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Profile Park Power Plant

Planning Application SD21A/0167

Response to Request for Clarification of Additional Information (CAI)

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Client Address:	C/O Centrica Business Solutions, 1 Seapoint Building, 44-45 Clontarf Road, Dublin 3, D03 F4A7
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Galway Office	Dublin Office	Castlebar Office
Fairgreen House, Fairgreen Road, Galway, H91 AXK8, Ireland. Tel: +353 (0)91 565 211	Block 10-4, Blanchardstown Corporate Park, Dublin 15, D15 X98N, Ireland. Tel: +353 (0)1 803 0406	Market Square, Castlebar, Mayo, F23 Y427, Ireland. Tel: +353 (0)94 902 1401

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1.0 INTRODUCTION

Greener Ideas Limited (GIL) is proposing to develop a gas fired peaking power plant at a site located in Profile Park, Dublin 22. Unlike traditional power stations, peaking plants generally run only when there is a high demand for electricity, typically during morning and evening peak usage times.

The need for peaking plants on the Irish electricity grid has grown, as renewable forms of power generation increase their penetration onto the system. The variability of renewable power generation increases EirGrid's challenge to operate an efficient, safe, and secure electricity system. This is especially the case in the greater Dublin region, where demand is growing rapidly, and there is expected to be a large increase in offshore wind power generation by 2030.

The modular design of the Profile Park peaker power plant, and its fast response capability, means it can react quickly to vary its output. So, mirroring the peaks and troughs of electricity generation, from renewable generators. The proposed plant will also be hydrogen enabled, in preparation for running on renewable gas when it is available. Which is consistent with the policy objectives set out in the Climate Action Plan 2021.

The construction of peaking plants, such as the one proposed for Profile Park, are in line with the government policy statement published on 30th November 2021[1]. Which states that the Government has approved "***the development of new conventional generation (including gas-fired and gasoil/distillate-fired generation) is a national priority and should be permitted and supported in order to ensure security of electricity supply and support the growth of renewable electricity generation***". The construction of peaking plants will also facilitate the decommissioning of the older less efficient power plants, which the government policy statement states that, "***existing conventional electricity generation capacity, including existing coal, heavy fuel oil and biomass fired generation, should be retained until the new conventional electricity generation capacity is developed in order to ensure security of electricity supply***". For example, it is expected that Moneypoint, a 915MW coal fired power station, will remain operational, beyond the previous target closure date of 2025, but only until it is replaced by new generation capacity[2].

The need for the Profile Park peaking plant has also been recently emphasised by the operator of Ireland's electricity market SEMO, who awarded the plant a 10-year capacity market contract, starting in October 2024[3]. This in turn has prompted EirGrid to issue the plant a grid connection offer, as directed by the Commission for the Regulation of Utilities, in March 2021[4].

It can, therefore, be seen that the construction of the Profile Park peaking plant not only supports development in the local area, but also in the greater Dublin region. And is in line with policies set out in the National Development Plan and the Climate Action Plan 2021, which target the development of circa 2,000 MW of flexible gas-fired generation capacity.

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[1] Dept of the Environment, Climate and Communications: *Policy Statement on Security of Energy Supply.*

[2] Dept of the Environment, Climate and Communications: *Press Release*

[3] SEM Capacity Market: *Final Capacity Auction Results 2024/2025 T3 Capacity Auction*

[4] Commission for the Regulation of Utilities: *CRU21030a CRU Direction to EirGrid*

1.1 BACKGROUND & STRATEGIC CONTEXT

A planning application for the proposed plant was submitted to South Dublin County Council on the 25th of June 2021. The application was supported by an Environmental Impact Assessment Report (EIAR). The need for the development was set out in Chapter 4 which included the following:

- Ireland will not achieve its 2020 carbon emissions targets. The need to significantly improve its performance in terms of decarbonisation in order to meet the 2030 targets are more and more important.
- The proposed power plant is consistent with the overarching strategy to achieve its binding 2030 emission targets. Gas fired power plant technology allows the delivery of an efficient, safe and secure electricity system by helping to manage fluctuating electricity demands and compensate for shortages occurring from wind or solar power. As a lower-carbon generation source it will also be a vital technology to mitigate the deficiency in electricity generation following the planned closure of fossil fuel power plants across the island of Ireland in the next six years.
- Electricity demand is increasing rapidly in the greater Dublin region primarily due to the growth of data centres which require large amounts of power. However, as large consumers of electricity, data centres also pose particular challenges to the future planning and operation of a sustainable power system.

Since the planning application was submitted to South Dublin County Council there has been further developments in relation to electricity supply challenges. EirGrid, which is the Transmission Systems Operator, has published its Generation Capacity Statement (GCS) for the years 2021 to 2030. In this report EirGrid has noted the following:

- The withdrawal of previously procured generation, and a recent auction which did not clear the desired amount of electricity capacity, means that if no action is taken, there is the potential for a shortfall in Ireland over the next five winters.
- Since January 2020, there have been eight system alerts in Ireland due to a combination of factors. These include periods of very low wind, limited interconnector support from Great Britain due to its tight margins, prolonged outages at two large gas generators due to technical problems and the impact of Covid-19 on maintenance schedules.
- Approximately 500MW of contracted generation expected to be delivered in 2022/23 will now not be delivered, leaving a significant generation gap in advance of the planned retirement of existing elements of the existing generator fleet.
- Actual electricity demand has continued to increase – Ireland experienced record system demand peaks in the winter of 2020/21, on the 3rd (5112MW) and 7th December (5357MW).
- The long-term demand forecast in Ireland continues to be heavily influenced by the expected growth of large energy users, primarily data centres. EirGrid's analysis shows that demand from data centres could account for 23% of all demand in Ireland by 2030.
- The reliability of the existing, older, fleet has declined beyond typical expectations, as evidenced by the prolonged outage of two reliable large gas generation units in Cork and Dublin.

EirGrid's CEO Mr. Mark Foley further advised in relation to the report that:

> "*It is clear from the report that **new, cleaner gas-fired generation plant** is required now to address this issue, especially for when wind and solar generation is low. Appropriate volumes of **dispatchable flexible gas generation are critical** to support the transition to a low-carbon power system into the next decade, as we move to 70% renewables by 2030 and, ultimately, a zero-carbon power system.*"

"It is very important that the market gets a clear signal that new clean gas generation has a key role to play in the all-island power system over the next decade and beyond, and that market participants can feel confident to invest and participate in the market."

The immediate short-term risk of electricity shortages in 2022 have been reduced due to the return to operation of two large gas generation units in Cork and Dublin. Although the risk has declined, it is still expected that winter supply margins will remain tight and there may be system alerts over the coming winter period. The long-term risks of electricity shortages beyond 2021/2022 however remain. Acknowledging the criticality of the issue, the Commission for the Regulation of Utilities (CRU), incorporating the recommendations of EirGrid and in conjunction with the Department of Environment, Climate and Communications (DECC), has developed a programme of work actions that will be delivered in the coming months and years. These actions include:

- The delivery, through the all-island capacity auctions of over 2000MW of enduring flexible and efficient gas-fired generation capacity by 2030, to provide for growing demand, replace retiring generators and support additional penetration of renewables to meet our 2030 decarbonisation policy goals.

It is clear, therefore, that there is an urgent demand for gas fired power plant to be consented, constructed and operational to address Ireland's climate targets for 2030. And address the immediate security of supply issues and 'keep the lights on' longer term.

It should also be noted that both the EirGrid GCS statement and the CRU programme of work actions, predated the Climate Action Plan 2021, which was published in November 2021. Which increased the share of renewable electricity, as part of the overall electricity supply mix, from 70% to 80% for 2030. This target provides additional urgency to ensure power plants such as that proposed in Profile Park are operational at the earliest possible time. Some of the relevant targets included in the Climate Action Plan 2021 included:

- Deliver circa 2 GW of new flexible gas-fired power stations in support of a high variable renewable electricity system.
- Ensure that 20-30% of system demand is flexible by 2030.
- Carry out a work programme to identify a route to deliver 1-3 TWh of zero emissions gas (including green hydrogen) by 2030.

Regarding green hydrogen the Climate Action Plan 2021 notes:

"Green hydrogen has been identified as having the potential to support decarbonisation across several sectors, and, in high-temperature heat for industry and in electricity generation.... Sector coupling is already happening, with the increased electrification of the heat and transport sectors. Some of the challenges that this presents for the electricity sector can be solved by renewable green hydrogen, including as back-up for intermittent renewables".

The power plant proposed at Profile Park is hydrogen enabled, in preparation for running on renewable gas when it is available. Therefore, the plant is consistent with the policy objectives set out in the Climate Action Plan 2021.

As indicated in the EIAR originally submitted to SDCC and in a Further Information response submitted to SDCC (dated March 11th, 2022), the proposed peaker power plant has the design flexibility to support the demands of both the local area, and the greater Dublin region. It will also support in the development of offshore wind power generation in the Irish Sea. With regard to emissions (i.e., noise, water, air etc) it has been demonstrated that these impacts are all acceptable and within the relevant statutory and best practise limits and thresholds. The proposed peaking power plant is, therefore, clearly consistent with the policies and objectives set out in the National Development Plan and the Climate Action Plan 2021, which target the development of circa 2,000 MW of flexible gas-fired generation capacity.

1.2 PLANNING APPLICATION HISTORY

As previously described, a planning application for the proposed development was submitted to South Dublin County Council on the 25th of June 2021 (SDCC Register: SD21A/0167).

A Request for Further Information (RFI) was issued by the Council on the 20th of August 2021 and a response to that RFI was submitted to the local authority on March 11th, 2022.

This report represents GIL's response to the request for "Clarification of Additional Information (CAI)" which is set out in the same sequence as the items raised in the CAI received from the Council. There are 7 no. CAI items which are summarised below under the following headings and an additional section to address cumulative assessment:

- CAI 1: Design Revisions
- CAI 2: Design Clarifications
- CAI 3: Surface Water Drainage
- CAI 4: Flood Risk Management
- CAI 5: Surface Water Management (SUDS) and Landscaping
- CAI 6: Noise
- CAI 7: Archaeology
- Cumulative Assessment

The remainder of this report sets out the detail response to the CAI under the above headings.

2.0 CAI 1: DESIGN REVISIONS

(a) The Planning Authority still has concerns regarding the design of the proposed development in terms of bulk and massing. Concerns that the proposed development represents an overdevelopment of the site given its footprint, hardstanding and underground attenuation tank also remain.

The applicant is therefore requested to review the submitted development and revise the plans /provide further justification for the scale in terms of:

(i) detail of the design of the road facing north, east and south frontages. Whilst colour adds variety to the facades, the applicant is requested to add further detail to break up these frontages. The presence of landscaping is welcomed however it should not be relied upon solely to mitigate visual impact.

(ii) massing and design of the stack structure. This is still extremely prominent and is encased in a structure for the most part. The stacks are significantly taller than all surrounding structures. The applicant is requested to reduce bulk of the encasement and reconsider the proposed materials.

(iii) overall level of development on the site. There are concerns that the proposal is overdevelopment. The applicant is requested to set out the percentage of land taken by buildings /tanks etc, roads and open spaces / attenuation. The applicant should investigate other lands to attenuate to provide for open and natural attenuation.

(b) The applicant previously provided an existing layout plan, indicating all natural features present. The Planning Authority would welcome the submission of existing and proposed sections /contiguous elevations that indicate the level changes across the site. Details of cut and fill should be provided.

2.1 RESPONSE

1(a)(i) - Based on the comments in the CAI relating to the adding of further design detail to the road frontage façade, in addition to just colour, it was clear that a greater consideration of context was required for the main façade treatment. A closer review of other buildings and structures within Profile Park indicated a considered departure from standard industrial premises. Using the same principles that had already been subtly applied (using dark and light tones to suggest regular solid and void) for breaking up the scale and massing, a more detailed tone and textural study was undertaken with the intention of generating a bolder and more effective architectural response.

The graphical process of this study is represented in Figure 2-1. The outcome of the study is the use of a series of broad horizontal bands of alternating dark and light tone blocks divided by narrow horizontal bangs of aluminium cladding. These narrow bands of aluminium cladding then tie into a much broader use of the same material for the entire northern end of the main building. The use of this high quality semi-reflective finish is threefold. It is intended to break up the perceived massing and length of the main building by using an alternate treatment to the southern and central façade; it expresses a high-quality finish that is not necessarily typical of industrial buildings but is typical of those within profile park including the adjacent data centre, and it provides the opportunity for reflectance of the sky and proposed landscaping treatment which is rich in tree planting. All of these attributes can be seen in the updated photomontage set, particularly from the nearest VP1, VP2, VP3 and VP4 locations. In all instances, it is considered that the design approach is more appropriate to this setting and although architecturally bolder, it will not result in increased visual impacts.

Table 2-1 Material Palette and Selection Process

1(a)(ii) - Due to the concern expressed regarding the bulk of the stack structure, the following design changes have been made:

- **The stacks have been divided into two groups and separated insofar as possible** – this will reduce the overall bulk and massing associated with bringing them together as a single group, which had originally been intended as a form of consolidation.
- **The stacks are only clad to the height of the buildings (approximately half height)** – Again, this will reduce the bulk and massing that was previously associated with the single fully clad stack structure.
- **The colour tone of each stack structure varies** – the same approach to that of the buildings and other structures has been applied to the two stack structures. This is the alternative use of dark and light tones to promote a sense of solid and void and to generally break up the massing of the development and provide visual interest.
- **The protruding stacks remain a light tone** – it is considered that a light tone for the unclad stack structures will help them to visually recede against the sky in silhouette which is commonly the case for surrounding receptors.

Please refer to drawing no.s 11069-2003, 11069-2043, 11069-2059, 11069-2060, 11069-2061, which illustrate the changes set out above.

1(a)(iii) - Please refer to table 2-1 below, which sets out the percentage of land taken by buildings/tanks etc, roads and open space/attenuation:

Current Application		
Item	Area (sq.m)	Site Percentage (%)
Overall Site	**18346**	**100%**
Bitumen Road	1174	6%
Gravel Road	993	5%
Footway	1030	6%
Grasscrete	323	2%
Concrete Plinth	1064	6%
Gravel Yard	5004	27%
Landscape Area	5410	29%
Attenuation Pond	509	3%
Tanks and Buildings		
Hardstanding Roof	2045	11%
Green Roof	468	3%
Tanks	268	1%
		100%

Table 2-2 Percentage of land taken by buildings/tanks, etc roads and open space/attenuation

In addition, please refer to drawing no.s 11069-2010, 11069-2045, 11069-2047 & 11069-2053, which sets out new a revised drainage plan for the proposed development and includes land provided for open and natural attention. Please refer to Appendix A for drainage calculation details.

1(b) - Please refer to drawing no. 11069-2065, which details existing and proposed sections /contiguous elevations that indicate the level changes across the site, as well as details of cut and fill.

3.0 CAI 2: DESIGN CLARIFICATIONS

As stated previously, the proposed power station introduces significant hardstanding and building development into the landscape which potentially runs contrary to Policy IE Objective 5 in the County Development Plan and other policies and objectives contained in Chapters 7 and 8 of the same plan. The applicant is requested to clearly set out:

(1) The percentage of hardstanding
(2) The plot ratio and how this had changed from initial proposal to current design

3.1 RESPONSE

3(1) – 33% - Please see Table 3-1 for breakdown.

3(2) – Please refer to Figure 3-1 and Table 3-1 below, which provide a break down of the hardstanding as a percentage of the overall site and a comparison between the initial proposal and the current proposal submitted to South Dublin County Council.

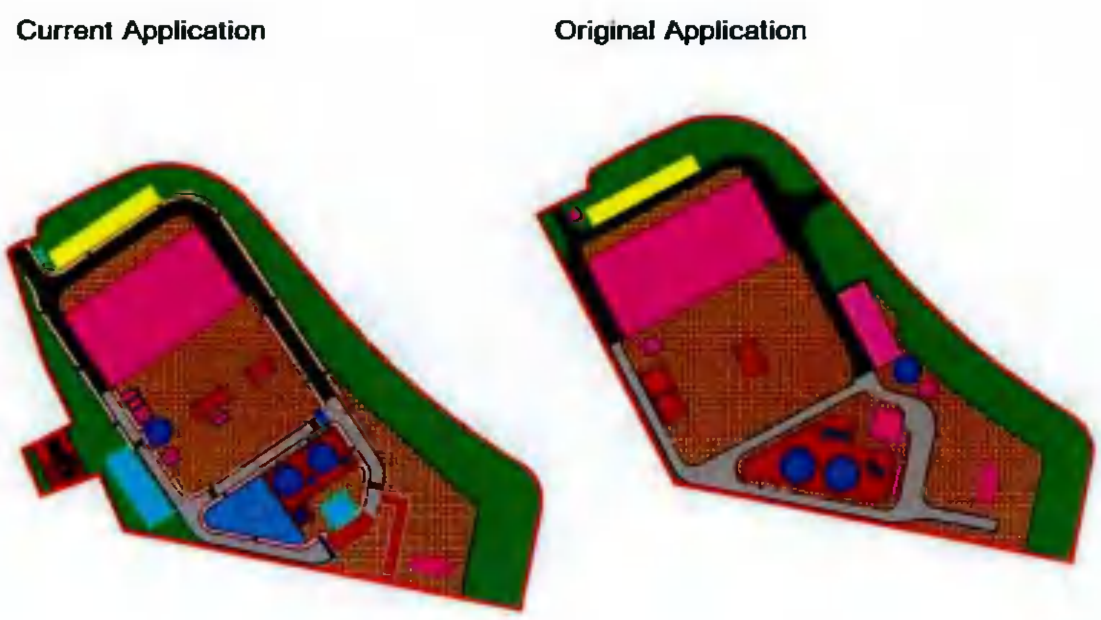

Figure 3-1 - Hard standing for current proposal and initial proposal submitted to South Dublin County Council

Current Application			First Application	
Item	Area (sq.m)	Site Percentage (%)	Area (sq.m)	Site Percentage (%)
Overall Site	18346	100%	18236	100%
Bitumen Road	1174	6%	1312	7%
Gravel Road	993	5%	1508	8%
Footway	1030	6%	0	0%
Grasscrete	323	2%	321	2%
Concrete Plinth	1064	6%	1400	8%
Gravel Yard	5004	27%	6284	34%
Landscape Area	5410	29%	4430	24%
Attenuation Pond	509	3%	0	0%
Tanks and Buildings			Tanks and Buildings	
Hardstanding Roof	2045	11%	2713	15%
Green Roof	468	3%	0	0%
Tanks	268	1%	367	2%
		100%		100%

Table 3-1 – Percentage of hard standing for current proposal and initial proposal

4.0 CAI 3: SURFACE WATER DRAINAGE

(i) The applicant's use of 1000mm for SAAR (Standard Average Annual Rainfall) value is too high. A SAAR value of 780mm shall be used in greenfield run off rate calculations which results in a maximum discharge rate from the suite of 3.8L/S.

The applicant is requested to submit a revised surface water drainage layout drawing and report with revised calculations showing revised attenuation calculations based on a maximum greenfield discharge rate from the site of 3.8L/S.

(ii) The applicant is requested to include green roofs on the site where feasible to reduce the amount of hardstanding area. Green roofs may be included on industrial buildings and/or ancillary buildings such as security huts, office admin buildings etc. The applicant is requested to submit a revised surface water drainage layout drawing showing the maximisation of green roofs across the site and include a section detail of the proposed green roof system.

4.1 RESPONSE

3(i) - The SAAR has been decreased to 780mm, thus decreasing the Discharge rate to 3.8l/s. The surface water attenuation requirement has increased from 435cu.m (Swale 80cum + Underground Tank 355cu.m) to 497.9cu.m (Detention Basin 140.5cu.m + Attenuation Pond .4 + Underground Tank 175cu.m) . Please see accompanying Simulation Criteria and Simulation Results (provided in Appendix A) demonstrating these changes and the effectiveness of the proposed Surface Water Drainage infrastructure.

3(ii) - Green roofs will now be provided on the Tank Farm Building, Worksop Building and on the Security hut. Please see accompanying drawing no.s 11069-2010 showing the locations of these buildings. In addition to the inclusion of the green roofs, it is also proposed to construct an attenuation pond and detention basin. Providing more soft scape surface water storage and treatment SUDs measures. Please see accompanying drawing no.s 11069-2045, 11069- 2047 & 11069-2053, which show the green roof build up and drawing no. 11069-2036 detailing the attenuation pond and detention basin. Please refer to Appendix A for drainage calculation details.

5.0 CAI 4: FLOOD RISK MANAGEMENT

(i) The applicant is requested to provide a report showing hydraulic model results for flood areas post development works. The report shall demonstrate the operation of the proposed flood compensation area for the 1 in 1000 year plus climate change scenario. The report shall take in consideration residual risks associated with the proposed flood mitigation measures on site.

(ii) It is unclear how surface water runoff will discharge from the proposed flood compensation area to the Baldonnel stream. The applicant is requested to submit a longitudinal section view drawing of the proposed flood compensation area which demonstrates how surface water will enter and exit the basin. The drawing shall include details of levels along the basin and at the discharge point of the stream to demonstrate this.

5.1 RESPONSE

5(i) - Please refer to Appendix B, which contains an updated Flood Risk Assessment Report.

5(ii) - Surface Water runoff will discharge through a headwall and will fall through gravity from the outlet within the flood drainage ditch to the existing stream, at a fall of 1:777. A cross section and long section has been provided on the accompanying drawing no. 11069-2011.

6.0 CAI 5: SURFACE WATER MANAGEMENT (SUDS) & LANDSCAPING

(1) SuDS

(i) The use of petrol interceptors is not best practice SuDS and should be avoided. The applicant is requested utilise above ground natural source control feature(s) such as filter strips/swales or basins in lieu of below ground oil interceptors. The applicant should refer to SDCC Sustainable Drainage Explanatory Design and Evaluation Guide (sections 7.4.5 and 7.4.7). An oil interceptor at a location where woodland and hedgerow mitigation planting is proposed is not compatible.

(ii) The applicant is requested to clarify whether the flood compensation storage volume taken into account the proposed mitigation tree planting?

(2) Landscaping

The applicant is requested to provide an updated Landscape (Mitigation) Plan that integrate the revised SuDS proposals to ensure they are achievable. A fully detailed landscape Masterplan, to be agreed with Public Realm, with full works specification, that accords with the specifications and requirements of the Council's Public Realm Section. The landscape Plan shall include hard and soft landscaping including levels, sections and elevations, detailed planting proposals for all SUDs features including proposed swale(s) and flood ditch.

The Landscape Masterplan shall include the following:

(i) A scaled Landscape Masterplan with cross-sections (where appropriate) showing the general layout and hard and soft landscape treatment of all external areas/spaces (including front and rear gardens), boundaries, structures and features. This shall be generally provided at a maximum scale of 1/200.

(ii) Details of Hard Landscape Design (where applicable) for boundaries, (walls, fences, screens), lighting, seating, kerbing, edging, surfacing and water features.

(iii) Details of Soft Landscape Design: detailed Planting Plan(s) and Planting Schedule(s) [species/varieties, quantities, sizes, rootball presentation, spacings]

(iv) A Landscape Specification for all materials (hard and soft landscaping), workmanship and landscape maintenance (18 months minimum period post Practical Completion).

(v) A timescale for implementation of all proposals, including specified landscape maintenance operations; Landscape Contract(s) to include an 18-months Defects Liability clause, (hard and soft landscaping) after Certified Practical Completion (by the landscape consultant)

(vi) Planting material where possible should be Irish Grown Nursey Stock and the importation of foreign planting material should be avoided within the proposed planting schemes.

(vii) Details of lighting and other underground services should also be included on a planting plan drawing to ensure that proposals are realistic, and planting is not precluded by the location of underground services. Details of lighting design that mitigate the impacts on commuting/foraging bats.

6.1 RESPONSE

6(1)(i) - Although the use of a Petrol interceptor is not best practice, it is a fail-safe system for the surface water drainage infrastructure and offers further safety measures to protect water courses from contamination. To further treat the surface water runoff from the site, permeable parking, a detention basin and an attenuation pond are proposed.

6(1)(ii) - No tree planting will be allowed within the flood compensation storage area.

6(2) - Revised landscape drawings have been prepared, which incorporate and take advantage of the upgraded external SUDs measures. As requested in the CAI, the following items are included in the revised landscape plan:

(i) A scaled Landscape Masterplan showing hard and soft landscape specifications and SUDs areas @ 1:500 / A1 (larger scale not necessarily due to low degree of complexity).

(ii) A scaled Planting Plan @ 1:500 / A1 incorporating native species throughout and indicating;
   a. Species mixes / planting densities / sizes / locations / sqm area coverage
   b. Individual specimen tree planting / numbers / spacing / sizes / locations

(iii) Cross sectional drawings X 3 @ 1:100 / A1.

(iv) A 'Landscape Maintenance and Management Schedule' document including planting performance specifications and maintenance schedules. It details an 'aftercare' (defects and liability) period of 60 months whereafter a regular maintenance and management contract should be entered into. This is welcomed by way of planning condition. Please refer to Appendix C.

(v) It should be noted that planting is only shown in areas of the site where it will not be precluded by underground services. It is intended that planting take place in the first available planting season following the completion of construction work.

(vi) Please refer to Appendix C for a Landscape Management and Maintenance Schedule.

(vii) Planting is only shown in areas of the site where it will not be precluded by underground services. As set out in section 12.6.2.1 of Chapter 12 of the EIAR, all new external lighting proposed within the development site will be designed in consultation with a suitably qualified ecologist and in accordance with the Bat Conservation Ireland guidelines. Lighting will only be switched on when manned. Light shields and directional lighting will be used to minimise light spill. All lighting will be directed away from surrounding linear features including treelines and hedgerows.

7.0 CAI 6: NOISE

The applicant has not clearly set out in the additional information submission that it can be demonstrated that the development can meet the standards set out by South Dublin County Council, as requested in item 7. The applicant is requested to submit an Acoustic Verification report as clarification of additional information. The report must confirm whether the development is capable of complying with Council's standard operational noise criteria, set out below: Noise due to the normal operation of the proposed development, expressed as Laeq over 15 minutes at the façade of a noise sensitive location, shall not exceed the daytime background level by more than 10 dB(A) and shall not exceed the background level for evening and night time.

(a) This Acoustic Verification report should comprise of noise monitoring data at any noise sensitive locations. It should also include the cumulative noise level whereby the existing noise levels are included in the assessment of the developments overall impact.
(b) The Acoustic Verification report should include performance specifications for any changes/modifications which have been incorporated in order to reduce operational noise levels during the night time period.
The report must include a statement certifying whether the development or proposed use is fully capable of complying with the requirements of the following noise control condition:
(1) Noise due to the normal operation of the proposed development, expressed as Laeq over 15 minutes at the façade of a noise sensitive location, shall not exceed the daytime background level by more than 10 dB(A) and shall not exceed the background level for evening and night time. Clearly audible and impulsive tones at noise sensitive locations during evening and nightshall be avoided irrespective of the noise level.

7.1 RESPONSE

Pleas refer to Appendix D, which provides a response to the items raised above.

8.0 CAI 7: ARCHAEOLOGY

Under item 8 of the request for further information, the Planning Authority noted the lack of information included within the EIAR regarding archaeology. It is noted that an archaeological assessment report has been prepared, however, it is noted that the EIAR has not been updated. The applicant is therefore requested to provide an update of the archaeology section of the EIAR.

8.1 RESPONSE

Please refer to Appendix E, which provides and update of the archaeology section of the EIAR.

9.0 CUMULATIVE ASSESSMENT

A cumulative assessment was undertaken in the original planning application submission, with the assessment methodology detailed in Chapter 2 of the Environmental Impact Assessment Report (EIAR) and the outcomes reported within each of the specialist assessments (Chapters 7-15 of the EIAR).

This section of the CAI response seeks to address the cumulative assessment elements of the project and surrounding area, which may have evolved since the original date of submission of this planning application.

9.1 POTENTIAL GRID CONNECTIONS

As set out under the original planning application, it was assumed that a grid connection for the proposed development would be made at a location within Profile Park.

The proposed electrical connection considered in the EIAR is an underground 110kV cable from the plant's main transformers to the existing Castlebaggot 220/110 kV Substation, which is operated by EirGrid *or* to anew proposed 110 kV substation in Profile Park.

It should be noted that at the time of the submission of the original planning application, no confirmed details of the potential new substation were available for consideration as part of the EIAR. Instead, the boundaries, design and environmental assessment of potential grid connections were at optioneering stage.

This has remained unchanged since the original submission of the planning application. However, the following update can be provided, at this stage:

- The applicant, Greener Ideas Ltd, has initiated the pre-application consultation process with An Bord Pleanála, to confirm if various grid connection options for the proposed development are deemed Strategic Infrastructure Development (Reg. Ref.: ABP - 312984-22).
- It is noted that the recent approval of the nearby application Reg. Ref: SD21A/0241 will involve the construction of a new substation within profile park, to be known as Kilcarbery Substation. This new substation would be located directly adjacent to the proposed powerplant. This new substation is currently under consideration by An Bord Pleanála and its currently predicted to be built and operational in Q4 2023. As the Kilcarbery substation would be located adjacent to the proposed powerplant, the construction of this new substation would present a viable grid connection option for the proposed development, if this future development were to become available. As set out above, it should be noted that at this early stage, grid connection options are still fluid and are not confirmed.
- It is noted that a application for planning permission for the construction of a 110kV Gas Insulated Switchgear (GIS) Substation compound and 110kV transmission lines along with associated and ancillary works has been lodged with An Bord Pleanála (Reg. Ref.: VA06S.312793) and is currently pending consideration. A decision is due to be issued on the 17th of August 2022.
- It is further noted that the proposed power plant forms part of the cumulative assessment of application VA06S.312793, with the following conclusions of note:
    - Construction Cumulative Effects: Construction cumulative effects would arise from SD21A/0167 in respect of air quality and transport and accessibility.
    - Significant construction cumulative air quality effects are unlikely to occur, as all cumulative developments within 350m of the site boundary of the Kilcarbery

Substation are anticipated to employ similar dust mitigation techniques such that individual construction stage effects are not significant, alone or in combination.

- To reduce cumulative transport and accessibility effects, the appointed construction contractor(s) and the Applicant of the Kilcarbery Substation would consult neighbouring schemes on the programme and local effects of the construction works, such as pedestrian routes, for example. In addition, collaboration around the scheduling of vehicle movements would be undertaken so that if works coincide with other construction activity already taking place within the immediate vicinity of the application site, the cumulative effect of construction traffic is considered not significant and can be minimised.
- Operation Cumulative Effects: Any generated additional traffic on the local highway network is considered in the overlap of the Kilcarbery Substation and the proposed development (SD21A/0167). The traffic flows from the development are not considered to be significant.

9.2 APPROVED PROJECTS – REG. REF.: SD21A/0241

It is noted that application SD21A/0241 received planning approval on the 16th of May 2022 for the construction of:

Demolition of the abandoned single storey dwelling and associated outbuilding (206sqm); construction of 2 two storey data centers with plant at roof level of each facility and associated ancillary development which will have a gross floor area of 40,589sq.m consisting of 1 two storey data center (Building 11) which will be located to the south of the site and will have a gross floor area of 24,667sq.m. including 22 emergency generators located at ground floor level within a compound to the western side of the data center with associated flues that will be 22.3m in height; 1 two storey data center (Building 12) which will be located to the north of the site, and to the immediate north of Building 11 and will have a gross floor area of 12,915sq.m including 11 emergency generators located at ground floor level within a compound to the western side of the data center with associated flues that will be 22.3m in height; each of the two data centers will include data storage rooms, associated electrical and mechanical plant rooms, loading bays, maintenance and storage spaces, office administration areas, and plant including PV panels at roof level as well as a separate house generator for each facility which will provide emergency power to the admin and ancillary spaces; each generator will include a diesel tank and there will be a refuelling area to serve the proposed emergency generators; the overall height of each data center apart from the flues and plant at roof level is c. 14.23m above the finished floor level; the overall height of each data center apart from the flues and plant at roof level is c. 14.23m above the finished floor level; single storey step-up substation (38sq.m) as well as 2 single storey switch substations (121sq.m); AGI Gas Regulator compound that include 3 single storey buildings (134sq.m); construction of a gas powered generation plant in the form of a 13m high single storey building with a gross floor area of 2,714sq.m that will contain 10 gas generators with associated flues that will be 25m in height, and grouped in pairs and threes; the Gas Plant will be located to the west of Building 11; ancillary site development works, that will include reorientation of the Baldonnel Stream, biodiversity management initiatives, attenuation ponds and the installation and connection to the underground foul and storm water drainage network, and installation of utility ducts and cables, that will include the drilling and laying of ducts and cables under the internal road network within Profile Park; other ancillary site development works will include hard and soft landscaping, lighting, fencing, signage, services road, entrance gates, sprinkler tanks and pump room; a temporary gas powered generation plant within a fenced yard containing 21 generator units in containers, each with associated flues (each 25m high), 12 transformers and 10 containers of controls to be located to the west *of, and associated with the first phase of Building 11, and will be required for a period of up to 2 years if connection to the national grid is delayed; this temporary plant will not be built if the connection to the national grid is in place prior to the operation of Building 11 at this site that includes an abandoned single storey residential property on the New Nangor Road (R134), Dublin 22; and on land within the townlands of Ballybane and Kilbride within Profile Park, Clondalkin, Dublin 22 on an overall site of 8.7 hectares.*

As there is potential for the construction and operation of the above approved project to overlap with the proposed development, a cumulative assessment has been carried out as part of this CAI response.

No significant cumulative effects are anticipated to arise in the event that the construction phase of these developments would overlap. Each development will be managed through best practice measures and restrictions as well as relevant environmental management standards and plans. The implementation of these measures and plans will be effective in avoiding any potential significant cumulative impacts, associated with construction activities.

With respect to the potential for overlapping cumulative effects arising from the operation of the proposed development in combination with the above approved project, and any other future projects, an assessment of effects of air have been provided in the updated Air Quality chapter, submitted as part of this CAI response. Please refer to Appendix F. It has concluded that ambient levels of nitrogen oxides (as NO_2, including background) from the proposed power plant as well as the cumulative emissions from Pfizer, Takeda, the Grange Castle Power Facility and Vantage Data Centre DUB11 are in compliance with the air quality limit values for the protection of human health and it is predicted that air emissions from the installation will not have a significant impact on the local environment.

With respect to any potential interaction arising from noise from the proposed development in combination with the above approved project, or any other future projects, operational generated noise is expected to operate within established noise emission limits and managed under standard environmental measures. Furthermore, no overlap is expected to occur between the proposed development and the above approved project, as set out under application SD21A/0241.

It should be noted that the cumulative assessment of noise and air has been undertaken under the above approved project SD21A/0241, under which no significant long term cumulative effects were anticipated at construction or during operation.

