



## A9000 Forth Road Bridge 10-Year Marine Licence

### Habitats Regulations Appraisal: Appendix E

#### Habitats Regulations Appraisal Appendix E: Construction Noise Management Plan

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BEAR Scotland

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## A9000 Forth Road Bridge 10-Year Marine Licence

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## **Executive Summary**

Jacobs, on behalf of BEAR Scotland, have undertaken a Construction Noise Management Plan for the Forth Road Bridge which covers the duration of the proposed Marine Licence over the next ten years, anticipated to be between 1 May 2026 and 30 May 2036.

The Construction Noise Management Plan covers the methods proposed to be put in place to consider the potential impacts upon the terns that breed on and otherwise use Long Craig Island, which forms part of the Forth Islands Special Protection Area (SPA). This assessment forms part of the application for a Marine Licence for the works. This has included a baseline noise assessment in the vicinity of the SPA, and construction noise calculations for the works currently designed and programmed.

Mitigation to minimise noise and vibration impacts will be employed to reduce the impacts of the construction works as much as possible. Noise monitoring may be carried out in response to complaints or for the purpose of refining work methods or techniques to minimise noise.

## 1. Introduction

### 1.1 Background

In August 2020, BEAR Scotland were appointed the Operating Company for the Network Management Contract (NMC) for the South East Trunk Road Unit. This contract sees BEAR Scotland responsible for the management and maintenance of trunk road assets in the south east of Scotland, until at least 2028. This includes the A9000 Forth Road Bridge (FRB) and the Queensferry Crossing. Jacobs have been engaged by BEAR Scotland to consider the impacts of noise generated by proposed maintenance works to be undertaken over the next 10 years, succeeding work also produced by Jacobs in 2021.

### 1.2 Forth Road Bridge

The Forth Road Bridge is a long span suspension bridge which carries the A9000 over the Firth of Forth, opened in 1964, and together with the approach viaducts is just over 2.5km in length. The Forth Road Bridge is designated by local authorities (Edinburgh City Council and Fife Council) as a Category A Listed Building. The Annual Average Daily Traffic (AADT) in 2018 was 643 movements, including motorcyclists, buses and taxis. As of September 2017, all other traffic has used the new Queensferry Crossing.

Most of the maintenance on the bridge is carried out during the day, and bridge workers routinely work in challenging conditions, including exposure to the elements and working at height, or in confined spaces, to keep the bridge safe and open to traffic.

The Forth Road Bridge spans sections of the Firth of Forth Special Protection Area (SPA) and Ramsar site and the Forth Islands SPA. Long Craig Island is located directly under the northern side span of the Forth Road Bridge and forms part of the Forth Islands SPA and is also designated as a Special Site of Scientific Interest (SSSI).

As maintenance works will be undertaken over the Forth Estuary, within the Mean High-Water Springs (MHWS) a marine licence is required under Part 4 of the Marine (Scotland) Act 2010 and Part 4 of the Marine and Coastal Access Act 2009.

### 1.3 Marine Licence

A marine licence application has been prepared for the next 10 years of maintenance works on the bridge which includes a Habitats Regulations Assessment (HRA) and an indicative programme of works. This Construction Noise Management Plan (CNMP) has been produced in support of the marine licence application and is presented as Appendix E of the HRA.

Long Craig Island supports populations of common tern, but more notably is a historic breeding colony of roseate terns (*Sterna dougallii*), which are one of the rarest breeding seabirds in the UK. It has not been recorded breeding on the island since 2009<sup>1</sup> and their breeding distribution is now restricted to just a few breeding colonies in the UK.

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<sup>1</sup> Knowles, C (2019). Forth Islands Tern Warden – Season Report 2019. Roseate Tern LIFE Recovery Project. Unpublished document.

Prior to BEAR taking on the maintenance contract, construction noise and visual disturbances associated with maintenance works on the Forth Road Bridge were reported to result in disturbance issues to terns present on Long Craig Island, for example in 2018 and 2020 as noted in reports issued by the Tern warden for Long Craig Island<sup>2,3</sup>. Jacobs undertook monitoring of the tern population during bridge works in 2021, 2023 and 2025. Although some disturbances to the terns as a result of works were noted, these were generally found to be quite limited and infrequent, with the large majority of disturbances due either to natural causes such as predators or climatic conditions; to external factors such as boats and kayaks; or to unknown causes.

## 1.4 Purpose

The aim of the CNMP is to:

- consider the potential construction noise impacts from the proposed programme of works; and,
- recommend reasonable measures to reduce the apparent noise impact wherever possible of maintenance activities to avoid disturbance to breeding birds, particularly during their breeding season, at the European Sites including Long Craig Island.

It does not cover worker Health & Safety issues relating to noise and vibration, and nor does it cover the construction noise impacts upon bridge users.

The Plan will:

- Provide BEAR Scotland employees and sub-contractors with a clear and concise description of their responsibilities, regarding noise management.
- Address the conditions of licence pertaining to noise contained within the previous 5 year marine licence for the Forth Road Bridge.
- Address legislative requirements and British Standards relevant to the CNMP.
- Provide a process to address any complaints received from statutory bodies.

## 1.5 Scope

This CNMP applies to all activities undertaken by BEAR Scotland, including its contractors, over the next ten years, anticipated to be between 1 May 2026 and 30 May 2036.

The plan will outline the existing noise environment, from survey work undertaken in 2021, indicate the noise levels from the proposed maintenance works, and identify the control measures to be used to minimise wherever possible the noise footprint of activities and mitigate where necessary.

The monitoring and measurement protocol for noise will be described and reporting procedures detailed, as well as establishing responsibilities for the management of noise.

This CNMP will be reviewed when required to ensure it remains valid and accurate. The CNMP will also be reviewed / updated to account for any changes to the conditions of licence, proposed works planned, proposed mitigation / monitoring strategy, etc., as deemed appropriate by a suitably qualified acoustician.

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<sup>2</sup> Amey (2018) Local Investigation Report Forth Bridges Unit

<sup>3</sup> Amey (2019) Appropriate Assessment Forth Road Bridge Maintenance Works. Revision 0, dated 20/12/2019.

## 2 Legislation and Guidance

### 2.1 Guidance on Noise Management

BEAR Scotland is committed to implementing the best practicable means to minimise construction noise and vibration during the maintenance activities to meet all requirements within the contract documents for the maintenance of the Forth Road Bridge. This CNMP stipulates the guidance to be followed to ensure that BEAR Scotland's activities do not cause pollution by way of deterioration in noise levels in accordance with Part III of the Environmental Protection Act (EPA) 1990.

### 2.2 Relevant Guidelines and Standards

#### 2.2.1 BS 5228-1: 2009 + A1:2014 Code of practice for noise and vibration control on construction & open sites - Part 1 (Noise)

This code of practice provides guidance and recommendations on methods for the measurement of construction noise and assessing its impact on those exposed to it. It also refers to the legislative background to noise control on construction sites and gives recommendations for basic methods of noise control. Suitable methods are provided for the calculation of noise from construction activities, including basic information regarding noise levels from a range of construction equipment.

The Standard provides guidance for the identification of the significance of noise levels from surface construction activity. Significance can be considered in relation to fixed limits for noise and vibration, or alternatively in considering the potential change in the ambient noise level with the construction noise.

