APPLICATION FOR AN ENVIRONMENTAL PERMIT UNDER THE ENVIRONMENTAL PERMITTING (ENGLAND AND WALES) REGULATIONS 2016 (AS AMENDED)

ENVIRONMENTAL PERMITTING TECHNICAL REQUIREMENTS DOCUMENT

PLOT 1C,
WILTON INDUSTRIAL ESTATE,
REDCAR,
TS10 4RF

MorGen Ref: 006-HS-SPC-00001
MorGen Rev: D02
ECL Ref: H2EE.02.01/EPTR
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ACRONYMS/TERMS USED IN THE TEXT

AELs	Associated Emission Levels
AMP	Accident Management Plan
API	Aerated Plate Interceptor
AWT	Air Water Treatment
BAT	Best Available Techniques
BOD	Biological Oxygen Demand
BRef	Best Available Techniques Reference Document
CCA	Climate Change Agreement
DAA	Directly Associated Activities
Demin	Demineralised Water
EA	The Environment Agency
ECL	Environmental Compliance Limited
EMS	Environmental Management System
EP Regulations	Environmental Permitting (England and Wales) Regulations 2016 as amended
EP	Environmental Permit
EPTR	Environmental Permitting Technical Requirements
EQS	Environmental Quality Standards
ERA	Environmental Risk Assessment
IED	Industrial Emissions Directive
LDAR	Leak Detection and Repair
OTNOC	Other Than Normal Operating Conditions
PPMR	Planned Preventative Maintenance Regime
QMS	Quality Management System
SDS	Safety Data Sheets
SCR	Site Condition Report
The Installation	MorGen Energy H_2 Plant
TOC	Total Organic Carbon

1. INTRODUCTION

1.1. Overview

1.1.1. Environmental Compliance Limited ("ECL") have been commissioned by MorGen Energy UK Limited ("MorGen") to prepare an Environmental Permit ("EP") application in relation to proposed Hydrogen ("H_2") Plant, hereafter referred to as "the Installation", located at Plot 1 C, the Wilton Industrial Estate, Redcar, TS10 4RF.

1.1.2. This permit application is for a 60 MW electrolytic hydrogen (H_2) plant of 1,080 kg H_2/h of nominal capacity. The H_2 plant would therefore comprise a listed activity under Section 4.2 Part A(1), sub paragraph (a)(i) *"Producing inorganic chemicals such as gases (for example….hydrogen)"*.

1.2. Installation Location

1.2.1. The Installation is located approximately 3km southwest of Redcar at Wilton Industrial Estate and is centred on national grid reference ("NGR") 457430 520790 covering an area of 3 hectares ("Ha") (see Figure 1). The approximate site area is shown in red on Figure 1 and the EP boundary is outlined in green on Drawing H2EE.02.01-01 – Site Location Plan submitted with the Permit Application Documents.

1.2.2. The H_2 plant will be constructed on an area of cleared grassland, bordered by a mix of overgrown scrub hedges and bushes.

1.2.3. Detailed drawings may be found in Section 3 of the EP application submission.

Figure 1: Indicative H_2 Plant Location

1.3. The Applicant

1.3.1. MorGen are developers of large-scale green hydrogen ecosystems. Founded in 2021 in Switzerland, MorGen delivers projects from conception to construction, and from production to delivery.

1.3.2. MorGen builds and operates the infrastructure needed to establish green hydrogen as a future core energy source, evolving the energy system to become more sustainable and resilient.

1.3.3. MorGen Energy was incorporated in 2025 under company number 16542901.

1.4. Pre-Application Advice

1.4.1. Basic pre-application advice has been sought from the EA, a copy of the Nature and Heritage Screening Assessment may be found in Appendix I of this report.

1.5. Approach to Application

1.5.1. Given the evolving nature of green hydrogen production, this application has been prepared in accordance with the following:

- the guidance followed is the EA's Guidance on Hydrogen production by electrolysis of water;
- there is no requirement for continuous emissions monitoring systems on the emissions to air;
- as hydrogen and oxygen are not listed within the H1 guidance tool, emissions of both screen out and no further assessment is required.

2. LISTED ACTIVITIES

2.1. Installation

2.1.1. The proposed Schedule 1 Activity under the EP Regulations is detailed in Table 1.

Table 1: Proposed Schedule 1 Activities

Schedule 1 Activity	Description of Specified Activity	Limits of Specified Activity
S4.2 A(1) (a) (i)	Production of hydrogen gas	Electrolysis of water to produce hydrogen and oxygen, and off site transfer of hydrogen gas via pipeline.

2.1.2. A 60MW H_2 generation plant will be installed within an area of approximately 3 hectares. The H_2 Plant will be able to generate a maximum of 1,080 kg of H_2 per hour.

2.1.3. The H_2 Plant is designed to operate 24/7, however will operate at lower loads during peak electricity prices. Occasionally, the plant will shut down for a few hours or days. Planned maintenance will occur for approximately 2 weeks every year. Consequently, the H_2 Plant is expected to be operational for 7,500 full-load hours.

2.2. Directly Associated Activities

There are no directly associated activities ("DAAs").

3. MANAGEMENT TECHNIQUES

3.1. Management Structure

3.1.1. A specific, local management team will be deployed during the upfront commissioning period; they will be in charge of developing a specific Environment Management System ("EMS"), integrated together with the broader HSE management system. This will include an organization chart and specific roles and responsibilities for each of the local operations stakeholder.

3.1.2. The Installation's Operations Manager will have overall responsibility for operational and technical aspects of the Installation, including Environmental matters. They will also take on the role of ensuring compliance with the Environmental Permit and will be supported by the MorGen Group HSE organisation.

3.2. Management System Overview

3.2.1. MorGen will operate a management system which is appropriate to the Installation and its operations and complies with the EA's Online Guidance "Develop a management system: environmental permits[1].

3.2.2. The Operations Manager has overall responsibility for environmental matters at the Installation.

3.2.3. Senior management are committed to high standards of protection for people and the environment which is further defined in company policies and procedures. The key commitments include:

- establishment of management system to ensure compliance with the Environmental Permit and the applicable set of standards, laws, codes and regulations
- communication of information to those that work on behalf of the organisation that could impact on these systems;
- selection criteria for personnel within key roles supported by appropriate training;
- objectives and targets to drive continual improvement; and
- allocation of resources to ensure systems are implemented and developed to a high standard.

3.3. Plan

3.3.1. The planning element of the management system includes:

- identification of environmental impacts and aspects associated with the activities, and assessing their significance; including an assessment of the potential environmental risks including those posed by the work of any contractors on site;
- identification and evaluation of relevant legal and other relevant requirements including Permit requirements;

[1] https://www.gov.uk/guidance/develop-a-management-system-environmental-permits

- identification of environmental objectives and targets that will be focussed on reducing the impact of the identified significant environmental aspects, in conjunction with financial planning and investment;
- a series of risk assessments to cover a range of issues, including site operations, maintenance, accidents, training and records, this includes the assessment of climate change; and
- details of how MorGen ensures that any relevant standards, guidance and codes of practice are met on an ongoing basis.

3.3.2. The outcomes of the above are:

- a comprehensive understanding of the potential and actual impacts of the permitted activities on the surrounding environment and people's health;
- the correct appropriate measures selected to manage environmental risks and prevent or minimise their effects so as not to cause pollution;
- a series of documented procedures covering all aspects of the Installation's activities; and
- a series of documented environmental objectives and targets, together with an action plan/development programme to ensure that these are met.

3.4. Implementation and Operation (Do)

3.4.1. This element includes:

- ensuring that management system roles and responsibilities are clearly defined and documented, and that site staff are made aware of these;
- ensuring that the Installation is operated by suitably competent staff who have received the necessary training in all aspects of the plant's operation, including where contractors are used, ensuring that they are suitably competent; in this regard:
    - the skills and competencies necessary for key posts are documented; these key posts include contractors, those responsible for liaising with contractors and those purchasing equipment and materials,
    - training requirements are identified by means of a documented training needs analysis,
    - documented training records are kept and updated as required,
    - training specifically addresses environmental awareness and environmental permit requirements, and
    - the requirement for ongoing/refresher training is identified;
- ensuring that there are site layout plans - including drainage plans - and that they are revised as required to reflect any changes;
- ensuring that there are documented procedures covering internal and external communications;
- ensuring that there are procedures in place for staff and contractors to have access to the Permit and management system requirements; with regard to contractors, ensuring that suitable instructions are provided with regard to protecting the environment whilst working on site;

- the establishment of a documented planned preventative maintenance regime ("PPMR") to ensure that all plant and site infrastructure are kept in suitable condition and operating effectively; this PPMR details what maintenance, tests and inspections need to completed and when; this also details the measures required to ensure continuing compliance with the permit conditions during maintenance/shutdown. The PPMR also:
  - identifies known or predictable malfunctions associated with the operations and the procedures, spare parts, tools and expertise required to deal with them,
  - includes a record of spare parts held, or details on where they can be sourced from, together with an assessment of how long they would take to obtain,
  - includes a defined procedure for identifying, reviewing and prioritising items of plant for which a preventative regime is appropriate,
  - ensure the necessary spare parts, tools, and competent staff are available prior to commencing maintenance. The design, installation and maintenance of infrastructure, plant and equipment will be carried out by competent people, including Construction Quality Assurance where appropriate,
- ensuring that there are documented procedures covering document control;
- ensuring that there are suitable documented record-keeping arrangements in place;
- ensuring that there are documented operational procedures and work instructions covering all aspects of the Installation's operation;
- ensuring that there are documented procedures covering emissions monitoring undertaken;
- ensuring that there are documented procedures that incorporate environmental issues into the control of process/equipment/engineering change, capital approval and purchasing policy;
- ensuring that there are documented procedures to address non-conformities/non-compliances and the associated corrective and preventative action; these will detail the means by which any such non-conformities/non-compliances are reported to management and the means by which they are reported to the EA;
- ensuring that there is a documented procedure for dealing with complaints;
- ensuring that there are documented procedures covering emergency preparedness and response; these will cover such incidents as major plant failures, significant spillages of potentially polluting substances, loss of mains electrical power etc as detailed in an Accident Management Plan. The Accident Management Plan also details the measures taken to prevent the events that may lead to an accident. MorGen will ensure that suitable measures are in place to communicate the Accident Management Plan to all employees, management and contractors who work at the site. There is an emergency co-ordinator (or deputy) who will take the lead and responsibility for implementing the accident management plan.
- ensuring there is a documented climate change adaptation plan which addresses the risks identified;
- ensuring that there are documented procedures for carrying out internal audits; these describe how to schedule, conduct, report and manage internal audits;
- ensuring that there is a documented contingency plan in place that ensures

compliance is maintained with all Permit conditions and operating procedures during maintenance/shutdown at the Installation or elsewhere.

3.4.2. The outcome of the above is evidence that day-to-day activities are taking place in accordance with the requirements of the management system and the Permit, specifically:

- that control measures and procedures are an integral part of the business operation;
- that the management system is easy for staff to access, understand and use;
- that staff are suitably trained and competent to carry out procedures and control measures; and
- that the requirements of the management system are effectively communicated to management, staff and contractors.

3.5. Check

3.5.1. This element includes:

- ensuring that all regulatory requirements in relation to monitoring and measurement are complied with, specifically:
  - the requirements relating to inspection and testing required under the applicable environmental legislation and the Installation's Environmental Permit and the associated procedures and work instructions,
  - the requirements relating to inspection and testing required under the applicable health and safety legislation and the associated procedures and work instructions, and
  - the requirements relating to the control of all inspection, measuring and test equipment relating to environmental requirements;
- ongoing evaluation of compliance with environmental legal requirements, policy requirements and objectives and targets; this will include:
  - an annual review of environmental legal register;
  - an annual review of utilities used on site and waste produced;
  - regular site inspections,
  - internal audit procedures (as detailed below);
- ensuring that non-conformities/non-compliances are properly recorded, investigated and that the appropriate corrective action is taken by the due date;
- ensuring that the necessary reporting and record-keeping required under the various Permit and consents are complied with;
- ensuring that internal audits are carried out in accordance with the documented procedures and that any audit actions are followed up; and
- ensuring that the results of all audits (internal and external) are made available to Senior Management on a regular basis.

3.5.2. The outcomes of the above will be:

- that checks are carried out to ensure that the management system is being implemented as intended, i.e. as documented; and

- the necessary preventative and corrective actions are undertaken to minimise non-compliances.

3.6. Review (Act)

3.6.1. This element includes:

- an annual management review of the management system to ensure that it is appropriate, being implemented and kept up to date, e.g. that any supplementary plans have been included into the management system;
- a management review of the management system when:
  - there are changes on site (in activities and/or plant/equipment),
  - if there is an accident, complaint, or breach of permit conditions.
- an annual review of both individual and organisational training needs;
- ensuring that all changes are properly recorded, and, if there are any major changes, the EA is informed;
- an assessment of whether the Facility's objectives, and any targets, have been met and reported;
- a review of the Installation's objectives and targets, and, where appropriate, any revisions to these so as to effect continual improvement.

3.6.2. The outcomes of the above will be:

- the management system is kept up to date, and
- the management system is continually improved.

4. OPERATING TECHNIQUES

4.1. Technical Standards

4.1.1. The production of H_2 by electrolysis of water is an emerging technique. Consequently, this activity is outside the scope of existing established guidance. The EA's online guidance for *"Hydrogen production by electrolysis of water: emerging techniques"* has been used to inform this application. The techniques described in the EA online guidance and an assessment of compliance with the relevant techniques is provided in Section 5 of this report.

4.1.2. There are no existing best available techniques ("BAT") reference documents ("BREFs") or guidance that specifically covers the production of H_2 from water by electrolysis. Consequently, Article 14(6) of the Industrial Emissions Directive ("IED") has been considered.

4.1.3. Article 14(6) states:

> *"Where an activity or a type of production process carried out within an installation is not covered by any of the BAT conclusions or where those conclusions do not address all the potential environmental effects of the activity or process, the competent authority shall, after prior consultations with the operator, set the permit conditions on the basis of the best available techniques that it has determined for the activities or processes concerned, by giving special consideration to the criteria listed in Annex III [of IED]".*

4.1.4. Annex III provides the criteria for determining BAT as follows:

1. the use of low-waste technology;
2. the use of less hazardous substances;
3. the furthering of recovery and recycling of substances generated and used in the process and of waste, where appropriate;
4. comparable processes, facilities or methods of operation which have been tried with success on an industrial scale;
5. technological advances and changes in scientific knowledge and understanding;
6. the nature, effects and volume of the emissions concerned;
7. the commissioning dates for new or existing installations;
8. the length of time needed to introduce the best available technique;
9. the consumption and nature of raw materials (including water) used in the process and energy efficiency;
10. the need to prevent or reduce to a minimum the overall impact of the emissions on the environment and the risks to it;
11. the need to prevent accidents and to minimise the consequences for the environment; and
12. information published by public international organisations.

4.1.5. These criteria have therefore been considered during the preparation of this permit application.

4.2. Process Description

4.2.1. It is proposed to undertake a listed activity, namely Section 4.2 A(1) (a) (i), the production of H_2 via the electrolysis of water ("the H_2 Plant").

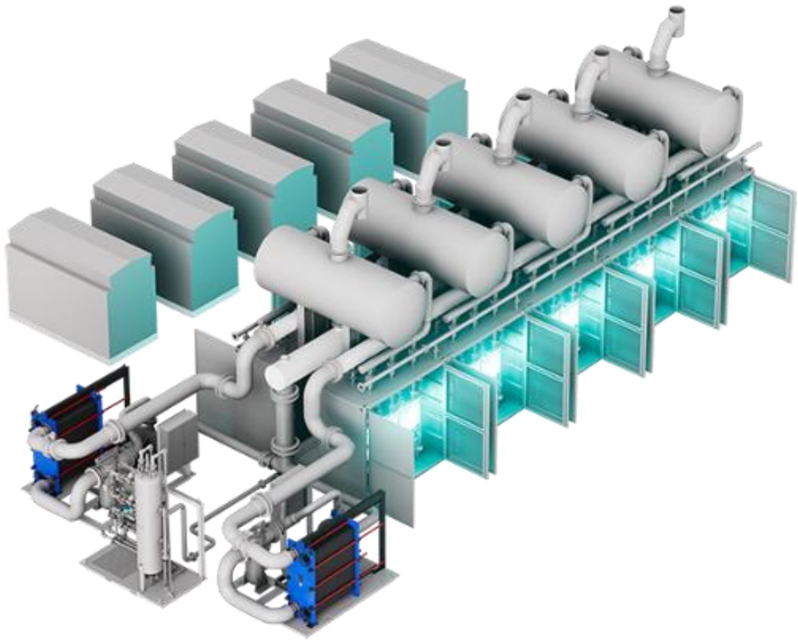
4.2.2. The site layout is shown on Drawing H2EE.02.01-02 – Site Layout submitted in Section 3 of the permit application. The H_2 Plant will be controlled and operated from the local control room.

