 392 | - | - | - | - | - | x |

| Receptor | Jacobs | | Airen | | Revised Airen | |
|---|---|---|---|---|---|---|
| | Background | HVO-Attributed | Background | HVO-Attributed | Background | HVO-Attributed |
| 393 | - | - | - | - | - | X |
| 394 | - | - | - | - | - | X |
| 395 | - | - | - | - | - | X |
| 398 | - | - | - | - | - | X |
| 404 | - | - | - | - | - | X |
| 407 | - | - | - | - | - | X |
| 408 | - | - | - | - | - | X |
| 420 | - | - | - | - | - | X |
| 429 | - | - | - | - | - | X |
| 431 | - | X | - | - | - | X |
| 434 | - | X | - | - | - | X |
| 436 | - | X | - | - | - | X |
| 440 | - | X | - | - | - | X |
| 463 | - | X | - | - | - | X |
| 471 | - | X | - | X | X | - |
| 497 | - | X | - | - | - | X |
| 498 | - | X | - | - | - | X |
| 499 | - | X | - | X | - | X |
| 507 | X | - | X | - | X | - |
| 511 | X | - | - | - | X | - |
| 592 | X | - | - | X | X | - |
| 596 | - | X | X | - | - | X |
| 598 | X | - | X | - | X | - |
| 599 | X | - | X | - | X | - |
| 613 | X | - | X | - | X | - |
| 614 | X | - | X | - | X | - |
| 619 | X | - | X | - | X | - |
| 621 | X | - | X | - | X | - |
| 623 | X | - | - | X | X | - |
| 624 | X | - | X | - | X | - |
| 626 | X | - | X | - | X | - |
| 627 | X | - | X | - | X | - |
| 628 | X | - | X | - | X | - |
| 629 | X | - | X | - | X | - |
| 735 | X | - | - | X | X | - |
| 797 | X | - | X | - | X | - |
| 799 | X | - | X | - | X | - |
| 800 | X | - | X | - | X | - |
| 829 | - | X | - | X | - | X |
| 830 | X | - | X | - | X | - |
| 833 | - | X | - | X | - | X |
| 834 | - | - | - | - | - | X |
| 839 | - | - | - | - | - | X |
| 846 | - | X | - | - | - | X |
| 860 | X | - | X | - | X | - |
| 861 | X | - | X | - | X | - |

| | Jacobs | | Airen | | Revised Airen | |
|---|---|---|---|---|---|---|
| Receptor | Background | HVO-Attributed | Background | HVO-Attributed | Background | HVO-Attributed |
| 862 | X | - | X | - | X | - |
| 870 | - | X | - | - | - | X |
| 947 | - | X | - | - | - | X |
| 949 | - | X | - | - | - | X |
| 950 | - | X | - | - | - | X |

151. The original Jacobs modelling predicts that 71 of the 228 modelled receptors would experience at least one year where the annual PM2.5 goal is not met. Of these 71 receptors, 45 are predicted to experience an exceedance only because of the cumulative impact of the HVO operation.

152. The Airen modelling for the Amendment Report now predicts that 30 of the modelled sensitive receptors would experience at least one exceedance of the annual PM2.5 goal, where 7 of these receptors have an annual exceedance that would be attributable to HVO.

153. The Adjusted Airen modelling returns results that are now worse than those provided in the original project EIS: 91 receptors with exceedances of the PM2.5 goal, 64 of which are predicted to be the result of the HVO project.

154. Of the 91 sensitive receptors identified across the modelled dataset at risk of not meeting the current Air NEPM annual PM2.5 goal, 52 are – according to the 2022 Receptor List (Appendix C of the EIS) – private dwellings not presently subject to acquisition rights.

155. The HVO project, in the predictions of the proponents, is expected to lock in almost two decades of dangerous and unhealthy air for nearby residents. Expected mean PM2.5 levels are predicted to be well in-excess of the WHO guideline (5 $\mu g/m^3$) and frequently exceed Australia's current national environment protection goal (7 $\mu g/m^3$).

156. A further question posed in the Brief to Expert is:

- *Do you agree with the Department's assessment that the air quality impacts are conservative and represent a worst case scenario? If not, why?*

157. I do not agree that the air quality modelling and assessment presents a conservative worst-case scenario. The most recent dispersion modelling, included as Appendix F of the 2025 Amendment Report, uses an assumed PM2.5 background that substantially underestimates background pollution in the region. The baseline is inconsistent with modelling in the original EIS and the NSW EPA have identified shortcomings which were never satisfactorily addressed.

158. Putting aside issues with the assumed background, the dispersion modelling is still likely to underestimate mean PM2.5 levels because it does not incorporate the impacts of secondary particulate matter. As previously stated, the Upper Hunter Fine Particle Characterisation

Study found secondary particulate matter to be a major component of PM2.5 in the region. Furthermore, it does not factor in variable meteorological conditions (such as el niño and la niña cycles) nor does it consider the impacts of climate change predicted to alter rainfall in the region over the coming decades.

## 7 Measures

159. In this section I respond to the following questions from the brief to expert:

- *In your opinion, are the measures proposed as part of the Project to mitigate and avoid impacts to air quality appropriate and sufficient? Are there any additional and appropriate measures that would minimise those impacts if consent was to be granted to the Project?*
- *In your opinion, are the Department's recommended mitigation measures contained within the assessment report adequate to minimise and manage the predicted air quality impacts?*

160. Measures proposed to mitigate dust impacts from the Project appear to be appropriate. This is the focus of the proposed measures, which aim to reduce short-term exposure of sensitive receptors to coarse particulate matter. Broadly speaking, these include proactive measures which are taken when a short-term exceedance is predicted to occur, and reactive measures which are taken when a short-term exceedance event is presently occurring (see paragraph 334 and 338 of the SSD Report). These measures operate in addition to routine dust-suppression activities.

161. Dust pollution is best captured by PM10 measurements, and consists mostly of mechanically generated particles. This includes solids introduced into the atmosphere from activities such as blasting, loading, hauling and crushing of rock and coal.

162. As outlined in Figure 1, dust generating activities contribute much more to the generation of coarse particular matter (best captured by PM10 measurements) than to fine particulate matter (best captured by PM2.5 measurements). Fine particulate matter is primarily formed through chemical reactions of gases. At HVO, this will include primary particles formed in the engines and exhausts of diesel engines, and secondary particles formed in the atmosphere following the emissions of pre-cursor gases like $NO_x$ and VOCs from diesel engines and ammonium nitrate blasting.

163. Dust suppression measures cannot be expected to be effective for mitigating fine particulate pollution, because the sources of these emissions are different. Short-term mitigation measures (*e.g.*, those designed to improve 1-hour or 1-day PM10 exposure) are not effective

at mitigating long-term cumulative air pollution (*e.g.*, annual mean PM2.5 levels) if they do not also reduce net production, because the activities avoided in the short-term simply end up being rescheduled.

164. The proposed mitigation measures for air pollutants at HVO focus on short-term dust emissions. They do not focus on long-term fine particle emissions and will be ineffective at mitigating PM2.5 pollution arising from the Project.

165. The prior sections of this report establish my opinion that long-term PM2.5 exposure is the most pressing air quality concern for the HVO sensitive receptors. Because PM2.5 particles are carried further in the atmosphere than coarser PM10 particles, and because secondary PM2.5 continue to form from chemical reactions in polluted air masses following their release, long-term PM2.5 exposure is also more of a health hazard to the larger population centres more distant from the Project, such as Muswellbrook and Singleton.

166. Measures that specifically target long-term PM2.5 pollution include those that reduce or eliminate tailpipe emissions of diesel-generated fine particles, $NO_x$, and VOCs, as well as measures that decrease the overall intensity of mining activity (*i.e.*, reducing annual extraction limits).

167. The SSD Assessment Report includes no measures to reduce annual average PM2.5 impact (see paragraphs 343 – 356 of that report). Airen Consulting misrepresent short-term measures as strategies to mitigate long-term (annual average) PM2.5 and PM10 exposure when they say HVO have designed the amended project to implement "dust management measures for the amended Project that are consistent with best practice dust mitigation measures (as per Table 19 of the AQIA)" and that "implementation of the measures would demonstrate that all reasonable and feasible avoidance and/or mitigation measures would be employed to minimise impacts of the amended Project" when addressing a request for additional information specifically in relation to annual cumulative PM10 and PM2.5.[55]

168. The Amendment Report AQIA does not predict substantially reduced PM2.5 emissions over the initial project EIS. This is demonstrated earlier in this report, where the dispersion modelling for the initial project EIS and the Amendment Report are shown to return similar results for annual PM2.5 predictions when using the same assumed background. Dramatic further reductions in annual extraction limits are likely required to effectively mitigate PM2.5 pollution.

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[55] Re: Request for Additional Information – Air Quality Impact Assessment. February 27, 2026 (see true page numbers 6 – 9).
https://majorprojects.planningportal.nsw.gov.au/prweb/PRRestService/mp/01/getContent?AttachRef=SSD-11826681%2120260302T004701.486+GMT

169. One strategy to reduce PM2.5 pollution from diesel machinery is to require that emissions comply with minimum standards. The Amendment Report does not commit to meeting emissions standards for new diesel engines, nor does the Department make such a recommendation. This is despite much effort at the state and federal level being devoted to ushering in diesel emissions standards in the mining sector.

170. Under the US Tier 3 emissions standards,[56,57] non-road diesel engines producing over 130 kW of power are required to produce less than 0.2 g of total PM per kWh. These standards were phased in by 2006 in the USA. In the EU, the Tier 3 standard is equivalent to Euro IIIa.[58] The more stringent Tier 4 standard limits engines producing 130 to 560 kW to 0.02 g of total PM per kWh, with limits of 0.04 g/kWh for engines above 560 kW (or 0.03 g/kWh for diesel engine electric generators). The Tier 4 PM standard was phased in by 2015 in the USA. In the European Union, the Euro IV emission standards place a similar limit on PM (0.025 g/kWh).

171. Studies from both the NSW and Commonwealth governments advocate for the adoption of Tier 4 emissions standards for non-road diesel vehicles and equipment.

172. In 2010 the NSW Department of Environment, Climate Change, and Water and the Australian Government Department of the Environment, Water, Heritage and Arts commissioned a study to identify measures to reduce emissions from non-road diesel engines. This study recommended the establishment of regulations for non-road diesel engines harmonised with US and/or EU standards, with progressive timeframes to allow eventual compliance with US Tier 4 or EU Euro IV standards.[59] Establishing such regulations would require a cost-benefit analysis.

173. The NSW EPA in 2015 then carried out a cost-benefit analysis to evaluate potential regulation of non-road diesel emissions in coal mining, with the findings detailed in the *Cleaner Non-Road Engine Project – Identification and Recommendation of Measures to Support the Uptake of Cleaner Non-Road Diesel Engines in Australia Final Report*. For new and in-service engines, this report recommended that they meet US EPA Tier 4 standards.

174. In 2018 the Commonwealth Government began evaluating the potential for a national approach to diesel emissions control.[60] The evaluation and accompanying cost-benefit

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[56] Regulations for Emissions from Heavy Equipment with Compression-Ignition (Diesel) Engines, United States Environmental Protection Agency 2004. https://www.epa.gov/regulations-emissions-vehicles-and-engines/regulations-emissions-heavy-equipment-compression.
[57] The Tier 2 and 3 standards are the same for PM but differ for other diesel pollutants.
[58] Non-Road Mobile Machinery: Directive 97/68/EC of the European Parliament.
[59] Pages 24 – 25 of: Cleaner Non-Road Diesel Engine Project – Identification and Recommendation of Measures to Support the Uptake of Cleaner Non-Road Diesel Engines in Australia Final Report, April 2010.
[60] National Clean Air Agreement – Work Plan 2018 to 2020, Australian Government Department of the Environment and Energy.

analysis[61] found that immediate Commonwealth regulation to Tier 4 emissions standards would be the most effective measure of those considered.

175. In January 2023 the NSW EPA released their *Climate Change Action Plan 2023 – 26* which states that it is "improving the management of non-road diesel emissions at NSW coal mines, by requiring all **new** [emphasis in original] large non-road diesel equipment to meet US EPA Tier 4 emissions standards (or better)."[62]

176. Requiring Tier 4 compliance for all new diesel-powered machinery would be an appropriate measure to help reduce long-term PM2.5 pollution from the Project, which is not currently recommended. However, because of the long operating lifespan for heavy machinery, the phase out of existing unregulated diesel equipment is unlikely to occur rapidly enough to substantially reduce PM2.5 pollution over the next decade.

Recoverable Signature

X

Dr. Gabriel da Silva
Associate Professor of Chemical Engineering
Signed by: gdasilva@unimelb.edu.au managementAttestation e3f36d84-3268-4f7a-8fa1-a69eb5fd971f

[61] Non-Road Diesel Engines – Cost-Benefit Analysis, Final Report, Department of Climate Change, Energy, the Environment and Water, 2022.
[62] Page 40 of: Climate Change Action Plan 2023 – 26, NSW EPA.

**Appendix A**

**Curriculum Vitae**

# Dr. Gabriel da Silva

Curriculum Vitae

**Contact Information**
Email: gdasilva@unimelb.edu.au; gxdasilva@gmail.com
Phone: (+61) 410 483 621

## EDUCATION

***Ph.D. (Chemical Engineering)*** 2006
The University of Newcastle, Australia

***B.Eng. (Chemical)*** 2001
The University of Newcastle, Australia
First Class Honours

## POSITIONS

**Associate Professor** 2022 -
Department of Chemical Engineering, The University of Melbourne, Australia

**Senior Lecturer** 2019 - 2021
Department of Chemical Engineering, The University of Melbourne, Australia

**ARC Future Fellow** 2014 - 2018
Department of Chemical Engineering, The University of Melbourne, Australia

**Lecturer** 2008 - 2014
Department of Chemical Engineering, The University of Melbourne, Australia

**Postdoctoral Research Fellow** 2005 - 2007
Department of Chemistry and Environmental Science, New Jersey Institute of Technology, USA

**Research Assistant** 2000 - 2001
BHP Billiton Minerals Technology, Newcastle, Australia

## ACADEMIC ROLES AND RESPONSIBILITIES

### Courses Taught

Energy, Emissions and Pollution Control - CHEN90041 2022 - 2026

Chemical Engineering Thermodynamics - CHEN90007 2016 - 2026

Process Simulation and Control - CHEN90032 2008 - 2014, 2019 - 2021, 2025 - 2026

Chemical Process Analysis - CHEN20008 2009 - 2012

### Ph.D. Students Supervised

Zhuojun Xiao 2065 -

Xiaoke Wang 2025 -

Reema Aroos 2023 -

Yufei Lin 2022 -

Thi Nguyen 2020 - 2026

Srivathsan Sundar 2019 - 2024

Milad Narimani 2019 - 2024

Saddam Al-hamadi 2019 - 2024

Yasir Khan 2018 - 2023

Ashraful Alam 2017 - 2023

Rasheed Adewale 2018 - 2022

Zhonghua Ren 2017 - 2022

Sui So 2012 - 2016

Catherine Sutton 2010 - 2014

Tien-Mun Foong 2010 - 2013

Kai Morganti 2010 - 2013

Hendy Thee 2010 - 2013

### University Leadership

Graduate Research Coordinator and Ph.D. Chair of Examiners 2019 - 2021

Oversaw the recruitment, support, and examination of around 100 PhD candidates across the department.

Casual Teaching Coordinator 2023 -

Responsible for recruiting, training, and helping to manage around 30 casual teaching staff each semester.

## ENGAGEMENT, POLICY, AND OUTREACH ACTIVITIES

### Expert Evidence

HVO Open Cut Coal Continuation Project SSD-11826681 & SSD-11826621, NSW Independent Planning Commission
Solicitors: Environmental Defenders Office

Maules Creek Community Council Inc v Environment Protection Authority. NSW Land and Environment Court
Solicitors: Environmental Defenders Office

Mt Pleasant Optimisation Project SSD 10418, NSW Independent Planning Commission
Solicitors: Environmental Defenders Office

Haselhurst v Toyota Motor Corporation Australia Ltd, Supreme Court of NSW
Solicitors: Herbert Smith Freehills

### Submissions to Government

HVO Open Cut Coal Continuation Project - Submission on Environmental Impact Statement — February 2023
NSW EPA

Submission on Vales Point Power Station Exemption Application — November 2021
NSW EPA

Submission to the Review of National Air Pollution Standards — August 2019
Environment Ministers of Australia

Submission in Response to Victoria's Air Quality Statement — June 2018
Department of Environment, Land, Water, and Planning

Submision on Methyl Bromide Fumigation — May 2018
North Carolina Department of Environmental Quality

### Scientific Communication for Non-Technical Audiences

What is the 'acid rain' in the wake of US bombings in Iran? An atmospheric scientist explains — March 2026
Scientific American

How might the Melbourne factory fire affect health and the environment? An air pollution expert explains — July 2024
The Conversation

Chemical weapons: how will we know if they have been used in Ukraine? — April 2022
The Conversation

Frequent extreme bushfires are our new reality. We need to learn how to live with smoke-filled air — November 2020
The Conversation

What is ammonium nitrate, the chemical that exploded in Beirut? — November 2020
Scientific American

What makes pepper spray so intense? And is it a tear gas? A chemical engineer explains June 2020
The Conversation

COVID-19 drop in pollution to be short-lived March 2020
Pursuit

Bushfire smoke is everywhere in our cities. Here's exactly what you are inhaling January 2020
The Conversation

Simulating smog August 2019
Pursuit

### Public Seminars

Climate Change and Air Pollution October 2020
AusWHO

Advancing Environmental Sustainability June 2020
Melbourne Connect

Pollution and the Pandemic May 2020
Point Advisory

### Media

**Live TV:** BBC News, EuroNews, Sky News Australia

**Recorded Interviews:** A Current Affair, ABC TV News, SBS TV News, 3RRR, ABC Radio Melbourne, 3AW Melbourne, 2CC Canberra, Triple M Melbourne, Radio New Zealand, ABC Radio National

**Print and Online:** Le Monde, Washington Post, The Boston Globe, USA Today, Nature, PBS.org, The Age, MSN.com, Yahoo! News, The Guardian, Canberra Times, ABC News, 7 News, Sydney Morning Herald, NewsWeek, etc.