A significance criterion is developed from noise measurements of existing ambient noise levels at the nearest sensitive receptors to the site. Sensitive receptors are residential housing; hotels and hostels; buildings in religious use; buildings in educational use and buildings in health and/or community use. Such issues of significance are in this case moot, and comparison with guidance from or the responses to consultation with NatureScot (formerly Scottish Natural Heritage) in relation to the potential impacts of noise on the bird population being of more relevance.

#### 2.2.2 Best Practicable Means

All maintenance and construction work will be carried out using the Best Practicable Means (BPM) as defined in Section 72 of the Control of Pollution Act, 1974<sup>4</sup> and British Standard BS 5228:2009+A1:2014 for Noise and Vibration<sup>5</sup>.

For static operations, or activities where works are taking place close to sensitive receptors, temporary barriers or enclosures should be employed, which will reduce the impacts somewhat. In addition, in accordance with good site practice, the following measures should be implemented.

Generic measures to assist in the reduction of noise levels generated from the site at sensitive receptors could include, but are not limited to the following:

- Noise and vibration control at source: e.g. selection of quiet and low vibration equipment, location of equipment on site, control of working hours and the provision of acoustic enclosures; and,

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<sup>4</sup> Scottish Government (1974), *Section 72, The Control of Pollution Act*

<sup>5</sup> British Standards (2009), *BS 5228-:2009+A1:2014, Code of Practice for noise and vibration control on construction and open sites. Part 1 Noise and Part 2 Vibration.*

- Screening: e.g. local screening of equipment or perimeter hoarding.

The measures to be addressed for each activity could include, but are not limited to the following:

- Careful selection of equipment by consideration of the EC Directive to ensure that the quietest available equipment is specified;
- Specification of the quietest methods or use of the programme to ensure that noise levels are minimised;
- Use of hoarding or specific noise barriers where this is possible and practicable. Night works are very unlikely, however should they be required, any equipment such as pumps and generators will be shielded from surrounding sensitive receptors, and all noisy hand-held equipment such as 'Stihl' saws and concrete breakers shall be shielded using temporary barriers such as 'Heras' fencing fitted with acoustic shielding panels (similar to 'Blok N Mesh');
- Site layout to locate noise sources as far away from sensitive receptors as possible, although given the site constraints for some activities this might be difficult;
- Provision of lined and sealed acoustic covers for all equipment where this is practicable;
- Regular maintenance of all equipment;
- Operation of equipment in the mode of operation that minimises noise;
- Shutting down equipment when not in use;
- No waiting or queuing on the public highway with engines running;
- Construction of temporary infrastructure to minimise noise and vibration;
- Handling all materials in a manner which minimises noise; and
- Audible warning systems designed to minimise noise.

Experience of the use of these forms of mitigation on other sites has shown that combined they have the potential to reduce construction noise levels by 5-10 dB. Nonetheless there is the potential that some of the proposed activities could still result in significant construction noise levels at sensitive receptors.

## 2.3 Marine Licence Conditions

The document forms part of the application for a Marine Licence for all proposed maintenance activities on the bridge for the next 10 years.

As for the previous Marine Licence, a Habitats Regulations Appraisal has been prepared in support of the application. This is required under regulation 48 of the Conservation (Natural Habitats, &c) Regulations 1994, to consider the implications of the activity in relation to European Sites. The Appropriate Assessment specifically considered whether any aspect of the proposed works is likely to have an adverse effect on site integrity on the Firth of Forth SPA/Ramsar or the Forth Islands SPA.

The Marine Licence MS00009380 was approved 30 September 2021, subsequently licence MS00010164 issued on the 12 April 2023 following an administrative alteration, and is due to expire on 30 September 2026. Conditions were put in place and noted below are those which relate to noise:

*3.1.19 The Licensee must adhere to the Construction Environmental Management Plan (CEMP) approved by the Licensing Authority on 18 May 2022. If any deviation from the approved CEMP is required, you must submit the updated CEMP to the Licensing Authority at least one month prior to start of works. Any updated CEMP is subject to approval by the Licensing Authority.*

*3.1.21 All works between 1 May and 30 September, and within 400 metres of Long Craig Island or 400 metres of Port Edgar marina, must be carried out in accordance with the CEMP approved under Condition 3.1.20. Works within these areas at these times must not be carried out unless the CEMP has been approved by the Licensing Authority.*

*3.1.22 The Licensee must strictly adhere to the Habitats Regulations Appraisal submitted to the Licensing Authority on 7 June 2021 unless otherwise agreed in writing with the Licensing Authority.*

It could be expected that similar conditions might be imposed to the current application for marine licence, and consequently this CNMP has been written to consider compliance with these conditions<sup>6</sup>, although it is understood that there will be a Site Environmental Management Plan (SEMP) in place of a CEMP. Additionally it should be noted the HRA has concluded that the buffer around Long Craig Island within which works require additional mitigation during the breeding period is proposed to be reduced from 400m to 300m.

It should be noted that previous versions of the licence stipulated a construction noise limit of 75dB which was thought would limit the level of impact upon the tern population during the nesting season. Subsequent experience has suggested that noise events have had little impact on changes in population, and it is not proposed that a noise limit be imposed for this licence. Furthermore, experience with the use of the permanent measurement equipment demonstrated that there were challenges achieving accurate measurements due to the exposed locations and the physical limitations of accurate noise measurement. Nonetheless the equipment will remain installed and operational and may be used to supply indicative data, around any identified tern disturbance events, should the atmospheric conditions be appropriate for noise measurement.

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<sup>6</sup> If conditions imposed by the proposed 10 year marine licence vary significantly from those detailed in the previously awarded 5 year marine licence in relation to relevant matters, then this CNMP will be required to be updated in advance of construction activities commencing.

### 3. Existing Noise Environment

#### 3.1 Ambient Noise Surveys

A noise survey was carried out on 1 and 2 March 2021 during both day and night hours at various locations to determine the ambient noise levels. Whilst this survey is now over 4 years old, in the absence of any significant noise generating developments in the vicinity, the results of the exercise are considered to remain valid. The locations utilised in the baseline noise survey were:

- The Boathouse;
- Ferry Barn Court;
- Forth Road Bridge, directly above Long Craig Island; &
- Off Ferry Barn Court on the northern shore under the bridge.

These are indicated in Annex B, together with the locations of the long-term measurement locations installed on the Bridge. Weather conditions during the surveys were predominantly dry and winds during the measurement survey were low (<5m/s) with all measurements taken within a free-field environment. As a conservative measure, the ambient noise level in the absence of the noise emissions of any construction works was not subtracted from the measured levels. The results of the survey are reported in Table 3.1:

Table 3.1: Results of Baseline Survey

<b>The Boathouse</b>									
Start Time	Duration	L <sub>Aeq</sub>	L <sub>AMax</sub>	L <sub>AMin</sub>	L <sub>A1</sub>	L <sub>A10</sub>	L <sub>A50</sub>	L <sub>A90</sub>	L <sub>A99</sub>
01/03/2021 12:53	00:15:00	52.3	80.5	40.5	62.4	56	46.3	43.2	41.6
01/03/2021 23:13	00:15:00	40.2	55.4	29.2	50.8	43.2	35.9	31.7	30.2
<b>Ferry Barns Court</b>									
Start Time	Duration	L <sub>Aeq</sub>	L <sub>AMax</sub>	L <sub>AMin</sub>	L <sub>A1</sub>	L <sub>A10</sub>	L <sub>A50</sub>	L <sub>A90</sub>	L <sub>A99</sub>
01/03/2021 13:18	00:15:00	54.5	71	46.9	63.5	56.1	52.7	50.1	48.4
01/03/2021 23:36	00:15:00	45.5	59.3	28.4	55.8	48.8	41.9	34.8	29.6
<b>Grassed Area off Ferry Barns Court</b>									
Start Time	Duration	L <sub>Aeq</sub>	L <sub>AMax</sub>	L <sub>AMin</sub>	L <sub>A1</sub>	L <sub>A10</sub>	L <sub>A50</sub>	L <sub>A90</sub>	L <sub>A99</sub>
01/03/2021 13:44	00:15:00	55.6	67.8	49.6	64.3	58.2	53.3	51.4	50.5
01/03/2021 23:58	00:15:00	46.4	66.5	34.1	57.1	49.4	42.9	38.8	35.7
<b>On Forth Road Bridge Above Long Craig Island</b>									
Start Time	Duration	L <sub>Aeq</sub>	L <sub>AMax</sub>	L <sub>AMin</sub>	L <sub>A1</sub>	L <sub>A10</sub>	L <sub>A50</sub>	L <sub>A90</sub>	L <sub>A99</sub>
01/03/2021 14:22	00:15:00	58.8	81.5	46.9	71	58.8	52.4	49.4	48
02/03/2021 00:37	00:15:00	46.1	66.8	34.9	54.8	46.6	43.2	38	36.1

From the above it is apparent that daytime levels in the area of the North Queensferry, rounded to the nearest 5dB, range from 50 to 55dB L<sub>Aeq</sub> whereas the night-time noise levels are between 40 and 45dB L<sub>Aeq</sub>.

The noise levels at the area directly above the designated site upon the bridge were identified as 60dB L<sub>Aeq</sub>, daytime and 45dB L<sub>Aeq</sub> night-time when rounded.

It was considered that the noise sources in the surrounding area were predominantly road traffic noise in the vicinity, with the Queensferry Crossing apparent both day and night. The main observed noise sources are associated with road traffic and the noise emissions from the noise produced from vehicles passing over the bridge joints.

## 4. Noise Management & Assessment Process

### 4.1 Reporting and Responsibilities

Table 4.1 describes the roles and responsibilities of the noise management process.

Table 4.1: Roles and responsibilities

<b>Roles</b>	<b>Responsibilities</b>
BEAR FRB Manager	<p>Ensure that all conditions are included as part of the design to guarantee that the noise levels are reduced where possible.</p> <p>Approve appropriate resources for the implementation of this Plan.</p> <p>Ensure the effective implementation of strategies designed to reduce noise impacts from the operation.</p> <p>Ensure that any sub-contractor abides to all conditions relating to the Marine Licence.</p> <p>Ensure any potential or actual noise issue is reported in accordance with legal requirements and the corporate standard.</p>
BEAR Engineer	<p>Provide that sufficient resources are allocated for the implementation of this Plan, as required.</p> <p>Ensure adequate resources are budgeted for in relation to noise monitoring for their task/project if required.</p> <p>Monitor the team members and contractors that carry out maintenance tasks and request noise monitoring where required.</p> <p>Preparation of method statements.</p> <p>Ensure any potential or actual noise management issue is controlled, or otherwise isolated.</p>
Noise Specialists: Noise Competency  <b>Principal Acoustician</b>	<p>Manage and maintain the noise monitoring programs in accordance with this plan.</p> <p>Should noise monitoring be required to be used (see Section 5.1), ensure monitoring equipment is operated in accordance with relevant industry standards and protocols.</p> <p>Ensure that all monitoring records are effectively maintained within scheme folders, where appropriate.</p> <p>Authority to instruct the relevant site manager to stop works if measurements reveal unacceptable noise levels. Coordinate the collation and evaluation of monitoring data.</p> <p>In conjunction with E&amp;S Manager, provide Marine Directorate with reports if requested.</p>
<b>Acoustician</b>	<p>Should noise monitoring be required to be used (see Section 5.1), ensure monitoring equipment is operated in accordance with relevant industry standards and protocols.</p> <p>Interface with construction team.</p>
BEAR Environmental Manager	<p>Ensure that the requirements of Construction Noise Management Plan are being adhered to and that roles and responsibilities are suitably adhered to.</p> <p>In conjunction with Noise Specialists, provide Marine Directorate with reports to Marine Directorate if requested.</p>
All employees and contractors	<p>Ensure the effective implementation of this Plan with respect to their work area.</p> <p>Ensure all equipment (relevant to task/area of responsibility) is maintained and operated in a proper and efficient manner.</p>

### 4.2 Phases of Construction Work and Plant and Equipment Utilised

The proposed programme of works to be undertaken over the 10-year duration of the Marine Licence are presented within Appendix A of the HRA.

A desktop analysis has been undertaken to determine the proposed machinery that could be used within the area, and the potential noise levels generated by the combination of plant and equipment proposed to be used for programmed operations. These have been agreed with BEAR engineers. It is important to note however that these calculations are likely to be an over-estimation of the noise levels generated by each proposed activity. This is because all plant has been assumed to be operating at the same time, which is not practical. As a consequence noise levels experienced, even in the absence of mitigation, are likely to be lower than those calculated.

Source noise levels were obtained from Annex C of BS 5228:2009+A1:2014 mainly as sound pressure levels at 10 m from the noise source (dB  $L_{Aeq}$  at 10m). This list is not exhaustive and may change depending on the proposed works. Where the Standard does not include data for the plant and equipment to be used, manufacturer's data or measured levels have been used.

It should be noted that the calculation of impacts has been undertaken in the absence of mitigation to demonstrate the worst case noise levels likely to be generated. In practice mitigation will be employed along the lines of that proposed in Section 2.1.2, which can reduce construction noise levels by between 5 to 10dB.

Tables 4.2 and 4.3 illustrate the type of plant that may potentially be used for maintenance of the Forth Road Bridge. The location of Long Craig Island to the road level is approximately 50m and to the underside walkway approximately 44m. Table 4.2 provides calculations as to the predicted A-weighted Sound Pressure Level  $L_{Aeq,T}$  dB at these levels.

For the avoidance of doubt, the Sound Power Level ( $L_{WA}$ ) dB is the acoustic power from a specific device or machine. It is an intrinsic characteristic of the machine. It does not depend on the location, whereas, the Sound Pressure Level ( $L_{Aeq,T}$ ) dB is the noise measured by the sound level meter at a given distance. It represents the loudness of sound. It depends on the location. If you measure further away from the noise source the Sound Pressure Level will be lower than if you measure close to the source.

It should be noted that every time the distance from a point source is doubled, the noise levels reduce by approximately 6dB  $L_{Aeq}$ , assuming hard ground between the source and the point of measurement<sup>7,8</sup>.

The relation between the sound power level of a specific machine ( $L_{WA}$ ) and the sound pressure level that would be measured at 10m from the noise source ( $L_{Aeq}$  at 10m), has been assumed to be 28dB(A)<sup>9</sup>. That is  $L_{WA} = L_{Aeq}$  at 10m + 28 dB(A).

This assumes that noise spreads hemispherically equally in all directions from a point source.

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<sup>7</sup> When the surface between the noise source and the measurement point is water, it is usually assumed hard ground conditions.

<sup>8</sup> See BS 5228-1:2009+A1:2014 formula F.1.

<sup>9</sup> See BS 5228-1:2009+A1:2014 section F.2.3.1.