4.2.3. The incoming electricity is directed to the MV/LV/LER building from where it is distributed to a series of transformers and rectifiers that convert the electricity from alternating current to direct current. It is then directed to the hydrogen production units.

4.2.4. Electrolysis – Proton Exchange Membrane ("PEM") - will be used to generate the H_2 gas. The main inputs to the process are water and electricity, to split water into its constituent parts.

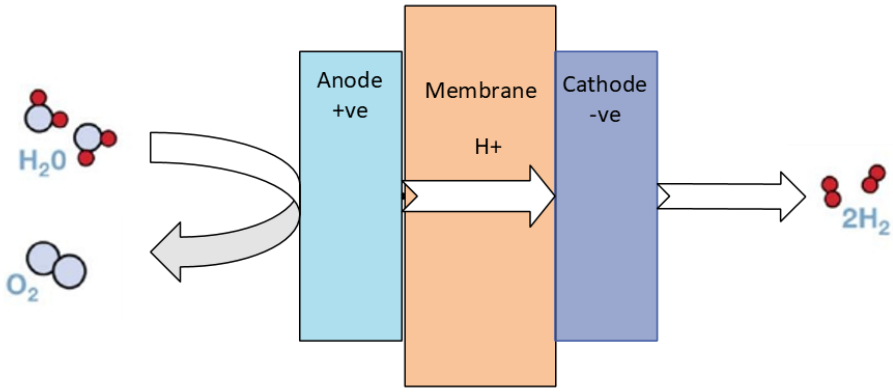
4.2.5. The individual electrolysis units have an input power of 20MW, therefore, there will be 3 units. Figure 2 shows an example of the electrolysis unit to be used. There are 30 stacks per unit, with an output of 0.667MW each – 20MW in total.

Figure 2: Example Electrolysis Unit



4.2.6. PEM electrolysis splits water into H_2 and O_2. The H^+ ions and some water are passed through a membrane where H^+ ions combine to form H_2 on the cathode side, leaving O_2 and excess water on the anode side. The membrane conducts the H^+ ions and therefore separates H_2 and O_2. A simplified model of the process is provided in Figure 3.

Figure 3: Simplified Electrolysis



4.2.7. The membranes are made from various materials including fluoropolymers, which belong to the per- and polyfluoroalkyl substances ("PFAS") family. The fluoropolymers used are highly resistant materials and are therefore released in very limited quantities.

4.2.8. Only a small portion of the water fed to the stacks is split into hydrogen and oxygen. The majority of the water is used to maintain the stacks at a safe operating temperature. This excess water is continuously re-circulated within the electrolysis unit with a fresh make up stream of ultra-pure water ("UPW") provided to replace the water split into H_2 and O_2 and any water lost, as water vapour, in the oxygen and hydrogen product streams. No liquid water is removed from the electrolysis unit during normal operation. Thus, any PFAS material released in the electrolysis units during operation remain in the electrolysis units.

4.2.9. It should be noted that PFAS is only released from the membrane in very limited amounts to the demineralised water passing through the electrolysis membrane. As the majority of ultra-pure water is recycled, to prevent build-up of PFAS materials, a small slip stream of the recycled water is continuously routed through a mixed ionic adsorption bed, which adsorbs the PFAS material.

4.2.10. Demineralised water will be provided from Sembcorp. Sembcorp operate the 2,000-acre site at the Wilton Industrial Estate and supply customers with development land, energy and utilities.

4.2.11. The demineralised water will be treated within the water treatment plant to be suitable for use in the electrolysis process. The water treatment will consist of:
(1) TOC reduction by means of UV units;
(2) Electro-deionisation (EDI) units;
(3) Final polishing by means of mixed ionic bed resin.

4.2.12. One gas treatment unit with deoxygenation and dehydration is located east of the electrolyser units and is used to dry the produced hydrogen and to remove remaining oxygen from the hydrogen product stream.

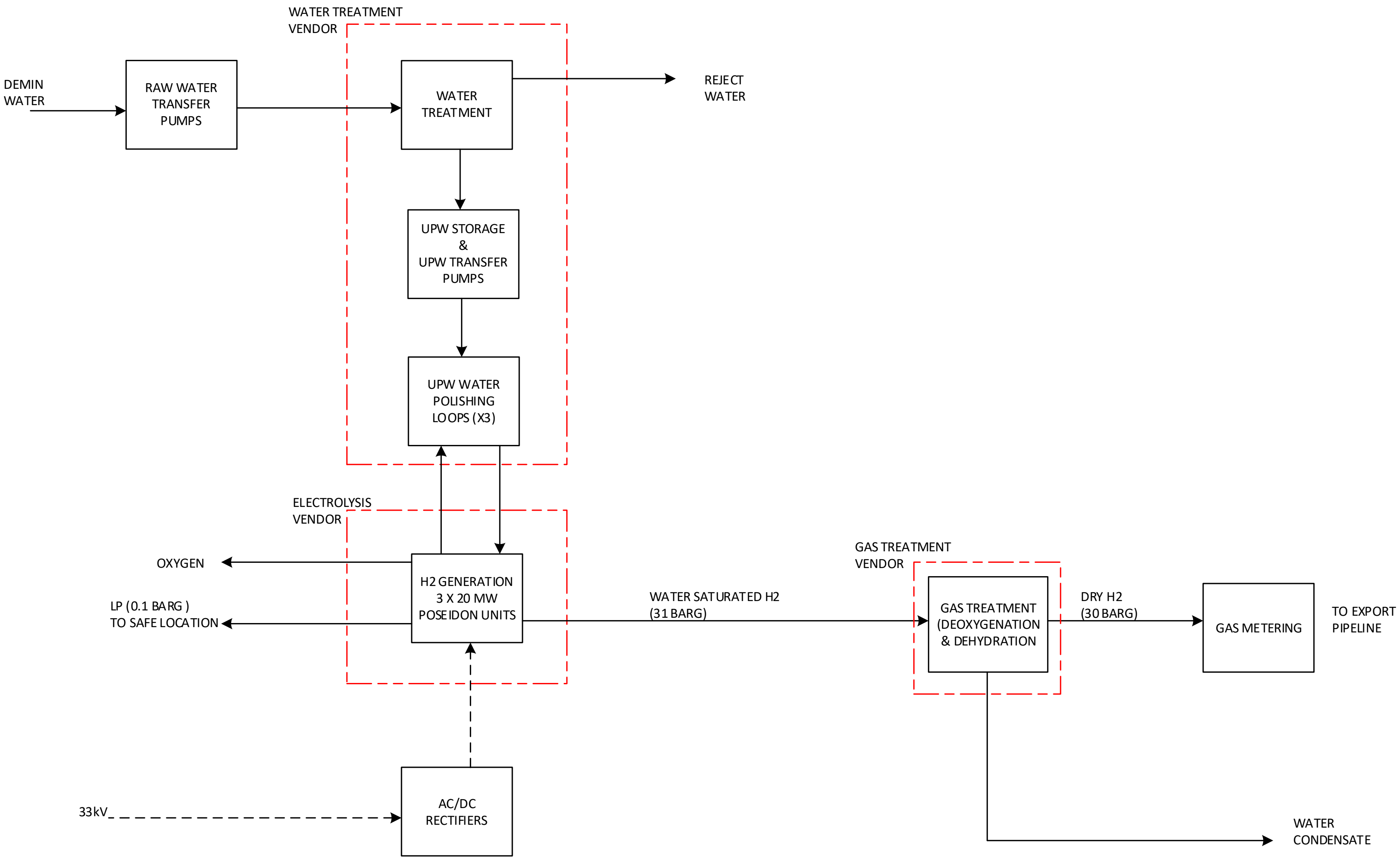
4.2.13. Air cooling units, located to the west of the electrolyser units, are used to disperse excess heat from the process.

4.2.14. A dedicated pipeline will be used to transport H_2 to local users in the wider Wilton area.

4.2.15. During the H_2 Plant's operation, it will vent approximately 52,000 tonnes per annum of oxygen as a by-product.

4.2.16. A block diagram is provided as Figure 4.

Figure 4: Block Diagram



5. EMERGING TECHNIQUES: HYDROGEN PRODUCTION

5.1. Technique Selection

5.1.1. When designing the H_2 Plant, the overall environmental performance of the H_2 Plant was considered which includes:

- energy demand and efficiency;
- water demand, efficiency and evaluation for re-use; and
- emissions to the environment.

5.1.2. The H_2 Plant will use PEM technology. An assessment of the three main technologies – Alkaline Electrolysis, PEM and Solid Oxide Electrolyser Cell - has been undertaken. This can be found in Table 2. As there is currently no BREF for this sector, the EA's guidance note on the Review of Emerging Techniques for Hydrogen Production from the Electrolysis of Water[2] has been used to inform the assessment.

5.1.3. In summary, PEM technology offers several advantages, including low operational temperatures and rapid response times allowing it to be used on demand when needed. Solid oxide electrolyser cell technology is not considered to be a sufficiently mature technology to be used. Whilst alkaline electrolysis is well established, the chemicals used (potassium hydroxide) carry a significant environmental risk compared to water.

5.1.4. It should also be noted that PEM also has a high efficiency and compatibility with renewable energy sources (thus future proofing the system should renewable energy such as wind and/or solar be considered in the future).

[2] https://assets.publishing.service.gov.uk/media/65fb0d06703c42001158f0c9/Review-of-emerging-techniques-for-production-of-hydrogen-by-electrolysis-of-water.pdf

Table 2: Review of Electrolysis Technologies

Consideration	Alkaline Electrolysis	Proton Electrolyte Membrane	Solid Oxide Electrolyser Cell
High efficiency and low environmental impact of the whole facility in addition to individual equipment items.	Operates at 70-90°C	Operates at 50-80°C	Operate at 500 - 1000°C, however more efficient than Alkaline or PEM
Input from original equipment manufacturers, particularly electrolyser suppliers, to ensure that environmental consequences of operation/maintenance are considered.	Electrolyser use of precious metals is avoided, but significant nickel content needed to withstand caustic environment. Circa 800kg of nickel per MWe.	Electrolysers place significant demand on platinum and iridium, resources - circa 0.3-1kg of platinum and 0.7kg for iridium per MWe. PFAS also used in membranes.	Electrolysers include materials from a range of limited global sources. Nickel is 150-200kg per Mwe, but there is potential to reduce to 10kg per MWe.
Potential inclusion of battery electrical storage to provide a steady power supply to the installation when there is intermittent availability of renewable power, such as from wind or solar.	Possible. Electrolyser is capable of following load changes fairly well.	Possible. Electrolyser is capable of following load changes very well.	Possible. High operating temperature leads to comparably slow start/stop-processes of electrolyser.
Higher pressure operation may increase safety concerns, potentially introducing requirements such as blast walls located between electrolysers.	Offered with both atmospheric and higher H_2 outlet pressure. Atmospheric pressure is more common. H_2 inventory in stacks/tubing remains low also at higher H_2 outlet pressure. Measures are required to be taken to prevent release of large H_2 amounts from vessels (e.g. separators) and effective removal of potentially leaked H_2.	Offered with both atmospheric and higher H_2 outlet pressure. H_2 inventory in stacks/tubing remains low also at higher H_2 outlet pressure. Measures are required to be taken to prevent release of large H_2 amounts from vessels (e.g. separators) and effective removal of potentially leaked H_2.	Offered typically with atmospheric H_2 outlet pressure.

Table 2: Review of Electrolysis Technologies (cont)

Consideration	Alkaline Electrolysis	Proton Electrolyte Membrane	Solid Oxide Electrolyser Cell
Leak detection and management (including potential for leak-free valve designs) to reduce potential emissions, which have both environmental and safety-related impacts.	Mature technology, potassium hydroxide electrolyte can have severe environmental impacts if released. Degraded system often show cauterisation.	Electrolyser is equipped with vent duct over stacks, including H_2 sensors in duct suitable for fast leak detection.	High temperatures and lower technology readiness level might lead to quicker material degradation and thus H_2.
Assessment of pressurised storage requirements to manage hydrogen supply and demand	Requirement for compressor and associated equipment if H_2 outlet pressure is atmospheric therefore increasing system complexity.		
Understanding of overall system design and performance under a range of operating conditions.	Mature technology - recent developments allow for increased operating pressure	Mature technology at small to middle scale with scope for development at larger scale	Novel technology
Seeking opportunities to simplify the system design where possible	Lye tank and scrubber needed and purification of H_2	Only requires water, and minimal purification of H_2.	No scrubbers required, however large heat/steam requirement
Ensuring equipment is appropriately sized (including design margins) to give best efficiency and minimise energy use, water use and heat loss.	Plant sizes from small to large, allowing operator to choose the appropriate electrolyser size, operating whenever possible in optimal range (40-50% load). Relatively fast ramp-up and down times allow limited use of this feature.	Plant sizes from small to large, allowing the operator to choose the appropriate electrolyser size, operating whenever possible in optimal range (40-50% load). Fast ramp-up and down times allow good use of this feature.	Typically larger installations, co-located with industrial processes where heat requirements can be integrated.
Consideration of differently sized parallel units to cover a range of duty points	Can be considered.	Can be considered.	More difficult to consider due to high ramp-up time due to high temperatures.
Designing the system to operate safely and efficiently for the range of operating scenarios.	Systems were not designed to respond to variability in electricity supply, therefore start up and response times are slow.	Very fast reaction times. Chemical reaction stops immediately when power is cut off (no need for purge each time electrolyser is stopped for short periods of time).	Less operational flexibility than alkaline or PEM due to high temperature requirements.

Table 2: Review of Electrolysis Technologies (cont)

Consideration	Alkaline Electrolysis	Proton Electrolyte Membrane	Solid Oxide Electrolyser Cell
Review potential for heat recovery and re-use through structured review of the system design	Heat recovery possible at elevated temperatures (80-85°C)	Heat recovery possible at relatively high temperatures (65-70°C)	Highest temperature therefore generates high quality waste, however due to high efficiency there is less waste heat available compared to PEM & Alkaline
Consideration of water recovery within the installation.	Water recovery is possible.	Water recovery is possible.	Not applicable as system uses steam.
Utility systems optimisation	Need for larger utility systems (demineralised water, power, deoxo scrubber)	Needs only demineralised water and power	For increased optimisation (in particular the increased electrical efficiency) a steam source needs to be available.
Consideration of environmental impacts to include design of equipment and control schemes for associated equipment	Significant storage and bunding requirements needed to prevent environmental impacts of accidental release of raw materials.	Minimal storage and bunding required for water treatment chemicals.	Minimal storage and bunding required for water treatment chemicals.
Evaluation of water supply source including options such as treated industrial wastewater.	Possible for all three, demineralisation plant needs to be adapted.		
Hydrogen production rate	Turn down ratio to 30%	Turn down ratio to 10-30%	Turn down ratio to 10-30%
Electrical efficiency	Alkaline and PEM are comparable when the characteristics of the systems are compared for on a like for like basis e.g. H_2 outlet pressure		Highest electrical efficiency. However, heat introduced to system via steam needs to be provided
Capital cost	Moderate (generally lower CAPEX for electrolyser, but higher CAPEX for hydrogen purification and compression)	Moderate (generally higher CAPEX for electrolyser, but lower CAPEX for hydrogen purification and compression)	High

Table 2: Review of Electrolysis Technologies (cont)

Consideration	Alkaline Electrolysis	Proton Electrolyte Membrane	Solid Oxide Electrolyser Cell
Materials and resources used in manufacture (including rare earth metals and PFAS)	Significant nickel content needed to withstand caustic environment. Circa 800kg of nickel per MWe.	Electrolysers place significant demand on platinum and iridium, resources - circa 0.3-1kg of platinum and 0.7kg for iridium per MWe. PFAS also used in membranes.	Electrolysers include materials from a range of limited global sources. Nickel is 150-200kg per Mwe, but there is potential to reduce to 10kg per MWe.
Operational flexibility – including speed of response	Can be integrated effectively through the provision of multiple stacks, each with its own rectifier.	10-15min start up time from full shut down.	Less operational flexibility due to higher operating temperatures, long start up times to warm up the process - circa 6 hours.
Emissions and effluents	Emissions and effluents from all three technologies are similar, emissions to air are as follows: • oxygen (continuous) • nitrogen (in case of operation stop) hydrogen (during start up and in case of emergency stop) Emissions to water include, effluents from ultra pure water production.		
Component design life – including degradation in use, frequency and cost of major outages for repairs/replacement of worn out components	Long established history of use. Lifetimes vary from 60,000 to 80,000 hours.	Lifetimes vary from 50,000 to 80,000 hours	Lifetime can be as low as 20,000 hours, although values of 93,000 hours are reported at lab scale, real world operation is likely to be lower due to elevated temperatures and thermal cycling - however UK ambient temperatures are not expected to impact significantly on this aspect.
Water quality	Ultra pure water required.	Ultra pure water required.	Ultra pure water required to generate steam.
Hydrogen product conditions for example pressure, purity	Hydrogen needs to be fed into scrubber before use. Potential contamination from potassium hydroxide solution. Pressure: from 0-15 (30) barg. 30 barg for newer, advanced alkaline solutions	Doesn't require scrubbing process. Pressure: usually 30-40 barg	Needs hydrogen purification, pressure usually low (0-2 barg)

Table 2: Review of Electrolysis Technologies (cont)

Consideration	Alkaline Electrolysis	Proton Electrolyte Membrane	Solid Oxide Electrolyser Cell
Decommissioning, ease of recycling	Recycling processes need to be developed at scale to maximise the end of life recycling for all technologies.		
Feedwater treatment	Ultra pure water purification unit required for all technologies.		
Electrolyte treatment and recovery	Necessary	Not necessary	Not necessary

5.2. Plant Design and Operation

Operation

5.2.1. Due to variability in the grid and the cost of electricity supply, the H_2 Plant is designed to operate in a flexible manner. It is designed to operate when electricity is at the most cost effective price, and therefore it can react to power fluctuations within less than 5min.

