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RPS

Review of Effects of Construction Noise on Birds in SSSI near Springs Road Exploratory Wellsite

For IGas Energy plc.

Report No. JAT9778-REPT-02-R1

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Quality Management

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1 Introduction

1.1 This document provides an analysis of the potential effects of noise from the construction of the Springs Road Exploratory Wellsite. The document is prepared on behalf of IGas Energy plc to address Condition 21 of Planning Permission 1/15/01498/CDM for the Springs Lane Exploratory Wellsite. The site is located within the administrative area of Nottinghamshire County Council (NCC).

1.2 This document provides an analysis of the potential effects of noise from the construction of the Springs Road Exploratory Wellsite on breeding birds including long-eared owls *Asio otus* within the Misson Training Ground SSSI. (A reason for the SSSI designation of the Misson Training Ground SSSI is the presence of *Asio otus* within it).

1.3 RPS is a member of the Association of Noise Consultants (ANC), the representative body for acoustics consultancies, having demonstrated the necessary professional and technical competence. This report has been prepared with integrity, objectivity and honesty in accordance with the Code of Conduct of the Institute of Acoustics (IOA) and ethically, professionally and lawfully in accordance with the Code of Ethics of the ANC.

1.4 The technical content of this report has been provided by RPS personnel, all of whom are corporate (MIOA) or non-corporate, associate members (AMIOA) of the IOA (the UK's professional body for those working in acoustics, noise and vibration). This report has been peer reviewed within the RPS team to ensure that the wealth of experience within the team is reflected in this document.

2 Noise Conditions

2.1 This document has been prepared to address Condition 21 of Planning Permission 1/15/01498/CDM, which is reproduced below for reference.

2.2 Condition 21 states:

"21. Phase 1 (construction) and Phase 4 (restoration) operations shall not be undertaken during the bird breeding season (February to August inclusive), except when approved in writing by the MPA and in such circumstance that it can be demonstrated to the satisfaction of the MPA that noise on the Misson Training Area SSSI will not have an adverse impact on breeding birds in the SSSI.

Reason: To ensure that breeding birds, particularly Long-Eared Owl, are not adversely affected by the development and in accordance with M3.19 (Sites of Special Scientific Interest) of the Nottinghamshire MLP."

3 Acoustic Terminology and Concepts

2.1 This section provides an overview of the fundamentals of how sound propagates away from a source.

2.2 **Distance -** Increasing the distance from a noise source typically results in the level of noise getting quieter, due primarily to the spreading of the sound with distance. The phenomenon is described by the Inverse Square Law in which a specified physical intensity is inversely proportional to the square of the distance from the source of that physical quantity. It is analogised in the way in which the ripples in a pond spread after a stone has been thrown in.

2.3 **Type of Ground -** The type of ground over which the sound is travelling effects the propagation of sound. Acoustically "soft" ground, (such as grassland, ploughed fields etc.) is more absorbent of energy than acoustically "hard" surfaces (e.g. concrete, water, paved areas). Consequently, noise over acoustically "hard" ground propagates further than the equivalent noise over acoustically "soft" ground. The rate in reduction of noise level depends on the frequency of the sound and the qualities of the ground it interacts with.

2.4 **Wind -** Wind affects the way in which sound propagates, with noise levels downwind of a source being louder than upwind. This is partly due to the sound waves being refracted by the wind, as shown in Figure 3.1.

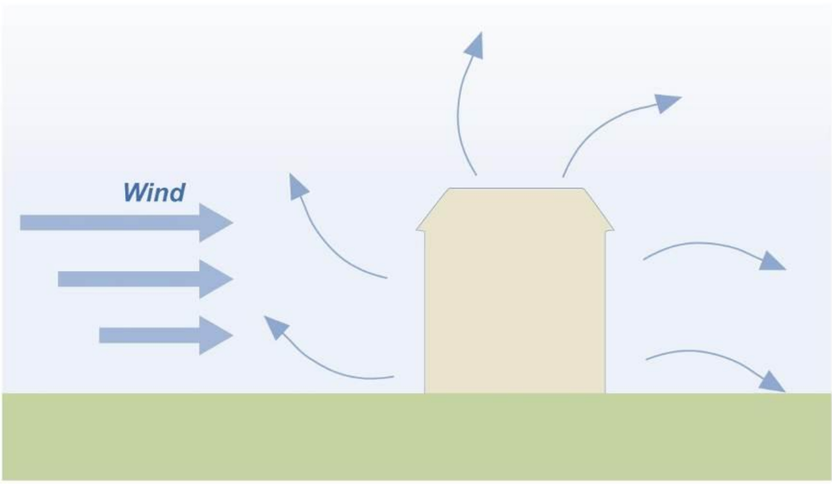

Figure 3.1 Refraction of sound waves due to wind gradients (increasing wind speed with height)

2.5 **Temperature Gradients –** Varying temperatures in the atmosphere can also cause sound waves to be refracted, adding to the complexity of sound propagation.

2.6 **Atmospheric Conditions –** Atmospheric pressure, humidity and temperature each has an effect on sound attenuation, primarily due to molecular absorption of the sound (converting sound into heat). Warmer, more humid atmospheres provide more noise attenuation than a colder, dryer atmosphere. Higher pitched (higher frequency) sounds are more readily absorbed than lower pitched (lower frequency) sounds. The effect of varying temperature and humidity is usually minimal when compared to other factors, such as wind and ground effects. However, where high frequency sounds are encountered, there may well be a significant variation between measured sound levels on different days due to variations in temperature and humidity.

2.7 When hearing noise in the open (e.g. from road traffic, aircraft, birds, wind in the trees etc.), it is common experience that the noise level is not constant in loudness but that overtime, it changes in amplitude. Therefore, in order to numerically describe the noise levels, it is beneficial to use statistical parameters. It has become standard practice to use indices which describe the noise level which has been exceeded for a certain percentage of the measurement period, and also an index which gives a form of average of the sound energy over a particular time interval. The former are termed percentile noise levels and are notated L_{A90}, L_{A50}, L_{A10} etc. and the latter is termed the equivalent continuous noise level and is notated by L_{Aeq}. It is worth noting that if the noise level does not vary with time, then all the parameters, in theory, normalise to a single value.

2.8 With regard to the percentile levels, the L_{A90} is the sound pressure level which is exceeded for 90% of the measurement time. It is generally used as the measure of background noise (i.e. the underlying noise) in environmental noise standards.

2.9 The L_{Aeq} (sometimes denoted $L_{Aeq,T}$) is the A-weighted equivalent continuous noise level and is an energy averaged value of the actual time varying sound pressure level over the time interval, T. It is used in the UK as a measure of the noise level of a specific industrial noise source when assessing the level of the specific source against the background noise. It is also used as a measure of ambient noise (i.e. the “all-encompassing” sound field).

2.10 Other useful parameters for describing noise include the maximum and minimum sound pressure level encountered over the time period, denote L_{Amax} and L_{Amin} respectively.

2.11 The term 'A' weighting implies a measurement made using a filter with a standardised frequency response which approximates the frequency response of the human ear at relatively low levels of noise. The resulting level, expressed in 'A' weighted decibels, or dBA, is widely used in noise standards, regulations and criteria throughout the world.