Table 4.2: List of Plant used upon the Forth Road Bridge – Scheme Works

Phase of Work	Plant Description	No	% On-Time	Shift Duration (hrs)	Duration of Activity (hrs)	% Activity Time	Total L <sub>w</sub> dB	Calculated Construction Noise Levels, dB L <sub>Aeq,1hr</sub> at Noted Distances				
								25m	50m	100m	200m	300m
Suspended Span Painting Works	Shotblast Nozzle	1	30%	10	8	80%	115.0	74.7	68.7	62.6	56.6	53.1
	Compressor	1	35%	10	8	80%	101.0					
	Scabblers	1	30%	10	8	80%	97.0					
	Angle grinder	2	20%	10	8	80%	111.0					
	Generator	1	25%	10	8	80%	85.0					
	General 4x4	1	30%	10	8	80%	108.0					
Suspended Span Strengthening Works	Shotblast Nozzle	1	30%	10	8	80%	115.0	75.1	69.0	63.0	57.0	53.5
	Compressor	1	35%	10	8	80%	101.0					
	Scabblers	1	30%	10	8	80%	97.0					
	Angle grinder	2	20%	10	8	80%	111.0					
	Generator	1	25%	10	8	80%	85.0					
	Impact Wrench	1	10%	10	8	80%	110.0					
	Hand Tools	1	30%	10	8	80%	87.0					
	General 4x4	1	30%	10	8	80%	108.0					
Hand-held welder	1	20%	10	8	80%	101.0						
Suspended Span Resurfacing	Road planer	1	25%	10	8	80%	110.0	76.1	70.0	64.0	58.0	54.5
	Lorry (4-axle wagon)	1	20%	10	8	80%	108.0					
	Petrol Pressure Washer	1	30%	10	8	80%	110.0					
	Angle grinder (grinding steel)	2	20%	10	8	80%	111.0					
	Generator for Welding	1	25%	10	8	80%	85.0					
	Blast Cleaning	1	30%	10	8	80%	115.0					
	Hand-held welder	1	25%	10	8	80%	101.0					
	Compressor	1	35%	10	8	80%	101.0					
Mastic Asphalt Tanker	1	15%	10	8	80%	104.0						
Footpath Resurfacing	Scabblers	1	25%	10	8	80%	97.0	70.2	64.1	58.1	52.1	48.6
	Hand-held welder	1	20%	10	8	80%	101.0					
	Angle grinder	2	20%	10	8	80%	111.0					
	Generator	1	25%	10	8	80%	85.0					
	General 4x4	1	30%	10	8	80%	108.0					

Phase of Work	Plant Description	No	% On-Time	Shift Duration (hrs)	Duration of Activity (hrs)	% Activity Time	Total L <sub>w</sub> dB	Calculated Construction Noise Levels, dB L <sub>Aeq,1hr</sub> at Noted Distances				
								25m	50m	100m	200m	300m
Suspended Span Under Deck Access	Hand-held welder	1	20%	10	8	80%	101.0					
	Impact Wrench	1	25%	10	8	80%	110.0	67.1	61.1	55.0	49.0	45.5
	Hand Tools	1	30%	10	8	80%	87.0					
Footpath Elastomeric Bearing Replacement	Impact Wrench	1	25%	10	8	80%	110.0	69.5	63.5	57.5	51.5	47.9
	Hand Tools	1	30%	10	8	80%	87.0					
	General 4x4	1	30%	10	8	80%	108.0					
	Generator	1	25%	10	8	80%	85.0					
Main Tower Lateral Thrust Bearing Replacement	Lorry with lifting boom	1	30%	10	8	80%	105.0	70.7	64.7	58.7	52.6	49.1
	Impact Wrench	1	15%	10	8	80%	110.0					
	Hammer Drill Under Load	1	20%	10	8	80%	101.0					
	Angle grinder	2	20%	10	8	80%	111.0					
	Hand-held welder	1	20%	10	8	80%	101.0					
	Generator	1	20%	10	8	80%	85.0					
	Hand-held welder	1	20%	10	8	80%	101.0					
Side Tower Rocker Replacement	Lorry with lifting boom	1	30%	10	8	80%	105.0	77.3	71.3	65.3	59.3	55.7
	Impact Wrench	1	15%	10	8	80%	110.0					
	Hammer Drill Under Load	1	20%	10	8	80%	101.0					
	Angle grinder	2	20%	10	8	80%	111.0					
	Hand-held welder	1	20%	10	8	80%	101.0					
	Generator	1	20%	10	8	80%	85.0					
	General 4x4	1	30%	10	8	80%	108.0					
	Hydro Demolition Equipment	1	30%	10	8	80%	118.0					
Hand-held welder	1	20%	10	8	80%	101.0						
Main Cable Intrusive Investigation	Lifting platform (8t)	1	20%	10	8	80%	95.0	52.0	46.0	40.0	34.0	30.5
	Hand Tools	1	30%	10	8	80%	87.0					
Pedestrian Balustrade Strengthening	Drill Under Load	1	15%	10	8	80%	101.0	68.3	62.3	56.3	50.3	46.8
	Angle grinder	2	20%	10	8	80%	111.0					
	Hand-held welder	1	25%	10	8	80%	101.0					
	Generator	1	25%	10	8	80%	85.0					
	Hand Tools	1	30%	10	8	80%	87.0					
	Hand-held welder	1	20%	10	8	80%	101.0					

Phase of Work	Plant Description	No	% On-Time	Shift Duration (hrs)	Duration of Activity (hrs)	% Activity Time	Total L <sub>w</sub> dB	Calculated Construction Noise Levels, dB L <sub>Aeq,1hr</sub> at Noted Distances				
								25m	50m	100m	200m	300m
Runway Beam Bracket Replacement & New Suspended Span Underdeck Access Gantry	Liebherr LTM1200 Crane	1	40%	10	8	80%	94.0	72.1	66.1	60.1	54.1	50.5
	Barge (On Idle)	1	50%	10	8	80%	112.0					
	Hand Tools	1	30%	10	8	80%	87.0					
Vehicle Restraint Barrier & Grillage Refurbishment	Hammer Drill Under Load	1	15%	10	8	80%	101.0	67.9	61.9	55.9	49.9	46.3
	Angle grinder	2	20%	10	8	80%	111.0					
	Hand-held welder	1	25%	10	8	80%	101.0					
	Generator	1	25%	10	8	80%	85.0					
	Hand Tools	1	30%	10	8	80%	87.0					
Suspended Span Half Joint Replacement	Shotblast Nozzle	1	30%	10	8	80%	115.0	74.5	68.4	62.4	56.4	52.9
	Compressor	1	35%	10	8	80%	101.0					
	Angle grinder	2	20%	10	8	80%	111.0					
	Generator	1	25%	10	8	80%	85.0					
	Impact Wrench	1	10%	10	8	80%	110.0					
	Hand Tools	1	30%	10	8	80%	87.0					
Suspended Span Carriageway Concrete Deck	Hand-held welder	1	20%	10	8	80%	101.0	76.0	70.0	64.0	58.0	54.5
	Hydro Demolition Equipment	1	30%	10	8	80%	118.0					
	Hand Tools	1	30%	10	8	80%	87.0					
	Compressor	2	35%	10	8	80%	104.0					
	Generator	2	25%	10	8	80%	88.0					

Table 4.3: List of Plant used upon the Forth Road Bridge – Routine Maintenance Activities