## SEMINAR / CONFERENCE PRESENTATIONS

Invited Talks Since 2011

| | |
|---|---|
| Fall Meeting of the American Geophysical Union<br>Online | 2020 |
| International Conference on Chemical Kinetics<br>Orleans, France | 2019 |
| East Asian Chemical Dynamics Workshop<br>Adelaide, Australia | 2019 |
| Atmospheric Chemical Mechanisms<br>Davis, USA | 2018 |
| East Asian Chemical Dynamics Workshop<br>Seoul, Korea | 2018 |
| $25^{th}$ International Symposium on Gas Kinetics<br>Lille, France | 2017 |
| $34^{th}$ International Symposium on Free Radicals<br>Kanagawa, Japan | 2017 |
| Atmospheric Composition and Chemistry Observations<br>Murramarang, Australia | 2017 |
| Atmospheric Chemical Mechanisms<br>Davis, USA | 2016 |
| $32^{nd}$ Symposium on Chemical Kinetics and Dynamics<br>Saitama, Japan | 2016 |
| Pacifichem<br>Honolulu, USA | 2015 |
| East Asian Chemical Dynamics Workshop<br>Broadbeach, Australia | 2015 |
| ACS Fall National Meeting<br>San Francisco, USA | 2014 |
| East Asian Chemical Dynamics Workshop<br>Kyushu, Japan | 2013 |
| Atmospheric Chemical Mechanisms<br>Davis, USA | 2012 |

## PEER RECOGNITION OF RESEARCH

| | |
|---|---|
| Grimwade Prize in Industrial Chemistry | 2020 |
| School of Chemical and Biomedical Engineering Outstanding Researcher Award | 2020 |
| Session Co-Chair and Organiser, Pacifichem 2020 | 2020 |
| Scientific Advisory Committee, $10^{th}$ International Conference on Chemical Kinetics | 2017 |
| Editorial Advisory Board, International Journal of Chemical Kinetics | 2013 - 2015 |
| Chairperson, Joint Victorian Chemical Engineering committee | 2012 - 2013 |
| AusTrade Visiting Researcher (Middle East) | 2011 |
| Selby Research Award | 2008 |

## RESEARCH SUPPORT

### Competitive Grants Awarded

Formation, Photochemistry and Fate of Gas-Phase Peroxyl Radicals $365 000
Australian Research Council Discovery Project [ID DP170101596] 2017 - 2019

The New Oxidation Chemistry of Amines $623 220
Australian Research Council Future Fellowship [ID FT130101304] 2014 - 2019

A Molecular Understanding of Transport Fuels to Drive Clean and Efficient Combustion $300 000
Australian Research Council Discovery Project [ID DP130100862] 2013 - 2015

Transformation of Organics in the Unpolluted Atmosphere $302 000
Australian Research Council Discovery Project [ID DP110103889] 2011 - 2014

### Consulting

Reaction Rate Modelling of Perflurionated Sulfonic Acids $12 000
Fulton Hogan Limited 2017 - 2018

### Synchrotron Beamtime

Gas-Phase Isomerisation of Hydroxy-Carbonyls 12 Shifts
Australian Synchrotron, Clayton 2017

Comprehensive Product Detection: Aromatic Oxidation and new PAH Pathways 10 Shifts
Advanced Light Source, Berkeley CA 2017

Pyrolysis of Aromatic Fuel Additives: Decomposition Pathways of Methylbenzyl Radicals 20 Shifts
Swiss Light Source, Villigen 2013

Comprehensive Product Detection Studies: Toluene and Xylene Oxidation 5 Shifts
Advanced Light Source, Berkeley CA 2012

IR Spectroscopy of Reactive Intermediates 2 Shifts
Australian Synchrotron, Clayton 2011

Methylbenzyl Radical Decomposition in Pyrolysis 35 Shifts
Swiss Light Source, Villigen 2011

## DETAILS OF PUBLISHED WORKS

### Refereed Journal Articles


151. Alam, A., da Silva, G. Oxidation of aminoacetaldehyde initiated by the OH radical. A theoretical mechanistic and kinetic study. Atmosphere 2025, 15, 1011
150. Shiels, O. J., Brydon, S. C., Poad, B. L. J, Marshall, D. L., Houston, S. D., Xing, H., Bernhardt, P. V., Savage, G. P., Williams, C. M., Harman, D. G., Kirk, B. B., da Silva, G., Blanksby, S. J., Trevitt, A. J. Electrostatically tuning radical addition and atom abstraction reactions with distonic radical ions. Chemical Science 2025, 16, 2861-2878.
149. Kelly, P. D., Turner, J. A., Shiels, O. J., da Silva, G., Blanksby, S. J., Poad, B. L. J., Trevitt, A. J. Don't forget the trans: Double bond isomerism radical-acetylene growth reactions affect the primary stages of PAH and soot formation. Physical Chemistry Chemical Physics 2025, 27, 83-95.
148. Shiels, O. J., Marlton, S. J. P., Poad, B. L. J, Blanksby, S. J., da Silva, G., Trevitt, A. J. Gas-phase phenyl radical + $O_2$ reacts via a submerged transition state. Journal of Physical Chemistry A 2024, 128, 413-419.
147. Krohn, O. A., Catani, K. J., Sundar, S. P., Greenberg, J., da Silva, G., Lewandowski, H. J. Reactions of acetonitrile with trapped, translationally cold acetylene cations. Journal of Physical Chemistry A 2023, 127, 5120-5128.
146. Khan, M. Y., Song, J., Narimani, M., da Silva, G. Thermal decomposition mechanism and kinetics of perfluorooctanoic acid (PFOA) and other perfluorinated carboxylic acids: A theoretical study. Environmental Science: Processes and Impacts 2022, 24, 2475-2487.
145. Narimani, M., Adams, J., da Silva, G. Toxic chemical formation during vaping of ethyl ester flavor additives: A chemical kinetic modeling study. Chemical Research in Toxicology 2022, 35, 522-528.
144. Shiels, O. J., Turner, J. A., Kelly, P. D., Blanksby, S., da Silva, G., Trevitt, A. Modelling reaction kinetics of distonic radical ions: A systematic investigation of phenyl-type radical addition to unsaturated hydrocarbons. Faraday Discussions 2022, 238, 475-490.
143. Levey, Z. D., Laws, B. A., Sundar, S. P., Nauta, K., Kable, S. H., da Silva, G., Stanton, J. F., Schmidt, T. W. PAH growth in flames and space: Formation of the phenalenyl radical. Journal of Physical Chemistry A 2021, 126, 101-108.
142. Shiels, O., Prendergast, M., Savee, J., Osborn, D., Taatjes, C. A., Blanksby, S., da Silva, G., Trevitt, A. J. Five vs. Six membered-ring PAH products from reaction of o-methylphenyl radical and two $C_3H_4$ isomers. Physical Chemistry Chemical Physics, 2021, 23, 14913-14924.
141. Adewale, R., da Silva, G. Kinetics of $C_5H_4$ isomer + H reactions and incorporation of $C_5H_x$ ($x$ = 3 - 5) chemistry into a detailed chemical kinetic model. Combustion and Flame, 2021, 227, 227-237.

140. Sundar, S. P., Al-Hammadi, S., Ren, Z., da Silva, G. Thermal Decomposition Kinetics of the Indenyl Radical: A Theoretical Study. Journal of Physical Chemistry A, 2021, 125, 2782-2790.
139. Al-Hammadi, S., da Silva, G. Thermal decomposition and isomerization of furfural and 2-pyrone: A theoretical kinetic study. Physical Chemistry Chemical Physics, 2021, 23, 2046-2054.
138. Krohn, O. A., Catani, K. J., Greenberg, J., Sundar. S. P., da Silva, G., Lewandowski, H. J. Isotope-specific reactions of acetonitrile ($CH_3CN$) with trapped, translationally cold $CCl^+$. Journal of Chemical Physics, 2021, 154, 074305.
137. Brydon, S. C., da Silva, G., O'Hair, R. A. J., White, J. M. Experimental and theoretical investigations into the mechanisms of halirenium ion pi-ligand exchange reactions with cyclic alkenes in the gas phase. Physical Chemistry Chemical Physics 2021, 23, 25572-25589.
136. Shiels, O. J., Kelly, P. D., Bright, C. C., Poad, B. L. J., Blanksby, S. J., da Silva, G., Trevitt, A. J. Reactivity trends in the gas-phase addition of acetylene to the N-protonated aryl radical cations of pyridine, aniline, and benzonitrile. Journal of the American Society for Mass Spectrometry, 2021, 32, 537-547.
135. Narimani, M., da Silva, G. Does 'dry hit' vaping of vitamin E acetate contribute to EVALI? Simulating toxic ketene formation during e-cigarette use. PLOS ONE 2020, 15, e0238140.
134. Narimani, M., da Silva, G. Pyrolysis of triclosan and its chlorinated derivatives. Journal of Physical Chemistry A 2020, 124, 8050-8056.
133. Brydon, S. C., da Silva, G., White, J. M. Evidence that pi-ligand exchange reactions of chalcogen iranium ions proceed via Huckel pseudocoarctate transition states. Journal of Physical Organic Chemistry 2020, e4111.
132. Ren, Z., da Silva, G. Auto-oxidation of a volatile silicon compound: A theoretical study of the atmospheric chemistry of tetramethylsilane. Journal of Physical Chemistry A 2020, 124, 6544-6551.
131. Ashraful, A. M., da Silva, G. A detailed chemical kinetic model for the supercritical water oxidation of methylamine: The importance of imine formation. International Journal of Chemical Kinetics 2020, 52, 701-711.
130. Bhujel, M., Marshall, D. L., Maccarone, A. T., McKinnon, B. I., Trevitt, A. J., da Silva, G., Blanksby, S. J., Poad, B. L. J. Gas phase reactions of iodide and bromide anions with ozone: evidence for stepwise and reversible reactions. Physical Chemistry Chemical Physics 2020, 22, 9982.
129. Muller, G., Jacovella, U., Catani, K. J., da Silva, G., Bieske, E. J. Electronic spectrum and photodissociation chemistry of the 1-butyn-3-yl cation, $H_3CCHCCH^+$. Journal of Physical Chemistry A 2020, 124, 2366-2371.
128. Shiels, O., Kelly, P., Blanksby, S. J., da Silva, G., Trevitt, A. J. Barrierless reactions of three benzonitrile cations with ethylene. Australian Journal of Chemistry 2020, CH19606.
127. Carrascosa, E., Bull, J. N., Buntine, da Silva, G., Santos, P. F., Bieske, E. J. Near-infrared photoswitching of an isolated azobenzene-stilbene dye. Chemical Physics Letters 2020, 741, 137065.

126. So, S., Kirk, B. B., Wille, U., Trevitt, A. J., Blanksby, S. J., da Silva, G. Reactions of a distonic peroxyl radical anion influenced by SOMO-HOMO conversion: An example of anion-directed channel switching. Physical Chemistry Chemical Physics 2020, 22, 2130-2141.
125. Narimani, M., da Silva, G. Thermal decomposition kinetics of glyphosate (GP) and its metabolite aminomethylphosphonic acid (AMPA). Environmental Science: Processes & Impacts 2020, 22, 152-160.
124. Khan, M. Y., So, S., da Silva, G. Decomposition kinetics of perfluorinated sulfonic acids. Chemosphere 2020, 238, 124615.
123. Sutton, C. R., Lim, C.-Y., da Silva, G. Self-catalyzed keto-enol tautomerizaton of malonic acid. International Journal of Quantum Chemistry 2019, e26114.
122. Sullivan, E. N., Nichols, B., von Kugelen, S., da Silva, G., Neumark, D. M. Multi-photon dissociation dynamics of the indenyl radical at 248 nm and 193 nm. Journal of Chemical Physics 2019, 151, 174303.
121. Ren, Z., da Silva, G. Atmospheric oxidation of piperazine initiated by OH: A theoretical kinetics investigation. ACS Earth and Space Chemistry 2019, 3, 2510-2516.
120. Kelly, P. D., Bright, C. C., Blanksby, S. J., da Silva, G., Trevitt, A. J. Molecular weight growth in the gas-phase reactions of dehydroanilinium radical cations with propene. Journal of Physical Chemistry A 2019, 123, 8881-8892.
119. Brydon, S. C., Ren, Z., da Silva, G., Lim, S. F., Khairallah, G. N., Rathjen, M. J., White, J. M., O'Hair, R. A. J. Experimental and DFT studies on the identity exchange reactions between phenyl chalcogen iranium ions and alkenes. Journal of Physical Chemistry A 2019, 123, 8200-8207.
118. Prendergast, M. B., Kirk, B. B., Savee, J. D., Osborn, D. L., Taatjes, C. A., Hemberger, P., Blanksby, S. J., da Silva, G., Trevitt, A. J. Product detection study of the gas-phase oxidation of methylphenyl radicals using synchrotron photoionization mass spectrometry. Physical Chemistry Chemical Physics 2019, 21, 17939-17949.
117. Brydon, S. C., Lim, S. F., Khairallah, G. N., Maitre, P., Loire, E., da Silva, G., O'Hair, R. A. J., White, J. M. Reactions of thiiranium and sulfonium ions with alkenes in the gas phase. Journal of Organic Chemistry 2019, 84, 10076-10087.
116. Alam, M. A., Ren, Z., da Silva, G. Nitramine and nitrosamine formation is a minor pathway in the atmospheric oxidation of methylamine: A theoretical kinetic study of the $CH_3NH + O_2$ reaction. International Journal of Chemical Kinetics 2019, 51, 723-728.
115. Bull, J. N., West, C. W., Anstöter, C. S., da Silva, G., Bieske, E. J., Verlet, J. R. R. Ultrafast photoisomerization of an isolated retinoid. Physical Chemistry Chemical Physics 2019, 21,10567-10579.
114. Osterstrom, F. F., Andersen, C., da Silva, G. Mechanistic study of the reaction of $CH_2F_2$ with Cl atoms in the absence and presence of $CH_4$ or $C_2H_6$: Decomposition of $CHF_2OH$ and fate of the $CHF_2O$ radical. Physical Chemistry Chemical Physics 2019, 21, 9376-9383.
113. Bull, J., da Silva, G., Scholz, M., Carrascosa, E., Bieske, E. J. Photoinitiated intramolecular proton transfer in deprotonated para-coumaric acid. Journal of Physical Chemistry A 2019, 123, 4419-4430.

112. Qiu, W., Gurr, P. A., da Silva, G., Qiao, G. G. Insights into the mechanochromism of spiropyran elastomers. Polymer Chemistry 2019, 10, 1650-1659.

111. Jacovella, U., da Silva, G., Bieske, E. J. Unveiling new isomers and rearrangement routs on the $C_7H_8$+ potential energy surface. Journal of Physical Chemistry A 2019, 123, 823-830.

110. da Silva. G. Improved rate coefficient expressions for the reaction of methyl bromide with OH and Cl radicals. Chemical Physics Letters 2018, 706, 371-374.

109. So, S., Wille, U., da Silva. G. Photoisomerization of methyl vinyl ketone and methacrolein in the troposphere: A theoretical investigation of ground state reaction pathways. ACS Earth and Space Chemistry 2018, 2, 753-764.

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## Patents

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## Appendix B

## Brief to Expert

Environmental Defenders Office

29 April 2026

A/Prof Gabriel da Silva
Senior Lecturer
University of Melbourne
Department of Chemical and Biomolecular Engineering

By email: mailto:gdasilva@unimelb.edu.au

**CONFIDENTIAL AND PRIVILEGED**

Dear Associate Professor da Silva

**Brief to Expert – HVO Open Cut Coal Continuation Project (SSD-11826621 and SSD-11826681) Independent Planning Commission public hearing**

1. We act for Lock the Gate Alliance Ltd (**LTGA**) in relation to the proposed Hunter Valley Operations (**HVO**) Open Cut Coal Continuation Project (**Project**) currently proposed by Hunter Valley Operations Pty Ltd (**Proponent**). The Proponent is owned by subsidiary companies of Yancoal and Glencore, as participants in the unincorporated HVO Joint Venture.

2. HVO is an open cut coal mining complex located in the Hunter Valley comprising two mine sites separated by the Hunter River, HVO North and HVO South. The Project represents a continuation of the existing operation with HVO North continuing until 2045 at the current extraction rate of 22 million tonnes per annum, and HVO South continuing until 2042 at a reduced extraction rate of 13 million tonnes per annum. The approval of the Project would result in the release of 809 million tonnes of total CO2e emissions over the life of the project.

3. Our client is a grassroots organisation whose mission is protect Australia's natural, cultural and agricultural resources from inappropriate mining. The major concerns of our client are the impact of the Project on climate change, water, air quality and biodiversity.

4. The Project has progressed through the following steps in the state planning and assessment process under the *Environmental Planning and Assessment Act 1979* (**EP&A Act**) thus far:
    a. Exhibition of Environmental Impact Statement (**EIS**) and receipt of public submissions.
    b. Provision of advice to Department of Planning, Housing and Infrastructure (**Department**) from government agencies in respect of EIS.
    c. Proponent's response to submissions and agency advice.
    d. Proponent application to amend the Project and publication of Amendment Report.

e. Provision of advice to the Department from government agencies in response to the Amendment Report.
f. [Current stage]: Assessment by the Department and provision of additional information about the Project in response to requests from government agencies. Following this, the Department will publish its assessment report, which has not yet occurred.

5. The Independent Planning Commission (**IPC**) will be the consent authority responsible for determining the Project.[1] At the time of this brief, the Minister for Planning has not yet directed that a public hearing should be held before the IPC. However, this is the usual practice in relation to coal projects and we expect that such a direction will be made, with the public hearing taking place between **June and July 2026** (based on current information).

6. The proponent subsequently sought to amend the SSD applications for the Project, as detailed in its Amendment Report dated August 2025.[2]

7. The public hearing removes merits appeal rights to the Land and Environment Court, so it is important the IPC is assisted by expert evidence.

8. Accordingly, our client wishes to retain your services to act as an independent expert to provide an expert report for submission to the IPC and also to present an oral presentation to the IPC at the anticipated public hearing.

**Background**

9. HVO is a multi-pit open cut coal mining complex comprising two mine sites separated by the Hunter River, HVO North and HVO South. While the HVO North and HVO South are approved under separate development consents, they operate as one complex. The following tables summarise the key features of the HVO Continuation Project.

HVO Continuation Project (combined North and South)

| **Feature** | **Proposed by Project** |
|---|---|
| Total coal resource estimate (run of mine (**ROM**) coal) | 430 million tonnes[3] |
| Scope 1 emissions (Mt CO2e) | 15.104[4] |
| Scope 2 emissions (Mt CO2e) | 0.215[5] |
| Scope 3 emissions (Mt CO2e) | 793.763[6] |
| Total GHG Emissions (Mt CO2e) | 809.082[7] |
| Disturbance area (ha) | Total additional area of 950[8] |

[1] As over 50 submissions have been received in respect of the Project: s 4.5(a) *Environmental Planning and Assessment Act 1979* (NSW); cl 2.7(1)(b) *State Environmental Planning Policy (Planning Systems) 2021.*
[2] Amendment Report (August 2025).
[3] Amendment Report, p 36.
[4] Amendment Report, p 69.
[5] Amendment Report, p 69.
[6] Amendment Report, p 70.
[7] Amendment Report, p 70.
[8] Amendment Report, p 32.

HVO North Continuation Project

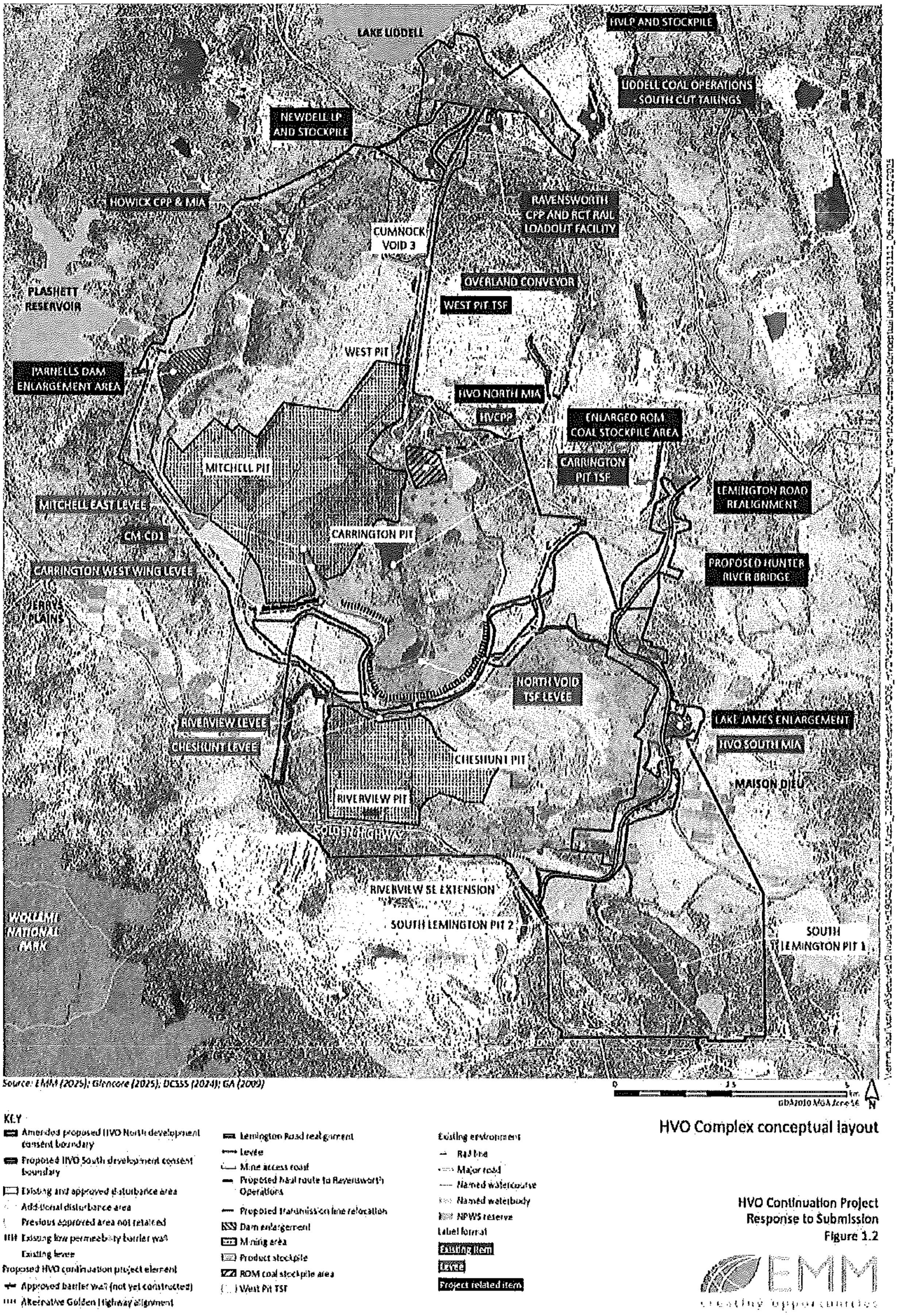
| Feature | Currently Approved | Proposed by Project |
|---|---|---|
| Life of mine | 31 December 2026[9] | 31 December 2045[10] |
| Annual extraction limit (peak rate, million tonnes of ROM coal per annum) | 22 Mtpa ROM coal | No change to total extraction limit.<br><br>Proposes to remove separate extraction limits for West Pit and Carrington Pit.<br><br>Proposes to set a HVO Complex limit of 26 Mtpa ROM coal whilst maintaining limits of up to 22 Mtpa from HVO North and up to 13 Mtpa from HVO South.[11] |
| Total coal resource estimate (ROM coal) | 498Mt ROM coal[12] | Additional 307 Mt to that currently approved, comprising approximately 200 Mt in areas beyond those currently approved for extraction.[13] |
| Disturbance area | 4,965 ha[14] | Additional 903 ha[15] |
| Final void | 3 final voids at Carrington, West, and Mitchell Pits | Two final voids being: one final void associated with the Mitchell Pit and final void in Carrington Pit (evaporative sink) as currently approved.[16] |

[9] Amendment Report, p 7.
[10] Ibid.
[11] Ibid.
[12] Ibid.
[13] Ibid.
[14] Ibid.
[15] Ibid.
[16] Amendment Report, p 12.

