EirGrid

CELTIC INTERCONNECTOR

Preliminary Acoustic Study

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EXECUTIVE SUMMARY

On behalf of EirGrid, WSP has undertaken a preliminary acoustic study of potential noise levels from the operation of a High Voltage Direct Current (HVDC) converter station at the three site options: Ballyadam (site reference CSS1); Meeleen (site reference CSS12), and Knockraha (site reference CSS9B).

The study comprises 3D acoustic models of each of the sites to establish the likely noise levels at the nearest Noise Sensitive Locations (NSLs). The models are based upon an assumed preliminary site layout, representative noise data for the proposed HVDC equipment, and Digital Terrain Modelling (DTM) data provided by Ordnance Survey Ireland. Please note that the assessment has been carried out in the absence of site-specific studies, including topographical surveys.

In the absence of baseline noise measurements, which will be undertaken to inform a further assessment at the planning stage, two sets of indicative noise limits have been proposed, based on those set out in Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4). The limits in NG4 on which this study is based are the general noise limits and the more onerous noise limits for areas of low background noise. This study assumes the night-time noise limits in both cases, which are more stringent than the associated daytime and evening limits.

The guidance and limits in NG4, whilst intended for use in the assessment of industrial sites licensed by the Environmental Protection Agency (EPA), serve as a reasonable noise limits for the purposes of this assessment of non-licensed utility sites, as has been suggested in advisory document Environmental Noise Guidance for Local Authority Planning & Enforcement Departments (dated June 2019) by the Association of Acoustics Consultants of Ireland (AACI).

The modelling results indicate that, for the initial indicative site layout and orientation and in the absence of mitigation, there are NSLs around each of the sites, which are predicted to be exposed to noise levels in excess of the NG4 guidance noise limits. It is important to note, however, that these indicative limits may be subject to change at the planning stage, once targeted site studies, including baseline noise measurements have been undertaken to establish noise levels.

An investigation of the site layout, site orientation and of noise source mitigation options has been undertaken to minimise noise levels at the nearest NSLs to all three site options. It is predicted that noise levels at NSLs around the three site options are likely to be able to meet the most stringent noise limit of 30 dB as set out in NG4, should it be needed. This could be achieved with mitigation applied to equipment within the site compound whilst maintaining the site layout and orientation. The 30 dB noise limit equates to the noise limit for areas of low background noise during the night time set out in NG4 and includes a 5 dB penalty to account for the possibility of tonal character exhibited from noise sources within the converter station site compound.

The site option at which noise levels predicted at the most exposed NSL are lowest is Meeleen. However, the background noise levels at the most exposed NSL to Meeleen may also be lower than at the other two site options. The proximity of existing noise sources to Knockraha (i.e. substation) and Ballyadam (N25 dual carriageway), for example, may preclude the need for such low noise limits at these sites. Therefore, the site which may be considered the best performing with regard to noise would depend on the existing background noise levels around each of the sites and their associated NSLs.

Note that as this study has been undertaken in the absence of baseline noise measurements the results should be read as preliminary and indicative and are for use at the consultation stage only.

1 INTRODUCTION

1.1.1. EirGrid is undertaking a programme of public consultation events for the Celtic Interconnector project, which proposes the construction and operation of a HVDC converter station and associated onshore cables in Ireland.

1.1.2. There are currently three site options being considered during the public consultation process, which are in Ballyadam; Meeleen; and Knockraha, County Cork. At present, consultation responses have included reference to the operational noise of the converter station as being a primary concern.

1.1.3. Consequently, EirGrid has appointed WSP to undertake a preliminary acoustic study of potential noise impacts from the operation of the converter station at the three site options.

1.1.4. This study is part of the pre-planning consultation process and site layouts may continue to evolve as part of the micro-siting exercise. This report describes the preliminary site layouts it is based on which were current at the time of the study. Any distances to closest receptors and the like are based on these layouts.

1.1.5. A 3D acoustic model has been created for each of the sites to establish the likely noise levels at the nearest Noise Sensitive Locations (NSLs). The models are based upon a preliminary site layout, representative noise data for the proposed HVDC equipment, and DTM data provided by Ordnance Survey Ireland. However, the assessment which will take place at the planning stage will take into account the engineered ground and finished floor levels, based upon topographical surveys and ground investigation.

1.1.6. As part of the study, a range of potential noise mitigation options have been explored, in order to minimise the likelihood of noise impacts at the NSLs. The results of the modelling exercise are used to inform a comparison of the three sites, to establish which is likely to be the most favourable in terms of noise.

1.1.7. Note that whilst the results of the modelling exercise are compared to noise guidance to provide some context, the purpose of this study is not to determine compliance with noise limits. This will be needed at the planning stage with criteria to be informed by the results of baseline noise measurements and relevant planning policy. As such, the modelling results and subsequent assessment herein should be considered preliminary and indicative for use at the pre-planning consultation stage only.

1.1.8. Please also note that the assessment has been carried out in the absence of site-specific studies, including topographical surveys.

2 PROPOSED DEVELOPMENT AND SITE DESCRIPTIONS

2.1 INTRODUCTION

2.1.1. This section provides details of the site layout and dominant noise sources within the converter station compound and a description of each of the three proposed sites. Plans indicating the approximate location of each of the three modelled sites are provided in **Appendix A**. These modelled sites are based on indicative site areas in advance of the micro-siting exercise being carried out as part of the detailed design stage of the project.

2.2 PROPOSED DEVELOPMENT

2.2.1. The proposals include an HVDC converter station compound with a footprint of up to 45,000 m^2, which will connect to the existing Knockraha substation and facilitate the transmission of electrical power between Ireland and France. The indicative converter station comprises the following key structures and components:

- Buildings
  - Valve hall
  - DC hall
  - Reactor hall
  - Control building
  - Store building
- Transformers
  - Converter transformers
  - Transformer cooling fans
- Valve cooling fan banks
- AC harmonic filters and switchyard
  - AC Filter reactors
  - AC Filter capacitors
  - Compensation reactor

2.2.2. Of the structures and components listed above, the dominant noise sources are the converter transformers, the transformer cooling fans and the valve cooling fan banks. These plant items are all external to the buildings for safety reasons and to allow sufficient airflow. Noise from equipment located within the buildings is usually not dominant owing to the sound insulation performance of the building envelope. The internal noise sources have been excluded from this assessment.

2.2.3. The proposed development is understood to operate continuously throughout the day and night time periods, with variations in power output correlating with typical diurnal energy demands.

2.3 THE MODELLED SITES

BALLYADAM

2.3.1. The modelled site is located in a rural area which lies between the towns of Carrigtohill and Midleton. The modelled converter station area within the Ballyadam site is based on an indicative

location identified at an early stage of the pre-panning consultation work and prior to the micro-siting exercise and, therefore, may evolve as the project progresses.

2.3.2. A railway line is located parallel to the northern site boundary at a distance of approximately 90 m and the site is bounded to the east and west by agricultural land, interspersed with dwellings. The N25 dual carriageway lies approximately 240 m south of the southern site boundary and Milebush Quarry, is located south of the N25.

2.3.3. It is anticipated that the dominant existing noise sources in proximity to the site are road traffic on the N25 and passing trains along the railway which are limited to 05:00 and 23:00 hours during a typical weekday. Operational noise from particular activities in the quarry, such as blasting and drilling (if present) and crushing may be perceptible in the area surrounding the site, however operations are restricted to daytime hours and are likely to be masked to a significant degree by road traffic on the intervening N25.

2.3.4. There are approximately 56 NSLs located within 1 km of the site boundary, the closest of which is located north of the railway line, approximately 130 m from the northern site boundary. The remaining NSLs are located in all directions around the site.

MEELEEN

2.3.5. The modelled site is located in a largely rural area approximately 1.4 km north east of Knockraha village. The site is bounded immediately to the north and west by Kilquane forest and by open land to the south and east.

2.3.6. There are no significant noise sources noted in close proximity to the site, with the nearest road located approximately 370 m to the south east of the site, which is an unnamed and unmarked single carriageway. The M8, located approximately 3.3 km to the west, may be perceptible under certain weather conditions. As such, there appear to be no dominant noise sources close to the site.

2.3.7. There are approximately 16 NSLs located within 1 km of the site boundary, the closest of which is located approximately 400 m south-east of the site. The remaining NSLs are located to the north-west and south-east of the site.

KNOCKRAHA

2.3.8. The modelled site is located in a largely rural area to the south east of Knockraha village. Approximately 160 m to the west lies Knockraha substation and approximately 60 m to the south lies an unmarked and unnamed single carriageway. The site is bounded to the north and east by agricultural land.

2.3.9. It is anticipated that the dominant source of noise in proximity to the site is operational noise from Knockraha substation, which operates continuously during the daytime and night time periods. Noise from traffic on the road to the south is likely to be perceptible, however vehicle movements are anticipated to be infrequent.

2.3.10. There are approximately 32 NSLs located within 1 km of the site boundary, the closest of which is located approximately 230 m to the east of the site. The remaining NSLs are located in all directions around the site.

3 NOISE GUIDANCE

3.1 INTRODUCTION

3.1.1. This section presents a summary of the noise guidance and limits for proposed industrial development in Ireland and a review of their suitability for the proposed development. Further noise guidance details are provided in **Appendix B**.

3.2 GUIDANCE NOTE FOR NOISE: LICENCE APPLICATIONS, SURVEYS AND ASSESSMENTS IN RELATION TO SCHEDULED ACTIVITIES (NG4)

3.2.1. Guidance note NG4 (dated January 2016), produced by the Environmental Protection Agency (EPA), is designed to provide acoustic guidelines to the operators of activities which are listed in the First Schedule of the Environmental Protection Agency Act (EPAA)[1]. Such activities include those undertaken in industrial, waste and agricultural sectors regulated by the EPA, and whilst HVDC converter stations are *not* subject to EPA regulation, or listed in the First Schedule of the EPAA, NG4 is commonly applied to such development, in the absence of other more authoritative Irish noise guidance. Note also that NG4 adopts key elements of BS 4142: 2014: *Methods for rating and assessing industrial and commercial sound*, which is the guidance document used in the UK for the assessment of noise from development such as the proposed converter station.

3.2.2. The document provides guidelines on acceptable environmental noise survey practices and a clear four-step procedure for setting applicable noise limits. The four steps are:

- Step 1 – Quiet area screening of the development location
- Step 2 – Baseline environmental noise survey
- Step 3 – Screen for areas of low background noise
- Step 4 - Determine appropriate noise criteria

3.2.3. Noise limits are typically set at the most exposed window of NSLs, however this is implied rather than stated in the guidance. NSL's are defined as:

"*…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*"

3.3 THE SUITABLE APPLICATION OF NG4

3.3.1. The application of noise limits presented in NG4 for utility installations outside of EPA regulation is recognised in the advisory document *Environmental Noise Guidance for Local Authority Planning & Enforcement Departments* (dated June 2019), published by the Association of Acoustics Consultants of Ireland (AACI). Section 11 of the document states:

"Industrial installations regulated by the EPA are typically subject to noise limits drawn from EPA document NG4 Guidance note for noise: Licence applications, surveys and assessments in relation

[1] First Schedule to the EPA Act 1992 as amended

to scheduled activities (2016). On this basis, NG4 is also arguably the most relevant guidance document with respect to industrial facilities regulated by Local Authorities."

3.3.2. Furthermore, we note that in granting planning consent for Knockraha substation reconfiguration (planning reference *ABP PL.04.244030/CCC Reg. Ref. 13/06402*), located in proximity to the proposed Knockraha site, An Bord Pleanála attached the following condition, which imposes noise limits for the substation, which bear similarity to the general noise limits set out in NG4:

"The noise level from the proposed development during operational stage shall not exceed 55 dB(A) rated sound level at the nearest noise sensitive location between 0800 and 2000 hours, Monday to Saturday inclusive, and shall not exceed 45 dB(A) at any other time."

3.3.3. Therefore, whilst it is acknowledged that HVDC converter stations are *not* industrial installations which are subject to licensing by the EPA, the limits and procedure for defining them presented in NG4 may be considered to provide a reasonable indication of the likely limits imposed at the planning stage by An Bord Pleanála and bear similarity to limits imposed on other industrial power sites.

4 ACOUSTIC MODELLING

4.1 INTRODUCTION

4.1.1. This section presents details of the approach to the modelling exercise for each of the three sites, including information regarding the modelled sources of noise. Also presented are any assumptions made in generating the models.

4.2 GENERAL

4.2.1. Detailed acoustic models of the three sites and their respective surrounding areas have been produced to assist in calculating the preliminary noise levels at the facades of NSLs located within 1 km of each of the sites. The models have been generated using CadnaA® noise mapping software and the modelled site is based upon the preliminary site layout drawing provided by the WSP Power Systems engineering team, which is presented in **Appendix C**, for reference.

4.2.2. The topography included in the models has been based on Digital Terrain Model (DTM) data provided by Ordnance Survey Ireland (OSI). For the purpose of this assessment it has been assumed that the finished levels across the sites will be similar to the existing topography, however, at the planning stage, the noise assessment will be based on finished floor levels, which will be provided by ground engineers. The DTM data provided by OSI were of a resolution which varied between 2m and 10m. A review of the land between the three modelled sites and the NSLs indicated that the topography does not undulate sufficiently to require more detailed DTM data for the purpose of this assessment. However, higher resolution DTM will be acquired for the detailed assessments required for the planning stage work.

4.2.3. The following general assumptions have been made in the preparation of the acoustic models:

- The model assumes downwind conditions which is considered a reasonable worst case.
- Ground absorption has been set at 1 to reflect the soft ground cover between the noise sources and the proposed facades.
- The dwellings and other miscellaneous buildings in the areas surrounding the three sites have been modelled at a height of 8 m.
- Given that the proposed development operates continuously, it follows that any noise impacts at NSLs are most likely during the night time period, when background noise levels are typically at their lowest and residents are at their most sensitive to noise. As such, receivers (i.e. calculation points) have been set at a height of 4.5 m above local ground level to reflect the typical location of bedrooms at first floor level.
- Receivers have been located at the facades of NSLs which are nearest to the three sites.

4.3 THE PROPOSED DEVELOPMENT

4.3.1. The orientation of the converter station compound in all three site options was modelled such that the AC switchyard was located closest to Knockraha substation to minimise the three-phase cable route between the two compounds. However, the final design will be based on further noise modelling which may influence the orientation of the converter station such that the propagation of noise to the NSLs is minimised.

4.3.2. The converter station building heights have been set based upon experience from similar projects and have been reviewed by WSP's Power Systems engineering team to ensure reasonable clearance is provided for equipment located within the buildings.

4.3.3. Noise transmission through the building envelope from equipment located within the buildings (e.g. thyristors) has not been modelled as the dominant sources of noise across the site are the equipment which are located externally. However, internal noise sources will be included in the more detailed planning stage noise model.