5.2.2. During start-up a small amount of off-specification H_2 may be vented for (5-10 minutes). Once the required specification is met, then the system is switched to export.

5.2.3. On a normal stop of the electrolysis units the stacks are depressurized.

5.2.4. On an emergency shutdown H2 is vented in a controlled manner to prevent escalation of the event.

Reliability and Availability

5.2.5. The Installation operates a preventative maintenance programme to identify and maintain items of monitoring and measurement equipment required for environmental, quality and safety reasons. The relevant procedures will be updated to identify equipment, systems, and operating and maintenance techniques to avoid emissions and minimise environmental impact.

5.2.6. The power supplied to the electrolyser stacks can be correlated to the H_2 output. The flow of H_2 is measured and any significant deviations from what is expected indicates that there is an issue which may be a potential leakage that needs to be resolved. This is observable from the control room.

5.2.7. The venting of H_2 is also acoustically audible. Daily inspections are undertaken which would identify any H_2 gas escape.

5.2.8. The electrolysis process has multiple feedback features on each stage of the production process which are all focused on ensuring that the safety on the production of hydrogen is built-in as a critical element on the development. The equipment suppliers adhere to the most stringent international standards, notably ISO 22734-1:2008 'Hydrogen generators using water electrolysis process', which defines the construction, safety and performance requirements of packaged or factory matched hydrogen gas generation appliances.

5.2.9. For monitoring of the H_2 and O_2 vent line and the following controls are in place:

- H_2 gas content is monitored in the oxygen product stream. If the hydrogen content in the oxygen product stream exceeds a pre-set value the electrolysis unit alarms and will then automatically trip if it exceeds a further set point (shutdown);
- the quantity of H_2 and O_2 being released will be calculated by mass balance.

5.2.10. OTNOC Management Plan – ("OTNOC") events will be addressed within the EMS, operating procedures will be updated to include the H_2 Plant. The frequency, and duration of OTNOC events to be described in the EMS. During startup and shut down a small amount of H_2 is vented to air from the A1-A3 emission points.

Hydrogen Venting versus Flaring

5.2.11. It is proposed to utilise venting for the release of hydrogen in connection with depressurisation and purging and continuous venting of unrecoverable low-pressure hydrogen.

5.2.12. A small amount of low pressure (< 1 barg) hydrogen will be released during normal operation due to the degassing of electrolyses water, approximately 2,5 kg/hr if the plant is operating at full rate which will be vented via emission points A1-3.

5.2.13. Safe and reliable recovery or combustion of such small amounts of low-pressure H_2 is not practicable and proven, commercially available technology is not available.

5.2.14. In case of emergency shut down of an individual electrolyser, the electrolyser inventory at 30 barg will be depressurised and disposed of by venting for safety reasons. In certain emergency situations, depressurisation of H_2 inventory downstream of the electrolysers will take place to bring the facility to safe condition – these inventories will be deposed of by venting.

5.2.15. The venting of H_2 is a well proven, simple, and reliable method for H_2 gas removal. Due to the very low density, high buoyancy and dispersion characteristics, H_2 will disperse effectively, imposing insignificant risk of accumulating at lower elevations.

5.2.16. The vent system design will include verification of impact if the vented gas ignites in terms of radiation and explosion gradients. No utility support or back-up systems, which potentially involve emissions, are involved.

5.2.17. In accordance with American National Standard "Guide to Safety of Hydrogen and Hydrogen Systems" ANSI/AIAA G-095A-2017, section 8.6.2, quantities of hydrogen up to 0.226 kg/s have been successfully vented from a single vent, which is considered to be above the Teesside Green Hydrogen Project requirements.

5.2.18. As discussed, the actual gas flow through the vent(s) will vary significantly throughout operation, resulting in a large variation in flow rates for a potential flare tip. Highly intermittent flow rates raise the risk of flame blowout and reignition.

5.2.19. A flare system will involve maintaining a pilot flame, ignition, flame monitoring system and purge systems.

5.2.20. Consequently, flaring is not considered the optimum technology choice outside of large facilities which have the infrastructure to support flare operations.

5.2.21. With due consideration to the amounts of hydrogen released in different scenarios, and the relative complexity involved in a flare system design, it has been decided to utilise venting as opposed to flaring for the Teesside Green Hydrogen project.

5.2.22. Furthermore, if a flare was used, this would require pilot gas from i.e. propane storage. The emissions involved in maintaining a flare pilot flame continuously throughout operation would emit approximately 50 tons per annum of $CO_{2,eq}$ which is considered to be detrimental to the overall objective of producing H_2.

Energy Efficiency, Process Efficiency and Cooling

5.2.23. Energy Efficiency Measures are discussed in Section 9.2 of this EPTR.

5.2.24. Maximising the life of the equipment and components, particularly rare global resources is critical to maximising the production of H_2. The electrolyser has an expected design life of 20 to 30 years with the individual stacks being replaced every 7-10 years.

5.2.25. To minimise the use of raw materials, the following measures are in place:

- recycling of water from various process units to minimise the Demin water consumption of the plant; and
- the electrolyser stacks are designed to enable recycling of the materials, especially precious metals used in the stacks.

5.2.26. Raw material use will be reviewed after the first year of operation and consideration will be given to further minimisation options.

5.2.27. It is not financially viable to recover the O_2 that is vented. It would require significant gas clean up, followed by compression and/or liquefaction. There are other, more cost effective and less energy intensive methods used to produce O_2.

5.2.28. The energy required for the electrolysis process will be obtained via a new connection to the Sembcorp private grid. Energy requirements are discussed in Section 9 of this RPTR.

5.2.29. A review of potential suitable offtakes for the low grade heat from the electrolyser has been undertaken, however there was nothing suitable in the area. This will continue to be reviewed as part of the EMS (i.e. continual improvement).

Water Supply and Use

5.2.30. The water used in the process is demineralised water and will be obtained from Sembcorp (see Section 4.2.). Around 9kg of water is required to produce 1kg of H_2 gas. The annual water consumption for the H_2 Plant will be around 100,000 tonnes.

5.2.31. The demineralised water will undergo a final polishing step within the water treatment plant to be suitable for use in the electrolysis process. Water is treated to remove particles and ions, and then further purified using an electric current (continuous electro deionisation ("CEDI")) through an ion exchange membrane. Organic components are removed using ultraviolet light, and finally the water is passed through a mixed bed filter to remove ions such as potassium and sodium.

5.2.32. There are no point source emissions to air from the water treatment process.

5.2.33. Effluent from the water treatment plant will be directed to the Installation's foul drainage system sewer (see Drawing H2EE.01.01-04 – Drainage) and will leave the Installation via emission point S1, prior to entering the Sembcorp combined drainage system, and finally discharging directly into the River Tees.

5.2.34. Waste heat is not used for any cooling methods.

Electricity Supply

5.2.35. Electricity will be supplied from Sembcorp's private network. Based on an expected operation of 6,000 hours per annum, based on the system on full load, it is anticipated that 400,000MWh will be consumed per annum.

5.2.36. An emergency power system in the form of a diesel-powered generator will be installed to ensure power supply to critical components (security systems and lighting) during any grid outages. The generator will have an electrical output of 0.3MW_e and thus an expected maximum input power of around 1MW_{th}.

Hydrogen Purification

5.2.37. Deoxygenation and dehydration of the hydrogen stream in an electrolyser plant is a critical purification step to ensure the hydrogen product meets the required purity standards, especially for applications like fuel cells or industrial processes where oxygen contamination can be detrimental. In a PEM electrolyser the hydrogen produced at the cathode may contain trace amounts of oxygen due to gas crossover through the membrane. To remove this oxygen, a deoxygenation unit is used downstream of the electrolyser.

5.2.38. Hydrogen and oxygen react over a catalyst (typically platinum or palladium on alumina) to form water as follows:

- $2H_2+O_2 \rightarrow 2H_2O$

5.2.39. This process operates at moderate temperatures (100–200°C)., is simple, effective, and doesn't require additional chemicals.

5.2.40. H_2 purification will be undertaken using a dehydration system, namely a temperature swing adsorber ("TSA"). TSA is a thermal process that can be used to purify hydrogen for fuel cells. TSA uses an adsorbent material (e.g. activated alumina) to selectively absorb impurities from a gas mixture, while allowing the H_2 molecules to pass through. The process can achieve high purity and recovery of hydrogen. TSA can also operate at low pressure ratios, which can reduce energy consumption and equipment costs compared to other methods.

5.3. Raw Materials

5.3.1. Raw material consumption, per annum, as part of the proposals is estimated in Table 3.

Table 3: Types and Amounts of Raw Materials

Schedule 1 Activity	Description of Raw Material and Composition Material	Maximum Stored on Site*1	Annual Throughput*1	Description of Use
S4.2 A(1)(a)(i)	Demineralised Water	$45m^3$ Tank	$9{,}000m^3$	Input water for purification
	Potable Water	No storage	$200m^3$	Safety Shower and domestic use
	DeOxo catalyst	420 kg	210 kg*2	Deoxygenation of hydrogen gas
	Activated alumina	820 kg	420 kg	Drying of hydrogen
	Ethylene glycol	1,035 litres	1,035 litres	Antifreeze

Note to Table:
*1 – It should be noted that quantities are approximate and may be subject to change following detail design
*2 – Likely to be changed every 2 years

5.3.2. Ionic resin is also used for the treatment of the demineralised water to produce ultra-pure water. Approximately 30,000 litres per annum, with a maximum of 15,000 litres stored on site at any one time.

5.3.3. Other raw materials are used in smaller quantities including:

- diesel for the emergency backup generator;
- transformer oil; and
- other maintenance fluids are used in very limited quantities such as lubricants, cleaners, paints and gasses.

5.3.4. A solid desiccant (activated alumina, silica gel or molecular sieves) will also be used to adsorb any water vapour from the hydrogen product gas stream. Two adsorption towers are provided with one in drying mode the other in regeneration (to remove the adsorbed water). As the wet hydrogen product stream is free of contaminants replacement of the solid desiccant is expected to happen only very rarely.

5.3.5. All potentially polluting substances are bunded and stored on impermeable hardstanding.

5.4. Emission to Air

5.4.1. An assessment of emissions to air has been undertaken and is provided in the Environmental Risk Assessment submitted with this application (see H2EE.02.01/ERA in Section 5 of the application submission).

Emissions of H_2

5.4.2. The H_2 Plant has been designed with the following hierarchy in mind:

1) prevent or avoid emissions of hydrogen;
2) recover or recycle hydrogen;
3) avoid flaring of hydrogen; and
4) avoid or minimise continuous or intermittent venting of hydrogen, whether for operational or safety reasons.

5.4.3. The following techniques have been used to achieve this:

- the H_2 Plant uses state of the art electrolyser technology with a proven track record of leak free stacks without hydrogen emissions; and
- The PEM technology selected requires only the electrolysis stack to be vented upon shutdown with the rest of the equipment remaining pressurised and thus minimises the emissions of hydrogen and enabling a fast start-up.

5.4.4. It should be noted that that, although the above measures have been implemented to prevent emissions of H_2, there is a small amount of low pressure H_2 that is released via emission point A2 which is integral to the process.

5.4.5. Emissions of H_2 are further discussed in Section 6 of this EPTR.

Emissions of O_2

5.4.6. Emissions of O_2 are discussed in Section 6 of this EPTR.

5.4.7. Options to purify and/or capture the waste O_2 were considered, however, there is no immediate demand for O_2 in the area. As discussed in Section 5.2, it is not commercially feasible to capture this by-product.

Other Emissions

5.4.8. The operations of the H_2 plant do~~es~~ not give rise to any odour emissions.

5.4.9. It should be noted that elemental nitrogen is also occasionally used to purge the system.

5.5. Emissions to Water

5.5.1. Wastewater is minimised as parts of the less concentrated water is collected and recirculated to be reused. Any remaining water is discharged through Sembcorp's combined drainage system for the wider Wilton site. The outputs from the process are listed in Table 4.

Table 4: Discharges from Water Treatment to Combined Drain to River Tees

Process	Mode	Water Content(1)	Duration and Frequency	Quantity
Electrodeionisation	Recirculation tank purge	Concentrated water	Continuous	$1.3m^3/h$
Gas Treatment	H2 Chiller Knock Out Drum	Water	Continuous	$0.05m^3/h$
	Adsorption beds	Ultra Pure Water	Once per regeneration	$0.008m^3/h$

Notes to Table

(1) Concentrated water is water with a higher concentration of the ions that are removed during the purification process (i.e. iron, chlorine, calcium and magnesium).

5.5.2. An assessment of emissions to water has been undertaken and is provided in the H1 Assessment to Water submitted with this application (see H2EE.02.01/H1 in Section 7 of the application submission). This concluded that the that the environmental risks to the receiving waters can be screened out or have been considered not significant.

5.6. Emissions to Ground and Groundwater

5.6.1. There will be no emissions to ground nor groundwater. Fugitive releases will be prevented by conducting all operations in areas sealed with an impervious barrier to prevent a pathway for migration to ground or groundwater.

5.7. Waste

5.7.1. Small quantities of waste will be generated and will consist of empty chemical packaging, waste from maintenance tasks and general commercial. All waste will be stored on impermeable hardstanding in containers with lids.

5.7.2. There will be small amounts of hazardous waste associated with the maintenance of, for example, pumps etc. (lubricating oil and similar).

5.7.3. As discussed in Section 4, PFAS accumulates within the ion exchange resins. In case of maintenance, the system is drained of water, which is handled in a closed drainage system where it is directed to a bunded storage tank. Following maintenance, the water is returned to the plant via resin filtration. No water from the electrolysis process is disposed of, consequently, no PFAS-containing water is discharged.

5.7.4. Based on 6,000 hours of annual operation, less than 6 kg PFAS will be deposited in 1.5 tons of resin. When the electrolysis membranes reach their end-of-life, they need to be replaced. As the cell blocks contain valuable metals and other components, they will be reprocessed and the materials recycled at a suitably permitted facility/installation. A replacement cycle of 7-10 years is planned. All resins will be disposed of to a suitably permitted facilities/installations by a suitably licensed waste carrier.

5.7.5. Spent adsorbent from the H_2 purification, and filter material from water treatment, will also be disposed of at suitably permitted facilities/installations.

5.8. Monitoring and Reporting

Monitoring of Point Source Emissions to Air

5.8.1. There are 18 point source emissions to air (see Section 6.1.) proposed as follows:

- A1-A3 for H_2; and
- A4-A18 for O_2.

