



Forth Replacement Crossing

Employer's Delivery Team Construction Noise Monitoring Report

December 2011



An agency of  The Scottish Government



FORTH REPLACEMENT CROSSING

**EMPLOYER'S DELIVERY TEAM
CONSTRUCTION NOISE MONITORING REPORT**

Revision Status

Revision	Date	Description	Author	Approved for Use
0	Jan 2011	Original	DGC	AMM

FORTH REPLACEMENT CROSSING

**EMPLOYER'S DELIVERY TEAM
CONSTRUCTION NOISE MONITORING REPORT**

CONTENTS

1. INTRODUCTION..... 1

2. M9 JUNCTION 1A CONTRACT NOISE MONITORING..... 2

3. FIFE ITS CONTRACT NOISE MONITORING 5

**APPENDIX A - M9 J1A CONTRACT – CONSTRUCTION NOISE MONITORING
REPORTS**

**APPENDIX B - FIFE ITS CONTRACT – CONSTRUCTION NOISE MONITORING
REPORTS**

1. INTRODUCTION

- 1.1 This report sets out the results of the construction noise monitoring undertaken on the Forth Replacement Crossing project.
- 1.2 The noise monitoring periods covered in this report are as follows:
- M9 Junction 1a: September 2011 to October 2011 – refer to Section 2 of this report.
 - Fife ITS: October 2011 to December 2011 – refer to Section 3 of this report.
- 1.3 Noise monitoring from the Principal Contract will form a separate report once this information is available. The Noise Liaison Group noted at its meeting in December 2011 that monitoring had been undertaken on the Principal Contract and that the results were being compiled by the contractor for issue to the Noise Liaison Group for review.

2. M9 JUNCTION 1A CONTRACT NOISE MONITORING

NOISE MONITORING LOCATIONS

- 2.1 Continuous noise monitoring was carried out at the fixed monitor locations in Table 2.1 below. The main construction activities carried out adjacent to the monitor locations are also listed.

Contractor's Report Ref.	Monitoring Location	Main Construction Activities
CNV 2	93 King Edwards Way	Breaking and excavation of rock, fencing works and earthworks during October.
CNV 7	15-17 Buie Rigg	Breaking and excavation of rock, construction of haul route and tree felling.
CNV 16	10 Kirklands Park Grove	Site access works and construction of haul route around site compound area.

Table 2.1 M9 Junction 1a Contract – Long Term Monitoring Locations

NOISE MONITORING RESULTS

- 2.2 Monitoring results from the M9 Junction 1a contract are contained in Appendix A of this report. The results are presented in charts using the template contained in the Construction Noise Monitoring Information Note which is available on the project website at http://www.transportscotland.gov.uk/files/documents/projects/forth-replacement/FRC_Construction_Noise_Monitoring_Information_Note_2.pdf.
- 2.3 The results of the construction noise monitoring provided in the M9 Junction 1a reports indicate that all construction activities were carried out in accordance with the thresholds set out in the project Code of Construction Practice.
- 2.4 Some exceedences of the maximum noise level thresholds occurred, although the exceedences are not considered to be due to the construction works being carried out. No formal exceedence reports are provided in this report for the exceedences in September 2011. The Noise Liaison Group reviewed the exceedences at the meeting of the Group in December 2011 and is content that based on the nature of the construction works being carried out at the time that the exceedences were not likely to be attributable to construction activities. Formal exceedence reports were

prepared by the contractor for October 2011 and the investigations identified that the exceedences were not due to construction related factors. Summary information regarding the exceedences of the maximum noise level thresholds are provided In Table 2.2 below. Copies of the exceedence reports are contained in Appendix A to this report.

Contractor's Report Ref.	Monitoring Location	Exceedence
CNV02 (Sep)	93 King Edwards Way	Maximum noise level threshold exceeded on 20 occasions during September 2011. The exceedences were due to non-construction related factors and were likely to be as a result of weather, traffic, aircraft and other noise sources.
CNV 2 (Oct)	93 King Edwards Way	Maximum noise level threshold exceeded on 21 occasions during October 2011. The exceedences were due to non-construction related factors and were attributed to high winds, traffic noise and other noise sources.
CNV07 (Sep)	15-17 Buie Rigg	Maximum noise level threshold exceeded on 12/09/11. The exceedence was due to non-construction related factors. High winds were recorded on the on the day in question and this is likely to be the reason for the exceedence.
CNV07 (Oct)	15-17 Buie Rigg	Maximum noise level threshold exceeded on 03/10/11 and 18/10/11. The exceedences were due to non-construction related factors and were attributed to heavy rainfall.
CNV16 (Sep)	10 Kirklands Park Grove	Maximum noise level threshold exceeded on 6/09/11, 15/09/11, 17/09/11 and 22/09/11. The

Contractor's Report Ref.	Monitoring Location	Exceedence
		exceedences were due to non-construction related factors.
CNV 16 (Oct)	10 Kirklands Park Grove	Maximum noise level threshold was exceeded on 06/10/11. The exceedence was due to non-construction related factors and was attributed to heavy rainfall.

Table 2.2 M9 Junction 1a Contract – Summary of Noise Threshold Exceedences

3. FIFE ITS CONTRACT NOISE MONITORING

NOISE MONITORING LOCATIONS

- 3.1 Noise monitoring was carried out at the locations in Table 3.1 below. Due to the linear nature of the site and timing of different construction activities, continuous monitoring was not appropriate and therefore targeted short-term monitoring of specific activities was carried out.

Contractor's Report Ref.	Location	Associated Works
CP/0003	West Back	Site clearance
CP/0004	Adjacent to borehole drilling rig	Ground investigation works
BMR/0005	Properties off Masterton Road	Grouting to consolidate mineworkings
CP/0006	Old Duloch	Installation of drainage and ducting
CR/0007	Craig Street	Earthworks

Table 3.1 Fife ITS Contract – Short Term Monitoring Locations

NOISE MONITORING RESULTS

- 3.2 Monitoring results from the Fife ITS contract are contained in Appendix B of this report. The results of the monitoring of earlier construction activities are presented as individual reports developed by the contractor. Monitoring results of the later construction activities are presented in charts using the template contained in the Construction Noise Monitoring Information Note which is available on the project website at [http://www.transportscotland.gov.uk/files/documents/projects/forth-replacement/FRC Construction Noise Monitoring Information Note 2 .pdf](http://www.transportscotland.gov.uk/files/documents/projects/forth-replacement/FRC_Construction_Noise_Monitoring_Information_Note_2_.pdf).
- 3.3 The results of the construction noise monitoring provided in the Fife ITS reports indicate that all construction activities were carried out in accordance with the thresholds set out in the project Code of Construction Practice.
- 3.4 Some exceedences of the maximum noise level thresholds occurred although the exceedences are not considered to be due to the construction works being carried out. Reviews of the exceedences were undertaken and are described in the

monitoring reports in Appendix B. Summary information regarding the exceedences of the maximum noise level thresholds are provided In Table 3.2 below.