2.12 For a more detailed analysis of the frequency characteristics of a noise source, then noise measurements can be made in bands of frequencies, usually one octave wide. The resulting levels are termed octave band sound pressure levels. The standard octave band centre frequencies range from 31.5 Hz (about three octaves below middle ‘C’ on the piano) to 8 kHz (about five octaves above middle ‘C’). This covers most of the audible range of frequencies (usually taken to be around 20 Hz to 20 kHz). Octave band noise levels are usually quoted as linear data – i.e. without an ‘A’ weighting filter being applied. For more detailed analysis narrowband filters are useful for analysing tones.

2.13 The term decibel is a relative quantity and should always be referenced to an absolute level. In this report, all sound pressure levels (denoted L_P) are expressed in dB re 20 µPa. Hence, a sound pressure level of 0 dBA refers to a pressure level of 20 µPa, which is generally taken as the lowest level of sound that the human ear can detect. A negative dBA value usually implies that the sound is below the threshold of human hearing.

2.14 Subjectively, and for steady noise levels, a change in noise level of 3 dB is normally just discernible to the human ear. However, a noise change of less than 3 dB could be discernible if it has particular frequency characteristics or if it varies in loudness over time. A difference of 10 dB represents a doubling or halving of subjective loudness.

2.15 Sound power (denoted L_W) is the acoustical power radiated from a sound source. The advantage of using the sound power level, rather than the sound pressure level, in reporting noise from a source is that the sound power is independent of the location of the source, distance from the measurement point and environmental conditions. If the sound power of a source is known, then it is possible to calculate the sound pressure level at a distance away from the source, accounting for the attenuation due to propagation, as discussed above. Sound power levels are referenced to power rather than pressure; hence sound power levels are expressed in dB re 1 pW.

4 Potential Effects of Noise on Birds

IECS 2009 Report

4.1 The IECS 2009 report (Cutts *et al.*, 2009) defines disturbance in the general context as discrete events that disrupt ecosystem, community or population structures or in some way alter resource levels i.e. food and space. It may also influence the survival of individual birds and reduce the function of the site either for roosting or feeding. The report states that disturbance varies in its magnitude, frequency, predictability, spatial distribution and duration, and species vary greatly in their susceptibility to disturbance and this susceptibility is likely to vary with age, season, weather and the degree of previous exposure. The links between visual and audible stimuli are evident throughout the report and it is clear that noise by itself is not necessarily a cause for disturbance if not accompanied by a perceived visual threat.

4.2 In its literature review the IECS report cites a Dutch study (Smit and Visser, 1993) that found that reactions to noise from shooting ranges are stronger if sounds are combined with visual disturbance.

4.3 The importance of visual stimuli to aircraft noise disturbance is also cited in a report by Brown (1990). The IECS report cites its author's personal observation of a remote controlled model aircraft in the vicinity of wildfowl having the greatest disturbance effect once the engine had cut, with the remote controlled aircraft becoming silent whilst still in the air. This immediately led to vigorous alarm calling and movement of individuals into cover, with presumably the loss of noise causing the aircraft to be perceived as a raptor.

4.4 The IECS report reviews a 1999 study (Cutts and Allen 1999) into the disturbance of birds in response to flood defence works at Saltend on the Humber estuary.

4.5 In a separate series of reports by IECS to the Saltend Cogeneration Company into the effects of piling noise on estuarine birds, the monitoring of noise related disturbance was carried out. Noise levels were predicted across the site and ranged between 55 – 84 dBA (no indication is given initially in the report of the noise index used but, in subsequent paragraphs, use is made of the L_{Amax} parameter, with the time response factor not identified – but it is presumed that the Fast time response is inferred).

4.6 Effects on the bird population were observed via observations of flight responses and or behavioural changes. With respect to specific noise levels the following response descriptors are given:

- Noise below 50 dB – low
- Regular noise 50 – 70 dB – low to moderate
- Irregular noise 50 – 70 dB – moderate
- Regular piling noise below 70 dB – moderate
- Irregular piling noise above 70 dB – moderate to high.

4.7 No indication is given of the response designation of *regular* piling noise above 70 dB, or indeed what is meant by *regular* piling noise. Noise levels of 70 dB L_{Amax} were considered to be above the level that would initiate a behavioural response and below the level that initiates flight responses in most cases.

4.8 The 2009 IECS reports refer to observations made during the construction of the South Humber Power Station. The report states that despite consistent periods of piling activity on the pump house construction site on the landward side of the seawall, birds appeared indifferent to the noise of piling and during visits in February and March, the numbers and distribution of birds on the mudflats at low tide were similar during periods of piling and periods without piling. The report considered that the screening of the mudflats by the seawall was effective in minimising disturbance effects and that any disturbance caused by piling activity could have been attributed to the increased presence of people associated with such activities.

4.9 The 2009 IECS report gives an illustrative overview of the effects of disturbance to waterbirds from different activities that may arise as a result of a construction project. Five levels of disturbance impact are defined for feeding and roosting, as set out in Table 4.1.

Table 4.1 IECS noise impact criteria

Level	Impact	Effect Level	dBA	Type of Noise
1	No impact	Low	Below 50	Regular construction noise
2	Behavioural changes (alarm calls, heads up, change in feeding/roosting activity)	Moderate	Equal to or below 70	Piling noise
3	Movement within zone	Moderate to high	Above 70	Piling noise
4	Movement out of zone but remaining on site	High	Above 85	Piling noise
5	Movement off site	High	Not defined	

4.10 The noise unit in Table 4.1 is not defined in the 2009 IECS report, but is probably meant to refer to the L_{Amax} index, as this has already been referenced in the IECS report in connection with the Saltend study.

Other Studies

4.11 An investigation was undertaken by researchers from the University of Leeds (Wright *et al.,* 2013). The experimental study deliberately disturbed birds at a high tide roost site, in an agricultural field adjacent to a sea wall on the south bank of the Humber. Use was made of an air horn which was reported as providing a noise level of 114 dBA at 2 m from the source. No indication of the frequency characteristics of the air horn were provided. Noise measurements were made at two different locations and the noise level at the roosting site estimated from these two measurements through a sound propagation model. The air horn was sounded for three seconds at a time and the noise level recorded at each of the two locations. It is not clear from the paper what the actual noise parameter used for the measurements was, and whether the term L_{bird} should be taken as L_{Aeq} value or some form of maximum level. A classification system for disturbance included Level 1 (behavioural change but not flight), Level 2 (flew but soon returned to the site) and Level 3 (flew and abandoned the site). Level 0 represented no behavioural changes observed. For curlew, the study found a mean Level 1 disturbance at about 72 dB L_{bird} and a mean Level 2 disturbance at about 76 dB L_{bird}. Golden plover and common gulls were slightly more sensitive to noise and Lapwings were found to be significantly more sensitive. Visual disturbance from the experimenter was taken into consideration in the methods used, but their effects could not be statistically separated from the overall results.