4.3.4. Noise data for the converter station have been sourced from publicly available information and from WSP's own library of data from previous interconnector projects which are no longer subject to non-disclosure agreements. These data have been reviewed by WSP's Power Systems engineering team to ensure that they are representative of the equipment which might be included in the final design. The noise data used in the model have been input in octave band format between 31 Hz (i.e. low frequency) and 8000 Hz.

4.3.5. The externally located equipment included in the noise model is as follows:

- 3 no. converter transformers (i.e. one per phase)
- 36 no. transformer cooling fans (i.e. 12 per transformer)
- 10 no. valve cooling fan banks
- 3 no. AC filter capacitors (i.e. one per phase)
- 3 no. AC filter reactors (i.e. one per phase)
- 1 no. compensation reactor (i.e. one three-phase reactor)

4.3.6. The octave band and A-weighted noise data for each of the above items, along with the assumed modelled heights is provided in tabular form in **Appendix D**.

4.3.7. A preliminary model for each of the three sites has been prepared, which is based upon the provided site layout and orientation and does not include any mitigation. Where noise levels at NSL's are predicted to exceed the proposed likely noise limits, a range of preliminary mitigation options have been explored, which are described in further detail in Section 5.5 of this report.

5 NOISE ASSESSMENT

5.1 INTRODUCTION

5.1.1. This section provides a preliminary assessment of the potential noise effects at the nearest and/or most exposed NSLs to the three sites and explores potential mitigation options to minimise noise levels. This assessment is based upon a Quiet Area site review and indicative noise limits – see Section 3, above.

5.1.2. Also provided is a comparison of the three sites to establish which is likely to be the most favourable in terms of noise.

5.1.3. Note that, in lieu of baseline noise measurements, the findings in this section should be treated as preliminary and indicative, only.

5.2 QUIET AREA SITE REVIEW

5.2.1. A review of each of the sites is presented, below, to establish whether any may be designated a 'Quiet Area'. This review has been undertaken using publicly available mapping data.

Table 5.1 – Quiet Area screening review for the three site options

Quiet area screening criteria	Ballyadam*	Meeleen	Knockraha
At least 3 km from urban areas with a population >1,000 people	x	✓	✓
At least 10 km from any urban areas with a population >5,000 people	x	x	x
At least 15 km from any urban areas with a population >10,000 people	x	x	x
At least 3 km from any local industry	x	✓	✓
At least 10 km from any major industry centre	x	x	x
At least 5 km from any National Primary Route	x	✓	✓
At least 7.5 km from any Motorway or Dual Carriageway	x	x	x
*Ballyadam modelled site is approximately 3km from the western edge of Midleton which has a population of >1,000 people.			

5.2.2. Table 5.1 indicates that none of the three sites satisfy all of the criteria for a 'Quiet Area', with the Ballyadam site meeting none of the seven criteria and Meeleen and Knockraha both meeting three. Therefore, it is anticipated that planning stage noise limits are likely to be based upon those set out in NG4 for *areas of low background noise* (Step 3), or the higher limits set out in NG4 known as the

general noise limits, which are proposed for sites with more elevated background noise levels and which are based upon the limits set out in World Health Organisation's *Guidelines for community noise*[2].

5.3 INDICATIVE NOISE LIMITS

5.3.1. In the absence of baseline noise measurements, at this preliminary stage, two sets of indicative noise limits are proposed which are based upon the limits in NG4 for areas of low background noise and the less onerous general noise limits. Both sets of noise limits are provided in Table 5.2, below.

Table 5.2 – Noise limits set out in NG4 for areas of low background noise and general noise

NG4 Noise Limit	Daytime Noise Criterion, dB $L_{Ar,T}$ (07:00 to 19:00hrs)	Evening Noise Criterion, dB $L_{Ar,T}$ (19:00 to 23:00hrs)	Night Noise Criterion, dB $L_{Ar,T}$ (23:00 to 07:00hrs)
Limits for areas of low background noise	45	40	35
General noise limits	55	50	45

5.3.2. Both sets of limits comprise day, evening and night time noise levels. However, as the proposed development will operate continuously over the 24-hour period, the primary consideration is the night time, when noise limits are most stringent. It follows, however, that if predicted noise levels at NSLs meet the required limits during the night time period, then noise limits are likely to be met comfortably during the day and evening periods. As such, this may be considered the worst case-scenario.

5.3.3. NG4 states that during the night time period, '*tonal noise from the facility should not be audible at any NSL*', however a 5 dB penalty should be applied for any audible tonality at NSLs during the day and evening. The likelihood of tonal noise cannot, at this preliminary stage, be discounted. Therefore, consideration is given to noise limits which account for audible tonality.

5.3.4. A 5 dB penalty for tonality has been applied to the night time criteria which results in limits of 40 dB in accordance with general noise limits in NG4 and 30 dB in accordance with the more onerous noise limit for areas of low background noise.

5.4 PRE-MITIGATION NOISE LEVELS

5.4.1. The most exposed NSL to each of the three sites are as follows:

- Ballyadam –NSL located 130 m to the north
- Meeleen – NSL located 400 m to the south-east
- Knockraha – NSL located 550 m to the west*

  * - Note that the *nearest* NSL to the Knockraha site is located 230 m to the east of site, however due to the screening effect from buildings within the proposed development, this NSL is not predicted to be the NSL most exposed to noise. This is with reference to the indicative layout at the pre-planning consultation stage and will be reviewed as the layout evolves as part of the micro-siting exercise.

[2] Guidelines for Community Noise. World Health Organisation, 1999

5.4.2. Noise levels have been predicted at each of the above NSLs, which are presented below in Table 5.3, along with the two indicative noise limits from NG4 (with and without the 5 dB penalty for tonality). The pre-mitigation noise levels at each site are also presented as noise contour plots in **Appendix E**.

Table 5.3 – Predicted noise levels at the most exposed NSLs and night-time noise limits

Site option	Most exposed NSL	Predicted noise level, dB	General noise limit in NG4, dB		Area of low background noise limit in NG4, dB	
			Night-time Limit	Night-time Limit (inc. tonality)	Night-time Limit	Night-time Limit (inc. tonality)
Ballyadam	130 m to the north	43	45	40	35	30
Meeleen	400 m to the south-east	36				
Knockraha	550 m to the west	37				

5.4.3. Table 5.3 indicates that the predicted noise level at the most exposed NSL to the Ballyadam site is 43 dB, which falls below the night-time general noise limit in NG4 by 2 dB (or exceeds the limit by 3 dB including the penalty for tonality) and exceeds the low background noise limit by 8 dB (or by 13 dB including the penalty for tonality).

5.4.4. The predicted noise level at the most exposed NSL to the Meeleen site during the night time is 36 dB, which falls below the general noise limit in NG4 by 9 dB (or by 4 dB including the penalty for tonality) and exceeds the low background noise limit by 1 dB (or by 6 dB including the penalty for tonality).

5.4.5. The predicted noise level at the most exposed NSL to the Knockraha site during the night time is 37 dB, which falls below the general noise limit in NG4 by 8 dB (or by 3 dB including the penalty for tonality) and exceeds the low background noise limit by 2 dB (or by 7 dB including the penalty for tonality).

5.4.6. The above results indicate that there is the potential at each site for noise levels to exceed night-time noise limits, particularly should noise sources exhibit tonal acoustic character. Therefore, consideration is given below to possible mitigation measures to ameliorate potential noise impacts at NSLs.

5.5 MITIGATION

5.5.1. Consideration is given below to mitigation options which may be applied to the most dominant noise sources, or at the site boundary. Consideration is also given to the site layout and the orientation of the sites in relation to their surroundings.

SITE LAYOUT

5.5.2. When exploring options for reconfiguring the site layout to minimise potential noise impacts, priority must be given to ensuring that the operation of the site is not undermined and that any proposed changes do not significantly impact on other design considerations. The preliminary site layout used for this assessment is shown in **Appendix C.**

5.5.3. The dominant sources of noise within the compound are the transformers and associated fans; the valve cooling fan banks; and the equipment located in the AC switchyard (i.e. harmonic filters, capacitors and reactors).

5.5.4. The transformers and fans are located adjacent to the reactor hall which is common to converter station design and necessary to operation. This configuration provides NSLs which are located towards the DC end of the site with some acoustic screening from the hall. Additionally, the blast walls located on either side of the transformers as a safety feature also act as an effective barrier to noise which is emitted laterally from the equipment to the NSLs.

5.5.5. The valve cooling fan banks have been located between the control building, store building and the DC, valve and reactor halls, providing effective acoustic screening laterally and towards the DC end of the compound. Locating valve cooling fan banks between these buildings is a common design feature of converter stations in that the banks need to be in proximity to the halls and benefit from acoustic screening from the nearby buildings. As such, locating the fans between the buildings is deemed the most effective in terms of noise.

5.5.6. It is noted at the Ballyadam site option, however, that the most exposed NSL is located 130 m to the north of the site where the nearest sources of noise from within the converter station compound would be the valve cooling fan banks, assuming the initial indicative layout. Should the site buildings and equipment be reconfigured slightly, such that the valve, reactor and DC halls are located towards the northern area of the site with the fan banks located further south, the most exposed NSL benefits from acoustic screening from the fan banks, afforded by the buildings within the converter station compound. The viability of reconfiguring the buildings in this way will need to be seen alongside other site constraints during the planning stage work to ensure the effective operation of the converter station.

5.5.7. This revised site layout has been incorporated into the noise model in the absence of any other form of mitigation. The predicted noise level during the night-time period at the most exposed NSL to the north is 41 dB, which is 2 dB lower than the predicted level assuming the initial indicative layout (as indicated in Table 5.3).

5.5.8. The predicted noise level at the nearest NSL to the south of the Ballyadam site, which is located approximately 500 m south of the southern boundary of the site, is 40 dB assuming the revised layout, which is equal to the predicted noise level at the NSL assuming the default site layout. Consequently, the relocation of the valve cooling fan banks is predicted to be of benefit to the NSL to the north and of no detriment to the other NSLs surrounding the site. As stated above, it is important to note, however, that whilst this revised site layout is predicted to be the better option in terms of minimising noise impacts at NSLs around the site, there are other design considerations which must be accounted for to ensure the effective operation of the converter station.

5.5.9. With regard to the location of valve cooling fan banks at the Meeleen and Knockraha sites, the locations of the NSLs around the sites are such that any potential acoustic benefit which may be afforded by relocating the fans, is predicted to be negligible.

5.5.10. The equipment in the AC switchyard is perhaps less constrained in terms of space than the transformers and valve cooling fan banks, however, the equipment connections in this area are reasonably rigid and an amount of clearance is required between equipment for safety and access. Consequently, the equipment in this area cannot be confined to a smaller footprint and the acoustic benefit which is likely to be achieved in doing this would be negligible, given the comparatively large distances between the NSLs and the converter station site options.

5.5.11. In summary, the dominant sources of noise are reasonably constrained in terms of relocation as allowances need to be made for effective operation of the site. However, reconfiguring the layout at the Ballyadam site such that the valve cooling fan banks are relocated towards the southern boundary and the halls relocated towards the north, is anticipated to reduce noise levels at the most exposed NSL located north of the site. Therefore, it is advised that consideration should be given to the feasibility of this reconfigured layout as the scheme evolves.

BOUNDARY ACOUSTIC BARRIER

5.5.12. Acoustic screening located on or around a site boundary is typically in the form of an acoustic fence or earth berm (or a combination of both).

5.5.13. Table 5.4 presents the predicted noise levels at the most exposed NSL to each site, with the inclusion of an acoustic fence, or an earth berm on the site boundary. In order to directly compare the predicted acoustic screening effect from both barrier options, the acoustic fence and berm have been modelled at a height of 2 m, which would provide an element of visual screening at ground level and have also been modelled at a height of 5 m (i.e. a height at which some acoustic screening effect would be anticipated). Note that the results indicate the effect of the barriers, alone, and the site includes no other forms of mitigation.

Table 5.4 – Predicted noise levels at the most exposed NSLs including an acoustic fence or berm

Barrier height	Predicted noise level at the most exposed NSL, dB					
	Ballyadam*		Meeleen		Knockraha	
	Fence	Berm	Fence	Berm	Fence	Berm
no barrier	43		36		37	
2 m	43		36		37	
5 m	41	38	36		34	
*Ballyadam results are for the initial indicative layout.						

5.5.14. It can be seen in Table 5.4 that the predicted noise levels at the most exposed NSL for the Ballyadam site range from 43 dB with no acoustic fence at the boundary to 41 dB with a 5 m high barrier, which is a range of 2 dB. A 2 m high fence is predicted to yield no attenuation.

5.5.15. At the same NSL, the noise level is predicted to be 38 dB with a 5 m high berm, with no attenuation predicted with the inclusion of a 2 m high berm. The improved performance of the berm in comparison to the fence is likely to be attributable to the intervening topography between the NSL

and the sources of noise within the site, which increases in height from the sources in the direction of the NSL.

5.5.16. The typical footprint required to construct a berm of 5 m in height means that the crest of the berm is located 15 m from the site boundary, assuming the berm is located as close to the boundary as possible, where topographical levels are higher than those at the site. The acoustic fence, however, is located at the site boundary, where topographical levels are lower. In effect, the crest of the berm is higher than that of the fence, relative to the sources and NSL, despite both being 5 m high relative to their respective local topographical level. The result of this at the Ballyadam site is that the berm is predicted to be more effective at attenuating noise to the north of the site than the fence.

5.5.17. The predicted noise levels at the most exposed NSL for the Meeleen site indicate that a 2 m high fence and a 2 m high berm would each yield no noise attenuation and 5 m high fence and a 5 m high berm would also each yield less than 1 dB of noise attenuation.

5.5.18. The predicted noise levels at the most exposed NSL for the Knockraha site range from 37 dB with no acoustic mitigation at the boundary to 34 dB with a 5 m high fence or a 5 m high berm , which is a range of 3 dB. A 2 m high fence or berm is predicted to yield no attenuation.

5.5.19. In summary, these results indicate that:

- a 2 m high fence or berm is likely to be ineffective in attenuating noise from any of the sites;
- a 5 m high fence is predicted to provide 3 dB attenuation at the Knockraha site, 2 dB at the Ballyadam site and no attenuation at the Meeleen site; and
- a 5 m high berm is predicted to provide 3 dB attenuation at the Knockraha site (i.e. the same predicted attenuation as the fence), 5 dB at the Ballyadam site (i.e. 3 dB more attenuation than the 5m high fence), and no attenuation at the Meeleen site (i.e. the same as the fence).

5.5.20. Therefore, both the fence and berm offer similar performance at the three sites, with the exception of Ballyadam, where the berm is predicted to offer a 2 dB improvement in noise attenuation at the most exposed NSL to the north of the site when compared to the fence. This improvement is as a result of the topography surrounding the Ballyadam site.