Contractor's Report Ref.	Monitoring Location	Exceedence
CR/0007	Craig Street	Maximum noise level threshold was exceeded on 08/12/11. The exceedence was due to non-construction related factors and was attributed to high winds.

Table 3.2 Fife ITS Contract – Summary of Noise Threshold Exceedences

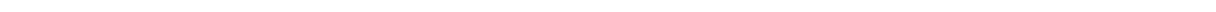
3.5 The Contractor has identified that at times the noise levels exceeded the assessments made in accordance with paragraph 5.2.5 of the Code of Construction although this did not result in any exceedences of the thresholds set out in the Code of Construction Practice. This is summarised in Table 3.3 below.

Contractor's Report Ref.	Monitoring Location	Exceedence
CP/0003	West Back	Contractor's forecast of plant maximum noise levels exceeded by 5dB although resulting maximum noise levels were approximately 15dB lower than the relevant Code of Construction Practice thresholds. Contractor advised to update its database of plant noise levels.
CP/0006	Old Duloch	Contractor's forecast of plant maximum noise levels exceeded by 4dB although resulting maximum noise levels were approximately 5dB lower than the relevant Code of Construction Practice thresholds. Contractor advised to update its database of plant noise levels. Contractor stated that monitored noise levels were greater than those predicted

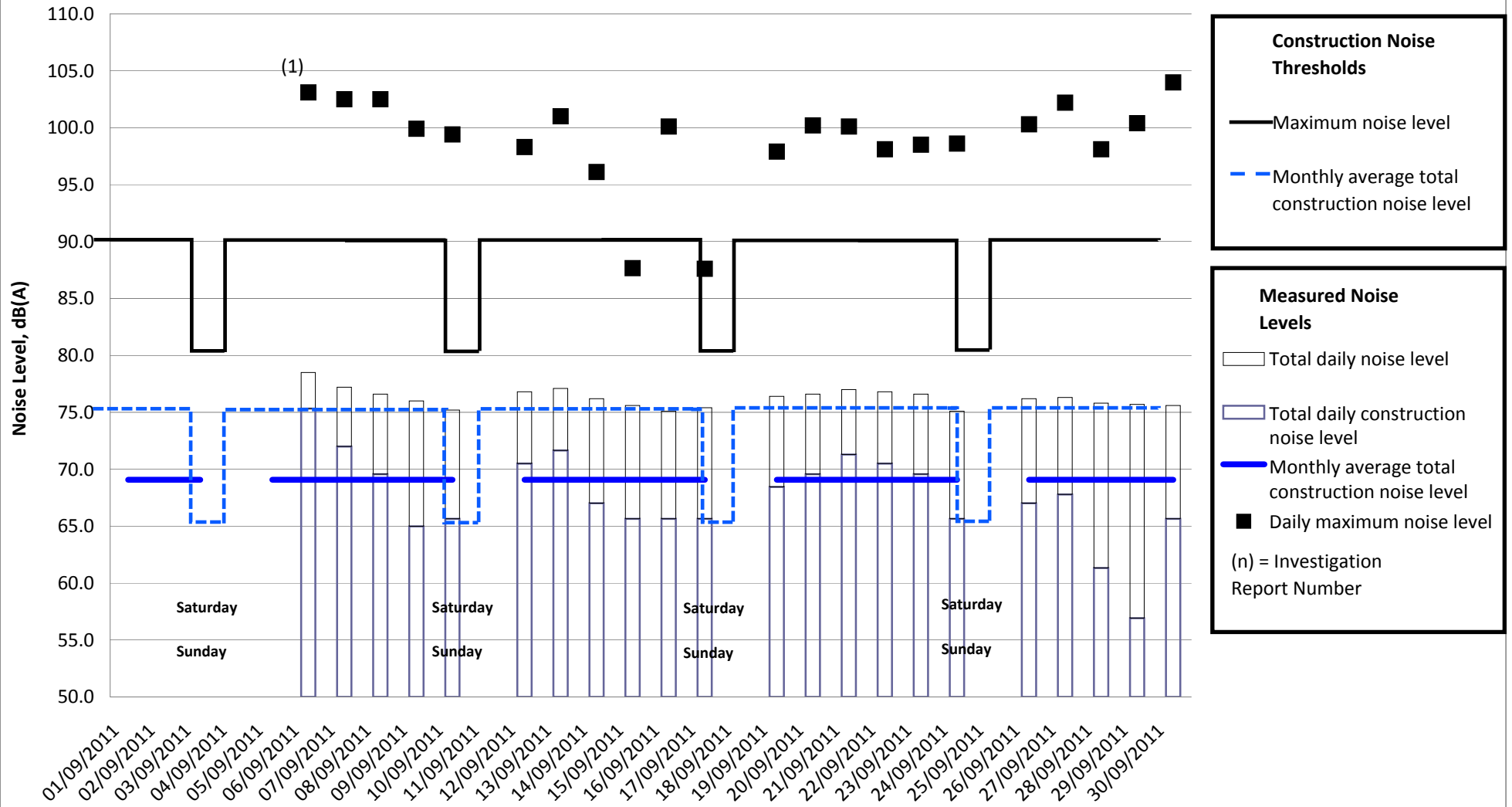
Contractor's Report Ref.	Monitoring Location	Exceedence
		<p>in its assessments. However, as required by the Code of Construction Practice the assessments considered construction noise rather than total noise. The total noise level recorded was below the Code of Construction Practice construction noise level threshold and was in line with the baseline noise level. This indicates that the noise environment was dominated by traffic noise from the M90 and that construction activities did not contribute significantly to any increased noise levels compared to the baseline.</p>

Table 3.3 Fife ITS Contract – Summary of Exceedences of Contractor Noise Assessments