Phase of Work	Plant Description	No	% On-Time	Shift Duration (hrs)	Duration of Activity (hrs)	% Activity Time	Total L <sub>w</sub> dB	Calculated Construction Noise Levels, dB L <sub>Aeq,1hr</sub> at Noted Distances				
								25m	50m	100m	200m	300m
Hanger Painting	Lifting platform (8t)	1	25%	10	8	80%	95.0	52.1	46.0	40.0	34.0	30.5
Hanger Replacement	Angle grinder	1	25%	10	8	80%	108.0	65.7	59.7	53.7	47.7	44.1
	Hand-held welder	1	20%	10	8	80%	101.0					
	Generator	1	25%	10	8	80%	85.0					
Weld Repairs	Angle grinder	2	20%	10	8	80%	111.0	67.1	61.1	55.0	49.0	45.5
	Generator	1	25%	10	8	80%	85.0					
	Hand Tools	1	30%	10	8	80%	87.0					
Bolt Replacement	Impact Wrench	1	25%	10	8	80%	110.0	67.1	61.1	55.0	49.0	45.5
	Hand Tools	1	30%	10	8	80%	87.0					
Kingpost Replacement (Bottom Lateral Supports)	Impact Wrench	1	25%	10	8	80%	110.0	67.1	61.1	55.0	49.0	45.5
	Hand Tools	1	30%	10	8	80%	87.0					
Pier Defences Repairs	Shotblast Nozzle	1	25%	10	8	80%	115.0	72.3	66.2	60.2	54.2	50.7
	Compressor	1	30%	10	8	80%	101.0					
	Hand Tools	1	30%	10	8	80%	87.0					
Billet Repair (Half Joint Repairs)	Angle grinder	2	20%	10	8	80%	111.0	67.6	61.6	55.6	49.6	46.1
	Generator	1	25%	10	8	80%	85.0					
	Hand Tools	1	30%	10	8	80%	87.0					
	Hand-held welder	1	25%	10	8	80%	101.0					
End Trimmer Replacement/Strengthening (Suspended Span)	Petrol circular saw	1	10%	10	8	80%	119.0	76.3	70.3	64.3	58.3	54.8
	Hand held hydraulic breaker	1	10%	10	8	80%	121.0					
	Hydraulic breaker power pack	1	10%	10	8	80%	102.0					
	Hammer Drill Under Load	1	20%	10	8	80%	101.0					
	Hand-held welder	1	25%	10	8	80%	101.0					
	Generator	1	35%	10	8	80%	85.0					
Removal of Lead Based Paint	Shotblast Nozzle	1	25%	10	8	80%	115.0	72.3	66.2	60.2	54.2	50.7
	Compressor	1	30%	10	8	80%	101.0					
Maintenance Painting	Shotblast Nozzle	1	20%	10	8	80%	115.0	71.3	65.3	59.3	53.2	49.7
	Compressor	1	25%	10	8	80%	101.0					
Repair of Cathodic Protection Systems	Lifting platform 35 kW (8t)	1	25%	10	8	80%	95.0	64.4	58.4	52.4	46.4	42.8
	Angle grinder (grinding steel)	1	20%	10	8	80%	108.0					

Phase of Work	Plant Description	No	% On-Time	Shift Duration (hrs)	Duration of Activity (hrs)	% Activity Time	Total L <sub>w</sub> dB	Calculated Construction Noise Levels, dB L <sub>Aeq,1hr</sub> at Noted Distances				
								25m	50m	100m	200m	300m
	Generator	1	25%	10	8	80%	85.0					
	Hand Tools	1	30%	10	8	80%	87.0					
Replacement & Installation of SHM Sensors	Hand Tools	1	30%	10	8	80%	87.0	44.8	38.8	32.8	26.9	23.5
Electrical Infrastructure	Angle grinder	2	20%	10	8	80%	111.0	67.1	61.1	55.0	49.0	45.5
	Generator	1	25%	10	8	80%	85.0					
	Hand Tools	1	30%	10	8	80%	87.0					
Lighting Infrastructure	Angle grinder	2	20%	10	8	80%	111.0	68.7	62.6	56.6	50.6	47.1
	Generator	1	25%	10	8	80%	85.0					
	Hand Tools	1	30%	10	8	80%	87.0					
	Impact Wrench	1	10%	10	8	80%	110.0					
	Lifting platform (8t)	1	25%	10	8	80%	95.0					
CCTV Infrastructure	Angle grinder	2	20%	10	8	80%	111.0	68.7	62.6	56.6	50.6	47.1
	Generator	1	25%	10	8	80%	85.0					
	Hand Tools	1	30%	10	8	80%	87.0					
	Impact Wrench	1	10%	10	8	80%	110.0					
	Lifting platform (8t)	1	25%	10	8	80%	95.0					
Bridge Signage	Angle grinder	2	20%	10	8	80%	111.0	68.7	62.6	56.6	50.6	47.1
	Generator	1	25%	10	8	80%	85.0					
	Hand Tools	1	30%	10	8	80%	87.0					
	Impact Wrench	1	10%	10	8	80%	110.0					
	Lifting platform (8t)	1	25%	10	8	80%	95.0					
Surfacing Repairs	Road planer 17t	1	25%	10	8	80%	110.0	73.9	69.9	63.9	57.9	54.3
	Lorry (4-axle wagon)	1	20%	10	8	80%	108.0					
	Road sweeper	1	15%	10	8	80%	104.0					
	Asphalt paver (+ tipper lorry)	1	25%	10	8	80%	103.0					
	Roller 12t	1	30%	10	8	80%	108.0					
	Hand held hydraulic breaker	1	10%	10	8	80%	121.0					
	Hydraulic breaker power pack	1	10%	10	8	80%	102.0					
Road Markings and Studs	Lorry (4-axle wagon)	1	25%	10	8	80%	108.0	65.1	59.1	53.1	47.1	43.5
	Generator	1	30%	10	8	80%	85.0					

Phase of Work	Plant Description	No	% On-Time	Shift Duration (hrs)	Duration of Activity (hrs)	% Activity Time	Total L <sub>w</sub> dB	Calculated Construction Noise Levels, dB L <sub>Aeq,1hr</sub> at Noted Distances				
								25m	50m	100m	200m	300m
Vehicle Restraint Repairs (Grillage)	Hand Tools	1	30%	10	8	80%	87.0	68.9	62.8	56.8	50.8	47.3
	Angle grinder	2	20%	10	8	80%	111.0					
	Generator	1	25%	10	8	80%	85.0					
	Hand Tools	1	30%	10	8	80%	87.0					
	Impact Wrench	1	10%	10	8	80%	110.0					
	Hand-held welder	1	20%	10	8	80%	101.0					
Main Cable Dehumidification	Angle grinder	2	20%	10	8	80%	111.0	68.6	62.5	56.5	50.5	47.3
	Generator	1	25%	10	8	80%	85.0					
	Hand Tools	1	30%	10	8	80%	87.0					
	Impact Wrench	1	10%	10	8	80%	110.0					
Suspended Span Drainage	Petrol Pressure Washer	1	30%	10	8	80%	105.0	66.6	60.5	54.5	48.5	45.0
	Angle grinder	1	20%	10	8	80%	108.0					
	Generator	1	25%	10	8	80%	85.0					
	Hand Tools	1	30%	10	8	80%	87.0					
Expansion Joints	Petrol Pressure Washer	1	30%	10	8	80%	105.0	68.8	62.8	56.8	50.7	47.2
	Road sweeper 70 kW	1	20%	10	8	80%	104.0					
	Generator	1	25%	10	8	80%	85.0					
	Hand Tools	1	30%	10	8	80%	87.0					
	Impact Wrench	1	10%	10	8	80%	110.0					
	Angle grinder	1	20%	10	8	80%	108.0					
Bearings	Angle grinder	2	20%	10	8	80%	111.0	68.6	62.5	56.5	50.5	47.0
	Generator	1	25%	10	8	80%	85.0					
	Hand Tools	1	30%	10	8	80%	87.0					
	Impact Wrench	1	10%	10	8	80%	110.0					
Routine Cleaning	Petrol Pressure Washer	1	30%	10	8	80%	105.0	64.7	58.7	52.7	46.7	43.2
	Road sweeper 70 kW	1	20%	10	8	80%	104.0					
	Hand Tools	1	30%	10	8	80%	87.0					
Concrete Repairs	Hand Tools	2	30%	10	8	80%	90.0	78.1	72.1	66.1	60.1	56.6
	Generator	1	25%	10	8	80%	85.0					
	Hydro Demolition Equipment	1	30%	10	8	80%	118.0					
	Hand held hydraulic breaker	1	10%	10	8	80%	121.0					