HVO South Continuation Project

| Feature | Currently Approved | Proposed by Project |
|---|---|---|
| Life of mine | 24 March 2030[17] | 31 December 2042[18] |
| Annual extraction limit (peak rate, million tonnes of run of mine (**ROM**) coal per annum) | 20 Mtpa ROM Coal[19] | Reduction to 13 Mtpa ROM coal[20] |
| Total coal resource estimate (ROM coal) | 320Mt ROM coal[21] | Additional 122Mt ROM coal[22] |
| Disturbance area | 3, 242 ha[23] | A total additional disturbance area of approximately 47 ha to that currently approved.<br><br>A total reduction in the current approved disturbance area by approximately 267 ha.[24]<br><br>Not proceeding further with Riverview South East Extension, South Lemington Pit 1, and South Lemington Pit 2.<br><br>Removal of the disturbance area associated with the construction of the LCPP and associated rail Facilities. |
| Final void | One final void in Riverview Pit[25] | Retains final void in Riverview Pit with some change to catchment and dimensions.[26] |

[17] Amendment Report, p 18.
[18] Ibid.
[19] Ibid.
[20] Ibid.
[21] Ibid.
[22] Ibid.
[23] Ibid.
[24] Ibid.
[25] Amendment Report, p 20.
[26] Ibid.




HVO Complex conceptual layout

HVO Continuation Project
Response to Submission
Figure 1.2

Emissions profile of the Project

10. The following tables and graphs summarise the latest figures for the Project's emissions profile, which have been revised in its Greenhouse Gas Assessment.[27] The amended Project is estimated to result in a total of about 809 million tonnes of carbon dioxide equivalent (Mt CO2-e) of GHG emissions (between 2027 and 2045) including scope 1, 2 and 3 emissions. It will produce a maximum of about 50 Mt CO2-e of total (scope 1, 2 and 3) annual emissions in 2039 and an annual average of about 43 Mt CO2-e (scope 1, 2 and 3).[28]

11. The term "Scenario 3" is defined on page 23 of 'Appendix E: Greenhouse Gas Assessment' to the Amendment Report and refers to the emissions scenario for the Amendment Project only.

**Table 3.4** **Annual scope 1 and scope 2 emissions (Scenario 3)**

| Calendar year | GHG emissions (kt $CO_2$-e/year) | | |
|---|---|---|---|
| | Scope 1 | Scope 2 | Scope 1 + scope 2 |
| 2027 | 1,082.4 | 42.2 | 1,124.6 |
| 2028 | 1,129.7 | 35.3 | 1,165.0 |
| 2029 | 1,103.8 | 23.2 | 1,127.0 |
| 2030 | 953.9 | 16.2 | 970.1 |
| 2031 | 814.6 | 15.8 | 830.4 |
| 2032 | 919.8 | 13.4 | 933.2 |
| 2033 | 883.6 | 9.4 | 893.0 |
| 2034 | 837.7 | 9.3 | 847.1 |
| 2035 | 932.2 | 7.4 | 939.7 |
| 2036 | 960.8 | 6.4 | 967.2 |
| 2037 | 833.2 | 6.3 | 839.5 |
| 2038 | 803.6 | 6.5 | 810.1 |
| 2039 | 705.0 | 7.1 | 712.1 |
| 2040 | 766.1 | 3.5 | 769.6 |
| 2041 | 796.2 | 3.2 | 799.4 |
| 2042 | 743.5 | 3.4 | 747.0 |
| 2043 | 383.5 | 2.7 | 386.1 |
| 2044 | 271.6 | 2.1 | 273.7 |
| 2045 | 183.0 | 1.3 | 184.4 |
| **Average (kt $CO_2$-e/year)** | **795.0** | **11.3** | **806.3** |
| **Total (kt $CO_2$-e)** | **15,104.2** | **214.9** | **15,319.1** |

[27] Appendix E, Greenhouse Gas Assessment p 25-27.
[28] Amendment Submissions Report, p 46.

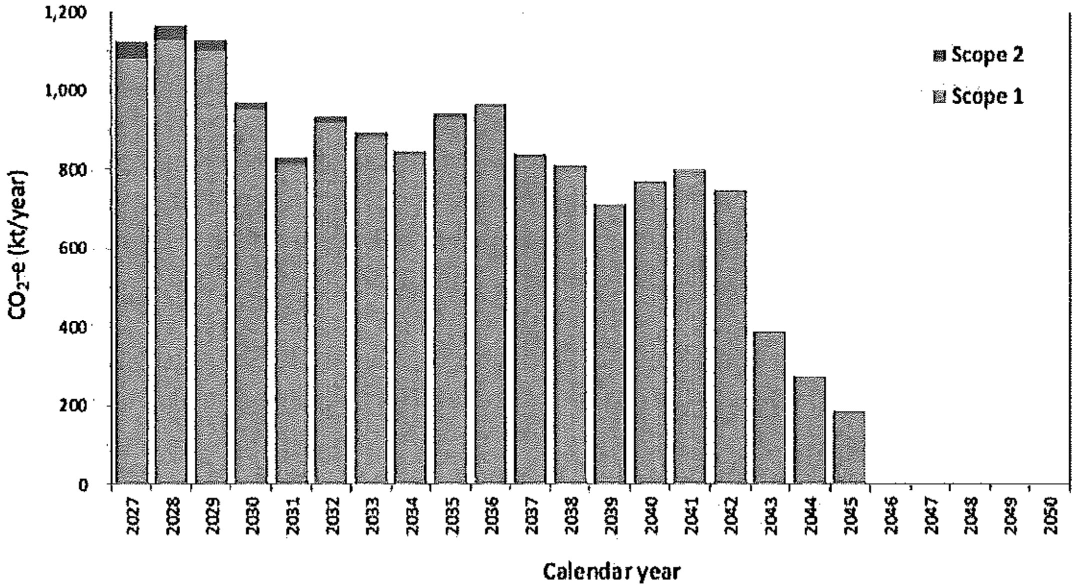



**Figure 3.2** Annual scope 1 and scope 2 emissions (Scenario 3)

**Table 3.5** Annual scope 3 emissions (Scenario 3)

| Calendar year | Scope 3 GHG emissions (kt $CO_2$-e/year) |
|---|---|
| 2027 | 41,171 |
| 2028 | 40,611 |
| 2029 | 42,059 |
| 2030 | 40,197 |
| 2031 | 42,677 |
| 2032 | 42,729 |
| 2033 | 45,294 |
| 2034 | 44,048 |
| 2035 | 46,052 |
| 2036 | 46,142 |
| 2037 | 45,878 |
| 2038 | 46,727 |
| 2039 | 49,153 |
| 2040 | 47,761 |
| 2041 | 42,085 |
| 2042 | 47,143 |
| 2043 | 36,869 |
| 2044 | 28,784 |
| 2045 | 18,379 |
| **Average (kt $CO_2$-e/year)** | **41,777** |
| **Total (kt $CO_2$-e)** | **793,763** |

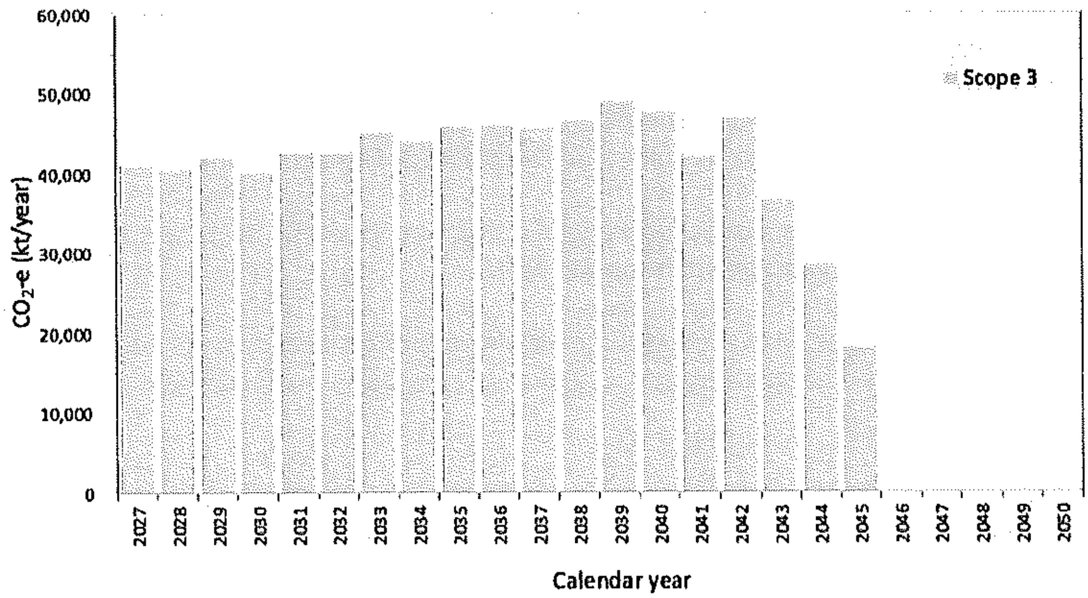



**Figure 3.3** **Annual scope 3 emissions (Scenario 3)**

Agency Comments

12. The Environment Protection Authority (**EPA**) provided advice to the Department on several occasions following the Proponent publishing its Amendment Report. The advice provided recommended conditions that reflected the Proponent's modelled inputs and assumptions used to achieve compliance with the impact assessment criteria.

13. On 6 March 2026, the EPA recommended that the Department clarify with the Proponent if the EPA's proposed conditions were achievable. If not, the EPA stated it may reconsider if the Proponent has transparently provided and modelled the triggers ($PM_{10}$ concentrations and meteorological conditions), actions (activities shutdown) and response (appropriate implementation time) that are required to achieve compliance.

14. The most recent advice on 17 April 2026, requested that the Department provide an opportunity for engagement on any draft conditions of consent. The EPA stated this would allow it the opportunity to understand how any conditions might interact with its regulation under the *Protection of Environment Operations Act 1997*.

**Purpose of your expert report**

15. We note as a preliminary matter that our primary purpose in briefing you to prepare your report is to assist the decision maker for the Project. We do not ask you to be an advocate for our client. You are requested to prepare an independent report that is clear and well-written.

16. In this respect, we draw your attention to Division 2 of Part 31 of the Uniform Civil Procedure Rules 2005 (UCPR), and the Expert Witness Code of Conduct (Code of Conduct) contained in Schedule 7 of the UCPR, both of which govern the use of expert evidence in NSW Courts (attached). We understand that the public hearing is not a Court proceeding, however, we are of the view that the same Code of Conduct should be adhered to in this instance.

17. In particular, clause 2 of the Code of Conduct states that:

> "An expert witness is not an advocate for a party and has a paramount duty, overriding any duty to the party to the proceedings or other person retaining the expert witness, to assist the court impartially on matters relevant to the area of expertise of the witness."

18. Your expert report must contain an acknowledgment that you have read the Expert Witness Code of Conduct and that you agree to be bound by it.

19. Your expert report will be used as evidence-in-chief of your professional opinion. Information of which you believe the decision maker should be aware must be contained in your expert report.

20. In providing your opinion to the decision maker you must set out all the assumptions upon which the opinion is based. This may include, for example, facts observed as a result of fieldwork or 'assumed' facts based on a body of scientific opinion. If the latter, you should provide references which demonstrate the existence of that body of opinion.

21. Your expert report must also set out the process of reasoning which you have undertaken in order to arrive at your conclusions. It is insufficient for an expert report to simply state your opinion or conclusion reached without an explanation as to how this was arrived at. The purpose of providing such assumptions and reasoning is to enable the decision maker and experts engaged by other parties to make an assessment as to the soundness of your opinion.

**Overview of work requested**

22. We request that you undertake the following work:
    a. review the documents listed below;
    b. prepare a written expert report that addresses the issues identified below ('Issues to address in your expert report'), and ensure that the work is prepared in accordance with Part 31, Division 2 of the UCPR; and
    c. appear as an expert witness at the public hearing (if a public hearing is held) for the purpose of giving oral evidence. While the public hearing itself may take place over several days, you are only required to attend to give an oral presentation to the IPC with an estimated duration of 10 to 15 minutes. The presentation can be conducted remotely via videoconference.

**Documents**

23. We enclose the Code of Conduct and Part 31 Division 2 of the UCPR.

24. Full Project documentation is available at the NSW Government Planning Portal for both HVO North and HVO South. As the Project's EIS documentation covers both HVO North and HVO South, the documentation accessible on these pages is identical except for those under 'Agency Advice'.

25. The following documents relating to the Project are provided for your particular consideration:

Environmental Impact Statement – noting the greenhouse gas and social impact assessments have been superseded by the Submissions and Amendment Reports

a. EIS Main Report, including (adopting true page numbers):
   i. Table of contents (p. 25)
   ii. Executive Summary (pp. 5 – 24)
   iii. Part A The Project (pp. 38 – 151)
   iv. Part D Impact Assessment
      1. Section 7 Assessment Approach (pp. 192 – 196)
      2. Section 8 Air Quality (pp. 197 – 212)
      3. Section 22 Hazards, public safety, and health (pp. 434 – 443)
      4. Section 23 Social impacts and benefits (pp. 444 – 462)
   v. Part E Justification and Conclusion (pp. 497 – 511)
   vi. Appendix C – Receptor List
   vii. Appendix D – Mine Plan Options Report and Infrastructure Options and Avoidance Report
   viii. Appendix H – Air Quality and Greenhouse Gas Assessment
   ix. Appendix U – Preliminary Hazard Analysis
   x. Appendix V – Social Impact Assessment

Submissions and Amendment Reports

b. Environment Protection Authority Advice on EIS (6 March 2023)
c. Singleton Council Advice on EIS (30 March 2023)
d. Submissions Report (November 2023) (superseded by the Amendment Submissions Report below)
   i. Appendix B Air modelling results
e. Environment Protection Authority Advice on RTS (Air and Noise) (8 March 2024)
f. Response to RFI (Air and Noise) (12 April 2024)
g. Singleton Council Advice on RTS - Table of Responses (13 March 2024)
h. Environment Protection Authority Additional Advice (Air and Noise) (30 May 2024)
i. Response to EPA Advice on Air Quality and Noise Impacts (13 June 2024)
j. Environment Protection Authority Additional Advice (Air and Noise) (4 July 2024)
k. Department Request for Additional Information (5 July 2024) – *Climate Change (Net Zero Future) Act 2023* (NSW) Guiding Principles and potential amendment to Project
l. Proponent Response to Request for Information and Proposed Project Amendments (26 March 2025)
m. Amendment Report (August 2025)
   ii. Appendix C Updated mitigation measures
   iii. Appendix B Amended Project Description
   iv. Appendix F Air quality impact assessment
   v. Appendix L Social impact assessment
n. Environment Protection Authority advice on Amendment Report (25 September 2025)
o. Amendment Submissions Report (November 2025)
   i. Appendix C Air Quality Letter Report
p. Environment Protection Authority Advice on Additional Information to Amendment Report (15 December 2025)
q. Environment Protection Authority advice on Additional Information to Amendment Report (23 December 2025)
r. DPHI letter responding to Air Quality Assessment (30 January 2026)

s. EPA Advice on Response to Residual Agency Advice (6 March 2026)
t. Response to EPA Advice on Residual Matters (2 April 2026)
u. EPA response on Draft Air Quality Licence Conditions (17 April 2026)

Assessment Report

v. Department's Assessment Report (forthcoming)

26. Please let us know as soon as possible if you require further information for the purpose of giving your expert opinion.

**Issues to address in your expert report**

27. We ask that your report address the following issues:

a. Please describe the basis of your expertise with reference to academic qualifications, professional background and any other training, study or experience that is relevant to this brief (you may wish to do this by reference to a current curriculum vitae).
b. Please summarise any potential impacts to air quality predicted to arise as a consequence of the Project.
c. In your opinion, was the Proponent's air quality assessment of the potential impacts on air quality appropriate and sufficient?
d. In your opinion, have the Proponent's air quality assessments adequately considered any cumulative impacts arising from the Project?
e. In your opinion, are the measures proposed as part of the Project to mitigate and avoid impacts to air quality appropriate and sufficient? Are there any additional and appropriate measures that would minimise those impacts if consent was to be granted to the Project?
f. Provide any further observations or opinions that you consider to be relevant.

28. We may add further questions once we receive the Assessment Report from the Department of Planning.

29. We request that you provide us with a draft of your report for review before finalising it. We emphasise that the purpose of this is not to influence the conclusions or recommendations you make but to ensure that the language and expression of the report is clear and complies with the formal legal requirements of an expert report.

**Key dates**

30. There is some uncertainty as to when the public hearing will take place, however, we expect the public hearing could take place between June and 2026. We will advise you as soon as we have certainty as to timing of the public hearing.
31. We request that you provide your draft expert report for discussion in conference by **Thursday, 4 June 2026.**

**Duty of confidentiality**

32. Please treat your work as strictly confidential until your expert report is provided to the Commission, unless authorised by us.

**Fees and Terms**

33. Thank you for agreeing to provide your advice in this matter on a pro bono (volunteer) basis. EDO relies on experts such as you to assist our client's accessing justice.

34. Please note the following terms:

    a. your work will only be used by EDO to relation to this matter;
    b. our client may choose to make your expert advice publicly available. Any public release of your report, whether by our client or by way of publication on the Commission's website, may result in disclosure of any works in your report over which you may claim copyright;
    c. EDO will take all reasonable steps to prevent your work being used for purposes other than that mentioned above, but we accept no responsibility for the actions of third parties;
    d. regardless of the above points, EDO may choose not to use your work; and
    e. you will not be covered by the EDO's insurance while undertaking the above tasks.

35. If you would like to discuss this brief further, please contact Isobel Brinin on (isobel.brinin@edo.org.au).

We are grateful for your assistance in this matter.