4.12 An investigation into disturbances to winter birds was commissioned by BP in the mid 1980's during the development of the Dorset Oilfield . The study was centred on Brand's Bay during a period of drilling for hydrocarbons. Besides investigating the disturbance by drilling operation stimuli, the study sought to put this into perspective by observing all disturbances caused by external stimuli such as fishing boats, aircraft, wildfowlers and natural predators. It was concluded that when the impact of the drilling rig was put into perspective against disturbances from other stimuli, the level of impact from the drilling rig was low. More disturbances were caused by natural predators, or large slow flying birds, low-flying aircraft and helicopters and by wildfowlers. In addition, there was evidence that habituation plays an important part in reducing the sensitivity of the species to disturbance. The initial site activity, before drilling commenced, caused most disturbances, but evidence suggests that birds became more accustomed to traffic noise during the next eight week period. Reaction to the Kelly Spinner (a particular noisy operation) was similar, in that disturbance was caused when it was first used, but that its use on eight subsequent occasions produced no response.

4.13 Another relevant historical report is a study which describes the effects of anthropogenic disturbances on Brent Geese wintering on the Essex coast near the site of the then proposed London Airport at Maplin Sands (Owens, 1977). The report concluded that Brent Geese quickly became habituated to most sounds, but unexpected sounds, such as nearby gunshots from wildfowlers, usually put the geese to flight. Similarly, the first shots of the day at nearby army gunnery ranges caused the birds to leave the area, but they quickly returned and ignored all subsequent firings for that day. Extremely loud but regular bangs made during nearby weapon testing caused little reaction after the first few weeks.

4.14 Further historical information from the Wilson Report (Wilson 1963) – states that to scare birds, a noise level of approximately 85 dB sound pressure level at the bird's ear was required. Also in 1974, the Noise Advisory Council in its leaflet "Noise in public places" stated that birds are not disturbed by continuous loud noise and a "bang" of less than 80 dBA would probably be ineffective as a bird scaring device.

Grimsby River Terminal Construction Pile Noise Monitoring and Bird Behaviour Observations

4.15 A detailed measurement exercise was undertaken by Xodus Group (Postlethwaite and Stephenson, 2012) of noise levels at the Pyewipe mudflats during piling for the new Grimsby River Terminal. The noise measurements were complemented by observations from a professional Ornithological Consultant. The study had the following objectives:

i. to record the day-to-day variation in received sound pressure levels at two locations representative of the Pyewipe mudflats throughout the monitoring period and to review the effect of weather conditions (particularly wind direction) on received noise levels when percussive piling is taking place;

ii. to determine the typical sound power levels of the piling rigs when driving piles into the river bed;

iii. to use the measured sound pressure level data at the two monitoring locations together with knowledge of the location of the rig, the sound power levels and the weather conditions pertaining at the time of piling, to predict the received sound pressure levels on other parts of the mudflats;

iv. to review the assemblages of birds on the mudflats and at the roost areas for different states of the tide and to catalogue changes to bird behaviour caused by external stimuli, and where possible, to identify each stimulus to changed behaviour;

v. to bring together the evidence from the study to see whether any trends become apparent with respect to received noise levels and changes to bird behaviour and as a secondary, albeit important issue, to see whether any habituation effects could be detected.

4.16 Two noise monitors were established to provide a measure of the noise gradient across the mudflats during piling. Observations of the numbers and species of birds on the Pyewipe mudflats were made over 13 separate occasions during the piling activity in May and July 2012. The observations included maps on an hourly basis of the bird assemblages across the mudflats (to about 1,500 m from the observation points). In addition a record was kept of:

i. all the observed disturbances together with the timing of the disturbance;

ii. the cause of the disturbance if this could be identified;

iii. the number, species and location of the birds disturbed; and

iv. the severity of the disturbance.

4.17 With respect to the latter this was classified into four disturbance categories:

Disturbance Level 1: Birds looking up or heads raised alert and temporarily stopping feeding, or roosting;

Disturbance Level 2: Birds moving away from the cause of the disturbance by walking or swimming before resuming feeding;

Disturbance Level 3: Birds taking flight and landing somewhere in the same feeding area or mudflat;

Disturbance Level 4: Birds taking flight and leaving the survey area completely.

4.18 This is a similar classification as used by IECS (2009) although the latter used the notation from Level 1 – “no effect” to Level 5 – “maximum response”.

4.19 Following the noise measurements and observations at Grismby, a computer based noise model was then developed and refined to give best fit to the measured noise data based on the location of the driven pile, and this allowed the noise levels across the mudflats to be determined as a series of contours. The observations of disturbances, together with observations of noise events when no disturbances were seen, were analysed in conjunction with the measured and computed noise level data and a number of conclusions made. Of particular note is that widespread disturbances to birds feeding on the mudflats were caused by natural predators (mainly peregrines), aircraft and helicopters, and that noise from the work site as a whole was the cause of a very small percentage of the disturbances observed. The general conclusions from the Xodus Group report included the following:

- Noise from the construction site as a whole (not just piling) caused about 1% of the total disturbances observed during construction activities, when measured as the number of birds disturbed.
- Disturbances to large number of birds at any one time were caused by raptors (mainly peregrine), aircraft and helicopters.
- Noise levels up to 81 dB $L_{Amax\ F}$, in some cases, caused no disturbance during percussive piling.

- Level 1 disturbances (heads up alert) were observed to occur in the noise level range of 66 to 83 dB $L_{Amax\ F}$ for percussive piling.
- Level 2 disturbances (short walk or swim from the source of noise) were observed to occur in the range 68 – 81 dB $L_{Amax\ F}$ for percussive piling.
- As no Level 3 (short flight) or Level 4 (flight out of area) noise related disturbances were observed, a percussive piling noise level greater than 83 dB $L_{Amax\ F}$ would be expected to be required to instigate a flight response.
- A percussive piling noise level less than 66 dB $L_{Amax\ F}$ gave rise to no noise disturbance.
- Whilst it was not possible to provide evidence of habituation to percussive piling noise from this study, the Level 1 disturbances generally indicated that where noise is not perceived as a threat, the disturbance is temporary.
- A noise level of 70 dB $L_{Amax\ F}$ has previously been proposed as an indicator of moderate disturbance to waterbirds due to piling noise (IECS 2009). The Xodus study concluded that this would be very precautionary if applied to the proposed development site, and a level 10 dB higher would still be precautionary level indicator of moderate adverse significance in relation to percussive piling noise.

Owls

4.20 Owls, being largely nocturnal species relying on sound for locating and hunting prey, may experience deleterious effects from elevated sound levels at night leading to a reduction in foraging efficiency.

4.21 Due to uncertainties on the precise complement of construction activities and the lack of noise monitoring within the SSSI at the time, a precautionary approach was agreed with NCC and Natural England. Natural England proposed a noise criteria of 42 dBA for assessing potential for disturbance due to owls. The scientific validity of using this threshold is questionable because it is not derived from scientific studies relating to long eared owls. However, due to lack of suitable evidence or an alternative threshold, Planning Condition 21 was worded to reflect this agreed position to allow for further detail to be submitted if construction activities are required to be undertaken within the bird breeding season.