Phase of Work	Plant Description	No	% On-Time	Shift Duration (hrs)	Duration of Activity (hrs)	% Activity Time	Total L <sub>w</sub> dB	Calculated Construction Noise Levels, dB L <sub>Aeq,1hr</sub> at Noted Distances				
								25m	50m	100m	200m	300m
	Hydraulic breaker power pack	1	10%	10	8	80%	102.0					
	Compressor	1	35%	10	8	80%	101.0					

Tables 4.2 and 4.3 show that all calculated noise emissions from the proposed operations are below the previously stipulated 75dB licence limit. Although not proposed for inclusion within this licence as noted in Sections 2.3 and Section 5, this is seen in this instance as an appropriate significance trigger, at 50m in the absence of noise control mitigation measures. Nonetheless as good practice it is recommended that the Best Practical Means reported in Section 2.1.2 above be implemented throughout any construction works. If this is applied, the noise levels generated by the activities reported in Tables 4.2 and 4.3 will be reduced by 5-10dB.

As a consequence, all proposed activities, using the plant and equipment noted in Tables 4.2 and 4.3 should not give rise to unacceptable noise levels above the 75dB significance criteria. If any new plant is used within the licence period that is not listed in Tables 4.2 and 4.3, the Project Manager must contact the Noise Specialist to determine if there would be the potential for any impacts to Long Craig Island.

### **4.3 Site Working Hours**

The Forth Road Bridge maintenance works are generally undertaken between the hours of 07:30 and 18:00, Monday to Saturday, with the first and last 30 minutes for set up and clearing activities. However, some weekend working will be required due to the operational restrictions of the Traffic Management window between 1 April and 31 October.

Due to a variety of reasons, there is the occasional requirement for night-time and / or weekend working, which may include emergency works.

If this is required for any more than a short period of time (1 or 2 nights), within 300m of Long Craig Island during the tern breeding season, the Project Manager must contact the BEAR Environmental Manager, who will consult with an Ecologist and the Principal Acoustician to determine if there would be the potential for any impacts to Long Craig Island.

## 5. Noise Monitoring Program

### 5.1 Monitoring Programme

From site observation and comparison with measured noise levels from the on-site sound level meters, there appears to be little correlation between noise events recorded and the behaviour of the tern colony. Irrespective of this however, knowledge of the construction noise impacts and methods in place to mitigate those impacts remains useful as good practice, and to demonstrate that efforts are being taken to control noise impacts. Because of the lack of demonstrated causal link however between elevated noise levels and activity in the tern colony, permanent noise monitoring is not proposed to be undertaken during this licence duration.

However, noise monitoring may be carried out in response to complaints, exceedances, or for the purpose of refining work methods or techniques to minimise noise. This will be possible by either attended or unattended means, the latter using the previously installed sound level meters located at the North Side Tower and North Main Tower. These meters will be kept calibrated and will operate continually throughout the plan period, in order that the data can be referred to if in the opinion of the BEAR FRB Manager it would be beneficial.

If attended monitoring is required, it will be carried out by an appropriately qualified Acoustician. Records of equipment calibration and testing will be kept on site and saved electronically in order to permit sharing as required.

Details of the site activities and equipment usage will be recorded during the attended noise monitoring events. Short reports prepared by a BEAR appointed noise specialist after each attended noise monitoring event will include the following information, but not limited to:

- the locations and results of noise monitoring;
- tabulation of noise measurement results (including  $L_{Amax}$ ,  $L_{Amin}$ ,  $LA1$ ,  $LA10$ ,  $LA50$ ,  $LA90$ ,  $LA99$  and  $L_{Aeq}$  noise levels) together with notes identifying the principal noise sources and operations;
- summary of any measurements exceeding the noise criteria levels, and descriptions of the plant or operations causing these exceedances; and
- details of corrective actions to address any noise criteria exceedances, and confirmation of its successful implementation.

Statistical descriptors recorded during each survey include  $L_{Amax}$ ,  $L_{Amin}$ ,  $LA1$ ,  $LA10$ ,  $LA50$ ,  $LA90$ ,  $LA99$  and  $L_{Aeq}$  noise levels. Meteorological conditions will be recorded throughout the surveys.

#### 5.1.1 Noise Monitoring Equipment

Any sound level meter to be used in noise survey work will meet the requirements of Type 1 under BS 7580-1:1997 or Class 1 under BS EN 61672-1:2013.

The Sound Level Meter (SLM) will be mounted on a tripod, with microphone set approximately 1.2m above ground level and set at grazing incidence in 'free field' conditions. A windshield will be fitted to the microphone to minimise the effects of wind-induced noise across the microphone diaphragm.

Any sound level meter and calibrator used on site during the works will be calibrated in a UKAS or NPL accredited laboratory every year for the calibrator and two years for the sound level meter. Before the commencement of any measurements during construction works the noise specialist will check that all equipment holds a valid certificate.

### **5.1.2 Monitoring Locations**

Monitoring locations will be tailored to the nearby operations wherever possible, with the locations utilised for the baseline noise survey unless there are closer receptors to the proposed works. Monitoring locations will be kept under review, and where required agreement with Marine Directorate and NatureScot will be gained before new measurement locations are added.

## **6. Training and Awareness**

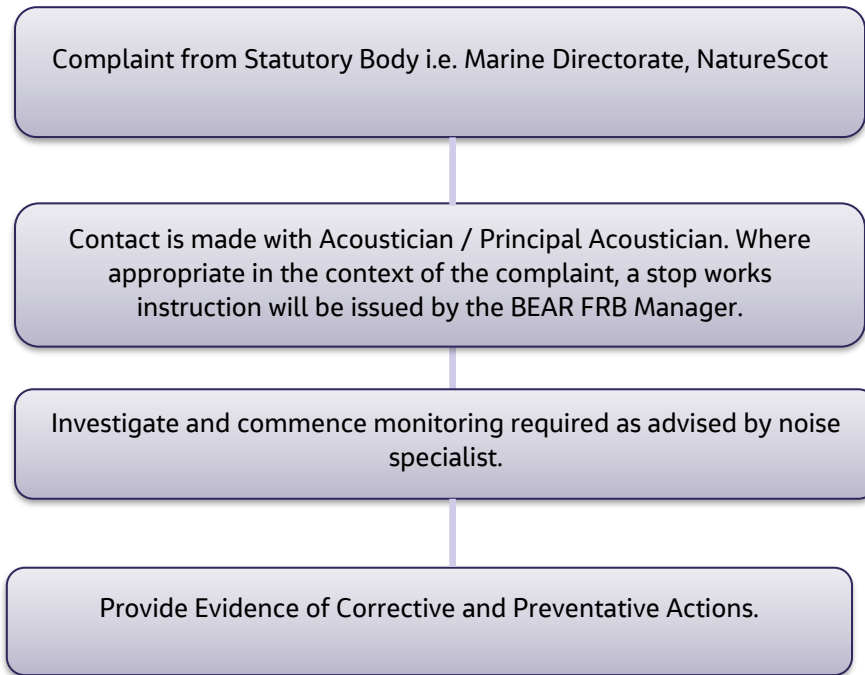
The CNMP will be briefed to all relevant parties to works planned on the bridge, such as BEAR Engineers, site supervisors, contractor site managers, etc. Furthermore, it will form part of the tender package for all works, ensuring that contractors are fully aware of all requirements and appropriately account for working methods or mitigation in their submissions within this environment. The aim is for the BEAR FRB Manager to roll this procedure and guidelines out at meetings and the project managers will cascade to all team members. This should be recorded and kept on record.