Yours sincerely
**Environmental Defenders Office**

**Isobel Brinin**
Senior Solicitor

**Appendix C**

**PM2.5 Tables**

**Jacobs**

| Receptor | 2029 | | | 2033 | | | 2040 | | |
|---|---|---|---|---|---|---|---|---|---|
| | Background | Project | Total | Background | Project | Total | Background | Project | Total |
| 17 | 5.5 | 0.1 | 5.6 | 5.5 | 0.1 | 5.6 | 5.3 | 0.1 | 5.4 |
| 19 | 5.6 | 0.1 | 5.7 | 5.6 | 0.1 | 5.7 | 5.3 | 0.1 | 5.4 |
| 37 | 5.6 | 0.1 | 5.7 | 5.6 | 0.1 | 5.7 | 5.3 | 0.1 | 5.4 |
| 102 | 9.2 | 0.7 | 9.9 | 8.5 | 0.9 | 9.4 | 5.8 | 0.9 | 6.7 |
| 120 | 6.3 | 0.9 | 7.2 | 6.3 | 0.9 | 7.2 | 5.6 | 1.1 | 6.7 |
| 121 | 6.4 | 1.0 | 7.4 | 6.3 | 1.0 | 7.3 | 5.6 | 1.1 | 6.7 |
| 122 | 6.3 | 0.9 | 7.2 | 6.3 | 0.9 | 7.2 | 5.7 | 1.0 | 6.7 |
| 123 | 6.4 | 0.9 | 7.3 | 6.4 | 0.9 | 7.3 | 5.6 | 1.1 | 6.7 |
| 124 | 6.3 | 0.9 | 7.2 | 6.3 | 0.9 | 7.2 | 5.7 | 1.0 | 6.7 |
| 126 | 6.3 | 0.7 | 7.0 | 6.4 | 0.7 | 7.1 | 5.5 | 0.7 | 6.2 |
| 127 | 6.4 | 0.8 | 7.2 | 6.4 | 0.8 | 7.2 | 5.8 | 0.8 | 6.6 |
| 128 | 6.2 | 0.8 | 7.0 | 6.2 | 0.8 | 7.0 | 5.5 | 0.8 | 6.3 |
| 130 | 6.1 | 0.8 | 6.9 | 6.1 | 0.8 | 6.9 | 5.5 | 0.8 | 6.3 |
| 134 | 6.1 | 0.7 | 6.8 | 6.1 | 0.7 | 6.8 | 5.5 | 0.8 | 6.3 |
| 139 | 6.0 | 0.7 | 6.7 | 6.0 | 0.7 | 6.7 | 5.5 | 0.7 | 6.2 |
| 141 | 6.2 | 0.6 | 6.8 | 6.1 | 0.7 | 6.8 | 5.7 | 0.7 | 6.4 |
| 160 | 6.4 | 0.9 | 7.3 | 6.3 | 1.0 | 7.3 | 5.7 | 1.2 | 6.9 |
| 161 | 6.4 | 0.9 | 7.3 | 6.3 | 1.0 | 7.3 | 5.7 | 1.2 | 6.9 |
| 162 | 6.4 | 0.9 | 7.3 | 6.3 | 1.0 | 7.3 | 5.7 | 1.2 | 6.9 |
| 163 | 6.3 | 0.9 | 7.2 | 6.3 | 1.0 | 7.3 | 5.7 | 1.2 | 6.9 |
| 167 | 6.1 | 0.6 | 6.7 | 6.1 | 0.6 | 6.7 | 5.6 | 0.7 | 6.3 |
| 169 | 6.1 | 0.6 | 6.7 | 6.0 | 0.7 | 6.7 | 5.6 | 0.7 | 6.3 |
| 170 | 6.1 | 0.6 | 6.7 | 6.1 | 0.6 | 6.7 | 5.7 | 0.7 | 6.4 |
| 173 | 5.9 | 0.7 | 6.6 | 5.9 | 0.7 | 6.6 | 5.5 | 0.7 | 6.2 |
| 174 | 6.0 | 0.6 | 6.6 | 6.0 | 0.6 | 6.6 | 5.5 | 0.7 | 6.2 |
| 175 | 6.0 | 0.6 | 6.6 | 6.0 | 0.6 | 6.6 | 5.5 | 0.7 | 6.2 |
| 176 | 5.9 | 0.6 | 6.5 | 5.9 | 0.6 | 6.5 | 5.6 | 0.6 | 6.2 |
| 178 | 5.9 | 0.5 | 6.4 | 5.9 | 0.5 | 6.4 | 5.5 | 0.6 | 6.1 |
| 179 | 5.8 | 0.5 | 6.3 | 5.8 | 0.5 | 6.3 | 5.6 | 0.5 | 6.1 |
| 244 | 6.4 | 0.8 | 7.2 | 6.4 | 0.9 | 7.3 | 5.8 | 1.0 | 6.8 |
| 245 | 6.4 | 0.8 | 7.2 | 6.4 | 0.9 | 7.3 | 5.7 | 1.1 | 6.8 |
| 246 | 6.5 | 0.8 | 7.3 | 6.4 | 0.9 | 7.3 | 5.9 | 1.0 | 6.9 |
| 247 | 6.5 | 0.8 | 7.3 | 6.4 | 0.9 | 7.3 | 5.9 | 1.0 | 6.9 |
| 248 | 5.9 | 0.6 | 6.5 | 5.9 | 0.6 | 6.5 | 5.6 | 0.6 | 6.2 |
| 249 | 6.0 | 0.5 | 6.5 | 5.9 | 0.6 | 6.5 | 5.6 | 0.6 | 6.2 |
| 250 | 5.9 | 0.4 | 6.3 | 5.8 | 0.5 | 6.3 | 5.6 | 0.5 | 6.1 |
| 251 | 5.8 | 0.4 | 6.2 | 5.8 | 0.4 | 6.2 | 5.5 | 0.5 | 6.0 |
| 256 | 6.3 | 0.9 | 7.2 | 6.3 | 1.0 | 7.3 | 5.8 | 1.2 | 7.0 |
| 258 | 6.3 | 0.9 | 7.2 | 6.3 | 1.0 | 7.3 | 5.7 | 1.2 | 6.9 |
| 260 | 6.4 | 0.9 | 7.3 | 6.4 | 0.9 | 7.3 | 5.8 | 1.1 | 6.9 |
| 261 | 6.4 | 0.9 | 7.3 | 6.3 | 1.0 | 7.3 | 5.7 | 1.2 | 6.9 |
| 262 | 6.3 | 0.7 | 7.0 | 6.3 | 0.7 | 7.0 | 5.5 | 0.7 | 6.2 |
| 264 | 9.1 | 0.7 | 9.8 | 8.5 | 0.9 | 9.4 | 5.8 | 0.9 | 6.7 |
| 266 | 5.6 | 0.1 | 5.7 | 5.6 | 0.1 | 5.7 | 5.3 | 0.1 | 5.4 |
| 308 | 6.2 | 0.8 | 7.0 | 7.4 | 0.9 | 8.3 | 6.0 | 1.3 | 7.3 |
| 310 | 6.2 | 0.7 | 6.9 | 7.1 | 0.9 | 8.0 | 6.0 | 1.1 | 7.1 |
| 311 | 6.0 | 0.9 | 6.9 | 6.7 | 1.0 | 7.7 | 5.8 | 1.4 | 7.2 |
| 317 | 6.0 | 0.9 | 6.9 | 6.6 | 1.0 | 7.6 | 5.8 | 1.4 | 7.2 |
| 321 | 5.9 | 0.8 | 6.7 | 6.2 | 0.9 | 7.1 | 5.6 | 1.3 | 6.9 |
| 322 | 5.8 | 0.8 | 6.6 | 6.0 | 0.9 | 6.9 | 5.6 | 1.2 | 6.8 |
| 324 | 5.8 | 0.8 | 6.6 | 6.1 | 0.9 | 7.0 | 5.6 | 1.2 | 6.8 |
| 326 | 5.7 | 0.9 | 6.6 | 5.7 | 1.0 | 6.7 | 5.5 | 1.3 | 6.8 |
| 327 | 5.7 | 0.9 | 6.6 | 5.7 | 1.0 | 6.7 | 5.5 | 1.3 | 6.8 |
| 328 | 5.7 | 0.9 | 6.6 | 5.8 | 1.0 | 6.8 | 5.4 | 1.4 | 6.8 |
| 330 | 5.6 | 0.9 | 6.5 | 5.8 | 0.9 | 6.7 | 5.5 | 1.2 | 6.7 |
| 331 | 5.7 | 0.9 | 6.6 | 5.8 | 1.0 | 6.8 | 5.5 | 1.3 | 6.8 |
| 332 | 5.7 | 0.8 | 6.5 | 5.8 | 0.9 | 6.7 | 5.5 | 1.2 | 6.7 |
| 333 | 5.7 | 0.8 | 6.5 | 5.8 | 0.9 | 6.7 | 5.4 | 1.2 | 6.6 |
| 334 | 5.7 | 0.8 | 6.5 | 5.8 | 0.9 | 6.7 | 5.5 | 1.1 | 6.6 |
| 335 | 5.7 | 0.8 | 6.5 | 5.8 | 0.9 | 6.7 | 5.4 | 1.2 | 6.6 |
| 336 | 5.7 | 0.9 | 6.6 | 5.8 | 0.9 | 6.7 | 5.5 | 1.2 | 6.7 |
| 337 | 5.7 | 0.8 | 6.5 | 5.8 | 0.9 | 6.7 | 5.5 | 1.2 | 6.7 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 338 | 5.8 | 0.8 | 6.6 | 5.8 | 0.9 | 6.7 | 5.5 | 1.2 | 6.7 |
| 339 | 5.7 | 0.8 | 6.5 | 5.8 | 0.8 | 6.6 | 5.5 | 1.0 | 6.5 |
| 340 | 5.7 | 0.8 | 6.5 | 5.8 | 0.8 | 6.6 | 5.4 | 1.1 | 6.5 |
| 341 | 5.7 | 0.8 | 6.5 | 5.8 | 0.8 | 6.6 | 5.4 | 1.1 | 6.5 |
| 342 | 5.7 | 0.8 | 6.5 | 5.9 | 0.8 | 6.7 | 5.5 | 1.1 | 6.6 |
| 343 | 5.7 | 0.8 | 6.5 | 5.9 | 0.8 | 6.7 | 5.5 | 1.1 | 6.6 |
| 344 | 5.7 | 0.8 | 6.5 | 5.9 | 0.8 | 6.7 | 5.5 | 1.1 | 6.6 |
| 345 | 5.7 | 0.8 | 6.5 | 5.8 | 0.9 | 6.7 | 5.5 | 1.1 | 6.6 |
| 346 | 5.7 | 0.8 | 6.5 | 5.8 | 0.9 | 6.7 | 5.4 | 1.2 | 6.6 |
| 347 | 5.8 | 0.8 | 6.6 | 5.9 | 0.9 | 6.8 | 5.5 | 1.2 | 6.7 |
| 348 | 5.8 | 0.8 | 6.6 | 5.8 | 0.9 | 6.7 | 5.5 | 1.2 | 6.7 |
| 349 | 5.7 | 0.8 | 6.5 | 5.8 | 0.9 | 6.7 | 5.5 | 1.2 | 6.7 |
| 350 | 5.7 | 0.8 | 6.5 | 5.8 | 0.9 | 6.7 | 5.5 | 1.2 | 6.7 |
| 351 | 5.8 | 0.8 | 6.6 | 5.9 | 0.9 | 6.8 | 5.5 | 1.2 | 6.7 |
| 352 | 5.8 | 0.8 | 6.6 | 5.9 | 0.9 | 6.8 | 5.5 | 1.2 | 6.7 |
| 353 | 5.8 | 0.8 | 6.6 | 5.9 | 0.9 | 6.8 | 5.5 | 1.2 | 6.7 |
| 355 | 5.8 | 0.8 | 6.6 | 5.9 | 0.9 | 6.8 | 5.5 | 1.2 | 6.7 |
| 356 | 5.8 | 0.8 | 6.6 | 5.9 | 0.9 | 6.8 | 5.5 | 1.2 | 6.7 |
| 357 | 5.7 | 0.8 | 6.5 | 5.8 | 0.9 | 6.7 | 5.5 | 1.2 | 6.7 |
| 358 | 5.8 | 0.8 | 6.6 | 5.9 | 0.9 | 6.8 | 5.5 | 1.2 | 6.7 |
| 359 | 5.8 | 0.8 | 6.6 | 5.9 | 0.9 | 6.8 | 5.5 | 1.2 | 6.7 |
| 360 | 5.8 | 0.8 | 6.6 | 5.9 | 0.9 | 6.8 | 5.5 | 1.2 | 6.7 |
| 361 | 5.7 | 0.9 | 6.6 | 5.9 | 0.9 | 6.8 | 5.4 | 1.3 | 6.7 |
| 362 | 5.7 | 0.9 | 6.6 | 5.9 | 0.9 | 6.8 | 5.4 | 1.3 | 6.7 |
| 363 | 5.8 | 0.8 | 6.6 | 5.9 | 0.9 | 6.8 | 5.5 | 1.2 | 6.7 |
| 366 | 5.8 | 0.8 | 6.6 | 5.9 | 0.9 | 6.8 | 5.5 | 1.2 | 6.7 |
| 367 | 5.8 | 0.8 | 6.6 | 5.9 | 0.9 | 6.8 | 5.5 | 1.2 | 6.7 |
| 368 | 5.8 | 0.8 | 6.6 | 5.9 | 0.9 | 6.8 | 5.5 | 1.2 | 6.7 |
| 369 | 5.8 | 0.8 | 6.6 | 5.9 | 0.9 | 6.8 | 5.5 | 1.2 | 6.7 |
| 370 | 5.7 | 0.8 | 6.5 | 5.8 | 0.9 | 6.7 | 5.5 | 1.2 | 6.7 |
| 371 | 5.7 | 0.8 | 6.5 | 5.9 | 0.9 | 6.8 | 5.4 | 1.2 | 6.6 |
| 372 | 5.7 | 0.8 | 6.5 | 5.9 | 0.8 | 6.7 | 5.5 | 1.1 | 6.6 |
| 373 | 5.7 | 0.8 | 6.5 | 5.9 | 0.9 | 6.8 | 5.5 | 1.2 | 6.7 |
| 374 | 5.7 | 0.8 | 6.5 | 5.9 | 0.9 | 6.8 | 5.4 | 1.2 | 6.6 |
| 375 | 5.7 | 0.8 | 6.5 | 5.9 | 0.9 | 6.8 | 5.4 | 1.2 | 6.6 |
| 376 | 5.8 | 0.8 | 6.6 | 5.9 | 0.9 | 6.8 | 5.5 | 1.2 | 6.7 |
| 377 | 5.8 | 0.8 | 6.6 | 5.9 | 0.9 | 6.8 | 5.5 | 1.2 | 6.7 |
| 380 | 5.7 | 0.8 | 6.5 | 5.9 | 0.9 | 6.8 | 5.5 | 1.1 | 6.6 |
| 381 | 5.7 | 0.8 | 6.5 | 5.9 | 0.9 | 6.8 | 5.4 | 1.2 | 6.6 |
| 382 | 5.7 | 0.8 | 6.5 | 5.9 | 0.9 | 6.8 | 5.4 | 1.2 | 6.6 |
| 383 | 5.8 | 0.8 | 6.6 | 5.9 | 0.9 | 6.8 | 5.5 | 1.2 | 6.7 |
| 384 | 5.7 | 0.8 | 6.5 | 5.9 | 0.9 | 6.8 | 5.5 | 1.2 | 6.7 |
| 385 | 5.7 | 0.8 | 6.5 | 5.9 | 0.9 | 6.8 | 5.5 | 1.1 | 6.6 |
| 386 | 5.7 | 0.8 | 6.5 | 5.9 | 0.8 | 6.7 | 5.5 | 1.1 | 6.6 |
| 389 | 5.8 | 0.8 | 6.6 | 5.9 | 0.9 | 6.8 | 5.5 | 1.2 | 6.7 |
| 390 | 5.8 | 0.8 | 6.6 | 5.9 | 0.9 | 6.8 | 5.5 | 1.2 | 6.7 |
| 391 | 5.8 | 0.8 | 6.6 | 6.0 | 0.9 | 6.9 | 5.5 | 1.2 | 6.7 |
| 392 | 5.8 | 0.8 | 6.6 | 6.0 | 0.9 | 6.9 | 5.5 | 1.2 | 6.7 |
| 393 | 5.8 | 0.8 | 6.6 | 6.0 | 0.9 | 6.9 | 5.5 | 1.2 | 6.7 |
| 394 | 5.8 | 0.8 | 6.6 | 6.0 | 0.9 | 6.9 | 5.5 | 1.2 | 6.7 |