**APPENDIX A - M9 J1A CONTRACT – CONSTRUCTION NOISE
MONITORING REPORTS**

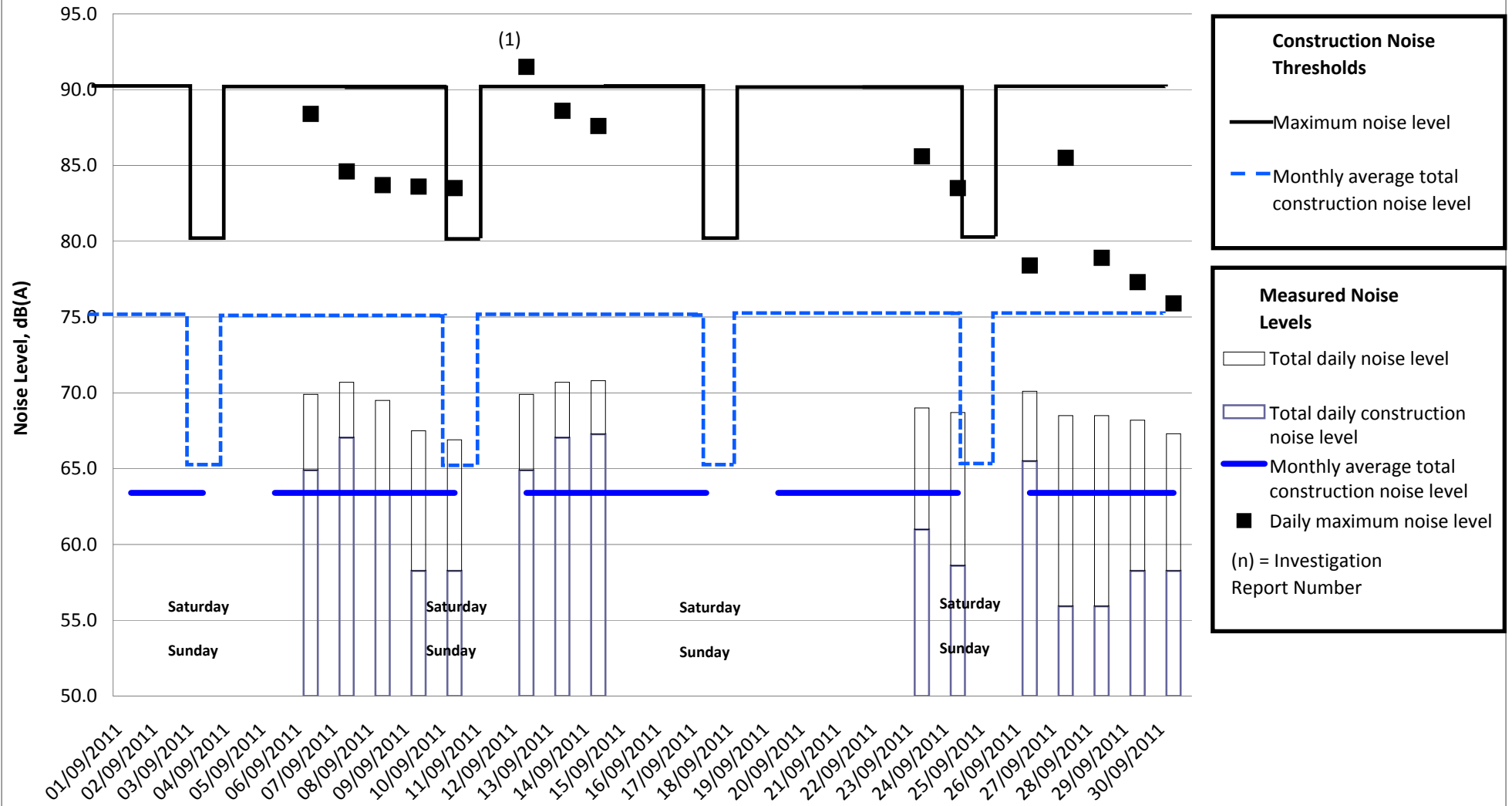


Measured daytime noise levels, 93/95 King Edwards Way (CNV02) 6th September 2011 to 30th September 2011



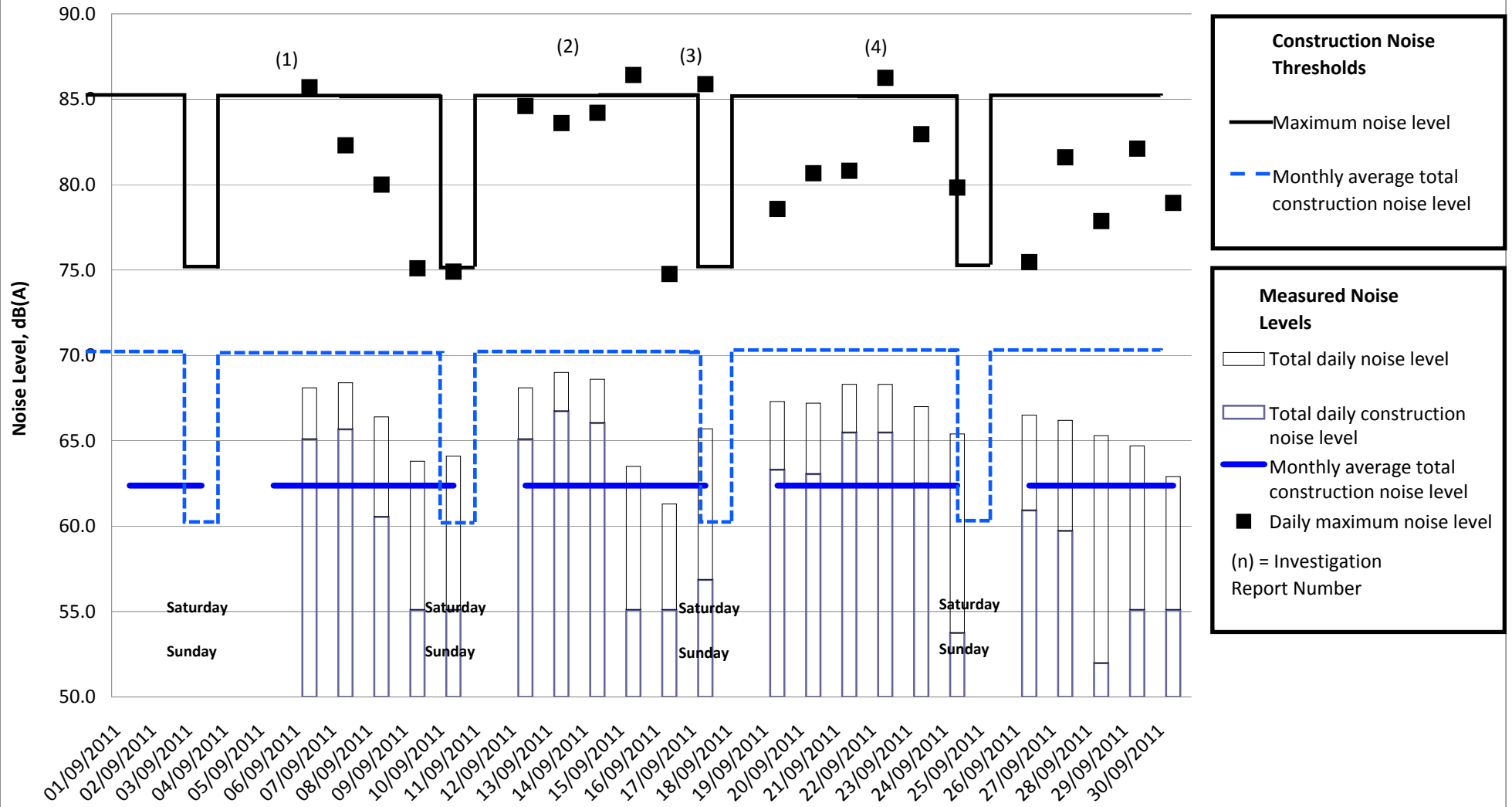
Sunday data have not been included as no construction works have been conducted during these hours.