Appendix A – Drainage Calculation Details

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes GDSDS Manhole Sizes IW Foul

FSR Rainfall Model - Scotland and Ireland

Return Period (years)	5	PIMP (%)	100
M5-60 (mm)	16.900	Add Flow / Climate Change (%)	20
Ratio R	0.272	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
1	74.800	1.050	Open Manhole	1200	1.000	73.750	300				
2	74.800	1.319	Open Manhole	1200	1.001	73.481	300	1.000	73.481	300	
4	74.800	1.449	Open Manhole	1200	1.002	73.351	300	1.001	73.351	300	
4	74.800	0.975	Open Manhole	1200	2.000	73.825	225				
5	74.800	1.026	Open Manhole	1200	2.001	73.774	225	2.000	73.774	225	
6	74.800	1.104	Open Manhole	1200	2.002	73.696	225	2.001	73.696	225	
7	74.800	1.231	Open Manhole	1200	2.003	73.569	225	2.002	73.569	225	
7	74.800	1.473	Open Manhole	1200	1.003	73.327	300	1.002	73.327	300	
								2.003	73.402	225	
8	74.800	1.558	Open Manhole	1350	1.004	73.242	375	1.003	73.317	300	
8	74.800	1.814	Open Manhole	1350	1.005	72.986	450	1.004	73.061	375	
9	74.800	1.841	Open Manhole	1350	1.006	72.959	450	1.005	72.959	450	
10	74.800	1.956	Open Manhole	1350	1.007	72.844	450	1.006	72.844	450	
11	74.800	1.982	Open Manhole	1350	1.008	72.818	450	1.007	72.818	450	
12	74.810	2.016	Open Manhole	1350	1.009	72.794	450	1.008	72.794	450	

Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
13	75.000	2.345	Open Manhole	1350	1.010	72.655	450	1.009	72.655	450	
14	75.000	2.368	Open Manhole	1350	1.011	72.632	450	1.010	72.632	450	
	74.800	2.190	Open Manhole	0		OUTFALL		1.011	72.610	450	

PIPELINE SCHEDULES for Storm

Upstream Manhole

- Indicates pipe length does not match coordinates

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	o	300	1	74.800	73.750	0.750	Open Manhole	1200
1.001	o	300	2	74.800	73.481	1.019	Open Manhole	1200
1.002	o	300	4	74.800	73.351	1.149	Open Manhole	1200
2.000	o	225	4	74.800	73.825	0.750	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	80.839	300.5	2	74.800	73.481	1.019	Open Manhole	1200
1.001	39.096	300.0	4	74.800	73.351	1.149	Open Manhole	1200
1.002	7.098	295.8	7	74.800	73.327	1.173	Open Manhole	1200
2.000	10.232	200.0	5	74.800	73.774	0.801	Open Manhole	1200

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
2.001	o	225	5	74.800	73.774	0.801	Open Manhole	1200
2.002	o	225	6	74.800	73.696	0.879	Open Manhole	1200
2.003	o	225	7	74.800	73.569	1.006	Open Manhole	1200
1.003	o	300	7	74.800	73.327	1.173	Open Manhole	1200
1.004	o	375	8	74.800	73.242	1.183	Open Manhole	1350

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
2.001	15.627	200.0	6	74.800	73.696	0.879	Open Manhole	1200
2.002	25.252	200.0	7	74.800	73.569	1.006	Open Manhole	1200
2.003	0.500#	3.0	7	74.800	73.402	1.173	Open Manhole	1200
1.003	0.500#	50.0	8	74.800	73.317	1.183	Open Manhole	1350
1.004	54.319	300.0	8	74.800	73.061	1.364	Open Manhole	1350

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.005	o	450	8	74.800	72.986	1.364	Open Manhole	1350
1.006	o	450	9	74.800	72.959	1.391	Open Manhole	1350
1.007	o	450	10	74.800	72.844	1.506	Open Manhole	1350
1.008	o	450	11	74.800	72.818	1.532	Open Manhole	1350
1.009	o	450	12	74.810	72.794	1.566	Open Manhole	1350
1.010	o	450	13	75.000	72.655	1.895	Open Manhole	1350

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.005	8.066	300.0	9	74.800	72.959	1.391	Open Manhole	1350
1.006	34.508	300.0	10	74.800	72.844	1.506	Open Manhole	1350
1.007	10.425	400.0	11	74.800	72.818	1.532	Open Manhole	1350
1.008	9.542	400.0	12	74.810	72.794	1.566	Open Manhole	1350
1.009	0.500#	3.6	13	75.000	72.655	1.895	Open Manhole	1350
1.010	9.112	396.2	14	75.000	72.632	1.918	Open Manhole	1350

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.011	o	450	14	75.000	72.632	1.918	Open Manhole	1350

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.011	8.957	407.1		74.800	72.610	1.740	Open Manhole	0

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	User	-	90	0.078	0.070	0.070
	User	-	90	0.085	0.076	0.147
	User	-	60	0.022	0.013	0.160
	User	-	60	0.083	0.050	0.209
	User	-	90	0.008	0.008	0.217
1.001	User	-	100	0.005	0.005	0.005
	User	-	75	0.034	0.026	0.031
	User	-	100	0.002	0.002	0.033
	User	-	100	0.010	0.010	0.044
	User	-	90	0.051	0.046	0.089
	User	-	60	0.080	0.048	0.137
	User	-	60	0.017	0.010	0.147
	User	-	80	0.002	0.001	0.149
1.002	User	-	75	0.006	0.005	0.005
2.000	-	-	100	0.000	0.000	0.000
2.001	User	-	100	0.002	0.002	0.002
2.002	User	-	60	0.011	0.007	0.007
	User	-	100	0.002	0.002	0.009
	User	-	75	0.017	0.013	0.022
2.003	User	-	75	0.174	0.131	0.131
	User	-	100	0.026	0.026	0.157

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.003	User	-	75	0.009	0.007	0.007
	User	-	100	0.010	0.010	0.016
	User	-	100	0.005	0.005	0.022
	User	-	75	0.026	0.019	0.041
1.004	User	-	60	0.036	0.021	0.021
	User	-	100	0.006	0.006	0.027
1.005	User	-	75	0.009	0.007	0.007
	User	-	80	0.011	0.009	0.016
	User	-	100	0.003	0.003	0.018
	User	-	60	0.123	0.074	0.092
1.006	User	-	90	0.024	0.022	0.022
	User	-	100	0.004	0.004	0.026
	User	-	100	0.007	0.007	0.033
	User	-	90	0.018	0.016	0.050
1.007	User	-	90	0.103	0.092	0.092
1.008	User	-	90	0.025	0.022	0.022
	User	-	75	0.021	0.015	0.037
	User	-	60	0.001	0.001	0.038
1.009	User	-	60	0.033	0.020	0.020
	User	-	90	0.027	0.025	0.044
1.010	-	-	100	0.000	0.000	0.000

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.011	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				1.216	0.936	0.936

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.011		74.800	72.610	72.500	0	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Manhole Headloss Coeff (Global)	0.500	Inlet Coeffiecient	0.800
Areal Reduction Factor	1.000	Foul Sewage per hectare (l/s)	0.000	Flow per Person per Day (l/per/day)	0.000
Hot Start (mins)	0	Additional Flow - % of Total Flow	20.000	Run Time (mins)	60
Hot Start Level (mm)	0	MADD Factor * 10m³/ha Storage	2.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Offline Controls	0	Number of Time/Area Diagrams	0
Number of Online Controls	1	Number of Storage Structures	3	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm)	16.900	Cv (Summer)	0.750
Return Period (years)	5	Ratio R	0.272	Cv (Winter)	0.840
Region	Scotland and Ireland	Profile Type	Summer	Storm Duration (mins)	30

Online Controls for Storm

Hydro-Brake® Optimum Manhole: 14, DS/PN: 1.011, Volume (m³): 4.6

Unit Reference	MD-SHE-0085-3800-1495-3800	Sump Available	Yes
Design Head (m)	1.495	Diameter (mm)	85
Design Flow (l/s)	3.8	Invert Level (m)	72.632
Flush-Flo™	Calculated	Minimum Outlet Pipe Diameter (mm)	100
Objective	Minimise upstream storage	Suggested Manhole Diameter (mm)	1200
Application	Surface		

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.495	3.8	Kick-Flo®	0.761	2.8
Flush-Flo™	0.375	3.5	Mean Flow over Head Range	-	3.1

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.6	0.300	3.4	0.500	3.4	0.800	2.8	1.200	3.4	1.600	3.9
0.200	3.2	0.400	3.5	0.600	3.3	1.000	3.2	1.400	3.7	1.800	4.1

Hydro-Brake® Optimum Manhole: 14, DS/PN: 1.011, Volume (m³): 4.6

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
2.000	4.3	2.600	4.9	4.000	6.0	5.500	7.0	7.000	7.8	8.500	8.6
2.200	4.5	3.000	5.2	4.500	6.3	6.000	7.3	7.500	8.1	9.000	8.8
2.400	4.7	3.500	5.6	5.000	6.7	6.500	7.5	8.000	8.3	9.500	9.0

Storage Structures for Storm

Tank or Pond Manhole: 7, DS/PN: 1.003

Invert Level (m) 73.327

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	228.1	0.800	228.1	0.801	0.0

Tank or Pond Manhole: 9, DS/PN: 1.006

Invert Level (m) 72.959

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	91.7	1.532	91.7	1.533	0.0

Tank or Pond Manhole: 13, DS/PN: 1.010

Invert Level (m) 72.655

Tank or Pond Manhole: 13, DS/PN: 1.010

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	175.0	1.000	175.0	1.001	0.0

Manhole Headloss for Storm

PN	US/MH Name	US/MH Headloss
1.000	1	0.500
1.001	2	0.500
1.002	4	0.500
2.000	4	0.500
2.001	5	0.500
2.002	6	0.500
2.003	7	0.500
1.003	7	0.500
1.004	8	0.500
1.005	8	0.500
1.006	9	0.500
1.007	10	0.500
1.008	11	0.500
1.009	12	0.500
1.010	13	0.500

Manhole Headloss for Storm

PN	US/MH Name	US/MH Headloss
1.011	14	0.500

Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor 1.000 Manhole Headloss Coeff (Global) 0.500 MADD Factor * 10m³/ha Storage 2.000
Hot Start (mins) 0 Foul Sewage per hectare (l/s) 0.000 Inlet Coeffiecient 0.800
Hot Start Level (mm) 0 Additional Flow - % of Total Flow 20.000 Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 3 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 16.900 Cv (Summer) 0.750
Region Scotland and Ireland Ratio R 0.272 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status ON
DVD Status OFF
Inertia Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 1, 30, 100

Summary of Critical Results by Maximum Level (Rank 1) for Storm

Climate Change (%) 0, 0, 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)
1.000	1	15 Winter	100	+0%	30/15 Summer				74.681	0.631	0.000	1.10		67.4
1.001	2	1440 Winter	100	+0%	30/15 Summer				74.589	0.808	0.000	0.16		9.3
1.002	4	1440 Winter	100	+0%	30/15 Summer				74.587	0.936	0.000	0.19		9.1
2.000	4	1440 Winter	100	+0%	100/360 Winter				74.586	0.536	0.000	0.01		0.5
2.001	5	1440 Winter	100	+0%	100/360 Winter				74.586	0.587	0.000	0.02		0.8
2.002	6	1440 Winter	100	+0%	100/240 Winter				74.586	0.665	0.000	0.03		0.8
2.003	7	1440 Winter	100	+0%	30/480 Winter				74.586	0.791	0.000	0.08		4.7
1.003	7	1440 Winter	100	+0%	30/240 Winter				74.586	0.959	0.000	0.23		13.4
1.004	8	1440 Winter	100	+0%	30/180 Winter				74.586	0.969	0.000	0.13		13.6
1.005	8	1440 Winter	100	+0%	30/60 Winter				74.583	1.148	0.000	0.12		14.5
1.006	9	1440 Winter	100	+0%	30/60 Winter				74.582	1.174	0.000	0.32		51.8
1.007	10	1440 Winter	100	+0%	1/360 Winter				74.581	1.287	0.000	0.43		42.4
1.008	11	960 Winter	100	+0%	1/360 Winter				74.606	1.338	0.000	0.37		35.0
1.009	12	960 Winter	100	+0%	1/240 Winter				74.628	1.384	0.000	0.12		25.8
1.010	13	960 Winter	100	+0%	1/120 Winter				74.635	1.530	0.000	0.12		11.2
1.011	14	960 Winter	100	+0%	1/120 Summer				74.636	1.554	0.000	0.05		4.3

Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Status	Level Exceeded
1.000	1	FLOOD RISK	
1.001	2	FLOOD RISK	
1.002	4	FLOOD RISK	
2.000	4	FLOOD RISK	
2.001	5	FLOOD RISK	
2.002	6	FLOOD RISK	
2.003	7	FLOOD RISK	
1.003	7	FLOOD RISK	
1.004	8	FLOOD RISK	
1.005	8	FLOOD RISK	
1.006	9	FLOOD RISK	
1.007	10	FLOOD RISK	
1.008	11	FLOOD RISK	
1.009	12	FLOOD RISK	
1.010	13	SURCHARGED	
1.011	14	SURCHARGED	

Appendix B – Flood Risk Assessment

TOBIN
CONSULTING ENGINEERS
BUILT ON KNOWLEDGE

Greener Ideas

Greener Ideas Limited

Proposed Power Plant, Profile Park, West Dublin

Flood Risk Assessment

Proposed Power Plant, Profile Park, West Dublin

Flood Risk Assessment

Document Control Sheet	
Document Reference	11069-TR01 FRA Profile Park PP
Report Status	Issued
Report Date	May 2022
Current Revision	B
Client:	Greener Ideas Limited
Client Address:	C/O Centrica Business Solutions, 1 Seapoint Building, 44-45 Clontarf Road, Dublin 3, D03 F4A7
Project Number	11069

Galway Office Fairgreen House, Fairgreen Road, Galway, H91 AXK8, Ireland Tel: +353 (0)91 565 211	Dublin Office Block 10-4, Blanchardstown Corporate Park, Dublin 15, D15 X98N, Ireland Tel: +353 (0)1 803 0406	Castlebar Office Market Square, Castlebar, Mayo, F23 Y427, Ireland Tel: +353 (0)94 902 1401

Revision	Description	Author:	Date	Reviewed By:	Date	Authorised by:	Date
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B	Issued	ML	17/05/2022	BM	17/05/2022	LB	17/05/2022
TOBIN Consulting Engineers							

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Appendices

1.0 INTRODUCTION

TOBIN Consulting Engineers were appointed by Greener Ideas Limited to undertake a Flood Risk Assessment (FRA) for the construction of a new power plant at Profile Park in West Dublin.

Figure 1-1 shows the location of the subject site in Profile Park, 16km from Dublin City Centre. The 1.9ha greenfield site is relatively flat, with existing ground levels ranging from 72.88mOD along the northeastern site boundary bordering the adjacent roadway, to 76.11mOD at the southeastern site corner.

A topographical survey of the proposed development site is provided in Appendix 1.

Due to the proximity of the site to the Baldonnell Stream, a tributary of the Grifeen River, fluvial flooding was initially considered a potential source of flood risk to the proposed development.

The purpose of this report is to communicate any potential flood risks to people and future development at the site.

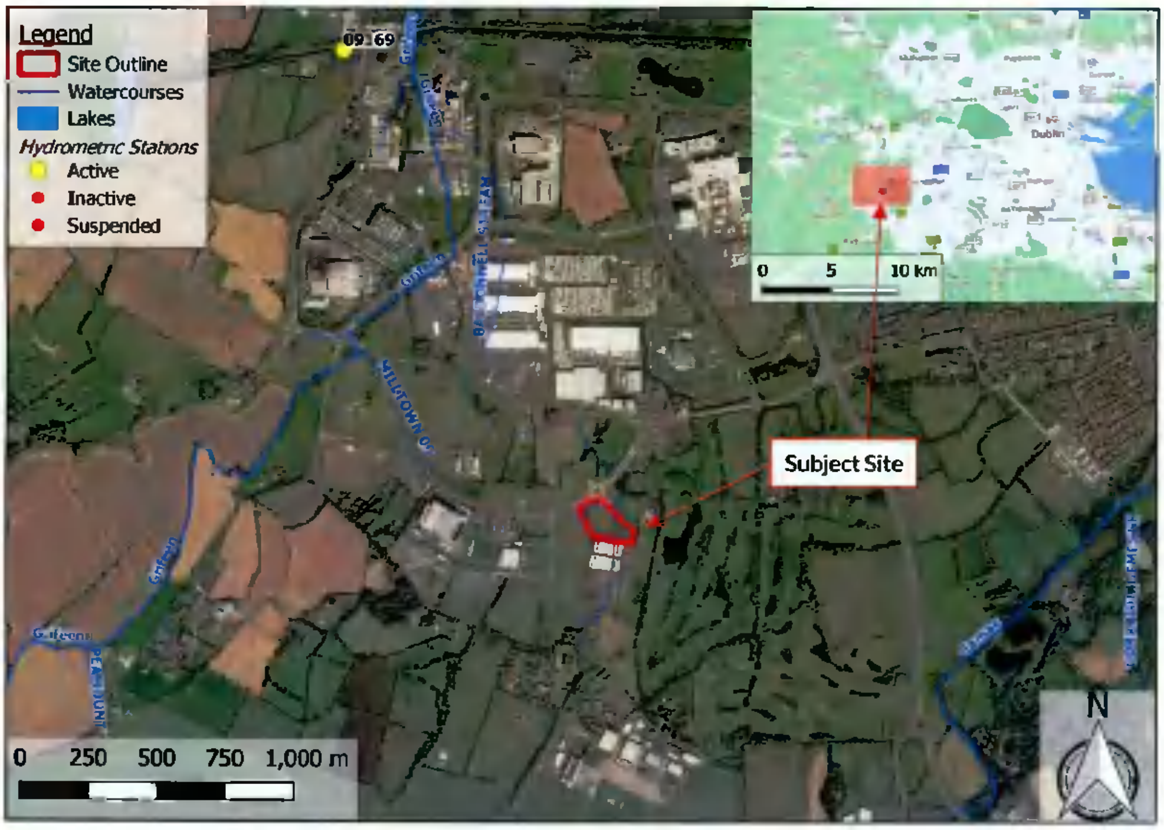

Figure 1-1 Site Location

It was noted that the Baldonnell Stream has been highly modified in the past, with much of its course upstream and downstream of the subject site being culverted. The watercourse also appears to have been rerouted to the eastern boundary; see Figure 1-2.

Figure 1-2 Baldonnell Stream

The proposed site layout (see Figure 1-3), includes grading ground elevation from existing levels (72.8mOD to 76.1mOD) to 74.0-75.0mOD, removing localised depressions, and incorporating on-site flood and stormwater storage areas.

Figure 1-3 Proposed Power Plant Layout

2.0 FLOOD RISK MANAGEMENT GUIDANCE

This Strategic Flood Risk Assessment was carried out in accordance with the following flood risk management guidance documents:

- The Planning System and Flood Risk Management Guidelines for Planning Authorities
- Flood Risk Management Climate Change Sectoral Adaptation Plan
- South Dublin County Council Development Plan & Strategic Flood Risk Assessment

2.1 The Planning System and Flood Risk Management Guidelines

The Planning System and Flood Risk Management Guidelines for Planning Authorities (PSFRM Guidelines) were published in 2009 by the Office of Public Works (OPW) and Department of the Environment, Heritage and Local Government (DoEHLG). Their aim is to ensure that flood risk is considered in development proposals and the assessment of planning applications.

2.1.1 Flood Zones and Vulnerability Classes

The PSFRM Guidelines discuss flood risk in terms of flood zones A, B, and C, which correspond to areas of high, medium, or low probability of flooding, respectively. The extents of each flood zone are based on the Annual Exceedance Probability (AEP) of various flood events.

The PSFRM Guidelines also categorise different types of development into three vulnerability classes based on their sensitivity to flooding. Power plants are considered "highly vulnerable" and are required to be operational during flooding.

Table 2-1 shows a decision matrix that indicates which types of development are appropriate in each flood zone and when the Justification Test (see Section 2.1.2) must be satisfied. The annual exceedance probabilities used to define each flood zone are also provided.

Table 2-1 Decision Matrix for Determining the Appropriateness of a Development

Flood Zone (Probability)	Annual Exceedance Probability (AEP)	Development Appropriateness		
		Highly Vulnerable	Less Vulnerable	Water Compatible
A (High)	Fluvial & Pluvial Flooding More frequent than 1% AEP	Justification Test	Justification Test	Appropriate
B (Medium)	Fluvial & Pluvial Flooding 0.1% to 1% AEP	Justification Test	Appropriate	Appropriate
C (Low)	Fluvial & Pluvial Flooding Less frequent than 0.1% AEP	Appropriate	Appropriate	Appropriate
Note: Given that coastal flooding is not a potential source of risk to the proposed development, the probabilities for coastal flooding have been omitted from this table.				

2.1.2 The Justification Test

Any proposed development being considered in an inappropriate flood zone (as determined by Table 2-1) must satisfy the criteria of the Justification Test outlined in Figure 2-1 (taken from the PSFRM Guidelines).

Box 5.1 Justification Test for development management (to be submitted by the applicant)

When considering proposals for development, which may be vulnerable to flooding, and that would generally be inappropriate as set out in Table 3.2, the following criteria must be satisfied:

1. The subject lands have been zoned or otherwise designated for the particular use or form of development in an operative development plan, which has been adopted or varied taking account of these Guidelines.
2. The proposal has been subject to an appropriate flood risk assessment that demonstrates:
   (i) The development proposed will not increase flood risk elsewhere and, if practicable, will reduce overall flood risk;
   (ii) The development proposal includes measures to minimise flood risk to people, property, the economy and the environment as far as reasonably possible;
   (iii) The development proposed includes measures to ensure that residual risks to the area and/or development can be managed to an acceptable level as regards the adequacy of existing flood protection measures or the design, implementation and funding of any future flood risk management measures and provisions for emergency services access; and
   (iv) The development proposed addresses the above in a manner that is also compatible with the achievement of wider planning objectives in relation to development of good urban design and vibrant and active streetscapes.

The acceptability or otherwise of levels of residual risk should be made with consideration of the type and foreseen use of the development and the local development context.

Note: See section 5.27 in relation to major development on zoned lands where sequential approach has not been applied in the operative development plan.

Refer to section 5.28 in relation to minor and infill developments.

Figure 2-1 Criteria of the Justification Test

2.2 The Flood Risk Management Climate Change Adaptation Plan

The Flood Risk Management Climate Change Sectoral Adaptation Plan was published in 2019 under the National Adaptation Framework and Climate Action Plan. This plan outlines the OPW's approach to climate change adaptation in terms of flood risk management.

This approach is based on a current understanding of the potential impacts of climate change on flooding and flood risk. Research has shown that climate change is likely to worsen flooding through more extreme rainfall patterns, more severe river flows, and rising mean sea levels.

To account for these changes, the Adaptation Plan presents two future flood risk scenarios to consider when assessing flood risk:

- Mid-Range Future Scenario (MRFS)
- High-End Future Scenario (HEFS)

Table 2-2 indicates the allowances that should be added to estimates of extreme rainfall depths, peak flood flows, and mean sea levels for the future scenarios.

Table 2-2 Climate Change Adaptation Allowances for Future Flood Risk Scenarios

Parameter	Mid-Range Future Scenario (MRFS)	High-End Future Scenario (HEFS)
Extreme Rainfall Depths	+ 20%	+ 30%
Peak River Flood Flows	+ 20%	+ 30%
Mean Sea Level Rise	+ 0.5 m	+ 1 m

2.3 South Dublin County Council Development Plan 2016-2022

The current South Dublin County Council Development Plan provides a strategic framework for planning and sustainable development in South Dublin for 2016 to 2022. Chapter 7 outlines South Dublin County Council's strategy for the management of Infrastructure & Environmental Quality, with Section 7.3 outlining the Council's approach to Flood Risk Management, presenting four key objectives:

INFRASTRUCTURE & ENVIRONMENTAL QUALITY (IE) Policy 3 Flood Risk

It is the policy of the Council to continue to incorporate Flood Risk Management into the spatial planning of the County, to meet the requirements of the EU Floods Directive and the EU Water Framework Directive.

IE3 Objective 1:

To support and co-operate with the Office of Public Works in delivering the Catchment Based Flood Risk Assessment and Management Programme and in particular the Eastern District CFRAMS and associated Flood Risk Management Plan (FRMP), the River Dodder CFRAMS and associated Flood Risk Management Plan (FRMP). The recommendations and outputs arising from the CFRAM study for the Eastern District shall be considered in preparing plans and assessing development proposals.

IE3 Objective 2:

To support the implementation of the EU Flood Risk Directive (2007/60/EC) on the assessment and management of flood risks and the Flood Risk Regulations (SI No 122 of 2010).

IE3 Objective 3:

To manage flood risk in the County in accordance with the requirements of The Planning System and Flood Risk Management Guidelines for Planning Authorities, DECLG and OPW (2009) and Circular PL02/2014 (August 2014), in particular when preparing plans and programmes and assessing development proposals. For lands identified as being at risk of flooding in (but not limited to) the Strategic Flood Risk Assessment, a site-specific Flood Risk Assessment to an appropriate level of detail, addressing all potential sources of flood risk, is required, demonstrating compliance with the aforementioned Guidelines or any updated version of these Guidelines, paying particular attention to residual flood risks and any proposed site specific flood management measures.

IE3 Objective 4:

To support and facilitate the delivery of flood alleviation schemes in South Dublin County, including the following schemes:

- Poddle Flood Alleviation Scheme
- Ballycullen Flood Alleviation Scheme
- Whitechurch River Flood Alleviation Scheme (at Rathfarnham), part of the Dodder CFRAMS

IE3 SLO 1:

To require the preparation of a site and catchment specific Flood Risk Assessment and Mitigation Strategy, prepared by a qualified person(s), to be submitted with any proposal for development on the 'EE' zoned lands and demonstration that the development satisfies all the criteria of the Development Management Justification Test as set out in Table 2.3 of the document titled 'Strategic Flood Risk Assessment for SDCC Development Plan - Detailed Report on Flood Risk in the Baldonnell Area'.

South Dublin County Council Development Plan mapping identifies the subject site within the Department of Defence Inner Zone[1], and within the area zoned under Objective E—to provide for enterprise and employment related uses[2].

[1] South Dublin County Council Development Plan, Index Map

[2] South Dublin County Council Development Plan, Map 4

2.3.1 Strategic Flood Risk Assessment for South Dublin County Council Development Plan 2016-2022

In June 2016, a Strategic Environmental Assessment (SEA) Environmental Report was published, assessing the likely effects of implementing the South Dublin County Council Development Plan on the environment. In support of this assessment, a Strategic Flood Risk Assessment (SFRA) was published in January 2016 under the requirements of The Planning System and Flood Risk Assessment Guidelines for Planning Authorities (2009) and Circular PL02/2014 (August 2014).

This SFRA includes requirements for development proposals in flood zones (Section 4.4), including the assessment of proposals for highly vulnerable developments (Section 4.4.3):

Highly vulnerable development proposals should not be considered in flood risk areas. Any applications for Highly Vulnerable Development shall be supplemented by an appropriately detailed FRA and meets the criteria of the Development Management Justification Test. The following considerations should be addressed in applications for highly vulnerable development in flood risk areas:

- *The minimum finished floor level for highly vulnerable development should be above the Flood Zone B (0.1% AEP) level plus suitable freeboard. The recommended level of freeboard is 500 mm for fluvial flood levels.*
- *Applications should outline the emergency procedures that will be applied in the event of a flood. Evacuation routes should be identified but if this is not possible then containment may be considered if is considered safe and practical to do so. If either safe evacuation or containment is not possible, then the development proposal should be refused.*
- *The site layout should follow the sequential approach to allocate land within a development based on the vulnerability class of the development i.e. more vulnerable development should be placed on higher ground while water compatible development e.g. car parking, greenfield space can placed in the flood zones.*
- *Compensatory storage for development that results in a loss of floodplain within Flood Zone A must be provided on a level for level basis, the lands should be in close proximity to the area that storage is being lost from, the land must be within the ownership of the developer and the land given to storage must be land which does not flood in the 1% AEP event. Also the compensatory storage area should be constructed before land is raised to facilitate development.*

Due to the nature of the proposed power plant as essential infrastructure, it is accordingly considered "Highly Vulnerable", whereby this assessment must be applied.

<u>Coastal Flooding</u>

Section 5.8.2 of the SFRA evaluates the risk of coastal flooding in South Dublin, referencing the landlocked nature of the county and Irish Coastal Protection Strategy Study (ICPSS) results to conclude coastal flooding is not a concern for the plan area. Further, any outstanding risk from "*a combination of high flow in rivers and a high tide [preventing] the river from discharging into the sea thus increasing water levels inland causing rivers to overtop their banks*" has been accounted for in the "*CFRAM mapping using joint probability analysis, hence any impact coastal influences may have upstream along the Dodder and the Liffey are accounted for in the mapping*".

Groundwater Flooding

Section 5.8.3 of the SFRA discusses groundwater flooding within the plan area. The report notes that "*The OPW Preliminary Flood Risk Assessments Groundwater Flooding Report concludes that ground water flooding is largely confined to the West Coast of Ireland due to the hydrogeology of the area*", concluding "*ground water flooding is not a risk for South Dublin County*".

Pluvial Flooding

The SFRA identifies pluvial and fluvial flooding as the primary concerns for the South Dublin plan area. Figure 2-2 shows OPW indicative pluvial flood mapping in the vicinity of the subject site, as presented in the SFRA. This mapping indicates a portion of the adjacent road to the northwest is liable to 0.1% AEP pluvial flooding.

The SFRA does not indicate any pluvial flooding within the bounds of the proposed development.

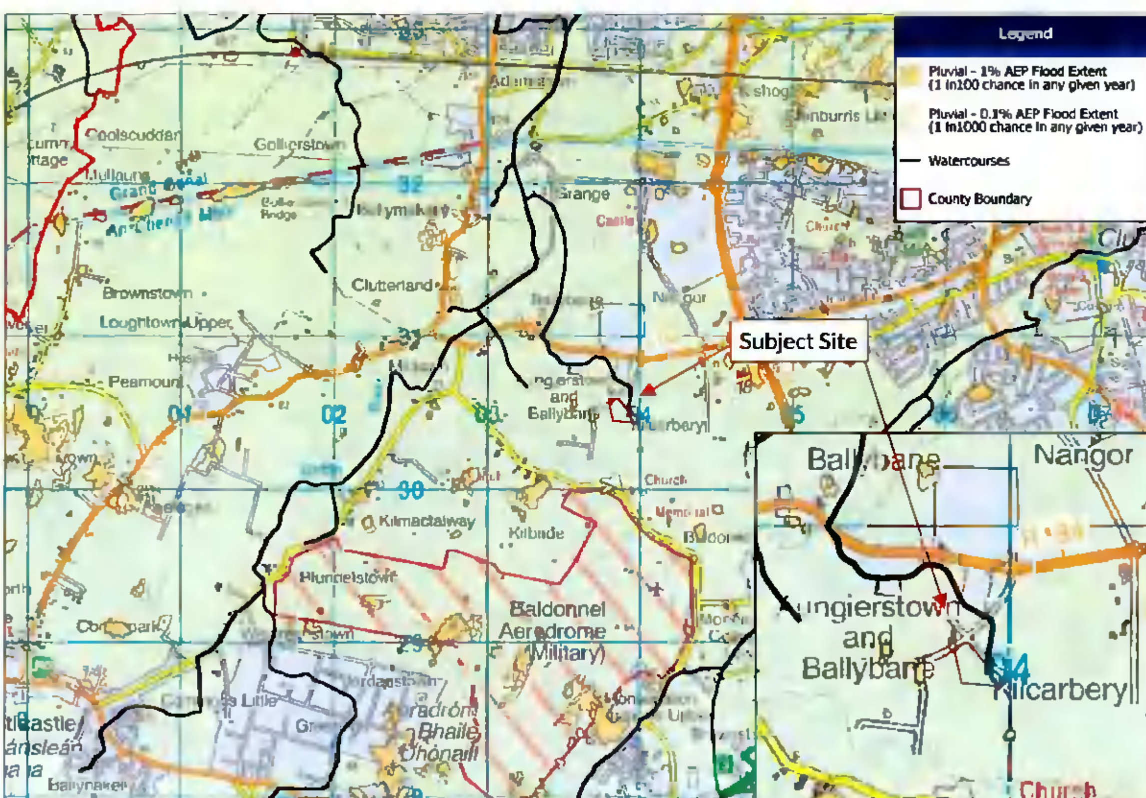

Figure 2-2 Excerpt of South Dublin County Council Strategic Flood Risk Assessment PFRA Indicative Pluvial Flood Zone Mapping, Figure MDW0657_0027 (14 January 2016)

Fluvial Flooding

SFRA fluvial flood zone mapping is based upon the Eastern Catchment Flood Risk Assessment and Management (CFRAM) Study and the River Dodder CFRAM Study fluvial flood extents, further discussed in Section 3.3. The SFRA notes all the principal watercourses and notable streams in South Dublin County are accounted for by this modelling, and historical flood risk information has been incorporated.

Figure 2-3 shows an excerpt of SFRA fluvial flood zone mapping for the area. This mapping indicates portions of the site may be liable during a 0.1% AEP fluvial or pluvial flood event, and is therefore located in Flood Zone B.

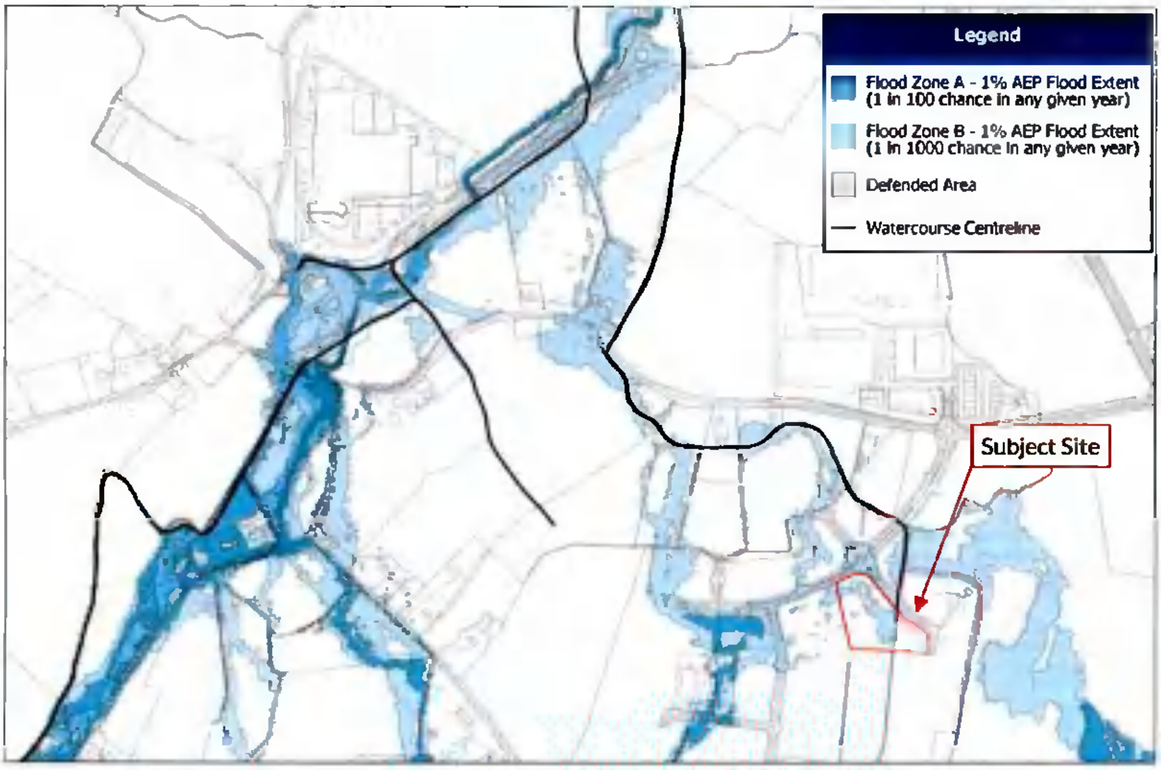

Figure 2-3 Excerpt of South Dublin County Council Strategic Flood Risk Assessment, Fluvial Flood Zone Mapping, Figure MDW657_0004 (14 January 2016)

2.3.2 Strategic Flood Risk Assessment for South Dublin County Council Development Plan 2016-2022

The 2022-2028 South Dublin County Council Development Plan is currently in draft, with final amendments being made and the plan to come into effect no later than 12th August 2022.

3.0 INITIAL FLOOD RISK ASESSMENT

3.1 Past Flood Events

The OPW's National Flood Information Portal[3] provides past flood event mapping with records of flooding reports, meeting minutes, photos, and/or hydrometric data.

Based on the flood map shown in Figure 3-1, no historical flooding has been recorded within 1km of the subject site. Historic flooding was recorded approximately 1.2km northwest of the proposed development site (Flood ID: 3320—Peamount R134 R120 junction Nov 2000). A South Dublin County Council report noted significant rainfall was experienced on 5th and 6th November 2000, with serious flooding experienced in the Griffeen Catchment area[4].

No recurring flooding has been identified at the proposed development site.

Figure 3-1 OPW Flood Map of Past Flood Events

[3] floodinfo.ie

[4] South Dublin County Council Report on Flooding 5th & 6th November, 2000

3.2 OPW Preliminary Flood Risk Assessment (PFRA) Study

In 2009, the OPW produced a series of maps to assist in the development of a broad-scale FRA throughout Ireland. These maps were produced from several sources.

The OPW's National Preliminary Flood Risk Assessment (PFRA) Overview Report from March 2012 noted that *"the flood extents shown on these maps are based on broad-scale simple analysis and may not be accurate for a specific location"*[5].

Limitations on potential sources of error associated with the PFRA maps include:

- Assumed channel capacity (due to absence of channel survey information)
- Absence of flood defences and other drainage improvements and channel structures (bridges, weirs, culverts)
- Local errors in the national Digital Terrain Model (DTM)

Figure 3-2 Indicative Flood Mapping from OPW PFRA Study

Modelling of the Baldonnell Stream does not extend to the subject site, and results indicate the site is not liable to flooding from neighbouring watercourses.

Improved hydraulic modelling was carried out through the Catchment Flood Risk Assessment and Management Study (CFRAM) in 2015 (discussed in Section 3.2) and is considered more accurate than the PFRA study as it utilised surveyed river geometry and was subject to greater model calibration.

[5] The National Preliminary Flood Risk Assessment (PFRA) Overview Report, OPW (March 2012)

3.3 Catchment Flood Risk Assessment and Management Study

In 2015, the OPW produced flood maps[1] as part of the Catchment Flood Risk Assessment and Management (CFRAM) Study. The flood extents in these maps are based on detailed modelling of Areas for Further Assessment identified by the National Preliminary Flood Risk Assessment.

As shown in Figure 3-3, the CFRAM study indicates that a portion of the site may be at risk from fluvial flooding during a 1-in-1000-year (0.1% AEP) event.

Based on a review of the CFRAM hydraulics report[6], the Camac and Grifeen Rivers were both surveyed and modelled. The Baldonnell Stream, however, does not appear to have been modelled explicitly. While the flood mapping indicates some flooding along its course, this is the result of overland spill from the Camac across the model's 2D domain (5m cell size). The additional capacity of the stream channel and culverts (not rectified in the terrain model) would likely alleviate some of this flooding.

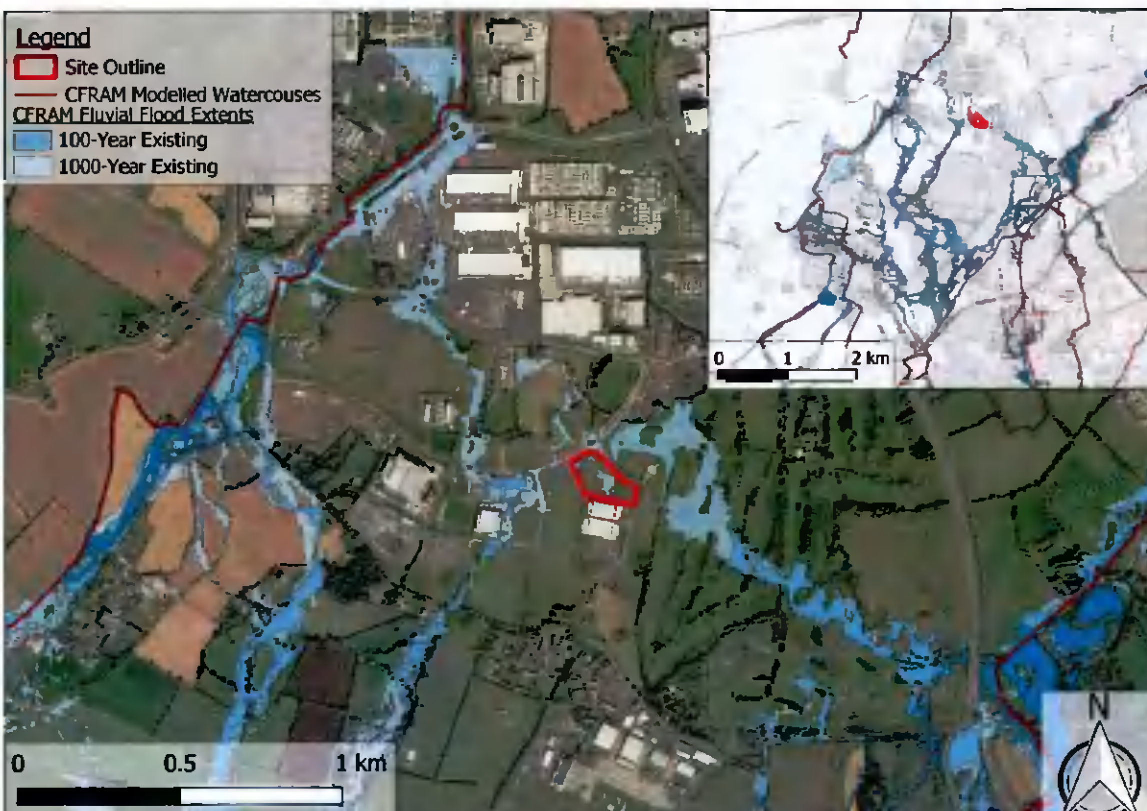

Figure 3-3 CFRAM Current Fluvial Model and Flood Extents in Vicinity of Subject Site

The Eastern CFRAM study also included an assessment of the likely impact of climate change on flood risk in the area. The flood extents for a Mid-Range Future Scenario are shown in Figure 3-4. Based on the findings of the study the proposed power plant is liable to fluvial flooding during a 0.1% AEP MRFS fluvial flood event.