5.8.2. These emission points are also used during start up or shut down or in the case of an emergency. Since neither are considered by the EA to be pollutants, and there are no air quality standards for either, monitoring of the discharge is not proposed.

5.8.3. The quantity of H_2 released will be calculated from a mass balance and year 1 will be used to set a baseline, with the objective of lowering emissions of H_2 year on year as low as practically possible.

5.8.4. The O_2 emission points are continually operational during the electrolysis process.

5.8.5. If should be noted that there are a number of fugitive emissions to air which are discussed in Section 6.4.

Monitoring of Emissions to Combined Drainage System

5.8.6. There is one point source emissions to water designated S1. This will comprise uncontaminated surface water and the effluent from the polishing of the demineralised water.

5.8.7. Emissions from S1 will be discharged into the Sembcorp combined drainage system prior to discharge into the River Tees.

5.8.8. An MCERTs effluent flow meter will not be required as the flow is less than $50m^3$ per day.

5.8.9. Sembcorp will issue an "internal" discharge consent to MorGen to ensure that limits at the final point of discharge can be met.

Monitoring Emissions to Ground and Groundwater

5.8.10. In accordance with the IED, soil monitoring will be undertaken every 10 years and groundwater every 5 years for any potentially polluting substances that will be used at the Installation.

Monitoring Standards

5.8.11. Where required, all monitoring will be undertaken by staff who are competent and work to recognised standards – e.g. UKAS/MCERTS accreditation. Any samples will be sent to UKAS/MCERTs laboratories.

Monitoring Process Performance

5.8.12. Monitoring of process performance will be contained within the Objectives and Targets Register of the Installation's EMS. For the H_2 Plant, in the first year of operations, the following will be monitored:

- energy consumption per kg of H_2 product; and
- water consumption per kg of H_2 product.

5.8.13. Year 1 will then be used as baseline to identify opportunities to reduce both energy and water consumption where technically and economically feasible.

5.9. Unplanned Emissions and Accidents

5.9.1. There will be a Planned Maintenance Plan ("PMP") for the Installation. The PMP will incorporate a risk based leak detection and repair ("LDAR") programme to cover all tanks, pipework, joints, seals and glands.

5.9.2. An Accident and Amenity Risk Assessment Environmental Risk Assessment document (Reference H2EE.02.01/ERA) has been submitted with this application which considers the risks of accidental releases to the environment.

5.10. Noise and Vibration

5.10.1. A Noise Impact Assessment ("NIA") was undertaken as part of the planning application and is included as Appendix II. The NIA considered the noise associated with the plant, operational activities and delivery vehicles.

5.10.2. The closest residential receptors are to the south-west approximately 600m from the environmental permit boundary.

5.10.3. The results of the assessment indicate that the proposed plant would likely contribute to the existing low-level hum audible below road traffic at quiet periods but is unlikely to pose a significant intensification. Within the context of the existing industry in the area the impact of this is unlikely to be significant.

6. EMISSIONS

6.1. Point Source Emissions to Air

6.1.1. There are 18 emission points to air proposed as follows:

- A1-A3 for H_2; and
- A4-A18 for O_2.

6.1.2. It should be noted that the H_2 vents are located at a suitable distance from the O_2 vents to minimise fire and explosion risk. In addition, there are strict controls in place to ensure that in the event of an emergency, where both H_2 and O_2 must be vented at the same time (e.g. emergency shut down), the H_2 is vented at a safe distance from the O_2 to avoid the risk of mixing and ignition.

Hydrogen

6.1.3. H_2 is continuously vented (via emission points (A1-A3), at a rate of 0.8kg/h from each electrolyser as part of the process (2.4kg/h total). The location of the emission points is shown on ECL Drawing H2EE.02.01-02 submitted as Section 3 of the permit application. The vents are 12m high.

6.1.4. There are pressure relief valves which can be used to vent H_2 in case of overpressure. The system / operators will take corrective measure to bring the plant back to normal operating conditions and the pressure relief valves will automatically close again.

Oxygen

6.1.5. Each of the three electrolysis modules will have five water-oxygen separators which will release O_2 at rate of 1,811Nm^3/h (5,433Nm^3/h total). The location of the emission points is shown on ECL Drawing H2EE.02.01-02 submitted as Section 3 of the permit application.

6.1.6. O_2 from electrolysers are vented via 10” vent lines above the anode separators. The vent is circa 12m high.

6.1.7. It should be noted that is a trace amount of hydrogen in the oxygen vent due to cross over from the oxygen side of the electrolyser. This is around 0.03% (mass basis) hydrogen, therefore there is no explosion risk.

Additional Emissions

6.1.8. An emergency power system in the form of a diesel-powered generator will be installed to ensure power supply to critical components (security systems and lighting) during any grid outages. The generator will have an electrical output of 0.3MW$_e$ and thus an expected maximum input power of around 1MW$_{th}$.

6.1.9. The generator will be tested occasionally (for less than 50 hours per year), and generally expected to be non-operational (it will be operated for less than 500 hours per year). Therefore, emission limits under Medium Combustion Plant Directive (“MCPD”) do not apply, and as the generator will be tested for less than 50 hours per year it will be considered as an ‘excluded generator’ with no set specific generator emission limits.

6.1.10. It is understood that there are the following draft BAT expectations for new emergency standby diesel generators within IED permits, however, they are not expected to be enforced at the current time of writing this application:

- emission levels shall be equivalent to TA-Luft 2g standard, or US EPA Tier 2;
- vertical stacks, no caps and cowls; and
- set monitoring requirements for NO_x and CO even if ELVs do not apply.

6.2. Point Source Emissions to Combined Sewer

6.2.1. Emissions to the combined sewer will arise from water treatment and from the dehydration and regeneration process. The likely emissions to the combined sewer are provided in Table 5.

Table 5: Emissions to Combined Sewer

System	Source	Mode	Water Content	Duration and Frequency	Quantity	Remarks
Water Treatment	Electrode ionisation (EDI) Unit	Normal operation	Concentrated salt solution	Continuous	1.3 m^3/h	Rate shown is for three water trains.
Gas Treatment	H2 Chiller Knock Out Drum	Dehydration	Water	Continuous	0.05 m^3/h	
Gas treatment	Adsorption beds	Regeneration	Water	Intermittent	0.008 m^3/h	Per regeneration. No of regenerations per year not known at this time
Roof Water and Yard	Rain water	n/a	Clean rain water	n/a	n/a	Clean roof water and any run off from the yard will be discharged via a three stage oil interceptor during rainfall events.

6.2.2. The emissions from the water treatment and gas treatment will be discharged into the Sembcorp combined drain direct to the River Tees. The composition of this discharge will be as provided in Table 6.

Table 6: Composition of Emissions to Combined Sewer

Substance	Concentration (µ/l)	Annual Mass Release (kg/year)
Total Inorganic Carbon	4,750	45.53
Total Organic Carbon	5,250	50.33
Chloride	88	0.84
Sulphate	431	4.13
Phosphate	39	0.38
Fluoride	20	0.19
Aluminium	49	0.47
Calcium	49	0.47
Chromium	196	1.88
Copper	49	0.47
Iron	49	0.47
Magnesium	49	0.47
Molybdenum	294	2.82
Nickel	294	2.82
Potassium	99	0.95
Sodium	99	0.95
Titanium	196	1.88
Zinc	1,764	16.91

6.2.3. Due to the substances discharged and the low mass release, the requirements of the common waste water treatment BREF are not applicable.

6.2.4. A H1 assessment of emissions to the River Tees has been undertaken. All substances can be screened out as not significant. The H1 assessment is provided as Section 7 of the application.

6.3. Point Source Emissions to Land

6.3.1. There are no emissions to land.

6.4. Fugitive Emissions to Air

6.4.1. There are a number of fugitive emission points as follows:

- vent for the pipeline;
- vent for the gas dehydration; and
- a vent in each water treatment train (currently 3 trains).

6.4.2. All plant and equipment will be operated in accordance with manufacturer manuals and instructions and subject to routine maintenance and inspection to ensure they are operating within set parameters and at optimal performance levels.

6.4.3. Fugitive emissions of H_2 would only arise should there be a leak in any pipework. Quantities of H_2 within the H_2 Plant are limited as the H_2 produced is transferred directly to drying and then transferred off site via pipeline.

6.4.4. It should be noted that elemental nitrogen is also occasionally used to purge the system in very low quantities.

6.5. Fugitive Emissions to Surface Water, Sewer and Groundwater

6.5.1. Fugitive releases to the groundwater will be prevented by conducting all operations in areas sealed with an impervious barrier to prevent a pathway for migration to ground and groundwater.

6.5.2. For the H_2 Plant, all water treatment is undertaken, on impermeable hardstanding. This eliminates the risk of fugitive emissions to surface water.

6.5.3. All potentially polluting liquids will be appropriately bunded providing a minimum capacity of either 110% of the capacity of the largest storage vessel or 25% of the total capacity of all the storage vessels within the bund, whichever is greater.

6.5.4. All plant and equipment will be subject to regular maintenance and servicing as per the PMP contained within the Installation's EMS. This will ensure all plant is in good working order to reduce the likelihood of any liquid leakage at the Installation.

6.5.5. External examinations of all storage vessels will be undertaken by a qualified engineer on an annual basis and any actions undertaken in accordance with the engineer's recommendations.

6.5.6. Additionally, any evidence of spillage/loss of containment, as well as the site infrastructure, including bunding and impermeable concrete surfacing, is inspected weekly. If remedial action is required, this will be reported immediately, and the issue rectified as soon as possible.

6.5.7. Any spillages at the H_2 Plant will be subject to the Installation's Accident Plan which will include spill response. This will prevent any potentially polluting materials from entering the Installation's surface water drainage network.

6.5.8. All relevant employees are suitably trained in spill response, such as the deployment of absorbent materials and drain covers. Spill kits are strategically located around the Installation with the contents regularly inspected and maintained.

7. GENERAL REQUIREMENTS

7.1. Emissions Management

7.1.1. The ERA (H2EE.02.01/ERA) has demonstrated that emissions of substances not controlled by emission limits (i.e. fugitive emissions) are not considered to be significant, consequently, an Emissions Management Plan is not required as part of this application.

7.2. Odour Management

7.2.1. The process does not give risk to any odours, consequently, an Odour Management Plan is not required as part of this application. Further detail is provided in the ERA (H2EE.02.01/ERA) submitted with the application.

7.3. Noise Management

7.3.1. It is not considered that the changes proposed as part of this application will result in noise nuisance being experienced by sensitive receptors in the surrounding area.

7.3.2. The ERA (H2EE.02.01/ERA) has demonstrated that with strict adherence to the control measures set out in the ERA, risk of noise emissions beyond the Installation EP boundary is not considered to be significant. Consequently, a Noise Management Plan is not required as part of this application.

7.4. Fire Management

7.4.1. The Installation will have an Accident Management Plan which will include details how to effectively manage and report incidents and potential emergency situations including fire.

7.4.2. The fire risk management measures are summarised as follows:

- fire extinguishers and fire alarms are located in strategic locations throughout the Installation and are tested and maintained periodically;
- allocation and training of site incident commanders and support teams;
- preventative maintenance on all equipment to prevent any faults occurring which may lead to a fire; and
- unannounced fire evacuation drills undertaken twice per year to ensure all staff are appropriately trained in the fire response, escape routes and assembly points; and
- any potentially contaminated firewater will be contained on site and sent for disposal off-site at a licenced facility following analytical testing.

8. RESOURCE EFFICIENCY AND CLIMATE CHANGE

8.1. Monitoring

8.1.1. MorGen will monitor the annual consumption of water, energy and raw materials, as well as the annual generation of residues and waste water, with a frequency of at least once a year.

8.2. Energy Efficiency Measures

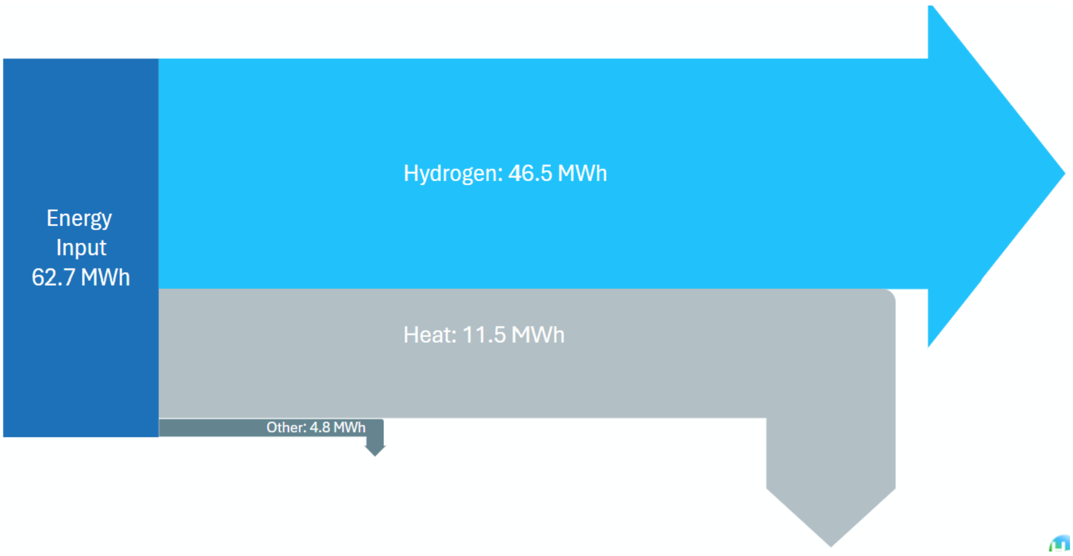
8.2.1. A number of energy efficiency measures will be implemented at the Installation as part of the proposals to improve energy efficiency:

- electricity will be used during low demand periods, helping balancing supply and demand in the overall electricity market;
- purchase and installation of energy efficient electrolyser technology and equipment;
- the electrolyser uses PEM technology running at 60°C which boosts performance and reduces energy demand;
- the electrolyser stacks are designed to enable recycling of the materials, especially precious materials used in the stacks;
- all plant and equipment will be regularly inspected and will be covered by service / maintenance contracts;
- a record is kept for each piece of machinery / plant detailing the routine servicing and maintenance required;
- the site operates a policy of switching off systems and machinery when not in use;
- completion of energy audits; and
- energy consumption is monitored and reported at management meetings.

8.3. Energy Consumption

8.3.1. The energy utilisation during one hour of full load of H_2 production is provided in Figure 6. In one hour, 1,080 kg H_2 is produced from 62.7MWh.

Figure 5: Sankey Diagram



8.4. Raw Materials Justification

8.4.1. It is not possible to substitute materials with waste as part of the proposals, however, the Installation will undertake an annual review of raw material usage and investigate the suitability of raw materials with an improved environmental profile.

8.4.2. Raw material consumption monitoring and reporting within the first year will allow MorGen to set a baseline against which improvement targets can be set as part of the EMS for the H_2 Plant.

8.4.3. Water use shall be minimised by implementation of the following measures:

- water management including water metering and water audits;
- impermeable surfacing;
- techniques to reduce the likelihood and impacts of overflows (level meters and gauges);
- flow control; and
- design and maintenance provisions to allow detection and repair of leaks.

8.5. Waste Minimisation

8.5.1. As part of the initial concept and design of the improvement proposals, waste minimisation was considered.

8.5.2. Very little waste is generated from the H_2 Plant, with the electrolyser stack only needing to be replaced every 7-10 years.

APPENDIX I

NATURE AND HERITAGE CONSERVATION SCREENING

Nature and Heritage Conservation

Screening Report: Bespoke – IR EPR discharges to air & water

Reference	**EPR/YP3824LA/P001**
NGR	**NZ 57422 20798**
Buffer (m)	**100**
Date report produced	**08/09/25**
Number of maps enclosed	**1**

This nature and heritage conservation report

The nature and heritage conservation sites, protected species and habitats, and other features identified in the table below **must be considered in your application**.

In the further information column, there are links which give more information about the site or feature type and indicate where you are able to self-serve to get the most accurate site boundaries or feature locations.

Most designated site boundaries are available on Magic map. Using Magic map allows you to zoom in and see the site boundary or feature location in detail, Magic map also allows you to measure the distance from these sites and features to your proposed boundary. Help videos are available on Magic map to guide you through.