Measured daytime noise levels, 15-17 Buie Rigg (CNV07) 6th September 2011 to 30th September 2011




Sunday data have not been included as no construction works have been conducted during these hours.

Measured daytime noise levels, 8 Kirklands Park Grove (CNV16) 6th September 2011 to 30th September 2011



Sunday data have not been included as no construction works have been conducted during these hours.

 QUALITY MANAGEMENT SYSTEM	Project Title: FORTH REPLACEMENT CROSSING M9 Junction 1A		Project Number: 208
	Contractor: SRB	Date: 30-11-11	NER. 04 Rev 1
	NOISE EXCEEDENCE REPORT		
Summary of Finding(s): <u>October 2011 – CNV02</u> Exceedences Nos: 21-41 (Maximum Noise Levels: Ranging from 93dB (A) to 105dB (A)) See CNV 2 – Construction Noise Breakdown – Oct 2011 Analysis: From the 1st to 17th October There were no works carried out within 300m of this receptor From the 18th to 30th October An analysis was carried out using the following data: <ul style="list-style-type: none"> • Recorded Noise Logs and Noise Data • Noise type • Site Diaries / Weather Data • Inspections by Senior Engineer (Roland Tarrant) This analysis has determined that the noise exceedences at Receptor CNV 02 are regular and occur throughout day, evening and night, are of a duration of less than 1.1seconds and are therefore unlikely to be construction related. Corrective Action Required: No corrective action required, maintain monitoring regime SignatureRoland Tarrant..... Date30-11-11.....			
NER Closed Works have been inspected and completed as described above. SignatureSeamus O'Brien.....Date30-11-11... Project Manager / Assist Project Manager			



Project Title:

**FORTH REPLACEMENT
CROSSING**

M9 Junction 1A

Project Number:

208

Recorded Noise Types and Noise Data

The monthly average total construction noise level was within threshold limits.

There were a large number of exceedences of the Maximum noise level threshold limits. These are explained below.

Noise Type:

An analysis of the noise recordings taken during the exceedence periods indicate that the noise is associated with environmental factors unrelated to the construction works. These include:

- Wind Speed >gusts of >10m/s and/or periods of rainfall
- Existing traffic noise (e.g. loose lorry loads flapping in the wind)

For all of these exceedences, the peak noise lasted for less than 1.1 seconds. This, in conjunction with an analysis of the site diary, indicates that the noise was not associated with any of the SRB construction activities taking place.

Additionally, it is suspected that the presence of dogs as pets in the vicinity of the Receptor means that the maximum levels are regularly exceeded. This is to be monitored going forward by SRB.

The nearest activity that took place over the month was in Area 6 (East of the existing M9 Structure- See Map). This included the breaking and excavating of rock. Should this activity have been the cause of the maximum noise level exceedence then it is likely that the activity would have affected the Laeq also, but it didn't.

Site Diaries / Weather Data:

The nearest works to the Sensitive Receptor carried out during the month were (See drawing attached):

Week 3 rd October- 8 th October Saturday works in compound only	Breaking and Excavation of Rock in area east of existing M9 Overbridge (Area 6 – No Line of Sight to CNV 2) Site Compound Works (Area 9)
Week 10 th October- 15 th October Saturday works tree felling Area 9	Breaking and Excavation of Rock in area east of existing M9 Overbridge (Area 6 – No Line of Sight to CNV 2) Tree felling (Area 4)
Week 17 th October- 22 nd October Saturday Works Tree felling Area 6+5	Breaking and Excavation of Rock in area east of existing M9 Overbridge (Area 6 – No Line of Sight to CNV 2) Hauling through Area 5 using ADTs and Excavators Erection of temporary fence in Area 2 (2 days) Embankment widening on South side of existing M9 (Area 4 - No line of sight to CNV 2)
Week 24 th October- 29 th October	Breaking and Excavation of Rock in area east of existing M9 Overbridge (Area 6 – No Line of Sight to CNV 2) Hauling through Area 5 using ADTs and Excavators Trial Hole for service location on B800 Embankment widening on South side of existing M9 (No line of sight to CNV 2)

Sunday Works

There were no Sunday Works during this period.

Night Works:

There were no night-works carried out during this period

Inspections by Senior Engineer:

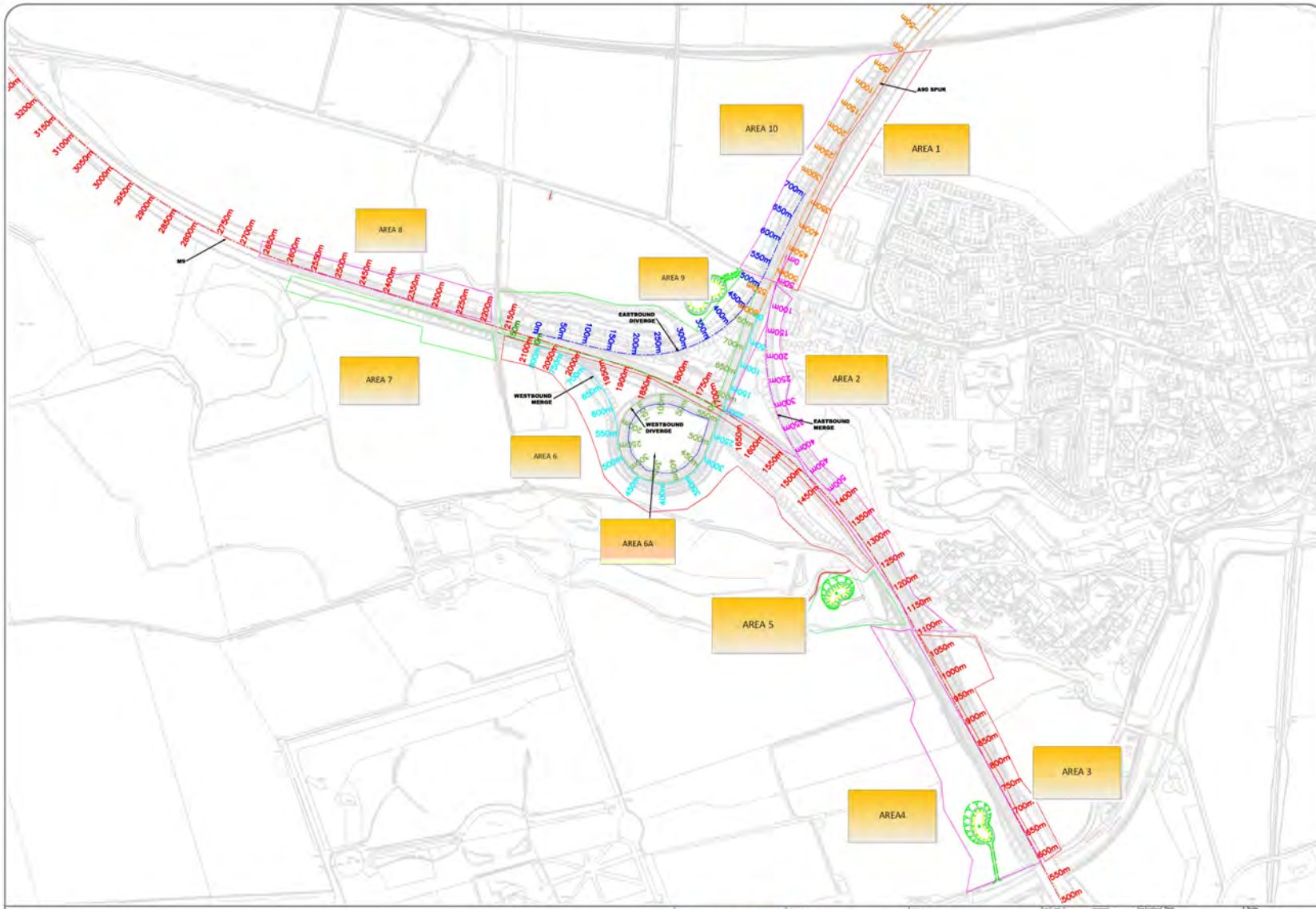
When an exceedence occurred, the process outlined in the Noise and Vibration Management Plan was implemented. A site inspection confirmed that SRB construction works were either not going on in this area or were not contributing to the noise readings.

On the 11th of October, SRB undertook a letter drop to the dwellings in the immediate vicinity of the Project. These included properties around Gateside and King Edwards Way (where the receptor is located). This gave advanced warning of construction works being undertaken and a freephone number to ring in the event of complaint or request for more information.

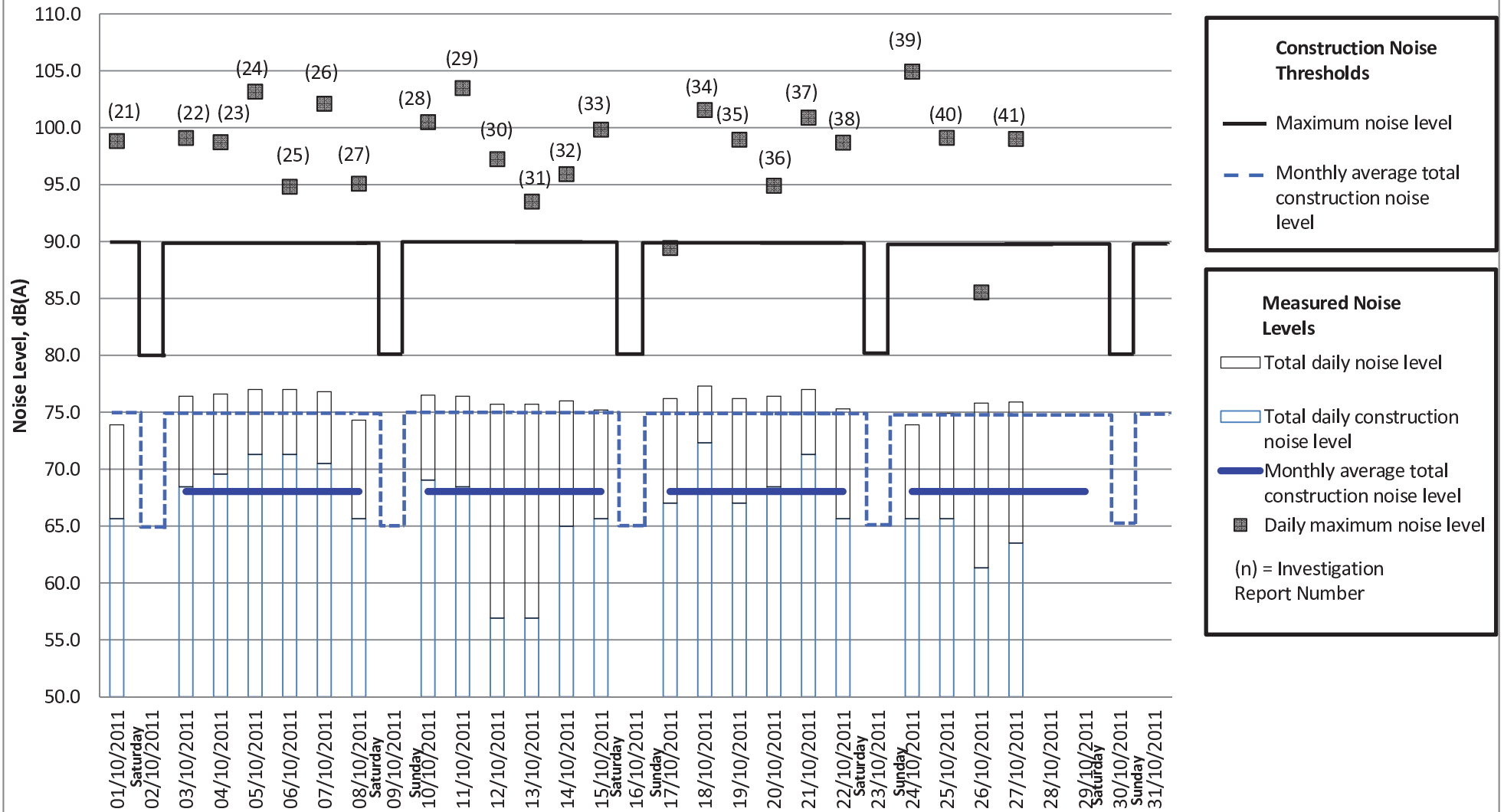
Summary:

Exceedences are likely not to be related to M9J1a construction activities.


In addition, there were no noise related complaints during the month of October



Measured daytime noise levels, 93/95 King Edwards Way (CNV02) 1st October 2011 to 31st October 2011



Sunday data have not been included as no construction works have been conducted during these hours.