4.22 The A-frequency weighting simulates noise energy according to human hearing range and sensitivity and generally is not appropriate for animal species (Delaney et al. 1999). Available research indicates that hearing is quite similar within members of the same Order. Using audiograms for great horned owl *Bubo virginianus* and barn owl *Tyto alba* (which is also know to breed within the SSSI albeit at a greater distance from the application site) Delaney *et al.* (1999) developed an audiogram to estimate the hearing range and sensitivity for the Mexican spotted owl. The authors' results indicate that spotted owl hearing sensitivity emphasized the middle frequency range. These three species are all within the same Suborder Strigi as long-eared owls; one of the species of interest for which the SSSI is designated, and it is reasonable to extrapolate that long-eared owls are also hearing sensitivity emphasized in the middle frequency range. While different avian species react differently to auditory and visual disturbances, most birds have "very similar frequency ranges and thresholds", due to the relatively simple construction of the avian ear (Awbrey and Bowles, 1990).

4.23 The frequency range of the noise created by power-equipment appears to be a major factor in flush response of the Mexican spotted owl. This species was flushed by chainsaw noise (≤46 dBA) that was considerably lower than helicopter noise levels that flushed owls (≥92 dBA) (Delaney *et al*. 1999) and it appears that this is due to the total noise energy from chainsaws was in the mid-frequency range, where the owl sensitivity was greatest.

4.24 In the USA the Fish and Wildlife Service (2009) has prepared guidance to help identify potential effects on northern spotted owl *Strix occidentalis caurina* and marbled murrulet *Brachyramphus marmoratus* (both federally listed species). This guidance provides an estimate of the distance within which increased sound level may harass an owl or Murrelet and is summarised in Table 4.2.

Table 4.2 Estimated harassment distance due to elevated action-generated sound levels for proposed actions affecting the northern spotted owl and marbled murrelet, by sound level

Baseline ambient sound level, dBA	Sound level at 15 m from sound source, dBA			
	Moderate (71 – 80 dBA)	High (81 – 90 dBA)	Very high (91 – 100 dBA)	Extreme (101 – 110 dBA)
Natural ambient (≤ 50 dBA)	50 m	150 m	400 m	400 m
Very low (51 – 60 dBA)	0 m	100 m	250 m	400 m
Low (61 – 70 dBA)	0 m	50 m	250 m	400 m
Moderate (71 – 80 dBA)	0 m	50 m	100 m	400 m
High (81 – 90 dBA)	0 m	50 m	50 m	150 m

4.25 The guidance takes into account the rise in noise levels above the baseline noise level (defined as the median value of the baseline sound level) where project-generated sound levels exceed the existing sound level currently experienced by individuals of the species near the project site by 20 to 25 dB. That is, the net sound contribution of the project may be perceived by this species as a threat.

4.26 The distances in Table 4.2 are based on a relatively simple sound propagation methodology. The guidance notes that it may be necessary to carry out more detailed predictions where multiple equipment is used, where topography may affect the sound propagation or where there are other special circumstances such as screening and barriers.

4.27 Caution should be applied if attempting to use a single noise index value as a measure of disturbance for a range of noise sources not actually investigated by the particular study on which the assessment criterion has been based. Whilst some birds have maximum hearing sensitivity at frequencies similar to that of humans, outside these frequencies the hearing sensitivity of birds can vary significantly from that of humans. Therefore, if attempting to use a noise assessment criterion for a noise source having a significantly different frequency content to that for the source of noise from which the noise criterion has been derived, inaccuracies must be expected, unless corrections are made to the assessment criterion.

4.28 As an example Figure 4.1 gives a range of average audiograms for different bird species relative to A-weighting frequency characteristics.

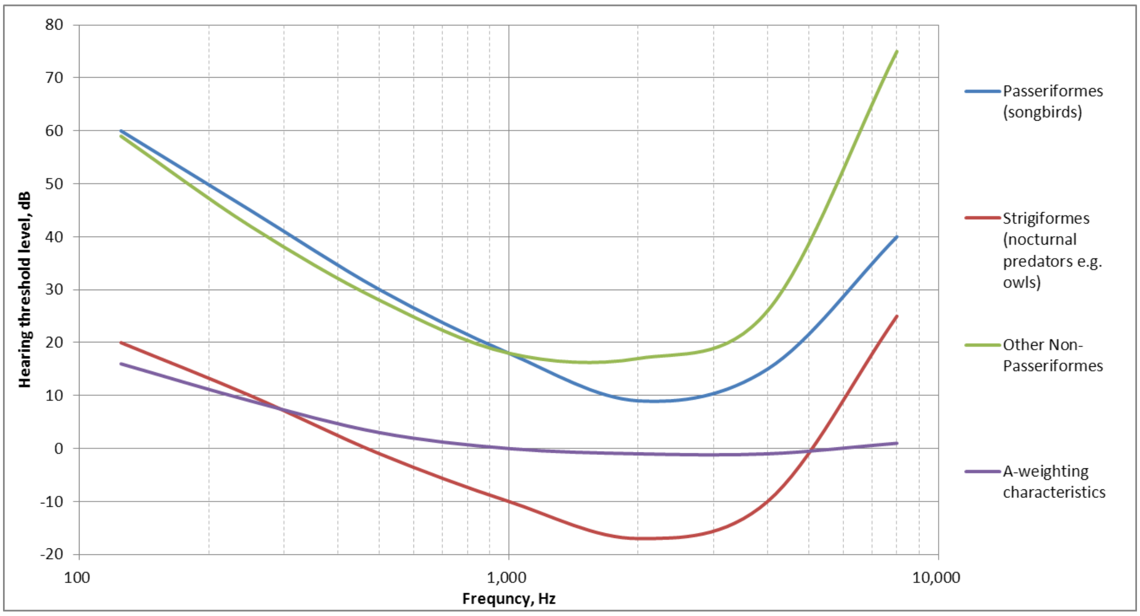

Figure 4.1 Hearing threshold levels of different bird species compared to A-weighted characteristics

4.29 It can be seen that nocturnal predators have significantly more sensitive hearing throughout the frequency range than the other bird species. Nocturnal predators have a greater hearing sensitivity than humans at 500 Hz and above.

5 Baseline Sound Levels in Misson SSSI

5.1 An unattended sound monitor was established in the SSSI on 20th October 2016 and has been continuously recording sound levels in the SSSI since. The location of the monitor is shown in Figure 5.1.