5.5.21. Whilst the above results indicate that some acoustic screening is afforded by the inclusion of a fence or berm, consideration should be given to the amount of attenuation achievable on balance with the practicalities and cost of these options. Typically, the application of mitigation to the *sources* of noise (i.e. applied to the equipment) is preferable to mitigation applied *further afield* (i.e. in the intervening land between the noise sources and the NSLs, such as berms or fences), as mitigation applied closest to the source is considered the most effective (where practicable). Therefore, options for mitigation at the noise source are explored, below.

NOISE SOURCE MITIGATION

5.5.22. Table 5.5 presents the source mitigation measures which have been considered in this section. Details of the sound insulation performance are provided in tabular form in **Appendix C**.

Table 5.5 – Range of potential mitigation options to equipment within the compound

Equipment	Mitigation applied
Converter transformers	acoustic enclosure
Transformer cooling fans	attenuators to all fans
Valve cooling fan banks	acoustic barrier / louvered enclosure and acoustic lined cowl
AC filter capacitors	sound shield
AC filter reactors	top hat and sound shield
Compensation reactor	top hat and sound shield

5.5.23. With particular regard to the valve cooling fan banks, there exist a number of potential mitigation measures which may be applied. Potential options include:

- An acoustic L-shaped barrier located at the side of the fan banks nearest to the site boundary (adjoining the control building).
- A louvered enclosure around the perimeter of the banks from ground level to the height of the fan outlet and an acoustically lined cowl extending vertically upward from the fan outlet around each fan within the banks.
- Reduced fan speed.
- Lower fan heights (default height at 3 m), with an increased number of fans to compensate for the reduced airflow.

5.5.24. Of the options presented above, the least effective in terms of noise mitigation is anticipated to be the lower fan heights with additional fans within the banks to compensate for the reduced airflow. Whilst the minimum height to which the fans can be lowered has not been determined at this preliminary stage (this is dependent on fan airflow requirements which would be specified at the detailed design stage), it is not likely that the fans can be significantly lower than one metre, to allow for the fan dimensions.

5.5.25. The fan banks have been modelled at each of the sites at one metre in height (rather than 3m in height used for the initial indicative layout – see noise model outputs in **Appendix E**) to establish the likely limits of any acoustic benefit which may be afforded (i.e. the lower the fans, the better, acoustically). The lowered fans have been modelled in the absence of any other mitigation to noise sources within the compound or acoustic barriers at or around the boundary.

5.5.26. For each site, the predicted noise level from the fan banks at the most exposed NSL decreased by no more than 2 dB when compared with predicted noise levels from fan banks at 3 m in height. Furthermore, as the number of additional fans needed to compensate for the required airflow has not been determined at this preliminary stage, the increase in noise level as a result of the additional fans has not been accounted for. As such, the increase in noise level from the additional fans is likely to (at least in part) offset the potential reduction in noise level at the most exposed NSLs achieved by lowering the fans.

5.5.27. The inclusion of a louvered enclosure around the perimeter of the fan banks (though open faced at the top to allow for airflow), along with acoustically lined cowls for each of the fans is conservatively estimated to attenuate fan noise emissions by 7 dB. By comparison, the modelling results indicate a similar level of noise attenuation for the fan banks can be achieved at the most exposed NSL to

Ballyadam through the inclusion of a 6 m high acoustic L-shaped barrier located north of the fan banks.

5.5.28. For the Knockraha site, the NSL most exposed to noise emissions specifically from the fan banks (i.e. not considering other noise sources within the compound) is located approximately 230 m east of the site boundary. This is closer than the most exposed NSL mentioned in Section 5.4.1 above which is the most exposed NSL when considering noise from all sources within the compound. To achieve a similar level of noise attenuation as the louvered enclosure and cowls at the NSL to the east, a 7 m high barrier acoustic barrier located between the DC hall and the store building towards the eastern boundary is predicted to be sufficient. This acoustic barrier would be in place of the L-shaped barrier adjoining the control building.

5.5.29. For the Meeleen site, noise emissions from the fan banks are not anticipated to dominate the noise climate at the most exposed NSL and, consequently, the inclusion of an acoustic barrier has not been considered.

5.5.30. As an additional option, a reduction in fan speed is conservatively estimated to reduce noise emissions from the fan banks by 3 dB, though this is typically determined through the fan specification at the design stage.

5.5.31. Whilst reducing the fan speed is not deemed the most effective measure in isolation, it may be used in combination with other mitigation options, should it be required. It should be noted that, whilst each of the other mitigation options for attenuating noise emissions from the fan banks have been considered in isolation for comparative purposes, they may also be applied in combination, to provide increased attenuation. The above comparison is intended at this stage to provide an indication of the efficacy of the available options. It is advised that further assessment of the most appropriate form of mitigation or combination of measures for the fan banks is undertaken at the planning stage, when the scheme has developed further.

5.5.32. The following sections set out potential mitigation measures which may be adopted to meet the indicative noise limits for each of the three sites; the resulting contours are presented in **Appendix E**. The options which have been explored are limited to noise source mitigation of equipment located within the converter station compound and do not account for any additional acoustic benefit which may be afforded by reconfiguration of the site layout, or inclusion of an acoustic barrier at or around the site boundary, both of which have been discussed earlier in this report. It should be noted, however, that these other forms of mitigation can be used in combination with the noise source mitigation measures set out below, to reduce noise levels even further at the most exposed NSLs.

5.5.33. Note also that for the attenuation of noise emissions from the fan banks in the sections below, the form of mitigation adopted is the acoustic barrier, as space for such a barrier has been demarked in the site layout plan provided by WSP Power Systems engineering team. However, this is for illustrative purposes and sufficient noise mitigation of noise emissions from the fan banks is also likely to be achievable through the inclusion of the louvered enclosure and cowls.

Ballyadam

5.5.34. The dominant sources of noise predicted at the most exposed NSL (with and without mitigation), are as follows:

1. Transformer cooling fans
2. Valve cooling fan banks
3. Converter transformers
4. AC filter capacitors
5. AC filter reactors

5.5.35. To meet a noise limit of 35 dB during the night time at the most exposed NSL (and all other NSLs by extension), which equates to the low background noise limit not including the penalty for tonality, the following mitigation would need to be applied.

Table 5.6 – Mitigation required to meet 35 dB during the night time

Equipment	Mitigation applied
3 no. converter transformers	acoustic enclosure
10 no. valve cooling fan banks	acoustic barrier of 5 m in height
36 no. transformer cooling fans	attenuators to all fans

5.5.36. To meet a noise limit of 30 dB during the night time at the most exposed NSL, which equates to the low background noise limit including the penalty for tonality (i.e. the lowest limit), the following mitigation would need to be applied.

Table 5.7 – Mitigation required to meet 30 dB during the night time

Equipment	Mitigation applied
3 no. converter transformers	acoustic enclosure
36 no. transformer cooling fans	attenuators to all fans
10 no. valve cooling fan banks	acoustic barrier of 7 m in height
3 no. AC filter capacitors	sound shield
3 no. AC filter reactors	top hat and sound shield

Meeleen

5.5.37. The dominant sources of noise predicted at the most exposed NSL, are as follows:

1. Transformer cooling fans
2. Converter transformers

5.5.38. To meet a noise limit of 35 dB during the night time at the most exposed NSL (and all other NSLs by extension), which equates to the low background noise limit not including the penalty for tonality, the following mitigation would need to be applied.

Table 5.8 – Mitigation required to meet 35 dB during the night time

Equipment	Mitigation applied
36 no. transformer cooling fans	attenuators to all fans

5.5.39. To meet a noise limit of 30 dB during the night time at the most exposed NSL, which equates to the low background noise limit including the penalty for tonality (i.e. the lowest limit), the following mitigation would need to be applied.

Table 5.9 – Mitigation required to meet 30 dB during the night time

Equipment	Mitigation applied
36 no. transformer cooling fans	attenuators to all fans
3 no. converter transformers	acoustic enclosure

Knockraha

5.5.40. The dominant sources of noise predicted at the most exposed NSL, are as follows:

1. Converter transformers
2. Transformer cooling fans
3. Valve cooling fan banks
4. AC filter capacitors
5. AC filter reactors
6. Compensation reactor

5.5.41. To meet a noise limit of 35 dB during the night time at the most exposed NSL (and all other NSLs by extension), which equates to the low background noise limit not including the penalty for tonality, the following mitigation would need to be applied.

Table 5.10 – Mitigation required to meet 35 dB during the night time

Equipment	Mitigation applied
3 no. converter transformers	acoustic enclosure

5.5.42. To meet a noise limit of 30 dB during the night time at the most exposed NSL, which equates to the low background noise limit including the penalty for tonality (i.e. the lowest limit), the following mitigation would need to be applied.

Table 5.11 – Mitigation required to meet 30 dB during the night time

Equipment	Mitigation applied
3 no. converter transformers	acoustic enclosure
36 no. transformer cooling fans	attenuators to all fans
10 no. valve cooling fan banks	acoustic barrier (of 7 m in height to the east, between the store building and DC hall)
3 no. AC filter capacitors	sound shield
3 no. AC filter reactors	top hat and sound shield
compensation reactor	top hat and sound shield

5.5.43. Note that noise from the valve cooling fan bank, passing between the control building and the DC hall will need to be controlled through the installation of a 7 m high barrier between the store building and DC hall, to ensure noise levels at the nearest NSL located approximately 230 m to the east of the site, meet the proposed limit.

SITE ORIENTATIONS

5.5.44. The current site orientations for the three sites, which are indicative at this stage and have been assumed only for the purposes of this study, are understood to have been determined such that the distances between the AC end of the site (i.e. switchyard) and the substation are minimised. At all sites, NSLs are located sparsely but in a number of directions around the boundary, which limits the directions in which the sites can be re-orientated.

5.5.45. Figures E-2, E-6 and E-10 in **Appendix E** present the contours for each of the sites in the absence of mitigation. The location of NSLs around each of the sites is such that there is no re-orientation option available which ensures that all NSLs are likely to be sufficiently protected from noise from the site in the absence of other mitigation measures.

5.6 SITE COMPARISON

5.6.1. Based on the predicted noise levels at each of the sites and the mitigation which is adjudged to be required to achieve the proposed noise limits, the site option at which noise levels predicted at the most exposed NSL are lowest is Meeleen. As such, the amount of mitigation likely to be required to achieve the indicative noise limits is anticipated to be lower than for the Ballyadam and Knockraha sites.

5.6.2. It should be noted, however, that whilst achieving lower noise levels at the most exposed NSL may be easier at the Meeleen site, the background noise levels at the most exposed NSL may also be lower than at the other two site options. The proximity of existing noise sources to Knockraha (i.e. substation) and Ballyadam (N25 dual carriageway), for example, may preclude the need for such low noise limits at these sites. Therefore, the site which may be considered most feasible with regard to noise would depend on the existing background noise levels around each of the sites and their associated NSLs and should be determined at the planning stage.

5.6.3. It is also acknowledged, that the noise impacts need to be judged alongside other design considerations and that the current standing of the three sites in terms of noise may not reflect the overall merits of the three sites, when considered with those other design considerations.

6 CONCLUSIONS

6.1.1. A preliminary acoustic study of potential noise impacts from the operation of the converter station at the three site options has been undertaken to support the pre-planning consultation process.

6.1.2. The study comprises 3D acoustic models of each of the sites to establish the likely noise levels at the nearest NSLs. The models are based upon an assumed preliminary site layout, representative noise data for the proposed HVDC equipment, and DTM data provided by Ordnance Survey Ireland.

6.1.3. In the absence of baseline noise measurements, two sets of indicative noise limits have been proposed, based on the general noise limits and the more onerous noise limits for areas of low background noise, set out in guidance document NG4 for the night time period. A review of the indicative site locations indicates that none of the three sites meet the criteria for a designated Quiet Area.

6.1.4. The modelling results indicate that, for the initial indicative site layout and orientation and in the absence of mitigation, there are NSLs around each of the sites, which are predicted to be exposed to noise levels in excess of the indicative noise limits. It is important to note, however, that, these indicative limits may be subject to change at the planning stage, once baseline noise measurements have been undertaken to establish the prevailing noise climate.

6.1.5. An investigation of the site layout, site orientation and of noise source mitigation options has been undertaken to minimise noise levels at the nearest NSLs to all three sites. It is predicted that noise levels at NSLs around the three sites are likely to meet an onerous noise limit of 30 dB, with mitigation applied to equipment within the site compound whilst maintaining the site layout and orientation. The 30 dB noise limit equates to the noise limit for areas of low background noise during the night time set out in NG4 and includes a 5 dB penalty to account for the possibility of tonal character exhibited from noise sources within the compound.