 <p>QUALITY MANAGEMENT SYSTEM</p>	Project Title: FORTH REPLACEMENT CROSSING M9 Junction 1A		Project Number: 208
	Contractor: SRB	Date: 30-11-11	NER. 05 Rev 1
	NOISE EXCEEDENCE REPORT		
<p>Summary of Finding(s): <u>October 2011 – CNV07</u></p> <p>Exceedences 43 and 44 (Maximum Noise Levels: Both were at 90-91 db (A)) See CNV 7 – Construction Noise Breakdown – Oct 2011</p> <p>Analysis:</p> <p>Exceedence 43 – Monday 3rd October</p> <p>Works focused on the compound setup and Area 6 at the Swine Burn.</p> <p>There is no line of sight from these works to the receptor at CNV 07 and the mass of the M9 Spur Embankment means that no noise would penetrate through.</p> <p>Exceedence 44 – Wednesday 18th October</p> <p>Works focused on the compound setup, Area 6 and Area 9.</p> <p>An analysis was carried out using the following data:</p> <ul style="list-style-type: none"> • Recorded Noise Logs and Noise Data • Noise type • Site Diaries / Weather Data • Inspections by Senior Engineer (Roland Tarrant) <p>There is no line of sight from these works to the receptor at CNV 07 and the mass of the M9 Spur Embankment means that no noise would penetrate through.</p> <p>Corrective Action Required:</p> <p>No corrective action required, maintain monitoring regime</p> <p>SignatureRoland Tarrant..... Date30-11-11.....</p>			
<p>NER Closed</p> <p>Works have been inspected and completed as described above.</p> <p>SignatureSeamus O'Brien.....Date30-11-11... Project Manager / Assist Project Manager</p>			



Project Title:

**FORTH REPLACEMENT
CROSSING
M9 Junction 1A**

Project Number:

208

Recorded Noise Types and Noise Data

The monthly average total construction noise level was within threshold limits.

There were two exceedences of the Maximum noise level threshold limits. These are explained below.

Noise Type:

An analysis of the noise data taken during the exceedence periods indicate that the noise is associated with environmental factors unrelated to the construction works i.e. rainfall.

Site Diaries / Weather Data:

The nearest works to the Sensitive Receptor carried out during the exceedence periods were (See drawing attached):

<p>3rd October - Monday</p>	<p>Breaking and Excavation of Rock in area east of existing M9 Overbridge (Area 6 – No Line of Sight to CNV 7)</p> <p>Site Compound Works (Area 9)</p>
<p>18th October- Tuesday</p>	<p>Breaking and Excavation of Rock in area east of existing M9 Overbridge (Area 6 – No Line of Sight to CNV 7)</p> <p>Construction of haul route around compound area (Area 9)</p> <p>Tree felling – Area 9 and 10</p>

These activities would not have contributed to the noise disturbance at the sensitive receptor location.

Weather Note:

There was very heavy rainfall in the morning and this is expected to have contributed to the maximum noise level recorded at the Sensitive Receptor CNV 07.

Inspections by Senior Engineer:

When an exceedence occurred, the process outlined in the Noise and Vibration Management Plan was implemented. A site inspection confirmed that SRB construction works were either not going on in this area or were not contributing to the noise readings.

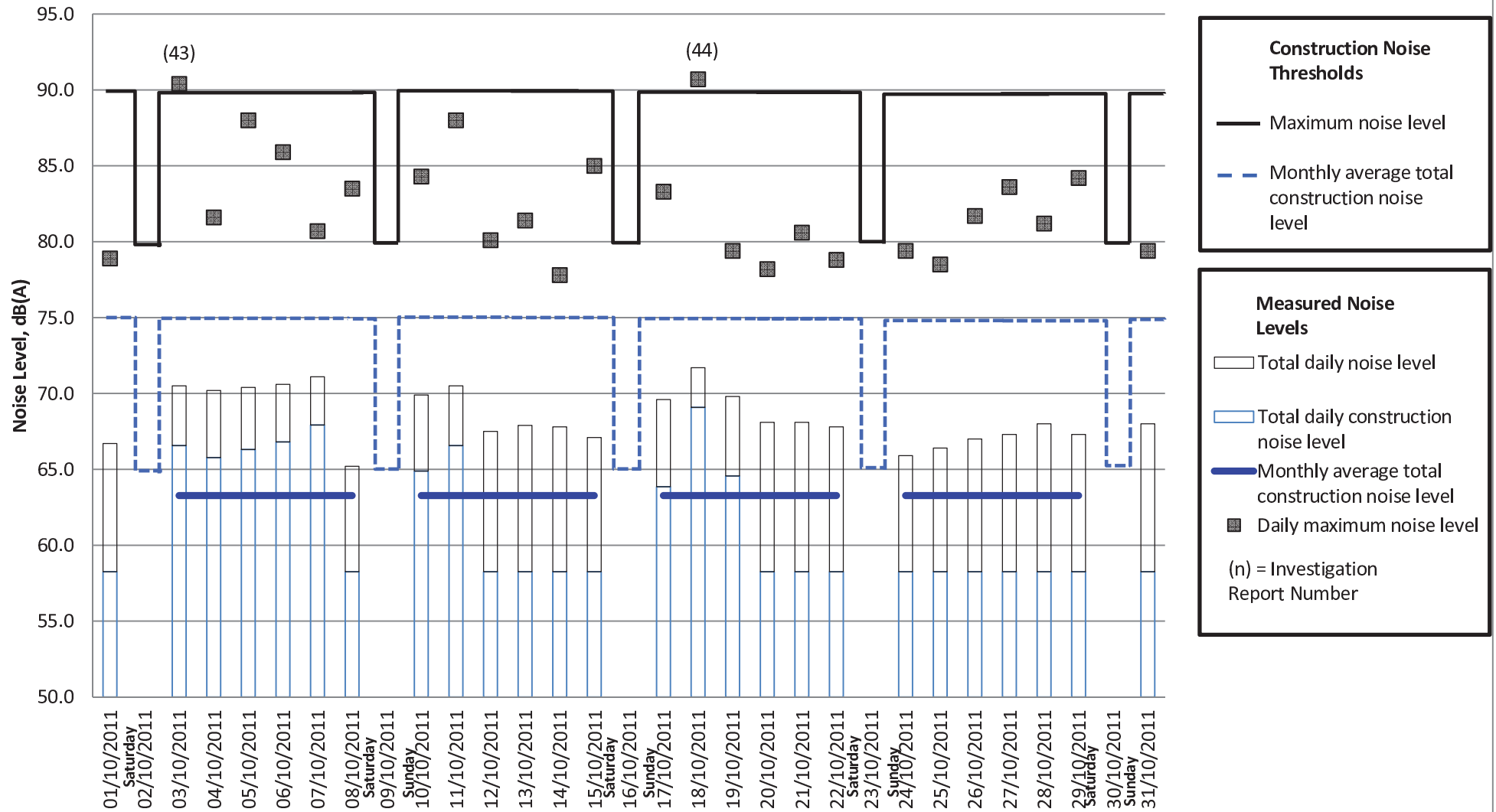
On the 11th of October, SRB undertook a letter drop to the dwellings in the immediate vicinity of the Project. These included properties around Buie Rigg (where the receptor is located). This gave advanced warning of construction works being undertaken and a freephone number to ring in the event of complaint or request for more information.