Further awareness of the marine licence conditions will be discussed as part of toolbox talks once the new Marine Licence has been issued.

## 7. Review and Improvements

### 7.1 Summary of Procedure in the event of Complaint

Figure 1 illustrates the procedure in the event of a complaint from a Statutory Body.



### 7.2 Summary of Mitigation Measures to address potential noise impacts

In general, all mitigation measures should adhere to BPM in accordance with Section 72 of the Control of Pollution Act 1974 and BS 5228:2009+A1:2014, Parts 1 & 2 Noise and Vibration. Refer to Section 2.1.2 of this report.

### 7.3 Improvements

Periodically the CNMP will be reviewed by BEAR and any improvements will be incorporated by a noise competent person with approval from the BEAR FRB Manager. All findings will be recorded and reported as required.

## 8. Definitions

Term	Definition
BPM	Best Practicable Means
CNMP	Construction Noise Management Plan
L <sub>A1</sub>	The L <sub>A1</sub> level is the noise level which is exceeded for 1% of the sample period. During the sample period, the noise level is below the L <sub>A1</sub> level for 99% of the time.
L <sub>A10</sub>	The L <sub>A10</sub> level is the noise level which is exceeded for 10% of the sample period. During the sample period, the noise level is below the L <sub>A10</sub> level for 90% of the time. The L <sub>A10</sub> is a common noise descriptor for environmental noise and road traffic noise.
L <sub>A50</sub>	The L <sub>A50</sub> level is the noise level which is exceeded for 50% of the sample period. During the sample period, the noise level is below the L <sub>A50</sub> level for 50% of the time.
L <sub>A90</sub>	The L <sub>A90</sub> level is the noise level which is exceeded for 90% of the sample period. During the sample period, the noise level is below the L <sub>A90</sub> level for 10% of the time. This measure is commonly referred to as the background noise level.
L <sub>A99</sub>	The L <sub>A99</sub> level is the noise level which is exceeded for 99% of the sample period. During the sample period, the noise level is below the L <sub>A99</sub> level for 1% of the time.
L <sub>Aeq</sub>	The equivalent continuous sound level (L <sub>Aeq</sub> ) is the energy average of the varying noise over the sample period and is equivalent to the level of a constant noise which contains the same energy as the varying noise environment. This measure is also a common measure of environmental noise and road traffic noise.
L <sub>Amax</sub>	Maximum Noise Level – The maximum noise level, measured on fast response, during the sample period.

## **Annex A. Best Practicable Means**

The following text is taken from the relevant Legislation and Guidance in relation to Best Practicable Means:

### **Control of Pollution Act 1974 - Section 72**

- This section applies to "Best Practicable Means (BPM)".
- In that expression "practicable means reasonably practicable having regard among other local conditions and circumstances including technical knowledge and financial implications.
- BPM should be employed during design, installation maintenance, during operation of plant and machinery and any maintenance of acoustic enclosures.
- Subject to the preceding provisions of this section, regard shall be had, in construing references to "BPM" to any relevant provision of a code of practice approved under the preceding section.

All these techniques will minimise to a reasonable level of noise which operators, neighbours site operations will be exposed.

### **BS 5228: 2009+A1 2014 – Code of practice for noise and vibration control on construction & open sites**

Section 7.3 of BS 5228: 2009+A1 2014 'Execution of works' states that all available techniques should be used to minimize, as far as is appropriate, the level of noise to which operators and others in the neighbourhood of site operations will be exposed.

Measures which should be taken include the following.

- The hours of working will be planned and account will be taken of the effects of noise upon persons in areas surrounding site operations and upon persons working on site, taking into account the nature of land use in the areas concerned, the duration of work and the likely consequence of any lengthening of work periods.
- Where reasonably practicable, quiet working methods will be employed, including use of the most suitable plant, reasonable hours of working for noisy operations, and economy and speed of operations. Site work continuing throughout 24h of a day will be programmed, when appropriate, so that haulage vehicles will not arrive at or leave the site between 19.00h and 07.00 h.
- Noise will be controlled at source and the spread of noise will be limited, in accordance with Clause 8.
- On-site noise levels will be monitored monthly during May to August, particularly if changes in machinery or project designs are introduced, by a suitably qualified person appointed specifically for the purpose.

When potential noise problems have been identified, or when problems have already occurred, consideration will be given to the implementation of practicable measures to avoid or minimise those problems. Local authorities, consulting with developers and their professional advisers or with site operators, will need to consider the extent of noise control measures necessary to prevent the occurrence of significant problems, and will also need to consider whether the implementation of those measures will be practicable. Local authorities might wish to consider whether to specify quantified limits on site noise and whether, additionally or instead, to lay down requirements relating to work programmes, plant to be used, siting of plant, periods of use, working hours, access points, etc. The latter approach will often be preferable in that it facilitates the monitoring of formally or informally specified requirements, both for the authorities and for the site operators.

In relation to best practicable means, the contractor will employ appropriate measures which may include:

Appropriate selection of plant, construction methods and programming, including appropriate scheduling of noisier activities within the permitted working hours. Only plant conforming with or better than relevant national or international standards, directives or recommendations on noise and vibration emissions will be used. Construction plant will be maintained in good condition regarding minimising noise output and workers' exposure to harmful noise and vibration.