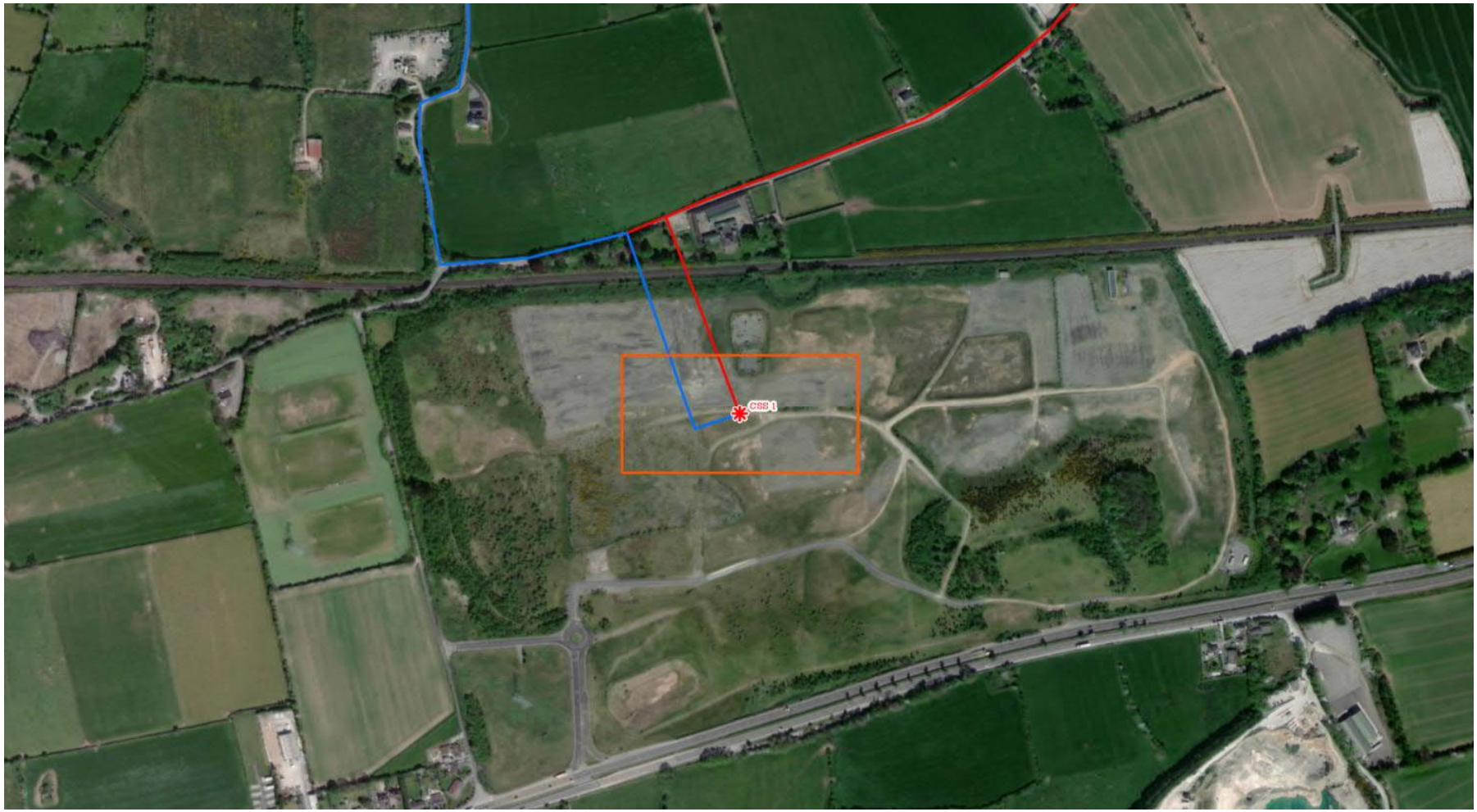
6.1.6. The site option at which noise levels predicted at the most exposed NSL are lowest is Meeleen. However, the background noise levels at the most exposed NSL to Meeleen may also be lower than at the other two site options. The proximity of existing noise sources to Knockraha (i.e. substation) and Ballyadam (N25 dual carriageway), for example, may preclude the need for such low noise limits at these sites. Therefore, the site which may be considered the best performing with regard to noise would depend on the existing background noise levels around each of the sites and their associated NSLs and should be determined at the planning stage.

6.1.7. Note that this study has been undertaken in the absence of baseline noise measurements and as such, the results should be read as preliminary and indicative for use at the consultation stage only.

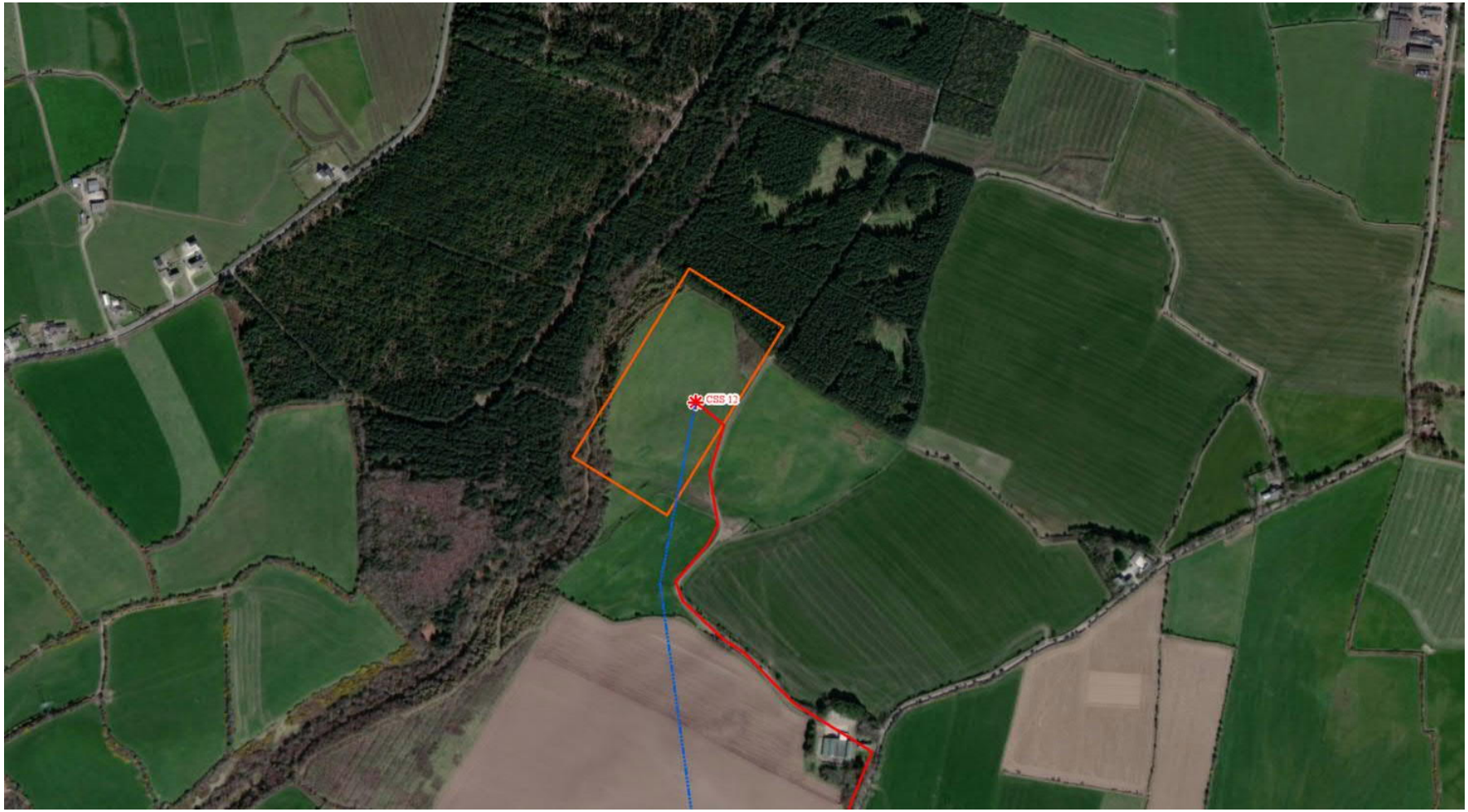
Appendix A

SITE LOCATIONS

A-1 Ballyadam modelled site location



A-2 Meeleen modelled site location



A-3 Knockraha modelled site location

Appendix B

NOISE GUIDANCE

This Section presents further details of the four-step procedure set out in NG4 for setting noise limits.

STEP 1 – QUIET AREA SCREENING OF THE DEVELOPMENT LOCATION

The first step requires the assessor to establish whether the location of the proposed development satisfies the criteria for a 'Quiet Area' set out in the EPA publication Environmental Quality Objectives - Noise in Quiet Areas3. These criteria are as follows:

- At least 3 km from urban areas with a population >1,000 people;
- At least 10 km from any urban areas with a population >5,000 people;
- At least 15 km from any urban areas with a population >10,000 people;
- At least 3 km from any local industry;
- At least 10 km from any major industry centre;
- At least 5 km from any National Primary Route, and;
- At least 7.5 km from any Motorway or Dual Carriageway.

Where the location satisfies these criteria, Table 1 of NG4 indicates that a noise limit should be set no greater than 10 dB below the average daytime background noise level measured during the baseline noise survey in Step 2. This limit applies to day, evening and night time periods.

STEP 2 – BASELINE ENVIRONMENTAL NOISE SURVEY

Whether or not the location satisfies the criteria in Step 1, a baseline noise survey should be undertaken in Step 2 to establish the background noise level at NSLs or locations which are considered representative. The resulting background noise level is used to set the noise limit for designated Quiet Areas (Step 1), or to establish areas of low background noise (Step 3).

STEP 3 – SCREEN FOR AREAS OF LOW BACKGROUND NOISE

Using the results of the baseline noise survey in Step 2, the assessor should establish whether the background noise levels at the measurement locations meet the following criteria:

- Average Daytime Background Noise Level ≤40 dB L_{AF90}; and
- Average Evening Background Noise Level ≤35 dB L_{AF90}, and
- Average Night time Background Noise Level ≤30 dB L_{AF90}

If *all three* criteria are met, the location is deemed to be an area of low background noise and limits of 45 dB during the daytime, 40 dB during the evening and 35 dB during the night time are to be imposed at NSLs, in accordance with Table 1 of NG4.

STEP 4 - DETERMINE APPROPRIATE NOISE CRITERIA

Where all three of the criteria in Step 3 are not met at an NSL, then NG4 proposes a set of general noise limits 55 dB during the daytime, 50 dB during the evening and 45 dB during the night time and which are presented in the summary Table 3.1, below.

[3] Environmental Quality Objectives Noise in Quiet Areas (2000-MS-14-M1), 2003

Table B-1 – Summary of criteria in NG4

Scenario	Daytime Noise Criterion, dB $L_{Ar,T}$ (07:00 to 19:00hrs)	Evening Noise Criterion, dB $L_{Ar,T}$ (19:00 to 23:00hrs)	Night Noise Criterion, dB $L_{Ar,T}$ (23:00 to 07:00hrs)
Quiet Area	Noise from the licensed site to be at least 10 dB below the average daytime background noise level measured during the baseline noise survey.	Noise from the licensed site to be at least 10 dB below the average daytime background noise level measured during the baseline noise survey.	Noise from the licensed site to be at least 10 dB below the average daytime background noise level measured during the baseline noise survey.
Areas of low background noise	45	40	35
All other areas	55	50	45

TONALITY

With respect to the potential for tonal acoustic character of noise perceptible from the proposed development, NG4 states that a 5 dB penalty should be applied during the day and evening periods where significant differences between adjacent third octave band levels are noted for sources of noise. These differences are as follows:

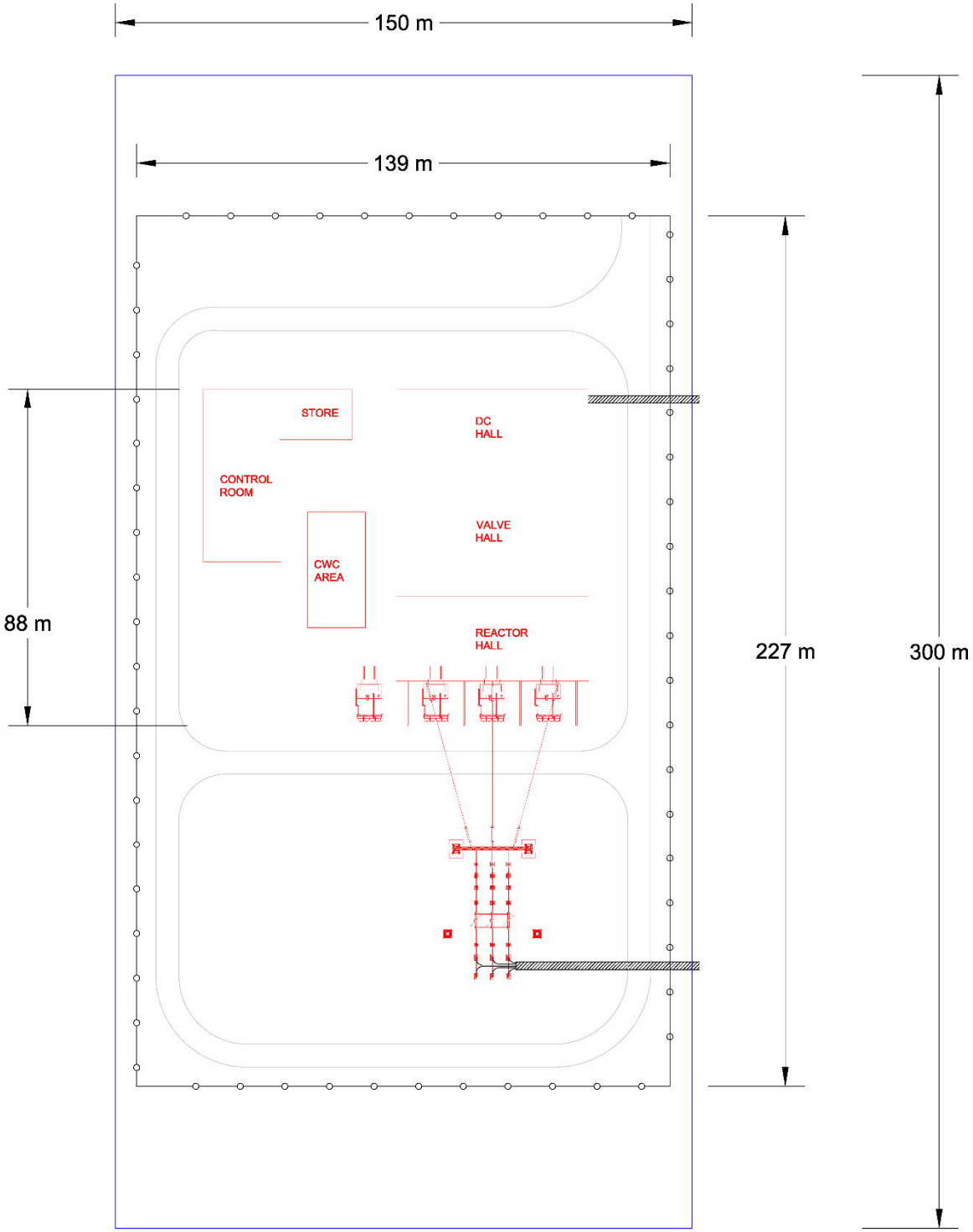
- 15 dB in low-frequency one-third-octave bands (25Hz to 125Hz);
- 8 dB in middle-frequency bands (160Hz to 400Hz), and;
- 5 dB in high-frequency bands (500Hz to 10,000Hz).

However, during the night time period, NG4 states that *'tonal noise from the facility should not be audible at any NSL'*.