Summary:


It is likely that exceedences are not related to M9J1a construction activities and are more likely due to weather conditions prevalent at the time.

In addition, there were no noise related complaints during the month of October

Measured daytime noise levels, 15-17 Buie Rigg (CNV07) 1st October 2011 to 31st October 2011



Sunday data have not been included as no construction works have been conducted during these hours.

 <p>QUALITY MANAGEMENT SYSTEM</p>	Project Title: FORTH REPLACEMENT CROSSING M9 Junction 1A		Project Number: 208
	Contractor: SRB	Date: 30-11-11	NER. 06 Rev 1
	NOISE EXCEEDENCE REPORT		
Summary of Finding(s): <u>October 2011 – CNV16</u> Exceedence No: 50 (Maximum Noise Level: 90dB (A)) See CNV 16 – Construction Noise Breakdown – Oct 2011 Analysis: Exceedence No: 50 – Thursday 6th October Works focused on the compound setup (Area 9) and Area 6 at the Swine Burn. An analysis was carried out using the following data: <ul style="list-style-type: none"> • Recorded Noise Logs and Noise Data • Noise type • Site Diaries / Weather Data • Inspections by Senior Engineer (Roland Tarrant) There is no line of sight from these works to the receptor at CNV 16 and the mass of the M9 Spur Embankment means that no noise would penetrate through. In addition, the very heavy showers and moderate winds recorded on the day may be the main factors associated with the exceedence. Corrective Action Required: No corrective action required, maintain monitoring regime SignatureRoland Tarrant..... Date30-11-11.....			
NER Closed Works have been inspected and completed as described above. SignatureSeamus O'Brien.....Date30-11-11... Project Manager / Assist Project Manager			



Project Title:

**FORTH REPLACEMENT
CROSSING
M9 Junction 1A**

Project Number:

208

Recorded Noise Types and Noise Data

The monthly average total construction noise level was within threshold limits.

There was one exceedence of the Maximum noise level threshold limits. These are explained below.

Noise Type:

An analysis of the noise data taken during the exceedence periods indicate that the noise is likely to be associated with environmental factors unrelated to the construction works. The Laeq for the period of the maximum noise level exceedence was below the Daytime Assessment Level for the Receptor location.

Site Diaries / Weather Data:

The nearest works to the Sensitive Receptor carried out during the exceedence periods were (See drawing attached):

06th October- Thursday	<p>Site access works to area of rock cutting east of existing M9 Overbridge (Area 6 – No Line of Sight to CNV 16)</p> <p>Construction of haul route around compound area (Area 9)</p>
------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

These activities would not have contributed to the noise disturbance at the sensitive receptor location.

Weather Note:

There was very heavy showers in the morning and this is expected to have contributed to the maximum noise level recorded at the Sensitive Receptor CNV 16.

Inspections by Senior Engineer:

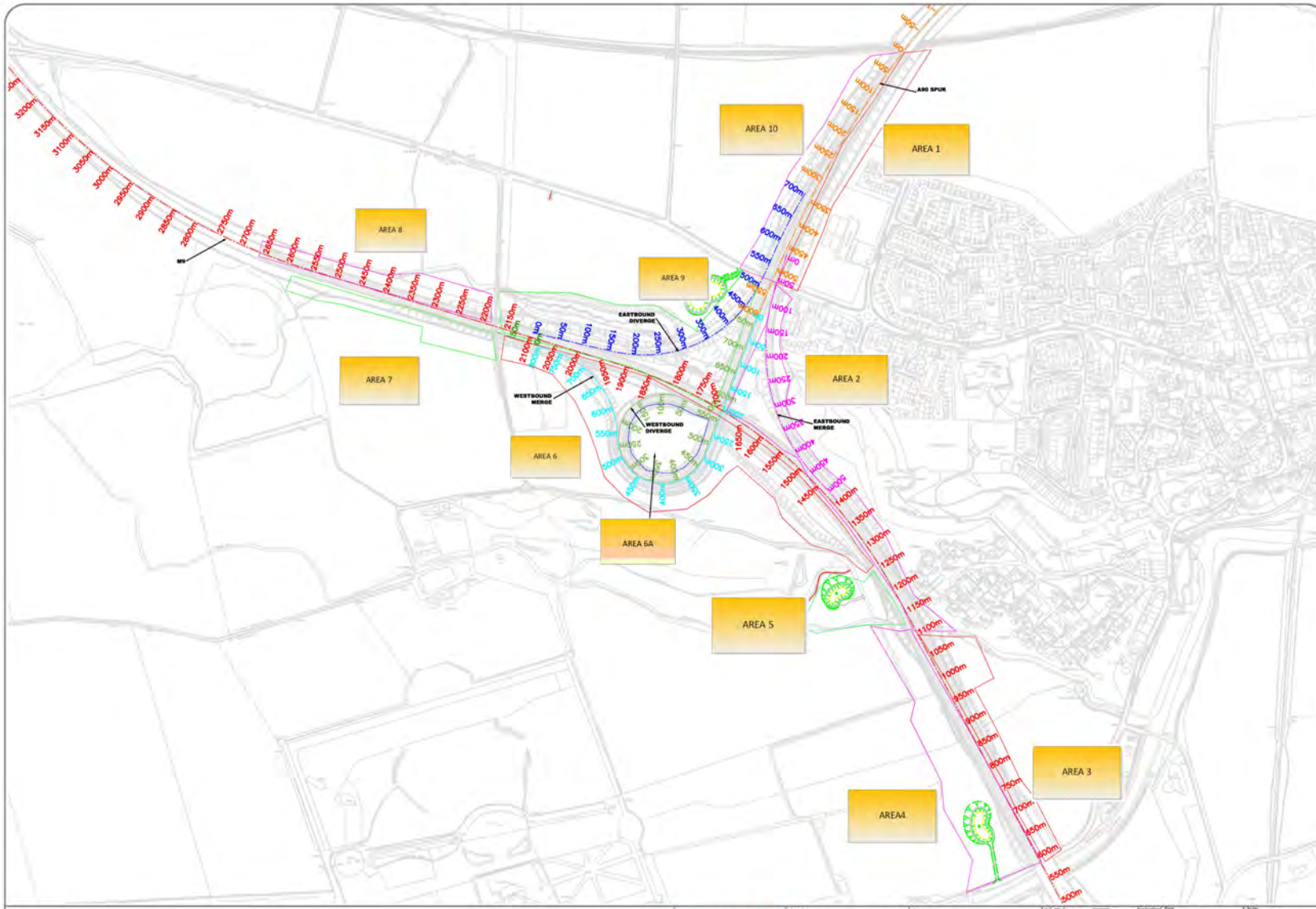
When an exceedence occurred, the process outlined in the Noise and Vibration Management Plan was implemented. A site inspection confirmed that SRB construction works were either not going on in this area or were not contributing to the noise readings.