| 395 | 5.8 | 0.8 | 6.6 | 6.0 | 0.9 | 6.9 | 5.5 | 1.2 | 6.7 |
| 396 | 5.7 | 0.8 | 6.5 | 6.0 | 0.8 | 6.8 | 5.5 | 1.1 | 6.6 |
| 397 | 5.8 | 0.8 | 6.6 | 5.9 | 0.9 | 6.8 | 5.5 | 1.2 | 6.7 |
| 398 | 5.7 | 0.8 | 6.5 | 6.0 | 0.8 | 6.8 | 5.5 | 1.1 | 6.6 |
| 399 | 5.8 | 0.8 | 6.6 | 5.9 | 0.9 | 6.8 | 5.5 | 1.2 | 6.7 |
| 400 | 5.8 | 0.8 | 6.6 | 5.9 | 0.9 | 6.8 | 5.5 | 1.2 | 6.7 |
| 401 | 5.8 | 0.8 | 6.6 | 5.9 | 0.9 | 6.8 | 5.5 | 1.2 | 6.7 |
| 402 | 5.8 | 0.8 | 6.6 | 5.9 | 0.9 | 6.8 | 5.5 | 1.2 | 6.7 |
| 403 | 5.8 | 0.8 | 6.6 | 5.9 | 0.9 | 6.8 | 5.5 | 1.2 | 6.7 |
| 404 | 5.7 | 0.8 | 6.5 | 6.0 | 0.8 | 6.8 | 5.5 | 1.1 | 6.6 |
| 405 | 5.8 | 0.8 | 6.6 | 5.9 | 0.9 | 6.8 | 5.5 | 1.2 | 6.7 |
| 406 | 5.8 | 0.8 | 6.6 | 5.9 | 0.9 | 6.8 | 5.5 | 1.2 | 6.7 |
| 407 | 5.7 | 0.8 | 6.5 | 6.0 | 0.8 | 6.8 | 5.5 | 1.1 | 6.6 |
| 408 | 5.7 | 0.8 | 6.5 | 6.0 | 0.8 | 6.8 | 5.5 | 1.1 | 6.6 |
| 409 | 5.7 | 0.8 | 6.5 | 5.9 | 0.8 | 6.7 | 5.5 | 1.1 | 6.6 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 410 | 5.7 | 0.8 | 6.5 | 5.9 | 0.8 | 6.7 | 5.5 | 1.1 | 6.6 |
| 411 | 5.7 | 0.8 | 6.5 | 5.9 | 0.8 | 6.7 | 5.5 | 1.1 | 6.6 |
| 412 | 5.7 | 0.8 | 6.5 | 5.9 | 0.8 | 6.7 | 5.5 | 1.1 | 6.6 |
| 413 | 5.7 | 0.8 | 6.5 | 5.9 | 0.8 | 6.7 | 5.5 | 1.1 | 6.6 |
| 414 | 5.7 | 0.8 | 6.5 | 5.9 | 0.8 | 6.7 | 5.5 | 1.1 | 6.6 |
| 415 | 5.7 | 0.8 | 6.5 | 5.9 | 0.8 | 6.7 | 5.5 | 1.1 | 6.6 |
| 417 | 5.7 | 0.8 | 6.5 | 5.9 | 0.9 | 6.8 | 5.5 | 1.2 | 6.7 |
| 418 | 5.7 | 0.8 | 6.5 | 5.9 | 0.8 | 6.7 | 5.5 | 1.1 | 6.6 |
| 419 | 5.7 | 0.7 | 6.4 | 5.9 | 0.8 | 6.7 | 5.5 | 1.0 | 6.5 |
| 420 | 5.7 | 0.8 | 6.5 | 6.0 | 0.8 | 6.8 | 5.5 | 1.1 | 6.6 |
| 421 | 5.8 | 0.8 | 6.6 | 5.9 | 0.9 | 6.8 | 5.5 | 1.2 | 6.7 |
| 422 | 5.8 | 0.8 | 6.6 | 5.9 | 0.9 | 6.8 | 5.5 | 1.2 | 6.7 |
| 423 | 5.8 | 0.8 | 6.6 | 5.9 | 0.9 | 6.8 | 5.5 | 1.2 | 6.7 |
| 425 | 5.7 | 0.6 | 6.3 | 5.7 | 0.7 | 6.4 | 5.5 | 0.8 | 6.3 |
| 426 | 5.7 | 0.6 | 6.3 | 5.8 | 0.7 | 6.5 | 5.5 | 0.8 | 6.3 |
| 427 | 5.7 | 0.7 | 6.4 | 5.9 | 0.8 | 6.7 | 5.5 | 1.0 | 6.5 |
| 428 | 5.8 | 0.7 | 6.5 | 5.9 | 0.8 | 6.7 | 5.5 | 1.0 | 6.5 |
| 429 | 5.8 | 0.8 | 6.6 | 6.0 | 0.9 | 6.9 | 5.6 | 1.1 | 6.7 |
| 430 | 5.8 | 0.7 | 6.5 | 6.0 | 0.8 | 6.8 | 5.5 | 1.0 | 6.5 |
| 431 | 5.8 | 0.8 | 6.6 | 6.1 | 0.9 | 7.0 | 5.5 | 1.2 | 6.7 |
| 432 | 5.7 | 0.7 | 6.4 | 6.1 | 0.7 | 6.8 | 5.5 | 1.0 | 6.5 |
| 433 | 5.8 | 0.6 | 6.4 | 6.0 | 0.7 | 6.7 | 5.5 | 0.9 | 6.4 |
| 434 | 6.0 | 0.9 | 6.9 | 6.5 | 1.0 | 7.5 | 5.7 | 1.4 | 7.1 |
| 436 | 6.0 | 0.8 | 6.8 | 6.4 | 1.0 | 7.4 | 5.7 | 1.3 | 7.0 |
| 437 | 5.7 | 0.9 | 6.6 | 5.7 | 1.0 | 6.7 | 5.5 | 1.3 | 6.8 |
| 438 | 5.6 | 0.8 | 6.4 | 5.6 | 0.9 | 6.5 | 5.4 | 1.2 | 6.6 |
| 440 | 5.9 | 0.8 | 6.7 | 6.4 | 0.9 | 7.3 | 5.7 | 1.2 | 6.9 |
| 451 | 5.8 | 0.4 | 6.2 | 6.1 | 0.5 | 6.6 | 5.5 | 0.6 | 6.1 |
| 452 | 5.8 | 0.4 | 6.2 | 6.0 | 0.5 | 6.5 | 5.5 | 0.6 | 6.1 |
| 453 | 5.7 | 0.4 | 6.1 | 6.0 | 0.4 | 6.4 | 5.5 | 0.5 | 6.0 |
| 454 | 5.8 | 0.4 | 6.2 | 6.0 | 0.4 | 6.4 | 5.5 | 0.5 | 6.0 |
| 455 | 5.8 | 0.3 | 6.1 | 5.9 | 0.4 | 6.3 | 5.5 | 0.4 | 5.9 |
| 456 | 5.7 | 0.3 | 6.0 | 5.9 | 0.3 | 6.2 | 5.4 | 0.4 | 5.8 |
| 457 | 5.7 | 0.3 | 6.0 | 5.8 | 0.3 | 6.1 | 5.4 | 0.4 | 5.8 |
| 458 | 5.7 | 0.3 | 6.0 | 5.8 | 0.3 | 6.1 | 5.4 | 0.4 | 5.8 |
| 459 | 5.7 | 0.4 | 6.1 | 5.9 | 0.4 | 6.3 | 5.5 | 0.5 | 6.0 |
| 460 | 5.6 | 0.4 | 6.0 | 5.8 | 0.4 | 6.2 | 5.4 | 0.5 | 5.9 |
| 462 | 5.7 | 0.3 | 6.0 | 5.8 | 0.4 | 6.2 | 5.5 | 0.4 | 5.9 |
| 463 | 6.2 | 0.8 | 7.0 | 7.2 | 0.9 | 8.1 | 6.0 | 1.3 | 7.3 |
| 464 | 5.6 | 0.5 | 6.1 | 5.8 | 0.5 | 6.3 | 5.4 | 0.7 | 6.1 |
| 466 | 5.7 | 0.6 | 6.3 | 5.7 | 0.7 | 6.4 | 5.4 | 0.8 | 6.2 |
| 471 | 7.8 | 1.1 | 8.9 | 7.7 | 1.2 | 8.9 | 7.0 | 1.0 | 8.0 |
| 472 | 5.4 | 0.2 | 5.6 | 5.4 | 0.2 | 5.6 | 5.3 | 0.2 | 5.5 |
| 473 | 5.8 | 0.8 | 6.6 | 5.9 | 0.9 | 6.8 | 5.5 | 1.2 | 6.7 |
| 477 | 5.6 | 0.2 | 5.8 | 5.6 | 0.2 | 5.8 | 5.3 | 0.3 | 5.6 |
| 478 | 5.7 | 0.4 | 6.1 | 6.0 | 0.4 | 6.4 | 5.5 | 0.5 | 6.0 |
| 481 | 5.7 | 0.7 | 6.4 | 5.9 | 0.8 | 6.7 | 5.5 | 1.0 | 6.5 |
| 482 | 5.8 | 0.8 | 6.6 | 5.9 | 0.9 | 6.8 | 5.5 | 1.2 | 6.7 |
| 483 | 5.7 | 0.8 | 6.5 | 5.8 | 0.9 | 6.7 | 5.4 | 1.2 | 6.6 |
| 484 | 5.7 | 0.8 | 6.5 | 5.8 | 0.9 | 6.7 | 5.5 | 1.2 | 6.7 |
| 487 | 5.6 | 0.9 | 6.5 | 5.7 | 0.9 | 6.6 | 5.5 | 1.2 | 6.7 |
| 488 | 5.6 | 0.7 | 6.3 | 5.6 | 0.8 | 6.4 | 5.4 | 1.0 | 6.4 |
| 489 | 5.6 | 0.7 | 6.3 | 5.6 | 0.8 | 6.4 | 5.4 | 1.0 | 6.4 |
| 497 | 6.3 | 0.9 | 7.2 | 6.3 | 1.0 | 7.3 | 5.8 | 1.2 | 7.0 |
| 498 | 6.4 | 0.8 | 7.2 | 6.4 | 0.9 | 7.3 | 5.8 | 1.0 | 6.8 |
| 499 | 7.6 | 1.0 | 8.6 | 7.6 | 1.0 | 8.6 | 6.9 | 0.8 | 7.7 |
| 507 | 10.1 | 0.2 | 10.3 | 10.4 | 0.2 | 10.6 | 6.1 | 0.2 | 6.3 |
| 511 | 7.9 | 0.2 | 8.1 | 8.2 | 0.2 | 8.4 | 6.0 | 0.1 | 6.1 |
| 592 | 8.4 | 0.2 | 8.6 | 8.7 | 0.2 | 8.9 | 6.2 | 0.2 | 6.4 |
| 596 | 13.6 | 0.5 | 14.1 | 13.4 | 0.4 | 13.8 | 6.8 | 0.3 | 7.1 |
| 598 | 8.3 | 0.2 | 8.5 | 8.7 | 0.2 | 8.9 | 6.2 | 0.1 | 6.3 |
| 599 | 8.7 | 0.2 | 8.9 | 9.1 | 0.2 | 9.3 | 6.2 | 0.2 | 6.4 |
| 613 | 8.7 | 0.2 | 8.9 | 9.1 | 0.2 | 9.3 | 6.2 | 0.2 | 6.4 |
| 614 | 8.7 | 0.2 | 8.9 | 9.1 | 0.2 | 9.3 | 6.2 | 0.2 | 6.4 |
| 619 | 9.1 | 0.8 | 9.9 | 8.9 | 0.6 | 9.5 | 7.1 | 0.4 | 7.5 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 621 | 9.9 | 0.9 | 10.8 | 9.8 | 0.8 | 10.6 | 7.9 | 0.6 | 8.5 |
| 623 | 8.7 | 1.0 | 9.7 | 8.5 | 0.8 | 9.3 | 7.2 | 0.5 | 7.7 |
| 624 | 9.0 | 0.9 | 9.9 | 8.7 | 0.8 | 9.5 | 7.3 | 0.5 | 7.8 |
| 626 | 9.3 | 0.9 | 10.2 | 9.0 | 0.8 | 9.8 | 7.3 | 0.5 | 7.8 |
| 627 | 9.3 | 0.8 | 10.1 | 9.0 | 0.7 | 9.7 | 7.2 | 0.5 | 7.7 |
| 628 | 9.2 | 0.8 | 10.0 | 8.9 | 0.7 | 9.6 | 7.1 | 0.5 | 7.6 |
| 629 | 9.2 | 0.8 | 10.0 | 8.8 | 0.7 | 9.5 | 7.1 | 0.4 | 7.5 |
| 735 | 14.1 | 0.9 | 15.0 | 11.0 | 0.7 | 11.7 | 7.9 | 0.5 | 8.4 |
| 797 | 13.7 | 0.9 | 14.6 | 10.9 | 0.7 | 11.6 | 8.1 | 0.5 | 8.6 |
| 799 | 13.7 | 0.9 | 14.6 | 10.9 | 0.7 | 11.6 | 8.1 | 0.5 | 8.6 |
| 800 | 13.7 | 0.9 | 14.6 | 10.9 | 0.7 | 11.6 | 8.1 | 0.5 | 8.6 |
| 829 | 6.9 | 0.8 | 7.7 | 6.9 | 0.8 | 7.7 | 5.5 | 0.8 | 6.3 |
| 830 | 7.6 | 0.7 | 8.3 | 7.6 | 0.8 | 8.4 | 5.5 | 0.8 | 6.3 |
| 833 | 8.0 | 3.1 | 11.1 | 7.3 | 3.4 | 10.7 | 5.8 | 3.6 | 9.4 |
| 834 | 5.8 | 0.8 | 6.6 | 6.0 | 0.9 | 6.9 | 5.5 | 1.2 | 6.7 |
| 835 | 5.8 | 0.8 | 6.6 | 5.9 | 0.9 | 6.8 | 5.5 | 1.2 | 6.7 |
| 836 | 5.7 | 0.8 | 6.5 | 5.8 | 0.9 | 6.7 | 5.4 | 1.2 | 6.6 |
| 837 | 5.7 | 0.8 | 6.5 | 5.8 | 0.9 | 6.7 | 5.4 | 1.2 | 6.6 |
| 838 | 5.8 | 0.8 | 6.6 | 5.9 | 0.9 | 6.8 | 5.5 | 1.2 | 6.7 |
| 839 | 5.7 | 0.8 | 6.5 | 6.0 | 0.8 | 6.8 | 5.5 | 1.1 | 6.6 |
| 840 | 5.7 | 0.8 | 6.5 | 5.9 | 0.9 | 6.8 | 5.5 | 1.1 | 6.6 |
| 843 | 5.9 | 0.5 | 6.4 | 5.9 | 0.5 | 6.4 | 5.7 | 0.5 | 6.2 |
| 846 | 6.5 | 0.5 | 7.0 | 6.5 | 0.5 | 7.0 | 6.0 | 0.6 | 6.6 |
| 847 | 6.3 | 0.5 | 6.8 | 6.3 | 0.5 | 6.8 | 5.9 | 0.6 | 6.5 |
| 852 | 6.2 | 0.5 | 6.7 | 6.2 | 0.6 | 6.8 | 5.8 | 0.6 | 6.4 |
| 855 | 5.9 | 0.6 | 6.5 | 5.9 | 0.6 | 6.5 | 5.6 | 0.6 | 6.2 |
| 856 | 6.1 | 0.5 | 6.6 | 6.2 | 0.5 | 6.7 | 5.7 | 0.6 | 6.3 |
| 860 | 10.0 | 0.8 | 10.8 | 9.8 | 0.7 | 10.5 | 7.3 | 0.5 | 7.8 |
| 861 | 10.7 | 0.6 | 11.3 | 10.3 | 0.5 | 10.8 | 7.0 | 0.4 | 7.4 |
| 862 | 10.6 | 0.7 | 11.3 | 10.0 | 0.6 | 10.6 | 7.4 | 0.4 | 7.8 |
| 863 | 10.7 | 0.7 | 11.4 | 10.1 | 0.6 | 10.7 | 7.3 | 0.4 | 7.7 |
| 869 | 6.9 | 1.0 | 7.9 | 6.9 | 1.1 | 8.0 | 6.3 | 1.1 | 7.4 |
| 870 | 7.0 | 0.9 | 7.9 | 7.0 | 1.0 | 8.0 | 6.4 | 1.0 | 7.4 |
| 947 | 6.3 | 0.9 | 7.2 | 6.3 | 1.0 | 7.3 | 5.8 | 1.2 | 7.0 |
| 949 | 6.3 | 0.9 | 7.2 | 6.3 | 1.0 | 7.3 | 5.8 | 1.2 | 7.0 |
| 950 | 6.3 | 0.9 | 7.2 | 6.3 | 1.0 | 7.3 | 5.8 | 1.2 | 7.0 |