Appendix C

SITE LAYOUT

C-1 – Preliminary site layout



Appendix D

INPUT DATA FOR MODELLED SITE EQUIPMENT

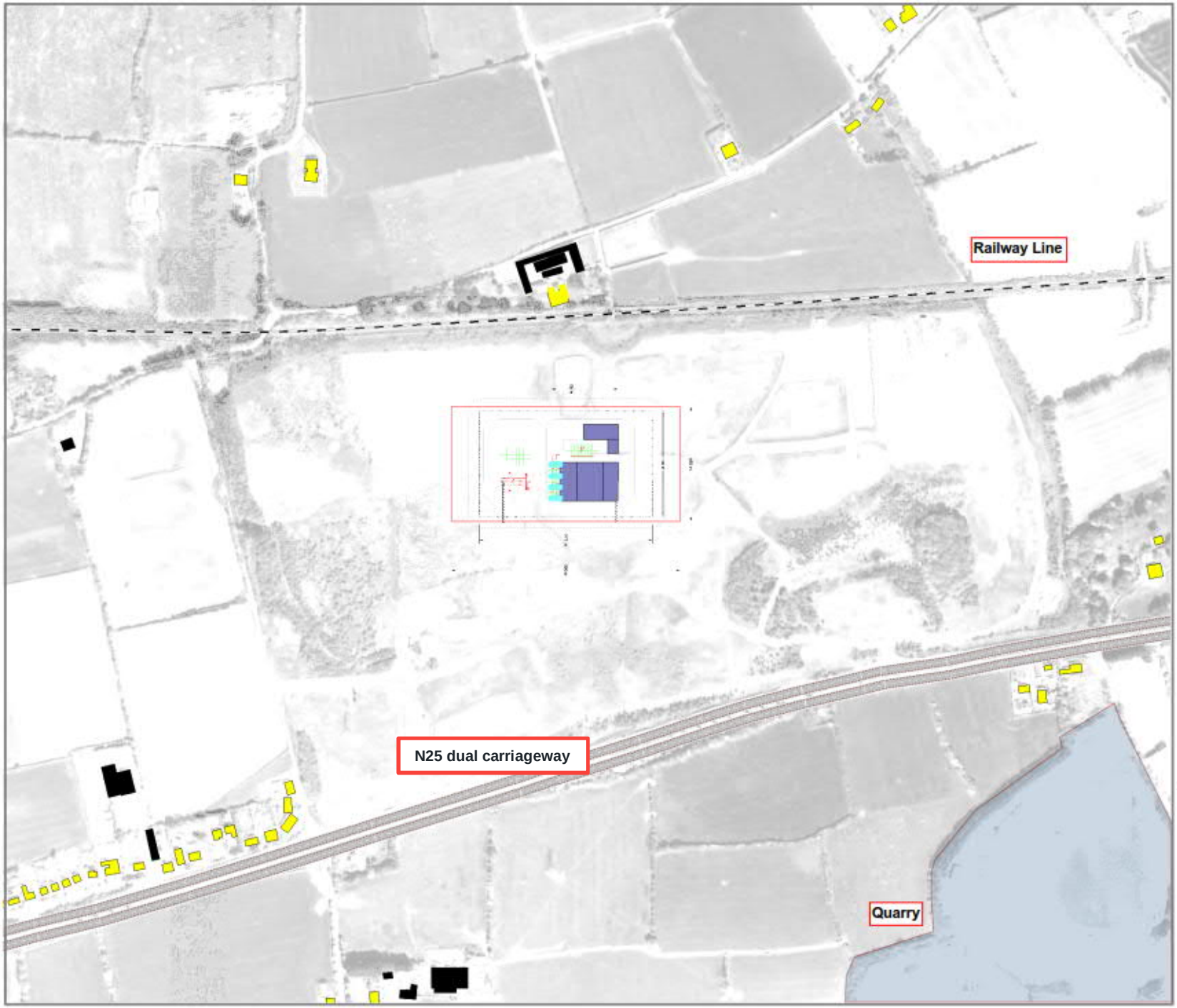
D-1 – input data used in the acoustic models

Plant	Equipment quantity	Modelled source height	Data type	Octave-band frequency data (Hz)									Sound Power Level (Lw) (dBA)	Details
				31	63	125	250	500	1000	2000	4000	8000		
Converter transformer (Tx)	3 (1 per phase)	5	Lw	89	89	106	103	102	84	79	83	75	101	Source:EWIC
			SRI of mitigation	21	21	25	31	41	50	56	61	60		Acoustic enclosure around aux transformer. Data source: dB Attenuation Ltd (Standard Panels) Overall performance: 33dBA
			Lw mitigated	68	68	81	72	61	34	23	22	15	68	
Converter transformer fans	12 (per Tx)	5	Lw	79	96	92	89	89	84	82	72	62	90	Source: NE Clean Power Link Project / Qunatity based on EWIC
			SRI of mitigation	4	4	7	13	19	23	23	16	13		Based on rectangular silencer 900mm in length with 40% free area. Overall performance: 16dBA. Source: WSP's generic library for a typical silencer.
			Lw mitigated	75	92	85	76	70	61	59	56	49	74	
Valve cooling fan bank	10	3	Lw	78	96	91	88	88	84	81	72	62	89	Source: NE Clean Power Link Project
			SRI of mitigation											
			Lw mitigated											
AC Filter capacitor	3 (1 per phase)	7	Lw	68	68	85	82	81	63	58	62	54	80	Source: NE Clean Power Link Project
			SRI of mitigation	7	7	7	7	7	7	7	7	7		7dB attenuation from noise enclosures on AC filter capacitors. Source: WSP's estimation of mitigation based on previous projects
			Lw mitigated	61	61	78	75	74	56	51	55	47	73	
AC Filter reactor	3 (1 per phase)	5	Lw	68	68	85	82	81	63	58	62	54	80	Source: NE Clean Power Link Project (based on AC valve reactor)
			SRI of mitigation	10	10	10	10	10	10	10	10	10		10dB attenuation from noise enclosures with top hats on compensation reactors. Source: WSP's estimation of mitigation based on previous projects
			Lw mitigated	58	58	75	72	71	53	48	52	44	70	
Compensation reactor	1 (3 phase reactor)	3.7	Lw	68	68	85	82	81	63	58	62	54	85	Source: Cige TB202
			SRI of mitigation	10	10	10	10	10	10	10	10	10		10dB attenuation from noise enclosures with top hats on AC filter reactors. Source: WSP's estimation of mitigation based on previous projects
			Lw mitigated	58	58	75	72	71	53	48	52	44	75	

Appendix E

NOISE MODEL OUTPUTS

E-1 – Ballyadam modelled site



KEY

- NSL
- NON-SENSITIVE BUILDING
- BLAST WALLS

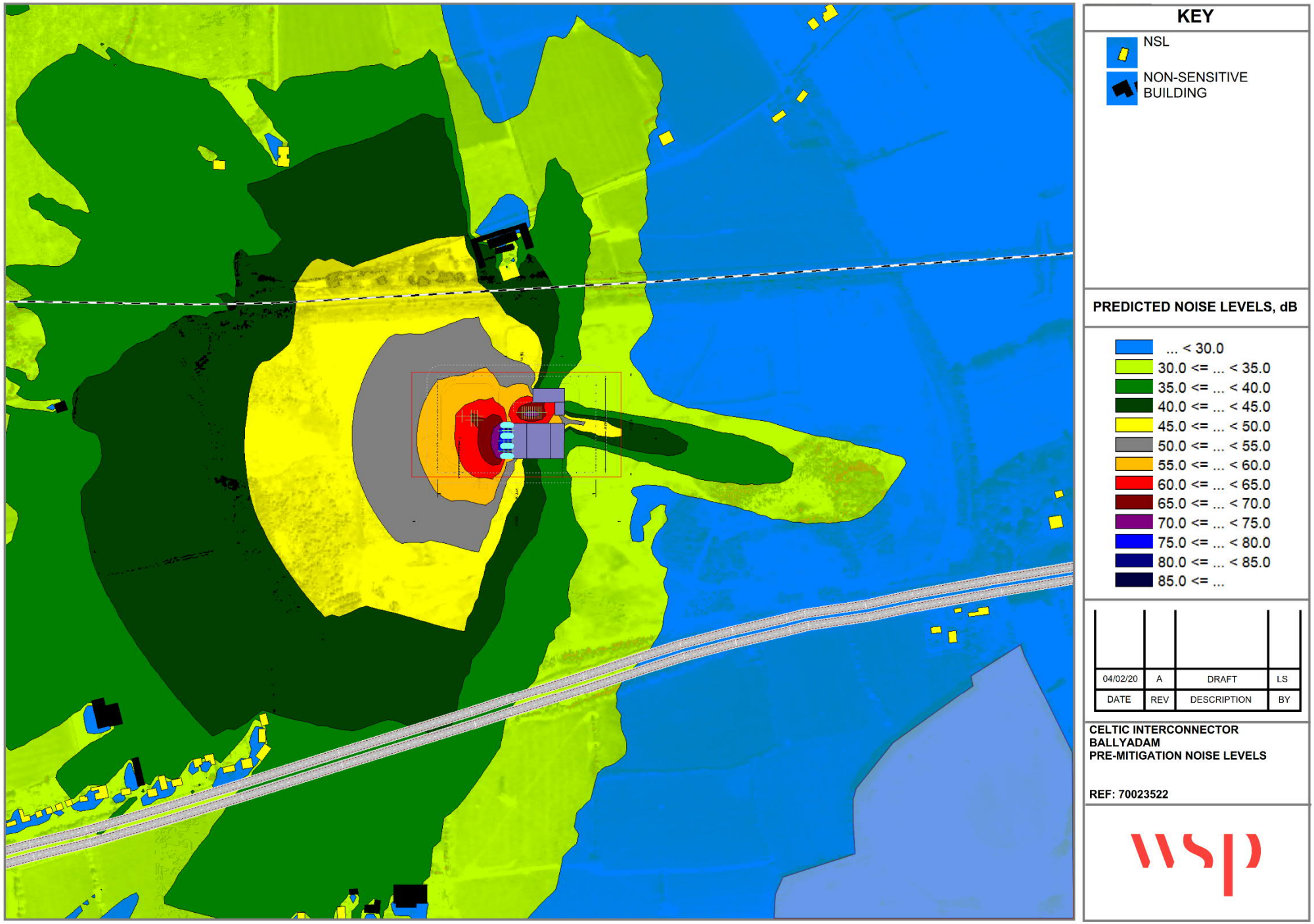
DATE	REV	DESCRIPTION	BY
04/02/20	A	DRAFT	LS