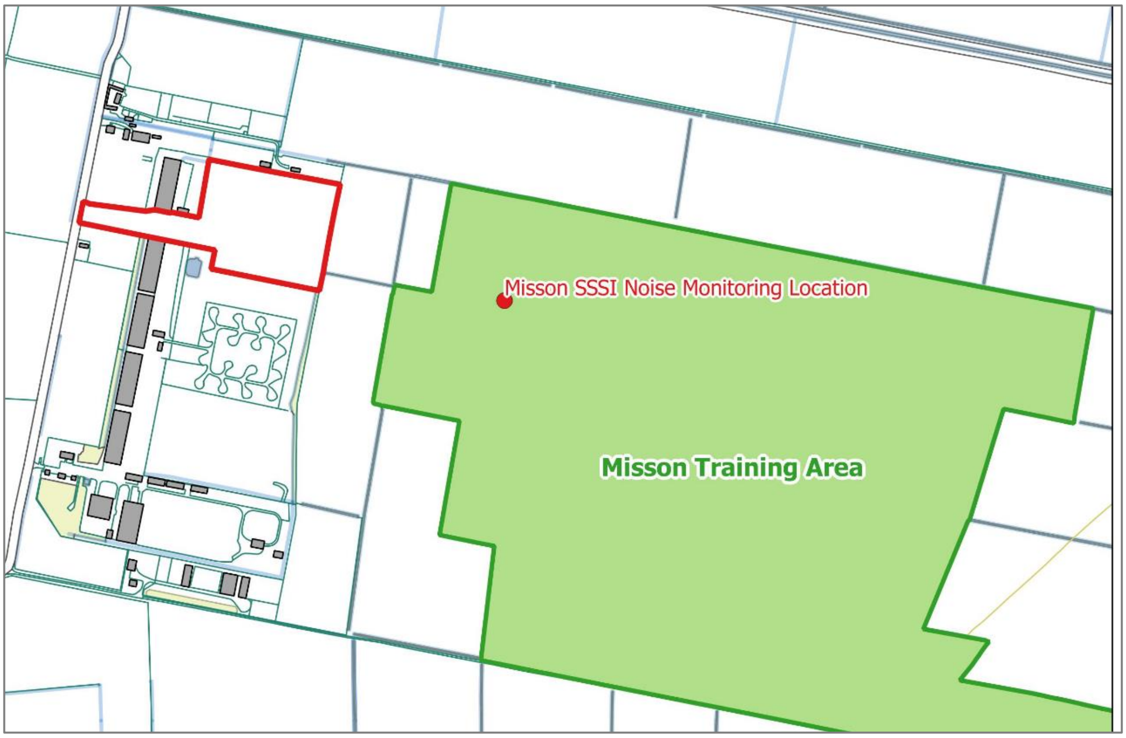

Figure 5.1 Location of noise monitor in Misson SSSI

5.2 The noise monitor complies with Class 1 of BS EN 61672-1:2013 ‘Electroacoustics – Sound level meters. Part 1: Specifications’[1] and is calibrated in accordance with BS 7580-1:1997 ‘Specification for the verification of sound level meters. Part 1: Comprehensive procedure’[2]. The noise monitor is set up to record the 5 minute A-weighted sound pressure level (including L_{Aeq}, L_{A90} and L_{Amax}) on a continuous basis.

5.3 Sound data recorded up until 15th November 2017 (i.e. more than one year’s monitoring data) is summarised in Table 5.1.

[1] British Standards Institution (2013) BS EN 61672-1:2013 ‘Electroacoustics – Sound level meters. Part 1: Specifications’. BSi.
[2] British Standards Institution (1997) BS 7580-1:1997 ‘Specification for the verification of sound level meters. Part 1: Comprehensive procedure’. BSi.

Table 5.1 Summary of sound level data measured in Misson SSSI recorded 20th October 2016 to 15th November 2017

	Sound pressure level, dBA		
	$L_{Aeq, 5 min}$	$L_{AFmax, 5 min}$	$L_{A90, 5 min}$
Range	16 - 83	20 - 96	15 - 63
25th percentile	32	44	27
50th percentile	38	51	32
75th percentile	44	58	36
Average	38	51	32
Standard deviation	8.7	10.6	6.9

5.4 Sound data recorded during the bird breeding season (i.e. February to August inclusive) is summarised in Table 5.2.

Table 5.2 Summary of sound level data measured in Misson SSSI recorded 1st February 2017 to 31st August 2017 (during bird breeding season)

	Sound pressure level, dBA		
	$L_{Aeq, 5 min}$	$L_{AFmax, 5 min}$	$L_{A90, 5 min}$
Range	16 - 71	20 - 94	15 - 62
25th percentile	33	45	27
50th percentile	40	54	33
75th percentile	46	60	37
Average	39	53	32
Standard deviation	9.2	11.2	6.9

5.5 A box and whisker plot showing the spread of data recorded over the monitoring period is provided in Figure 5.2 for all the measured data as well as data within the bird breeding season (denoted BBS). Lower quartile values are given by the lower boundary of the red box, median values by the boundary between red and green boxes, and upper quartile values by the upper border of the green box. Maximum and minimum values are given by the upper and lower tails for each box.

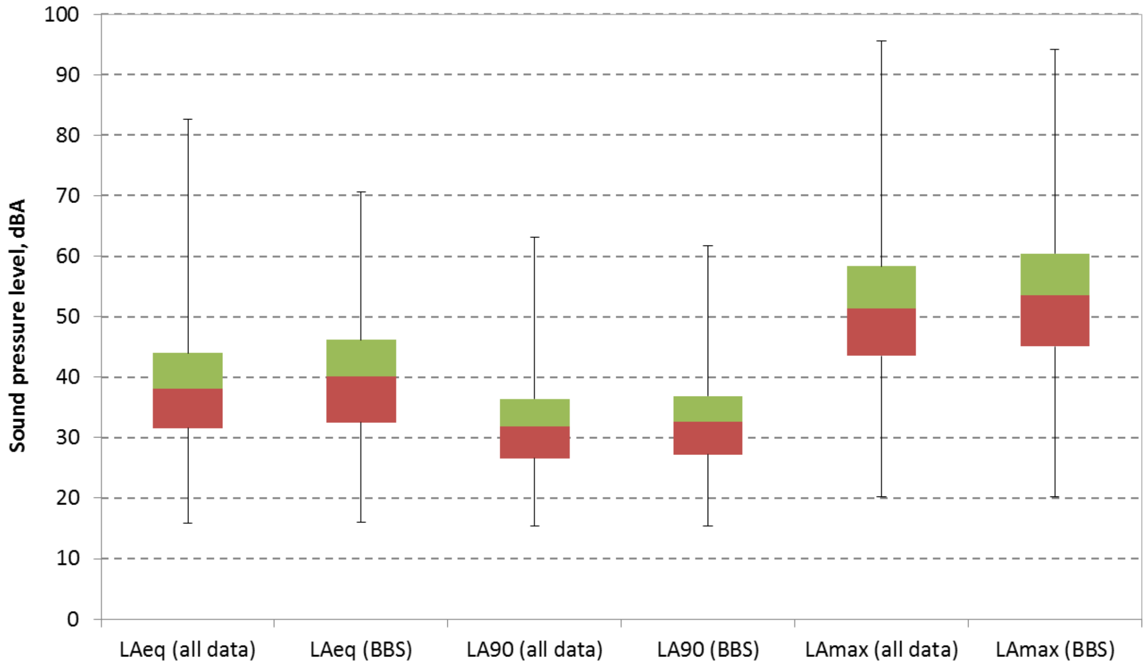

Figure 5.2 Box and whisker plot showing spread of measured noise levels in Misson SSSI (BBS = within bird breeding season)

6 Predicted Sound Levels Due to Construction of Springs Road Exploratory Wellsite in Misson SSSI

6.1 A noise assessment was carried out by Xodus Group in 2015 (Document Number: L-300359-S00-REPT-001 | Rev: A01 | Dated: 15/09/2015)[3].

6.2 Additional noise modelling has been undertaken by RPS using SoundPLAN computer modelling software, version 7.4, based on the latest construction schedule. Noise input data used for the modelling is provided in Table 6.1.