As noted previously, some of this flooding will be alleviated by local drainage channels and culverts (including the Baldonnell Stream) which were not considered in the CFRAM study.

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[6] Eastern CFRAM UoM09 Hydraulics Report (9th August 2017)

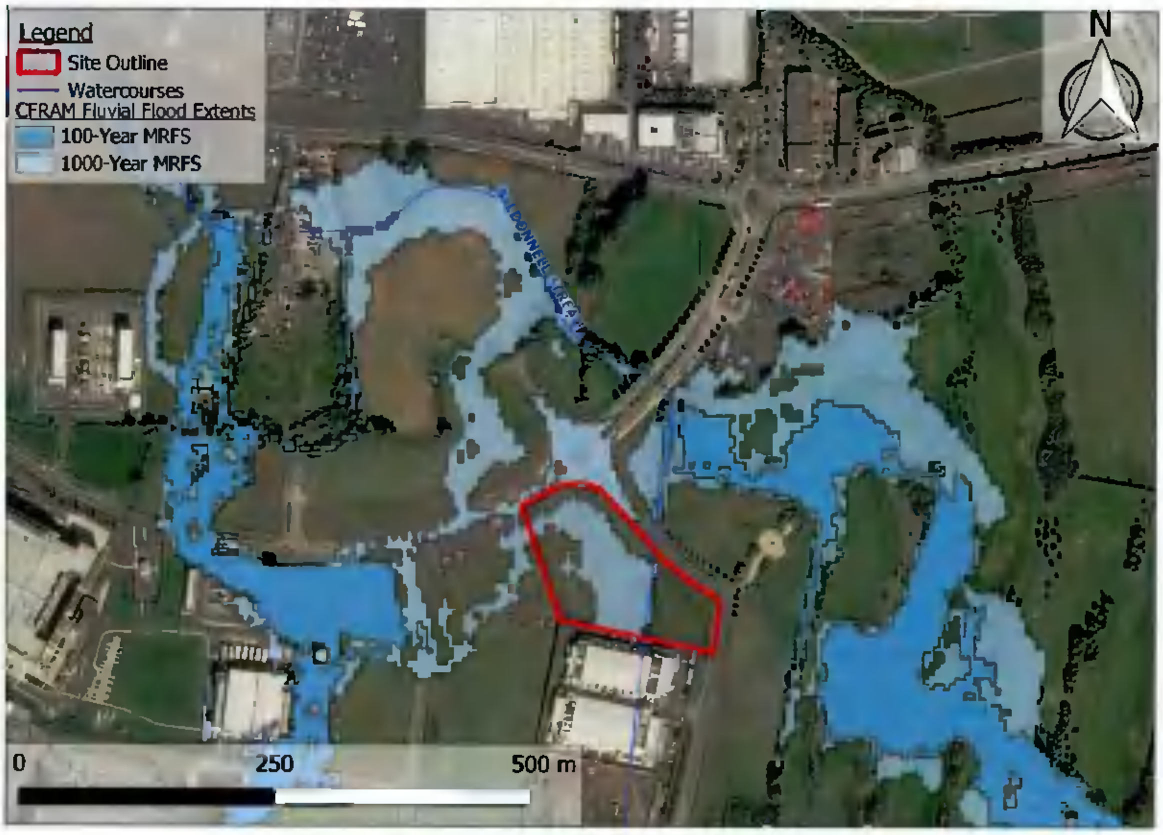

Figure 3-4 CFRAM MRFS Fluvial Flood Extents

3.4 Geological Survey Ireland Mapping

The Geological Survey Ireland (GSI) provides mapping[7] with data related to Ireland's subsurface. Based on the map shown in Figure 3-5, there are no karst features (caves, springs, turloughs, etc.) in the surrounding 1km area. The St. Columbs Well (spring) is located approximately 6.7km northwest of the subject site, and is the nearest karst feature.

Therefore, the subject site is not estimated to be at risk of groundwater flooding.

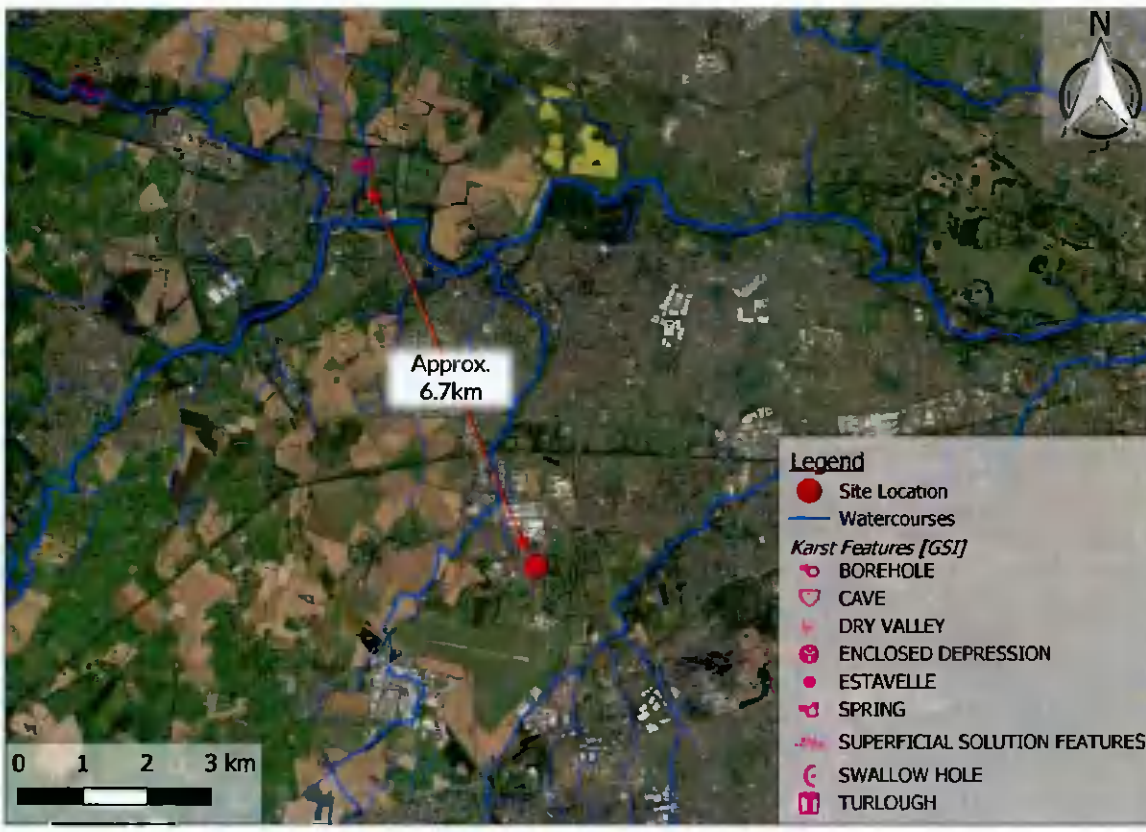

Figure 3-5 GSI Mapping of Karst Features

[7] https://www.gsi.ie/en-ie/data-and-maps/Pages/default.aspx

4.0 SITE SPECIFIC HYDRAULIC ANALYSIS

Due to the proximity of the Baldonnell Stream to the proposed development, and the potential for fluvial flood risk highlighted by the Eastern CFRAM study, a site-specific hydraulic assessment was required.

4.1 Flow Estimation

As shown in Figure 1-1, the natural course of the Baldonnell Stream passed through the subject site. This stream appears to have been rerouted to the eastern boundary of the site, likely as part of the development immediately upstream.

The catchment area for the stream at the subject site was estimated at 0.86 km^2 based on the OPW's FSU dataset and the topography of the area. See Figure 4-1.

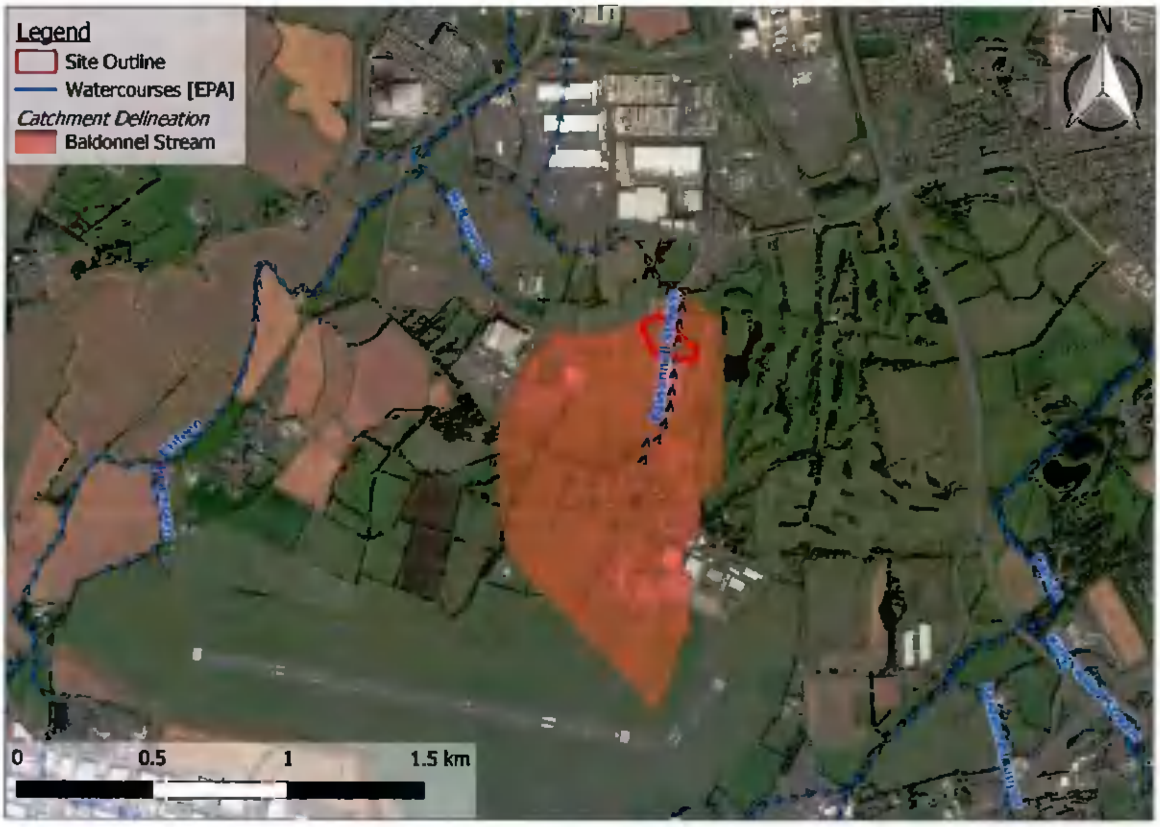

Figure 4-1 Catchment Delineation

The 100- and 1000-year flow in the watercourse was estimated based on catchment descriptors, see Table 4-1. Four different methodologies were considered:

- Flood Studies Update (FSU) method
- The Centre for Ecology and Hydrology Flood Estimation Handbook (FEH) method
- The Institute of Hydrology Report No. 124 (IH124) method
- The Modified Rational Method (MRM)

Table 4-1 Summary of Catchment Descriptors

Descriptor	Units	Baldonnell Stream	Source
Catchment	-	Liffey	EPA
Catchment Area	km^2	0.864	FSU/TOBIN
Method applicability			
FSU	-	NO	
FEH	-	YES	
IH124	-	YES	
MRM	-	YES	
Catchment Descriptors			
BFI_{SOIL}	-	0.520	FSU
SAAR	mm	714.82	FSU/MET
FARL	-	1.000	FSU
DRAIND	km/km^2	0.721	FSU
S1085	m/km	0.100	FSU/DEM
ARTDRAIN2	-	0.200	FSU
URBEXT	-	0.359	FSU
S1		0	WRAP
S2		1	WRAP
S3		0	WRAP
S4		0	WRAP
S5		0	WRAP
i_{10}	mm/hr	21.40	MET
i_{100}	mm/hr	43.20	MET
i_{1000}	mm/hr	76.60	MET
CWI	-	90.0	graph
URBAN	fraction	0.10	user
UCWI (winter)	-	133.5	graph

EV1 growth factors (1.90 and 2.41 as defined by the FSR for the East) were applied to the estimation of Q_{bar} to predict the 100- and 1000-year flows, respectively.

In accordance with the Climate Change Sectorial Adaption Plan, the proposed development was assessed against a Mid-Range-Future-Scenario (MRFS) which includes a 20% increase in flow.

The largest flows from each methodology were compared, and the largest was conservatively adopted as the design flow. See Table 4-2.

Table 4-2 Estimated Flows

Description	Units	Value
Method adopted	-	MRM
100-year Flow	m^3/s	0.74
1000-year Flow	m^3/s	1.32
100-year MRFS Flow	**m^3/s**	**0.89**
1000-year MRFS Flow	**m^3/s**	**1.58**

4.2 Hydraulic Model Construction

A site-specific hydraulic model of the site area was developed using the latest version (5.0.7) of the Hydraulic Engineering Centre's River Analysis System (HEC-RAS) software. HEC-RAS is designed to perform one-dimensional hydraulic calculations for a full network of natural and constructed channels. The three primary inputs into the HEC-RAS model are summarised below:

- Geometric Data: Cross-sectional survey of watercourse, culverts and bridges
- Inflow Data: 100 and 1,000 year existing and MRFS design flows
- Boundary Data: Normal depth downstream boundary

An overview of the hydraulic model is shown in Figure 4-2.

Figure 4-2 HEC-RAS Model Configuration

The Baldonnell Stream channel and floodplain in the vicinity of the proposed site were surveyed by TOBIN in March 2021. The hydraulic model includes two existing watercourse crossing structures: a 1.1m diameter circular culvert located directly adjacent to the subject site, and two 1.4m dia. circular culvert barrels conveying the watercourse beneath Profile Park Road to the north, approximately 150m downstream.

Conservative roughness values of 0.04 and 0.06 were applied to the channel and floodplain, respectively, based on a review of site photography and channel conditions.

The model was used to run four unsteady flow scenarios: the 100-year and 1000-year floods, with and without climate change. These events were simulated over a 3-day duration with 1-minute computational timesteps. The results of the hydraulic modelling are given in Section 4.3.

4.3 Hydraulic Model Results

Modelling of the Baldonnell Stream in the vicinity of the subject site indicates the watercourse is not predicted to burst its banks under existing flow conditions. As such, the subject site is not estimated to be liable to flooding for the current 0.1% AEP fluvial flood event, and is located in Flood Zone C.

Figure 4-3 shows the 100- and 1000-year water surface levels estimated in the Baldonnell Stream using the hydraulic model.

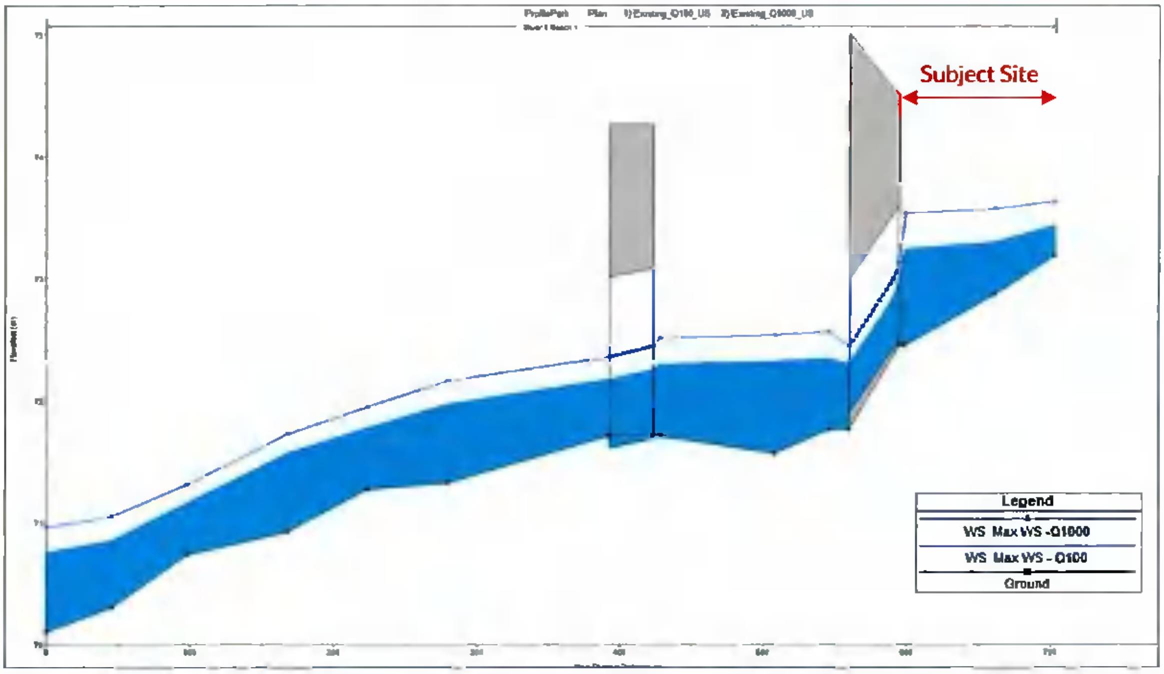

Figure 4-3 Predicted Maximum Water Surface Elevation [100- & 1000- Year without climate change]

In accordance with the Climate Change Sectorial Adaption Plan, the proposed development was also assessed against a Mid-Range-Future-Scenario (MRFS) which includes a 20% increase in flow.

The water surface level for the 0.1% AEP MRFS fluvial event is estimated at 73.66mOD, while existing ground elevations at the subject site range from approximately 72.8mOD to 76.1mOD. Figure 4-4 shows the 1000-year MRFS flood extents estimated in the vicinity of the subject site using the hydraulic model.

Based on the results of the hydraulic model, it is estimated that a part of the site may be liable to flooding during the 1000-year MRFS scenario due to surcharging of the adjacent culvert.

Figure 4-4 Predicted 1000- Year MRFS Fluvial Flood Extent

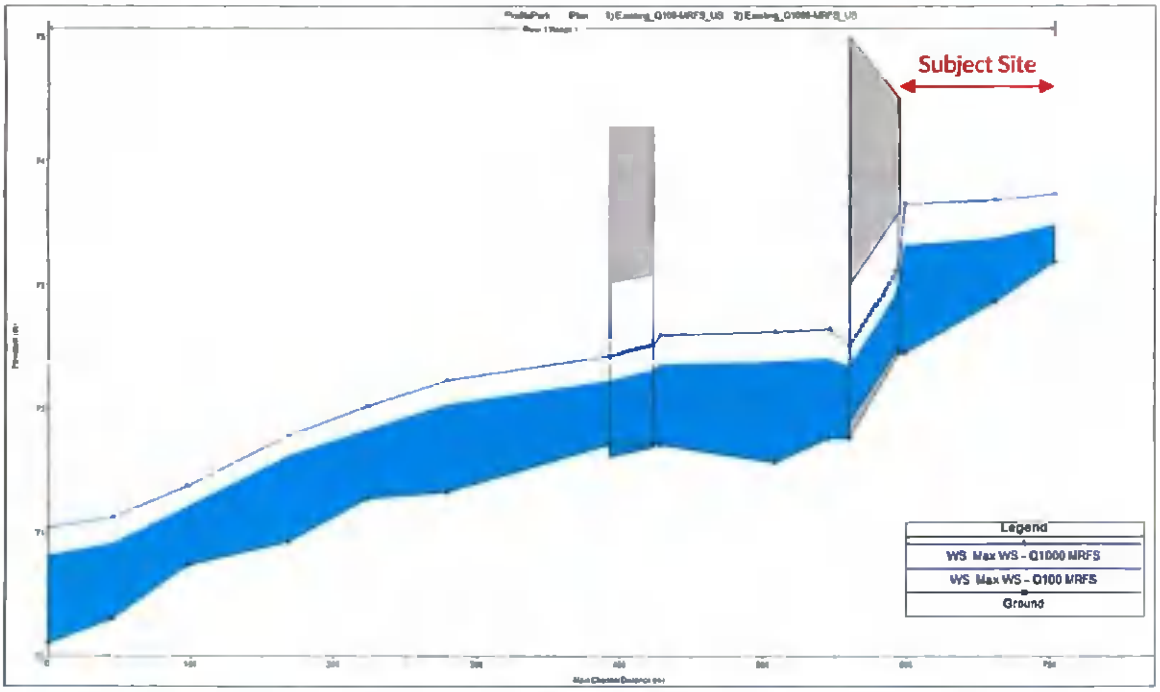

Figure 4-5 Predicted Maximum Water Surface Elevation [100- & 1000- Year MRFS]

4.4 Flood Mitigation Strategy

4.4.1 Site Grading

As part of the power plant development, it is proposed to raise ground levels to 74.0mOD or higher. This provides 0.34m of freeboard above the 0.1% AEP MRFS flood levels predicted by site-specific hydraulic modelling.

The hydraulic model was updated to assess the impact of raising ground levels on floodplain storage and flood risk elsewhere.

Based on the results of the hydraulic analysis, it is predicted that increasing site elevations increase water levels up to 0.005m at the subject site during a 1000-year MRFS event, see Figure 4-6. It is estimated that the effects of this will be imperceptible elsewhere in the catchment, where downstream impacts of proposed flood mitigation works are considered negligible due to the existing downstream constraint of the adjacent 1.1m diameter culvert

As there is no flooding predicted on site for the existing 1000-year event, or events of lower magnitude, site grading will have no impact on floodplain storage or flood risk elsewhere in these scenarios.

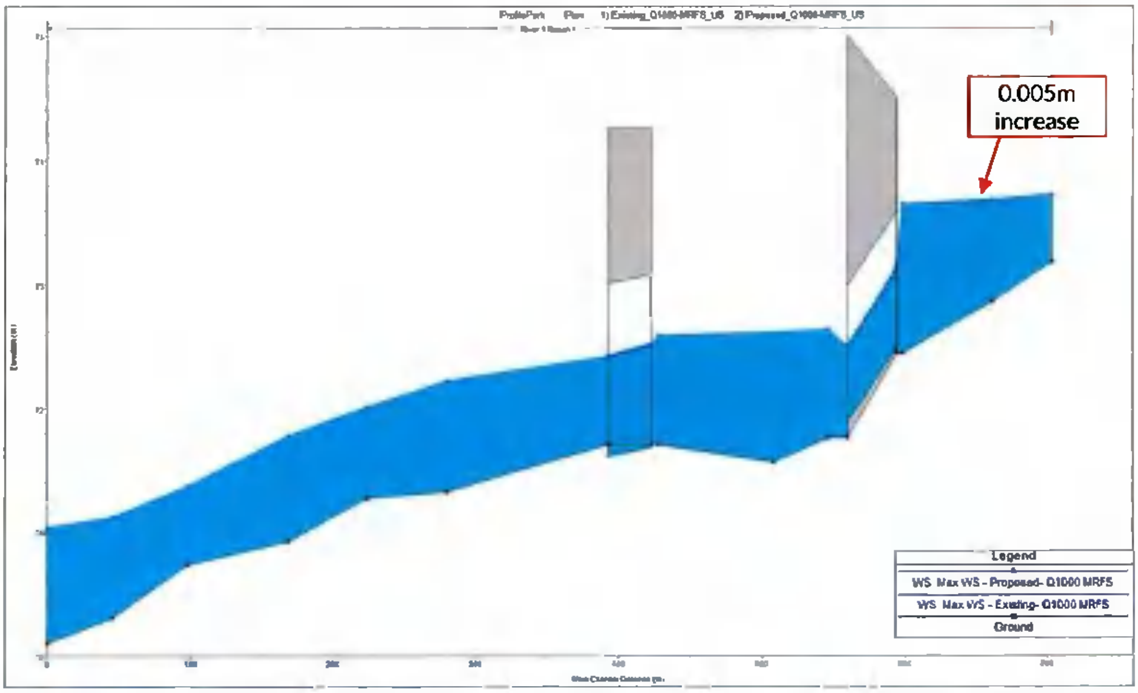

Figure 4-6 Predicted Maximum Water Surface Elevation with Site Regrading [1000- Year MRFS Existing and Proposed]

4.4.2 Compensation Storage

The proposed site regrading will remove the proposed development from the 0.1% AEP MRFS fluvial flood extents; based on existing and proposed site topography and the design flood level of 73.66mOD, approximately 803m^3 of floodplain storage is predicted to be displaced by the proposed site regrading.

The PSFRM Guidelines classify compensatory flood storage into Direct and Indirect methods, where Direct methods are preferred and "*re-grade land and provide a direct replacement for the lost storage volume*"[8], while Indirect methods *"rely on water entering a defined storage area which then releases it at a slower rate"*.

As per Figure XX-XX, direct, volumetric compensation flood storage is provided within the subject site through the design of a grassed flood storage area to provide open attenuation on site. The proposed storage area provides 1034m^3 of floodplain storage, introducing an additional 231m^3 within the subject site and reducing overall flood risk. Care has been taken in the design of compensatory flood storage to ensure connectivity with the floodplain, maintenance of existing channel banks, and efficacy of the proposed drainage system.

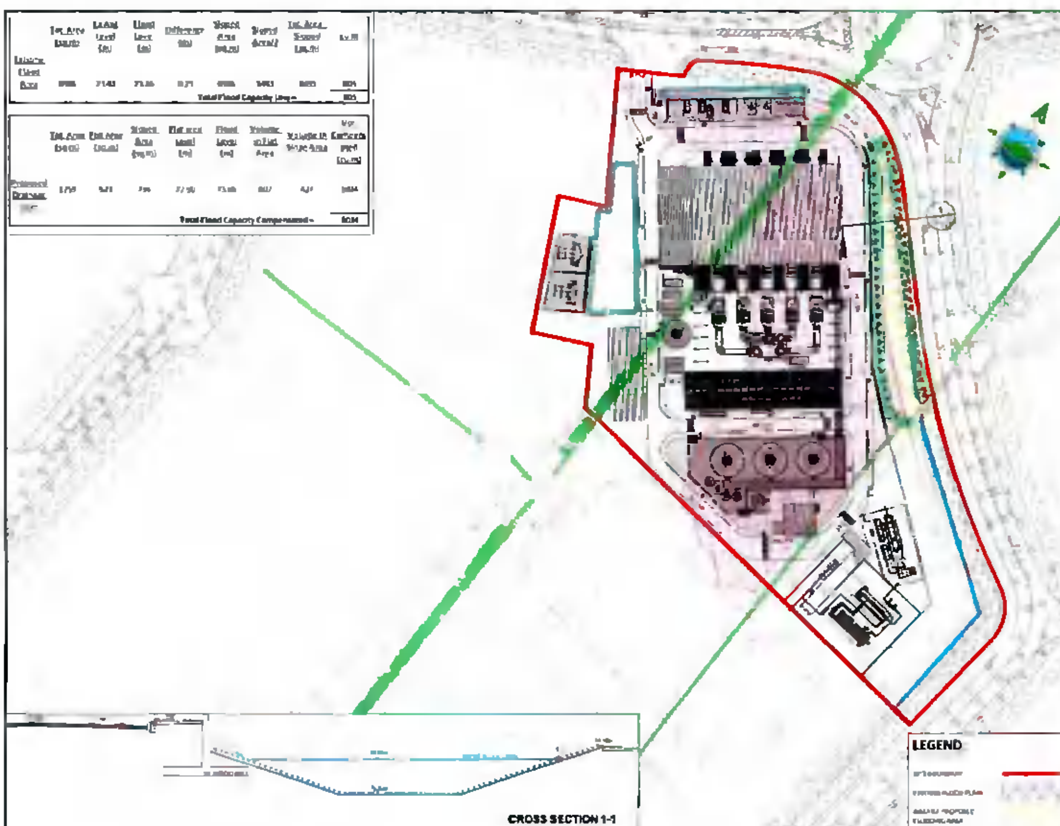

Figure 4-7 Proposed Direct Flood Compensation

The hydraulic model was updated to assess the impact of the provision of floodplain storage on flood risk elsewhere.

Based on the design of the site and results of hydraulic analysis, it is predicted that the proposed site grading and compensation storage will maintain the hydraulic regime of the stream, constraining flows to the banks and leaving water levels unchanged in the existing 1000-year events. In the 1000-year MRFS event, flows will spill over the maintained channel bank, filling the dedicated flood storage area, while constraining flood flows away from the proposed vulnerable areas and access routes.

[8] The Planning System and Flood Risk Management Guidelines for Planning Authorities, Technical Appendices, OPW (November 2009)

Based on the results of hydraulic analysis, the dedicated flood storage will provide a benefit to flood risk on site and elsewhere, reducing maximum water surface elevations by up to 0.061m.

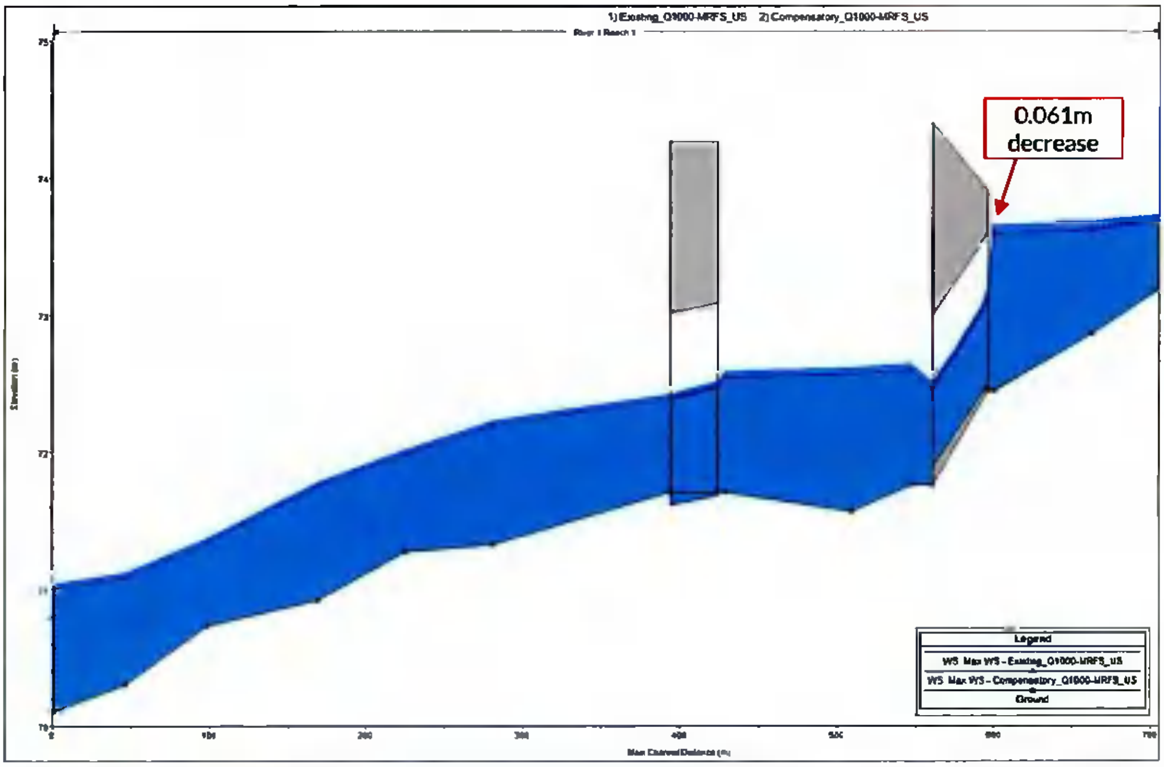

Figure 4-8 Predicted Maximum Water Surface Elevation with Compensation Storage [1000-Year MRFS Existing and Proposed]

5.0 DETAILED FLOOD RISK ASESSMENT

The PSFRM Guidelines classify power plants as "essential infrastructure", and therefore "highly vulnerable" in terms of sensitivity to flooding. Such facilities are required to be operational during a flood event. As such, the proposed development should be constructed in flood zone C—where there is less than a 0.1% Annual Exceedance Probability (AEP) of pluvial and fluvial flooding—or assessed under the PSFRM Justification Test (see Section 2.1.2).

A Mid-Range Future Scenario (MRFS) has also been considered as part of this assessment to allow for the likely effects of climate change.

5.1 Pluvial Flooding

Previous flood studies which covered the area (OPW PFRA and South Dublin SFRA) indicated that the proposed development site is not at risk of pluvial flooding (see Figure 2-2).

Existing ground elevations at the subject site vary from 72.88mOd to 76.11mOD. The topographic survey indicates that there is a depression adjacent to the culvert inlet, below predicted flood levels in which pluvial flooding/ponding may occur, as evidenced by CFRAM study (Figure 3-3 and Figure 3-4).

Minor ponding (depths <200mm) was observed in depression during site visits, see Figure 5-1.

This pluvial ponding will be managed by the proposed drainage system, in conjunction with site regrading (proposed ground elevations 74-75mOD).

Figure 5-1 Site Photo of Ponding at Localised Depression (25 January 2021)

The landscaping and topography of the developed site will provide safe exceedance flow paths and prevent surface water ponding to minimise residual risks associated with an extreme flood event or a scenario where the stormwater drainage system becomes blocked.

Surface water arising at the site will be managed by a dedicated stormwater drainage system designed in accordance with Sustainable Drainage Systems (SuDS) principles, limiting discharge from the site to greenfield runoff rates.

Therefore, the proposed development at the site is not estimated to be at risk of pluvial flooding.

5.2 Groundwater Flooding

Based on Geological Survey Ireland (GSI) subsurface mapping, there are no karst features (caves, springs, turloughs, etc.) of concern to the proposed site location (see Figure 3-5).

Further, the South Dublin County SFRA notes that "*ground water flooding is not a risk for South Dublin County*".

Therefore, the proposed development at the site is not estimated to be at risk of groundwater flooding.

5.3 Coastal Flooding

The proposed site in Profile Park is located inland, over 15km from the sea. The subject site (existing ground levels 72.8mOD or higher) is over 69m above the nearest 0.1% AEP MRFS coastal flood level estimated by the Eastern CFRAM study at Merrion (approx. 3.3mOD)[9].

Further, based on previous flood studies for the area (OPW PFRA, ICPSS, Eastern CFRAM, and South Dublin SFRA), the proposed development site is not at risk of coastal flooding.

5.4 Fluvial Flooding

The River Grifeen flows through the area of the proposed development, with several small tributaries flowing to the main watercourse, including the Baldonnell Stream which runs through the subject site. There are no historical flood reports in the vicinity of the subject site.

The Eastern CFRAM study includes models of the Camac and Grifeen Rivers; however, the Baldonnell Stream has not been explicitly modelled. CFRAM modelling notes that the site may liable to the 0.1% AEP fluvial flood event (see Figure 3-3) as a result of an overland spill from the Camac River, without accounting for the capacity of the Baldonnel Stream or other local drainage channels.

Site-specific hydraulic modelling was carried out by TOBIN to quantify the risk of flooding associated with the proposed development, and the Baldonnell Stream.

Based on the initial findings of the study, the subject site is liable to fluvial flooding in an extreme 0.1% AEP MRFS event (see Figure 4-4); however, the Baldonnell Stream is confined to its banks in an existing 0.1% AEP and 1% AEP MRFS event.

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[9] Eastern CFRAM Study, Map No. E09SAN_EXCCD_F2_02 (14 November 2017)

Proposed site elevations (≥74.0mOD) provide more than 0.3m freeboard above the predicted 0.1% AEP MRFS flood level (73.66mOD), removing the proposed development from the floodplain, and has imperceptible impacts on flood risk upstream/downstream of the subject site. Proposed infrastructure and access routes are elevated (FFL of 74.8mOD) to provide more than 1m freeboard above the predicted 0.1% AEP MRFS flood level at the site.

Based on the findings of site-specific hydraulic modelling, it is estimated that the risk of fluvial flooding associated with the development is minimal when accounting for proposed site elevations; however, under unimproved conditions and a MRFS, the site is estimated to be at risk of fluvial flooding in the 0.1% AEP MRFS event.

Accordingly, the site has been assessed under the PSFRM Justification Test to assess suitability.

5.5 Impact of the Development Elsewhere

It is predicted that the proposed development is not at risk of flooding during a 100-year MRFS. Therefore, the development will not affect floodplain storage or obstruct the flow path of any existing watercourses.

Hydraulic modelling demonstrates an imperceptible impact on flood levels upstream/downstream in a 1000-year MRFS fluvial event. Flows from the subject site are limited by the adjacent 1.1m diameter culvert, whereby in conjunction with the provision of compensatory storage, it is therefore predicted the proposed development will not impact flood risk elsewhere in the catchment, and decreases flood risk to the subject site.

A flood compensation strategy is proposed to mitigate increased flood risk elsewhere associated with decreased floodplain storage where the proposed flood defence restricts flows.

Surface water arising from within the site will be managed by an on-site storm water drainage system and on-site attenuation. On this basis, it is predicted that the proposed power plant will not contribute to flood risk elsewhere in the area.

5.6 The Justification Test

The PSFRM Guidelines classify power plants and essential infrastructure as "highly vulnerable", in terms of sensitivity to flooding. As such, the proposed development should be constructed in Flood Zone C—where there is less than a 0.1% Annual Exceedance Probability (AEP) of flooding, including added allowances for a Mid-Range Future Scenario (MRFS) to account for the likely effects of climate change on extreme rainfall depths and peak flood flows—or assessed for suitability through the Justification Test.

As outlined in Figure 4-4, portions of the subject site are within Flood Zone B. Accordingly, the proposed development has been assessed against the criteria of the Justification Test (see Figure 2-1):

1. The site is zoned for enterprise and employment related uses, and is therefore considered suitable for the proposed development.
2. The site has been subject to this detailed FRA, which demonstrates:
    - (i) The proposed development is not predicted to have an impact on flood risk elsewhere in the locality (see Section 5.5).
    - (ii) It is predicted that the proposed development will not impede the flow of surface water during extreme flood events. The layout of the development will minimise the flood risk to people, property, the economy, and the environment.

(iii) Residual risks to the site and to the proposed development during an extreme flood event can be managed to an acceptable level through a dedicated stormwater drainage system and effective landscaping and topography.
(iv) The proposed power plant is compatible with the wider planning objectives of the area, which promote sustainable growth and development.

The proposed development satisfies the PSFRM criteria of the Justification Test.

6.0 CONCLUSIONS

TOBIN Consulting Engineers were appointed by appointed by Greener Ideas Limited to undertake a Flood Risk Assessment (FRA) for the construction of a new power plant at Profile Park, West Dublin.

The Planning System and Flood Risk Management (PSFRM) Guidelines (OPW/DoEHLG, 2009) classify power plants as essential infrastructure, and "highly vulnerable" in terms of their sensitivity to flooding. The proposed development should therefore be built in Flood Zone C, where there is less than a 0.1% Annual Exceedance Probability (AEP) of flooding, or assessed for suitability through the PSFRM Justification Test.