CELTIC INTERCONNECTOR
BALLYADAM
MODELLED SITE

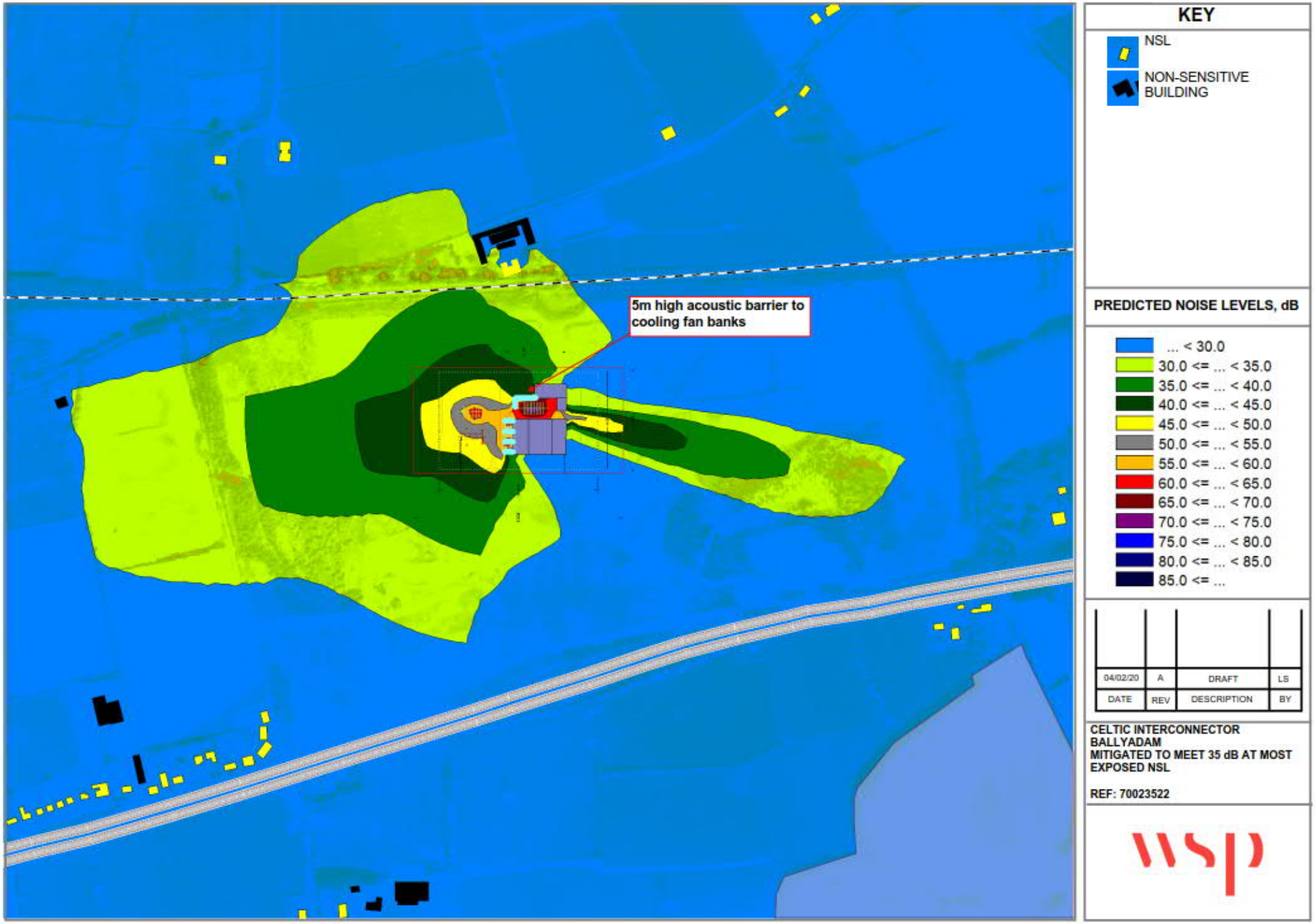
REF: 70023522

wsp

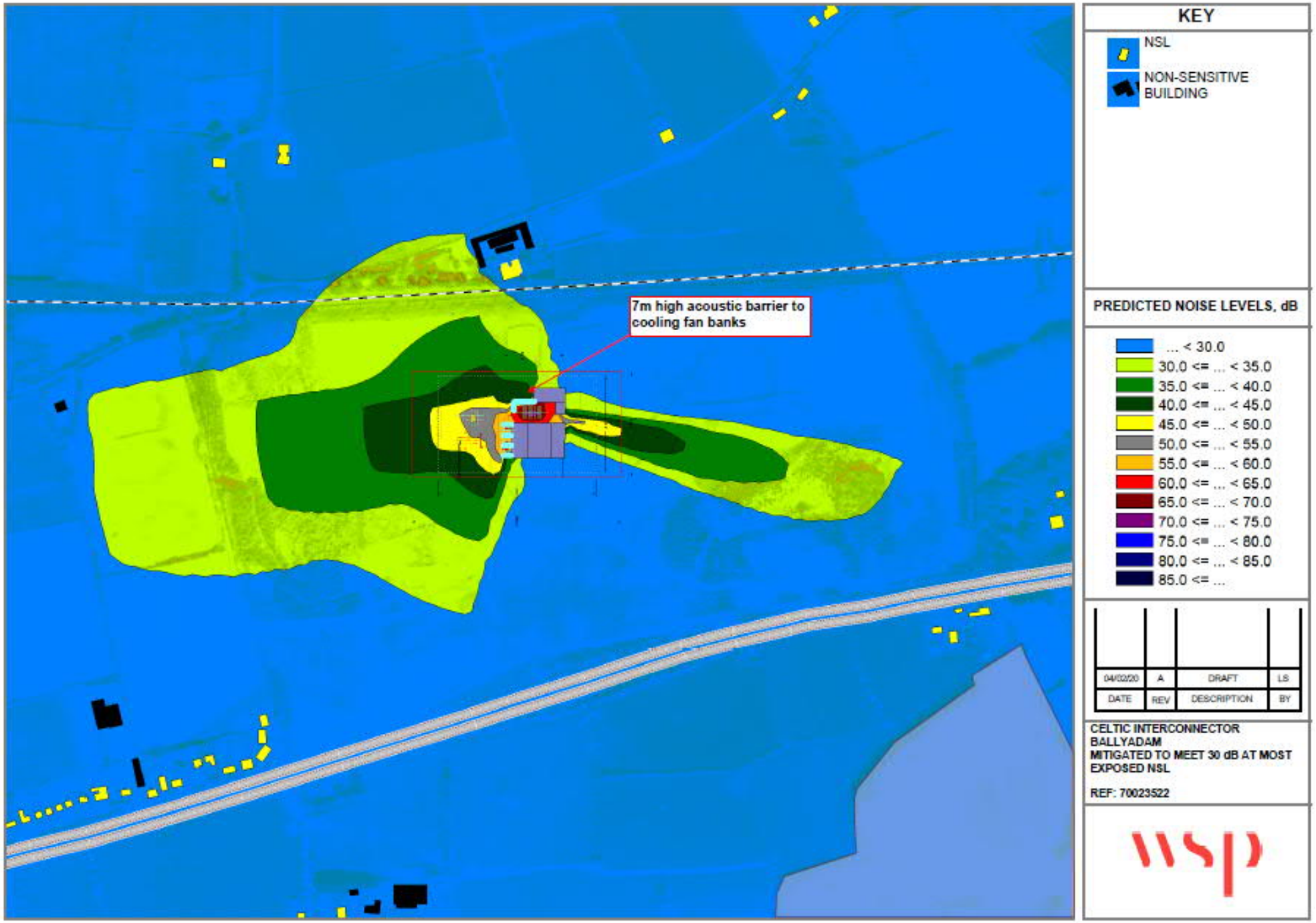
E-2 – Ballyadam predicted noise levels pre-mitigation



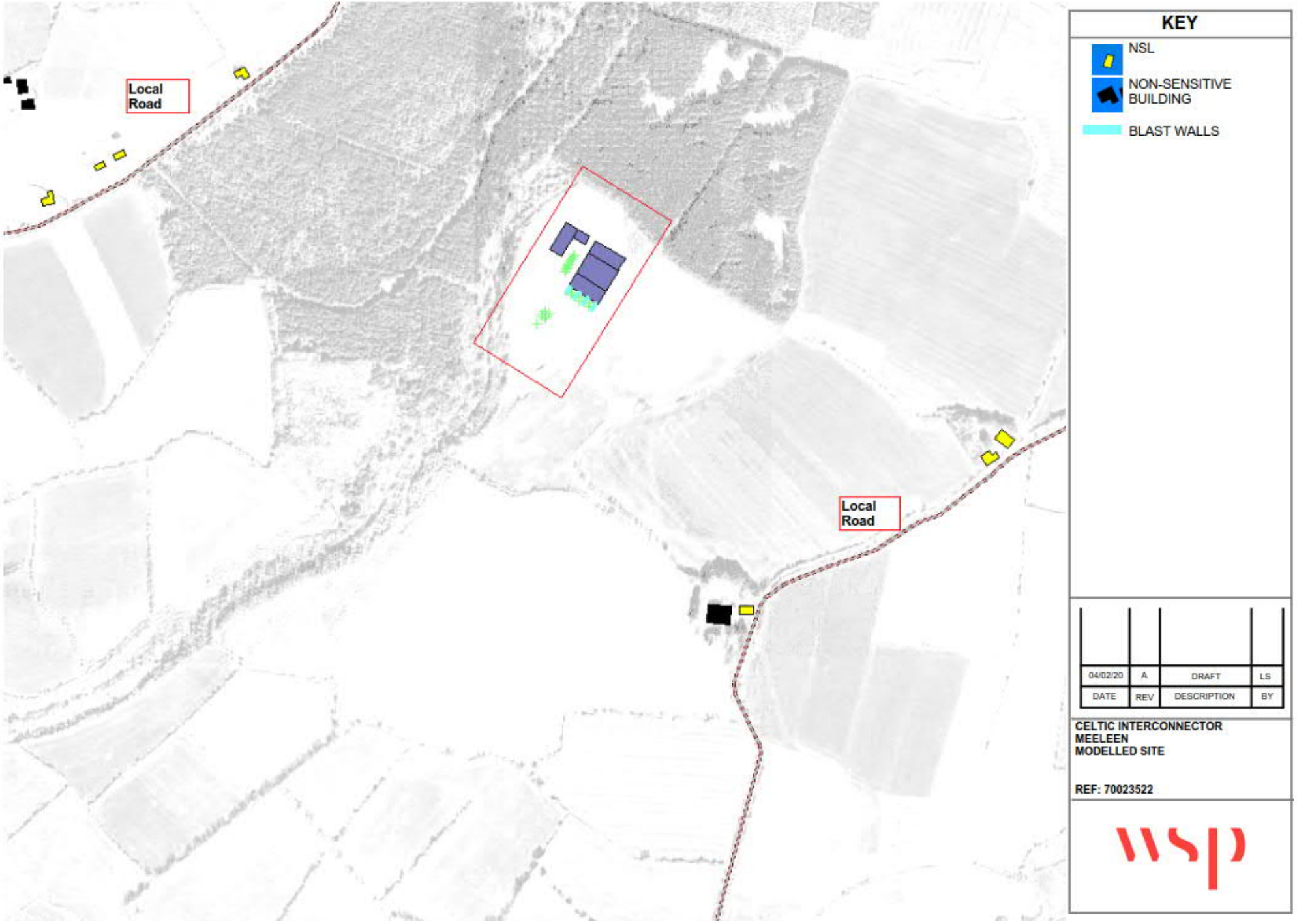
E-3 – Ballyadam mitigated to meet 35 dB at the most exposed NSL



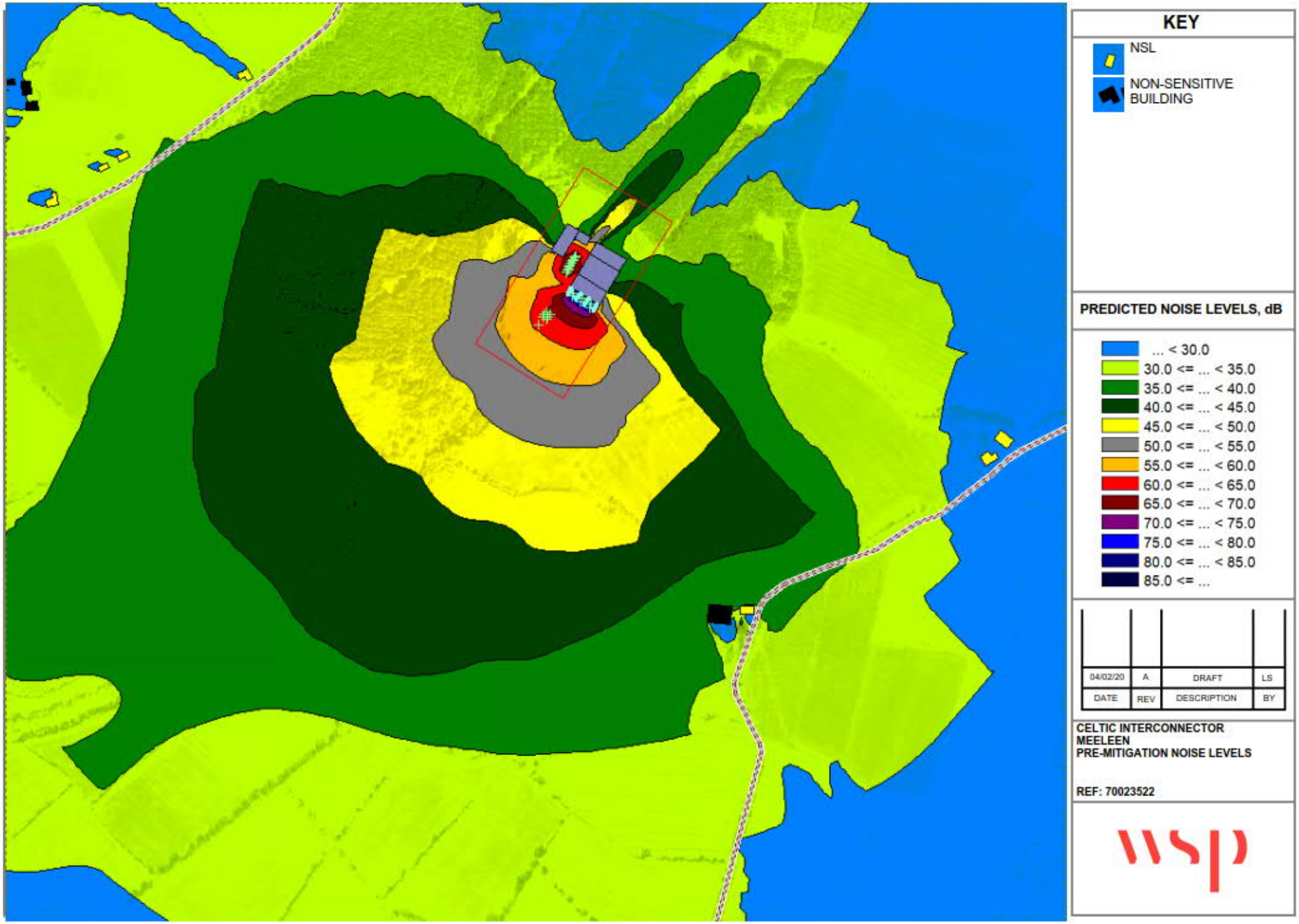
E-4 – Ballyadam mitigated to meet 30 dB at the most exposed NSL