Table 6.1 Construction plant sound power level data used in model

Plant / Equipment	Overall L_w dBA	Linear octave band sound power level, dB re 1 pW							
		63	125	250	500	1k	2k	4k	8k
C2.11 Dozer	107	103	107	105	105	102	99	93	85
C2.16 Tracked excavator	103	100	99	102	101	97	94	91	86
Cat | 16M3 Motor Grader | Caterpillar	111	113	112	107	104	109	102	99	90
C8.20 Tipper lorry	108	117	111	102	103	103	101	99	96

6.3 In order to provide a robust assessment, activities have been predicted as occurring simultaneously, at the same location, and for 100% of the time although in practice this is unlikely to occur. It is likely that construction noise emissions would vary spatially throughout the programme as work is undertaken in different areas. Consequently, it is likely that noise levels will be lower than predicted within this assessment for the majority of the time.

6.4 No impact or impulsive noise sources are proposed for use during construction activities. Consequently, it is anticipated that noise due to construction will be relatively continuous in character albeit of a varying level over the course of a day.

6.5 The results of the noise modelling for construction of the access track and site compound are shown in Figures A1 – A4 at the back of this report.

[3] Xodus Group (2015) 'Noise Assessment - Springs Road, Proposed Exploratory Wellsite. Noise Impact Assessment. IGas Energy plc. Assignment Number: L300359-S00. Document Number: L-300359-S00-REPT-001'. Xodus Group

7 Assessment and Discussion

7.1 As discussed previously, a threshold of 42 dBA for assessing potential disturbance to owls within the Misson SSSI has been agreed by all parties in securing the planning permission for the site due to the lack of available evidence on the effects of noise on long eared owls. This is considered a precautionary threshold and does not therefore necessarily indicate the onset of disturbance.

7.2 Ambient sound levels within the SSSI already exceed the 42 dBA threshold for approximately 33% of the time based on all data, and for 42% of the time during the bird breeding season of February to August. This is due to a combination of natural and anthropogenic noise sources including chainsaws, aircraft, local traffic and wind in the trees.

7.3 If noise levels of 42 dBA or more already exist in the SSSI for a significant proportion of the time without causing disturbance to owls, then this introduces further questions about the validity of the proposed 42 dBA threshold. The primary concerns with the proposed threshold is that it does not take into account the existing baseline ambient noise environment (which, now that measurements have been conducted in the SSSI, has been shown to already exceed the proposed threshold for a third of the time without disturbing owls).

7.4 On the basis of the above factors, and in particular the fact that baseline noise levels already frequently exceed this level, it is concluded that the proposed threshold of 42 dBA for assessing disturbance to owls or breeding birds could be over precautionary. Nevertheless, drawings showing the extent of the 42 dBA sound contour due to construction of the site and access track are shown in Figures A3 and A4. The contours show that noise due to construction of the main compound will exceed the 42 dBA threshold over an area of approximately 0.1 km^2 of the SSSI, equating to 12% of the SSSI area. During construction of the access track only 1% of the SSSI (0.013 km^2) will be subjected to construction noise levels exceeding this threshold.

7.5 According to USA the Fish and Wildlife Service guidance, owls could be disturbed when exposed to sound levels exceeding the median baseline ambient sound level by 20 to 25 dB. The median ambient sound level measured over the course of more than a year in the SSSI is 38 dB L_{Aeq}. Consequently, disturbance could occur when the sound level due to construction exceeds 58 to 63 dBA.

7.6 The highest predicted noise level due to construction in the SSSI is 51 dBA at the closest point to site (see Figures A1 and A2) reducing to 24 dBA at the easternmost point. Consequently, it is highly unlikely that owls would be disturbed or harassed due to construction noise at any point in the SSSI according to the USA the Fish and Wildlife Service guidance criteria.

7.7 Based on Figure 4.1 it is clear that the hearing of non-passiformes is significantly less acute than for owls. Consequently, it is considered highly unlikely that birds with less acute hearing than owls would be disturbed due to construction noise.

7.8 Given that construction noise levels throughout the vast majority of the SSSI are likely to be lower than the 50 dBA threshold suggested in IECS, this would classify the noise as having a low impact. (Only 0.05% of the SSSI area is likely to exceed the 50 dBA threshold at the point closest to the site, with noise levels being less than 42 dBA across 88% of the SSSI area.) Because no impact techniques will be used for construction (e.g. impact piling, pneumatic breaking etc.), it is unlikely that there will be high levels of impulsive sound due to construction activities. Consequently, it is unlikely that breeding birds in the SSSI will be startled by construction activities.

8 Conclusions

8.1 Based on the results of the noise modelling, it is concluded that:

- predicted construction noise levels in the SSSI are well below the threshold for disturbance to owls contained in USA the Fish and Wildlife Service guidance;
- construction noise levels are also below the guideline criteria contained in IECS for disturbance to birds;
- disturbance to owls or other birds due to construction noise is unlikely to occur;
- noise from construction is unlikely to contain high level impulses (such as those contained in piling or pneumatic breaking) and it is therefore highly unlikely that birds will be startled.

8.2 It is therefore concluded that there is no reason why construction of the site compound and access track should not go ahead at any time of year, including during the breeding season.

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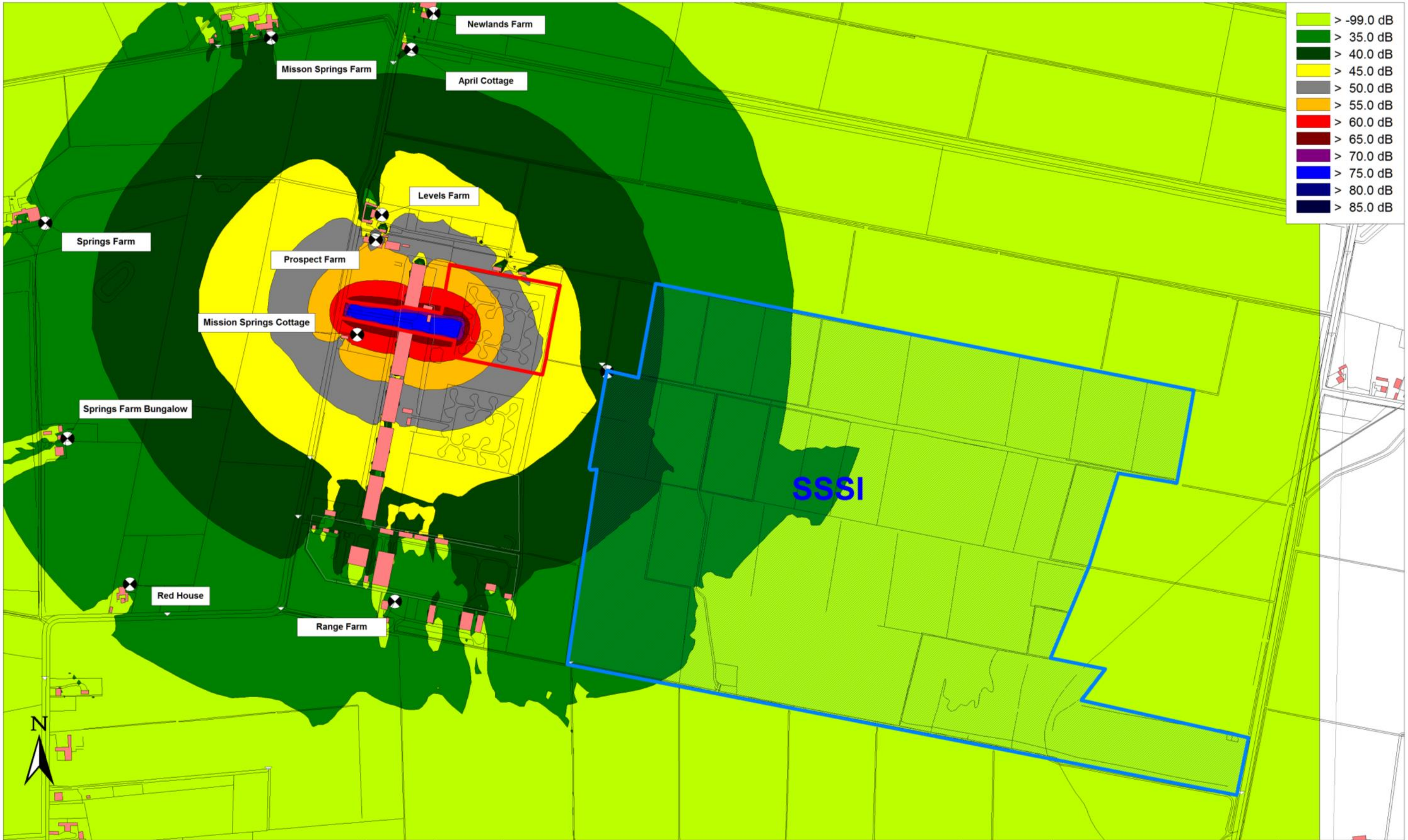
Figures