Where information is not publicly available, or is only available to those with GIS access, we have provided a map at the end of this report.

Sites and Features within screening distance	Screening distance (km)	Further Information
Special Areas of Conservation (cSAC or SAC) **North York Moors**	10	Joint Nature Conservation Committee and Magic map
Special Protection Area (pSPA or SPA) **Teesmouth and Cleveland Coast**	10	Joint Nature Conservation Committee and Magic map

Ramsar **Teesmouth and Cleveland Coast**	10	Joint Nature Conservation Committee and Magic map
Local Wildlife Sites (LWS) (see map below) **Wilton Woods Complex**	2	Appropriate Local Record Centre (LRC)
Ancient Woodland **Wilton Wood**	2	Woodland Trust Forestry Commission Natural England and Magic map

Where protected species are present, a licence may be required from Natural England to handle the species or undertake the proposed works.

The relevant Local Records Centre must be contacted for information on the features within local wildlife sites. A small administration charge may also be incurred for this service.

The following nature and heritage conservation sites, protected species and habitats, and other features have been checked for, where they are relevant for the permit type requested, but have not been found within screening distance of your site unless included in the list above.

Special Areas of Conservation (cSAC or SAC), Special Protection Area (pSPA or SPA), Marine Conservation Zone (MCZ), Ramsar, Sites of Special Scientific Interest (SSSI), National Nature Reserve (NNR), Local Nature Reserve (LNR), Local Wildlife Sites (LWS), Ancient Woodland, relevant species and habitats.

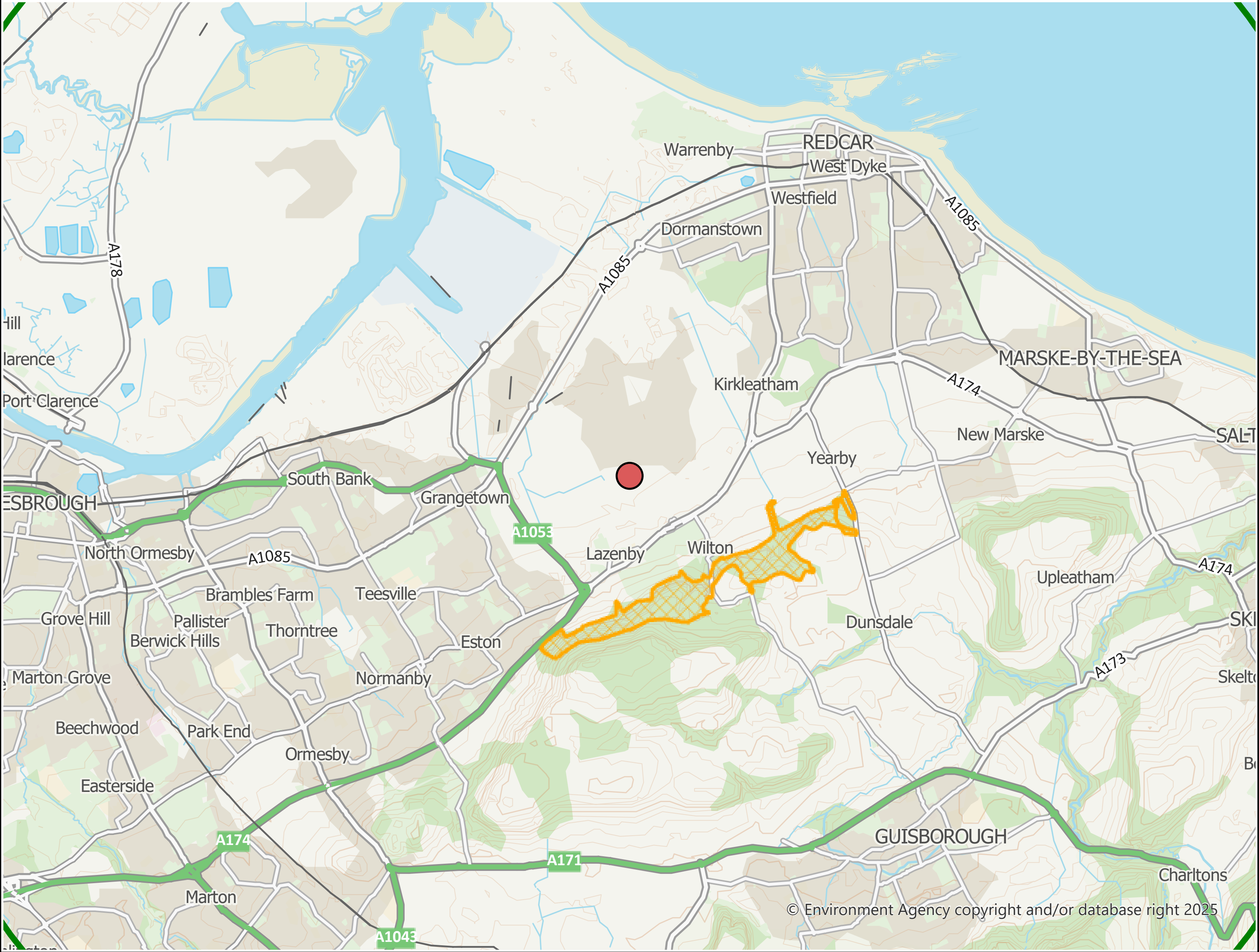
Please note we have screened this application for features for which we have information. It is however your responsibility to comply with all environmental and planning legislation, this information does not imply that no other checks or permissions will be required.

The nature and heritage screening we have conducted as part of this report is subject to change as it is based on data we hold at the time it is generated. We cannot guarantee there will be no changes to our screening data between the date of this report and the submission of the permit application, which could result in the return of an application or requesting further information.

Local Wildlife Sites

Local Wildlife Sites

Local Wildlife Sites



0 5

Kilometer

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APPENDIX II
NOISE IMPACT ASSESSMENT REPORT

Tel: 0116 272 5908
Email: info@noiseair.co.uk
Web: www.noiseair.co.uk

ENVIRONMENTAL COMPLIANCE LTD

NOISE IMPACT ASSESSMENT REPORT

LAND TO THE REAR OF XPO LOGISTICS, LAZENBY, MIDDLESBOROUGH

Client: Environmental Compliance Ltd

Report Ref: P8878-R1-V5

Issue Date: 13th October 2025

Document Status: Version 5

Units 8-11, Bridgewater House, North Road, Ellesmere Port, CH65 1AF
The Counting House, High Street, Lutterworth, Leicestershire, LE17 4AY

DATE ISSUED: 13TH OCTOBER 2025

REPORT REFERENCE P8878-R1-V5

ENVIRONMENTAL COMPLIANCE LTD

NOISE IMPACT ASSESSMENT REPORT

LAND TO THE REAR OF XPO LOGISTICS, LAZENBY, MIDDLESBOROUGH

REPORT VERSION CONTROL:

Document Reference	Date	Report Written by	Report Authorised by
P8878-R1-V5	13/10/2025	Reid Malster, BSc (Hons), PGDip, MIOA	M. J. Malone, BSc (Hons), MIOA
			M. J.

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CONTENTS

APPENDICES

1 INTRODUCTION

1.1.1 By instruction from Environmental Compliance Ltd, NoiseAir was commissioned to conduct a noise impact assessment (NIA) in support of a planning application proposing the installation of 60MW Green Hydrogen Plant and associated infrastructure.

1.1.2 This report assesses the results of a noise survey in accordance with current guidance and includes recommendations and mitigation, as appropriate.

1.1.3 General limitations with respect to this NIA are outlined in **Appendix A**.

1.2 Site Description and Context

1.2.1 The Teesside Green Hydrogen Project is a large-scale green hydrogen production project being developed by MorGen Energy, a wholly owned subsidiary of Trafigura. The facility, to be located in the Wilton International Complex in Teesside, UK, will have a total capacity of 60 Mwe, delivered through three 20 Mwe Proton Exchange Membrane (PEM) electrolysers. It will produce approximately 15-18 tonnes of green hydrogen per day using electricity that meets the UK's Low Carbon Hydrogen Standard, source from a mix of new and existing wind farms.

1.2.2 The hydrogen will primarily support the decarbonisation of Teesside's industrial cluster, serving as a chemical feedstock or replacement of natural gas as high-temperature industrial heat. Distribution to end users will occur via a dedicated pipeline network within the Wilton International complex in Teesside.

1.2.3 The proposed development site is located within a predominantly industrial and commercial area. The closest sensitive receptors are residential receptors are situated approximately 600 m south of the proposed development site.

1.2.4 The dominant sources of noise in the locale are road traffic from the A1053 and A174, along with industrial and commercial sound from the surrounding industrial uses.

1.2.5 **Figure 1** presents an aerial image of the development site with respect to the local area and its context.

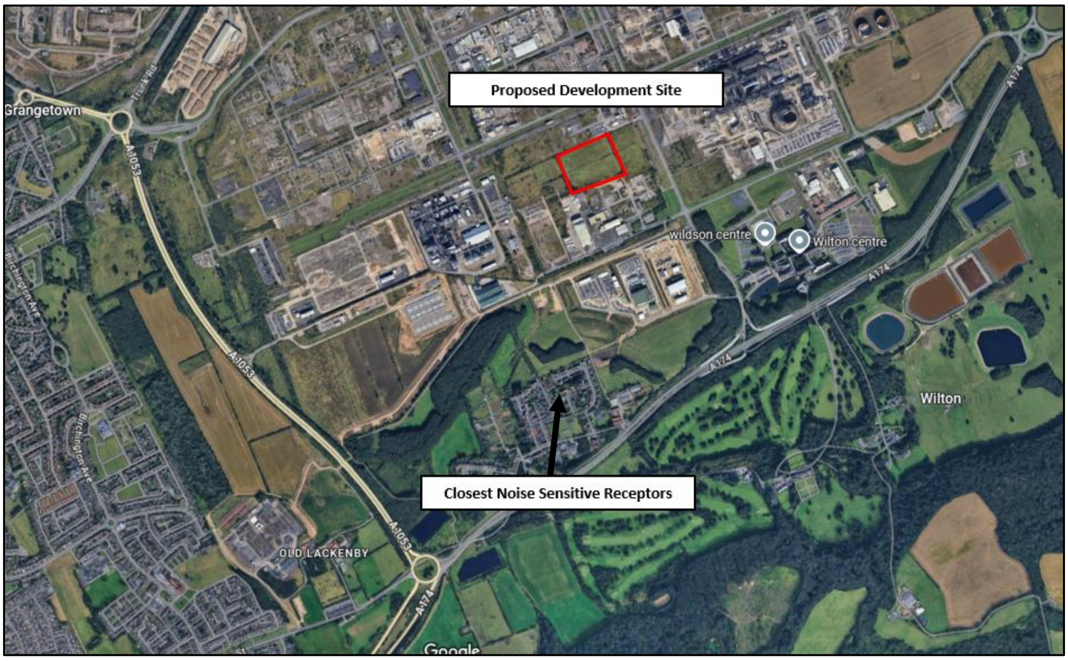


Figure 1: Proposed Development Site Location

1.3 Site Proposal

1.3.1 The proposal is to install 60 MW Hydrogen Plant and associated infrastructure at the site. **Figure 2** and **Figure 3** below show the proposed layout, with known noise sources marked and quantified by relevant contractors. An enlarged version is also provided in **Appendix C**.

1.3.2 At the time of writing, not all specification requirements have been determined, meaning that not all aspects of the design can be identified and a noise level determined for every aspect of the proposed development.

1.3.3 In the case of noise sources identified by the applicant for which noise levels have no been provided, NoiseAir have provided noise level estimates at the applicant's request. These are indicative only and should be superseded by robust technical data at a later date.

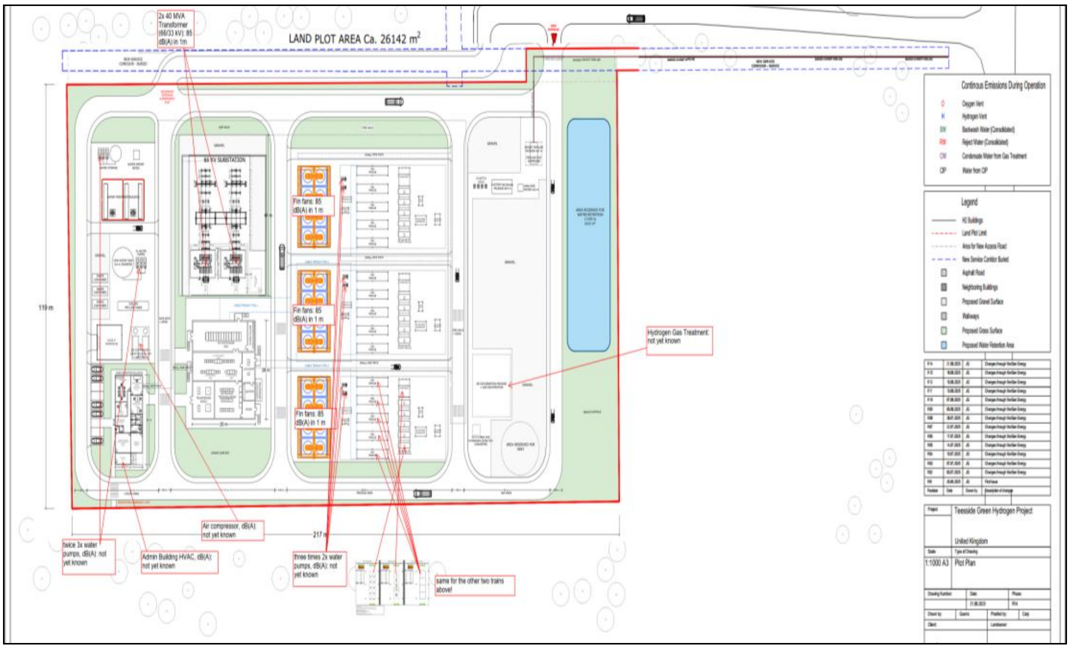


Figure 2: Proposed Layout – Known Noise Sources Marked

Figure 3: Proposed Layout Markup – Enlarged

1.3.4 The assessment is undertaken on the assumption that all noise sources identified would operate on a 24/7 basis.

2 ASSESSMENT METHODOLOGY AND SCOPE OF WORKS

2.1 Scope of Works

2.1.1 This report assesses the proposed noise sources to BS 4142:2014+A1:2019. Daytime and night-time periods are assessed.

2.1.2 A summary of the standard is provided below.

2.2 British Standard 4142:2014+A1:2019 (BS 4142:2014+A1:2019)

2.2.1 British Standard 4142:2014 - Methods for rating and assessing industrial and commercial sound, sets the methodology for rating and assessing sound of an industrial and commercial nature, which includes sound from fixed installations such as mechanical and electrical plant and equipment.

2.2.2 In BS 4142:2014, a noise rating is determined and compared with the existing local background sound level based on several more cumulative acoustic feature corrections to apply where appropriate. For example, if the noise includes a distinguishable tone, impulse, intermittency or other readily distinguishable sound characteristic, then additional cumulative penalties individually ranging from 0 to 9 dB may be applied depending on the type of noise.

2.2.3 BS 4142:2014 seeks to determine a "representative" background sound level, stating that "…the objective is not simply to ascertain a lowest measured background sound level, but rather to quantify what is typical during particular time periods".

2.2.4 The assessment of the impact depends upon the margin by which the rating level of the specific sound source exceeds the background sound level but also promotes a consideration of the context in which the sound occurs when making an assessment. BS 4142:2014 states that an initial estimate of the impact of the specific sound is made by subtracting the measured background sound level from the rating level, while considering the following points:

- Typically, the greater this difference, the greater the magnitude of the impact;
- A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context;
- A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context; and,
- The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the

background sound level, this is an indication of the specific sound source having a low impact, depending on the context.

2.2.5 Therefore, a BS 4142:2014 assessment may deduce a low impact where the specific sound level is below the background sound level.

2.2.6 While the standard is ultimately for the assessment of potential impacts based on external sound levels, the 2019 amendments to the standard also introduce the consideration of internal noise levels to the context of assessments during the night-time. Example assessments are provided in the standard showing how this may be undertaken, which show references to BS 8233:2014 and comments on internal character as contextual considerations within the assessment.

3 ACOUSTIC SURVEY

3.1 Background Sound Level Survey

3.1.1 Noise monitoring was undertaken at a free-field external location to determine existing background sound levels between Thu 24/07/2025 12:30 – Tue 29/07/2025 15:30 at the location marked on **Figure 4**.