Pluvial Flooding:

Minor pluvial ponding was noted on-site during site visits, where a localised depression was recorded by the topographic survey. The risk of pluvial flooding will be managed by site regrading and the proposed stormwater drainage system.

Surface water arising at the site will be managed by a dedicated stormwater drainage system designed in accordance with SuDS, limiting discharge from the site to greenfield runoff rates. On this basis, it is predicted that the development of the site will not increase the risk of flooding elsewhere in the catchment.

The landscaping and topography of the site will provide safe exceedance flow paths and prevent surface water ponding to minimise residual risks associated with extreme flooding or blockage of the stormwater drainage system.

It is therefore estimated that the risk of pluvial flooding associated with the proposed development is minimal.

Groundwater Flooding:

There is no evidence to suggest groundwater as a potential source of flood risk to the proposed development site.

Coastal/Tidal Flooding:

The site is not at risk of coastal flooding due to its elevation and distance inland.

Fluvial Flooding:

The subject site is bounded to the east by the Baldonnell Stream, a tributary of the Grifeen River.

Previous flood studies in the area (CFRAM and PFRA) modelled the Grifeen and Camac Rivers, however the Baldonnel Stream was not explicitly modelled. CFRAM modelling of the area shows the site as liable to fluvial flooding, without accounting for the conveyance capacity of the Baldonnell Stream.

To quantify the risk of fluvial flooding at the subject site, a site-specific hydraulic model of the Baldonnell Stream was prepared. Based on the results of this model, it is estimated that the Baldonnel Stream will not burst its banks under existing flow conditions; however, the subject site may be impacted due to climate change (0.1% AEP Mid-Range Future Scenario).

Proposed site regrading (proposed elevations ≥74.0mOD) provide more than 0.3m freeboard above the predicted 0.1% AEP MRFS flood level, removing the proposed development from the future floodplain..

Compensatory flood storage is proposed for the site, introducing an additional 231m^3 within the subject site and reducing overall flood risk.

Based on the result of site-specific modelling, it is predicted that the development will have an imperceptible impact on flood risk upstream/downstream of the subject site, and that the risk of fluvial flooding associated with the development will be minimal.

The development satisfies the criteria of the PSFRM's Justification Test.

Appendix 1 - Drawings

Topographical Survey

www.tobin.ie

TOBIN Consulting Engineers

@tobinengineers

Galway
Fairgreen House,
Fairgreen Road,
Galway,
H91 AXK8,
Ireland.
Tel: +353 (0)91 565 211

Dublin
Block 10-4,
Blanchardstown Corporate Park,
Dublin 15,
D15 X98N,
Ireland.
Tel: +353 (0)1 803 0406

Castlebar
Market Square,
Castlebar,
Mayo,
F23 Y427,
Ireland.
Tel: +353 (0)94 902 1401

Appendix C – Landscape Management and Maintenance Schedule

1. LANDSCAPE MANAGEMENT & MAINTENANCE SCHEDULE

INTRODUCTION

This management and maintenance schedule has been prepared in respect of a development at Profile Park, Kilbride, County Dublin.

1.1. PLANT MATERIAL

All plant material shall be good quality nursery stock, free from fungal, bacterial or viral infection, aphids, red spider or other insect pests and any physical damage. Planting shall be in accordance with BS4428: 1989 Code of practice for general landscape operations (excluding hard surfaces).

All plants shall have been nursery grown in accordance with good practice and shall be supplied through the normal channels of the wholesale nursery trade. They shall have the habit of growth that is normal for the species. Country of origin must be shown in all cases for species grown from seed. All species will be from certified native stock and preferably from an approved supplier of the *Green, Low-Carbon, Agri Environment Scheme (GLAS).*

1.2. PLANT SPECIES

It is imperative to use native Irish species in so far as possible as they are adapted to Irish conditions and therefore more likely to thrive compared to imported stock. Selected species should also represent woodland and hedgerows in the surrounding environs although non-native species are not to be used, unless otherwise agreed with the Planning Authority. All plants supplied shall be exactly true to name as shown in the plant schedules. Varieties with variegated and/or coloured leaves will not be accepted, and any plant found to be of this type upon leafing-out shall be replaced by the contractor. Bundles of plants shall be marked in conformity with BS3936: Part 1: 1965 and BS3936: part 4: 1966. The nursery supplier shall replace any plants which, on leafing out, are found not to conform to the labels.

Native Tree Planting:

It is proposed to plant 188 native trees around the permitter of the site along the boundary hedgerow and as copses of native trees within areas of species rich meadow. These will be native species and will comprises of the following:

- *Alnus glutinosa*
- *Betula Pendula*
- *Prunus avium*
- *Quercus robur 'fastigiata'*
- *Salix caprea*
- *Sorbus aucuparia*
- *Pinus sylvetris*

Native Woodland Planting Mix (795 sqm):

Woodland planting will occupy areas along the eastern, northern and southern perimeter of the proposal site. Mix to consist of native woodland species prevalent in the surrounding area. Proposed woodland planting can be separated in two four groups ranging from larger to smaller species.

- High canopy, also known as dominants will make up <20% of the total planting mix and will comprise of a max of Pendunculate Oak (*Quercus robur*) and Scots Pine (*Pinus sylvestris*).

- Low Canopy also known as sub-dominants will total 20-25% of the proposed woodland planting mix and will consist of a mix of Alder (*Alnus glutinosa*), Downy Birch (*Betula pubescens*) and Wild Cherry (*Prunus avium*).

- Understory and Fringe also known as higher shrubs will make up 20-40% of the total woodland planting mix and will comprise of Crab Apple (*Prunus Padus*), Hawthorn (*Crataegus monogyna*), Hazel (*Corylus avellana*) and Holly (*Ilex aquifolium*).

- Under story and Edge also known as lower shrubs will total 15-25% of the total woodland planting mix and comprise of Blackthorn (*Prunus spinosa*), Dog-rose (*Rosa-canina*) and Spindle (*Euonymus europaeus*).

Hedgerow Planting (516 linear meters):
It is proposed to plant a section of native hedgerow around the outer perimeter of the site. The composition of hedgerow will consist of three layers; Primary Structure (60%), Secondary Structure (30%) and Shrub Species Structure (10%).

- The primary structure of proposed hedgerows will comprise of 60% of total stock and is to consist of *Crataegus monogyna* (Hawthorn). It is important that Hawthorn saplings are of native Irish stock, as imported stock is not known to be as vigorous or thorny.

- Secondary structure to consist of a mix of *Prunus spinosa* (Blackthorn) and *Ilex aquifolium* (Holly). Secondary structure will make up 30% of the overall hedgerow stock with species such as Ilex included to produce a year round screening effect.

- Remainder of hedgerows (10%) to comprise of a mix of the following species: *Viburnum opulus* (Guelder rose), *Sambucus nigra* (Elder), *Corylus avellana* (Hazel), *Rosa canina* (Dog rose), *Euonymus europaeus* (Spindle) or in certain cases native willow shrubs (*Salix cinerea, Salix aurita, Salix caprea*).

Wetland Planting (779sqm):
A native wetland planting mix will occupy the embankments surrounding the propsoed SuDS basins within the site. This native mix will be planted at a density of 3 plants per sqm and will include the following; *Glyceria maxima, Carex riparia, Typha latifolia, Typha angustafolia* and *Iris psuedacorus* and other similar marginal species.

1.3. PROTECTION

PROPOSED PLANTING

The interval between the lifting of stock at the heeling-in area and planting on site is to be kept to an absolute minimum. Plants shall be protected from drying out and from damage in transport. All stock awaiting planting on site shall be stored in a sheltered place protected from the wind and frost and from drying out. Except when heeled-in, all plants shall be protected in polythene at all times until planted into their final position on site.

The level of protection needed depends on whether the adjoining lands will be used for grazing during the periods of planting establishment. Rabbit-proof guards and/or rabbit proof fencing shall be provided to all newly planted hedgerow species where applicable.

DAMAGE

On completion of planting any broken branches shall be pruned and any areas of damaged bark neatly pared back to sound tissue.

WATERING / FERTILISERS

All trees and shrubs shall be soaked in water for one hour prior to planting. Fertilisers shall conform to BS 5581: 1981. In the case of granular fertiliser being added to plantings, it must be mixed through and incorporated into the base of the planting hole and covered over in order to avoid roots of plants coming in direct contact. Approved slow release fertiliser granules are to be incorporated into backfill material at manufacturers specified rates. Fertilisers shall be supplied in sealed bags or containers bearing the manufacturers name, the net weight and analysis.

1.4. PLANTING METHODS

STAKING

Younger hedgerow plants should not require staking, however, in such cases where advanced nursery stock is needed, staking may be required.

Standard Trees

Round stakes shall be of peeled larch, pine or Douglas fir, preserved with a water-borne copper chrome arsenic composition in accordance with I.S. 131. Stakes shall be round, minimum 1.6m long, 75mm in diameter. Set stakes vertically in the pit, to the western side of the tree station, and drive before planting. Drive stake with a wooden maul or cast-iron headed drive. Sledgehammer should not be used. Set stakes vertically in the pit and drive before planting. Drive stake with a drive- all, wooden maul or cast-iron headed mell.

Tree Ties

For standard trees, tree ties shall be of rubber, PVC or proprietary fabric laminate composition and shall be strong and durable enough to hold the tree securely in all weather conditions for a period of three years. They shall be flexible enough to allow proper tightening of the tie. Ties shall be min. 25mm wide for 120cm height trees and min. 38mm for larger sizes. They shall be fitted with a simple collar spacer to prevent chafing. Two ties per tree shall be applied to standard trees. Ties shall be nailed to the stake with one galvanised nail.

TREE PLANTING

Trees shall be planted at the same depth as in the nursery, indicated by the soil mark on the stem of the tree. They shall be planted in the centre of the planting pit and planted upright. Stones or other rubbish over 75mm shall be removed. Supply and drive the stake 800mm into the ground for standard trees. Backfill planting hole with excavated topsoil, and remove all stones and debris, firming plant into position. Upon completion of planting, all pits hall be raked over lightly to leave an even surface and neat appearance. All stones greater than 25mm diameter to be removed. Provision should be made for the watering of root-balled trees in the first year following planting.

Table 1.1 Propose native tree planting

NR	Plant Name	Height	Girth	Root
	Trees			
6	*Alnus glutinosa*	2-3m	8-10cm	B
28	*Alnus glutinosa*	3-4m	12-14cm	RB
37	*Betula pendula*	3-4m	12-14cm	RB
12	*Prunus avium*	2-3m	8-10cm	B
23	*Quercus robus 'fastigiata'*	3-4m	12-14cm	RB
17	*Salix caprea*	2-3m	8-10cm	B
15	*Sorbus aucuparia*	2-3m	8-10cm	B
38	*Sorbus aucuparia*	3-4m	12-14cm	RB
	Conifers			
12	*Pinus sylvestris*	250-300cm		RB

Specimen Trees

Excavate tree pits to 1200mm x 1200mm x 1000mm deep. Farmyard manure 800mm deep and 100g of fertiliser shall be applied to each tree pit prior to planting. Farmyard manure shall consist of predominantly of faecal matter and shall be free of loose, dry straw and undigested hay. It shall be free of surplus liquid effluent. Install tree support system as per above. Fill planting hole with topsoil, and remove all stones and debris, firming plant into position.

Small Trees/Large Shrubs

Excavate tree pits to 750mm x 750mm x 750mm deep. Farmyard manure 800mm deep and 100g of fertiliser shall be applied to each tree pit prior to planting. Farmyard manure shall consist of predominantly of faecal matter and shall be free of loose, dry straw and undigested hay. It shall be free of surplus liquid effluent. Install tree support system as per above. Fill planting hole with topsoil, and remove all stones and debris, firming plant into

WHIP PLANTING 40-60CM, 80-100CM, 100-120CM

Remove vegetation by hand and create notch to depth as necessary to fully contain the length of the plant root system using standard steel spade, place plant in notch, spreading roots to ensure the roots are not constricted in the planting notch. (Notch should be made at right angles to line of hedge). Using the ball of the foot, press the edges of the notch together taking care not to scrape the bark of the plant. Ensure that the root collar finishes level with the ground and that the plant finishes upright.

Planting should not take place during prolonged wet periods, periods of frost or periods of drought. The principal hedgerow planting types are detailed below.

Native woodland planting:

- Proposed woodland planting to consist of feathered whips (of various sizes) and advanced nursery stock 1m centres.
- The location and density of tree planting to be determined by the landscape architect prior to the ordering of advanced nursery stock.

- All whips within the low canopy and understory and fringe to be a minimum height of 90-120cm and the other shrub species within the understory and edge to be a minimum height of 40-60cm.

Table 1.2 Proposed Native Woodland Mix

Botanical name	Common name	Size	%
High Canopy (Dominants);			
Quercus Robur Pinus sylvestris	Penduncculate Oak Scots Pine	Standard Tree, 250-300cm, bare root Feathered Trees, 250-300cm, root ball	<20%
Low Canopy (Sub-dominants);			
Alnus glutinosa Betula pubescens Prunus avium	Alder Downy Birch Wild Cherry	Feathered Trees, 250-300cm, bare root Feathered Trees, 250-300cm, bare root 90-120cm, bare root	20-25%
Understory and fringe (higher shrubs);			
Prunus Padus Corylus avellana Ilex aquifolium Crataegus monogyna	Crab Apple Hazel Holly Hawthorn	90-120cm 90-120cm 90-120cm 90-120cm	20-40%
Understory and edge (lower shrubs);			
Prunus spinosa Rosa-canina Euonymus europaeus	Blackthorn Dog-rose Spindle	40-60cm 40-60cm 40-60cm	15-25%

<u>Proposed Hedgerow:</u>

- New sections of hedgerow to consist of feathered whips (of various sizes) and advanced nursery stock (standard trees) in double staggered rows, at a spacing 500mm apart with a gap of 500mm between rows.
- 1/3rd of the primary structure to consist of advanced nursery stock (standard trees) and to be evenly distributed to create an instant screening effect upon planting.
- All other native species will be planted as whips, with the primary and secondary structure to be a minimum height of 80-100cm and the other shrub species to be a minimum height of 40-60cm.

Table 1.3 Hedgerow planting schedule

Botanical name	Common name	Size	%
Primary structure;			
Crateagus monogyna	Hawthorn	80-100cm	60%
Secondary structure;			
Prunus spinosa	Blackthorn	80-100cm	15%
Ilex aquifolium	Holly	80-100cm	15%
Shrub species structure			
Viburnum opulus	Guelder Rose	40-60cm	2.5%
Corylus avellana	Hazel	40-60cm	2.5%
Rosa canina	Dog-rose	40-60cm	2.5%
Euonymus europaeus	Spindle	140-60cm	2.5%

CONTAINER GROWN SHRUBS, GRASSES, PERENNIALS P9 /20-30 / 30-40CM

Excavate planting hole to a dept of 500mm x 500mm x 500mm deep; the base to be broken to a depth of 50mm and glazed sides roughened. Apply farmyard manure to base of hole to a depth of 150mm and 30g of fertilizer per planting pit. Backfill planting hole with excavated topsoil, and remove all stones and debris, firming plant into position.

CONTAINER GROWN SHRUBS, GRASSES, PERENNIALS, 40-60cm

Excavate planting hole to a dept of 500mm x 500mm x 500mm deep; the base to be broken to a depth of 50mm and glazed sides roughened. Apply farmyard manure to base of hole to a depth of 150mm and 50g of fertilizer per planting pit. Backfill planting hole with excavated topsoil, and remove all stones and debris, firming plant into position.

SPECIES RICH MEADOWN – POLLINATOR FRIENDLY WILDFLOWER SEEDING.

Species rich meadow of local provenance to occupy residual space within the site. Seed mix as per the All-Ireland Pollinator Plan Wildflower Mixture:

> Birdsfoot Trefoil, Black Meddick, Cowslip, Devil's Bit Scabious, Meadow Buttercup, Field Scabious, Hemp Agrimony, Kidney Vetch, Lady's Bedstraw, Lady's Ann lace, Lesser Knapweed, Meadowsweet, Mullein, Ox-eye Daisy, Purple Loosestrife, Ragged Robin, Red Campion, Red Clover, Ribwort Plantain, Rough Hawksbit, Sorrel, St Johnswort, Wild Angelica, Wild Carrot, Yarrow. Yellow Agrimony, Yellow Rattle, Teasel and more. Also includes 35% annuals: Corn Marigold, Corn Poppy, Corncockle, Cornflower, Scented Mayweed,

1.5. MANAGEMENT AND MAINTENANCE

HEDGEROWS

Immediate aftercare of newly planted hedgerows is essential for them to become established.

- In the first growing year it is important to control the development of competing vegetation and weeds along the base of the hedgerow. This will help the overall establishment of the lower branches of the plants, giving a more favourable dense basal layer to the hedgerow. Manual weeding is preferable as chemical herbicides can damage young hedgerow plants. Mulching immediately after planting will also help to suppress any weeds. Noxious weeds (Dock, Thistle, Ragwort) shall not be allowed to flower and all such weeds shall be killed or removed at each maintenance visit.

- Within the first summer season any dead or dying stock is to be counted, tagged and replaced during the following planting season. Occasional plant failure is not of particular concern as this can lead to more 'natural' looking hedgerows.

- Hawthorn can be trimmed back to encourage new growth at its base. This will ensure and dense, bushy plant habit in the long term.

- Once established new sections of hedgerow should be trimmed on a 2-3 year rotation to encourage flowering pollinators and fruiting for birds. This will encourage faster hedgerow growth, which will ensure a natural, bushy form. When trimming hedgerows it is important to use reciprocating bar cutters that slice through branches leaving a neater cut. This gives the plants a better chance of healing without infection. Hedgerow trimming and maintenance should only take place between the 1st of September and the last day of February to avoid harming nesting birds.

- Existing sections of hedgerow should also be trimmed on a 2-3 year rotation to encourage gradual consolidation to a minimum height of 4m and to promote dense and bushy habit. Trees and hedgerows are not to be cut during nesting and breeding season between the **1st March and the 31st August**, in order to protect nesting birds.

- If gaps become apparent in the hedgerows over time, long-term management solutions (20-30 year intervals) such as laying or coppicing may be needed and will help to retain the hedgerows biodiversity, density and structure.

- Once weed growth is not highly prevalent within the wild grass seeding area, they will only need to be trimmed back on an annual basis, usually in late August. Noxious weeds to be controlled with spot treatments of appropriate herbicides.

WILDFLOWER SEEDING

First Year

In the first year it is important to keep the area cut short. This is firstly to keep "weeds" down but also to provide light to seedlings to help them grow. Cut the sward to a height of 75 mm whenever the vegetation reaches 150mm, and remove the cut vegetation if possible. Over the first season perennial weeds should be treated (removed by mechanical means or by careful spot spraying) after cutting. Cut the meadow no later than mid-November to a height of 30 mm and remove all vegetation.

Second Year

After year one, the meadow is cut just once annually. The goal in years 2 and 3 is to encourage germination the following year. Cut the sward just once, after the seed has set (or no later than mid-November), to a height of 30 mm. Leave the cut vegetation for 3 days then remove. After cutting, perennial weeds should continue to be treated through mechanical removal or careful spot spraying.

- There is no specific time for annual cutting as it can depend on weather and other unpredictable factors. Seeds should be allowed to ripen and fall from the seed heads before cutting.
- After cutting in Year 2 and 3, Yellow Rattle can be over-sown. Yellow rattle is a semi-parasite that reduces grass dominance.
- If more diversity is required, that wildflower meadow can be enhanced with plug plants of other wildflowers

GENERAL PLANTING AFTERCARE

Planting shall be tended for 60 months from the dates of completion of all Works.

Weeding

Throughout the aftercare period keep all shrub planting areas weed free. For tree planting keep an area of 1 m. in diameter around each planting station in a weed free condition. This may be achieved by the use of an approved herbicide or by regular cultivation. A minimum of 3 visits for weed control will be required during the growing season. All injurious weeds, will be removed from the remainder of each transplant tree or shrub plot. The growth of herbaceous material between the weed free planting stations should be controlled by strimming twice per year.

Stakes, Trees, Shrubs and Ties

All stakes, trees and shrubs shall be maintained in firm positions within the ground and with all ties securely fixed and adjusted to allow for the increase in stem girth.

Replacements

Plants that fail to thrive, are removed, uprooted or destroyed or die during the aftercare period will be replaced with equivalent plants as soon as possible during the following planting season. Replacements shall be of the same size and species as that originally specified unless otherwise agreed with the Planning Authority. Defects shall be made good by the end of the planting season of the year in which the defect is identified.

- Shrub areas – all dead stock shall be replaced at the end of each growing season to obtain 100% stocking
- Cell grown/root trainers and transplant planting – throughout the aftercare period, all dead stock shall be replaced at the end of each growing season to obtain 90% stock providing that failures are evenly distributed throughout both planting areas and species
- Standard trees – throughout the aftercare period all dead and diseased stock shall be replaced at the end of each growing season.

MAINENANCE SCHEDULE

Tasks	*WINTER*	*SPRING*	*SUMMER*	*AUTUMN*
General Tasks;				
Landscape Architect inspection				
Replacing failed plants				
Refirming				
Pest and disease control				
Check Plant supports				
General pruning				
Tasks for Whips/Transplants;				
Weed control				
Slow release fertiliser				
Tasks for Trees;				
Weed control				
Slow release fertiliser				
Tasks for wildgrass/wildflower seeding areas;				
Mowing				
Weed control				

MONITORING

A qualified Landscape Architect should monitor the site on an annual basis for the duration of the 3 yr Maintenance and Management Schedule and make adjustments to the Management and Maintenance Strategy where required.

Appendix D – Noise Technical Note

awnconsulting
A Trinity Consultants Company

The Tecpro Building,
Clonshaugh Business & Technology Park,
Dublin 17, Ireland.

T: + 353 1 847 4220
F: + 353 1 847 4257
E: info@awnconsulting.com
W: www.awnconsulting.com

TECHNICAL NOTE

Project	**Profile Park Gas Generation**
Subject	**SDCC FI Response**
Author	**Dermot Blunnie**
Date	**22 May 2022**
Ref.	**DB/21/12055/NT05b**

This note has been prepared to present comment on the Profile Park Gas Generation development in response to an additional request for further information (RFI) received from South Dublin County Council (SDCC).

1.0 ITEM 6 OF CURRENT CORRESPONDENCE FROM SDCC

Item 6 of the current correspondence states:

"6. *The applicant has not clearly set out in the additional information submission that it can be demonstrated that the development can meet the standards set out by South Dublin County Council, as requested in item 7.*

The applicant is requested to submit an Acoustic Verification report as clarification of additional information. The report must confirm whether the development is capable of complying with Council's standard operational noise criteria, set out below:

Noise due to the normal operation of the proposed development, expressed as Laeq over 15 minutes at the façade of a noise sensitive location, shall not exceed the daytime background level by more than 10 dB(A) and shall not exceed the background level for evening and night time.

(a) This Acoustic Verification report should comprise of noise monitoring data at any noise sensitive locations. It should also include the cumulative noise level whereby the existing noise levels are included in the assessment of the developments overall impact.

Cork Office
Unit 5, ATS Building,
Carrigaline Industrial Estate,
Carrigaline, Co. Cork.
T: + 353 21 438 7400
F: + 353 21 483 4606

AWN Consulting Limited
Registered in Ireland No. 319812

(b) The Acoustic Verification report should include performance specifications for any changes/modifications which have been incorporated in order to reduce operational noise levels during the night time period. The report must include a statement certifying whether the development or proposed use is fully capable of complying with the requirements of the following noise control condition:

(1) Noise due to the normal operation of the proposed development, expressed as Laeq over 15 minutes at the façade of a noise sensitive location, shall not exceed the daytime background level by more than 10 dB(A) and shall not exceed the background level for evening and night time. Clearly audible and impulsive tones at noise sensitive locations during evening and night shall be avoided irrespective of the noise level.

It is important to note the wording of the RFI, this clearly states, "*The development must not give rise to noise levels that exceed the background level for evening and night time periods*". That is to say that noise generated by the proposed development under consideration here shall not exceed (i.e., be no higher than) the existing background noise level. This is explicit in the wording of the RFI.

This is the approach adopted as a part of the EIAR and as reiterated in the original response to for further information. The EIAR assessment represents an *"Acoustic Verification"* report that *"include performance specifications for any changes/modifications which have been incorporated in order to reduce operational noise levels during the night time period."*

The RFI does not request that the proposed development does not increase existing background noise levels due to its operation. A review of conditions applied to date on nearby facilities does not identify a situation where the specific wording of a condition requires that existing background noise levels are not increased due to a new development. All conditions take the same approach adopted in the EIAR, and requested in the wording of the original RFI, i.e., *"the development must not give rise to noise levels that exceed the background level for evening and night time periods."*

The response to the original RFI is reproduced below as it is considered this clearly addresses the requirements of Item 6 of the current correspondence as well as Item 7 of the original RFI.

2.0 RESPONSE TO ITEM 7 OR ORIGINAL RFI

Item 7 of the original RFI states the following:

"7. *The proposed application highlights a potential for noise to impact a number of nearby receivers. The noise levels predict a notable change in the noise at these receivers during the night-time period.*

- *The applicant is required to assess and re-evaluate all noise emitting equipment proposed on site in this application.*
- *The applicant must undertake necessary modifications to the proposed structures and operations on site in order to reduce the predicted noise levels at nearby receivers to acceptable level during both day and night time.*
- *The development must not give rise to noise levels that exceed the background level for evening and night time periods.*
- *The applicant must demonstrate the development can meet the standards set out by South Dublin County Council as noted below:*

> *Noise due the normal operation of the proposed development expressed as L_{Aeq} over 15 minutes at the façade of a noise sensitive location, shall not exceed the daytime background level by more than 10 dB(A) and should not exceed the background level for evening and night time. Clearly audible and impulsive tones at noise sensitive locations during evening and night shall be avoided irrespective of noise level."*

The following is noted:

- The adopted noise limits proposed in the EIAR (see Section 12.2.1.7) satisfy the "*standards set out by South Dublin Council*" as noted in the RFI. The criteria were selected such that predicted noise associated with the site does "*not exceed the daytime background level by more than 10 dB(A)*" and does "*not exceed the background level for evening and night time*".
- As part of the original EIAR the plant was reviewed and selected such that the predicted noise levels satisfy the "*standards set out by South Dublin County Council*" as noted in the RFI. Therefore, there is no requirement for "*modifications to the proposed structures and operations on site in order to reduce the predicted noise levels at nearby receivers to acceptable level during both day and night time*". The noise impact presented in the EIAR is directly applicable to the impact presented for the revised layout being proposed as part of the wider RFI response and outlined in the later sections of this document.
- While the predicted noise levels presented in the EIAR did show a change in noise level at nearby noise sensitive locations, the impacts were not determined as significant as detailed in the relevant sections of the EIAR (i.e., Table 12.19, Table 12.20, and Table 12.21).
- To reiterate the predicted noise levels presented in the EIAR did not present "*noise levels that exceed the background level for evening and night time periods*".

As part of a wider response to the RFI the site layout has altered with a reduction in the size of the building and one less generator unit being proposed. The noise modelling presented in the EIAR has been updated and the results of this exercise are presented in the following sections. The results of the updated modelling do not change the comments presented above in relation to Item 7 of the RFI.

3.0 MODEL ASSUMPTIONS

Table 1 presents the noise data assumed for the various buildings. Data has been supplied by Tobin Engineering unless otherwise stated. The noise predictions show that the selected plant items and building structure result in "*predicted noise levels at nearby receivers to acceptable level during both day and night time*".

Item	Octave Band Sound Power Level dB L_w									dB(A)
	31.5	63	125	250	500	1000	2000	4000	8000	
A – Intake Air (Opening) [1]	103	97	94	86	80	90	89	86	84	95
B – Exhaust Stack Outlet [1]	107	100	94	92	86	83	81	82	84	91
C – Radiator Coolers [1]	–	103	97	93	92	91	86	81	83	95
D – Air Exhaust Roof [2]	108	98	78	63	61	59	59	52	57	74
E – Roof [3]	79	72	70	66	59	51	46	34	31	61

Item	Octave Band Sound Power Level dB L_w									dB(A)
	31.5	63	125	250	500	1000	2000	4000	8000	
F – Walls [3]	77	70	67	64	57	48	43	31	28	59
G – Ventilation Unit [4]	--	--	--	--	--	84	--	--	--	84
H – Gas AGI [5]	--	--	--	--	--	80	--	--	--	80
I – Gas PRS [6]	--	--	--	--	--	80	--	--	--	80
J – Transformer [7]	--	--	--	--	--	82	--	--	--	80

Table 1 Summary of Noise Data for EIAR Noise Model

Note 1 6 in number. Data as supplied.

Note 2 Based on assumption of a $25m^2$ opening. 6 openings in the roof in total. Internal noise level within the building estimated as follows:

	Lp - Octave Band Centre Frequency (Hz) - Linear									
	31.5	63	125	250	500	1000	2000	4000	8000	dB	dB(A)
Total Lp Level in Hall	112	111	107	107	108	106	106	99	96	117	112

Attenuation for hall exhaust assumed to be as follows as supplied from a similar project:

Description	Insertion Loss (dB) per Octave Band (Hz)								
	31.5	63	125	250	500	1000	2000	4000	8000
Attenuator Performance 3 m Length, 25 % Free Area[1]	12	21	37	52	55	55	55	55	47

[1] Data taken from an alternative supplier on a similar project

Note 3 L_w level per m^2. Based on the 'L_p Level in Hall' stated in Note 2 and the assumption that the roof offers the following sound reduction performance (as advised from a similar project).

Description	Insertion Loss (dB) per Octave Band (Hz)								
	31.5	63	125	250	500	1000	2000	4000	8000
Walls	37	43	42	45	53	60	65	70	70
Roof	35	41	39	43	51	57	62	67	67

Example wall and roof constructions capable of achieving the performance specifications outlined in **Table 3** are:

- Walls: 215 mm thick solid concrete block
- Roof: 250 mm thick hollowcore concrete planks

Note 4 12 units in total. Overall L_w level supplied.

Note 5 80 dB(A) at 1m advised for building. This level has been assumed and L_w estimated for walls/roof of building based on areas obtained from drawings to hand.

Note 6 Overall L_w level supplied.

Note 7 2 units in total. Overall L_w level supplied.

Figure 1 presents a 3D render of the developed noise model.

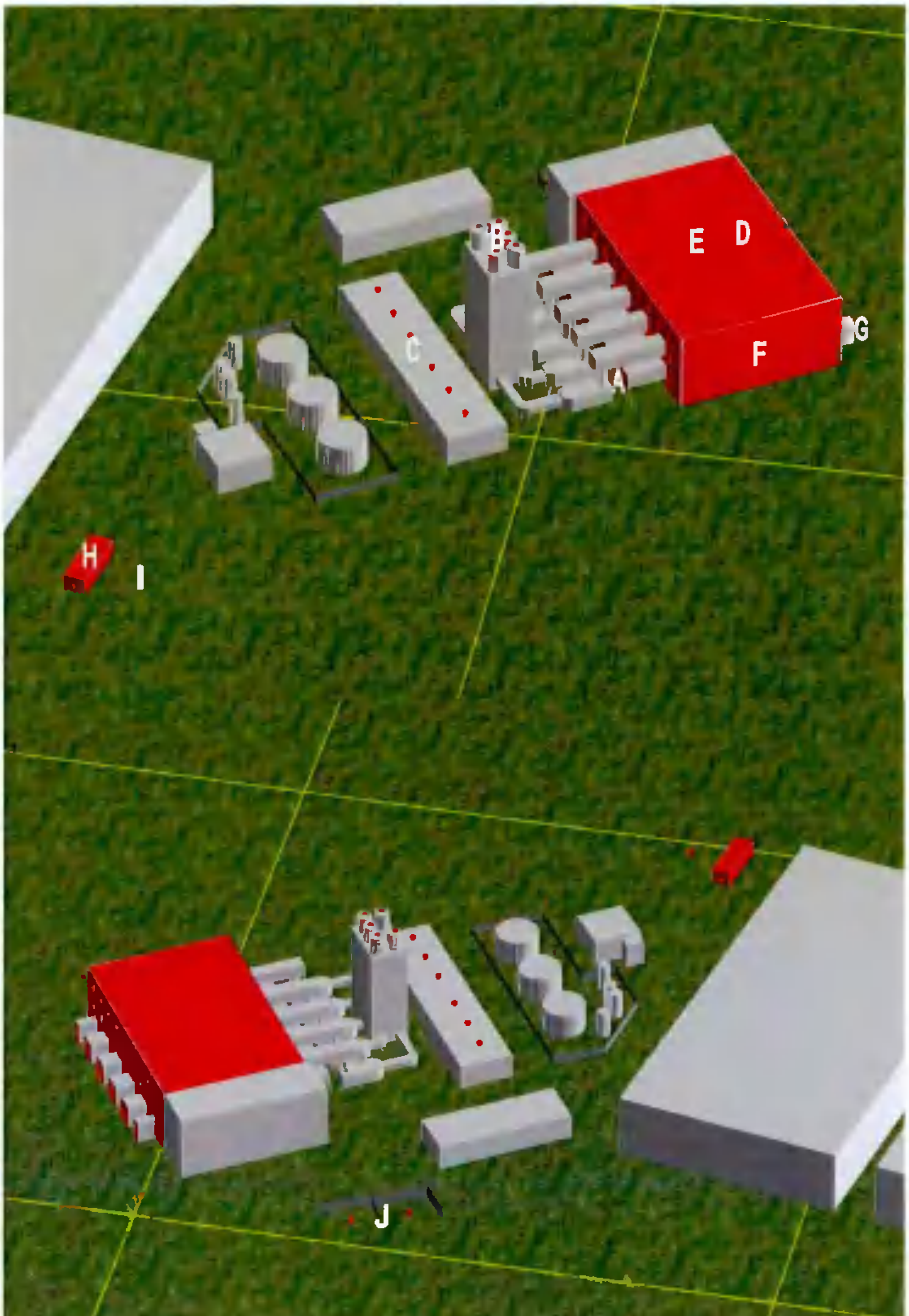


Figure 1 3D Render of Developed Noise Model

4.0 UPDATED ASSESSMENT

Table 2 presents the predicted noise at all assessment locations considering the impact of the Proposed Development.

Ref.	Sound Pressure (dB) per Octave Band Centre Freq (Hz)									dB(A)
	31.5	63	125	250	500	1k	2k	4k	8k	
R01	53	48	37	32	26	27	20	7	--	31
R02	52	47	36	31	27	30	24	5	--	33
R03	52	47	36	31	27	31	24	5	--	33
R04	52	48	35	30	27	32	26	7	--	34
R05	50	45	34	28	25	27	17	--	--	30
R06	56	50	39	35	30	35	17	5	--	37
R07	55	46	33	28	21	21	11	--	--	27
R08	57	51	40	36	31	36	20	6	--	38
R09	61	55	46	42	38	43	33	23	3	45
R10	57	51	41	37	33	37	28	14	--	39
R11	57	51	41	37	33	37	27	12	--	39
R12	56	51	41	37	33	37	28	12	--	39
R13	56	51	40	36	33	37	27	12	--	39
R14	55	50	39	36	32	36	27	10	--	38
R15	66	61	53	44	41	45	40	32	--	48
R16	54	51	38	31	28	51	25	18	8	51

Table 2 Predicted Noise Levels

A noise contour for day-to-day operation of the proposed development has been presented in Figure 3. Table 3 compares the predicted noise at all assessment locations against the adopted criteria. Note that R06 to R13 and also R15 and R16 refer to locations that are commercial uses, therefore the daytime noise limit applies.

Ref.	Predicted Noise Level dB(A)	Criterion dB $L_{Aeq,15min}$	Excess (dB)
R01	31	37	--
R02	33	37	--
R03	33	37	--
R04	34	37	--
R05	30	37	--
R06	37	55	--
R07	27	55	--
R08	38	55	--
R09	45	55	--
R10	39	55	--
R11	39	55	--
R12	39	55	--
R13	39	55	--
R14	38	39	--
R15	48	55	--
R16	51	55	--

Table 3 Review of Overall Noise Levels

The updated predicted noise levels satisfy the relevant noise criteria adopted in this assessment.

Table 4 reviews the predicted low-frequency noise at each location vs. the nominal limits recommended in relation to this issue in Section 12.2.1.5 of the Nosie and Vibration Chapter of the EIAR. Review of the predictions indicate that the proposed low frequency noise limits are substantively complied with at the nearest residential noise sensitive locations to the site.

Ref.	Predicted Noise Level dB(A) per Octave Band Centre Frequency		
	31.5Hz	63Hz	125Hz
Limit (All locations)	*56*	*50*	*40*
R01	53	48	37
Excess	--	--	--
R02	52	47	36
Excess	--	--	--
R03	52	47	36
Excess	--	--	--
R04	52	48	35
Excess	--	--	--
R05	50	45	34
Excess	--	--	--
R14	55	50	39
Excess	--	--	--

Table 4 Review of Low Frequency Noise

Table 5, 6 and 7 present the predicted changes in noise level associated with the development at the nearest residential noise sensitive locations to the site.

Ref.	Daytime (07:00 – 19:00 hrs)				
	Predicted dB $L_{Aeq,T}$	Background Level dB $L_{A90,T}$	Cumulative Noise Level (dB(A))	Change in Noise Level (dB)	EPA Glossary of Impacts
R01	31	43	43	0	Not Significant
R02	33	52	52	0	Not Significant
R03	33	52	52	0	Not Significant
R04	34	52	52	0	Not Significant
R05	30	52	52	0	Not Significant
R14	38	52	52	0	Not Significant

Table 5 Review of Predicted Changes in Existing Noise Levels – Day

Ref.	Evening (19:00 – 23:00 hrs)				
	Predicted dB $L_{Aeq,T}$	Background Level dB $L_{A90,T}$	Cumulative Noise Level (dB(A))	Change in Noise Level (dB)	EPA Glossary of Impacts
R01	31	38	39	1	Not Significant
R02	33	42	43	1	Not Significant
R03	33	42	43	1	Not Significant
R04	34	42	43	1	Not Significant
R05	30	42	42	0	Not Significant
R14	38	42	44	2	Not Significant

Table 6 Review of Predicted Changes in Existing Noise Levels – Evening

Ref.	Night (23:00 – 07:00 hrs)				
	Predicted dB $L_{Aeq,T}$	Background Level dB $L_{A90,T}$	Cumulative Noise Level (dB(A))	Change in Noise Level (dB)	EPA Glossary of Impacts
R01	31	37	38	1	Not Significant
R02	33	39	40	1	Not Significant
R03	33	39	40	1	Not Significant
R04	34	39	40	1	Not Significant
R05	30	39	40	1	Not Significant
R14	38	39	42	3	Slight

Table 7 Review of Predicted Changes in Existing Noise Levels – Night

Review of the predicted increases in noise level at the nearest residential noise sensitive locations conclude that the associated impact is 'Not Significant' at all locations for daytime and evening periods. During night-time periods the predicted impact is Not Significant at all locations with the exception of R01 and R14 where a Slight impact is predicted.