IGas Energy

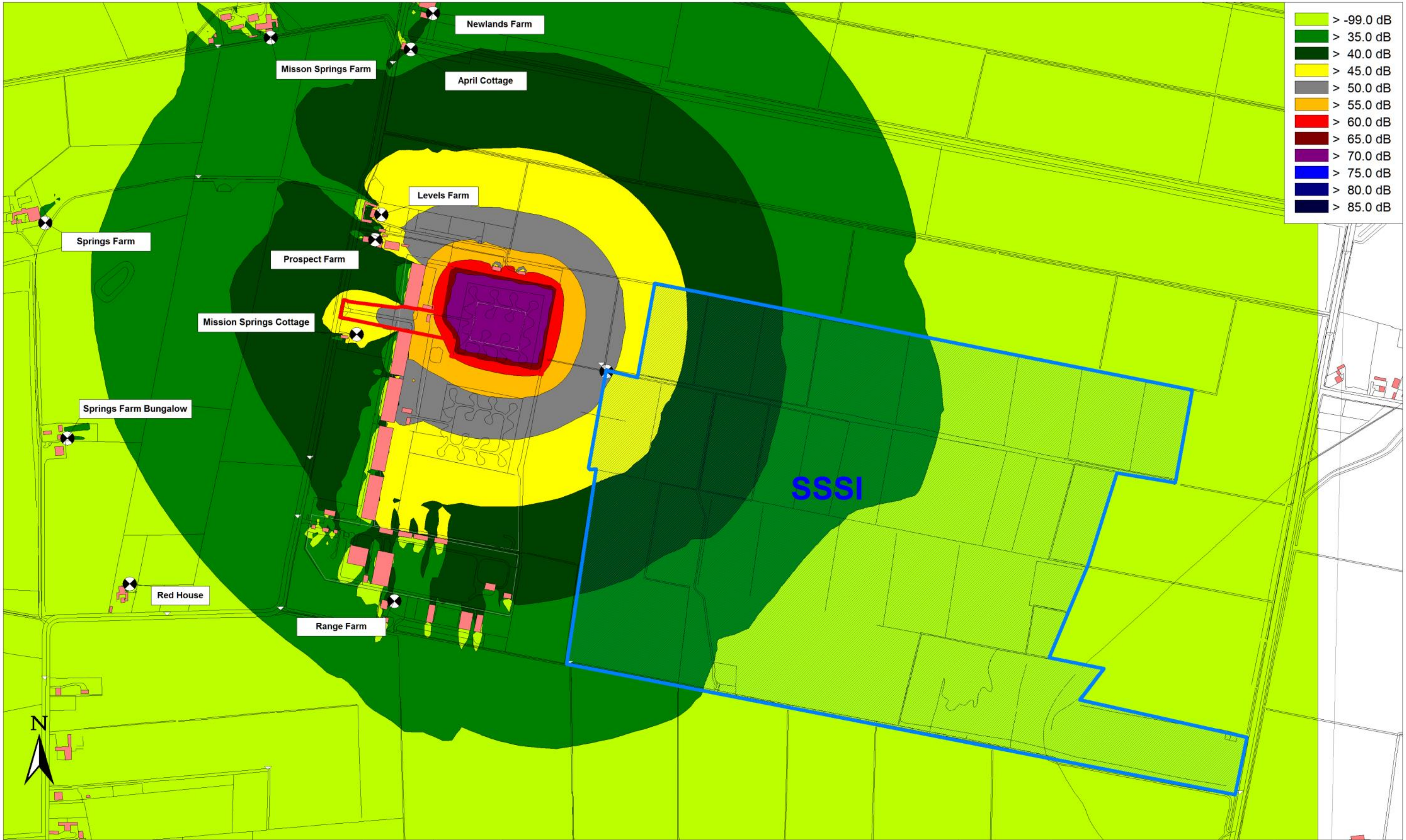
Author	SJS
Scale	1:7500@A3

Springs Road Exploratory Wellsite
Access track construction noise contours
Assuming all plant operating 100% of the time

Sheet 1 of 1

Project No.	JAT9778
Project Title	Springs Road Wellsite Noise
Drawing No.	Figure A1
Date	08.12.17

RPS



IGas Energy	Author	SJS	**Springs Road Exploratory Wellsite** **Site compound construction noise contours** **Assuming all plant operating 100% of the time**	Project No.	JAT9778
				Project Title	Springs Road Wellsite Noise
	Scale	1:7500@A3		Drawing No.	Figure A2
			Sheet 1 of 1	Date	08.12.17