Figure 4: Noise Monitoring Location

3.1.2 The dominant noise source at the monitoring location was road traffic noise. A low-level hum from the nearby industrial area was also audible. The location was selected as the closest available secure position to leave the monitoring equipment unattended for the duration of the survey and is deemed representative of background sound levels at nearby noise sensitive receptors.

3.1.1 The noise measurements were conducted using a Class 1, integrating sound level meter (SLM). The acoustic equipment was calibrated to comply with Section 4.2 of BS 7445-1:2003[1], before and after the noise monitoring periods.

[1] BS 7445-2003 "Description and measurement of environmental noise – Part 1: Guide to quantities and procedures.

Table 1: Summary of SLM used for survey and associated field calibration						
SLM (Serial Number)	**Preamp (Serial Number**	**Microphone (Serial Number)**	**Calibrator (Serial Number)**	**Start Calibration**	**End Calibration**	**Drift**
NOR140 (1402826)	NOR1209 (15455)	NOR1225 (168289)	B&K 4321 (2431761)	-26.2	-26.4	0.2 dB

3.1.2 The unattended measurement results are summarised in **Table 2** and shown in **Chart 1**.

Table 2: NSR1 Background Sound Level Survey			
Monitoring Period	**Adverse Weather?**	**Measured Noise Levels**	
		$L_{Aeq,T}$ **(dB)**	**Mode** $L_{AF90,15min}$ **(dB)**
Thu 24/07/2025 12:30 - Thu 24/07/2025 23:00	OK	45.4	41
Thu 24/07/2025 23:00 - Fri 25/07/2025 07:00	OK	43	37
Fri 25/07/2025 07:00 - Fri 25/07/2025 23:00	OK	46.3	46
Fri 25/07/2025 23:00 - Sat 26/07/2025 07:00	OK	41.3	38
Sat 26/07/2025 07:00 - Sat 26/07/2025 23:00	OK	44.5	42
Sat 26/07/2025 23:00 - Sun 27/07/2025 07:00	OK	41.8	39
Sun 27/07/2025 07:00 - Sun 27/07/2025 23:00	High winds in afternoon	45.9	43
Sun 27/07/2025 23:00 - Mon 28/07/2025 07:00	OK	42.6	39
Mon 28/07/2025 07:00 - Mon 28/07/2025 23:00	Rain in morning, higher winds throughout the day	45.7	44
Mon 28/07/2025 23:00 - Tue 29/07/2025 07:00	OK	42.2	39
Tue 29/07/2025 07:00 - Tue 29/07/2025 15:30	OK	43.4	38

3.1.3 Weather conditions were noted to be suitable for environmental noise monitoring upon installation and collection of the survey. Weather data from a nearby weather station identified that conditions were generally suitable throughout the survey.

3.1.4 The most conservative daytime (07:00-23:00) and night-time (23:00-07:00) periods in terms of Background Sound Levels are:

- **Daytime:** Sat 26/07/2025 07:00 – Sat 26/07/2025 23:00
- **Night-time:** Thu 24/07/2025 23:00 – Fri 25/07/2025 07:00

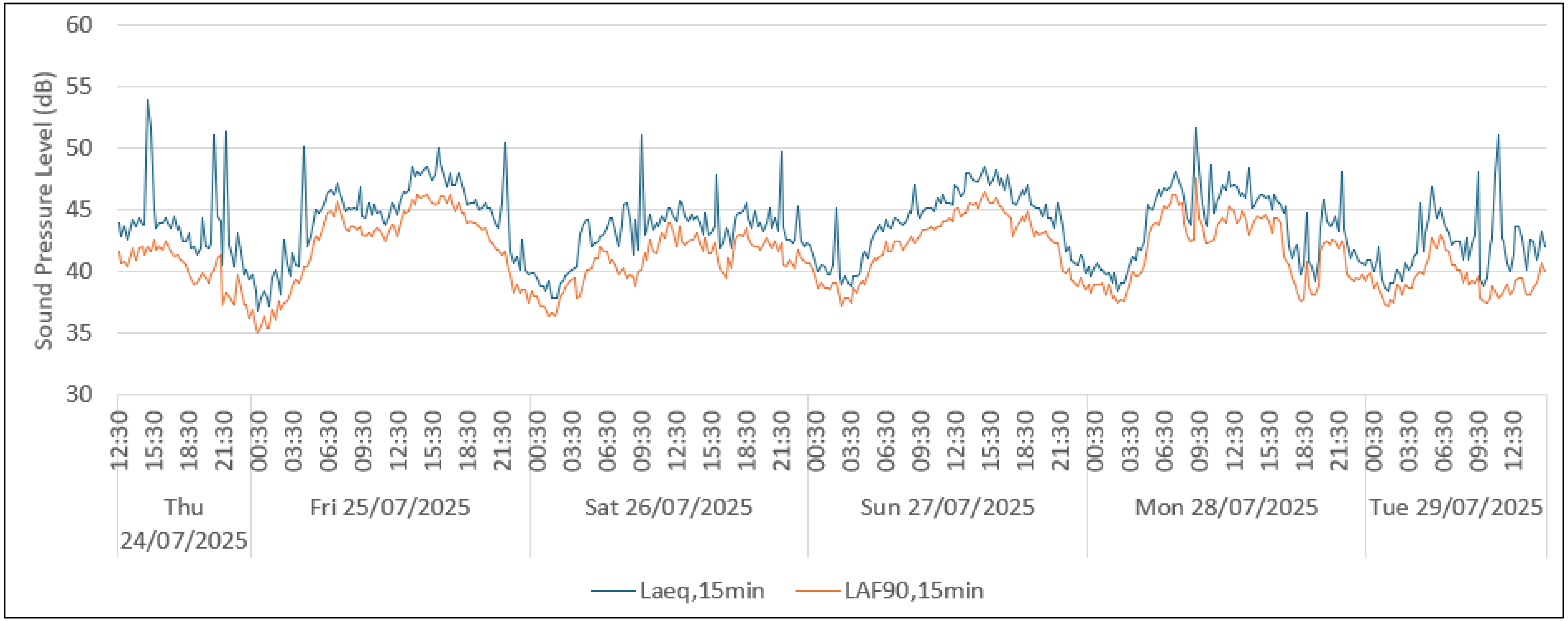


Chart 1: Noise Monitoring Results at ML1

3.2 Determination of Typical Background Sound Levels

3.2.1 Analysis of Background Sound Levels has been undertaken for the most conservative daytime and night-time monitoring periods (see **Chart 2** and **Chart 3** below).

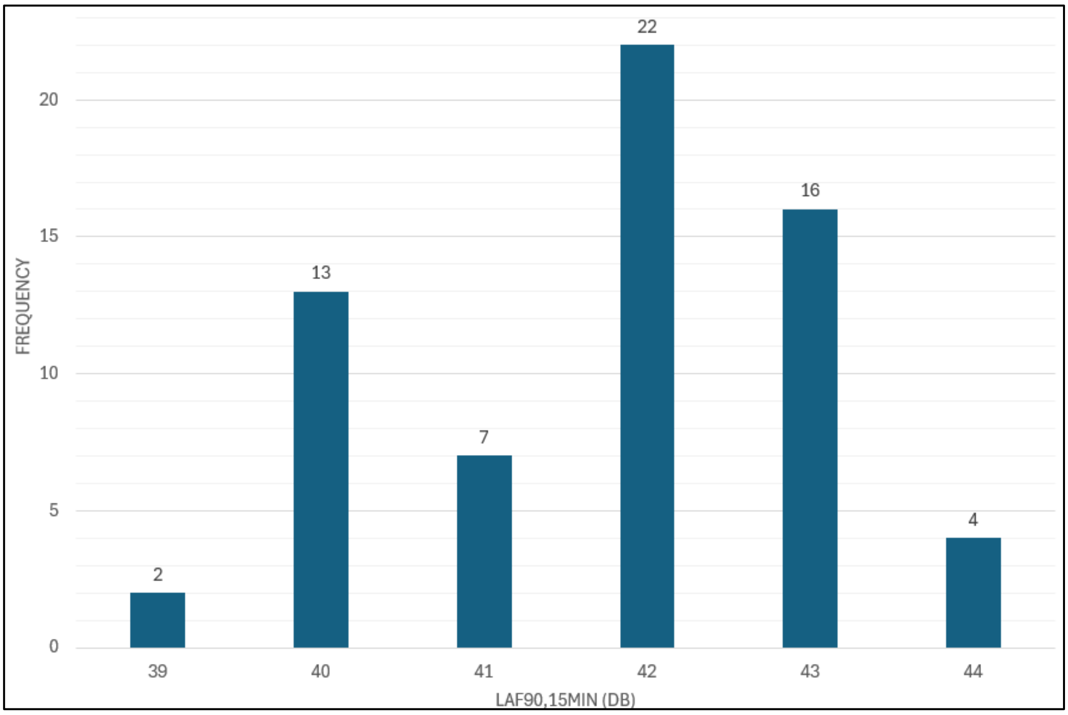


Chart 2: Statistical Analysis of $L_{AF90,15min}$ Daytime Background Sound Levels from Sat 26/07/2025 07:00 – Sat 26/07/2025 23:00

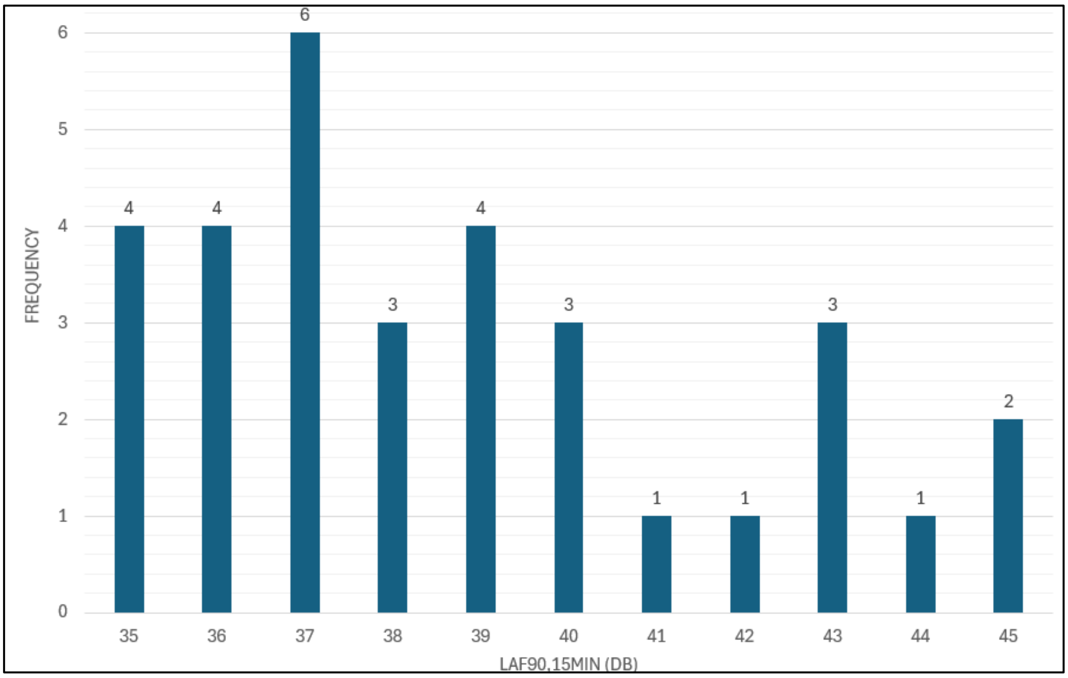


Chart 3: Statistical Analysis of $L_{AF90,15min}$ Night-time Background Sound Levels from Thu 24/07/2025 23:00 – Fri 25/07/2025 07:00

3.2.2 During the daytime the mode value of 42 dB $L_{AF90,15min}$ appeared to be typical over the broader daytime period, with 40 dB $L_{AF90,15min}$ being more typical for the morning and evening periods.

3.2.3 During the night-time, 37 dB $L_{AF90,15min}$ is deemed typical.

4 NOISE IMPACT ASSESSMENT

4.1 Introduction

4.1.1 Based on the noise levels provided to NoiseAir, a 3D computer noise model of the site has been created to calculate the noise propagation between the application site and nearby residential dwellings. The calculation method used was ISO 9613-2.

4.1.2 Noise levels have been calculated at the closest noise sensitive receptors approximately 600 m south of the proposed development site as identified in **Figure 1** in **Section 1.2** of this report.

4.2 3D Sound Model

4.2.1 At this stage of the design, the type of equipment required has been identified. However, the required specifications of each piece of equipment have not been determined, nor makes/models etc.

4.2.2 Consequently, noise data for each source cannot yet be identified. An indication of the likely noise levels has been provided by the technical design team based on similar Hydrogen Plant schemes.

4.2.3 **Figure 2** and **Figure 3,** which showed the noise information available at this stage have been repeated below as **Figure 5** and **Figure 6** for convenience. An enlarged version is also provided in **Appendix C**.

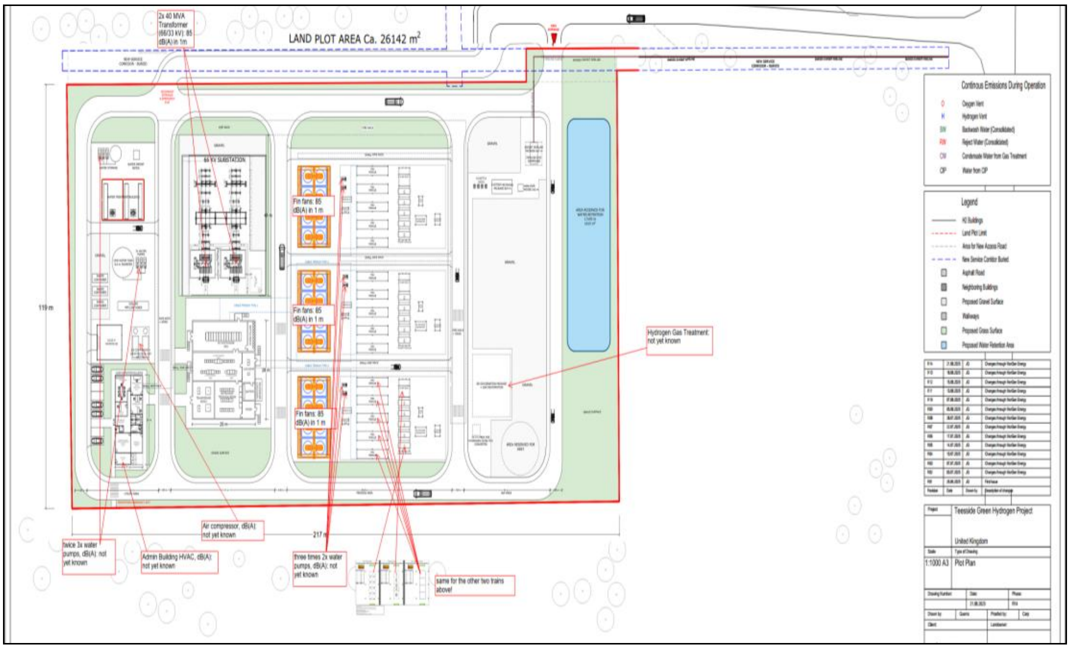


Figure 5: Proposed Layout – Known Noise Sources Marked

Figure 6: Proposed Layout Markup – Enlarged

4.2.4 Sound power levels for the sources identified have been calculated using the equation below:

$$L_w = L_p - 10\log\left(\frac{Q}{4\pi\, r^2}\right)$$

4.2.5 Calculations have been undertaken with a distance (r) of 1 m (as stated on plans) and a Q factor of 2 for hemispherical propagation.

4.2.6 The known noise sources within the noise modelling are summarised in **Table 3** below.

Table 3: Noise Sources in 3D Noise Model

Noise Source	Sound Pressure Level at 1 m (dBA)	Sound Power Level (dB)	No. of source in Noise Model
Fin Fans	85	93	3
Electrolyser Package	58.7	66.7	3
Equipment Package	73.4	81.4	3
Power Supply Unit Container	79.5	87.5	15
40 MVA Transformer (66/33 kV)	85	93	2

4.2.7 The remaining noise sources marked on the plans currently do not have a noise level available. Estimated sound power levels have been indicated for these sources

- Water Pumps - 55 dB L_w
- Air Compressor - 70 dB L_w
- Admin Building HVAC – 50 dB L_w
- Hydrogen Gas Treatment 75 dB L_w

4.2.8 The assumed noise levels are indicative only for inclusion in the noise model as requested by the applicant. The noise level of the noise sources described can vary significantly depending on the required specification of the noise sources specified and the estimates above may not reflect in-situ noise emissions. Noise modelling should be updated to reflect accurate noise levels for the sources above once the information becomes available.