**Airen**

| Receptor | 2029 Background | 2029 Project | 2029 Total | 2034 Background | 2034 Project | 2034 Total | 2041 Background | 2041 Project | 2041 Total |
|---|---|---|---|---|---|---|---|---|---|
| 17 | 4.7 | 0.1 | 4.8 | 4.7 | 0.1 | 4.8 | 4.2 | 0.1 | 4.3 |
| 19 | 4.7 | 0.1 | 4.8 | 4.7 | 0.1 | 4.8 | 4.2 | 0.1 | 4.3 |
| 37 | 4.8 | 0.1 | 4.9 | 4.8 | 0.1 | 4.9 | 4.2 | 0.1 | 4.3 |
| 102 | 9.8 | 0.9 | 10.7 | 9.8 | 0.7 | 10.5 | 6.4 | 0.5 | 6.9 |
| 120 | 5.6 | 0.9 | 6.5 | 5.6 | 0.8 | 6.4 | 4.2 | 0.8 | 5.0 |
| 121 | 5.7 | 1.1 | 6.8 | 5.7 | 0.8 | 6.5 | 4.3 | 0.7 | 5.0 |
| 122 | 5.6 | 0.9 | 6.5 | 5.6 | 0.8 | 6.4 | 4.2 | 0.8 | 5.0 |
| 123 | 5.7 | 1.0 | 6.7 | 5.7 | 0.8 | 6.5 | 4.3 | 0.7 | 5.0 |
| 124 | 5.6 | 0.9 | 6.5 | 5.6 | 0.8 | 6.4 | 4.2 | 0.8 | 5.0 |
| 126 | 5.7 | 0.8 | 6.5 | 5.7 | 0.6 | 6.3 | 4.3 | 0.4 | 4.7 |
| 127 | 6.0 | 0.8 | 6.8 | 6.0 | 0.7 | 6.7 | 4.2 | 0.6 | 4.8 |
| 128 | 5.7 | 0.9 | 6.6 | 5.6 | 0.7 | 6.3 | 4.2 | 0.5 | 4.7 |
| 130 | 5.4 | 0.9 | 6.3 | 4.5 | 0.6 | 5.1 | 4.2 | 0.5 | 4.7 |
| 134 | 5.4 | 0.8 | 6.2 | 5.4 | 0.6 | 6.0 | 4.2 | 0.5 | 4.7 |
| 139 | 5.3 | 0.8 | 6.1 | 5.3 | 0.6 | 5.9 | 4.3 | 0.4 | 4.7 |
| 141 | 5.5 | 0.6 | 6.1 | 5.5 | 0.6 | 6.1 | 4.2 | 0.5 | 4.7 |
| 160 | 5.6 | 0.9 | 6.5 | 5.6 | 0.8 | 6.4 | 4.2 | 0.9 | 5.1 |
| 161 | 5.7 | 0.8 | 6.5 | 5.7 | 0.8 | 6.5 | 4.3 | 0.9 | 5.2 |
| 162 | 5.7 | 0.8 | 6.5 | 5.7 | 0.8 | 6.5 | 4.2 | 0.9 | 5.1 |
| 163 | 5.6 | 0.8 | 6.4 | 5.6 | 0.8 | 6.4 | 4.2 | 0.9 | 5.1 |
| 167 | 5.4 | 0.6 | 6.0 | 5.5 | 0.5 | 6.0 | 4.2 | 0.5 | 4.7 |
| 169 | 5.4 | 0.6 | 6.0 | 5.4 | 0.6 | 6.0 | 4.2 | 0.5 | 4.7 |
| 170 | 5.5 | 0.6 | 6.1 | 5.6 | 0.5 | 6.1 | 4.2 | 0.5 | 4.7 |
| 173 | 5.2 | 0.7 | 5.9 | 5.2 | 0.6 | 5.8 | 4.2 | 0.5 | 4.7 |
| 174 | 5.1 | 0.7 | 5.8 | 5.2 | 0.5 | 5.7 | 4.3 | 0.4 | 4.7 |
| 175 | 5.2 | 0.6 | 5.8 | 5.2 | 0.5 | 5.7 | 4.2 | 0.5 | 4.7 |
| 176 | 5.1 | 0.6 | 5.7 | 5.2 | 0.5 | 5.7 | 4.2 | 0.4 | 4.6 |
| 178 | 5.1 | 0.5 | 5.6 | 5.0 | 0.5 | 5.5 | 4.2 | 0.4 | 4.6 |
| 179 | 4.9 | 0.5 | 5.4 | 5.0 | 0.4 | 5.4 | 4.2 | 0.4 | 4.6 |
| 244 | 5.7 | 0.8 | 6.5 | 5.7 | 0.8 | 6.5 | 4.2 | 0.8 | 5.0 |
| 245 | 5.6 | 0.8 | 6.4 | 5.7 | 0.8 | 6.5 | 4.3 | 0.8 | 5.1 |
| 246 | 5.7 | 0.8 | 6.5 | 5.7 | 0.8 | 6.5 | 4.3 | 0.8 | 5.1 |
| 247 | 5.7 | 0.8 | 6.5 | 5.8 | 0.8 | 6.6 | 4.3 | 0.8 | 5.1 |
| 248 | 5.1 | 0.6 | 5.7 | 5.1 | 0.5 | 5.6 | 4.2 | 0.4 | 4.6 |
| 249 | 5.2 | 0.5 | 5.7 | 5.1 | 0.5 | 5.6 | 4.2 | 0.4 | 4.6 |
| 250 | 5.0 | 0.4 | 5.4 | 4.9 | 0.4 | 5.3 | 4.2 | 0.4 | 4.6 |
| 251 | 4.9 | 0.4 | 5.3 | 4.8 | 0.4 | 5.2 | 4.1 | 0.4 | 4.5 |
| 256 | 5.5 | 0.8 | 6.3 | 5.6 | 0.8 | 6.4 | 4.3 | 0.9 | 5.2 |
| 258 | 5.6 | 0.8 | 6.4 | 5.6 | 0.8 | 6.4 | 4.2 | 0.9 | 5.1 |
| 260 | 5.7 | 0.8 | 6.5 | 5.7 | 0.8 | 6.5 | 4.2 | 0.9 | 5.1 |
| 261 | 5.6 | 0.9 | 6.5 | 5.7 | 0.8 | 6.5 | 4.2 | 0.9 | 5.1 |
| 262 | 5.7 | 0.8 | 6.5 | 5.7 | 0.6 | 6.3 | 4.3 | 0.4 | 4.7 |
| 264 | 9.8 | 0.8 | 10.6 | 9.8 | 0.7 | 10.5 | 6.2 | 0.5 | 6.7 |
| 266 | 4.6 | 0.1 | 4.7 | 4.6 | 0.1 | 4.7 | 4.3 | 0.1 | 4.4 |
| 308 | 5.4 | 1.0 | 6.4 | 5.4 | 1.0 | 6.4 | 5.0 | 1.0 | 6.0 |
| 310 | 5.1 | 0.9 | 6.0 | 5.3 | 1.0 | 6.3 | 5.0 | 0.9 | 5.9 |
| 311 | 5.2 | 1.2 | 6.4 | 5.2 | 1.2 | 6.4 | 4.8 | 1.2 | 6.0 |
| 317 | 5.2 | 1.2 | 6.4 | 5.1 | 1.2 | 6.3 | 4.7 | 1.2 | 5.9 |
| 321 | 5.0 | 1.1 | 6.1 | 5.0 | 1.1 | 6.1 | 4.6 | 1.1 | 5.7 |
| 322 | 4.9 | 1.1 | 6.0 | 5.0 | 1.0 | 6.0 | 4.6 | 1.0 | 5.6 |
| 324 | 4.9 | 1.1 | 6.0 | 4.9 | 1.1 | 6.0 | 4.6 | 1.0 | 5.6 |
| 326 | 4.7 | 1.1 | 5.8 | 4.7 | 1.1 | 5.8 | 4.4 | 1.0 | 5.4 |
| 327 | 4.7 | 1.1 | 5.8 | 4.7 | 1.1 | 5.8 | 4.4 | 1.0 | 5.4 |
| 328 | 4.8 | 1.1 | 5.9 | 4.8 | 1.1 | 5.9 | 4.5 | 1.0 | 5.5 |
| 330 | 4.7 | 1.1 | 5.8 | 4.8 | 1.0 | 5.8 | 4.4 | 1.0 | 5.4 |
| 331 | 4.8 | 1.1 | 5.9 | 4.8 | 1.1 | 5.9 | 4.5 | 1.0 | 5.5 |
| 332 | 4.8 | 1.0 | 5.8 | 4.8 | 1.0 | 5.8 | 4.4 | 1.0 | 5.4 |
| 333 | 4.8 | 1.0 | 5.8 | 4.8 | 1.0 | 5.8 | 4.5 | 0.9 | 5.4 |
| 334 | 4.8 | 1.0 | 5.8 | 4.7 | 1.0 | 5.7 | 4.5 | 0.9 | 5.4 |
| 335 | 4.8 | 1.0 | 5.8 | 4.8 | 1.0 | 5.8 | 4.5 | 0.9 | 5.4 |
| 336 | 4.8 | 1.1 | 5.9 | 4.8 | 1.0 | 5.8 | 4.4 | 1.0 | 5.4 |
| 337 | 4.8 | 1.0 | 5.8 | 4.8 | 1.0 | 5.8 | 4.4 | 1.0 | 5.4 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 338 | 4.8 | 1.1 | 5.9 | 4.8 | 1.0 | 5.8 | 4.5 | 1.0 | 5.5 |
| 339 | 4.8 | 0.9 | 5.7 | 4.8 | 0.9 | 5.7 | 4.4 | 0.9 | 5.3 |
| 340 | 4.8 | 0.9 | 5.7 | 4.8 | 0.9 | 5.7 | 4.4 | 0.9 | 5.3 |
| 341 | 4.7 | 1.0 | 5.7 | 4.8 | 0.9 | 5.7 | 4.4 | 0.9 | 5.3 |
| 342 | 4.7 | 1.0 | 5.7 | 4.7 | 1.0 | 5.7 | 4.5 | 0.9 | 5.4 |
| 343 | 4.8 | 1.0 | 5.8 | 4.7 | 1.0 | 5.7 | 4.5 | 0.9 | 5.4 |
| 344 | 4.8 | 1.0 | 5.8 | 4.8 | 1.0 | 5.8 | 4.5 | 0.9 | 5.4 |
| 345 | 4.8 | 1.0 | 5.8 | 4.8 | 1.0 | 5.8 | 4.5 | 0.9 | 5.4 |
| 346 | 4.8 | 1.0 | 5.8 | 4.8 | 1.0 | 5.8 | 4.5 | 0.9 | 5.4 |
| 347 | 4.8 | 1.1 | 5.9 | 4.8 | 1.0 | 5.8 | 4.5 | 1.0 | 5.5 |
| 348 | 4.8 | 1.1 | 5.9 | 4.8 | 1.0 | 5.8 | 4.4 | 1.0 | 5.4 |
| 349 | 4.8 | 1.0 | 5.8 | 4.8 | 1.0 | 5.8 | 4.4 | 1.0 | 5.4 |
| 350 | 4.9 | 1.0 | 5.9 | 4.8 | 1.0 | 5.8 | 4.4 | 1.0 | 5.4 |
| 351 | 4.8 | 1.1 | 5.9 | 4.8 | 1.0 | 5.8 | 4.5 | 1.0 | 5.5 |
| 352 | 4.8 | 1.1 | 5.9 | 4.9 | 1.0 | 5.9 | 4.5 | 1.0 | 5.5 |
| 353 | 4.8 | 1.1 | 5.9 | 4.9 | 1.0 | 5.9 | 4.5 | 1.0 | 5.5 |
| 355 | 4.8 | 1.1 | 5.9 | 4.9 | 1.0 | 5.9 | 4.5 | 1.0 | 5.5 |
| 356 | 4.8 | 1.1 | 5.9 | 4.8 | 1.0 | 5.8 | 4.5 | 1.0 | 5.5 |
| 357 | 4.9 | 1.0 | 5.9 | 4.8 | 1.0 | 5.8 | 4.4 | 1.0 | 5.4 |
| 358 | 4.9 | 1.0 | 5.9 | 4.8 | 1.0 | 5.8 | 4.4 | 1.0 | 5.4 |
| 359 | 4.8 | 1.1 | 5.9 | 4.9 | 1.0 | 5.9 | 4.5 | 1.0 | 5.5 |
| 360 | 4.8 | 1.1 | 5.9 | 4.8 | 1.1 | 5.9 | 4.5 | 1.0 | 5.5 |
| 361 | 4.8 | 1.1 | 5.9 | 4.8 | 1.1 | 5.9 | 4.5 | 1.0 | 5.5 |
| 362 | 4.8 | 1.1 | 5.9 | 4.8 | 1.1 | 5.9 | 4.5 | 1.0 | 5.5 |
| 363 | 4.8 | 1.1 | 5.9 | 4.8 | 1.1 | 5.9 | 4.5 | 1.0 | 5.5 |
| 366 | 4.8 | 1.1 | 5.9 | 4.9 | 1.0 | 5.9 | 4.5 | 1.0 | 5.5 |
| 367 | 4.8 | 1.1 | 5.9 | 4.8 | 1.0 | 5.8 | 4.5 | 1.0 | 5.5 |
| 368 | 4.8 | 1.1 | 5.9 | 4.9 | 1.0 | 5.9 | 4.5 | 1.0 | 5.5 |
| 369 | 4.8 | 1.1 | 5.9 | 4.9 | 1.0 | 5.9 | 4.5 | 1.0 | 5.5 |
| 370 | 4.8 | 1.0 | 5.8 | 4.8 | 1.0 | 5.8 | 4.4 | 1.0 | 5.4 |
| 371 | 4.8 | 1.0 | 5.8 | 4.8 | 1.0 | 5.8 | 4.5 | 0.9 | 5.4 |
| 372 | 4.8 | 1.0 | 5.8 | 4.8 | 1.0 | 5.8 | 4.5 | 0.9 | 5.4 |
| 373 | 4.9 | 1.0 | 5.9 | 4.8 | 1.0 | 5.8 | 4.4 | 1.0 | 5.4 |
| 374 | 4.8 | 1.0 | 5.8 | 4.8 | 1.0 | 5.8 | 4.5 | 0.9 | 5.4 |
| 375 | 4.8 | 1.0 | 5.8 | 4.8 | 1.0 | 5.8 | 4.5 | 0.9 | 5.4 |
| 376 | 4.8 | 1.1 | 5.9 | 4.9 | 1.0 | 5.9 | 4.5 | 1.0 | 5.5 |
| 377 | 4.8 | 1.1 | 5.9 | 4.9 | 1.0 | 5.9 | 4.5 | 1.0 | 5.5 |
| 380 | 4.8 | 1.0 | 5.8 | 4.8 | 1.0 | 5.8 | 4.6 | 0.9 | 5.5 |
| 381 | 4.9 | 1.0 | 5.9 | 4.8 | 1.0 | 5.8 | 4.5 | 1.0 | 5.5 |
| 382 | 4.9 | 1.0 | 5.9 | 4.8 | 1.0 | 5.8 | 4.5 | 1.0 | 5.5 |
| 383 | 4.9 | 1.0 | 5.9 | 4.9 | 1.0 | 5.9 | 4.5 | 1.0 | 5.5 |
| 384 | 4.9 | 1.0 | 5.9 | 4.8 | 1.0 | 5.8 | 4.5 | 1.0 | 5.5 |
| 385 | 4.8 | 1.0 | 5.8 | 4.8 | 1.0 | 5.8 | 4.5 | 0.9 | 5.4 |
| 386 | 4.8 | 1.0 | 5.8 | 4.8 | 1.0 | 5.8 | 4.5 | 0.9 | 5.4 |
| 389 | 4.8 | 1.1 | 5.9 | 4.9 | 1.0 | 5.9 | 4.5 | 1.0 | 5.5 |
| 390 | 4.8 | 1.1 | 5.9 | 4.9 | 1.0 | 5.9 | 4.5 | 1.0 | 5.5 |
| 391 | 4.8 | 1.1 | 5.9 | 4.9 | 1.0 | 5.9 | 4.5 | 1.0 | 5.5 |
| 392 | 4.8 | 1.1 | 5.9 | 4.9 | 1.0 | 5.9 | 4.5 | 1.0 | 5.5 |
| 393 | 4.8 | 1.1 | 5.9 | 4.9 | 1.0 | 5.9 | 4.5 | 1.0 | 5.5 |
| 394 | 4.9 | 1.0 | 5.9 | 4.9 | 1.0 | 5.9 | 4.5 | 1.0 | 5.5 |
| 395 | 4.9 | 1.1 | 6.0 | 4.8 | 1.1 | 5.9 | 4.5 | 1.0 | 5.5 |
| 396 | 4.8 | 1.0 | 5.8 | 4.9 | 0.9 | 5.8 | 4.5 | 0.9 | 5.4 |
| 397 | 4.9 | 1.0 | 5.9 | 4.9 | 1.0 | 5.9 | 4.5 | 1.0 | 5.5 |
| 398 | 4.8 | 1.0 | 5.8 | 4.8 | 1.0 | 5.8 | 4.5 | 0.9 | 5.4 |
| 399 | 4.9 | 1.0 | 5.9 | 4.9 | 1.0 | 5.9 | 4.5 | 1.0 | 5.5 |
| 400 | 4.9 | 1.0 | 5.9 | 4.9 | 1.0 | 5.9 | 4.5 | 1.0 | 5.5 |
| 401 | 4.9 | 1.0 | 5.9 | 4.9 | 1.0 | 5.9 | 4.5 | 1.0 | 5.5 |
| 402 | 4.9 | 1.0 | 5.9 | 4.9 | 1.0 | 5.9 | 4.5 | 1.0 | 5.5 |
| 403 | 4.9 | 1.0 | 5.9 | 4.9 | 1.0 | 5.9 | 4.5 | 1.0 | 5.5 |
| 404 | 4.8 | 1.0 | 5.8 | 4.8 | 1.0 | 5.8 | 4.5 | 0.9 | 5.4 |
| 405 | 4.9 | 1.0 | 5.9 | 4.9 | 1.0 | 5.9 | 4.5 | 1.0 | 5.5 |
| 406 | 4.9 | 1.0 | 5.9 | 4.9 | 1.0 | 5.9 | 4.5 | 1.0 | 5.5 |
| 407 | 4.8 | 1.0 | 5.8 | 4.8 | 1.0 | 5.8 | 4.5 | 0.9 | 5.4 |
| 408 | 4.8 | 1.0 | 5.8 | 4.8 | 1.0 | 5.8 | 4.5 | 0.9 | 5.4 |
| 409 | 4.8 | 1.0 | 5.8 | 4.8 | 1.0 | 5.8 | 4.5 | 0.9 | 5.4 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 410 | 4.8 | 1.0 | 5.8 | 4.8 | 1.0 | 5.8 | 4.5 | 0.9 | 5.4 |
| 411 | 4.8 | 1.0 | 5.8 | 4.8 | 1.0 | 5.8 | 4.5 | 0.9 | 5.4 |
| 412 | 4.8 | 1.0 | 5.8 | 4.9 | 0.9 | 5.8 | 4.5 | 0.9 | 5.4 |
| 413 | 4.9 | 0.9 | 5.8 | 4.9 | 0.9 | 5.8 | 4.5 | 0.9 | 5.4 |
| 414 | 4.9 | 0.9 | 5.8 | 4.9 | 0.9 | 5.8 | 4.5 | 0.9 | 5.4 |
| 415 | 4.8 | 1.0 | 5.8 | 4.9 | 0.9 | 5.8 | 4.5 | 0.9 | 5.4 |
| 417 | 4.9 | 1.0 | 5.9 | 4.8 | 1.0 | 5.8 | 4.4 | 1.0 | 5.4 |
| 418 | 4.8 | 1.0 | 5.8 | 4.8 | 1.0 | 5.8 | 4.5 | 0.9 | 5.4 |
| 419 | 4.8 | 0.9 | 5.7 | 4.8 | 0.9 | 5.7 | 4.4 | 0.9 | 5.3 |
| 420 | 4.8 | 1.0 | 5.8 | 4.8 | 1.0 | 5.8 | 4.5 | 0.9 | 5.4 |
| 421 | 4.8 | 1.1 | 5.9 | 4.9 | 1.0 | 5.9 | 4.5 | 1.0 | 5.5 |
| 422 | 4.8 | 1.1 | 5.9 | 4.9 | 1.0 | 5.9 | 4.5 | 1.0 | 5.5 |
| 423 | 4.8 | 1.1 | 5.9 | 4.9 | 1.0 | 5.9 | 4.5 | 1.0 | 5.5 |
| 425 | 4.7 | 0.7 | 5.4 | 4.7 | 0.7 | 5.4 | 4.4 | 0.7 | 5.1 |
| 426 | 4.7 | 0.7 | 5.4 | 4.8 | 0.7 | 5.5 | 4.4 | 0.7 | 5.1 |
| 427 | 4.8 | 0.8 | 5.6 | 4.8 | 0.9 | 5.7 | 4.5 | 0.8 | 5.3 |
| 428 | 4.8 | 0.9 | 5.7 | 4.8 | 0.9 | 5.7 | 4.5 | 0.9 | 5.4 |
| 429 | 4.9 | 1.0 | 5.9 | 4.9 | 1.0 | 5.9 | 4.5 | 1.0 | 5.5 |
| 430 | 4.8 | 0.9 | 5.7 | 4.8 | 0.9 | 5.7 | 4.5 | 0.9 | 5.4 |
| 431 | 4.9 | 1.0 | 5.9 | 4.9 | 1.0 | 5.9 | 4.6 | 1.0 | 5.6 |
| 432 | 4.8 | 0.8 | 5.6 | 4.8 | 0.8 | 5.6 | 4.5 | 0.8 | 5.3 |
| 433 | 4.8 | 0.7 | 5.5 | 4.9 | 0.7 | 5.6 | 4.5 | 0.7 | 5.2 |
| 434 | 5.2 | 1.2 | 6.4 | 5.1 | 1.2 | 6.3 | 4.7 | 1.2 | 5.9 |
| 436 | 5.1 | 1.1 | 6.2 | 5.1 | 1.1 | 6.2 | 4.7 | 1.1 | 5.8 |
| 437 | 4.7 | 1.1 | 5.8 | 4.8 | 1.0 | 5.8 | 4.4 | 1.0 | 5.4 |
| 438 | 4.7 | 0.9 | 5.6 | 4.7 | 0.9 | 5.6 | 4.3 | 0.9 | 5.2 |
| 440 | 5.0 | 1.0 | 6.0 | 5.0 | 1.0 | 6.0 | 4.7 | 1.0 | 5.7 |
| 451 | 4.8 | 0.5 | 5.3 | 4.8 | 0.5 | 5.3 | 4.5 | 0.5 | 5.0 |
| 452 | 4.8 | 0.5 | 5.3 | 4.8 | 0.5 | 5.3 | 4.5 | 0.5 | 5.0 |
| 453 | 4.8 | 0.4 | 5.2 | 4.8 | 0.4 | 5.2 | 4.5 | 0.4 | 4.9 |
| 454 | 4.8 | 0.4 | 5.2 | 4.8 | 0.4 | 5.2 | 4.6 | 0.4 | 5.0 |
| 455 | 4.7 | 0.4 | 5.1 | 4.7 | 0.4 | 5.1 | 4.5 | 0.4 | 4.9 |
| 456 | 4.7 | 0.3 | 5.0 | 4.6 | 0.4 | 5.0 | 4.5 | 0.3 | 4.8 |
| 457 | 4.7 | 0.3 | 5.0 | 4.6 | 0.4 | 5.0 | 4.5 | 0.3 | 4.8 |
| 458 | 4.6 | 0.3 | 4.9 | 4.6 | 0.4 | 5.0 | 4.4 | 0.3 | 4.7 |
| 459 | 4.7 | 0.4 | 5.1 | 4.8 | 0.4 | 5.2 | 4.5 | 0.4 | 4.9 |
| 460 | 4.7 | 0.4 | 5.1 | 4.7 | 0.4 | 5.1 | 4.4 | 0.4 | 4.8 |
| 462 | 4.6 | 0.4 | 5.0 | 4.6 | 0.4 | 5.0 | 4.4 | 0.4 | 4.8 |
| 463 | 5.4 | 1.0 | 6.4 | 5.4 | 1.0 | 6.4 | 5.0 | 1.0 | 6.0 |
| 464 | 4.6 | 0.6 | 5.2 | 4.7 | 0.6 | 5.3 | 4.4 | 0.6 | 5.0 |
| 466 | 4.7 | 0.7 | 5.4 | 4.7 | 0.7 | 5.4 | 4.4 | 0.7 | 5.1 |
| 471 | 6.4 | 0.9 | 7.3 | 6.5 | 1.2 | 7.7 | 4.2 | 0.9 | 5.1 |
| 472 | 4.4 | 0.2 | 4.6 | 4.4 | 0.2 | 4.6 | 4.2 | 0.2 | 4.4 |
| 473 | 4.9 | 1.0 | 5.9 | 4.9 | 1.0 | 5.9 | 4.5 | 1.0 | 5.5 |
| 477 | 4.6 | 0.2 | 4.8 | 4.5 | 0.3 | 4.8 | 4.3 | 0.3 | 4.6 |
| 478 | 4.8 | 0.4 | 5.2 | 4.8 | 0.4 | 5.2 | 4.5 | 0.4 | 4.9 |
| 481 | 4.8 | 0.8 | 5.6 | 4.8 | 0.9 | 5.7 | 4.5 | 0.8 | 5.3 |
| 482 | 4.8 | 1.1 | 5.9 | 4.9 | 1.0 | 5.9 | 4.5 | 1.0 | 5.5 |
| 483 | 4.8 | 1.0 | 5.8 | 4.8 | 1.0 | 5.8 | 4.5 | 0.9 | 5.4 |
| 484 | 4.8 | 1.0 | 5.8 | 4.8 | 1.0 | 5.8 | 4.4 | 1.0 | 5.4 |
| 487 | 4.7 | 1.0 | 5.7 | 4.7 | 1.0 | 5.7 | 4.4 | 0.9 | 5.3 |
| 488 | 4.7 | 0.8 | 5.5 | 4.6 | 0.8 | 5.4 | 4.3 | 0.8 | 5.1 |
| 489 | 4.7 | 0.8 | 5.5 | 4.7 | 0.8 | 5.5 | 4.3 | 0.8 | 5.1 |
| 497 | 5.5 | 0.8 | 6.3 | 5.6 | 0.8 | 6.4 | 4.3 | 0.9 | 5.2 |
| 498 | 5.7 | 0.8 | 6.5 | 5.7 | 0.8 | 6.5 | 4.3 | 0.8 | 5.1 |
| 499 | 6.2 | 0.8 | 7.0 | 6.3 | 1.0 | 7.3 | 4.1 | 0.8 | 4.9 |
| 507 | 8.4 | 0.2 | 8.6 | 8.4 | 0.2 | 8.6 | 4.2 | 0.1 | 4.3 |
| 511 | 6.4 | 0.2 | 6.6 | 6.4 | 0.2 | 6.6 | 4.2 | 0.1 | 4.3 |
| 592 | 6.8 | 0.2 | 7.0 | 6.8 | 0.2 | 7.0 | 4.2 | 0.1 | 4.3 |
| 596 | 11.9 | 0.4 | 12.3 | 11.8 | 0.5 | 12.3 | 4.1 | 0.3 | 4.4 |
| 598 | 7.0 | 0.2 | 7.2 | 7.0 | 0.2 | 7.2 | 4.2 | 0.1 | 4.3 |
| 599 | 7.5 | 0.2 | 7.7 | 7.5 | 0.2 | 7.7 | 4.2 | 0.1 | 4.3 |
| 613 | 7.5 | 0.2 | 7.7 | 7.5 | 0.2 | 7.7 | 4.2 | 0.1 | 4.3 |
| 614 | 7.5 | 0.2 | 7.7 | 7.5 | 0.2 | 7.7 | 4.2 | 0.1 | 4.3 |
| 619 | 7.2 | 0.6 | 7.8 | 7.2 | 0.7 | 7.9 | 4.2 | 0.4 | 4.6 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 621 | 8.8 | 0.7 | 9.5 | 8.8 | 0.9 | 9.7 | 4.1 | 0.6 | 4.7 |
| 623 | 6.8 | 0.7 | 7.5 | 6.8 | 0.9 | 7.7 | 4.2 | 0.5 | 4.7 |
| 624 | 7.1 | 0.7 | 7.8 | 7.0 | 0.9 | 7.9 | 4.2 | 0.5 | 4.7 |
| 626 | 7.3 | 0.7 | 8.0 | 7.4 | 0.8 | 8.2 | 4.1 | 0.5 | 4.6 |
| 627 | 7.2 | 0.7 | 7.9 | 7.3 | 0.8 | 8.1 | 4.2 | 0.4 | 4.6 |
| 628 | 7.2 | 0.6 | 7.8 | 7.3 | 0.7 | 8.0 | 4.2 | 0.4 | 4.6 |
| 629 | 7.1 | 0.6 | 7.7 | 7.1 | 0.7 | 7.8 | 4.2 | 0.4 | 4.6 |
| 735 | 6.8 | 0.6 | 7.4 | 6.8 | 0.7 | 7.5 | 4.2 | 0.4 | 4.6 |
| 797 | 7.0 | 0.7 | 7.7 | 7.0 | 0.8 | 7.8 | 4.1 | 0.5 | 4.6 |
| 799 | 7.0 | 0.7 | 7.7 | 7.0 | 0.8 | 7.8 | 4.1 | 0.5 | 4.6 |
| 800 | 7.0 | 0.7 | 7.7 | 7.0 | 0.8 | 7.8 | 4.1 | 0.5 | 4.6 |
| 829 | 6.3 | 1.0 | 7.3 | 6.3 | 0.8 | 7.1 | 4.3 | 0.5 | 4.8 |
| 830 | 7.1 | 0.9 | 8.0 | 7.1 | 0.7 | 7.8 | 4.4 | 0.5 | 4.9 |
| 833 | 7.7 | 4.0 | 11.7 | 7.7 | 2.8 | 10.5 | 5.7 | 1.6 | 7.3 |
| 834 | 4.8 | 1.1 | 5.9 | 4.9 | 1.0 | 5.9 | 4.5 | 1.0 | 5.5 |
| 835 | 4.8 | 1.1 | 5.9 | 4.9 | 1.0 | 5.9 | 4.5 | 1.0 | 5.5 |
| 836 | 4.8 | 1.0 | 5.8 | 4.8 | 1.0 | 5.8 | 4.5 | 0.9 | 5.4 |
| 837 | 4.8 | 1.0 | 5.8 | 4.8 | 1.0 | 5.8 | 4.5 | 0.9 | 5.4 |
| 838 | 4.9 | 1.0 | 5.9 | 4.9 | 1.0 | 5.9 | 4.5 | 1.0 | 5.5 |
| 839 | 4.8 | 1.0 | 5.8 | 4.8 | 1.0 | 5.8 | 4.5 | 0.9 | 5.4 |
| 840 | 4.9 | 1.0 | 5.9 | 4.8 | 1.0 | 5.8 | 4.6 | 0.9 | 5.5 |
| 843 | 5.2 | 0.4 | 5.6 | 5.2 | 0.4 | 5.6 | 4.2 | 0.4 | 4.6 |
| 846 | 6.1 | 0.5 | 6.6 | 6.2 | 0.5 | 6.7 | 4.1 | 0.5 | 4.6 |
| 847 | 5.7 | 0.5 | 6.2 | 5.8 | 0.5 | 6.3 | 4.1 | 0.5 | 4.6 |
| 852 | 5.6 | 0.5 | 6.1 | 5.6 | 0.5 | 6.1 | 4.2 | 0.5 | 4.7 |
| 855 | 5.2 | 0.6 | 5.8 | 5.2 | 0.5 | 5.7 | 4.3 | 0.4 | 4.7 |
| 856 | 5.5 | 0.5 | 6.0 | 5.5 | 0.5 | 6.0 | 4.1 | 0.5 | 4.6 |
| 860 | 8.3 | 0.6 | 8.9 | 8.3 | 0.7 | 9.0 | 4.2 | 0.4 | 4.6 |
| 861 | 8.7 | 0.5 | 9.2 | 8.7 | 0.6 | 9.3 | 4.2 | 0.3 | 4.5 |
| 862 | 8.1 | 0.6 | 8.7 | 8.1 | 0.7 | 8.8 | 4.2 | 0.4 | 4.6 |
| 863 | 8.4 | 0.5 | 8.9 | 8.4 | 0.6 | 9.0 | 4.1 | 0.4 | 4.5 |
| 869 | 5.9 | 0.8 | 6.7 | 5.9 | 1.0 | 6.9 | 4.2 | 0.9 | 5.1 |
| 870 | 5.9 | 0.7 | 6.6 | 5.9 | 1.0 | 6.9 | 4.2 | 0.9 | 5.1 |
| 947 | 5.6 | 0.7 | 6.3 | 5.5 | 0.9 | 6.4 | 4.3 | 0.9 | 5.2 |
| 949 | 5.6 | 0.7 | 6.3 | 5.5 | 0.9 | 6.4 | 4.3 | 0.9 | 5.2 |
| 950 | 5.6 | 0.7 | 6.3 | 5.5 | 0.9 | 6.4 | 4.3 | 0.9 | 5.2 |