Description of Effects

With respect to the EPA's criteria for description of effects, the potential worst-case associated effects at the nearest noise sensitive locations associated with operation of the proposed development is described below.

Quality	*Significance*	*Duration*
Negative	Slight	Long-term

The above effects should be considered in terms that this assessment considers the locations of the greatest potential impact.

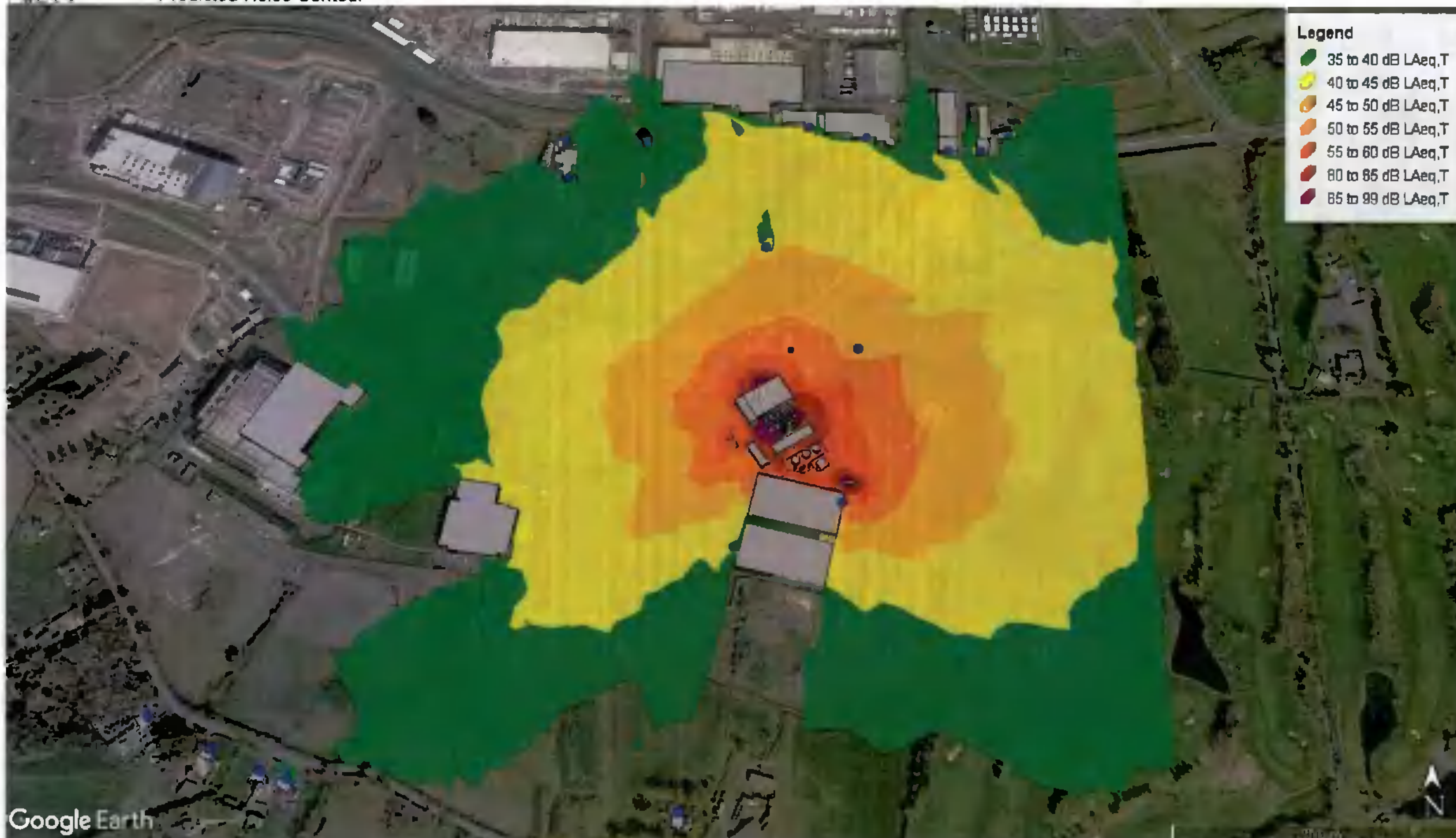
For the all residential locations assessed here the effect of the proposed development can be considered to be as follows:

Quality	*Significance*	*Duration*
Negative	Not Significant	Long-term

There are no expected sources of vibration associated with the operational phase of the proposed development. In relation to vibration the associated effect is summarised as follows:

Quality	*Significance*	*Duration*
Negative	Imperceptible	Long-term

Figure 3 Predicted Noise Contour



APPENDIX A – GLOSSARY OF ACOUSTIC TERMINOLOGY

ambient noise	The totally encompassing sound in a given situation at a given time, usually composed of sound from many sources, near and far.
background noise	The steady existing noise level present without contribution from any intermittent sources. The A-weighted sound pressure level of the residual noise at the assessment position that is exceeded for 90 per cent of a given time interval, T ($L_{AF90,T}$).
broadband	Sounds that contain energy distributed across a wide range of frequencies.
dB	Decibel - The scale in which sound pressure level is expressed. It is defined as 20 times the logarithm of the ratio between the RMS pressure of the sound field and the reference pressure of 20 micro-pascals (20 μPa).
dB L_{pA}	An 'A-weighted decibel' - a measure of the overall noise level of sound across the audible frequency range (20 Hz – 20 kHz) with A-frequency weighting (i.e. 'A'–weighting) to compensate for the varying sensitivity of the human ear to sound at different frequencies.
Hertz (Hz)	The unit of sound frequency in cycles per second.
impulsive noise	A noise that is of short duration (typically less than one second), the sound pressure level of which is significantly higher than the background.
$L_{Aeq,T}$	This is the equivalent continuous sound level. It is a type of average and is used to describe a fluctuating noise in terms of a single noise level over the sample period (T). The closer the L_{Aeq} value is to either the L_{AF10} or L_{AF90} value indicates the relative impact of the intermittent sources and their contribution. The relative spread between the values determines the impact of intermittent sources such as traffic on the background.
L_{AFN}	The A-weighted noise level exceeded for N% of the sampling interval. Measured using the "Fast" time weighting.
L_{AFmax}	is the instantaneous slow time weighted maximum sound level measured during the sample period (usually referred to in relation to construction noise levels).
$L_{Ar,T}$	The Rated Noise Level, equal to the L_{Aeq} during a specified time interval (T), plus specified adjustments for tonal character and impulsiveness of the sound.
L_{AF90}	Refers to those A-weighted noise levels in the lower 90 percentile of the sampling interval; it is the level which is exceeded for 90% of the measurement period. It will therefore exclude the intermittent features of traffic and is used to estimate a background level. Measured using the "Fast" time weighting.

L_{AT}(DW)	equivalent continuous downwind sound pressure level.
L_{fT}(DW)	equivalent continuous downwind octave-band sound pressure level.
L_{day}	L_{day} is the average noise level during the daytime period of 07:00hrs to 19:00hrs
L_{night}	L_{night} is the average noise level during the night-time period of 23:00hrs to 07:00hrs.
low frequency noise	LFN - noise which is dominated by frequency components towards the lower end of the frequency spectrum.
noise	Any sound, that has the potential to cause disturbance, discomfort or psychological stress to a person exposed to it, or any sound that could cause actual physiological harm to a person exposed to it, or physical damage to any structure exposed to it, is known as noise.
noise sensitive location	NSL – Any dwelling house, hotel or hostel, health building, educational establishment, place of worship or entertainment, or any other facility or other area of high amenity which for its proper enjoyment requires the absence of noise at nuisance levels.
octave band	A frequency interval, the upper limit of which is twice that of the lower limit. For example, the 1,000Hz octave band contains acoustical energy between 707Hz and 1,414Hz. The centre frequencies used for the designation of octave bands are defined in ISO and ANSI standards.
rating level	See $L_{Ar,T}$.
sound power level	The logarithmic measure of sound power in comparison to a referenced sound intensity level of one picowatt (1pW) per m^2 where: $$Lw = 10Log\frac{P}{P_0} \text{ dB}$$ Where: p is the rms value of sound power in pascals; and P_0 is 1 pW.
sound pressure level	The sound pressure level at a point is defined as: $$Lp = 20Log\frac{P}{P_0} \text{ dB}$$
specific noise level	A component of the ambient noise which can be specifically identified by acoustical means and may be associated with a specific source. In BS 4142, there is a more precise definition as follows: 'the equivalent continuous A-weighted sound pressure level at the assessment position produced by the specific noise source over a given reference time interval ($L_{Aeq,T}$)'.

tonal Sounds which cover a range of only a few Hz which contains a clearly audible tone i.e. distinguishable, discrete or continuous noise (whine, hiss, screech, or hum etc.) are referred to as being 'tonal'.

Appendix E – Archaeology

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BUILT ON KNOWLEDGE

Greener Ideas

PROFILE PARK POWER PLANT

ENVIRONMENTAL IMPACT ASSESSMENT REPORT (EIAR)

VOLUME II – EIAR MAIN REPORT
CHAPTER 13: CULTURAL HERITAGE

PROFILE PARK POWER PLANT

ENVIRONMENTAL IMPACT ASSESSMENT REPORT – VOLUME II, Chapter 13: Cultural Heritage

Document Control Sheet	
Document Reference	11069-D02
Report Status	Planning Issue
Report Date	May 2022
Current Revision	D01
Client:	GREENER IDEAS LIMITED
Client Address:	C/O Centrica Business Solutions, 1 Seapoint Building, 44-45 Clontarf Road, Dublin 3, D03 F4A7
Project Number	11069

Galway Office	Dublin Office	Castlebar Office
Fairgreen House, Fairgreen Road, Galway, H91 AXK8, Ireland. Tel: +353 (0)91 565 211	Block 10-4, Blanchardstown Corporate Park, Dublin 15, D15 X98N, Ireland. Tel: +353 (0)1 803 0406	Market Square, Castlebar, Mayo, F23 Y427, Ireland. Tel: +353 (0)94 902 1401

Revision	Description	Author:	Date	Reviewed By:	Date	Authorised by:	Date
B	Planning Issue	Various	3/6/21	FB	17/05/22	LB	24/05/22

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13.0 CULTURAL HERITAGE

13.1 INTRODUCTION

IAC Archaeology has prepared this chapter to assess the impact, if any, on the archaeological and cultural heritage resource of the proposed power plant in Profile Park. The assessment determines, as far as reasonably possible from existing records, the nature of the archaeological and cultural heritage resource in and within the vicinity of the proposed power plant using appropriate methods of study. An impact assessment was undertaken to identify potential adverse impacts that the proposed power plant may have on the cultural heritage resource, while the mitigation strategy is designed to avoid, reduce, or offset such adverse impacts.

13.1.1 Statement of Authority

This assessment was completed by Faith Bailey who is an Associate Director and Senior Archaeologist and Cultural Heritage Consultant with IAC Ltd. Faith holds an MA in Cultural Landscape Management (archaeology and built heritage) and a BA in single honours archaeology from the University of Wales, Lampeter. She is a licence eligible archaeologist, a member of the Chartered Institute of for Archaeologists, a member of the Institute of Archaeologists of Ireland and has over 18 years' experience working in the commercial archaeological and cultural heritage sector.

The assessment has been informed by a programme of archaeological test trenching, which was carried out in December 2021 by Marc Pierra of IAC under licence 21E0692, as issued by the National Monuments Service of the Department of Housing, Local Government and Heritage.

13.2 METHODOLOGY

13.2.1 Definitions

In order to assess, distil and present the findings of this study, the following definitions apply:

- 'Cultural Heritage' where used generically, is an over-arching term applied to describe any combination of archaeological, architectural, and cultural heritage features, where –the term 'archaeological heritage' is applied to objects, monuments, buildings or landscapes of an (assumed) age typically older than AD 1700 (and recorded as archaeological sites within the Record of Monuments and Places).
- the term 'cultural heritage', where used specifically, is applied to other (often less tangible) aspects of the landscape such as historical events, folklore memories and cultural associations.

13.2.2 Legislation and Guidelines

The following legislation, standards and guidelines were consulted as part of the assessment.

- National Monuments Act, 1930 to 2014;
- The Planning and Development Acts, 2000 to 2017;
- Heritage Act, 1995, as amended;
- Draft Advice Notes on Current Practice (in the preparation of Environmental Impact Statements), 2015, EPA;

- Draft Guidelines on the Information to be Contained in Environmental Impact Statements. Dublin. Government Publications Office, 2017, EPA;
- Frameworks and Principles for the Protection of the Archaeological Heritage, 1999, (formerly) Department of Arts, Heritage, Gaeltacht, and Islands; and
- Architectural Heritage (National Inventory) and Historic Monuments (Miscellaneous Provisions) Act, 2000 and the Local Government (Planning and Development) Act 2000.

13.2.3 Consultation

During scoping and research for the assessment and EIAR, a number of statutory and voluntary bodies were consulted to gain further insight into the cultural background of the receiving environment and study area, as follows:

- Department of Housing, Local Government and Heritage (DoHLGH)– the Heritage Service and Policy Unit, National Monuments and Historic Properties Section: Record of Monuments and Places; Sites and Monuments Record; Monuments in State Care Database; Preservation Orders; Register of Historic Monuments;
- National Museum of Ireland, Irish Antiquities Division: topographical files of Ireland; and
- South Dublin County Council: Planning Section.

13.2.4 Paper Survey

This is a document search. The following sources were examined and a list of areas of archaeological and cultural heritage potential was compiled:

- Record of Monuments and Places for County Dublin;
- Sites and Monuments Record for County Dublin;
- National Monuments in State Care Database;
- Preservation Orders List;
- Register of Historic Monuments;
- Topographical files of the National Museum of Ireland;
- Cartographic and written sources relating to the study area;
- South Dublin County Development Plan 2016–2022;
- Aerial photographs;
- Excavations Bulletin (1970–2020); and
- Place Names.

Record of Monuments and Places (RMP) is a list of archaeological sites known to the National Monuments Section, which are afforded legal protection under Section 12 of the 1994 National Monuments Act and are published as a record.

Sites and Monuments Record (SMR) holds documentary evidence and field inspections of all known archaeological sites and monuments. Some information is also held about archaeological sites and monuments whose precise location is not known e.g. only a site type and townland are recorded. These are known to the National Monuments Section as 'un-located sites' and cannot be afforded legal protection due to lack of locational information. As a result, these are omitted from the Record of Monuments and Places. SMR sites are also listed on a website maintained by the Department of Housing, Local Government and Heritage (DoHLGH) – www.archaeology.ie.

National Monuments in State Care Database is a list of all the National Monuments in State guardianship or ownership. Each is assigned a National Monument number whether in guardianship or ownership and has a brief description of the remains of each Monument.

The Minister for the Department of Housing, Local Government and Heritage may acquire national monuments by agreement or by compulsory order. The state or local authority may assume guardianship of any national monument (other than dwellings). The owners of national monuments (other than dwellings) may also appoint the Minister or the local authority as guardian of that monument if the state or local authority agrees. Once the site is in ownership or guardianship of the state, it may not be interfered with without the written consent of the Minister.

Preservation Orders List contains information on Preservation Orders and/or Temporary Preservation Orders, which have been assigned to a site or sites. Sites deemed to be in danger of injury or destruction can be allocated Preservation Orders under the 1930 Act. Preservation Orders make any interference with the site illegal. Temporary Preservation Orders can be attached under the 1954 Act. These perform the same function as a Preservation Order but have a time limit of six months, after which the situation must be reviewed. Work may only be undertaken on or in the vicinity of sites under Preservation Orders with the written consent, and at the discretion, of the Minister.

Register of Historic Monuments was established under Section 5 of the 1987 National Monuments Act, which requires the Minister to establish and maintain such a record. Historic monuments and archaeological areas present on the register are afforded statutory protection under the 1987 Act. The register also includes sites under Preservation Orders and Temporary Preservation Orders. All registered monuments are included in the Record of Monuments and Places.

The topographical files of the National Museum of Ireland are the national archive of all known finds recorded by the National Museum. This archive relates primarily to artefacts but also includes references to monuments and unique records of previous excavations. The find spots of artefacts are important sources of information on the discovery of sites of archaeological significance.

Cartographic sources are important in tracing land use development within the development area as well as providing important topographical information on areas of archaeological potential and the development of buildings. Cartographic analysis of all relevant maps has been made to identify any topographical anomalies or structures that no longer remain within the landscape.

- Down Survey Maps of the Barony of Newcastle c. 1655
- Rocque's An Actual Survey of County Dublin, 1760
- Taylor's Map of the Environs of Dublin, 1816
- Ordnance Survey Maps of Dublin, 1843–1938

Documentary sources were consulted to gain background information on the archaeological and cultural heritage landscape of the proposed development area.

Development Plans contain a catalogue of all the Protected Structures and archaeological sites within the county. The South Dublin County Development Plan (2016–2022) was consulted to obtain information on cultural heritage sites in and within the immediate vicinity of the proposed development area.

Aerial photographic coverage is an important source of information regarding the precise location of sites and their extent. It also provides initial information on the terrain and its likely potential for archaeology. A number of sources were consulted including aerial photographs and satellite imagery held by the Ordnance Survey, Google Earth, and Bing Maps.

Excavations Bulletin is a summary publication that has been produced every year since 1970. This summarises every archaeological excavation that has taken place in Ireland during that year up until 2010 and since 1987 has been edited by Isabel Bennett. This information is vital when examining the archaeological content of any area, which may not have been recorded under the SMR and RMP files. This information is also available online (www.excavations.ie) from 1970–2020.

Place Names are an important part in understanding both the archaeology, history, and cultural heritage of an area. Place names can be used for generations and in some cases have been found to have their root deep in the historical past. The main references used for the place name analysis is *Irish Local Names Explained* by P.W Joyce (1870) and the Place Names Database of Ireland.

13.2.5 Field Inspection

Field inspection is necessary to determine the extent and nature of archaeological, architectural. and historical remains and can also lead to the identification of previously unrecorded or suspected sites and portable finds through topographical observation and local information.

The archaeological field inspection entailed -

- Walking the proposed development and its immediate environs.
- Noting and recording the terrain type and land usage.
- Noting and recording the presence of features of archaeological or historical significance.
- Verifying the extent and condition of any recorded sites.
- Visually investigating any suspect landscape anomalies to determine the possibility of their being anthropogenic in origin.

13.3 BASELINE ENVIRONMENT

13.3.1 Archaeological and Historical Background

The proposed power plant is located in the townland of Kilbride, Parish of Kilbride and Barony of Newcastle. There are two groups or individual recorded monuments within 500m of the proposed power plant site. These comprise a castle (DU0021-004) and a church, graveyard and ecclesiastical enclosure group (DU0021-005001-3) (Figure 13-1**Error! Reference source not found.**), located over 300m to the south.

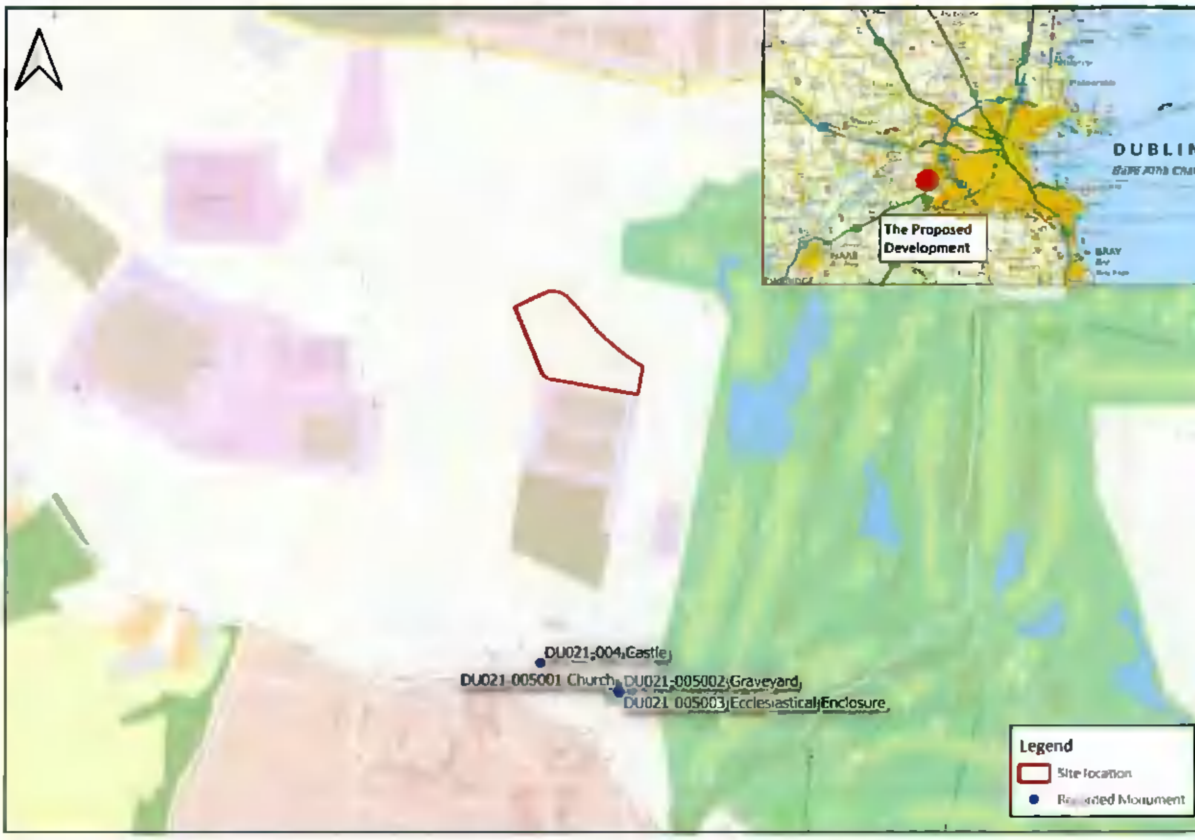

Figure 13-1: Site location showing recorded monuments

13.3.1.1 Mesolithic Period (6000–4000 BC)

Although recent discoveries have suggested the possibility of human activity in the southwest of Ireland as early as the Upper Palaeolithic (Dowd and Carden 2016), the Mesolithic period is the first time for which there is widespread evidence of human occupation on the island of Ireland. Mesolithic people led a mobile lifestyle, hunting, foraging and fishing for sustenance and migrating to exploit seasonal resources. As a result, coastal and riverine resources were of particular importance to these communities. Such transient ways of life leave little trace in the archaeological record. Often the only indication of Mesolithic activity are scatters of flint implements and debitage. Occasionally shell middens have been found to date to this period. Although Mesolithic activity has been identified in County Dublin, there are no recorded sites of Mesolithic date within the vicinity of the proposed power plant.

13.3.1.2 Neolithic Period (4000–2500 BC)

The Neolithic period began with the introduction and adoption of agriculture to Ireland. This period was revolutionary. Neolithic groups turned to cereal cultivation and the rearing of stock for sustenance. There was no longer a need to move frequently and as a result settlement became more permanent. Pottery was being produced possibly for the first time. A new preoccupation with claiming territory to farm contributed to the megalithic tomb tradition that emerged in the Neolithic. There are four main types of megalithic tombs; court cairns, portal tombs, passage tombs and the later wedge tombs of the early Bronze Age. These monuments served as tombs for the dead, ceremonial centres for the living and territorial markers in the landscape. They would have required significant organisation and cooperation to construct. The proposed development area would have remained favourable for settlement into the Neolithic period although there are no recorded Neolithic sites in the vicinity of the proposed power plant.

13.3.1.3 Bronze Age (2500–800 BC)

The Bronze Age was marked by the widespread use of metal for the first time in Ireland. As with the transition from Mesolithic to Neolithic, the transition into the early Bronze Age was accompanied by changes in society. The megalithic tomb tradition went into decline and ended by the middle Bronze Age and the burial of the individual became typical. Cremated or inhumed individuals were often placed in a cist, which is a stone-lined grave, usually built of slabs set upright to form a box-like construction and capped by a large slab or several smaller lintels (Buckley and Sweetman 1991). Barrows and pit burials are also funerary monuments associated with this period.

Another site type thought to reveal of glimpse of domestic life at this time is the burnt mound or *fulacht fia*. A common site within the archaeological record, they are traditionally interpreted as temporary cooking sites but it has been suggested that they may have had other functions such as brewing, dyeing and bathing. They survive as low mounds of charcoal-enriched soil mixed with an abundance of heat-shattered stones. They are usually horseshoe-shaped and located in low-lying areas near a water source and are often found in clusters. Even when levelled by an activity such as ploughing, they are identifiable as burnt spreads in the landscape (Brindley and Lanting, 1990).

No Bronze Age site have been recorded within the study area of the proposed power plant to date.

13.3.1.4 Iron Age (800 BC–AD 500)

Compared to the rest of Irish prehistory, there is very little evidence in Ireland, as a whole, representing the Iron Age. As in Europe, there are two phases of the Iron Age in Ireland; the Hallstatt and the La Tène. The Hallstatt period generally dates from 700BC onwards and spread rapidly from Austria, across Europe, and then into Ireland. The later Iron Age or La Tène also originated in Europe during the middle of the 5th century BC. While in Ireland, evidence of a Hallstatt phase is rare, La Tene influences are reflected strongly in the style of metalwork of this period. It is clear that there was significant contact and interaction between the Continental Europe, Britain and Ireland at this time. There are no recorded sites of Iron Age date in the vicinity of the proposed development area. There are no recorded sites of Iron Age date in the vicinity of the proposed power lant.

13.3.1.5 Early Medieval Period (AD 500–1100)

Ireland, as depicted in the surviving sources, was entirely rural in the early medieval period. Ireland at this time was a patchwork of larger and smaller kingdoms known as *túath* and *trícha cét* respectively. Byrne (1973) estimates that there were as many as 150 kings in Ireland at the time, each ruling over a basic territorial unit known as the *túath*. If estimates placing the population of Ireland in the early medieval period at quarter to half a million people are accurate, then each king would have ruled over between 1,700 and 3,300 subjects within his *túath* (Stout 2017). From the 6th century, many of these subjects would have lived in enclosed settlements known as ringforts.

Secular habitation sites in the early medieval period include *crannógs*, cashels and ringforts, which are largely defined as circular enclosures surrounded by banks and ditches. In addition to these, there is some evidence for unenclosed settlements which are more difficult to identify in the archaeological record. The ringfort or *ráth* is considered to be the most common indicator of settlement during the early medieval period. Ringforts are strongly associated with agricultural land and, as such, are rarely situated at higher altitudes. Ringforts and potential ringforts (enclosures) are the most common archaeological sites recorded across the Irish landscape. Enclosures, in many cases, represent damaged or denuded ringforts.

This period was also characterised by the introduction of Christianity to Ireland. Early churches tended to be constructed of wood or post-and-wattle. Between the late 8th and 10th centuries, mortared stone churches gradually replaced these earlier structures. Many of the sites, some of which were monastic foundations, were probably originally defined by an enclosing wall or bank similar to that found at the coeval secular sites. This enclosing feature was probably built more to define the sacred character of the area of the church than as a defence against aggression. An inner and outer enclosure can be seen at some of the more important sites; the inner enclosure surrounding the sacred area of church and burial ground and the outer enclosure providing a boundary around living quarters and craft areas. Where remains of an enclosure survive, it is often the only evidence that the site was an early Christian foundation. An ecclesiastical enclosure (DU021-005003) is recorded c. 393m south of the proposed development area. The sub-circular raised area contains a graveyard (DU021-005002) and a medieval stone church (DU021-005001). Although the surviving church is of medieval date it may stand on the site of an early medieval ecclesiastical site.

In 2020 a geophysical survey was carried out within lands to the immediate west of the proposed development area. This resulted in the identification of a circular enclosure with a diameter of c. 30m, likely to represent the remains of an early medieval ringfort.

13.3.1.6 Medieval Period (AD 1100–1600)

This period began with the arrival of the Anglo-Normans in Ireland in support of the deposed King of Leinster, Diarmait MacMurchadha. By the end of the 12th century the Normans had succeeded in conquering much of the country (Stout and Stout 1997). Leinster, including Dublin and Meath, was 'sub-infeudated', meaning that great swathes of land were parcelled out among the Anglo-Norman elites. The Anglo-Norman tenurial system more or less appropriated the older established land units known as *túaths* in the early medieval period but described the territories as manors (MacCotter 2008). The initial stage of the invasion of the country was marked by the construction of motte and bailey castles, which were later replaced with stone castles.

In the later medieval period, a total of seven tower houses were constructed in the wider environs of the proposed development area. These include Grange Castle (DU017-034), from which the wider area takes its name, Kilbride Castle (DU021-004), c. 391m south of the proposed development area and Nangor Castle (DU017-037), c. 925m to the northeast. Kilbride Castle (DU021-004) is no longer extant with its location now occupied by a farm complex. Some of the farm buildings may have been built from the reclaimed fabric of the castle. The castle appears to have survived until 1871-5, when it was depicted on the historic OS mapping. By the time of the 1906-9 OS map, it is annotated as 'site of', indicating it has been demolished.

The existing Kilbride Church (DU021-005001) dates to the medieval period, though stands in ruins today. It was described at the dissolution in 1547 as an old chapel- indicating it was considered old even in the mid-16th century and described as ruinous as early as 1630 (SMR file). The church was dedicated to St. Bridget, giving the townland its name, Kilbride, deriving from *Cill Bhríde*.

13.3.1.7 Post-Medieval Period (AD 1600–1900)

The 17th century witnessed the systematic reduction of all of Ireland to English authority, largely through conflicts and the forced settlements, 'The Plantations'. With the onset of the 18th century, the political climate settled and this saw a dramatic rise in the establishment of large residential houses around the country. This was largely due to the fact that after the turbulence of the preceding centuries, the success of the Protestant cause and effective removal of any political opposition, the country was at peace. The large country house was only a small part of the overall estate of a large landowner and provided a base to manage often large areas of land that could be dispersed nationally. During the latter part of the 18th century, the establishment of a parkland context (or demesnes) for large houses was the fashion. Although the creation of a parkland landscape involved working with nature, rather than against it, considerable construction effort went into their creation. Major topographical features like rivers and mountains were desirable features for inclusion into, and as a setting, for the large house and parkland. The closest former parklands to the proposed power plant, is a modest demesne associated with Kilcarbury House, c. 490m to the east and the much larger Castle Baggot, c. 575m to the southwest.

13.3.2 Summary of Previous Archaeological Fieldwork

A review of the Excavations Bulletin (1970–2021) revealed that no previous archaeological investigations have been carried out within the site of the proposed power plant. Three archaeological investigations have taken place within 500m of this site.

Archaeological monitoring was carried out during the construction of the development to the immediate south under licence 12E067. Nothing of archaeological significance was uncovered (Bennett 2012:188).

In 2020 a geophysical survey was carried out within lands to the immediate west of the proposed development area (Licence Ref.: 20R0080). This resulted in the identification of a circular enclosure with a diameter of c. 30m, likely to represent the remains of an early medieval ringfort. The site is located c 55m west-southwest of the proposed development area.

Archaeological monitoring was also carried out prior to industrial development to the north of the proposed development area, within the 'Kilcarbery Distribution Park' (Licence 98E0572, Bennett 1999:170). No features or deposits of archaeological potential were identified during these works. Post-medieval and modern pottery was recovered from the topsoil.

13.3.3 Cartographic Analysis

13.3.3.1 Down Survey Maps of the Barony of Newcastle, c. 1655

There is little detail provided for the site of the proposed power plant in these early maps. It would appear that the site is located within an area noted as 'unforfeited lands' and it is therefore not shown in any detail as the primary purpose of these early maps was to detail land to be forfeited. It is likely the site area was in use as agricultural land at this time.

13.3.3.2 John Rocque, Map of County Dublin, 1760 (Figure 13-2)

By the time of this mapping in 1760, the site of the proposed power plant is depicted as open agricultural land. Kilbride church (DU021-005001), annotated as in ruins, is shown to the south. A structure is shown in the approximate location of Kilbride castle (DU021-004) but is unlabelled. In the wider landscape, Grange Castle (DU017-034) and Nangor (DU017-037) are also shown.

13.3.3.3 John Taylor, Map of Dublin City and its Environs, 1816 (Figure 13-2)

The site of the proposed power plant is depicted in an undeveloped location on this map, within an area labelled 'lands of Kilbride'. Kilbride church (DU021-005001) is again shown and labelled as in ruins. A small structure is depicted to the west of the site's approximate location and labelled 'Kilcarbery'.

13.3.3.4 First Edition Ordnance Survey Map, 1843, scale 1:10,056 (Figure 13-3)

This is the first accurate historic mapping coverage of the area containing the proposed development. The site of the proposed power plant forms part of an agricultural landscape, comprising parts of three fields. A laneway passes north-south through the proposed development area leading to Kilbride Castle (DU021-004) to the south. Kilbride Church (DU021-005001) is also shown within a sub-circular graveyard.

13.3.3.5 Second Edition Ordnance Survey Map, 1871-5, scale 1:10,056 (Figure 13-3)

There is no change to the site of the proposed power plant by the time of this map. To the south, Kilbride House has been constructed immediately to the west of Kilbride Castle (DU021-004).

13.3.3.6 Ordnance Survey Map, 1906–9, scale 1:2500

There is no significant change to the proposed development area shown on this map. Kilbride Castle (DU021-004) is now annotated as 'site of' indicating that the castle is no longer extant by this time. While Kilbride Church (DU021-005001) is marked as 'in ruins' for the first time.

13.3.3.7 Third Edition Ordnance Survey Map, 1935-8, scale 1:10,056

There are no significant changes to the site of the proposed power plant on this map.

Figure 13-2: Extracts from historic OS maps (1843 and 1871-5) showing the proposed development area

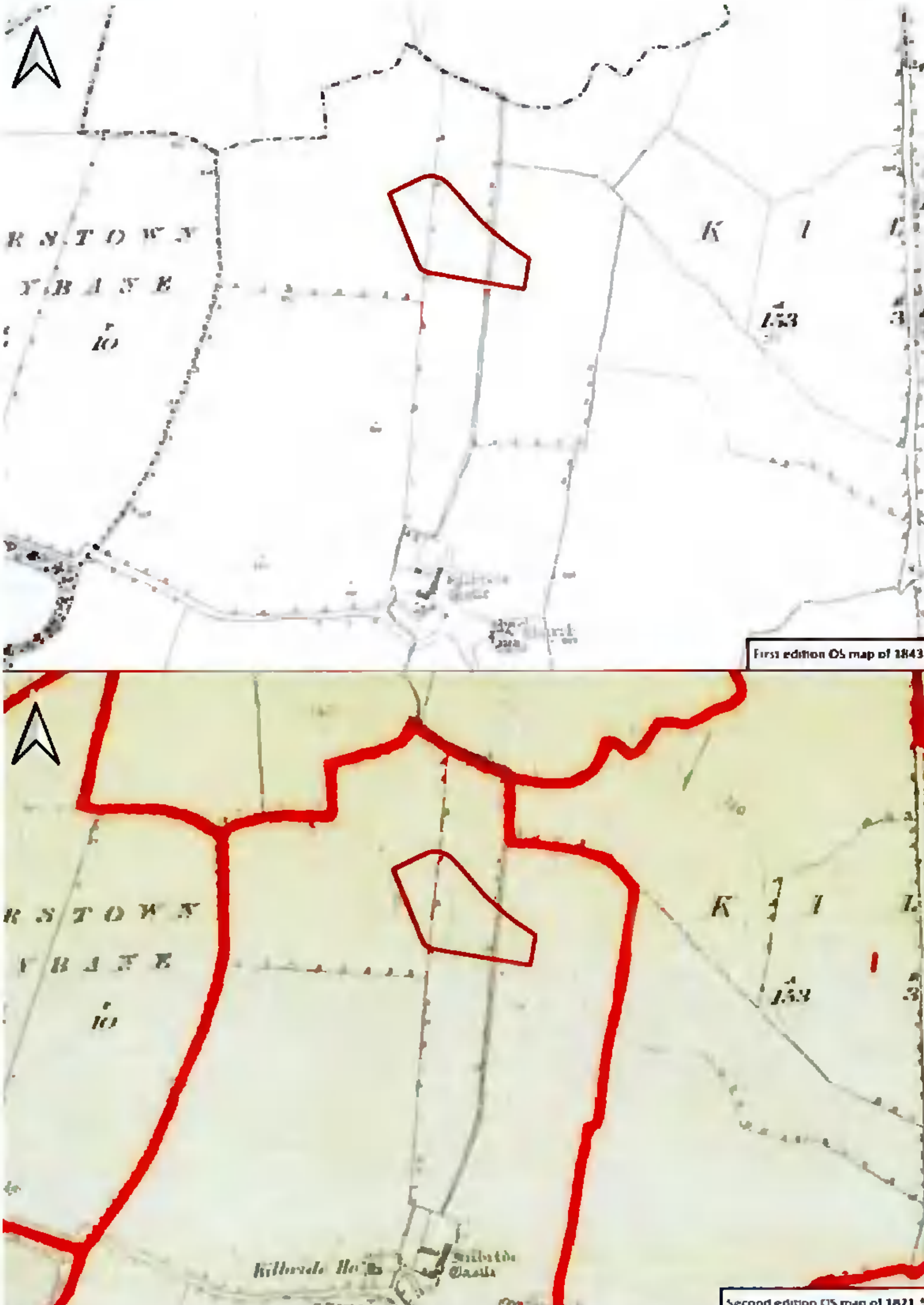

Figure 13-3: Extracts from historic OS maps (1843 and 1871-5) showing the proposed development area

13.3.4 County Development Plan

The South County Dublin Development Plan (2016–2022) recognises the statutory protection afforded to all RMP sites under the National Monuments Legislation (1930–2014). The development plans list a number of aims and objectives in relation to archaeological heritage (Appendix 13.1). It is a policy of the South County Dublin Development Plan (2016–2022) to promote the in-situ preservation of archaeology as the preferred option where development would have an impact on buried artefacts. Where preservation in situ is not feasible, sites of archaeological interest shall be subject to archaeological investigations and recording according to best practice, in advance of redevelopment.

There are no recorded archaeological sites within the proposed development area. There are four recorded monuments within 500m of the site (Appendix 13.1; Table 1).

Table 13-1: Recorded Archaeological Sites

RMP No.	Location	Classification	Distance From Site
DU021-004	Kilbride	Castle - unclassified	391m south
DU021-00500103	Kilbride	Church, Graveyard and Ecclesiastical enclosure	393m south

13.3.5 Stray Finds within the Surrounding Area

Information on artefact finds from the study area in County Dublin has been recorded by the National Museum of Ireland since the late 18th century. Location information relating to these finds is important in establishing prehistoric and historic activity in the study area.