4.2.9 Each noise source was modelled as a point source at the marked location on the plans provided.

4.2.10 NoiseAir have only been provided with broadband noise levels for the equipment. We understand that frequency information is not available. The sources are therefore modelled as propagating at 500 Hz, which is the default ISO 9613 propagation for noise sources without spectral information.

4.2.11 The implication of this is that the propagation assumed may be conservative and result in higher noise levels for noise sources where most of the noise emitted is in high to mid frequency bands.

4.2.12 The results are shown in **Figure 7** and **Figure 8** and summarised below. Grid heights are shown at 1.5 m height and 4.0 m height. The numbered façade points show the noise level at the most affected storey in both figures. Enlarged versions of the results are shown in **Appendix B**.

4.2.13 The highest predicted noise level from the initial modelling is **32 dB $L_{Aeq,T}$.** The modelling shows a range of 30-32 dB at the north facing facades of dwellings furthest north at the houses to the south of the proposed development site.

4.2.14 Due to information about all noise sources not being provided yet, the modelling below are initial results only and may be subject to future updates as required.

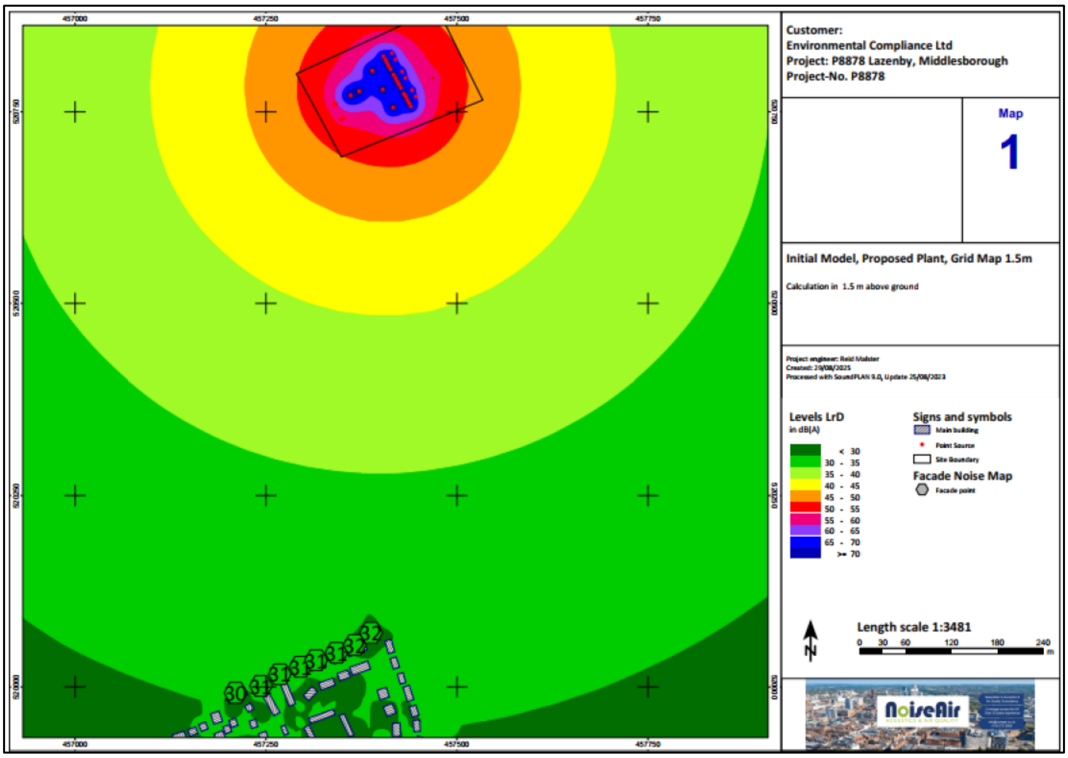


Figure 7: Initial Noise Modelling Results – Proposed Plant – 1.5 m Grid Height

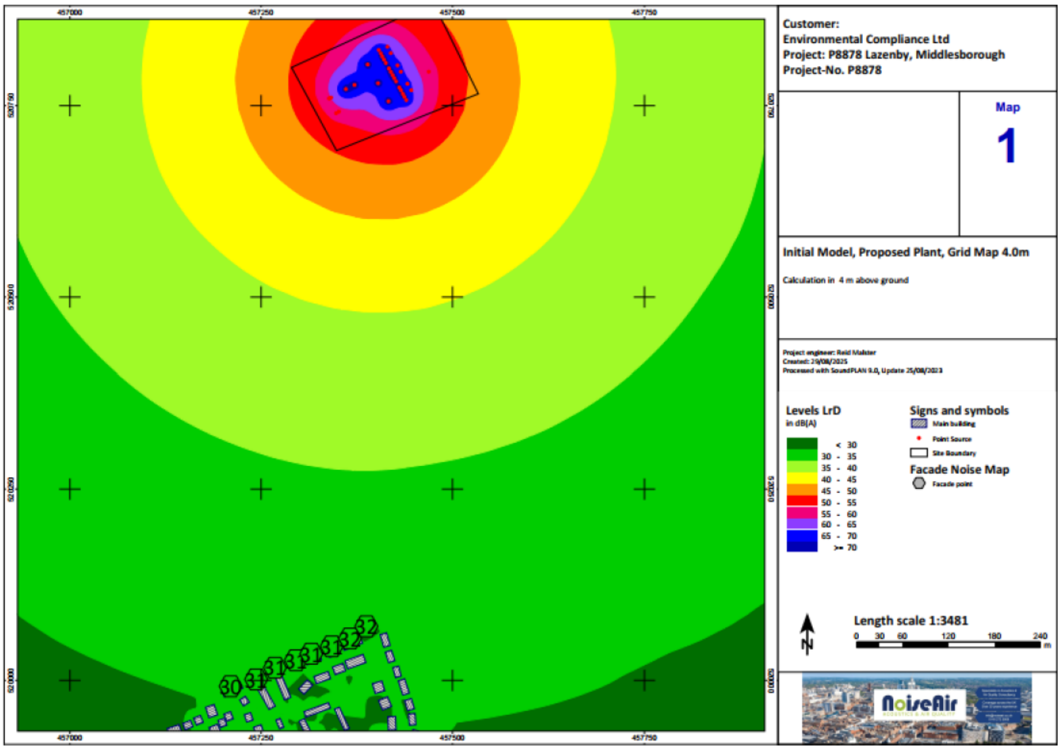


Figure 8: Initial Noise Modelling Results – Initial Noise Modelling Results – Proposed Plant – 4.0 m Grid Height

5 BS4142:2014 ASSESSMENT

5.1 Specific Sound Level

5.1.1 The Specific Sound Level within the noise model is 32 dB L_{Aeq} for both the daytime and night-time as per the noise modelling presented in **Section 4**.

5.2 Background Sound Level

5.2.1 The measured background sound levels have been presented within Section 3 of this report.

5.2.2 During the daytime, 42 dB $L_{AF90,15min}$ has been identified as being typical with background sound levels closer to 40 dB $L_{AF90,15min}$ being more typical of morning and evening periods.

5.2.3 During the night-time, 37 dB $L_{AF90,15min}$ has been deemed typical.

5.3 Character Corrections

5.3.1 The noise sources assessed are unlikely to be impulsive or intermittent in their operation but may contain tonal elements often associated with plant of this type.

5.3.2 Given the distance between the sources and receivers this is unlikely to be clearly perceptible in any significant sense. We note that an audible, low-level hum from the wider industrial area is already audible below road traffic noise at the receptor locations, the proposals are unlikely to have any significant effect on this existing situation.

5.3.3 A Character Correction of +2 dB has been applied for tonality.

5.4 Rating Level

5.4.1 The Rating Level is therefore 34 dB.

5.5 BS4142:2014 Initial Assessment

5.5.1 A BS4142:2014 assessment is presented in **Table 4**.

Table 4: BS4142:2014 Initial assessment		
Quantity	Sound level (dB)	
	Daytime	Night-time
Typical Background Sound Level, dB $L_{A90,15min}$	42	37
Specific sound level $L_{Aeq,T}$	32	32
Character Corrections	+2	+2
Rating Level	34	34
Excess of Rating Level over Background Sound Level	-8	-3
Initial impact	Low Impact	Low Impact

5.5.2 Initial modelling and assessment indicate the impact of the proposals would be low.

5.5.3 There is uncertainty in the Specific Sound Level in that noise levels are not yet available for all the noise sources. However, the remaining noise sources to be quantified are unlikely to increase noise levels by 8 dB or more (more than a mathematical doubling of the current calculated emissions), which is where a potential Adverse Impact may be identified based on the measured Background Sound Levels.

5.5.4 The proposed plant would likely contribute to the existing low-level hum audible below road traffic at quiet periods but is unlikely to pose a significant intensification. Within the context of the existing industry in the area the impact of this is unlikely to be significant.

5.5.5 This initial assessment therefore demonstrates that based on the early design proposals, the proposals are feasible in principle in noise terms.

6 CONCLUSIONS

6.1.1 NoiseAir conducted a noise impact assessment in relation to proposed Green Hydrogen Plant and associated infrastructure within an industrial area in Lazenby, Middlesborough.

6.1.2 A noise survey was undertaken at a location representative of the closest residential dwellings to the proposed development site.

6.1.3 Based on preliminary design information, a 3D noise model of the proposals was created to calculate noise levels at the closest residential dwellings.

6.1.4 While noise information is not available for all the proposed noise sources at this early design stage, the available information was sufficient to undertake a preliminary assessment, which concluded that the proposals would likely pose a Low Impact.

6.1.5 It has therefore been demonstrated that in noise terms, the proposals are feasible in principle.

APPENDIX A - REPORT LIMITATIONS

This Report is presented Environmental Compliance Ltd may not be used or relied on by any other person or by the client in relation to any other matters not covered specifically by the scope of this report.

Notwithstanding anything to the contrary contained in the report, NoiseAir Limited is obliged to exercise reasonable skill, care and diligence in the performance of the services required by Environmental Compliance Ltd and NoiseAir shall not be liable except to the extent that it has failed to exercise reasonable skill, care and diligence, and this report shall be read and construed accordingly.

This report has been prepared by NoiseAir Limited. No individual is personally liable in connection with the preparation of this report. By receiving this report and acting on it, the client or any other person accepts that no individual is personally liable whether in contract, tort, for breach of statutory duty or otherwise.

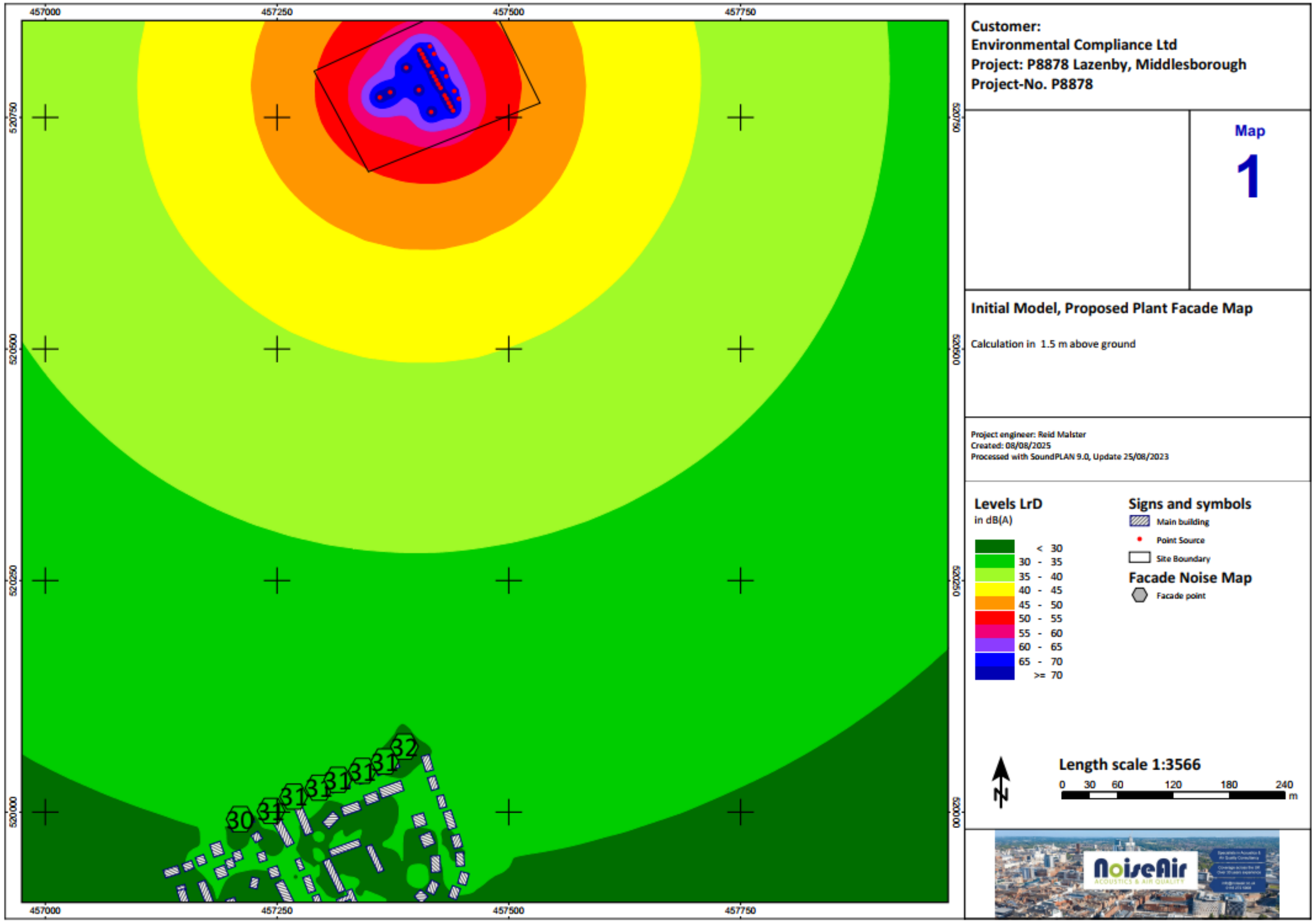
The conclusions and recommendations contained in this report are based upon information provided by others and upon the assumption that all relevant information has been provided by those parties from who it has been requested and that such information is accurate. Information obtained by NoiseAir Limited has not been independently verified by NoiseAir Limited unless otherwise stated in the report and should be treated accordingly.