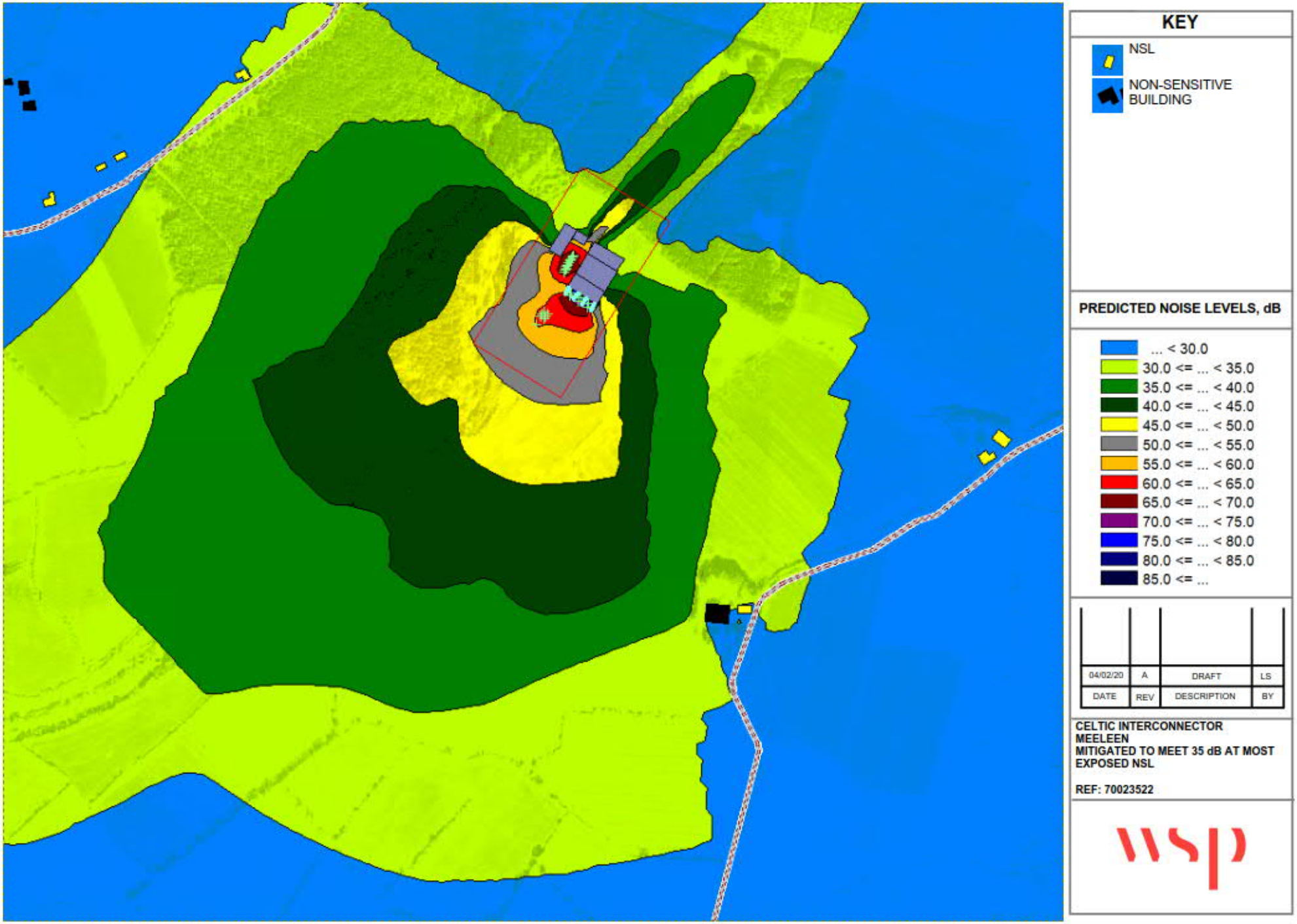
E-5 – Meeleen modelled site



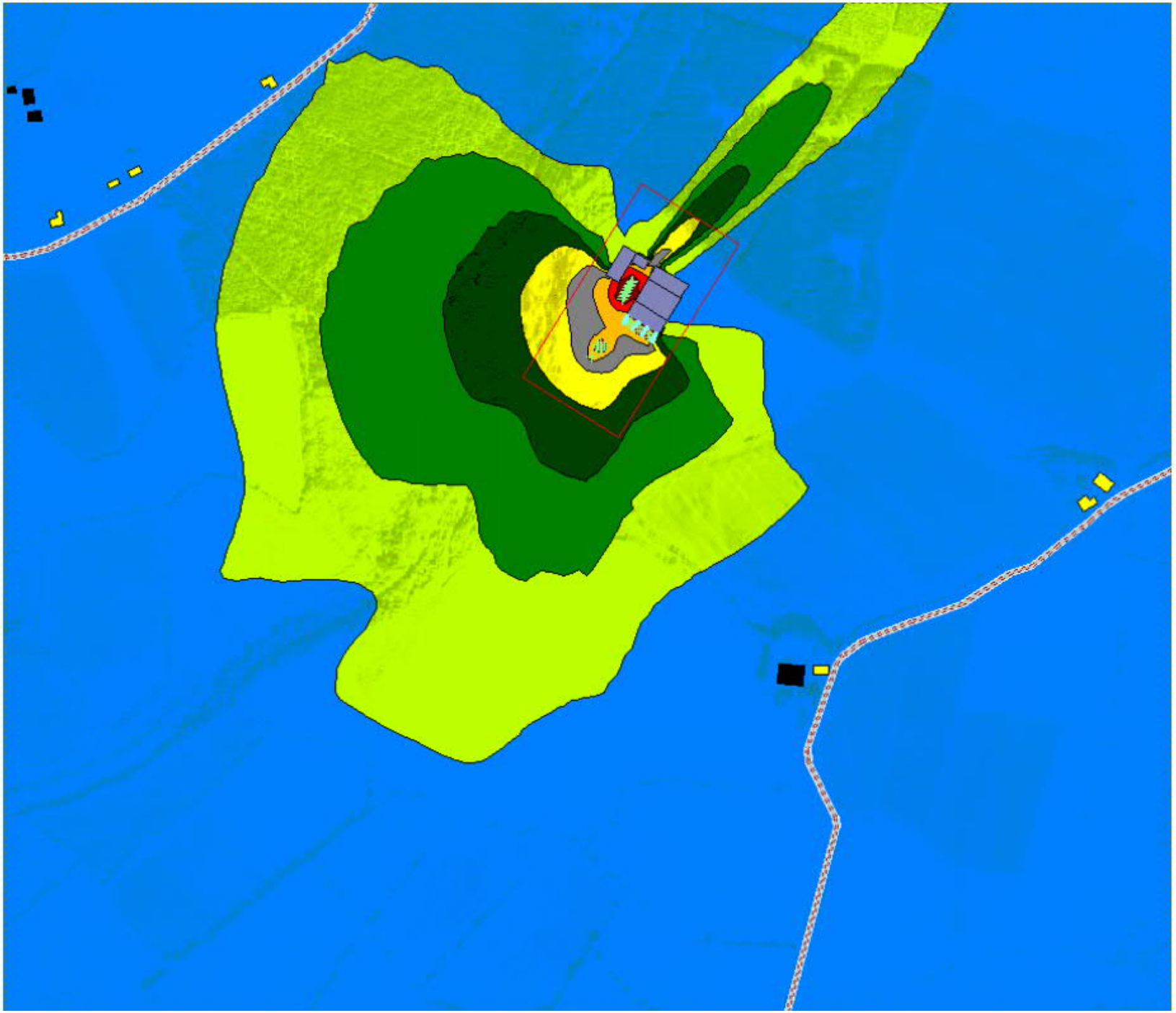
E-6 – Meeleen predicted noise levels pre-mitigation



E-7 – Meeleen mitigated to meet 35 dB at the most exposed NSL



E-8 – Meeleen mitigated to meet 30 dB at the most exposed NSL



KEY

NSL

NON-SENSITIVE BUILDING

PREDICTED NOISE LEVELS, dB

... < 30.0
30.0 <= ... < 35.0
35.0 <= ... < 40.0
40.0 <= ... < 45.0
45.0 <= ... < 50.0
50.0 <= ... < 55.0
55.0 <= ... < 60.0
60.0 <= ... < 65.0
65.0 <= ... < 70.0
70.0 <= ... < 75.0
75.0 <= ... < 80.0
80.0 <= ... < 85.0
85.0 <= ...

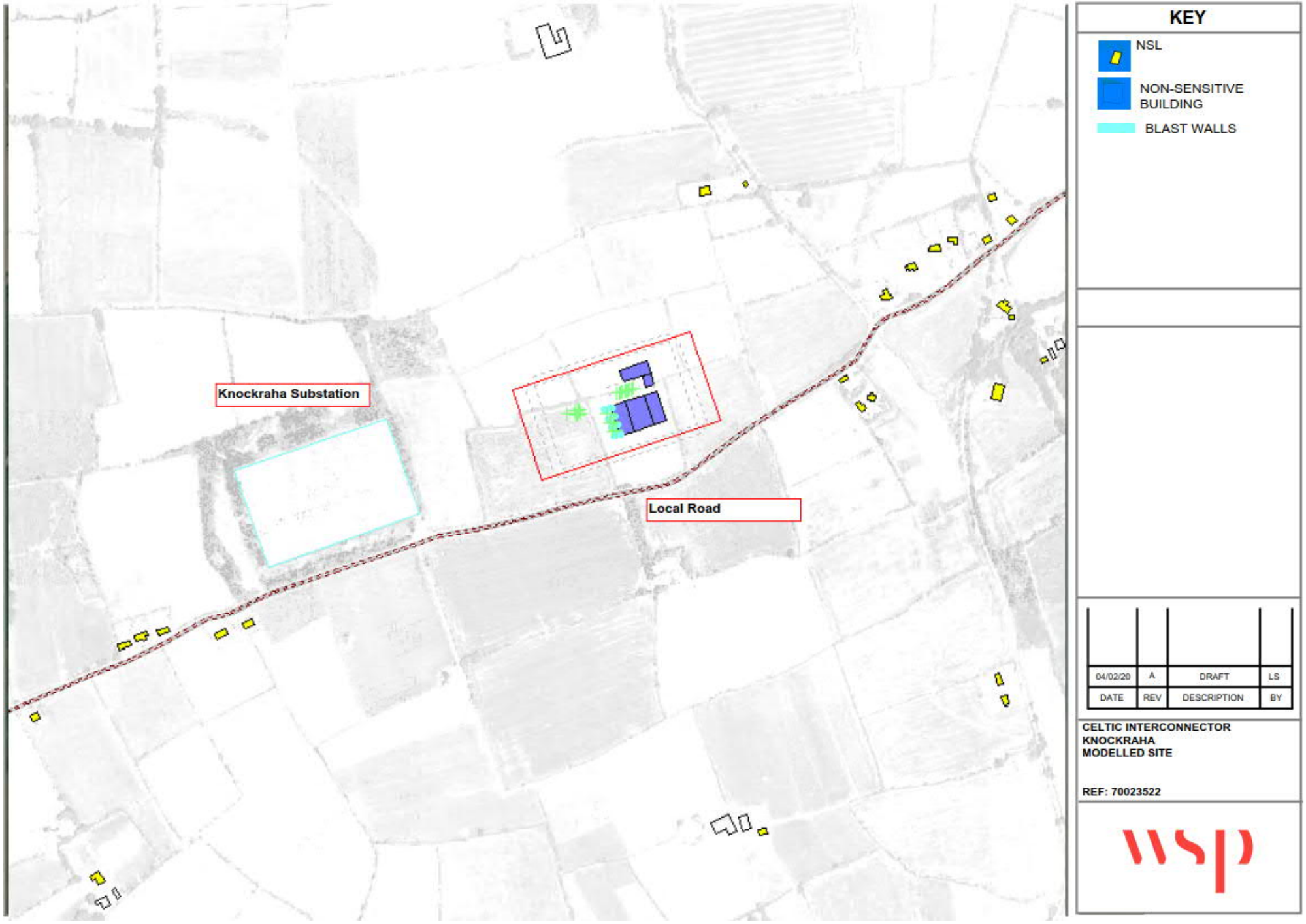
DATE	REV	DESCRIPTION	BY
04/02/20	A	DRAFT	LS

CELTIC INTERCONNECTOR
MEELEEN
MITIGATED TO MEET 30 dB AT MOST EXPOSED NSL

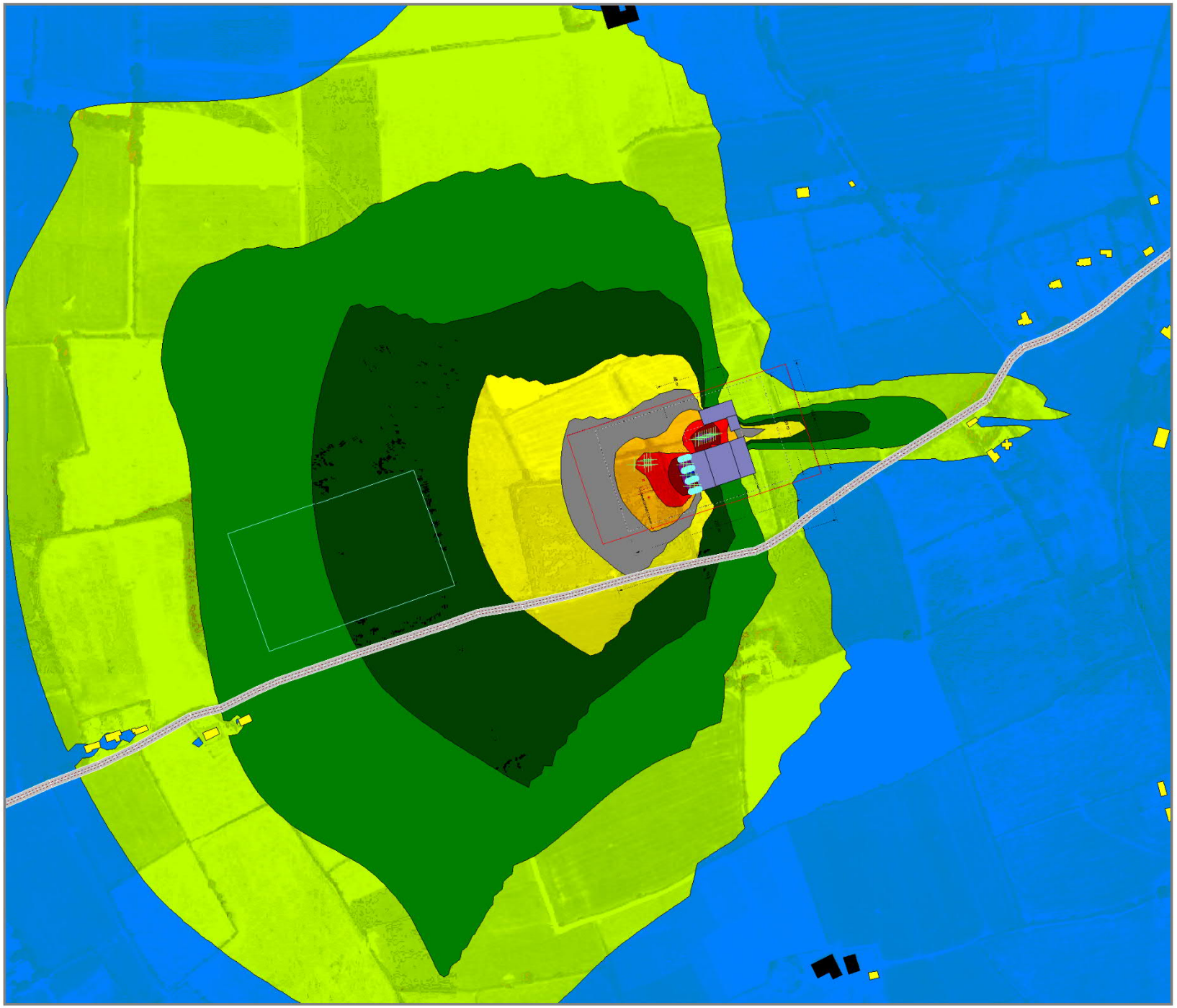
REF: 70023522

wsp

E-9 – Knockraha modelled site



E-10 – Knockraha predicted noise levels pre-mitigation



KEY

NSL

NON-SENSITIVE BUILDING

PREDICTED NOISE LEVELS, dB

- ... < 30.0
- 30.0 <= ... < 35.0
- 35.0 <= ... < 40.0
- 40.0 <= ... < 45.0
- 45.0 <= ... < 50.0
- 50.0 <= ... < 55.0
- 55.0 <= ... < 60.0
- 60.0 <= ... < 65.0
- 65.0 <= ... < 70.0
- 70.0 <= ... < 75.0
- 75.0 <= ... < 80.0
- 80.0 <= ... < 85.0
- 85.0 <= ...

DATE	REV	DESCRIPTION	BY
04/02/20	A	DRAFT	LS

CELTIC INTERCONNECTOR
KNOCKRAHA
PRE-MITIGATION NOISE LEVELS

REF: 70023522

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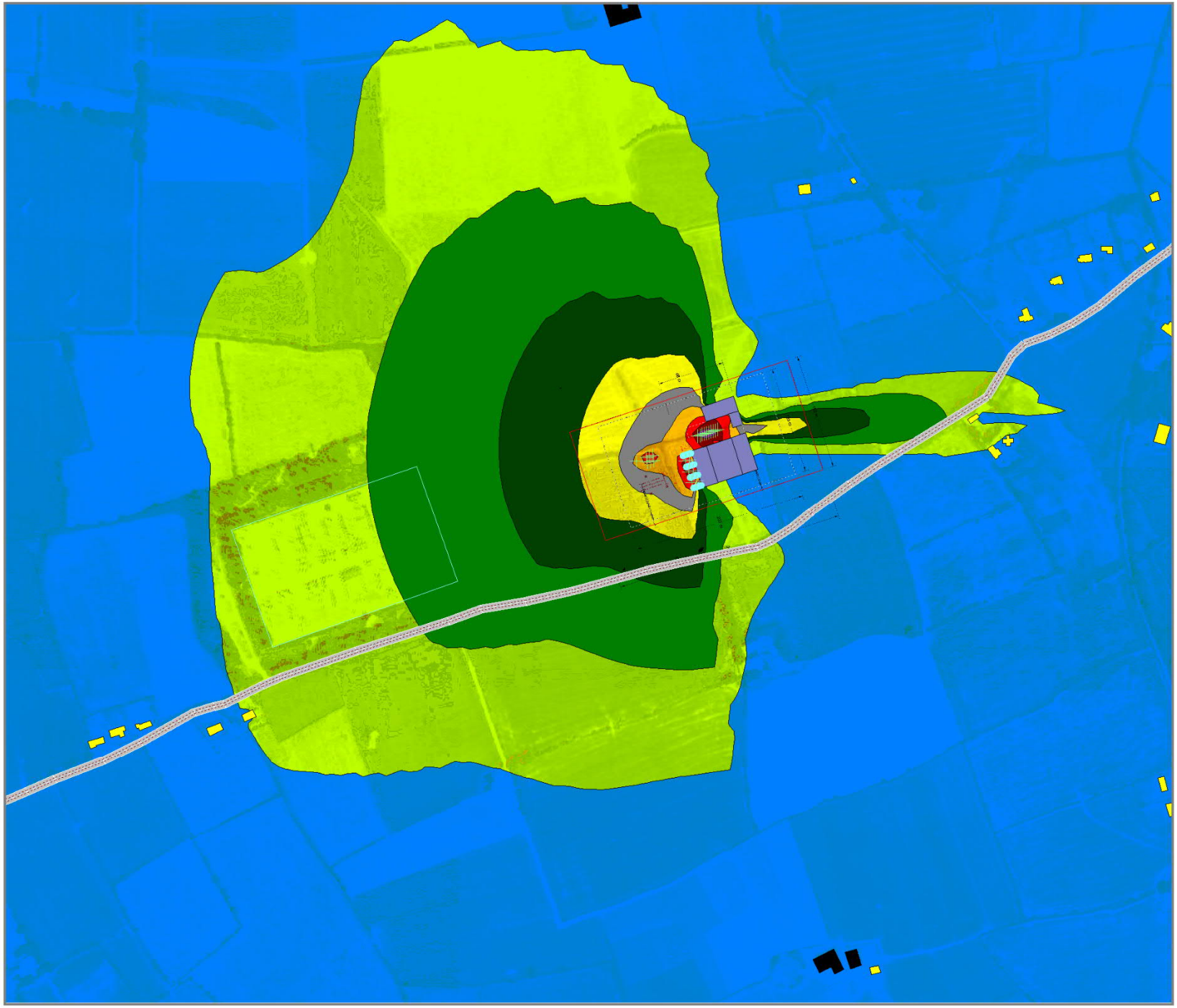
E-11 – Knockraha mitigated to meet 35 dB at the most exposed NSL