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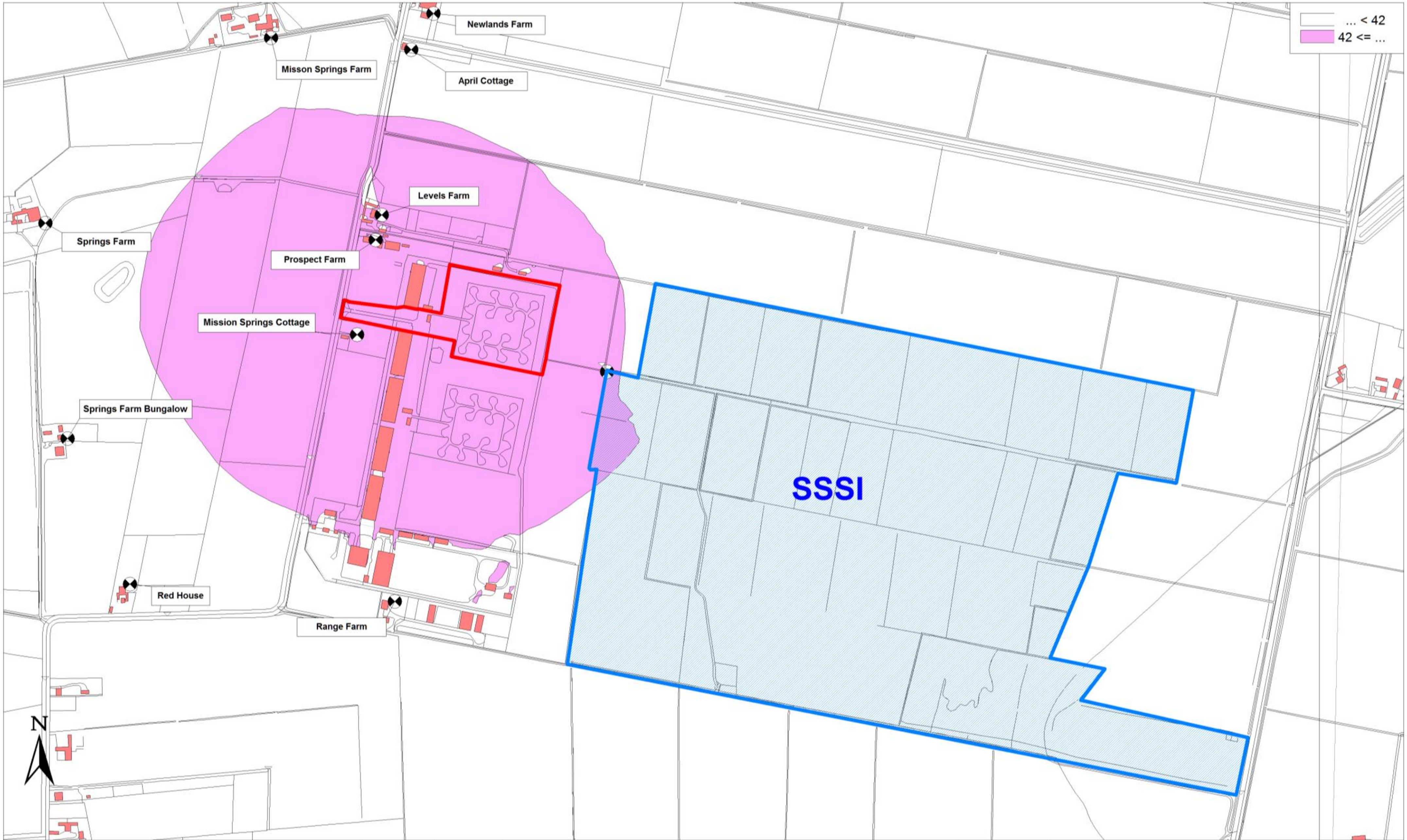
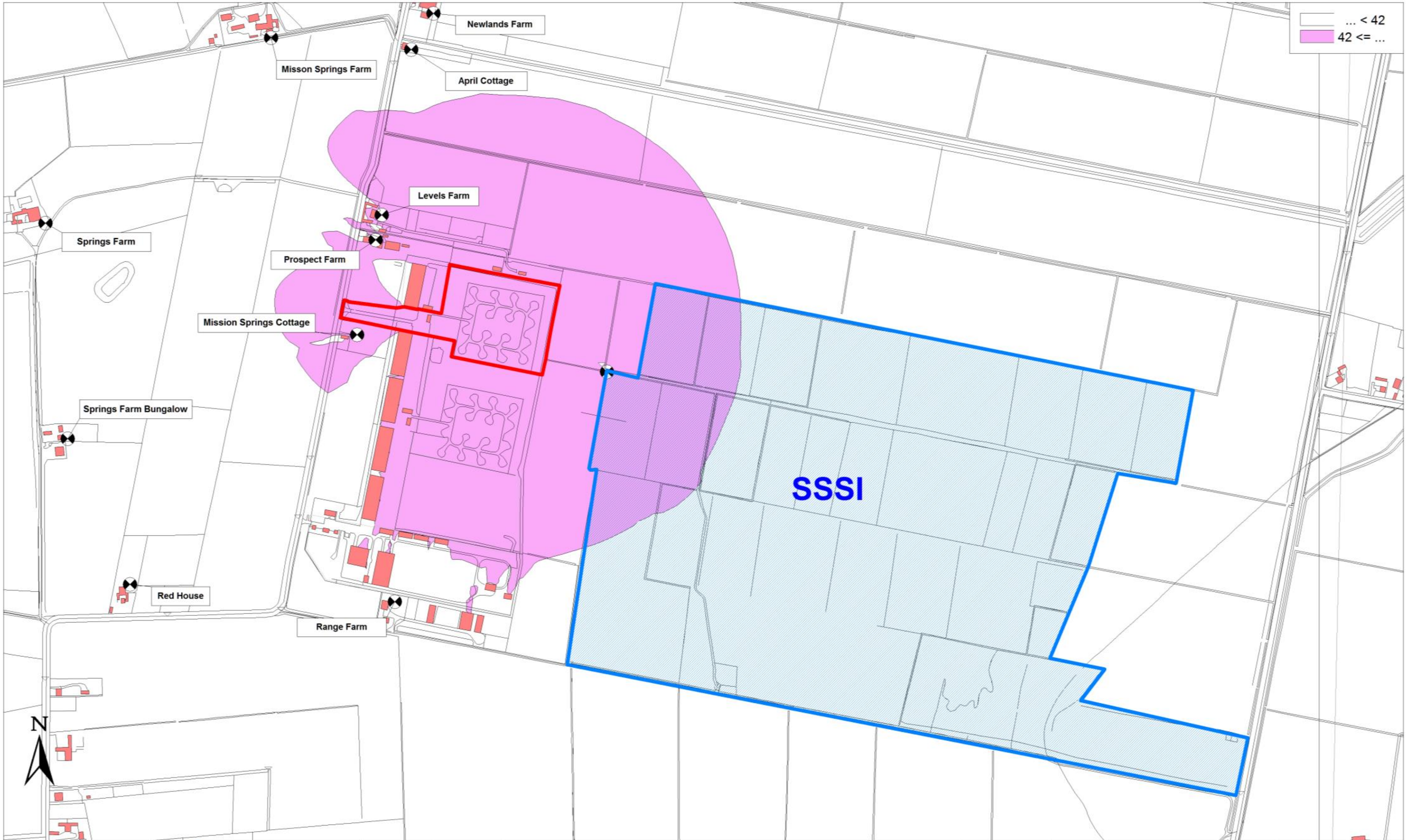


IGas Energy

Author	SJS	**Springs Road Exploratory Wellsite** **Access Track construction noise contours (42 dBA)** **Assuming all plant operating 100% of the time**	Project No.	JAT9778
			Project Title	Springs Road Wellsite Noise
Scale	1:7500@A3		Drawing No.	Figure A3
		Sheet 1 of 1	Date	08.12.17

RPS



Author	SJS	Project No.	JAT9778
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		Drawing No.	Figure A4
		Date	08.12.17

Springs Road Exploratory Wellsite
Site compound construction noise contours (42 dBA)
Assuming all plant operating 100% of the time

Sheet 1 of 1