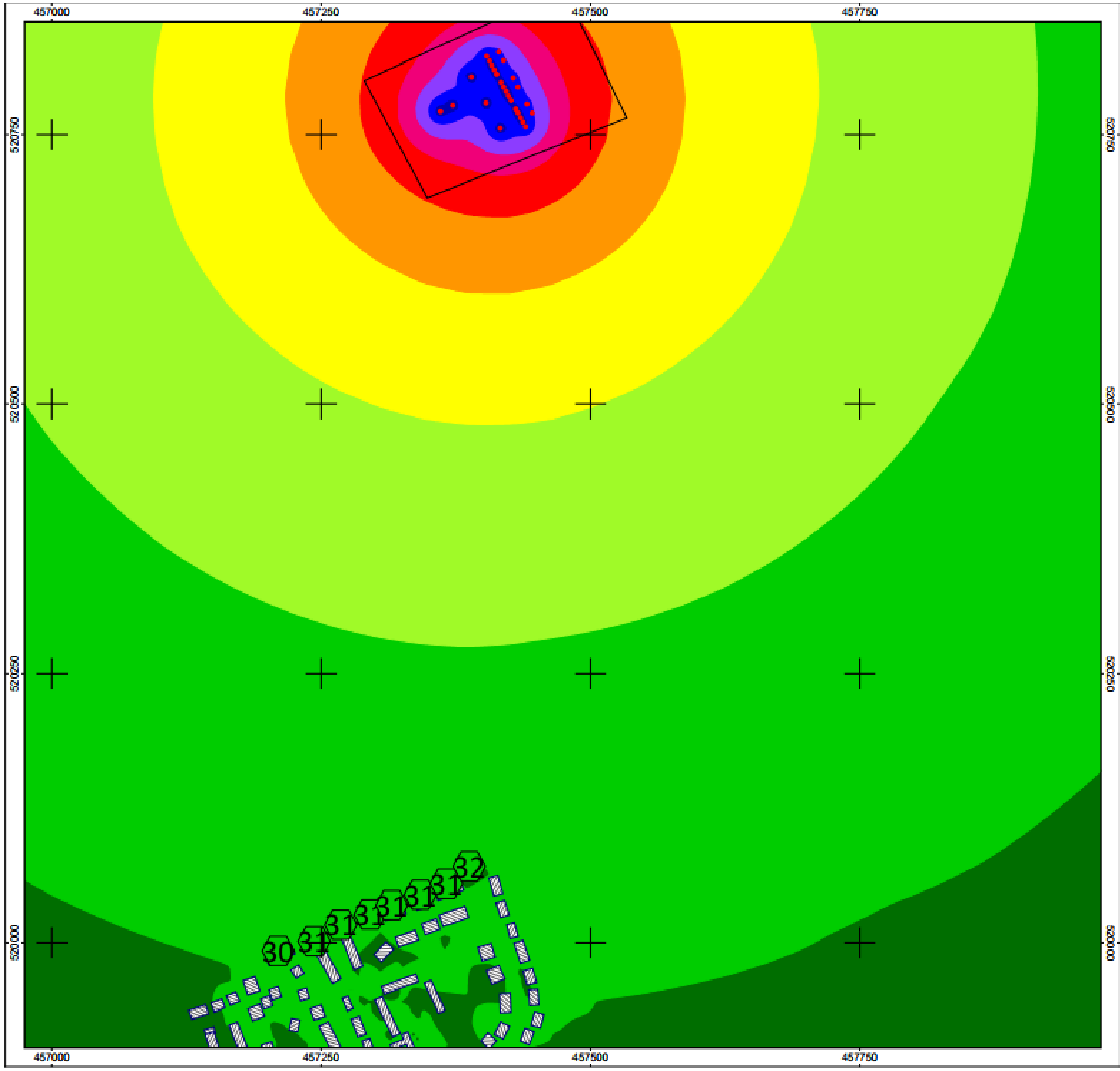
Where assessments of works or costs identified in this report are made, such assessments are based upon the information available at the time and where appropriate are subject to further investigations or information which may become available.

Where / if estimates and projects are made within this report, are made based on reasonable assumptions as of the date of this report, such statements however by their very nature involve risks and uncertainties that could cause actual results to differ materially from the results predicted. NoiseAir Limited specifically does not guarantee or warrant any estimates or projects contained in this report.

DISCLAIMER- This report was prepared by NoiseAir Limited. The material in it contains NoiseAir Limited best judgment in light of the information available at the time of preparation of this report. Any use which a third party makes of this report, or any reliance on, or decisions based on it are the responsibility of such third parties. NoiseAir Limited accept no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions taken based on this report.

APPENDIX B – NOISE MODELLING RESULTS





Customer:
Environmental Compliance Ltd
Project: P8878 Lazenby, Middlesborough
Project-No. P8878

Map
1

Initial Model, Proposed Plant, Grid Map 4.0m

Calculation in 4 m above ground

Project engineer: Reid Malster
Created: 08/08/2025
Processed with SoundPLAN 9.0, Update 25/08/2023

Levels LrD
in dB(A)

	< 30
30	- 35
35	- 40
40	- 45
45	- 50
50	- 55
55	- 60
60	- 65
65	- 70
	>= 70

Signs and symbols
Main building
Point Source
Site Boundary

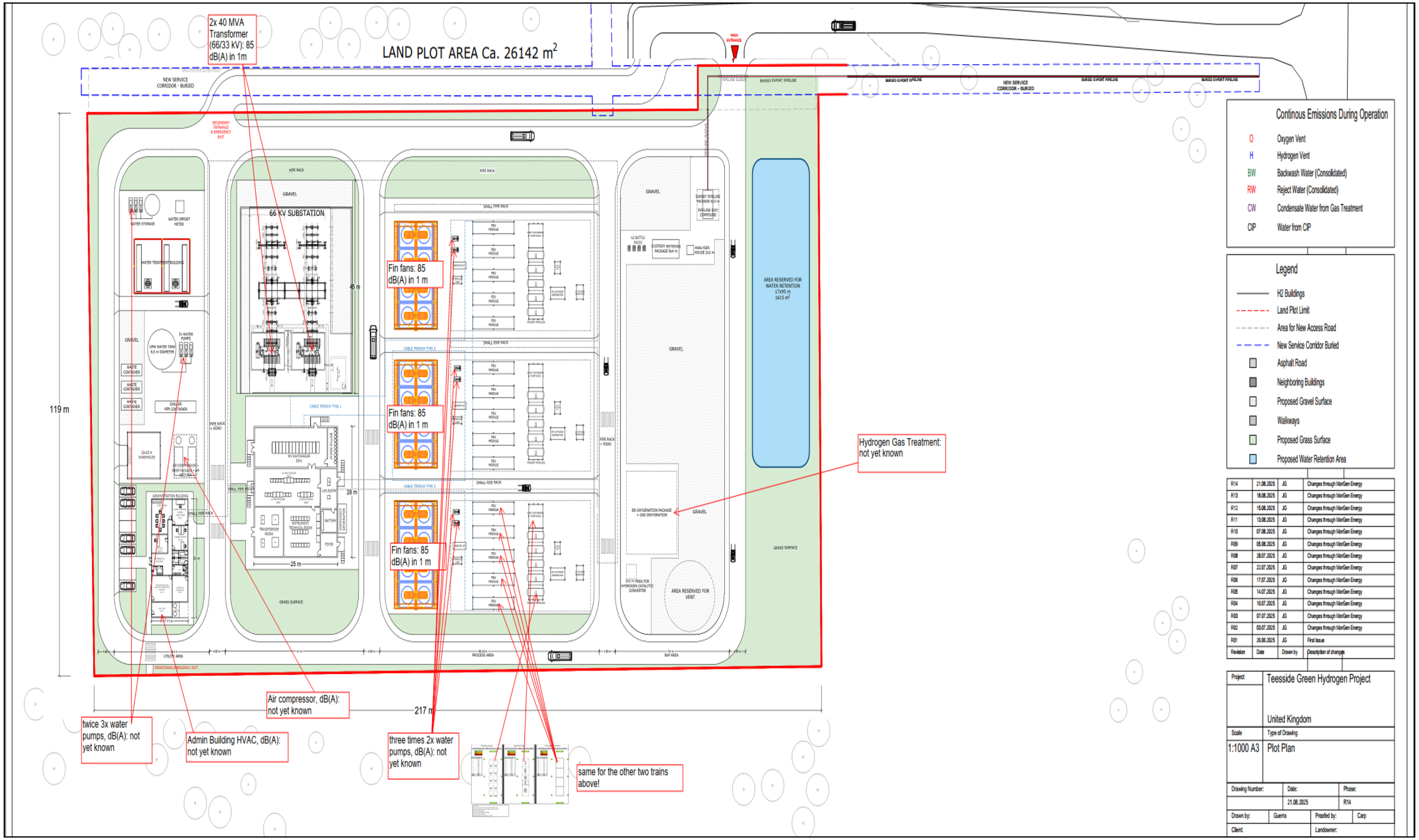
Facade Noise Map
Facade point

N

Length scale 1:3566
0 30 60 120 180 240 m

NoiseAir

APPENDIX C – NOISE INFORMATION (ENLARGED)



APPENDIX D – GLOSSARY

A-weighted sound pressure, p_A	Value of overall sound pressure, measured in pascals (Pa), after the electrical signal derived from a microphone has been passed through an A-weighting network. *NOTE: The A-weighting network modifies the electrical response of a sound level meter with frequency in approximately the same way as the sensitivity of the human hearing system.*
A-weighted sound pressure level, L_{pA}	Quantity of A-weighted sound pressure in decibels (dBA).
Acoustic environment	Sound from all sound sources as modified by the environment [BS ISO 12913-1:2013].
Ambient sound	Totally encompassing sound in a given situation at a given time, usually composed of sound from many sources near and far. *NOTE: The ambient sound comprises the residual sound and the specific sound when present.*
Ambient sound level, $L_a = L_{Aeq,T}$ (BS 4142:2014)	Equivalent continuous A-weighted sound pressure level of the totally encompassing sound in a given situation at a given time, usually from many sources near and far, at the assessment location over a given time interval, T *NOTE: The ambient sound level is a measure of the residual sound and the specific sound when present.*
Background sound	Underlying level of sound over a period, *T*, which might in part be an indication of relative quietness at a given location.
Background sound level, $L_{A90,T}$ (BS 4142:2014)	A-weighted sound pressure level that is exceeded by the residual sound at the assessment location for 90% of a given time interval, T, measured using time weighting F and quoted to the nearest whole number of decibels.
Break-in	Noise transmission into a structure from outside.
Break-out	Noise transmission from inside a structure to the outside.
Cross-talk	Noise transmission between one room and another room or space via a duct or other path.
C_{tr}	Correction term applied against the sound insulation single-number values (R_w, D_w, and $D_{nT,w}$) to provide a weighting against low frequency performance. *NOTE: The reference values used within the C_{tr} calculation are based on urban traffic noise.*
Equivalent continuous A-weighted sound pressure level, $L_{Aeq,T}$	Value of the A-weighted sound pressure level in decibels (dB) of a continuous, steady sound that, within a specified time interval, T, has the same mean-squared sound pressure as the sound under consideration that varies with time.
Equivalent continuous A-weighted sound pressure level, $L_{Aeq,T}$ (BS 4142:2014)	Value of the A-weighted sound pressure level in decibels of continuous steady sound that, within a specified time interval, $T = t_2 – t_1$, has the same mean-squared sound pressure as a sound that varies with time.
Equivalent sound absorption area of a room, A	Hypothetical area of a totally absorbing surface without diffraction effects, expressed in square metres (m2), which, if it were the only absorbing element in the room, would give the same reverberation time as the room under consideration
Facade level	Sound pressure level 1 m in front of the façade. *NOTE: Facade level measurements of L_{pA} are typically 1 dB to 2 dB higher than corresponding free-field measurements because of the reflection from the facade.*
Free-field level	Sound pressure level away from reflecting surfaces. *NOTE: Measurements made 1.2 m to 1.5 m above the ground and at least 3.5 m away from other reflecting surfaces are usually regarded as free-field. To minimize the effect of reflections the measuring position has to be at least 3.5 m to the side of the reflecting surface (i.e., not 3.5 m from the reflecting surface in the direction of the source). Estimates of noise from aircraft overhead usually include a correction of 2 dB to allow for reflections from the ground.*

Impact sound pressure level, L_i	Average sound pressure level in a specific frequency band in a room below a floor when it is excited by a standard tapping machine or equivalent.
Indoor ambient noise	Noise in a given situation at a given time, usually composed of noise from many sources, inside and outside the building, but excluding noise from activities of the occupants. *NOTE: The location(s) within the room at which the ambient indoor noise is to be measured or calculated ought to be considered.*
Measurement time interval, T_m (BS 4142:2014)	Total time over which measurements are taken. *NOTE: This may consist of the sum of a number of non-contiguous, short-term measurement time intervals.*
Noise criteria	Numerical indices used to define design goals in a given space.
Noise rating, NR	Graphical method for rating a noise by comparing the noise spectrum with a family of noise rating curves.
Normalised impact sound pressure level, L_n	Impact sound pressure level normalized for a standard absorption area in the receiving room. *NOTE: Normalised impact sound pressure level is usually used to characterize the insulation of a floor in a laboratory against impact sound in a stated frequency band.*
Octave band	Band of frequencies in which the upper limit of the band is twice the frequency of the lower limit.
Percentile level, $L_{AN,T}$	A-weighted sound pressure level obtained using time-weighting “F”, which is exceeded for *N*% of a specified time interval.
Reference time interval, T_r (BS 4142:2014)	Specified interval over which the specific sound level is determined. *NOTE: This is 1 h during the day from 07:00 h to 23:00 h and a shorter period of 15 min at night from 23:00 h to 07:00 h.*
Residual sound (BS 4142:2014)	Ambient sound remaining at the assessment location when the specific sound source is suppressed to such a degree that it does not contribute to the ambient sound.
Residual sound level, $L_r = L_{Aeq,T}$ (BS 4142:2014)	Equivalent continuous A-weighted sound pressure level of the residual sound at the assessment location over a given time interval, T.
Rating level, $L_{Ar,Tr}$	Equivalent continuous A-weighted sound pressure level of the noise, plus any adjustment for the characteristic features of the noise. *NOTE: This is used in BS 7445 and BS 4142 for rating industrial noise, where the noise is the specific noise from the source under investigation.*
Reverberation time, T	Time that would be required for the sound pressure level to decrease by 60 dB after the sound source has stopped.
Sound exposure level, L_{AE}	Level of a sound, of 1 s duration, that has the same sound energy as the actual noise event considered.
Sound level difference, D	Difference between the sound pressure level in the source room and the sound pressure level in the receiving room.
Sound pressure, p	Root-mean-square value of the variation in air pressure, measured in pascals (Pa) above and below atmospheric pressure, caused by the sound.
Sound pressure level, L_p	Quantity of sound pressure, in decibels (dB).
Sound reduction index, R	Laboratory measure of the sound insulating properties of a material or building element in a stated frequency band.

Specific sound level, $L_s = L_{Aeq,Tr}$ (BS 4142:2014)	Equivalent continuous A-weighted sound pressure level produced by the specific sound source at the assessment location over a given reference time interval, T_r.
Specific sound source (BS 4142:2014)	Sound source being assessed.
Standardised impact sound pressure level, L'_{nT}	Impact sound pressure level normalized to a reverberation time in the receiving room of 0.5 s.
Standardised level difference, D_{nT}	Difference in sound level between a pair of rooms, in a stated frequency band, normalized to a reference reverberation time of 0.5 s for dwellings.
Groundborne noise	Audible noise caused by the vibration of elements of a structure, for which the vibration propagation path from the source is partially or wholly through the ground. *NOTE Common sources of ground-borne noise include railways and heavy construction work on adjacent construction sites.*
Structure-borne noise	Audible noise caused by the vibration of elements of a structure, the source of which is within a building or structure with common elements. *NOTE Common sources of structure-borne noise include building services plant, manufacturing machinery and construction or demolition of the structure.*
Third octave band	Band of frequencies in which the upper limit of the band is 2⅓ times the frequency of the lower limit.
Weighted level difference, D_w	Single-number quantity that characterizes airborne sound insulation between rooms, but which is not adjusted to reference conditions. *NOTE Weighted level difference is used to characterize the insulation between rooms in a building as they are. Values cannot normally be compared with measurements made under other conditions (see BS EN ISO 717-1).*
Weighted normalised impact sound pressure level, $L'_{n,w}$	Single-number quantity used to characterize the impact sound insulation of floors over a range of frequencies.
Weighted sound reduction index, R_w	Single-number quantity which characterizes the airborne sound insulating properties of a material or
Weighted standardised impact sound pressure level $L'_{nT,w}$	Single-number quantity used to characterize the impact sound insulation of floors over a range of frequencies.
Weighted standardised level difference, $D_{nT,w}$	Single-number quantity that characterizes the airborne sound insulation between rooms.

Symbols

D_w	Weighted level difference (dB)
D_{nT}	Standardized level difference (dB)
$D_{nT,w}$	Weighted standardized level difference (dB)
L_{Amax}	Maximum noise level (dB)
$L_{Ar,Tr}$	Rating level (dB)
L_n	Normalised impact sound pressure level (dB)
L'_{nT}	Standardised impact sound pressure level (dB)
$L'_{nT,w}$	Weighted standardised impact sound pressure level (dB)
$L'_{n,w}$	Weighted normalised impact sound pressure level (dB)
L_p	Sound pressure level (dB)
L_{pA}	A-weighted sound pressure level (dB)
$L_{AN,T}$	Percentile level (dB)
L_{AE}	Sound exposure level (dB)
LAeq,*T*	Equivalent continuous A-weighted sound pressure level (dB)
p	Sound pressure (Pa)
p_A	A-weighted sound pressure (dB)
$p_{A(t)}$	Instantaneous A-weighted sound pressure (Pa)

R	Sound reduction index (dB)
R_w	Weighted sound reduction index (dB)
T	Time interval (also used for reverberation time) (s)
t_0	Reference time interval (s)

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