KEY

NSL

NON-SENSITIVE BUILDING

PREDICTED NOISE LEVELS, dB

- ... < 30.0
- 30.0 <= ... < 35.0
- 35.0 <= ... < 40.0
- 40.0 <= ... < 45.0
- 45.0 <= ... < 50.0
- 50.0 <= ... < 55.0
- 55.0 <= ... < 60.0
- 60.0 <= ... < 65.0
- 65.0 <= ... < 70.0
- 70.0 <= ... < 75.0
- 75.0 <= ... < 80.0
- 80.0 <= ... < 85.0
- 85.0 <= ...

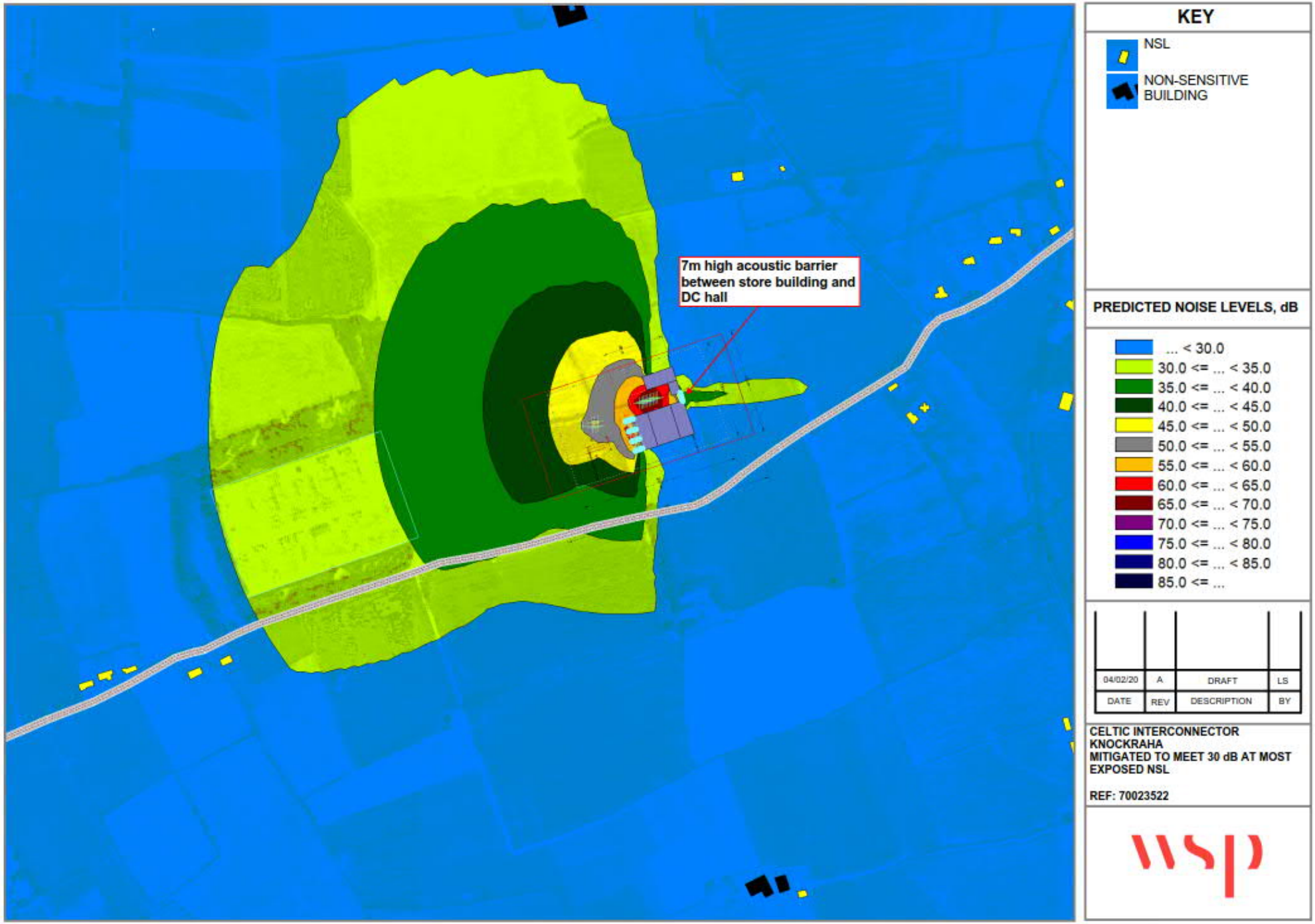
DATE	REV	DESCRIPTION	BY
04/02/20	A	DRAFT	LS

CELTIC INTERCONNECTOR
KNOCKRAHA
MITIGATED TO MEET 35 dB AT MOST EXPOSED NSL

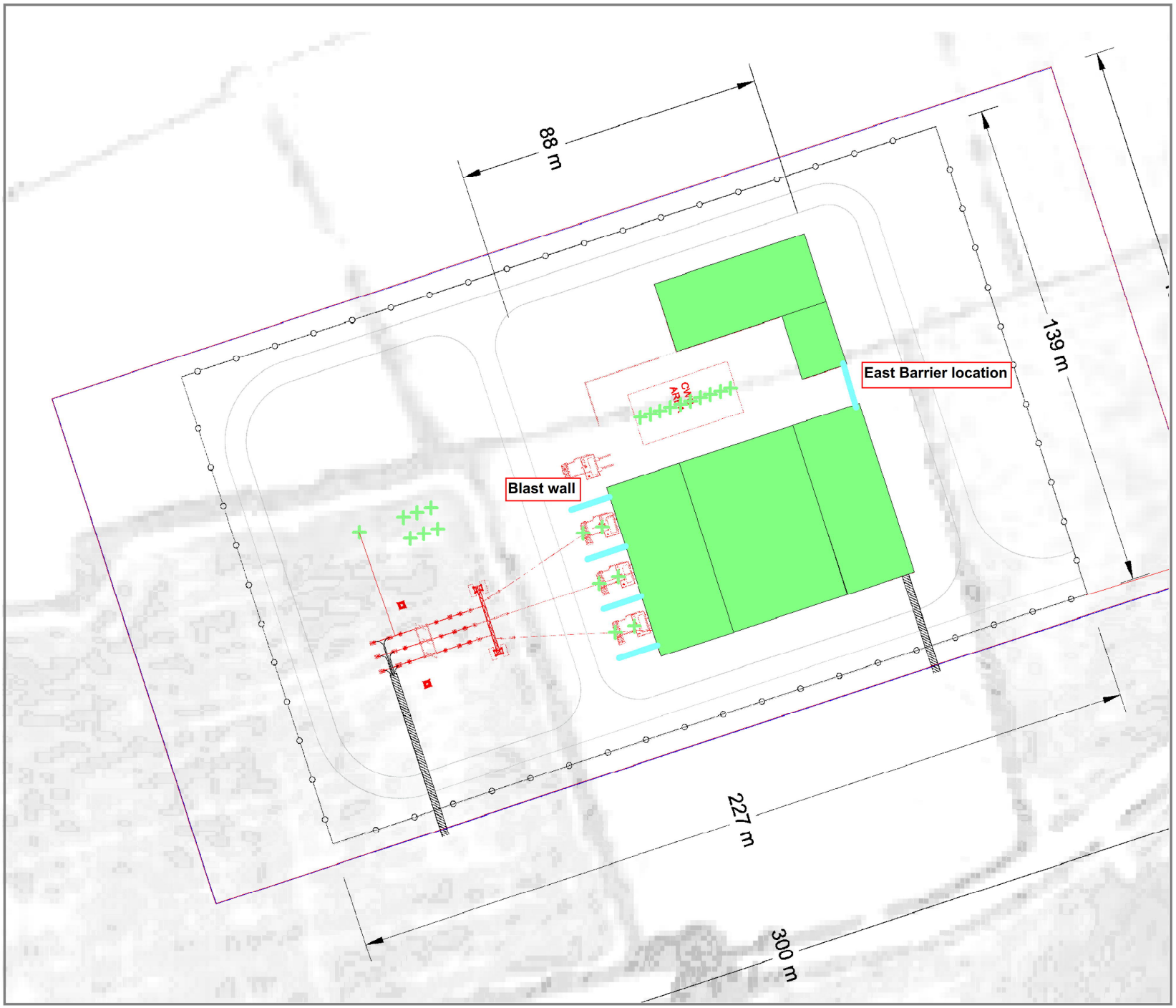
REF: 70023522

wsp

E-12 – Knockraha mitigated to meet 30 dB at the most exposed NSL



E-13 – Location of the valve cooling fan banks barrier between the DC hall and store building



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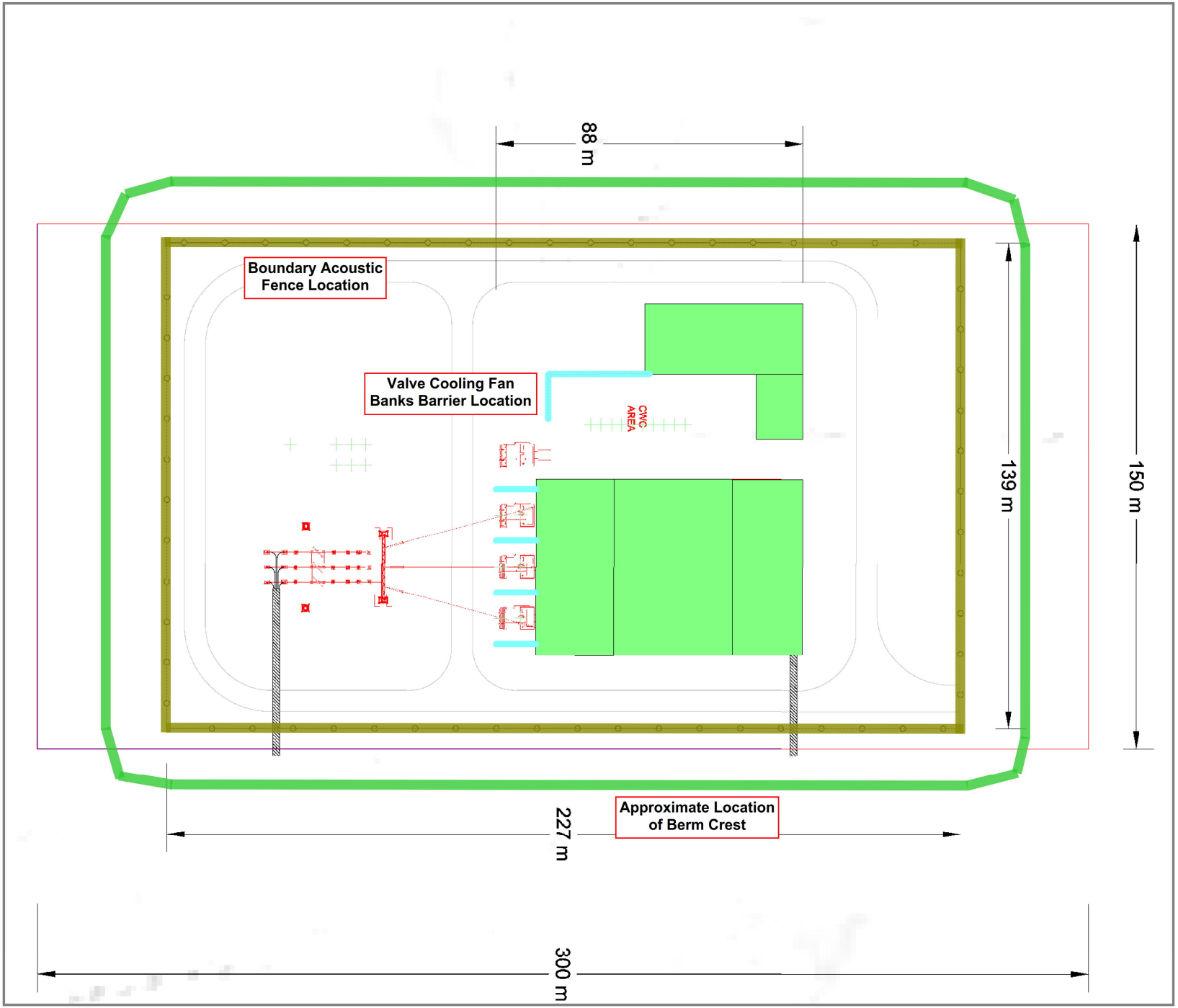
CELTIC INTERCONNECTOR
KNOCKRAHA
BARRIER

REF: 70023522

E-14 – Location of the L-shaped valve cooling fan banks acoustic barrier, boundary acoustic fence and crest of the boundary berm



DATE	REV	DESCRIPTION	BY
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CELTIC INTERCONNECTOR
BALLYADAM
BARRIER

REF: 70023522

Appendix F

LIMITATIONS TO THIS REPORT

REPORT LIMITATIONS

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The findings and opinions expressed are relevant to the dates of the study and should not be relied upon to represent conditions at substantially later dates. Opinions included therein are based on information gathered during the study and from our experience. If additional information becomes available which may affect our comments, conclusions or recommendations WSP reserve the right to review the information, reassess any new potential concerns and modify our opinions accordingly.

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