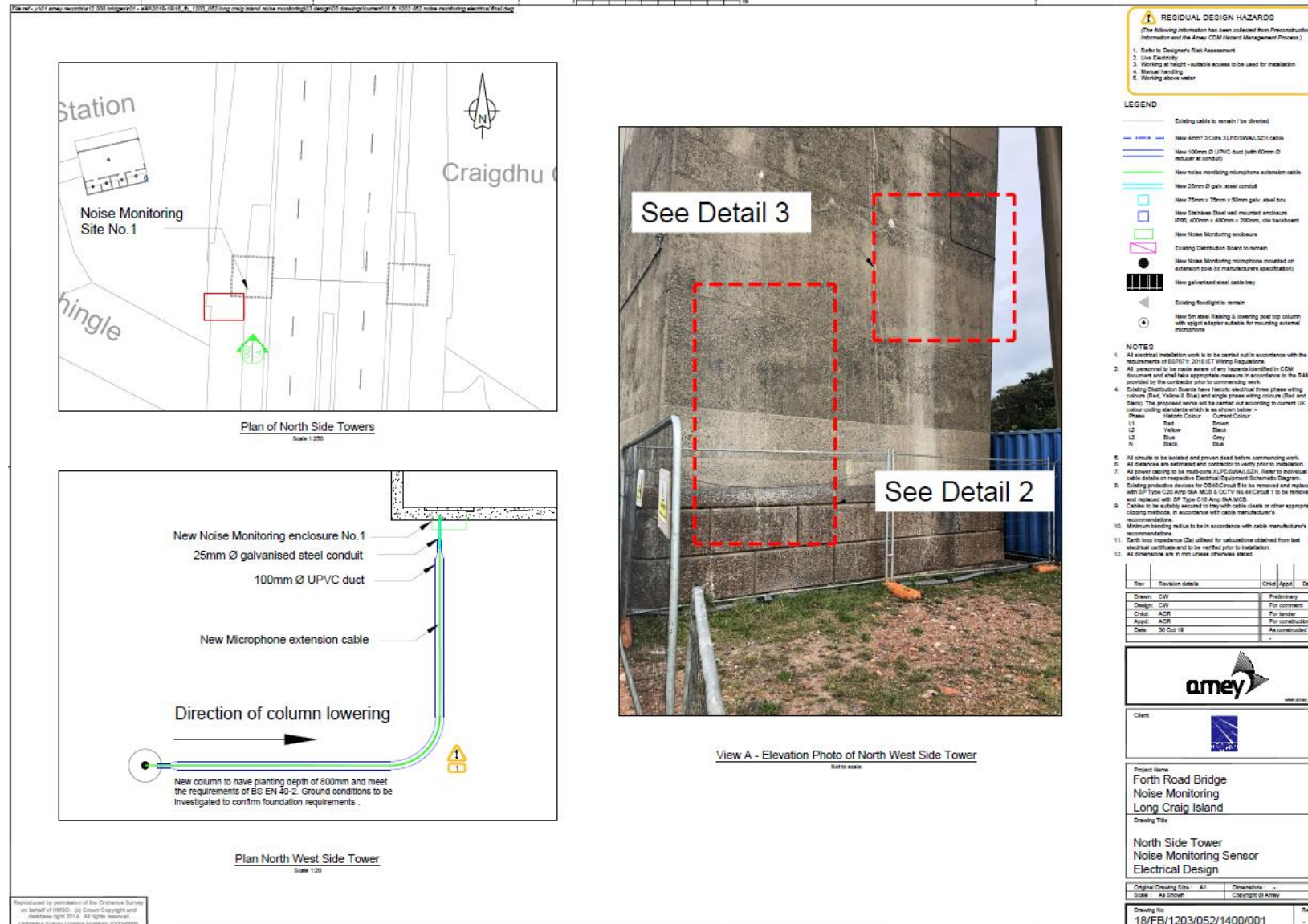
- In addition to minimising noise and vibration at source or adverse effects through other mitigation measures, the contractor will demonstrate in its planning and assessments that it has considered undertaking works in those hours that minimise potential disturbance.
- Construction plant will be operated and maintained appropriately, having regard to the manufacturer's written recommendations, or using other appropriate operation and maintenance programmes which reduce noise and vibration emissions. All vehicles and plant will be switched off when not in use.
- Where practicable, erection of noise barriers as early as practicable to provide additional protection against construction/maintenance noise.
- The positioning of construction plant and activities to minimise noise at sensitive locations.
- The use of mufflers on pneumatic tools.
- The use of non-reciprocating constructional plant.
- The use, where necessary, of effective sound reducing enclosures.

## Annex B. Figures – Including Monitoring Locations

Sample Measurement Locations – baseline survey 1 & 2 March 2021

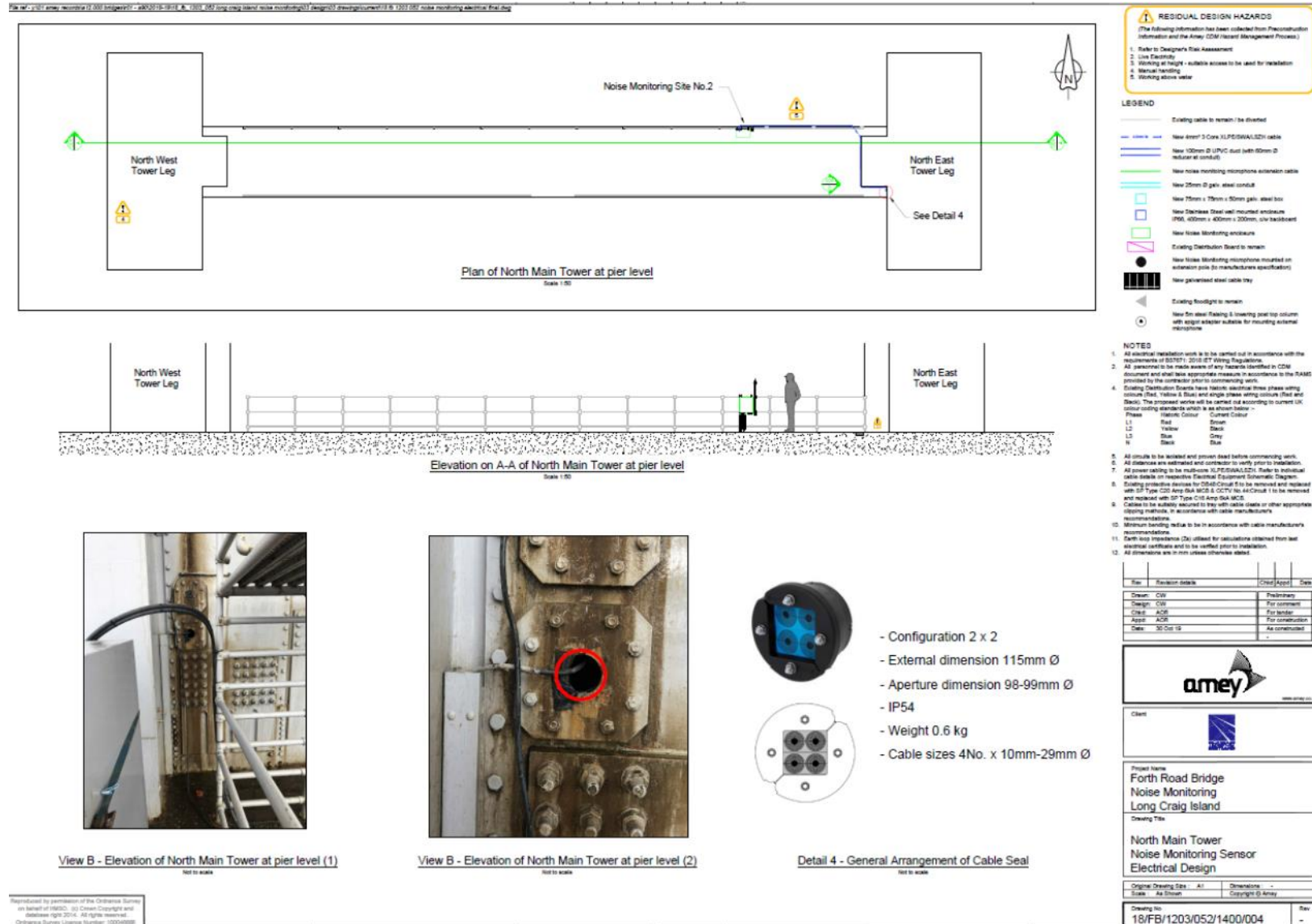


Permanent Measurement Location 1



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Permanent Measurement Location 2



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