**Adjusted Airen**

| Receptor | 2029 Background | 2029 Project | 2029 Total | 2034 Background | 2034 Project | 2034 Total | 2041 Background | 2041 Project | 2041 Total |
|---|---|---|---|---|---|---|---|---|---|
| 17 | 5.5 | 0.1 | 5.6 | 5.5 | 0.1 | 5.6 | 5.3 | 0.1 | 5.4 |
| 19 | 5.6 | 0.1 | 5.7 | 5.6 | 0.1 | 5.7 | 5.3 | 0.1 | 5.4 |
| 37 | 5.6 | 0.1 | 5.7 | 5.6 | 0.1 | 5.7 | 5.3 | 0.1 | 5.4 |
| 102 | 9.2 | 0.9 | 10.1 | 8.5 | 0.7 | 9.2 | 5.8 | 0.5 | 6.3 |
| 120 | 6.3 | 0.9 | 7.2 | 6.3 | 0.8 | 7.1 | 5.6 | 0.8 | 6.4 |
| 121 | 6.4 | 1.1 | 7.5 | 6.3 | 0.8 | 7.1 | 5.6 | 0.7 | 6.3 |
| 122 | 6.3 | 0.9 | 7.2 | 6.3 | 0.8 | 7.1 | 5.7 | 0.8 | 6.5 |
| 123 | 6.4 | 1.0 | 7.4 | 6.4 | 0.8 | 7.2 | 5.6 | 0.7 | 6.3 |
| 124 | 6.3 | 0.9 | 7.2 | 6.3 | 0.8 | 7.1 | 5.7 | 0.8 | 6.5 |
| 126 | 6.3 | 0.8 | 7.1 | 6.4 | 0.6 | 7.0 | 5.5 | 0.4 | 5.9 |
| 127 | 6.4 | 0.8 | 7.2 | 6.4 | 0.7 | 7.1 | 5.8 | 0.6 | 6.4 |
| 128 | 6.2 | 0.9 | 7.1 | 6.2 | 0.7 | 6.9 | 5.5 | 0.5 | 6.0 |
| 130 | 6.1 | 0.9 | 7.0 | 6.1 | 0.6 | 6.7 | 5.5 | 0.5 | 6.0 |
| 134 | 6.1 | 0.8 | 6.9 | 6.1 | 0.6 | 6.7 | 5.5 | 0.5 | 6.0 |
| 139 | 6.0 | 0.8 | 6.8 | 6.0 | 0.6 | 6.6 | 5.5 | 0.4 | 5.9 |
| 141 | 6.2 | 0.6 | 6.8 | 6.1 | 0.6 | 6.7 | 5.7 | 0.5 | 6.2 |
| 160 | 6.4 | 0.9 | 7.3 | 6.3 | 0.8 | 7.1 | 5.7 | 0.9 | 6.6 |
| 161 | 6.4 | 0.8 | 7.2 | 6.3 | 0.8 | 7.1 | 5.7 | 0.9 | 6.6 |
| 162 | 6.4 | 0.8 | 7.2 | 6.3 | 0.8 | 7.1 | 5.7 | 0.9 | 6.6 |
| 163 | 6.3 | 0.8 | 7.1 | 6.3 | 0.8 | 7.1 | 5.7 | 0.9 | 6.6 |
| 167 | 6.1 | 0.6 | 6.7 | 6.1 | 0.5 | 6.6 | 5.6 | 0.5 | 6.1 |
| 169 | 6.1 | 0.6 | 6.7 | 6.0 | 0.6 | 6.6 | 5.6 | 0.5 | 6.1 |
| 170 | 6.1 | 0.6 | 6.7 | 6.1 | 0.5 | 6.6 | 5.7 | 0.5 | 6.2 |
| 173 | 5.9 | 0.7 | 6.6 | 5.9 | 0.6 | 6.5 | 5.5 | 0.5 | 6.0 |
| 174 | 6.0 | 0.7 | 6.7 | 6.0 | 0.5 | 6.5 | 5.5 | 0.4 | 5.9 |
| 175 | 6.0 | 0.6 | 6.6 | 6.0 | 0.5 | 6.5 | 5.5 | 0.5 | 6.0 |
| 176 | 5.9 | 0.6 | 6.5 | 5.9 | 0.5 | 6.4 | 5.6 | 0.4 | 6.0 |
| 178 | 5.9 | 0.5 | 6.4 | 5.9 | 0.5 | 6.4 | 5.5 | 0.4 | 5.9 |
| 179 | 5.8 | 0.5 | 6.3 | 5.8 | 0.4 | 6.2 | 5.6 | 0.4 | 6.0 |
| 244 | 6.4 | 0.8 | 7.2 | 6.4 | 0.8 | 7.2 | 5.8 | 0.8 | 6.6 |
| 245 | 6.4 | 0.8 | 7.2 | 6.4 | 0.8 | 7.2 | 5.7 | 0.8 | 6.5 |
| 246 | 6.5 | 0.8 | 7.3 | 6.4 | 0.8 | 7.2 | 5.9 | 0.8 | 6.7 |
| 247 | 6.5 | 0.8 | 7.3 | 6.4 | 0.8 | 7.2 | 5.9 | 0.8 | 6.7 |
| 248 | 5.9 | 0.6 | 6.5 | 5.9 | 0.5 | 6.4 | 5.6 | 0.4 | 6.0 |
| 249 | 6.0 | 0.5 | 6.5 | 5.9 | 0.5 | 6.4 | 5.6 | 0.4 | 6.0 |
| 250 | 5.9 | 0.4 | 6.3 | 5.8 | 0.4 | 6.2 | 5.6 | 0.4 | 6.0 |
| 251 | 5.8 | 0.4 | 6.2 | 5.8 | 0.4 | 6.2 | 5.5 | 0.4 | 5.9 |
| 256 | 6.3 | 0.8 | 7.1 | 6.3 | 0.8 | 7.1 | 5.8 | 0.9 | 6.7 |
| 258 | 6.3 | 0.8 | 7.1 | 6.3 | 0.8 | 7.1 | 5.7 | 0.9 | 6.6 |
| 260 | 6.4 | 0.8 | 7.2 | 6.4 | 0.8 | 7.2 | 5.8 | 0.9 | 6.7 |
| 261 | 6.4 | 0.9 | 7.3 | 6.3 | 0.8 | 7.1 | 5.7 | 0.9 | 6.6 |
| 262 | 6.3 | 0.8 | 7.1 | 6.3 | 0.6 | 6.9 | 5.5 | 0.4 | 5.9 |
| 264 | 9.1 | 0.8 | 9.9 | 8.5 | 0.7 | 9.2 | 5.8 | 0.5 | 6.3 |
| 266 | 5.6 | 0.1 | 5.7 | 5.6 | 0.1 | 5.7 | 5.3 | 0.1 | 5.4 |
| 308 | 6.2 | 1.0 | 7.2 | 7.4 | 1.0 | 8.4 | 6.0 | 1.0 | 7.0 |
| 310 | 6.2 | 0.9 | 7.1 | 7.1 | 1.0 | 8.1 | 6.0 | 0.9 | 6.9 |
| 311 | 6.0 | 1.2 | 7.2 | 6.7 | 1.2 | 7.9 | 5.8 | 1.2 | 7.0 |
| 317 | 6.0 | 1.2 | 7.2 | 6.6 | 1.2 | 7.8 | 5.8 | 1.2 | 7.0 |
| 321 | 5.9 | 1.1 | 7.0 | 6.2 | 1.1 | 7.3 | 5.6 | 1.1 | 6.7 |
| 322 | 5.8 | 1.1 | 6.9 | 6.0 | 1.0 | 7.0 | 5.6 | 1.0 | 6.6 |
| 324 | 5.8 | 1.1 | 6.9 | 6.1 | 1.1 | 7.2 | 5.6 | 1.0 | 6.6 |
| 326 | 5.7 | 1.1 | 6.8 | 5.7 | 1.1 | 6.8 | 5.5 | 1.0 | 6.5 |
| 327 | 5.7 | 1.1 | 6.8 | 5.7 | 1.1 | 6.8 | 5.5 | 1.0 | 6.5 |
| 328 | 5.7 | 1.1 | 6.8 | 5.8 | 1.1 | 6.9 | 5.4 | 1.0 | 6.4 |
| 330 | 5.6 | 1.1 | 6.7 | 5.8 | 1.0 | 6.8 | 5.5 | 1.0 | 6.5 |
| 331 | 5.7 | 1.1 | 6.8 | 5.8 | 1.1 | 6.9 | 5.5 | 1.0 | 6.5 |
| 332 | 5.7 | 1.0 | 6.7 | 5.8 | 1.0 | 6.8 | 5.5 | 1.0 | 6.5 |
| 333 | 5.7 | 1.0 | 6.7 | 5.8 | 1.0 | 6.8 | 5.4 | 0.9 | 6.3 |
| 334 | 5.7 | 1.0 | 6.7 | 5.8 | 1.0 | 6.8 | 5.5 | 0.9 | 6.4 |
| 335 | 5.7 | 1.0 | 6.7 | 5.8 | 1.0 | 6.8 | 5.4 | 0.9 | 6.3 |
| 336 | 5.7 | 1.1 | 6.8 | 5.8 | 1.0 | 6.8 | 5.5 | 1.0 | 6.5 |
| 337 | 5.7 | 1.0 | 6.7 | 5.8 | 1.0 | 6.8 | 5.5 | 1.0 | 6.5 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 338 | 5.8 | 1.1 | 6.9 | 5.8 | 1.0 | 6.8 | 5.5 | 1.0 | 6.5 |
| 339 | 5.7 | 0.9 | 6.6 | 5.8 | 0.9 | 6.7 | 5.5 | 0.9 | 6.4 |
| 340 | 5.7 | 0.9 | 6.6 | 5.8 | 0.9 | 6.7 | 5.4 | 0.9 | 6.3 |
| 341 | 5.7 | 1.0 | 6.7 | 5.8 | 0.9 | 6.7 | 5.4 | 0.9 | 6.3 |
| 342 | 5.7 | 1.0 | 6.7 | 5.9 | 1.0 | 6.9 | 5.5 | 0.9 | 6.4 |
| 343 | 5.7 | 1.0 | 6.7 | 5.9 | 1.0 | 6.9 | 5.5 | 0.9 | 6.4 |
| 344 | 5.7 | 1.0 | 6.7 | 5.9 | 1.0 | 6.9 | 5.5 | 0.9 | 6.4 |
| 345 | 5.7 | 1.0 | 6.7 | 5.8 | 1.0 | 6.8 | 5.5 | 0.9 | 6.4 |
| 346 | 5.7 | 1.0 | 6.7 | 5.8 | 1.0 | 6.8 | 5.4 | 0.9 | 6.3 |
| 347 | 5.8 | 1.1 | 6.9 | 5.9 | 1.0 | 6.9 | 5.5 | 1.0 | 6.5 |
| 348 | 5.8 | 1.1 | 6.9 | 5.8 | 1.0 | 6.8 | 5.5 | 1.0 | 6.5 |
| 349 | 5.7 | 1.0 | 6.7 | 5.8 | 1.0 | 6.8 | 5.5 | 1.0 | 6.5 |
| 350 | 5.7 | 1.0 | 6.7 | 5.8 | 1.0 | 6.8 | 5.5 | 1.0 | 6.5 |
| 351 | 5.8 | 1.1 | 6.9 | 5.9 | 1.0 | 6.9 | 5.5 | 1.0 | 6.5 |
| 352 | 5.8 | 1.1 | 6.9 | 5.9 | 1.0 | 6.9 | 5.5 | 1.0 | 6.5 |
| 353 | 5.8 | 1.1 | 6.9 | 5.9 | 1.0 | 6.9 | 5.5 | 1.0 | 6.5 |
| 355 | 5.8 | 1.1 | 6.9 | 5.9 | 1.0 | 6.9 | 5.5 | 1.0 | 6.5 |
| 356 | 5.8 | 1.1 | 6.9 | 5.9 | 1.0 | 6.9 | 5.5 | 1.0 | 6.5 |
| 357 | 5.7 | 1.0 | 6.7 | 5.8 | 1.0 | 6.8 | 5.5 | 1.0 | 6.5 |
| 358 | 5.8 | 1.0 | 6.8 | 5.9 | 1.0 | 6.9 | 5.5 | 1.0 | 6.5 |
| 359 | 5.8 | 1.1 | 6.9 | 5.9 | 1.0 | 6.9 | 5.5 | 1.0 | 6.5 |
| 360 | 5.8 | 1.1 | 6.9 | 5.9 | 1.1 | 7.0 | 5.5 | 1.0 | 6.5 |
| 361 | 5.7 | 1.1 | 6.8 | 5.9 | 1.1 | 7.0 | 5.4 | 1.0 | 6.4 |
| 362 | 5.7 | 1.1 | 6.8 | 5.9 | 1.1 | 7.0 | 5.4 | 1.0 | 6.4 |
| 363 | 5.8 | 1.1 | 6.9 | 5.9 | 1.1 | 7.0 | 5.5 | 1.0 | 6.5 |
| 366 | 5.8 | 1.1 | 6.9 | 5.9 | 1.0 | 6.9 | 5.5 | 1.0 | 6.5 |
| 367 | 5.8 | 1.1 | 6.9 | 5.9 | 1.0 | 6.9 | 5.5 | 1.0 | 6.5 |
| 368 | 5.8 | 1.1 | 6.9 | 5.9 | 1.0 | 6.9 | 5.5 | 1.0 | 6.5 |
| 369 | 5.8 | 1.1 | 6.9 | 5.9 | 1.0 | 6.9 | 5.5 | 1.0 | 6.5 |
| 370 | 5.7 | 1.0 | 6.7 | 5.8 | 1.0 | 6.8 | 5.5 | 1.0 | 6.5 |
| 371 | 5.7 | 1.0 | 6.7 | 5.9 | 1.0 | 6.9 | 5.4 | 0.9 | 6.3 |
| 372 | 5.7 | 1.0 | 6.7 | 5.9 | 1.0 | 6.9 | 5.5 | 0.9 | 6.4 |
| 373 | 5.7 | 1.0 | 6.7 | 5.9 | 1.0 | 6.9 | 5.5 | 1.0 | 6.5 |
| 374 | 5.7 | 1.0 | 6.7 | 5.9 | 1.0 | 6.9 | 5.4 | 0.9 | 6.3 |
| 375 | 5.7 | 1.0 | 6.7 | 5.9 | 1.0 | 6.9 | 5.4 | 0.9 | 6.3 |
| 376 | 5.8 | 1.1 | 6.9 | 5.9 | 1.0 | 6.9 | 5.5 | 1.0 | 6.5 |
| 377 | 5.8 | 1.1 | 6.9 | 5.9 | 1.0 | 6.9 | 5.5 | 1.0 | 6.5 |
| 380 | 5.7 | 1.0 | 6.7 | 5.9 | 1.0 | 6.9 | 5.5 | 0.9 | 6.4 |
| 381 | 5.7 | 1.0 | 6.7 | 5.9 | 1.0 | 6.9 | 5.4 | 1.0 | 6.4 |
| 382 | 5.7 | 1.0 | 6.7 | 5.9 | 1.0 | 6.9 | 5.4 | 1.0 | 6.4 |
| 383 | 5.8 | 1.0 | 6.8 | 5.9 | 1.0 | 6.9 | 5.5 | 1.0 | 6.5 |
| 384 | 5.7 | 1.0 | 6.7 | 5.9 | 1.0 | 6.9 | 5.5 | 1.0 | 6.5 |
| 385 | 5.7 | 1.0 | 6.7 | 5.9 | 1.0 | 6.9 | 5.5 | 0.9 | 6.4 |
| 386 | 5.7 | 1.0 | 6.7 | 5.9 | 1.0 | 6.9 | 5.5 | 0.9 | 6.4 |
| 389 | 5.8 | 1.1 | 6.9 | 5.9 | 1.0 | 6.9 | 5.5 | 1.0 | 6.5 |
| 390 | 5.8 | 1.1 | 6.9 | 5.9 | 1.0 | 6.9 | 5.5 | 1.0 | 6.5 |
| 391 | 5.8 | 1.1 | 6.9 | 6.0 | 1.0 | 7.0 | 5.5 | 1.0 | 6.5 |
| 392 | 5.8 | 1.1 | 6.9 | 6.0 | 1.0 | 7.0 | 5.5 | 1.0 | 6.5 |
| 393 | 5.8 | 1.1 | 6.9 | 6.0 | 1.0 | 7.0 | 5.5 | 1.0 | 6.5 |
| 394 | 5.8 | 1.0 | 6.8 | 6.0 | 1.0 | 7.0 | 5.5 | 1.0 | 6.5 |
| 395 | 5.8 | 1.1 | 6.9 | 6.0 | 1.1 | 7.1 | 5.5 | 1.0 | 6.5 |