A review of the topographical files revealed that no stray finds have been recovered from within the study area of the proposed development to date.

13.3.6 Aerial Photographic Analysis

Inspection of the aerial photographic coverage of the proposed development area held by the Ordnance Survey (1995–2013), Google Earth (2008–2020) and Bing Maps (2021) revealed the proposed development area has been subject to topsoil disturbance in recent years during the construction of the roadway to the north and east (Google Earth 2009, Figure 13-4). No previously unknown archaeological sites were noted during the analysis.

Figure 13-4: Satellite imagery of the proposed development area (Google Earth 2009)

13.3.7 Field Inspection

The field inspection sought to assess the site, its previous and current land use, the topography, and any additional information relevant to the report. During the course of the field investigation the proposed development site and its immediate surrounding environs including the proposed electrical grid and gas connections were inspected (Figure 13-4).

The proposed development area comprises an area of flat disturbed ground (Figures 13-5 and 13-6). It is bounded by the public road to the east and north and by a large industrial complex to the south. The disturbed ground continues west beyond the site. A deep drainage feature is present running along the site's eastern boundary (Figure 13-7). It continues north along the eastern side of the site before it crosses underneath the public road and continues north.

No previously unrecorded features or areas of archaeological significance were identified during the site inspection. The inspection confirmed that the site has been disturbed in recent years, as indicated in the aerial photographic coverage.

Figure 13-5: Proposed development area, facing southwest

Figure 13-6: Proposed development area, facing southwest

Figure 13-7: Drainage feature on eastern side of site, facing northwest

13.3.8 Cultural Heritage

The term 'cultural heritage' can be used as an over-arching term that can be applied to both archaeology and architectural; however, it also refers to more ephemeral aspects of the environment, which are often recorded in folk law or tradition or possibly date to a more recent period. There are no specific sites of cultural heritage significance within the study area of the proposed power plant, however the archaeological sites discussed above should also be considered cultural heritage and the townlands and placename analysis detailed below are also of cultural heritage significance.

13.3.8.1 Townlands

The townland is an Irish land unit of considerable longevity as many of the units are likely to represent much earlier land divisions. However, the term townland was not used to denote a unit of land until the Civil Survey of 1654. It bears no relation to the modern word 'town' but like the Irish word *baile* refers to a place. It is possible that the word is derived from the Old English *tun land* and meant 'the land forming an estate or manor' (Culleton 1999, 174).

Gaelic land ownership required a clear definition of the territories held by each sept and a need for strong, permanent fences around their territories. It is possible that boundaries following ridge tops, streams or bog are more likely to be older in date than those composed of straight lines (*ibid.* 179).

The vast majority of townlands are referred to in the 17th century, when land documentation records begin. Many of the townlands are mapped within the Down Survey of the 1650s, so called as all measurements were carefully 'laid downe' on paper at a scale of forty perches to one inch. Therefore, most are in the context of pre-17th century landscape organisation (McErlean 1983, 315).

In the 19th century, some demesnes, deer parks or large farms were given townland status during the Ordnance Survey and some imprecise townland boundaries in areas such as bogs or lakes, were given more precise definition (*ibid*). Larger tracks of land were divided into a number of townlands, and named Upper, Middle or Lower, as well as Beg and More (small and large) and north, east, south, and west (Culleton 1999, 179). By the time the first Ordnance Survey had been completed a total of 62,000 townlands were recorded in Ireland.

The proposed power plant is located within the townland of Kilbride. The surrounding townlands consist of Aungierstown and Ballybane, Baldonnell Lower, Baldonnell Upper, Ballybane, Kilcarbery and Kilmactalway.

13.3.8.2 Toponomy of Townlands

Townland and topographic names are an invaluable source of information on topography, land ownership and land use within the landscape. They also provide information on history; archaeological monuments and folklore of an area. A place name may refer to a long-forgotten site and may indicate the possibility that the remains of certain sites may still survive below the ground surface. The Ordnance Survey surveyors wrote down townland names in the 1830's and 1840's, when the entire country was mapped for the first time. Some of the townland names in the study area are of Irish origin and through time have been anglicised. The main references used for the place name analysis are *Irish Local Names Explained* by P.W Joyce (1870) and www.logainm.ie. A description and possible explanation of each townland name in the environs of the proposed route are provided in the below table.

Table 13-2: Place Name Analysis

Name	Derivation	Possible Meaning
Aungierstown and Ballybane	-	Aungier's Town/The white homestead
Kilbride	*Cill Bhríde*	St. Bridget's Church
Kilmactalway	*Cill Mhic Thalmhaigh*	Mac Shalwy's Church
Ballybane	*An Baile Bán*	The white homestead
Baldonnell	*Baile Dhónaill*	Donal's homestead
Kilcarbery	*Cill/coill Chairbre*	Church/wood of Cairbre

13.3.9 Archaeological Testing

In November 2021 a programme of archaeological testing was carried out across the proposed development area under licence 21E0692, as issued by the National Monuments Service of the DoHLGH. The programme of assessment was undertaken by Marc Piera of IAC (Figure 13-8). Archaeological testing comprised the excavation of six trenches and six trial pits, totalling 382 linear metres. The eastern portion of the site was characterised by c. 2.5m of modern backfill and the central part of the site was formerly stripped of topsoil with the natural subsoils reduced. A small section of the western part of the site was less disturbed, as illustrated by the identification of a small pit in Trench 7. The pit contained a fill characterised with inclusions of charcoal and animal bones.

The assessment recommended that the pit be subject to archaeological preservation by record (excavation) prior to construction going ahead and that ground disturbances within the development area be monitored by a suitably qualified archaeologist.

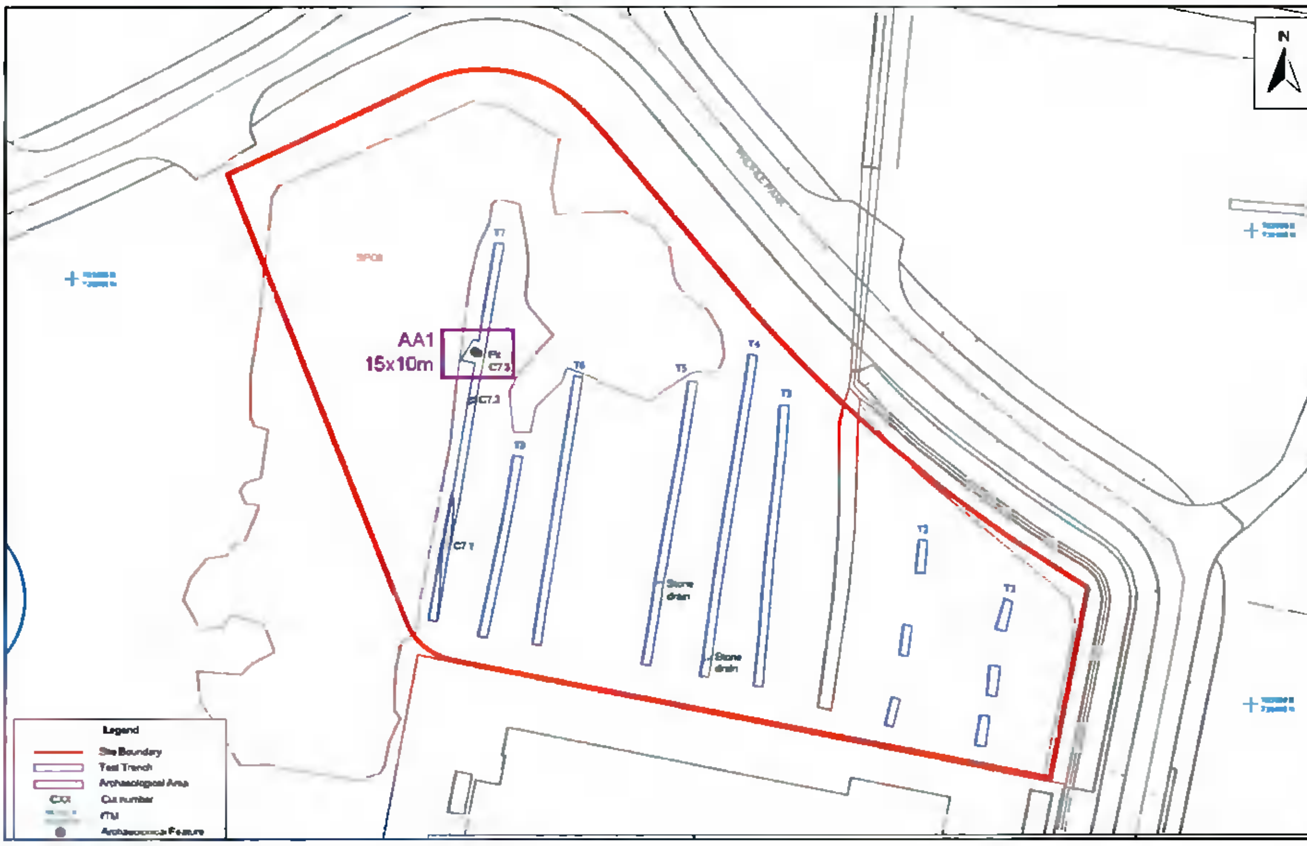

Figure 13-8: Plan of archaeological test trenches

13.4 CONCLUSIONS

The proposed power plant is located in the townland of Kilbride, Parish of Kilbride and Barony of Newcastle. There are two individual or groups of recorded monuments located within 500m of the proposed power plant. These comprise a castle (DU0021-004) and a church, graveyard and ecclesiastical enclosure group (DU0021-005001-3), located over 300m to the south.

There have been no archaeological investigations within the proposed development area to date. A review of Excavations Bulletin (1970-2021) revealed that two previous programmes of archaeological monitoring of took place in the vicinity of the proposed development area, one to the immediate south and one c. 327m north of the site. Neither revealed any features or deposits of archaeological significance (Licence 12E067, Bennett 2012:188, Licence 98E0572, Bennett 1999:170). In 2020 a programme of geophysical survey was carried out to the immediate west of the proposed development area, which revealed a circular enclosure c. 55m west-southwest of the site. The enclosure is likely to represent the remains of an early medieval ringfort.

A review of the historic mapping demonstrated that the proposed development area remained as undeveloped agricultural greenfield throughout the post-medieval period. Aerial photographic analysis and satellite imagery proved the site remained greenfield until the construction of the roadways to the immediate east and north c. 2009 (Google Earth). The aerial photographic coverage has shown that the site of the proposed power plant has been subject to disturbance in the recent past.

A review of the topographical files revealed that no stray finds have been recovered from within the study area of the proposed power plant to date.

A field inspection confirmed that the area of the proposed power plant has been subject to disturbance, as indicated in the aerial photographic coverage. No features of archaeological potential were identified during the field inspection.

Both the electrical grid and gas connections will be installed in existing public or private roads and there is no potential for discovering new archaeological features given this is made ground with existing utility infrastructure already in situ.

A programme of archaeological testing has been carried out across the development area, which confirmed that the central and eastern portions of the site have been subject to disturbance. A small portion of the western part of the site is less disturbed and testing identified a pit in this part of the site, which contained charcoal and animal bone, but no dating material was identified.

13.5 ASSESSMENT OF SIGNIFICANT EFFECTS

13.5.1 Do Nothing Scenario

If the proposed power plant were not to proceed, there would be no negative impact on the archaeological or cultural heritage resource of the site or its surrounding area.

13.5.2 Construction Phase

13.5.2.1 Archaeology

Ground disturbances associated with the development will result in a direct and negative impact on the pit identified during testing in 2021. This is a small and isolated feature and the significance of effect is deemed to be moderate.

Whilst the site of the proposed power plant has been subject to disturbances, it is unclear how this disturbance may have affected the potential archaeological resource. It remains possible that ground disturbances associated with the development may have a direct negative impact on archaeological remains that may survive within the site. Impacts have the potential to range from moderate to significant in scale, prior to the application of mitigation.

13.5.2.2 Cultural Heritage

No potential negative impacts upon the cultural heritage resource are predicted as a result of the construction of the proposed power plant.

13.5.3 Operational Phase

No negative impacts during operation are predicted upon the archaeological and cultural heritage resource.

13.5.3.1 Potential Cumulative Impacts

As it is proposed to monitor construction activity and preserve any identified archaeological features by record, no cumulative impacts are predicted upon the archaeological or cultural heritage resource.

13.6 MITIGATION AND MONITORING MEASURES

13.6.1 Construction Phase

13.6.1.1 Archaeology

Prior to the commencement of construction, the pit that was identified during archaeological testing will be subject to archaeological preservation by record (excavation). This will be undertaken under an extension to the existing licence and in consultation with the National Monuments Service of the DoHLGH.

All topsoil/overburden stripping associated with the proposed power plant will be monitored by a suitably qualified archaeologist. If any features of archaeological potential are discovered during the course of the works further archaeological mitigation may be required, such as preservation in-situ or by record. Any further mitigation will require approval from the National Monuments Service of the Department of Housing, Local Government and Heritage (DoHLGH).

The mitigation measure identified above would also function as a monitoring system during construction to allow the further assessment of the scale of the predicted impacts and the effectiveness of the recommended mitigation measures.

13.6.1.2 Cultural Heritage

As there are no potential impacts on the cultural heritage resource, no mitigation is deemed necessary.

13.6.2 Operational phase

No mitigation relating to the operational phase and the archaeological and cultural heritage resource is required.

13.7 CUMULATIVE EFFECTS

Both the electrical grid and gas connections will be installed in existing public or private roads and there is no potential for discovering new archaeological features given this is made ground with existing utility infrastructure already in situ. No other cumulative impact with other projects are predicted.

13.8 RESIDUAL EFFECTS

There are no predicted residual impacts for the operational phase of the proposed development upon the archaeological and cultural heritage resource.

13.9 REFERENCES

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www.tobin.ie

TOBIN Consulting Engineers

@tobinengineers

Galway
Fairgreen House,
Fairgreen Road,
Galway,
H91 AXK8,
Ireland.
Tel: +353 (0)91 565 211

Dublin
Block 10-4,
Blanchardstown Corporate Park,
Dublin 15,
D15 X98N,
Ireland.
Tel: +353 (0)1 803 0406

Castlebar
Market Square,
Castlebar,
Mayo,
F23 Y427,
Ireland.
Tel: +353 (0)94 902 1401

London
17 Bowling Green Lane
Clerkenwell
London,
EC1R 0QB,
United Kingdom.
Tel: (+44) (0)203 915 6301

Appendix F – Air

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ENVIRONMENTAL IMPACT ASSESSMENT REPORT

CHAPTER 10: AIR QUALITY AND CLIMATE

MAY 2022

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10.0 AIR QUALITY AND CLIMATE

10.1 INTRODUCTION

AWN Consulting Ltd. were commissioned to undertake an air quality and climate assessment of the proposed power plant at Profile Park. The purpose of the assessment was to determine the air quality and climatic impact, in line with the Industrial Emissions Directive (2010/75/EU) and Best Available Techniques (BAT) Reference Document for Large Combustion Plants (2017), from the proposed plant in isolation and cumulatively with the existing licensed facilities at Profile Park.

The assessment of the emissions to air included other Industrial Emissions (IE) Licenced plants include Pfizer, Takeda, the Grange Castle Power Facility and Vantage Data Centre DUB11 and these have been modelled alongside the proposed plant.

The impact assessment consisted of the following components:

- Review of emission data and other relevant information needed for the modelling study;
- Summary of background NO_2 levels;
- Dispersion modelling of released substances under the normal operations scenario, where there are 5 no. exhaust flues, one for each gas engine;
- Cumulative assessment of the Profile Park Power Station and all existing IE Licenced emission points in the region for each scenario;
- Presentation of predicted ground level concentrations of released substances;
- Evaluation of the significance of these predicted concentrations, including consideration of whether these ground level concentrations are likely to exceed the relevant ambient air quality limit values;
- Assessment of the potential greenhouse gas (GHG) emissions associated with the proposed development; and
- Assessment of the potential impact of the plumes associated with the operational phase of the proposed station on aircraft.

The natural gas engines may also be powered by diesel oil as back-up to the normal gas supply. Testing in this mode is expected to occur for a maximum of 18 hours per annum (Section **Error! Reference source not found.**). Emergency operation and testing of the engines using diesel oil have been scoped out of this air modelling assessment as it is not expected that these operation modes would cause any significant impacts on ambient air quality considering the infrequent and unpredictable usage of this back-up fuel, as per Section **Error! Reference source not found.** of the EIAR. A pre-heat boiler will also be in operation to prepare the main generators i.e. the boiler and main generators will not operate simultaneously. A worst-case scenario of the main generators operating continuously 24 hours per day, 7 days per week has been modelled.

Information supporting the conclusions has been detailed in the following sections. The assessment methodology and study inputs are presented in Section 10.2. The dispersion modelling results for the normal operations scenario and assessment summaries are presented in Section 10.5. The model formulation is detailed in Appendix 10.1 and a review of the meteorological data used is detailed in Appendix 10.2. The plume modelling results for the normal operations scenario are presented in Appendix 10.3. For a glossary of terms used in this chapter please refer to Appendix 10-1.

10.1.1 Statement of Competency

This chapter of the EIAR has been prepared by the following staff of AWN Consulting Ltd:

Dr. Jovanna Arndt (Senior Air Quality Consultant) holds a BSc (Hons) in Environmental Science, a PhD in Atmospheric Chemistry and is a member of the Institute of Air Quality Management. Jovanna has specialised in air quality since 2010 and has extensive knowledge of air dispersion modelling of a variety of infrastructure projects, including power stations, and is experienced in monitoring and managing the associated air quality impacts.

Dr. Edward Porter (Director) holds a BSc (Hons) in Chemistry a PhD in Atmospheric Chemistry and is a member of the Institute of Air Quality Management. Edward has specialised in air quality since 1993 and has extensive knowledge of air dispersion modelling air monitoring and climate impact assessments.

10.2 METHODOLOGY

10.2.1 Air Quality Methodology

Emissions from the Profile Park power plant and the existing air emission points at Pfizer, Takeda, the Grange Castle Power Facility and Vantage Data Centre DUB11 have been modelled using the AERMOD dispersion model (Version 19191) which has been developed by the U.S. Environmental Protection Agency (USEPA) (USEPA, 2019) and following guidance issued by the EPA (EPA, 2020a). The model is a steady-state Gaussian plume model used to assess pollutant concentrations associated with industrial sources and has replaced ISCST3 (USEPA, 1995) as the regulatory model by the USEPA for modelling emissions from industrial sources in both flat and rolling terrain (USEPA, 1998, 2000a, 2017). The model has more advanced algorithms and gives better agreement with monitoring data in extensive validation studies (EPA, 2021; Schulman et al., 1998; Paine & lew, 1997a, 1997b; USEPA, 1999). An overview of the AERMOD dispersion model is outlined in Appendix 10.1.

The air dispersion modelling input data consisted of information on the physical environment (including existing and proposed building dimensions and terrain features), design details and process emissions data for the existing air emissions points and estimated process emissions data for the proposed power plant as well as five years of appropriate hourly meteorological data. Using this input data the model predicted ambient ground level concentrations beyond the site boundary for each hour of the modelled meteorological years. The model post-processed the data to identify the location and maximum of the worst-case ground level concentration. This worst-case concentration was then added to the background concentration to give the worst-case predicted environmental concentration (PEC). The PEC was then compared with the relevant ambient air quality limit value to assess the significance of impacts associated with the existing and proposed emissions from the site.

The modelling aims to achieve compliance with the guidance outlined within the EPA AG4 Guidance for Air Dispersion Modelling (EPA, 2020a) for the maximum permissible process contribution:

> *"When modelling a facility, the uncertainty in the model should be considered. If the facility is operated continually at close to the maximum licenced mass emission rate (i.e.*

maximum concentration and maximum volume flow) the process contribution (PC) should be less than 75% of the ambient air quality standard and less than this where background levels account for a significant fraction of the ambient air quality standard based on the formula":

Maximum Allowable Process Contribution= 0.75(AQS-BC)*

This approach allows for inherent uncertainty in air dispersion modelling to be taken into account in order to avoid a risk of exceeding the air quality standards. The modelling assessment has aimed to achieve a process contribution that is less than 75% of the ambient air quality standard at licenced conditions.

Throughout this study a worst-case approach was taken. This will most likely lead to an over-estimation of the levels that will arise in practice. The worst-case assumptions are outlined below:

- Maximum predicted concentrations were reported in this study, even if no residential receptors were near the location of this maximum;
- Conservative background concentrations were used;
- The effect of building downwash, due to on-site and any nearby off-site buildings, has been included in the model;
- All emission points were assumed to run continuously, every hour of the day, 365 days per year;
- The Ozone Limiting Method (OLM) was used to model NO_2 concentrations. The OLM is a regulatory option in AERMOD which calculates ambient NO_2 concentrations by applying a background ozone concentration and an in-stack NO_2/NO_X ratio to predicted NO_X concentrations. An in-stack NO_2/NO_X ratio of 0.1 and a background ozone concentration of 55 $\mu g/m^3$ were used for modelling the proposed Profile Park Power Station and all existing emission points for the purpose of this study even though the in-stack ratios are likely to be lower in reality;

The contour patterns shown in the figures in this chapter, which are a representation of the variation in ambient ground level pollutant concentrations beyond the site boundary, are a function of several interacting parameters. Wind speed and direction are important in determining offsite ambient concentrations. However, building downwash is also an important consideration and for each emission point the relative position of the stack to the dominant building will be important and will lead to variations in the offsite contour patterns which cannot be intuitively forecast in advance. Thus, the resultant pollutant contour pattern is a function of several parameters and will vary as a result of how all of these parameters interact with each other.

10.2.2 Ambient Air Quality Standards

In order to reduce the risk to health from poor air quality, national and European statutory bodies have set limit values in ambient air for a range of air pollutants. These limit values or "Air Quality Standards" are health- or environmental-based levels for which additional factors may be considered. The applicable limit values in Ireland include the Air Quality Standards Regulations 2011, which incorporate EU Directive 2008/50/EC (see Table 10.1).

These limit values have been used in the current assessment to determine the potential impact of NO_X emissions from the proposed facility on air quality. Oxides of nitrogen (NO_X) is a term commonly used to describe a mixture of nitric oxide (NO) and nitrogen dioxide (NO_2), referred to collectively as NO_X. These are primarily formed from atmospheric and fuel nitrogen as a result of high temperature combustion. The major sources in most countries are road traffic and power generation. During the process of combustion, atmospheric and fuel nitrogen is partially oxidised via a series of complex reactions to NO. The process is dependent on the temperature, pressure, oxygen concentration and residence time of the combustion gases in the combustion zone. Most NO_X exhausting from a combustion process is in the form of NO, which is a colourless and tasteless gas. It is readily oxidised to NO_2, a more harmful form of NO_X, by chemical reaction with ozone and other chemicals in the atmosphere.

Modelling for NO_2 was undertaken in detail for the dual fuel gas engines. These engines (as per CRU requirements) are also required to have the capacity to operate on diesel oil in emergency scenarios. These operating scenarios are *'other than normal operating conditions'* (OTNOC) and therefore any emissions during these periods (i.e. NO_2, CO, SO_2 and particulate matter (PM_{10}/$PM_{2.5}$) are not subject to emissions limit values specified in the Industrial Emissions Directive (2010/75/EU) and Best Available Techniques (BAT) Reference Document for Large Combustion Plants (2017). Further detail on OTNOC is provided in Section 10.2.3.6.

No modelling for NO_2 was undertaken for the gas engines using diesel oil to for start up operations as this is also OTNOC and will occur for less than five minutes on start up. In relation to CO, SO_2, PM_{10} and $PM_{2.5}$ no detailed modelling was undertaken. Emissions of these pollutants are significantly lower than the NO_X emissions from the generators relative to their ambient air quality standards and thus ensuring compliance with the NO_2 ambient limit value will ensure compliance for all other pollutants. For example, the emission of CO from the generators is at least eight times lower than NO_X whilst the CO ambient air quality standard is 10,000 $\mu g/m^3$ compared to the 1-hour NO_2 standard of 200 $\mu g/m^3$. Similarly, levels of PM_{10}/$PM_{2.5}$ emitted from the generators will be 90 times lower whilst the ambient air quality standards are comparable. Emissions of SO_2 are approximately 55 times lower than emissions of NO_X.

Table 10-1: Air Quality Standards 2011 (Based on Directive 2008/50/EC)

Pollutant	Regulation Note 1	Limit Type	Value
Nitrogen Dioxide	2008/50/EC	Hourly limit for protection of human health - not to be exceeded more than 18 times/year	200 $\mu g/m^3$ NO_2
		Annual limit for protection of human health	40 $\mu g/m^3$ NO_2
		Critical level for protection of vegetation	30 $\mu g/m^3$ NO + NO_2

Note A EU 2008/50/EC – Clean Air For Europe (CAFÉ) Directive replaces the previous Air Framework Directive (1996/30/EC) and daughter directives 1999/30/EC and 2000/69/EC.

10.2.3 Air Dispersion Modelling Methodology

The United States Environmental Protection Agency (USEPA) approved AERMOD dispersion model has been used to predict the ground level concentrations (GLC) of compounds emitted from the proposed power plant.

The modelling incorporated the following features:

- Three receptor grids were created at which concentrations would be modelled. Receptors were mapped with sufficient resolution to ensure all localised "hot-spots" were identified without adding unduly to processing time. The receptor grids were based on Cartesian grids with the site at the centre. The inner grid measured 3 km x 3 km with concentrations calculated at 125m intervals. The medium grid measured 10 km x 10 km with concentrations calculated at 250m intervals, whilst the outer grid measured 20 km x 20 km with concentrations calculated at 500m intervals. Boundary receptor locations were also placed along the ownership boundary of the site at 100 m intervals and sensitive receptors were also identified, giving a total of 1,753 calculation points for the model.
- All on-site buildings and significant process structures were mapped into the computer to create a three dimensional visualisation of the site and its emission points. Buildings and process structures can influence the passage of airflow over the emission stacks and draw plumes down towards the ground (termed building downwash). The stacks themselves can influence airflow in the same way as buildings by causing low pressure regions behind them (termed stack tip downwash). Both building and stack tip downwash were incorporated into the modelling.
- Detailed terrain has been mapped into the model using SRTM data with 30 m resolution. All terrain features have been mapped in detail into the model using the terrain pre-processor AERMAP (USEPA, 2018a).
- Hourly-sequenced meteorological information has been used in the model. Meteorological data over a five year period (Casement Aerodrome Meteorological Station, 2016 – 2020) was used in the model (see Figure 10-1).
- The source and emissions data, including stack dimensions, gas velocities, emission temperatures and pollutant emission rates have been incorporated into the model.
- A stack height determination study was also undertaken as part of the air dispersion modelling study to ensure that ambient levels of pollutants beyond the site boundary are below the maximum allowable process contribution (PC) based on the following formula for maximum operations outlined in AG4:

Maximum Allowable PC = 0.75*(AQS)
where there is no significant background concentration

Maximum Allowable PC = 0.75*(AQS – BC)
where there is a significant background concentration

This approach allows for the inherent uncertainty in air dispersion modelling to be taken into account in order to avoid a risk of exceeding the air quality limit values.

10.2.3.1 Terrain

The AERMOD air dispersion model has a terrain pre-processor AERMAP (USEPA, 2018) which was used to map the physical environment in detail over the receptor grid. The digital terrain input data used in the AERMAP pre-processor was obtained from SRTM. This data was run to obtain for each receptor point the terrain height and the terrain height scale. The terrain height scale is used in AERMOD to calculate the critical dividing streamline height, Hcrit, for each receptor. The terrain height scale is derived from the Digital Elevation Model (DEM) files in AERMAP by computing the relief height of the DEM point relative to the height of the receptor and determining the slope. If the slope is less than 10%, the program goes to the next DEM point. If the slope is 10% or greater, the controlling hill height is updated if it is higher than the stored hill height.

In areas of complex terrain, AERMOD models the impact of terrain using the concept of the dividing streamline (Hc). As outlined in the AERMOD model formulation (USEPA, 2019) a plume embedded in the flow below Hc tends to remain horizontal; it might go around the hill or impact on it. A plume above Hc will ride over the hill. Associated with this is a tendency for the plume to be depressed toward the terrain surface, for the flow to speed up, and for vertical turbulent intensities to increase.

AERMOD model formulation states that the model "captures the effect of flow above and below the dividing streamline by weighting the plume concentration associated with two possible extreme states of the boundary layer (horizontal plume and terrain-following). The relative weighting of the two states depends on: 1) the degree of atmospheric stability; 2) the wind speed; and 3) the plume height relative to terrain. In stable conditions, the horizontal plume "dominates" and is given greater weight while in neutral and unstable conditions, the plume traveling over the terrain is more heavily weighted" (USEPA, 2019).

The modelling domain is an area of generally moderate terrain to the east, north and west with complex terrain rising in the south due to the proximity of the Dublin Mountains within 5-10km of the site boundary.

10.2.3.2 Meteorological Data

The selection of the appropriate meteorological data has followed the guidance issued by the USEPA (USEPA, 2000a). Casement Aerodrome meteorological station, which is located approximately 9.5 km northwest of the site, collects data in the correct format and has data capture collection of greater than 90% for the required parameters. Long-term hourly observations at Casement Aerodrome meteorological station provide an indication of the prevailing wind conditions for the region (see Figure 10-1). Results indicate that the prevailing wind direction is from a westerly to south-westerly direction over the period 2016 - 2020. The mean wind speed is 5.5 m/s over the period 1981 – 2010. The data is provided by Met Éireann (source www.met.ie).

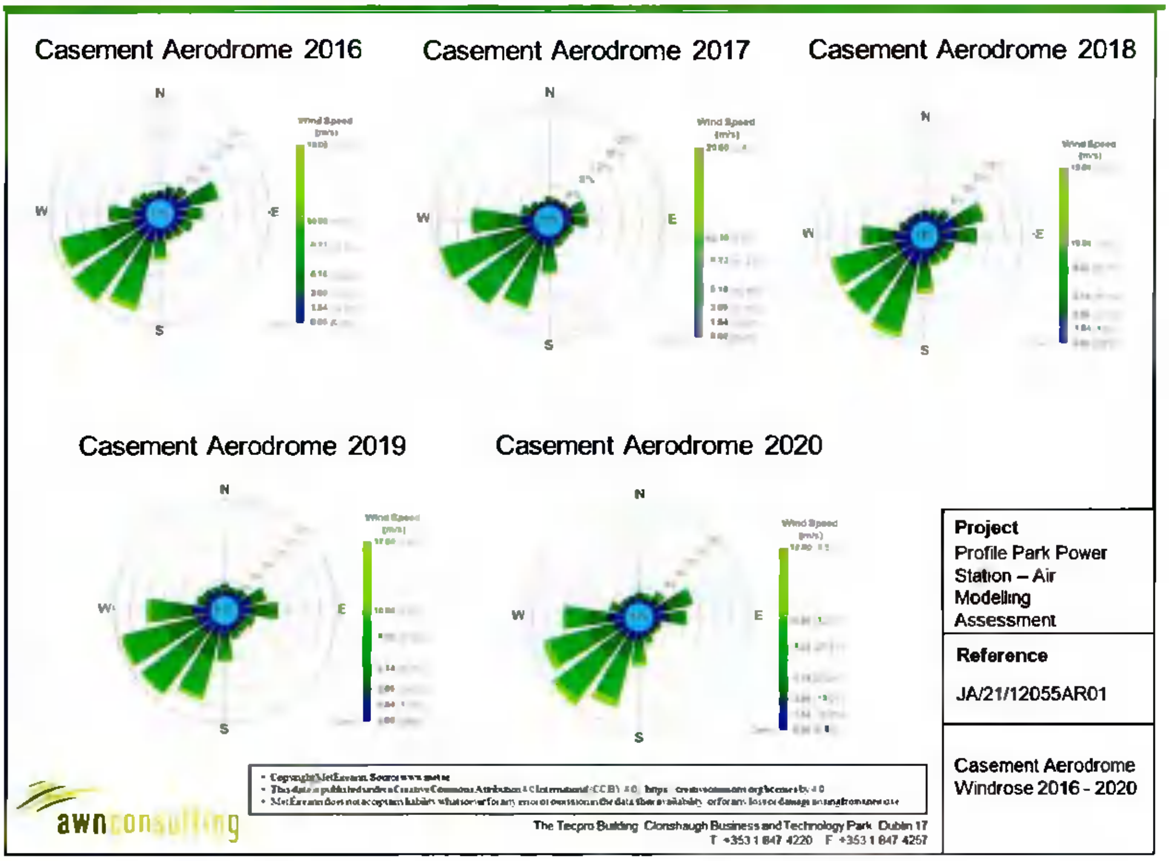

Figure 10-1: Casement Aerodrome Meteorological Station Windrose 2016 to 2020 (Met Éireann 2021)

10.2.3.3 Geophysical Considerations

AERMOD simulates the dispersion process using planetary boundary layer (PBL) scaling theory (USEPA, 2019). PBL depth and the dispersion of pollutants within this layer are influenced by specific surface characteristics such as surface roughness, albedo and the availability of surface moisture. Surface roughness is a measure of the aerodynamic roughness of the surface and is related to the height of the roughness element. Albedo is a measure of the reflectivity of the surface whilst the Bowen ratio is a measure of the availability of surface moisture.

AERMOD incorporates a meteorological pre-processor AERMET (USEPA, 2018) to enable the calculation of the appropriate parameters. The AERMET meteorological pre-processor requires the input of surface characteristics, including surface roughness (z_0), Bowen Ratio and albedo by sector and season, as well as hourly observations of wind speed, wind direction, cloud cover, and temperature. The values of albedo, Bowen Ratio and surface roughness depend on land-use type (e.g., urban, cultivated land etc.) and vary with seasons and wind direction. The assessment of appropriate land-use type was carried out to a distance of 10 km from the meteorological station for Bowen Ratio and albedo and to a distance of 1 km for surface roughness in line with USEPA recommendations (USEPA, 2014, 2018).

In relation to AERMOD, detailed guidance for calculating the relevant surface parameters has been published (ADEC, 2008). The most pertinent features are:

- The surface characteristics should be those of the meteorological site (Casement Aerodrome Meteorological Station) rather than the installation;

- Surface roughness should use a default 1 km radius upwind of the meteorological tower and should be based on an inverse-distance weighted geometric mean. If land use varies around the site, the land use should be sub-divided by sectors with a minimum sector size of 30°;
- Bowen ratio and albedo should be based on a 10 km grid. The Bowen ratio should be based on an un-weighted geometric mean. The albedo should be based on a simple un-weighted arithmetic mean.

AERMOD has an associated pre-processor, AERSURFACE (USEPA, 2014), which has representative values for these parameters depending on land use type. The AERSURFACE pre-processor currently only accepts NLCD92 land use data which covers the USA. Thus, manual input of surface parameters is necessary when modelling in Ireland. Ordnance survey discovery maps (1:50,000) and digital maps such as those provided by the EPA, National Parks and Wildlife Service (NPWS) and Google Earth® are useful in determining the relevant land use in the region of the meteorological station. The Alaska Department of Environmental Conservation has issued a guidance note for the manual calculation of geometric mean for surface roughness and Bowen ratio for use in AERMET (ADEC, 2008). This approach has been applied to the current site.

10.2.3.4 Building Downwash

When modelling emissions from an industrial installation, stacks which are relatively short can be subjected to additional turbulence due to the presence of nearby buildings. Buildings are considered nearby if they are within five times the lesser of the building height or maximum projected building width (but not greater than 800 m).

The USEPA has defined the "Good Engineering Practice" (GEP) stack height as the building height plus 1.5 times the lesser of the building height or maximum projected building width. It is generally considered unlikely that building downwash will occur when stacks are at or greater than GEP (USEPA, 1985).

When stacks are less than this height, building downwash will tend to occur. As the wind approaches a building it is forced upwards and around the building leading to the formation of turbulent eddies. In the lee of the building these eddies will lead to downward mixing (reduced plume centreline and reduced plume rise) and the creation of a cavity zone (near wake) where re-circulation of the air can occur. Plumes released from short stacks may be entrained in this airflow leading to higher ground level concentrations than in the absence of the building.

The Plume Rise Model Enhancements (PRIME) (Paine & Lew, 1997, Schulman et al., 1998) plume rise and building downwash algorithms, which calculates the impact of buildings on plume rise and dispersion, have been incorporated into AERMOD. The building input processor BPIP-PRIME produces the parameters which are required in order to run PRIME. The model takes into account the position of each stack relative to each relevant building and the projected shape of each building for 36 wind directions (at 10° intervals). The model determines the change in plume centreline location with downwind distance based on the slope of the mean streamlines and coupled to a numerical plume rise model (Paine & lew, 1997).

10.2.3.5 Process Emissions

Dispersion modelling of NO_2 has been undertaken to determine the following:

- A normal operations scenario with five stacks, one for each gas engine, grouped into two stack columns from the proposed power plant;
- Process contributions from the proposed plant for the normal operations scenario; and
- Cumulative impacts (Proposed power plant + Pfizer + Takeda + Grange backup power + Vantage Data Centre DUB11 + background concentrations) for the normal operations scenario.

Information on the gas fired engines to be used at the power plant were provided by the engine supplier. Information on the Pfizer, Takeda and Grange backup power IE Licensed facilities in the area has been taken from their IE Licences and from Grange Backup Power Air Dispersion Modelling Report (document ID: IE0311313-22-RP-0005). Information on the Vantage Data Centre DUB11 has been taken from the Environmental Impact Assessment Report submitted with the now granted planning application (reference SD21A/0241). For the purposes of this assessment all plants were assumed to be operating at full load continuously all year round.

The physical stack information for the proposed power station emission points and existing air emission points is provided in Table 10-2 and the process emission information used in the dispersion model for the emission points operating on natural gas is shown in Table 10-3.