| 396 | 5.7 | 1.0 | 6.7 | 6.0 | 0.9 | 6.9 | 5.5 | 0.9 | 6.4 |
| 397 | 5.8 | 1.0 | 6.8 | 5.9 | 1.0 | 6.9 | 5.5 | 1.0 | 6.5 |
| 398 | 5.7 | 1.0 | 6.7 | 6.0 | 1.0 | 7.0 | 5.5 | 0.9 | 6.4 |
| 399 | 5.8 | 1.0 | 6.8 | 5.9 | 1.0 | 6.9 | 5.5 | 1.0 | 6.5 |
| 400 | 5.8 | 1.0 | 6.8 | 5.9 | 1.0 | 6.9 | 5.5 | 1.0 | 6.5 |
| 401 | 5.8 | 1.0 | 6.8 | 5.9 | 1.0 | 6.9 | 5.5 | 1.0 | 6.5 |
| 402 | 5.8 | 1.0 | 6.8 | 5.9 | 1.0 | 6.9 | 5.5 | 1.0 | 6.5 |
| 403 | 5.8 | 1.0 | 6.8 | 5.9 | 1.0 | 6.9 | 5.5 | 1.0 | 6.5 |
| 404 | 5.7 | 1.0 | 6.7 | 6.0 | 1.0 | 7.0 | 5.5 | 0.9 | 6.4 |
| 405 | 5.8 | 1.0 | 6.8 | 5.9 | 1.0 | 6.9 | 5.5 | 1.0 | 6.5 |
| 406 | 5.8 | 1.0 | 6.8 | 5.9 | 1.0 | 6.9 | 5.5 | 1.0 | 6.5 |
| 407 | 5.7 | 1.0 | 6.7 | 6.0 | 1.0 | 7.0 | 5.5 | 0.9 | 6.4 |
| 408 | 5.7 | 1.0 | 6.7 | 6.0 | 1.0 | 7.0 | 5.5 | 0.9 | 6.4 |
| 409 | 5.7 | 1.0 | 6.7 | 5.9 | 1.0 | 6.9 | 5.5 | 0.9 | 6.4 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 410 | 5.7 | 1.0 | 6.7 | 5.9 | 1.0 | 6.9 | 5.5 | 0.9 | 6.4 |
| 411 | 5.7 | 1.0 | 6.7 | 5.9 | 1.0 | 6.9 | 5.5 | 0.9 | 6.4 |
| 412 | 5.7 | 1.0 | 6.7 | 5.9 | 0.9 | 6.8 | 5.5 | 0.9 | 6.4 |
| 413 | 5.7 | 0.9 | 6.6 | 5.9 | 0.9 | 6.8 | 5.5 | 0.9 | 6.4 |
| 414 | 5.7 | 0.9 | 6.6 | 5.9 | 0.9 | 6.8 | 5.5 | 0.9 | 6.4 |
| 415 | 5.7 | 1.0 | 6.7 | 5.9 | 0.9 | 6.8 | 5.5 | 0.9 | 6.4 |
| 417 | 5.7 | 1.0 | 6.7 | 5.9 | 1.0 | 6.9 | 5.5 | 1.0 | 6.5 |
| 418 | 5.7 | 1.0 | 6.7 | 5.9 | 1.0 | 6.9 | 5.5 | 0.9 | 6.4 |
| 419 | 5.7 | 0.9 | 6.6 | 5.9 | 0.9 | 6.8 | 5.5 | 0.9 | 6.4 |
| 420 | 5.7 | 1.0 | 6.7 | 6.0 | 1.0 | 7.0 | 5.5 | 0.9 | 6.4 |
| 421 | 5.8 | 1.1 | 6.9 | 5.9 | 1.0 | 6.9 | 5.5 | 1.0 | 6.5 |
| 422 | 5.8 | 1.1 | 6.9 | 5.9 | 1.0 | 6.9 | 5.5 | 1.0 | 6.5 |
| 423 | 5.8 | 1.1 | 6.9 | 5.9 | 1.0 | 6.9 | 5.5 | 1.0 | 6.5 |
| 425 | 5.7 | 0.7 | 6.4 | 5.7 | 0.7 | 6.4 | 5.5 | 0.7 | 6.2 |
| 426 | 5.7 | 0.7 | 6.4 | 5.8 | 0.7 | 6.5 | 5.5 | 0.7 | 6.2 |
| 427 | 5.7 | 0.8 | 6.5 | 5.9 | 0.9 | 6.8 | 5.5 | 0.8 | 6.3 |
| 428 | 5.8 | 0.9 | 6.7 | 5.9 | 0.9 | 6.8 | 5.5 | 0.9 | 6.4 |
| 429 | 5.8 | 1.0 | 6.8 | 6.0 | 1.0 | 7.0 | 5.6 | 1.0 | 6.6 |
| 430 | 5.8 | 0.9 | 6.7 | 6.0 | 0.9 | 6.9 | 5.5 | 0.9 | 6.4 |
| 431 | 5.8 | 1.0 | 6.8 | 6.1 | 1.0 | 7.1 | 5.5 | 1.0 | 6.5 |
| 432 | 5.7 | 0.8 | 6.5 | 6.1 | 0.8 | 6.9 | 5.5 | 0.8 | 6.3 |
| 433 | 5.8 | 0.7 | 6.5 | 6.0 | 0.7 | 6.7 | 5.5 | 0.7 | 6.2 |
| 434 | 6.0 | 1.2 | 7.2 | 6.5 | 1.2 | 7.7 | 5.7 | 1.2 | 6.9 |
| 436 | 6.0 | 1.1 | 7.1 | 6.4 | 1.1 | 7.5 | 5.7 | 1.1 | 6.8 |
| 437 | 5.7 | 1.1 | 6.8 | 5.7 | 1.0 | 6.7 | 5.5 | 1.0 | 6.5 |
| 438 | 5.6 | 0.9 | 6.5 | 5.6 | 0.9 | 6.5 | 5.4 | 0.9 | 6.3 |
| 440 | 5.9 | 1.0 | 6.9 | 6.4 | 1.0 | 7.4 | 5.7 | 1.0 | 6.7 |
| 451 | 5.8 | 0.5 | 6.3 | 6.1 | 0.5 | 6.6 | 5.5 | 0.5 | 6.0 |
| 452 | 5.8 | 0.5 | 6.3 | 6.0 | 0.5 | 6.5 | 5.5 | 0.5 | 6.0 |
| 453 | 5.7 | 0.4 | 6.1 | 6.0 | 0.4 | 6.4 | 5.5 | 0.4 | 5.9 |
| 454 | 5.8 | 0.4 | 6.2 | 6.0 | 0.4 | 6.4 | 5.5 | 0.4 | 5.9 |
| 455 | 5.8 | 0.4 | 6.2 | 5.9 | 0.4 | 6.3 | 5.5 | 0.4 | 5.9 |
| 456 | 5.7 | 0.3 | 6.0 | 5.9 | 0.4 | 6.3 | 5.4 | 0.3 | 5.7 |
| 457 | 5.7 | 0.3 | 6.0 | 5.8 | 0.4 | 6.2 | 5.4 | 0.3 | 5.7 |
| 458 | 5.7 | 0.3 | 6.0 | 5.8 | 0.4 | 6.2 | 5.4 | 0.3 | 5.7 |
| 459 | 5.7 | 0.4 | 6.1 | 5.9 | 0.4 | 6.3 | 5.5 | 0.4 | 5.9 |
| 460 | 5.6 | 0.4 | 6.0 | 5.8 | 0.4 | 6.2 | 5.4 | 0.4 | 5.8 |
| 462 | 5.7 | 0.4 | 6.1 | 5.8 | 0.4 | 6.2 | 5.5 | 0.4 | 5.9 |
| 463 | 6.2 | 1.0 | 7.2 | 7.2 | 1.0 | 8.2 | 6.0 | 1.0 | 7.0 |
| 464 | 5.6 | 0.6 | 6.2 | 5.8 | 0.6 | 6.4 | 5.4 | 0.6 | 6.0 |
| 466 | 5.7 | 0.7 | 6.4 | 5.7 | 0.7 | 6.4 | 5.4 | 0.7 | 6.1 |
| 471 | 7.8 | 0.9 | 8.7 | 7.7 | 1.2 | 8.9 | 7.0 | 0.9 | 7.9 |
| 472 | 5.4 | 0.2 | 5.6 | 5.4 | 0.2 | 5.6 | 5.3 | 0.2 | 5.5 |
| 473 | 5.8 | 1.0 | 6.8 | 5.9 | 1.0 | 6.9 | 5.5 | 1.0 | 6.5 |
| 477 | 5.6 | 0.2 | 5.8 | 5.6 | 0.3 | 5.9 | 5.3 | 0.3 | 5.6 |
| 478 | 5.7 | 0.4 | 6.1 | 6.0 | 0.4 | 6.4 | 5.5 | 0.4 | 5.9 |
| 481 | 5.7 | 0.8 | 6.5 | 5.9 | 0.9 | 6.8 | 5.5 | 0.8 | 6.3 |
| 482 | 5.8 | 1.1 | 6.9 | 5.9 | 1.0 | 6.9 | 5.5 | 1.0 | 6.5 |
| 483 | 5.7 | 1.0 | 6.7 | 5.8 | 1.0 | 6.8 | 5.4 | 0.9 | 6.3 |
| 484 | 5.7 | 1.0 | 6.7 | 5.8 | 1.0 | 6.8 | 5.5 | 1.0 | 6.5 |
| 487 | 5.6 | 1.0 | 6.6 | 5.7 | 1.0 | 6.7 | 5.5 | 0.9 | 6.4 |
| 488 | 5.6 | 0.8 | 6.4 | 5.6 | 0.8 | 6.4 | 5.4 | 0.8 | 6.2 |
| 489 | 5.6 | 0.8 | 6.4 | 5.6 | 0.8 | 6.4 | 5.4 | 0.8 | 6.2 |
| 497 | 6.3 | 0.8 | 7.1 | 6.3 | 0.8 | 7.1 | 5.8 | 0.9 | 6.7 |
| 498 | 6.4 | 0.8 | 7.2 | 6.4 | 0.8 | 7.2 | 5.8 | 0.8 | 6.6 |
| 499 | 7.6 | 0.8 | 8.4 | 7.6 | 1.0 | 8.6 | 6.9 | 0.8 | 7.7 |
| 507 | 10.1 | 0.2 | 10.3 | 10.4 | 0.2 | 10.6 | 6.1 | 0.1 | 6.2 |
| 511 | 7.9 | 0.2 | 8.1 | 8.2 | 0.2 | 8.4 | 6.0 | 0.1 | 6.1 |
| 592 | 8.4 | 0.2 | 8.6 | 8.7 | 0.2 | 8.9 | 6.2 | 0.1 | 6.3 |
| 596 | 13.6 | 0.4 | 14.0 | 13.4 | 0.5 | 13.9 | 6.8 | 0.3 | 7.1 |
| 598 | 8.3 | 0.2 | 8.5 | 8.7 | 0.2 | 8.9 | 6.2 | 0.1 | 6.3 |
| 599 | 8.7 | 0.2 | 8.9 | 9.1 | 0.2 | 9.3 | 6.2 | 0.1 | 6.3 |
| 613 | 8.7 | 0.2 | 8.9 | 9.1 | 0.2 | 9.3 | 6.2 | 0.1 | 6.3 |
| 614 | 8.7 | 0.2 | 8.9 | 9.1 | 0.2 | 9.3 | 6.2 | 0.1 | 6.3 |
| 619 | 9.1 | 0.6 | 9.7 | 8.9 | 0.7 | 9.6 | 7.1 | 0.4 | 7.5 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 621 | 9.9 | 0.7 | 10.6 | 9.8 | 0.9 | 10.7 | 7.9 | 0.6 | 8.5 |
| 623 | 8.7 | 0.7 | 9.4 | 8.5 | 0.9 | 9.4 | 7.2 | 0.5 | 7.7 |
| 624 | 9.0 | 0.7 | 9.7 | 8.7 | 0.9 | 9.6 | 7.3 | 0.5 | 7.8 |
| 626 | 9.3 | 0.7 | 10.0 | 9.0 | 0.8 | 9.8 | 7.3 | 0.5 | 7.8 |
| 627 | 9.3 | 0.7 | 10.0 | 9.0 | 0.8 | 9.8 | 7.2 | 0.4 | 7.6 |
| 628 | 9.2 | 0.6 | 9.8 | 8.9 | 0.7 | 9.6 | 7.1 | 0.4 | 7.5 |
| 629 | 9.2 | 0.6 | 9.8 | 8.8 | 0.7 | 9.5 | 7.1 | 0.4 | 7.5 |
| 735 | 14.1 | 0.6 | 14.7 | 11.0 | 0.7 | 11.7 | 7.9 | 0.4 | 8.3 |
| 797 | 13.7 | 0.7 | 14.4 | 10.9 | 0.8 | 11.7 | 8.1 | 0.5 | 8.6 |
| 799 | 13.7 | 0.7 | 14.4 | 10.9 | 0.8 | 11.7 | 8.1 | 0.5 | 8.6 |
| 800 | 13.7 | 0.7 | 14.4 | 10.9 | 0.8 | 11.7 | 8.1 | 0.5 | 8.6 |
| 829 | 6.9 | 1.0 | 7.9 | 6.9 | 0.8 | 7.7 | 5.5 | 0.5 | 6.0 |
| 830 | 7.6 | 0.9 | 8.5 | 7.6 | 0.7 | 8.3 | 5.5 | 0.5 | 6.0 |
| 833 | 8.0 | 4.0 | 12.0 | 7.3 | 2.8 | 10.1 | 5.8 | 1.6 | 7.4 |
| 834 | 5.8 | 1.1 | 6.9 | 6.0 | 1.0 | 7.0 | 5.5 | 1.0 | 6.5 |
| 835 | 5.8 | 1.1 | 6.9 | 5.9 | 1.0 | 6.9 | 5.5 | 1.0 | 6.5 |
| 836 | 5.7 | 1.0 | 6.7 | 5.8 | 1.0 | 6.8 | 5.4 | 0.9 | 6.3 |
| 837 | 5.7 | 1.0 | 6.7 | 5.8 | 1.0 | 6.8 | 5.4 | 0.9 | 6.3 |
| 838 | 5.8 | 1.0 | 6.8 | 5.9 | 1.0 | 6.9 | 5.5 | 1.0 | 6.5 |
| 839 | 5.7 | 1.0 | 6.7 | 6.0 | 1.0 | 7.0 | 5.5 | 0.9 | 6.4 |
| 840 | 5.7 | 1.0 | 6.7 | 5.9 | 1.0 | 6.9 | 5.5 | 0.9 | 6.4 |
| 843 | 5.9 | 0.4 | 6.3 | 5.9 | 0.4 | 6.3 | 5.7 | 0.4 | 6.1 |
| 846 | 6.5 | 0.5 | 7.0 | 6.5 | 0.5 | 7.0 | 6.0 | 0.5 | 6.5 |
| 847 | 6.3 | 0.5 | 6.8 | 6.3 | 0.5 | 6.8 | 5.9 | 0.5 | 6.4 |
| 852 | 6.2 | 0.5 | 6.7 | 6.2 | 0.5 | 6.7 | 5.8 | 0.5 | 6.3 |
| 855 | 5.9 | 0.6 | 6.5 | 5.9 | 0.5 | 6.4 | 5.6 | 0.4 | 6.0 |
| 856 | 6.1 | 0.5 | 6.6 | 6.2 | 0.5 | 6.7 | 5.7 | 0.5 | 6.2 |
| 860 | 10.0 | 0.6 | 10.6 | 9.8 | 0.7 | 10.5 | 7.3 | 0.4 | 7.7 |
| 861 | 10.7 | 0.5 | 11.2 | 10.3 | 0.6 | 10.9 | 7.0 | 0.3 | 7.3 |
| 862 | 10.6 | 0.6 | 11.2 | 10.0 | 0.7 | 10.7 | 7.4 | 0.4 | 7.8 |
| 863 | 10.7 | 0.5 | 11.2 | 10.1 | 0.6 | 10.7 | 7.3 | 0.4 | 7.7 |
| 869 | 6.9 | 0.8 | 7.7 | 6.9 | 1.0 | 7.9 | 6.3 | 0.9 | 7.2 |
| 870 | 7.0 | 0.7 | 7.7 | 7.0 | 1.0 | 8.0 | 6.4 | 0.9 | 7.3 |
| 947 | 6.3 | 0.7 | 7.0 | 6.3 | 0.9 | 7.2 | 5.8 | 0.9 | 6.7 |
| 949 | 6.3 | 0.7 | 7.0 | 6.3 | 0.9 | 7.2 | 5.8 | 0.9 | 6.7 |
| 950 | 6.3 | 0.7 | 7.0 | 6.3 | 0.9 | 7.2 | 5.8 | 0.9 | 6.7 |