Table 10-2: Physical Stack Information for the Proposed Profile Park Power Station Emission Points and Existing Air Emission Points

Stack Reference	Stack Co-ordinates (UTM) Note A, B	Height Above Ground Level (m) Note B	Exit Diameter (m) Note B
Profile Park Stacks	670355 E 5910344 N 670359 E 5910346 N 670357 E 5910340 N 670361 E 5910342 N 670359 E 5910367 N 670362 E 5910338 N	28.0	1.704
Takeda Facility	669804 E 5911743 N	15	0.56
Grange Backup Power Stack 1	670173 E 5911957 N	25	2.77
Grange Backup Power Stack 2	670148 E 5911958 N	25	3.2
Pfizer Stack 1	670750 E 5911546 N	45	0.85
Pfizer Stack 2	670751 E 5911544 N	45	0.85
Pfizer Stack 3	670752 E 5911543 N	45	0.85
Pfizer Stack 4	670753 E 5911543 N	45	0.85
Pfizer Stack 5	670752 E 5911546 N	45	2.0
Vantage MFGP Stack 1	670148 E 5910549 N	30	1.2
Vantage MFGP Stack 2	670148 E 5910545 N	30	1.2
Vantage MFGP Stack 3	670149 E 5910530 N	30	1.2
Vantage MFGP Stack 4	670149 E 5910527 N	30	1.2
Vantage MFGP Stack 5	670150 E 5910525 N	30	1.2
Vantage MFGP Stack 6	670153 E 5910490 N	30	1.2
Vantage MFGP Stack 7	670153 E 5910487 N	30	1.2
Vantage MFGP Stack 8	670153 E 5910484 N	30	1.2
Vantage MFGP Stack 9	670155 E 5910469 N	30	1.2
Vantage MFGP Stack 10	670155 E 5910466 N	30	1.2

Stack Reference	Stack Co-ordinates (UTM) Note A B	Height Above Ground Level (m) Note B	Exit Diameter (m) Note B
Vantage MFGP Stack 11	670155 E 5910463 N	30	1.2

Note A Stack locations are in UTM Zone 29 and are approximate to nearest 5m.

Note B Taken from IE Licences, Grange Backup Power Air Dispersion Modelling Report (document ID: IE0311313-22-RP-0005) and Vantage Environmental Impact Assessment Report (planning application reference SD21A/0241).

Table 10-3: Process Emissions Information for the Proposed Profile Park Power Station Emission Points and Existing Air Emission Points

Stack Reference	Temp (K) Note A	Volume Flow (Nm^3/hr)	Exit Velocity (m/sec actual) Note A	NO_x Mass Emission (g/s) Note A, B, C
Profile Park Stacks	595.2	133,862	29.54	2.79
Takeda Facility	533.15	1,181,880	12.88	0.23
Grange Backup Power Stack 1	663.15	594,360	27.6	6.72
Grange Backup Power Stack 2	663.15	594,360	27.6	6.72
Pfizer Stack 1	441	22,320	10.9	0.29
Pfizer Stack 2	441	22,320	10.9	0.29
Pfizer Stack 3	441	22,320	10.9	0.29
Pfizer Stack 4	441	95,040	9.15	1.33
Pfizer Stack 5	441	95,040	9.15	1.33
Vantage MFGP Stacks	633.15	115,631	28.4	0.2

Note A Taken from Grange Backup Power Air Dispersion Modelling Report (document ID: IE0311313-22-RP-0005) and Vantage Environmental Impact Assessment Report (planning application reference SD21A/0241, Phase 2 scenario).

Note B Emissions from Profile Park Power Station engines staring-up on diesel oil have been scoped out of modelling as they will occur for 5 minutes or less.

Note C Emissions from Profile Park Power Station engines running on natural gas calculated at emission limit value of 75 mg/Nm^3 NO_x.

10.2.3.6 Other Than Normal Operating Conditions (OTNOC)

As per Section 3.1.16 of the Best Available Techniques (BAT) Reference Document for Large Combustion Plants (2017), it is important to identify OTNOC as they may affect the level of emissions and can include, among others, periods corresponding to the use of emergency fuels for a very short period due to the lack of availability of normally used fuels (serious shortage or sudden interruption) or to disturbances in fuel feeding.

Dispersion modelling of OTNOC has been scoped out of this assessment due to their infrequent occurrence. However, for the emissions that do occur a management plan as part of the environmental management system may be implemented to reduce these emissions, and can include measures such as:

- appropriate design of systems considered to cause OTNOC and that may have an impact on emissions (e.g. low load design concepts for reducing the minimum start-up and shutdown loads for stable generation in gas turbines);
- drawing up of specific preventive maintenance plans for these relevant systems, where needed;
- review and recording of emissions caused by OTNOC;

- implementation of corrective actions to return to normal operating conditions (NOC);
- periodic assessment of overall emissions during OTNOC (e.g. frequency of events, duration, emissions quantification/estimation) and implementation of corrective actions if necessary.

10.2.4 Climate Methodology

The impact of the construction phase of the development on climate is determined by a qualitative assessment of the nature, scale and duration of greenhouse gas generating construction activities associated with the proposed development.

The proposed facility, as an electricity provider, forms part of the EU-wide Emission Trading Scheme (ETS) and thus greenhouse gas emission from this electricity generator is not included when determining compliance with Ireland's targeted 20% reduction in the non-ETS sector by 2020 i.e. electricity associated greenhouse gas emissions will not count towards the Effort Sharing Decision (406/2009/EC) target (European Parliament and Council of Europe, 2009).

In terms of future obligations under the "*2030 Climate and Energy Policy Framework*", the European Council (EC, 2014) endorsed a binding EU target of at least a 40% domestic reduction in greenhouse gas emissions by 2030 compared to 1990. The target will be delivered collectively by the EU in the most cost-effective manner possible, with the reductions in the ETS sector amounting to 43% by 2030 compared to 2005. Thus, the EU policy of operating the ETS (on an EU-wide basis) for large industrial emitters including electricity generators will continue up to 2030 as a minimum and thus electricity generation will have no impact on the non-ETS targets up to 2030.

10.2.5 Climate Agreements

Ireland is party to both the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol. The Paris Agreement, which entered into force in 2016, is an important milestone in terms of international climate change agreements and includes an aim of limiting global temperature increases to no more than 2°C above pre-industrial levels with efforts to limit this rise to 1.5°C. The aim is to limit global GHG emissions to 40 gigatonnes as soon as possible whilst acknowledging that peaking of GHG emissions will take longer for developing countries. Contributions to GHG emissions will be based on Intended Nationally Determined Contributions (INDCs) which will form the foundation for climate action post 2020. Significant progress was also made in the Paris Agreement on elevating adaption onto the same level as action to cut and curb emissions.

In order to meet the commitments under the Paris Agreement, the EU enacted *Regulation (EU) 2018/842 on binding annual greenhouse gas emission reductions by Member States from 2021 to 2030 contributing to climate action to meet commitments under the Paris Agreement and amending Regulation (EU) No. 525/2013* (the Regulation). The Regulation aims to deliver, collectively by the EU in the most cost-effective manner possible, reductions in GHG emissions from the Emission Trading Scheme (ETS) and non-ETS sectors amounting to 43% and 30%, respectively, by 2030 compared to 2005. Ireland's obligation under the Regulation is a 30% reduction in non-ETS greenhouse gas emissions by 2030 relative to its 2005 levels.

In 2015, the Climate Action and Low Carbon Development Act 2015 (No. 46 of 2015) (Government of Ireland, 2015) was enacted (the Act). The purpose of the Act was to enable Ireland '*to pursue, and achieve, the transition to a low carbon, climate resilient and environmentally* *sustainable economy by the end of the year 2050'* (3.(1) of No. 46 of 2015). This is referred to in the Act as the 'national transition objective'.

The Act makes provision for a national mitigation plan, and a national adaptation framework. In addition, the Act provided for the establishment of the Climate Change Advisory Council with the function to advise and make recommendations on the preparation of the national mitigation and adaptation plans and compliance with existing climate obligations.

The *Climate Action Plan* (CAP) (Government of Ireland, 2019), published in June 2019, outlines the current status across key sectors including Electricity, Transport, Built Environment, Industry and Agriculture and outlines the various broadscale measures required for each sector to achieve ambitious decarbonisation targets. The CAP also details the required governance arrangements for implementation including carbon-proofing of policies, establishment of carbon budgets, a strengthened Climate Change Advisory Council and greater accountability to the Oireachtas. The CAP has set a built environment sector reduction target of 40 - 45% relative to 2030 pre-NDP (National Development Plan) projections.

Following on from Ireland declaring a climate and biodiversity emergency in May 2019 and the European Parliament approving a resolution declaring a climate and environment emergency in Europe in November 2019, the Government approved the publication of the General Scheme for the Climate Action (Amendment) Bill 2019 in December 2019 (Government of Ireland, 2020a). The General Scheme was prepared for the purposes of giving statutory effect to the core objectives stated within the CAP. The Climate Action and Low Carbon Development (Amendment) Bill 2021 (the Bill) was published in March 2021.

The purpose of the 2021 Climate Bill is to provide for the approval of plans '*for the purpose of pursuing the transition to a climate resilient and climate neutral economy by the end of the year 2050*'. The 2021 Climate Bill will also '*provide for carbon budgets and a decarbonisation target range for certain sectors of the economy*'. The 2021 Climate Bill removes any reference to a national mitigation plan and instead refers to both the Climate Action Plan, as published in 2019, and a series of National Long Term Climate Action Strategies. In addition, the Environment Minister shall request each local authority to make a 'local authority climate action plan' lasting five years and to specify the mitigation measures and the adaptation measures to be adopted by the local authority. The Bill has set a target of a 51% reduction in the total amount of greenhouse gases over the course of the first two carbon periods ending 31 December 2030 relative to 2018 annual emissions. The 2021 Climate Bill defines the carbon budget as 'the total amount of greenhouse gas emissions that are permitted during the budget period'.

Individual county councils in Ireland have also published their own Climate Change Strategies which outline the specific climate objectives for that local authority and associated actions to achieve the objectives. South Dublin's County Council's Climate Change Action Plan 2019 - 2024 was published by South Dublin County Council in 2019 and includes the following actions which relate to the Energy and Buildings:

- Energy Planning – E1: "Create Energy Master Plan for the Dublin Region.";
- Energy Planning – E4: "Evidence-based Climate Change Chapter in County Development Plan 2022-2028."; and
- Research & Innovation – E20: "Identify sites for trialling renewable energy projects, including solar PV and geothermal technologies."

10.3 BASELINE ENVIRONMENT

10.3.1 Background Concentrations of Pollutants

Air quality monitoring programs have been undertaken in recent years by the EPA and Local Authorities (EPA, 2020, 2021). The most recent annual report on air quality "Air Quality in Ireland 2019" (EPA, 2020), details the range and scope of monitoring undertaken throughout Ireland. As part of the implementation of the Framework Directive on Air Quality (1996/62/EC), four air quality zones have been defined in Ireland for air quality management and assessment purposes (EPA, 2020). Dublin is defined as Zone A and Cork as Zone B. Zone C is composed of 23 towns with a population of greater than 15,000. The remainder of the country, which represents rural Ireland but also includes all towns with a population of less than 15,000 is defined as Zone D. In terms of air monitoring, Profile Park is categorised as Zone A (EPA, 2020).

With regard to NO_2, continuous monitoring data from the EPA (EPA, 2020), at suburban (non-road) Zone A locations in Rathmines, Ringsend, Dun Laoghaire, Swords and Ballyfermot show that current levels of NO_2 are below both the annual and 1-hour limit values, with annual average levels ranging from 15 – 24 µg/m^3 in 2019 (see *Table 10-4*). Sufficient data is available for the stations in Rathmines, Dún Laoghaire, Swords, Ballyfermot and Ringsend and to observe the long-term trend since 2015 (EPA, 2020) (see *Table 10-4*), with results ranging from 14 – 24 µg/m^3 and few exceedances of the one-hour limit value, normally transport related, and with an average annual mean for Swords for this period (2015 - 2019) of 14.7 µg/m^3. Based on these results, and the highest concentration recorded at Swords between 2015 – 2019, a conservative estimate of the background NO_2 concentration in the region of the proposed development in 2019 is 16 µg/m^3.

Table 10-4: Annual Mean NO_2 Concentrations In Representative Zone A Locations 2015 - 2019 (µg/m^3)

Year	Rathmines	Dún Laoghaire	Swords	Ballyfermot	Ringsend
2015	18	16	13	16	-
2016	20	19	16	17	-
2017	17	17	14	17	22
2018	20	19	16	17	27
2019	22	15	15	20	24
Average	**19.4**	**17.1**	**14.7**	**17.4**	**24.3**

In summary, existing baseline levels of the pollutants based on extensive long-term data from the EPA are expected to be below ambient air quality limit values in the vicinity of the proposed development.

The Ozone Limiting Method (OLM) was used to model NO_2 concentrations. The OLM is a regulatory option in AERMOD which calculates ambient NO_2 concentrations by applying a background ozone concentration and an in-stack NO_2/NOX ratio to predicted NO_X concentrations. An in-stack NO_2/NO_X ratio of 0.1 and a conservative ozone value of 55 µg/m^3 was used in the assessment based on the maximum annual average levels recorded over a 5-year period (2015 – 2019) at EPA Zone A locations.

In relation to the annual averages, the ambient background concentration was added directly to the process concentration.

In relation to the short-term peak concentrations, for NO_2 these were assumed to have an ambient background concentration of twice the annual mean background concentration.

10.4 POTENTIAL IMPACTS

10.4.1.1 Construction Phase – Air Quality

The greatest potential impact on air quality during the construction phase of the Proposed Development is from construction dust emissions as a result of excavation works, infilling and landscaping activities and storage of soil in stockpiles. This leads to the potential for nuisance dust. While construction dust tends to be deposited within 350 m of a construction site, the majority of the deposition occurs within the first 50 m (IAQM, 2014). The extent of any dust generation depends on the nature of the dust (soils, peat, sands, gravels, silts etc.) and the nature of the construction activity. In addition, the potential for dust dispersion and deposition depends on local meteorological factors such as rainfall, wind speed and wind direction.

Initial commissioning activities will involve testing of the power plant engines with low sulphur diesel oil on site i.e. the first testing sequence will be commissioning of the standby generators..

10.4.1.2 Construction Phase – Climate

Construction traffic is be expected to be the dominant source of greenhouse gas emissions as a result of the Proposed Development. Construction vehicles and machinery will give rise to CO_2 and N_2O emissions during construction of the Proposed Development. The Institute of Air Quality Management document 'Guidance on the Assessment of Dust from Demolition and Construction' (IAQM, 2014) states that site traffic and plant is unlikely to make a significant impact on climate.

10.4.1.3 Operational Phase – Air Quality

The potential impact to air quality during the operational phase of the proposed power plant is a breach of the ambient air quality standards as a result of air emissions from the power plant engines. However, as outlined in Section 10.5.3, an iterative stack height determination was undertaken as part of the air dispersion modelling study to ensure that an adequate release height was selected for all emission points to aid dispersion of the plume and ensure compliance with the ambient air quality limit values beyond the site boundary.

The back-up diesel oil will only be used in the event of a power failure at the site. During normal operations at the facility, the electricity will be supplied from the national grid. Electricity to operate the facility will be purchased from the available energy suppliers including power stations and renewable generation sources such as wind power. The Electricity Supplier for the site currently holds a Commission for Regulation of Utilities (CRU) certified fuel mix disclosure, guaranteeing every megawatt-hour (MWh) that they supply in the market is generated from renewable sources.

10.4.1.4 Operational Phase – Climate

The potential impact to climate during the operational phase of the proposed power plant is an increase in GHG emissions associated with the generation of electricity.

10.5 PREDICTED IMPACTS

10.5.1 Construction Phase

10.5.1.1 Air Quality

It is important to note that the potential impacts associated with the construction phase of the proposed power plant are short-term in nature. When the dust mitigation measures detailed in the mitigation section (Section 10.5.3.1) of this report are implemented, fugitive emissions of dust and particulate matter from the site will be ***negative***, ***short-term*** and ***imperceptible*** in nature, posing no nuisance at nearby receptors.

10.5.1.2 Climate

The Institute of Air Quality Management document 'Guidance on the Assessment of Dust from Demolition and Construction' (IAQM, 2014) states that site traffic and plant is unlikely to make a significant impact on climate. Based on the scale and temporary nature of the construction works and the intermittent use of equipment, the potential impact on climate change and transboundary pollution from the Proposed Development is deemed to be ***short-term***, ***negative*** and ***imperceptible*** in relation to Ireland's obligations under the EU 2030 target.

10.5.1.3 Human Health

Best practice mitigation measures are proposed for the construction phase of the Proposed Development which will focus on the pro-active control of dust and other air pollutants to minimise generation of emissions at source. The mitigation measures that will be put in place during construction of the Proposed Development will ensure that the impact of the development complies with all EU ambient air quality legislative limit values which are based on the protection of human health. Therefore, the impact of construction of the Proposed Development is likely to be ***neutral***, ***short-term*** and ***imperceptible*** with respect to human health.

10.5.2 Operational Phase

10.5.2.1 Air Quality

The NO_2 modelling results for the power plant normal operations scenario are detailed in Table 10-5. The results indicate that the ambient ground level concentrations are below the relevant air quality limit values for NO_2. For the worst-case year, emissions from the site lead to an ambient NO_2 concentration (including background) which is 48% of the maximum ambient 1-hour limit value (measured as a 99.8th percentile) and 70% of the annual limit value at the worst-case off-site receptor.

Table 10-5: Modelled NO_2 ($\mu g/m^3$) Concentrations for the Profile Park Power Station

Pollutant/ Year	Averaging Period	Process Contribution NO_2 ($\mu g/m^3$)	Background Concentration ($\mu g/m^3$)Note A	Predicted Emission Concentration - PEC NO_2 ($\mu g/Nm^3$)	Limit Values ($\mu g/Nm^3$) Note B	PEC as a % of Limit Value
NO_2/2016	Annual Mean	8.8	16	24.8	40	62%

Pollutant/ Year	Averaging Period	Process Contribution NO_2 (µg/m^3)	Background Concentration (µg/m^3) Note A	Predicted Emission Concentration - PEC NO_2 (µg/Nm^3)	Limit Values (µg/Nm^3) Note B	PEC as a % of Limit Value
	99.8th%ile of 1-hr means	64.4	32	96.4	200	48%
NO_2/2017	Annual Mean	9.0	16	25.0	40	63%
	99.8th%ile of 1-hr means	62.9	32	94.9	200	47%
NO_2/2018	Annual Mean	8.8	16	24.8	40	62%
	99.8th%ile of 1-hr means	64.5	32	96.5	200	48%
NO_2/2019	Annual Mean	8.7	16	24.7	40	62%
	99.8th%ile of 1-hr means	64.0	32	96.0	200	48%
NO_2/2020	Annual Mean	11.8	16	27.8	40	70%
	99.8th%ile of 1-hr means	64.5	32	96.5	200	48%

Note A The short-term peaks are assumed to have an ambient background concentration of twice the annual mean background concentration.

Note B Air Quality Standards 2011 (from EU Directive 2008/50/EC and S.I. 180 of 2011).

The geographical variations in ground level NO_2 concentrations beyond the facility boundary for the worst-case years modelled are illustrated as concentration contours in *Figure 10-2* and *Figure 10-3*. The locations of the maximum concentrations for NO_2 are close to the boundary of the site with concentrations decreasing with distance from the facility.

The operational phase impact of the Proposed Development is considered ***long-term, localised, negative*** and ***slight***.

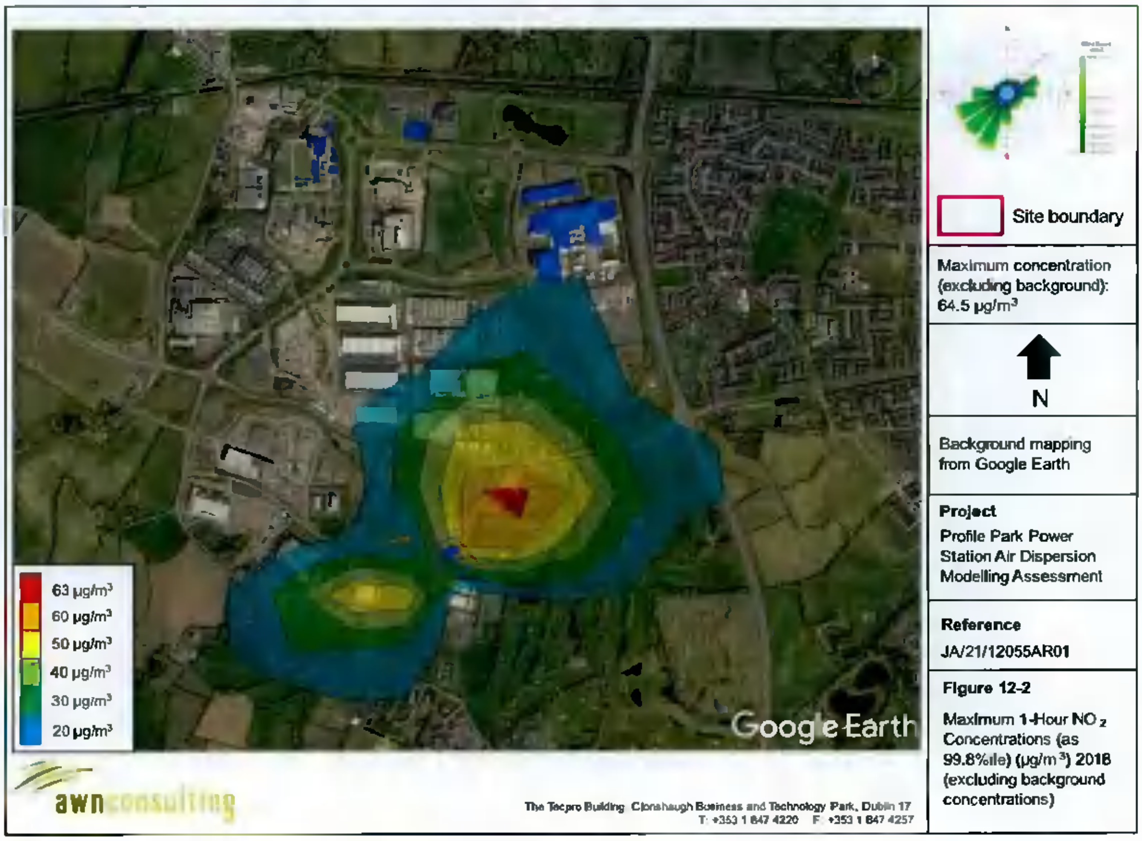

Figure 10-2: Profile Park Power Station Normal Operations Scenario: Predicted NO_2 99.8th Percentile of Hourly Concentrations (2018)

Figure 10-3: Profile Park Power Plant Normal Operations Scenario: Predicted Annual Mean NO_2 Concentrations (2020)

10.5.2.2 Climate

Electricity providers form part of the EU-wide Emission Trading Scheme (ETS) and thus greenhouse gas emissions from these electricity generators are not included when determining compliance with the targeted 30% reduction in the non-ETS sector i.e. electricity associated greenhouse gas emissions will not count towards the Effort Sharing Decision target. Thus, any necessary increase in electricity generation will have no impact on Ireland's obligation to meet the EU Effort Sharing Decision. Under this scenario, as outlined in the Regulation, the new electricity provider will be treated as a "new entrant" under Phase IV of the ETS (i.e. an electricity generator obtaining a greenhouse gas emissions permit for the first time after 30th June 2018). The new electricity provider will be required to purchase allocations in the same manner as existing players in the market using the European Energy Exchange. EU leaders have also decided that during Phase IV (2021-2030) 90% of the revenue from the auctions will be allocated to the Member States on the basis of their share of verified emissions with 10% allocated to the least wealthy EU member states. The revised EU ETS Directive has enshrined in law the requirement that at least 50% of the auctioning revenues or the equivalent in financial value should be used for climate and energy related purposes.

In 2018, the market reported a fall of 4.1% (73 million tones CO2eq) from 2017, the EU noted that much of the revenue raised by the cap and trade scheme is going towards climate and energy objectives (European Commission, 2019):

> *"In 2018, a strengthened carbon price signal led to a record amount of revenues for Member States from the selling of ETS allowances. The generated amount equalled some EUR 14 billion - more than doubling the revenues generated in 2017. Member States spent or planned to spend close to 70% of these revenues on advancing climate and energy objectives - well above the 50% required in the legislation"*

In terms of the current project, as the facility is over 20 MW, a greenhouse gas emission permit will be required which will be regulated under the ETS scheme also. Thus the emissions are not included when determining compliance with the targeted 30% reduction in the non-ETS sector. In addition, on an EU-wide basis, where the ETS market in 2018 is approximately 1,655 million tonnes CO2eq, the impact of the emissions associated with the proposed development will be less than 0.03% of the total EU-wide ETS market which is imperceptible.

In terms of wider energy policy, as outlined in the EPA publication *"Ireland's Greenhouse Gas Projections 2019-2040"* (EPA, 2020e) under the With Additional Measures scenario, emissions from the energy industries sector are projected to decrease by 34% to 7 Mt CO2eq over the period 2019 to 2030 including the proposed increase in renewable energy generation to approximately 70% of electricity consumption:

- "In this scenario it is assumed that for 2020 there is a 36.3% share of renewable energy in electricity generation. In 2030 it is estimated that renewable energy generation increases to approximately 70% of electricity consumption. This is mainly a result of further expansion in wind energy (comprising 3.5 GW offshore and approximately 8.2 GW onshore). Expansion of other renewables (e.g. solar photovoltaics) also occurs under this scenario;
- Under the With Additional Measures scenario two peat stations are assumed to run on 100% peat to the end of 2020 but PSO support finishes at the end of 2019. For 2020 the operation of the peat plants is determined by the electricity market. The third peat station operates to the end of 2023 with 30% co-firing;
- In this scenario the Moneypoint power station is assumed to operate in the market up to end 2024 at which point it no longer generates electricity from coal as set out in the Climate Action Plan; and
- In terms of inter-connection, it is assumed that the Greenlink 500MW interconnector to the UK to come on stream in 2025 and the Celtic 700MW interconnector to France to come on stream in 2026". (EPA, 2020e)

As emissions from the proposed power plant will form part of the EU-wide ETS scheme, the relevant cumulative impact would be the EU as a whole rather than Ireland. However, as highlighted above, the facility's impact will be less than 0.03% of the total EU-wide ETS market which is not significant and thus an EU-wide cumulative assessment is not merited.

The direct CO_2 emissions from electricity to operate the facility will not be significant in relation to Ireland's national annual CO_2 emissions. A Report titled 'Energy Related CO_2 Emissions In Ireland 2005 – 2018 (2019 Report)' published by the Sustainable Energy Authority of Ireland (SEAI, 2020) states the average CO_2 emission factor for electricity generated from natural gas in Ireland was 366 gCO_2/kWh in 2018. On the basis that the proposed power station will generate 125 MW of power this equates to 1,095 GWh annually. This translates to approximately 400,000 tonnes of CO_2eq per year. This will have a ***direct***, ***long-term***, ***negative*** and ***slight*** impact on climate.

10.5.2.3 Regional Air Quality

Directive (EU) 2016/2284 *"On The Reduction Of National Emissions Of Certain Atmospheric Pollutants And Amending Directive 2003/35/EC And Repealing Directive 2001/81/EC"* was published in December 2016. The Directive will apply the 2010 National Emission Ceiling Directive limits until 2020 and establish new national emission reduction commitments which will be applicable from 2020 and 2030 for SO_2, NO_X, NMVOC, NH_3 and $PM_{2.5}$ as detailed in Section **Error! Reference source not found.**.

Natural gas will be used to generate 125 MW by the power plant. The NO_X emissions associated with this electricity over the course of one year (i.e. 1,095 GWh based on 125 MW for 8,760 hours per annum) will equate to 365 tonnes per annum which is 0.56% of the National Emission Ceiling limit for Ireland from 2020 onwards. Similarly, SO_2 emissions associated this electricity over the course of one year (1,095 GWh) will equate to 138 tonnes per annum which is 0.33% of the National Emission Ceiling limit for Ireland from 2020. Additionally, NMVOC emissions associated this electricity over the course of one year (1,095 GWh) will equate to 415 tonnes per annum which is 0.75% of the National Emission Ceiling limit for Ireland from 2020. Thus, the NO_X, SO_2 and NMVOC direct emissions associated with the operation of the proposed power plant are ***direct***, ***long-term***, ***negative*** and ***not significant*** with regards to regional air quality.

10.5.2.4 Human Health

Air dispersion modelling was undertaken to assess the impact of the development with reference to EU ambient air quality standards which are based on the protection of human health. As demonstrated by the dispersion modelling results, emissions from the site are compliant with all National and EU ambient air quality limit values and, therefore, will not result in a significant impact on human health. In relation to the spatial extent of air quality impacts from the site, ambient concentrations will decrease significantly with distance from the site boundary. Further details of the potential impacts on human health associated with the proposed power plant are discussed in Chapter 7 of this EIA Report.

10.5.2.5 Impact of NO_X on Sensitive Ecosystems

The impact of emissions of NO_X from the proposed plant and existing emission points on ambient ground level concentrations within the Dodder Valley pNHA, Glenasmole Valley SAC/pNHA, Grand Canal pNHA, Kilteel Wood pNHA, Liffey Valley pNHA, Lugmore Glen pNHA, Royal Canal pNHA, Rye Water Valley/Carton SAC/pNHA, Slade of Saggart and Crooksling Glen pNHA and Wicklow Mountains SPA/SAC was assessed using AERMOD. An annual limit value of 30 $\mu g/m^3$ for NO_X is specified within EU Directive 2008/50/EC for the protection of ecosystems. The NO_X limit value is applicable only in highly rural areas away from major sources of NO_X such as large conurbations, factories and high road vehicle activity such as a dual carriageway or motorway. Annex III of EU Directive 2008/50/EC identifies that monitoring to demonstrate compliance with the NO_X limit value for the protection of vegetation should be carried out distances greater than:

- 5 km from the nearest motorway or dual carriageway;
- 5 km from the nearest major industrial installation;
- 20 km from a major urban conurbation.

As the sections of the designated sites which are near the power plant are within an urban setting and, more specifically, an industrial area, the limit value for NO_X for the protection of ecosystems is not technically applicable. Regardless, the annual average concentrations for NO_X from all emission points from the power plant were predicted at receptors within the designated sites for all five years of meteorological data modelled (2016 – 2020). The receptor spacing ranged from 25 m to 100 m with 8,360 discrete receptors modelled in total within the sensitive ecosystems.

The Profile Park Power Station NO_X modelling results are detailed in Table 10-6. Emissions from the facility lead to an ambient NO_X concentration (excluding background) which ranges from 2 – 3% of the annual limit value at the worst-case location within the designated sites over the five years of meteorological data modelled. No background value has been added to the results as the background concentration of NO_X exceeds the limit value for the protection of ecosystems at most urban and suburban locations in Dublin based on a review of the EPA NO_X monitoring data (EPA, 2019 and 2020). As previously discussed, the NO_X limit value is applicable only in highly rural areas away from major sources of NO_X such as large conurbations, factories and high road vehicle activity such as a dual carriageway or motorway. Therefore, the NO_X limit value is not applicable at Profile Park due to the urban and industrial nature of the environs of the proposed site. In addition, modelling results based on conservative assumptions indicate that the proposed power plant in isolation will have an imperceptible impact on NO_X concentrations within the sensitive ecosystems contributing at most 3% of the limit value at the worst-case location in the worst-case year modelled.

Table 10-6: Modelled NO_X Concentrations (μg/m^3) excluding background within the Dodder Valley pNHA, Glenasmole Valley SAC/pNHA, Grand Canal pNHA, Kilteel Wood pNHA, Liffey Valley pNHA, Lugmore Glen pNHA, Royal Canal pNHA, Rye Water Valley/Carton SAC/pNHA, Slade of Saggart and Crooksling Glen pNHA and Wicklow Mountains SPA/SAC for all Emission Points at Profile Park Power Station

Pollutant/ Year	Averaging Period	Process Contribution (μg/m^3)	Limit Value (μg/Nm^3) Note A	Process Contribution as a % of Limit Value
NO_x/2016	Annual Mean	0.65	30	2%
NO_x/2017	Annual Mean	0.71	30	2%
NO_x/2018	Annual Mean	0.59	30	2%
NO_x/2019	Annual Mean	0.64	30	2%
NO_x/2020	Annual Mean	0.86	30	3%

Note A: Air Quality Standards 2011 (from EU Directive 2008/50/EC and S.I. 180 of 2011).

10.5.3 Mitigation Measures

10.5.3.1 Construction Phase

The objective of dust control at the site is to ensure that no significant nuisance occurs at nearby sensitive receptors. In order to develop a workable and transparent dust control strategy, the following management plan has been formulated by drawing on best practice guidance from Ireland, the UK and the USA based on the following publications:

- 'Guidance on the Assessment of Dust from Demolition and Construction' (IAQM, 2014);
- 'Planning Advice Note PAN50 Annex B: Controlling The Environmental Effects Of Surface Mineral Workings Annex B: The Control of Dust at Surface Mineral Workings' (The Scottish Office, 1996);
- 'Controlling the Environmental Effects of Recycled and Secondary Aggregates Production Good Practice Guidance' (UK Office of Deputy Prime Minister, 2002);

- 'Controlling Particles, Vapours & Noise Pollution From Construction Sites' (BRE, 2003);
- 'Fugitive Dust Technical Information Document for the Best Available Control Measures' (USEPA, 1997); and
- 'Compilation of Air Pollutant Emission Factors, AP-42, Fifth Edition' (periodically updated) (USEPA, 1986).

The construction phase is predicted to have a 'Negligible to Low Risk' in terms of dust soiling and PM_{10} effects with no mitigation in place. Best practice mitigation measures for the proposed power plant as outlined in guidance from the IAQM are presented below. These mitigation measures should be incorporated into the proposed development's Construction Environment Management Plan (CEMP).

- Communication and Site Management
  - Display the name and contact details of person(s) accountable for air quality and dust issues on the site boundary;
  - Display the head or regional office contact information; and
  - It is recommended that community engagement be undertaken before works commence on site explaining the nature and duration of the works to local residents.
  - Record all dust and air quality complaints, identify causes and take appropriate measures to reduce emissions in a timely manner and record the measures taken;
  - Make a complaint log available to the local authority, when requested; and
  - Record any exceptional incidents that cause dust and or air emissions, either on or off site, and the action taken to resolve the situation in the log book.
- Monitoring
  - Carry out regular site inspections to monitor compliance with the DMP, record inspection results and make an inspection log available to the local authority, when requested; and
  - Increase the frequency of site inspections by the person accountable for air quality and dust issues on site when activities with a high potential to produce dust are being carried out and during prolonged dry or windy conditions
- Preparing and maintaining the site
  - Plan site layout so that machinery and dust causing activities are located away from receptors as far as possible;
  - Erect solid screens or barriers around dusty activities or the construction site boundary that are at least as high as any stockpiles;
  - Fully enclose site or specific operations where there is a high potential for dust production and the site is active for an extensive period;
  - Avoid site runoff of water or mud;
  - Keep site fencing, barriers and scaffolding clean using wet methods;
  - Remove materials that have a potential to produce dust from site as soon as possible unless being re-used on site; if they are being reused on site, cover as described below;
  - Cover seed or fence stockpiles to prevent wind whipping;
  - Ensure all vehicles switch off engines when stationary – no idling vehicles;

- Avoid the use of diesel- or petrol-powered generators and use mains electricity or battery powered equipment, where practicable; and
- Impose and signpost a maximum-speed limit of 15mph on surfaced and 10mph on unpaved surface haul roads and work areas

- Operations
  - Only use cutting, grinding or sawing equipment fitted or in conjunction with suitable dust suppression techniques such as water sprays or local extraction;
  - Ensure an adequate water supply on the site for effective dust/ particulate matter suppression/ mitigation using non-potable water, where possible and appropriate;
  - Use enclosed chutes and conveyors and covered skips;
  - Minimise drop heights from conveyors, loading shovels, hoppers and other loading or handling equipment and use fine water sprays on such equipment wherever available; and
  - Ensure equipment is readily available on site to clean any dry spillages and clean up spillages as soon as reasonably practicable after the event using wet cleaning methods
  - Measures specific to construction
  - Ensure sand and other aggregates are stored in bunded areas and are not allowed to dry out, unless this is required for a particular process in which case ensure that appropriate additional controls measures are in place
- Measures specific to trackout;
  - Use water-assisted dust sweepers on the access and local roads to remove as necessary any material tracked out of site;
  - Avoid dry sweeping of large areas;
  - Ensure vehicles entering and leaving sites are covered to prevent escape of materials during transport;
  - Inspect on-site haul routes for integrity and instigate necessary repairs to the surface as soon as reasonably practicable;
  - Record all inspections of haul routes; and
  - Implement a wheel washing system (with rumble grids to dislodge accumulated dust and mud prior to leaving the site where reasonably practicable)

10.5.3.2 Operational Phase

For the operational scenarios associated with the proposed power plant plant (either operating on natural gas or oil backup), no mitigation measures in addition to those already inherent to the design of the proposed plant are required. These inherent design features are considered within the dispersion modelling which demonstrates compliance with BAT associated emission levels, IED emission limits and appropriate stack height. The stack heights of the proposed power plant emission points have been designed in an iterative fashion to ensure that an adequate height has been selected to aid dispersion of the emissions and achieve compliance with the EU ambient air quality standards beyond the site boundary (including background concentrations). It should be noted that the proposed power plant will be licensed by the EPA under the industrial emissions licensing process. The licence will state the limits for atmospheric emissions that the proposed power plant will be required to comply with.

10.5.4 Cumulative Impacts

10.5.4.1 Air Quality

The cumulative impact of NO_2 emissions from the power plant and emissions from Pfizer, Takeda, the Grange Castle Power Facility and Vantage Data Centre DUB11 are detailed in Table 10-7 below. The results indicate that the ambient ground level concentrations are below the relevant air quality limit values for NO_2. For the worst-case year, emissions from the sites lead to an ambient NO_2 concentration (including background) which is 48% of the maximum 1 hour limit value (measured as a 99.8th%ile) and 72% of the annual limit value at the worst-case off-site receptor.

Table 10-7: Modelled NO_2 (μg/m³) Concentrations for the Cumulative Assessment

Pollutant/ Year	Averaging Period	Process Contribution NO_2 (μg/m³)	Background Concentration (μg/m³) Note A	Predicted Emission Concentration - PEC NO_2 (μg/Nm³)	Limit Values (μg/Nm³) Note B	PEC as a % of Limit Value
NO_2/2016	Annual Mean	9.6	16	25.6	40	64%
	99.8th%ile of 1-hr means	64.4	32	96.4	200	48%
NO_2/2017	Annual Mean	9.9	16	25.9	40	65%
	99.8th%ile of 1-hr means	62.9	32	94.9	200	47%
NO_2/2018	Annual Mean	9.4	16	25.4	40	64%
	99.8th%ile of 1-hr means	64.5	32	96.5	200	48%
NO_2/2019	Annual Mean	9.4	16	25.4	40	64%
	99.8th%ile of 1-hr means	64.0	32	96.0	200	48%
NO_2/2020	Annual Mean	13.0	16	29.0	40	72%
	99.8th%ile of 1-hr means	64.5	32	96.5	200	48%

Note A The short-term peaks are assumed to have an ambient background concentration of twice the annual mean background concentration.

Note B Air Quality Standards 2011 (from EU Directive 2008/50/EC and S.I. 180 of 2011).

10.5.4.2 Impact of NO_X on Sensitive Ecosystems

The NO_X modelling results for the cumulative assessment are detailed in Table 10-8. Emissions from the facility lead to an ambient NO_X concentration (excluding background) which ranges from 15 – 18% of the annual limit value at the worst-case location within the designated sites over the five years of meteorological data modelled. In addition, modelling results based on conservative assumptions indicate that the proposed power plant in isolation will have a small impact on NO_X concentrations within the sensitive ecosystems contributing at most 18% of the limit value at the worst-case location in the worst-case year modelled.

Table 10-8: Modelled NO_X Concentrations (µg/m³) excluding background within the Dodder Valley pNHA, Glenasmole Valley SAC/pNHA, Grand Canal pNHA, Kilteel Wood pNHA, Liffey Valley pNHA, Lugmore Glen pNHA, Royal Canal pNHA, Rye Water Valley/Carton SAC/pNHA, Slade of Saggart and Crooksling Glen pNHA and Wicklow Mountains SPA/SAC for the Cumulative Assessment

Pollutant/ Year	Averaging Period	Process Contribution (µg/m³)	Limit Value (µg/Nm³) Note A	Process Contribution as a % of Limit Value
NO_x/2016	Annual Mean	4.71	30	16%
NO_x/2017	Annual Mean	5.36	30	18%
NO_x/2018	Annual Mean	4.59	30	15%
NO_x/2019	Annual Mean	4.86	30	16%
NO_x/2020	Annual Mean	5.29	30	18%

Note A Air Quality Standards 2011 (from EU Directive 2008/50/EC and S.I. 180 of 2011).

10.5.4.3 Climate

Cumulative climatic impacts due to the Proposed Development and nearby facilities are considered to be not significant.

10.5.5 Residual Impacts

Once the mitigation measures outlined in Section 10.5.3 are implemented, the residual impact on air quality from the construction of the Proposed Development will be ***short-term*** and ***imperceptible*** and for the operational phases of the Proposed Development will be ***long-term***, ***negative*** and ***slight***.

The residual impact on climate from the construction of the Proposed Development will be ***short-term*** and ***imperceptible*** and for the operational phases of the Proposed Development will be ***long-term***, ***negative*** and ***slight***.

10.5.6 Summary of Modelling Results

With regard to NO_2, emissions from the facility will result in ambient NO_2 concentrations (including background) which are in compliance with the relevant limit values, reaching at most 48% of the 1-hour limit value (measured as a 99.8th%ile) and 70% of the annual limit value at the worst-case off-site receptor. NO_X concentrations at the worst-case ecological receptor in the worst-case year modelled were at most 3% of the limit value.

The cumulative assessment with Pfizer, Takeda, the Grange Castle Power Facility and Vantage Data Centre DUB11 also found results to be in compliance with the relevant ambient air quality limit values. Emissions from these facilities lead to an ambient NO_2 concentration (including background) which is 48% of the maximum ambient 1-hour limit value (measured as a 99.8th%ile) and 72% of the annual mean limit value at the worst-case off-site receptor. NO_X concentrations at the worst-case ecological receptor in the worst-case year modelled were at most 18% of the limit value.

In conclusion, ambient levels of nitrogen oxides (as NO_2, including background) from the proposed power plant as well as the cumulative emissions from Pfizer, Takeda, the Grange Castle Power Facility and Vantage Data Centre DUB11 are in compliance with the air quality limit values for the protection of human health and it is predicted that air emissions from the installation will not have a significant impact on the local environment.

As emissions from the Proposed Development will form part of the EU-wide ETS scheme, the facility's impact will be less than 0.03% of the total EU-wide ETS market which is not significant.

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TOBIN Consulting Engineers

@tobinengineers

Galway
Fairgreen House,
Fairgreen Road,
Galway,
H91 AXK8,
Ireland.
Tel: +353 (0)91 565 211

Dublin
Block 10-4,
Blanchardstown Corporate Park,
Dublin 15,
D15 X98N,
Ireland.
Tel: +353 (0)1 803 0406

Castlebar
Market Square,
Castlebar,
Mayo,
F23 Y427,
Ireland.
Tel: +353 (0)94 902 1401

London
17 Bowling Green Lane
Clerkenwell
London,
EC1R 0QB,
United Kingdom.
Tel: (+44) (0)203 915 6301

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CHAPTER 10: AIR QUALITY AND CLIMATE (APPENDICES)

MAY 2022

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10.1 DESCRIPTION OF THE AERMOD MODEL

The AERMOD dispersion model has been recently developed in part by the U.S. Environmental Protection Agency (USEPA) (USEPA, 2019). The model is a steady-state Gaussian model used to assess pollutant concentrations associated with industrial sources. The model is an enhancement on the Industrial Source Complex-Short Term 3 (ISCST3) model which has been widely used for emissions from industrial sources.

Improvements over the ISCST3 model include the treatment of the vertical distribution of concentration within the plume. ISCST3 assumes a Gaussian distribution in both the horizontal and vertical direction under all weather conditions. AERMOD with PRIME, however, treats the vertical distribution as non-Gaussian under convective (unstable) conditions while maintaining a Gaussian distribution in both the horizontal and vertical direction during stable conditions. This treatment reflects the fact that the plume is skewed upwards under convective conditions due to the greater intensity of turbulence above the plume than below. The result is a more accurate portrayal of actual conditions using the AERMOD model. AERMOD also enhances the turbulence of night-time urban boundary layers thus simulating the influence of the urban heat island.

In contrast to ISCST3, AERMOD is widely applicable in all types of terrain. Differentiation of the simple versus complex terrain is unnecessary with AERMOD. In complex terrain, AERMOD employs the dividing-streamline concept in a simplified simulation of the effects of plume-terrain interactions. In the dividing-streamline concept, flow below this height remains horizontal, and flow above this height tends to rise up and over terrain. Extensive validation studies have found that AERMOD (precursor to AERMOD with PRIME) performs better than ISCST3 for many applications and as well or better than CTDMPLUS for several complex terrain data sets (USEPA, 1998).

Due to the proximity to surrounding buildings, the PRIME (Plume Rise Model Enhancements) building downwash algorithm has been incorporated into the model to determine the influence (wake effects) of these buildings on dispersion in each direction considered. The PRIME algorithm takes into account the position of the stack relative to the building in calculating building downwash. In the absence of the building, the plume from the stack will rise due to momentum and/or buoyancy forces. Wind streamlines act on the plume leads to the bending over of the plume as it disperses. However, due to the presence of the building, wind streamlines are disrupted leading to a lowering of the plume centreline.

When there are multiple buildings, the building tier leading to the largest cavity height is used to determine building downwash. The cavity height calculation is an empirical formula based on building height, the length scale (which is a factor of building height & width) and the cavity length (which is based on building width, length and height). As the direction of the wind will lead to the identification of differing dominant tiers, calculations are carried out in intervals of 10 degrees.

In PRIME, the nature of the wind streamline disruption as it passes over the dominant building tier is a function of the exact dimensions of the building and the angle at which the wind approaches the building. Once the streamline encounters the zone of influence of the building, two forces act on the plume. Firstly, the disruption caused by the building leads to increased turbulence and enhances horizontal and vertical dispersion. Secondly, the streamline descends in the lee of the building due to the reduced pressure and drags the plume (or part of) nearer to the ground, leading to higher ground level concentrations. The model calculates the descent of the plume as a function of the building shape and, using a numerical plume rise model, calculates the change in the plume centreline location with distance downwind.

The immediate zone in the lee of the building is termed the cavity or near wake and is characterised by high intensity turbulence and an area of uniform low pressure. Plume mass captured by the cavity region is re-emitted to the far wake as a ground-level volume source. The volume source is located at the base of the lee wall of the building, but is only evaluated near the end of the near wake and beyond. In this region, the disruption caused by the building downwash gradually fades with distance to ambient values downwind of the building.

AERMOD has made substantial improvements in the area of plume growth rates in comparison to ISCST3 (USEPA, 2019). ISCST3 approximates turbulence using six Pasquill-Gifford-Turner Stability Classes and bases the resulting dispersion curves upon surface release experiments. This treatment, however, cannot explicitly account for turbulence in the formulation. AERMOD is based on the more realistic modern planetary boundary layer (PBL) theory which allows turbulence to vary with height. This use of turbulence-based plume growth with height leads to a substantial advancement over the ISCST3 treatment.

Improvements have also been made in relation to mixing height (USEPA, 2019). The treatment of mixing height by ISCST3 is based on a single morning upper air sounding each day. AERMOD, however, calculates mixing height on an hourly basis based on the morning upper air sounding and the surface energy balance, accounting for the solar radiation, cloud cover, reflectivity of the ground and the latent heat due to evaporation from the ground cover. This more advanced formulation provides a more realistic sequence of the diurnal mixing height changes.

AERMOD also contains improved algorithms for dealing with low wind speed (near calm) conditions. As a result, AERMOD can produce model estimates for conditions when the wind speed may be less than 1 m/s, but still greater than the instrument threshold.

10.2 METEOROLOGICAL DATA - AERMET

AERMOD incorporates a meteorological pre-processor AERMET (version 19191) (USEPA, 2018b). AERMET allows AERMOD to account for changes in the plume behaviour with height. AERMET calculates hourly boundary layer parameters for use by AERMOD, including friction velocity, Monin-Obukhov length, convective velocity scale, convective (CBL) and stable boundary layer (SBL) height and surface heat flux. AERMOD uses this information to calculate concentrations in a manner that accounts for changes in dispersion rate with height, allows for a non-Gaussian plume in convective conditions, and accounts for a dispersion rate that is a continuous function of meteorology.

The AERMET meteorological preprocessor requires the input of surface characteristics, including surface roughness (z_0), Bowen Ratio and albedo by sector and season, as well as hourly observations of wind speed, wind direction, cloud cover, and temperature. A morning sounding from a representative upper air station, latitude, longitude, time zone, and wind speed threshold are also required.

Two files are produced by AERMET for input to the AERMOD dispersion model. The surface file contains observed and calculated surface variables, one record per hour. The profile file contains the observations made at each level of a meteorological tower, if available, or the one-level observations taken from other representative data, one record level per hour.

From the surface characteristics (i.e. surface roughness, albedo and amount of moisture available (Bowen Ratio)) AERMET calculates several boundary layer parameters that are important in the evolution of the boundary layer, which, in turn, influences the dispersion of pollutants. These parameters include the surface friction velocity, which is a measure of the vertical transport of horizontal momentum; the sensible heat flux, which is the vertical transport of heat to/from the surface; the Monin-Obukhov length which is a stability parameter relating the surface friction velocity to the sensible heat flux; the daytime mixed layer height; the nocturnal surface layer height and the convective velocity scale which combines the daytime mixed layer height and the sensible heat flux. These parameters all depend on the underlying surface.

The values of albedo, Bowen Ratio and surface roughness depend on land-use type (e.g., urban, cultivated land etc) and vary with seasons and wind direction. The assessment of appropriate land-use types was carried out in line with USEPA recommendations[4] and using the detailed methodology outlined by the Alaska Department of Environmental Conservation[17]. AERMET has also been updated to allow for an adjustment of the surface friction velocity (u^*) for low wind speed stable conditions based on the work of Qian and Venkatram (BLM, 2011). Previously, the model had a tendency to over-predict concentrations produced by near-ground sources in stable conditions.

SURFACE ROUGHNESS

Surface roughness length is the height above the ground at which the wind speed goes to zero. Surface roughness length is defined by the individual elements on the landscape such as trees and buildings. In order to determine surface roughness length, the USEPA recommends that a representative length be defined for each sector, based on an upwind area-weighted average of the land use within the sector, by using the eight land use categories outlined by the USEPA. The inverse-distance weighted surface roughness length derived from the land use classification within a radius of 1km from Casement Aerodrome Meteorological Station is shown in Table 1.

Table 1: Surface Roughness based on an inverse distance weighted average of the land use within a 1km radius of Casement Aerodrome Meteorological Station

Sector	Area Weighted Land Use Classification	Spring	Summer	Autumn	Winter Note A
270-180	100% Grassland	0.05	0.10	0.01	0.01
180-270	100% Urban	1	1	1	1

Note A Winter defined as periods when surfaces covered permanently by snow whereas autumn is defined as periods when freezing conditions are common, deciduous trees are leafless and no snow is present (Iqbal (1983)). Thus for the current location autumn more accurately defines "winter" conditions in Ireland.

ALBEDO

Noon-time albedo is the fraction of the incoming solar radiation that is reflected from the ground when the sun is directly overhead. Albedo is used in calculating the hourly net heat balance at the surface for calculating hourly values of Monin-Obuklov length. A 10km x 10km square area is drawn around the meteorological station to determine the albedo based on a simple average for the land use types within the area independent of both distance from the station and the near-field sector. The classification within 10km from Casement Aerodrome Meteorological Station is shown in Table 2.

Table 2: Albedo based on a simple average of the land use within a 10km × 10km grid centred on Casement Aerodrome Meteorological Station

Area Weighted Land Use Classification	Spring	Summer	Autumn	Winter Note A
0.5% Water, 30% Urban, 0.5% Coniferous Forest 38% Grassland, 19% Cultivated Land	0.155	0.180	0.187	0.187

Note A For the current location autumn more accurately defines "winter" conditions in Ireland.

BOWEN RATIO

The Bowen ratio is a measure of the amount of moisture at the surface of the earth. The presence of moisture affects the heat balance resulting from evaporative cooling which, in turn, affects the Monin-Obukhov length which is used in the formulation of the boundary layer. A 10km x 10km square area is drawn around the meteorological station to determine the Bowen Ratio based on geometric mean of the land use types within the area independent of both distance from the station and the near-field sector. The classification within 10km from Casement Aerodrome Meteorological Station is shown in Table 3.

Table 3: Bowen Ratio based on a geometric mean of the land use within a 10km × 10km grid centred on Casement Aerodrome Meteorological Station.

Area Weighted Land Use Classification	Spring	Summer	Autumn	Winter[Note A]
0.5% Water, 30% Urban, 0.5% Coniferous Forest 38% Grassland, 19% Cultivated Land	0.549	1.06	1.202	1.202

Note A For the current location autumn more accurately defines "winter" conditions in Ireland.

10.3 THERMAL PLUME MODELLING

INTRODUCTION

This appendix provides an assessment of the potential impact of the plumes associated with the operational phase of the Profile Park Power Station on aircraft, and in particular helicopters, in the region.

The issue of plume characteristics and the effect on the operation of helicopters in the region of the site has been assessed below. An assessment has been undertaken to determine the region surrounding the facility where levels of excess temperature, turbulence (vertical velocity) and reduced oxygen could potentially be encountered. Studies undertaken by the MITRE Corporation (MITRE, 2012) and outlined in the user manual for the "Exhaust-Plume-Analyzer" model detail the likely impact of an exhaust plume on aircraft based on a range of parameters / criteria including the thermal buoyancy and temperature of the plume.

The current study is based on detailed site-specific information. The site-specific study, using the Cambridge Environmental Research Consultants (CERC) AMDS-5 model for oxygen, temperature and vertical velocity, allows the actual emission data for the facility to be used as input into the model. In addition, meteorological data for the region, based on three full years of data from Casement Aerodrome (2018-2020) and building data also forms part of the inputs to the model to allow an accurate representation of the impact of the facility in the surrounding environment.

METHODOLOGY

The parameters of the plume which are most relevant to helicopters has been investigated by the Mitre Corporation as part of the development of the "Expanded Model For Determining The Effects Of Vertical Plumes On Aviation Safety" (MITRE, 2012). These parameters have been reviewed below.

Oxygen

The Mitre Corporation report confirms that oxygen levels below 12% are potentially hazardous to helicopters (MITRE, 2012) and thus the oxygen content of the plume with distance from the stack has been investigated.

In relation to the gas generator, the oxygen content of the plume at stack top will typically be 13%.

Temperature

The Mitre Corporation report confirms that temperatures in excess of 50°C are potentially hazardous to helicopters (MITRE, 2012) and thus the temperature of the plume with distance from the stack has been investigated.

In relation to the gas generator, the temperature of the plume at stack top is 592.2K (319°C).

Vertical Velocity

High vertical velocities are also a concern when considering helicopter / plume interactions as they can lead to increased turbulence in the atmosphere. The literature (CASA, 2012) suggests that the critical level for vertical velocities is 4.3 m/s. Thus, modelling has been undertaken to understand the worst-case vertical velocities of the gas generator plume with distance from the stacks.

The change in each of these parameters with distance from the stack has been reviewed below. For each of these parameters, three full years of meteorological conditions has been used in the analysis including periods of atmospheric pressure / temperature inversions. Meteorological data for the years 2018-2020 for Casement Aerodrome have been used in the analysis for all scenarios outlined, with results for the worst case year reported. The ADMS-5 model has the capability to process calm conditions by setting the wind speed to 0.3 m/s and allowing an equal probability for all wind directions. This option has been used in this assessment for both the temperature assessment and the vertical velocity assessment.

The model was also run with a high density receptor grid based on 5m horizontal spacing and 0.5m vertical spacing in the region of the stack top to determine the changes in the parameters above over very short distances. The receptor spacing of 0.5m was selected as the change with vertical distance in oxygen, temperature and vertical velocity from the stack top is rapid and would be difficult to determine with a coarser grid resolution.

PROCESS EMISSIONS

The proposed Profile Park Power Station gas generator stacks were modelled at a height of 31.8m (~75m OD). The source information for the modelled emission points has been summarised in Table 1.

Table 1: Summary of Source Information

Scenario	Height Above Ground Level (m)	Exit Diameter (m)	Cross-Sectional Area (m^2)	Temp (K)	Max Volume Flow (Nm^3/hr)	Exit Velocity (m/sec actual)	NO_2	
							Conc. (mg/Nm^3)	Mass Emission (g/s)
Individual stacks	31.8m (75m OD)	1.704	2.28	592.2	133,862	29.54	75.0	2.79

RESULTS & DISCUSSION

Oxygen / Plume Interaction

The Mitre Corporation report (MITRE, 2012) confirms that depleted oxygen is generally of greatest concern when considering helicopter/plume interactions. The Mitre Corporation report confirms that at an oxygen content below 12% oxygen there is a risk of engine cut-out whilst above this level there is no risk to helicopter engines. Thus, modelling has been undertaken to determine the oxygen percentage of operations both on natural gas and diesel oil.

The following equation is used to model the % of oxygen in the plume with distance from the stack top. For a given emission concentration of any pollutant e (in µg/m^3), the oxygen content O (%), is related to the plume concentration c (in µg/m^3) by the following relationship (13% is the plume oxygen percentage at release for gas generators):

$$c / e = (20.95-O) / (20.95-13)$$

Thus, the calculation can be re-arranged to determine the oxygen content (%) of the plume as a function of distance from the stack top. The re-arranged equation is:

$$O (\%) = 20.95- [(c/e) * (7.65)]$$

AERMOD was thus run to calculate the pollutant concentration and identify the distance from the plume centreline where the 12% oxygen level was exceeded. Modelling was undertaken using Casement Aerodrome data for 2018-2020. Figures 1 and 2 show the results for the full worst-case year of 2020.

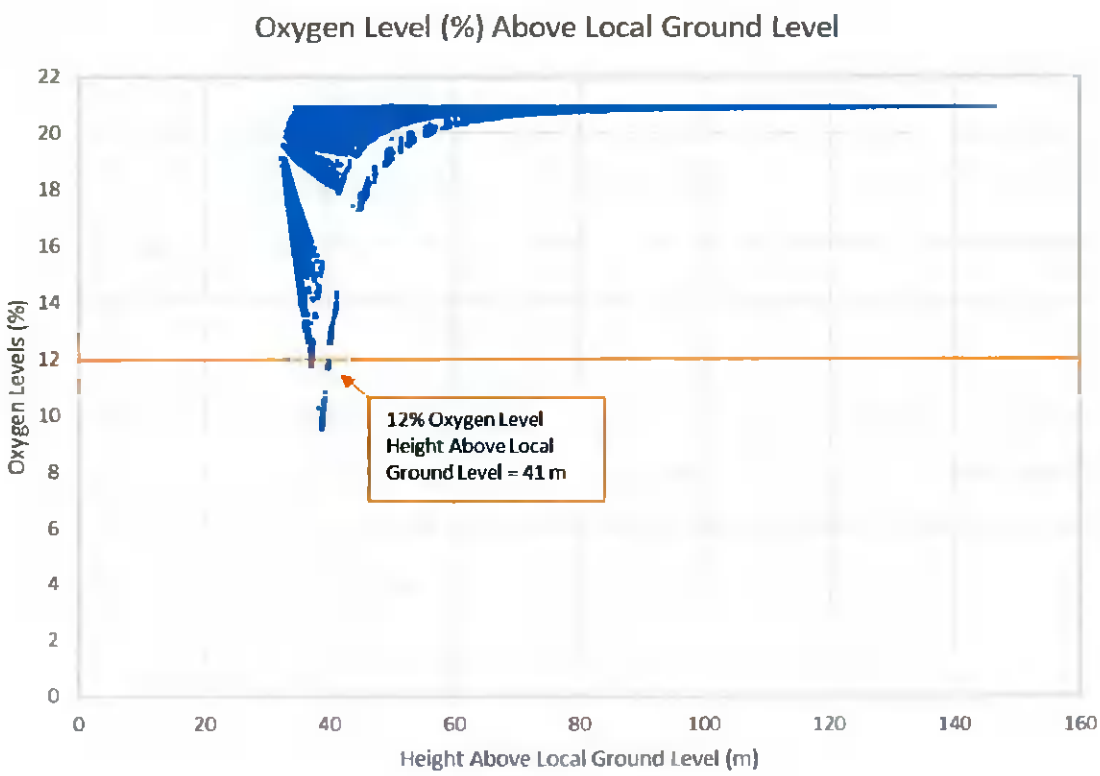

Figure 1: Oxygen Content Of The Plume (%) With Distance Above Ground Level

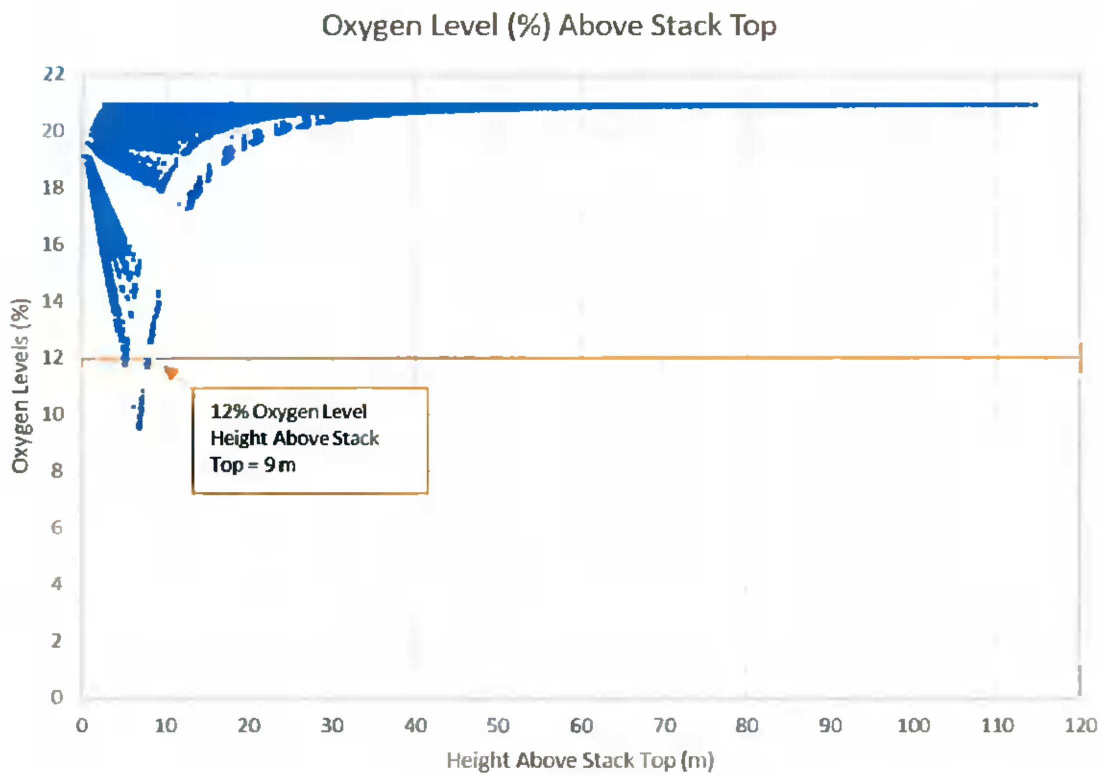

Figure 2: Oxygen Content Of The Plume (%) With Distance From Stack Top

The modelling results confirm that within a distance of 9 m from the stack top (41 m above local ground level) the oxygen content of the stacks plume will be 12% or greater. This analysis is based on every hour of the worst case year 2020 and includes all meteorological conditions including pressure / temperature inversions.

Temperature / Plume Interactions

Temperatures in excess of 50°C are potentially hazardous to helicopters and thus the decrease in the initial temperature of stack plumes (319°C) with distance from the stack has been investigated. Modelling of the temperature of the plume with distance from the stack has been undertaken using the CERC ADMS-5 model for every hour of the year based on Casement Aerodrome 2018-2020 meteorological data. The model has a specific temperature module which can, as part of the model output, give the temperature of the plume centreline with distance from the stack top.

The results are outlined below in Figure 3 and 4 for the worst case year of 2020.

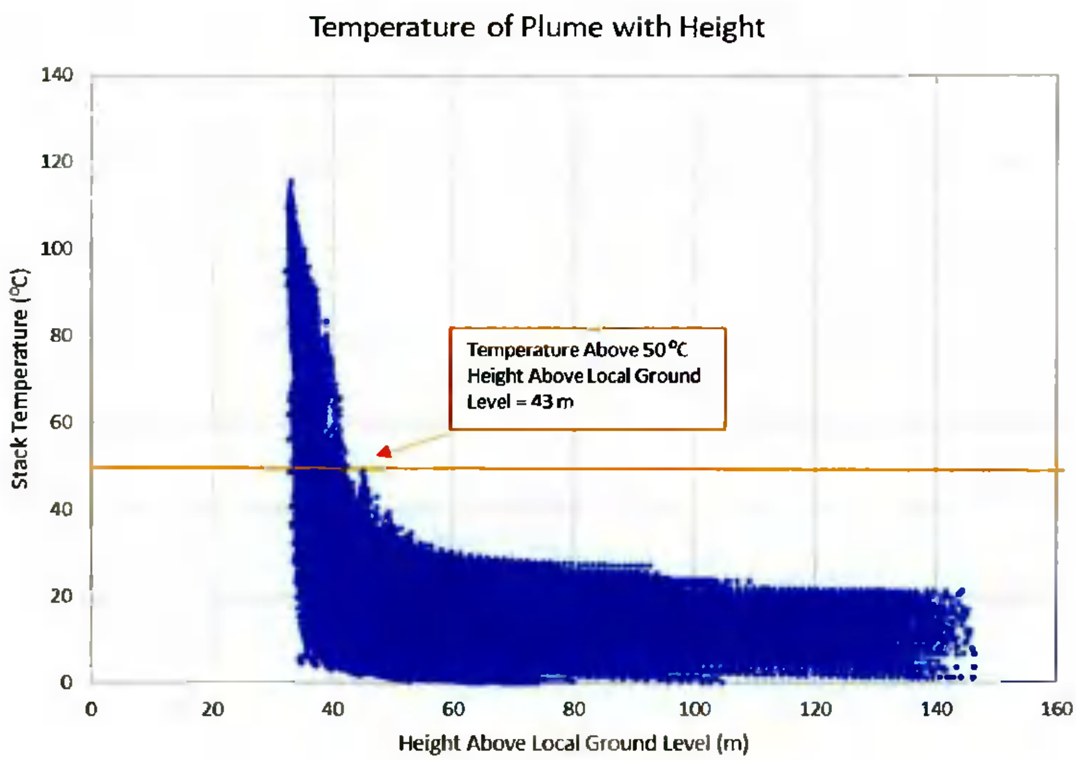

Figure 3: Temperature Of The Plume (°C) With Distance Above Ground Level

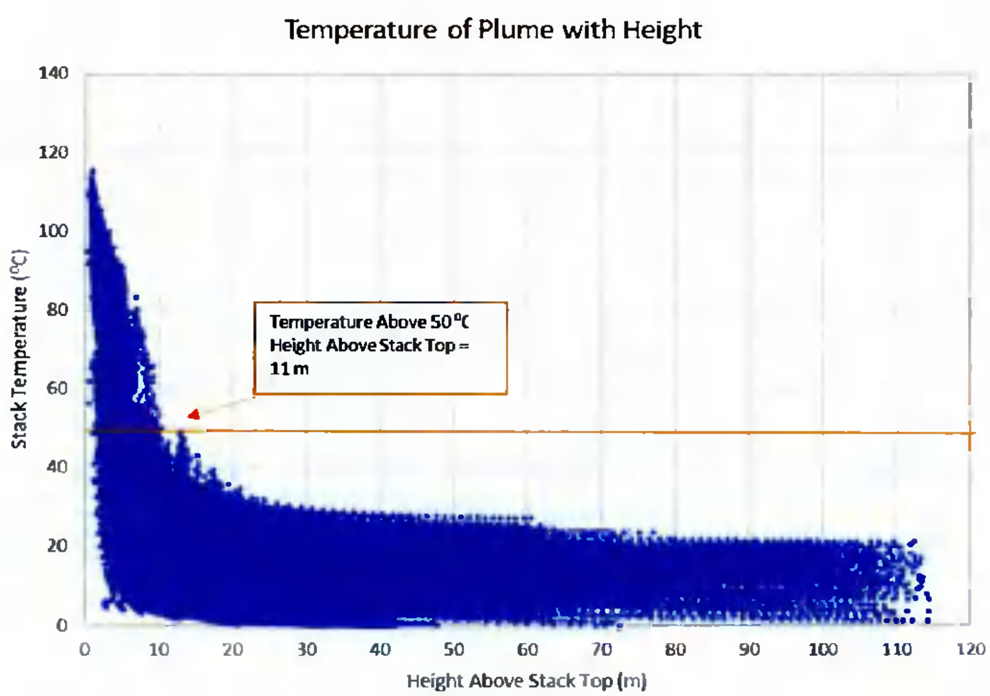

Figure 4: Temperature Of The Plume (°C) With Distance From Stack Top

The results confirm that the plume will be below 50°C within 11 m of the stack top (43 m above ground level) for every hour over the year for the stack including all meteorological conditions including pressure / temperature inversions.

Vertical Velocity / Plume Interactions

High vertical velocities are also relevant when considering helicopter/plume interactions. The Australian CASA (CASA, 2012) consider that the critical level for vertical velocity is 4.3 m/s. Thus, modelling has been undertaken to understand the vertical velocity of the plume with distance from the stack.

Cambridge Environmental Research Consultants (CERC), the developers of the EPA approved AMDS-5 model, were contacted to determine whether vertical velocity could be derived indirectly from the travel time of the plume with distance from the stack. CERC confirmed that the vertical velocity (in m/s) could be derived from an analysis of the plume centreline height (in metres) and the plume travel time (in seconds). The vertical velocity has been calculated for every hour of the year using Casement Aerodrome 2018-2020. The results are outlined below in Figures 5 and 6 for the worst case year of 2020.

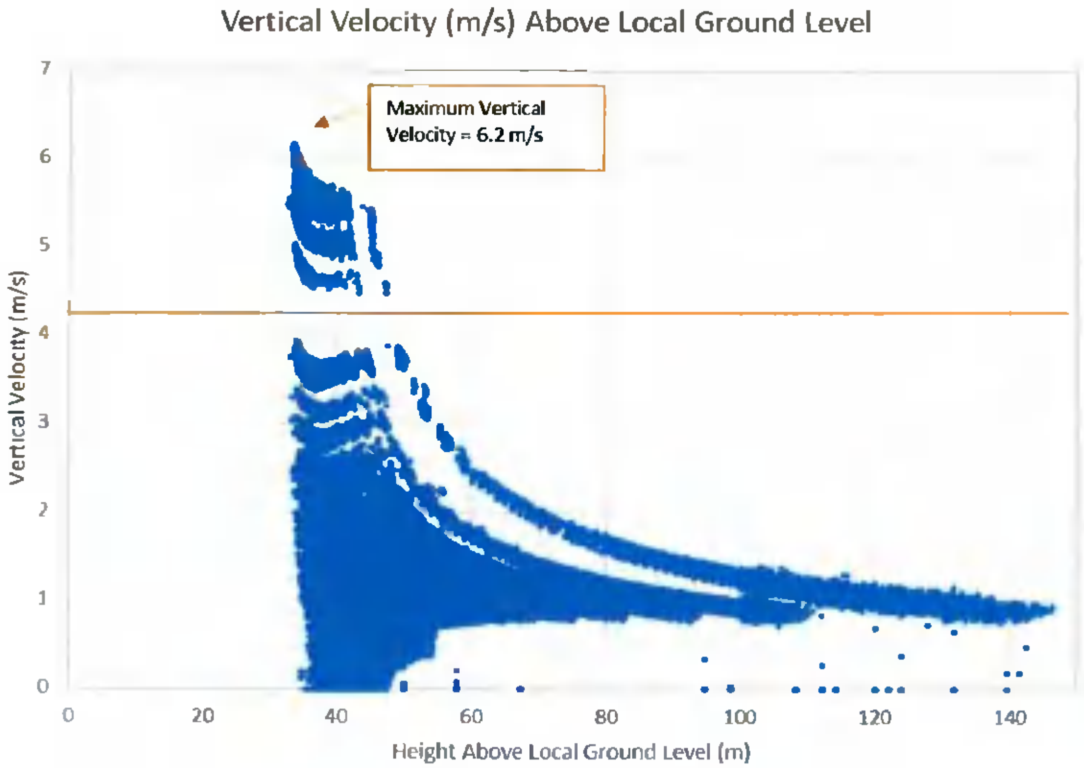

Figure 5: Vertical Velocity Of The Plume (m/s) With Distance Above Ground Level

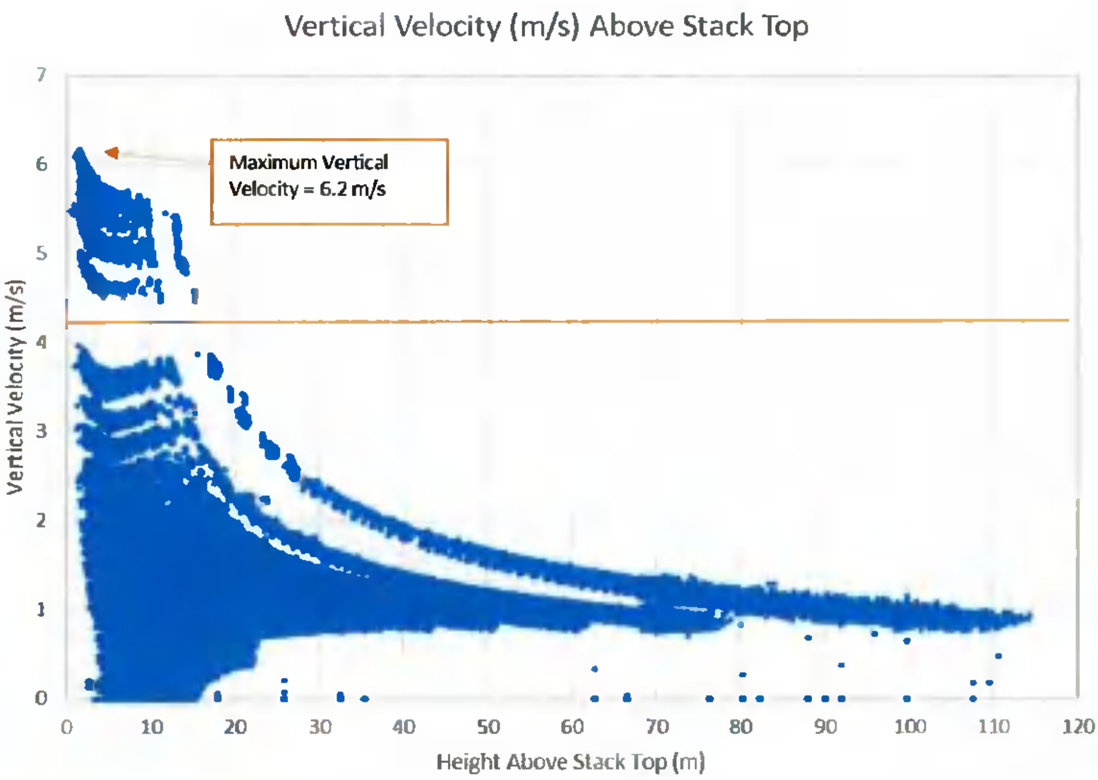

Figure 6: Vertical Velocity Of The Plume (m/s) With Distance From Stack Top

The results confirm that the velocity of the plume will be below 4.3 m/s within 15 m of the stack top (47 m above ground level) of the stack including all meteorological conditions including pressure / temperature inversions.

SUMMARY

Thus, in summary the results of the analysis are as follows.

- **Oxygen Content** – within 9 metres of the stack top the oxygen concentration will increase above the 12% risk level for oxygen.
- **Temperature** – the temperature of the plume will drop to less than 50°C within 11 metres of the stack.
- **Vertical Velocity** – the critical vertical velocity of 4.3 m/s will not be exceeded within 15 metre from the stack top.

Thus, the maximum extent of the risk zone of the plume for each parameter is shown below based on three full years of meteorological data covering all meteorological conditions including pressure / temperature inversions:

- Risk Zone for Oxygen – 9 metres
- Risk Zone for Temperature – 11 metres
- Risk Zone for Vertical Velocity – 15 metres

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TOBIN Consulting Engineers

@tobinengineers

Galway
Fairgreen House,
Fairgreen Road,
Galway,
H91 AXK8,
Ireland.
Tel: +353 (0)91 565 211

Dublin
Block 10-4,
Blanchardstown Corporate Park,
Dublin 15,
D15 X98N,
Ireland.
Tel: +353 (0)1 803 0406

Castlebar
Market Square,
Castlebar,
Mayo,
F23 Y427,
Ireland.
Tel: +353 (0)94 902 1401

London
17 Bowling Green Lane
Clerkenwell
London,
EC1R 0QB,
United Kingdom.
Tel: (+44) (0)203 915 6301

www.tobin.ie

TOBIN Consulting Engineers

@tobinengineers

Galway
Fairgreen House,
Fairgreen Road,
Galway,
H91 AXK8,
Ireland.
Tel: +353 (0)91 565 211

Dublin
Block 10-4,
Blanchardstown Corporate Park,
Dublin 15,
D15 X98N,
Ireland.
Tel: +353 (0)1 803 0406

Castlebar
Market Square,
Castlebar,
Mayo,
F23 Y427,
Ireland.
Tel: +353 (0)94 902 1401