On the 11th of October, SRB undertook a letter drop to the dwellings in the immediate vicinity of the Project. These included properties around Kirklands Park (where the receptor is located). This gave advanced warning of construction works being undertaken and a freephone number to ring in the event of complaint or request for more information.

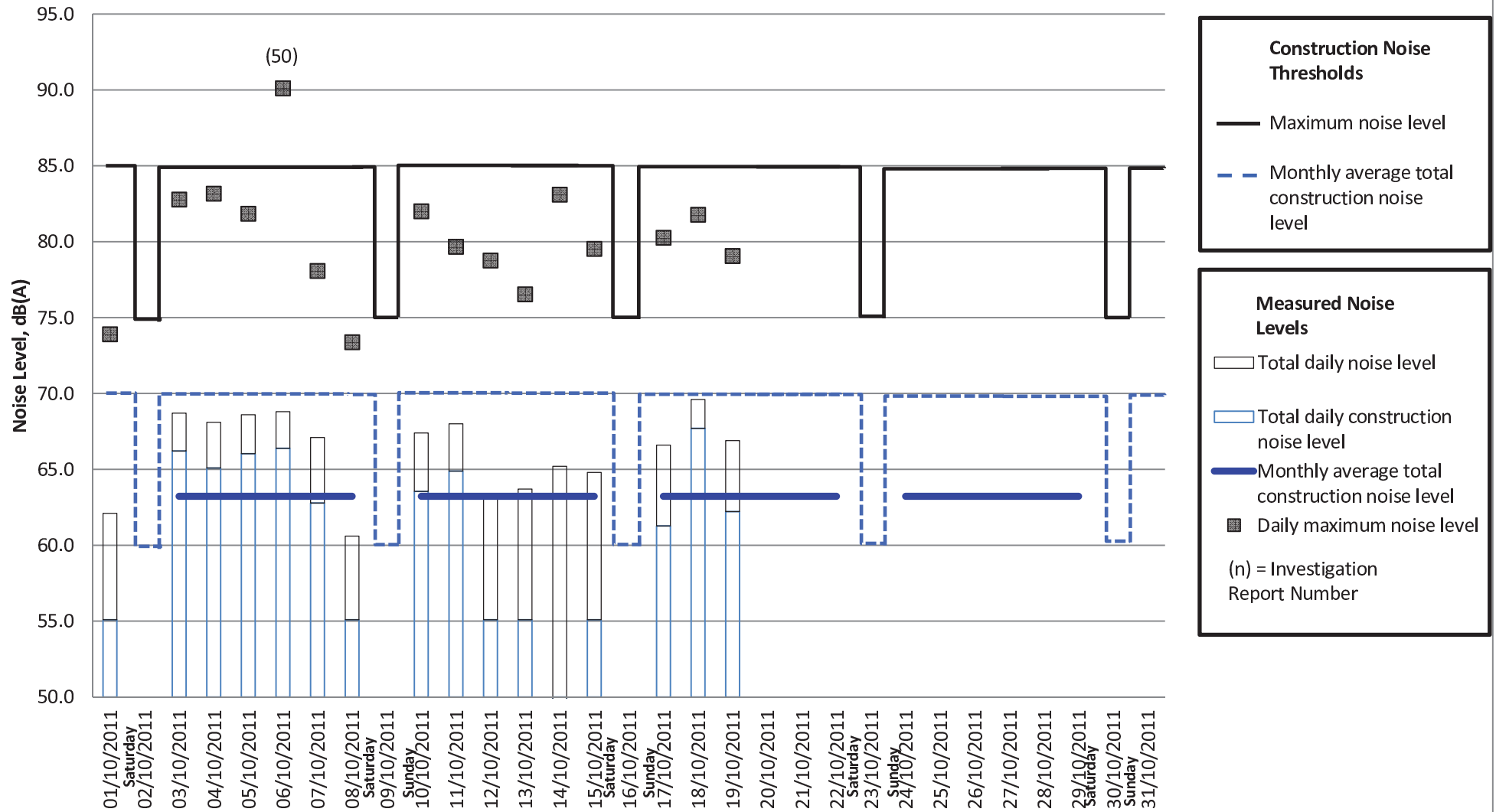
Summary:

It is likely that exceedences are not related to M9J1a construction activities and are more likely due to weather conditions prevalent at the time.

In addition, there were no noise related complaints during the month of October



Measured daytime noise levels, 8 Kirklands Park Grove (CNV16) 1st October 2011 to 31st October 2011



Sunday data have not been included as no construction works have been conducted during these hours.

**APPENDIX B - FIFE ITS CONTRACT – CONSTRUCTION NOISE
MONITORING REPORTS**

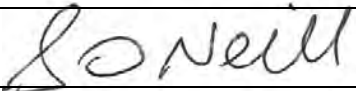
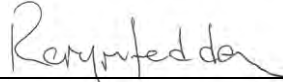



 GRAHAM


 CONSTRUCTION

FORTH REPLACEMENT CROSSING – FIFE ITS

FRC/FITS/JG/PCNV/CP/0003 Rev 1

SITE CLEARANCE COMPLIANCE REPORT.

Completed by:	Sean O'Neill	Reviewed by:	Rory McFadden		
Signed:		Signed:			
Position:	Site Engineer	Position:	Sub Agent		
Date:	30/11/2011	Date:	30/11/2011		
Comments:		 			
Revision Record					
<i>Revision</i>	<i>Date</i>	<i>By</i>	<i>Summary of Changes</i>	<i>Checked</i>	<i>Approved</i>
1	11/01/12	SON	Changes following EDT comments.	RMcF	RMcF



Fife ITS Compliance Monitoring Report

Site Clearance Gantry Site 19F (FRC-FITS-JG-PCNV-007)

January 2012

Waterman Energy, Environment & Design Limited

2ND Floor , South Central, 11 Peter Street, Manchester, M2 5QR , United Kingdom
www.watermangroup.com



Client Name: Graham Construction
Document Reference: EED12317-100-R-3-1-2
Project Number: EED12317

Quality Assurance – Approval Status

This document has been prepared and checked in accordance with Waterman Group's IMS (BS EN ISO 9001: 2008 and BS EN ISO 14001: 2004)

Issue	Date	Prepared by	Checked by	Approved by
First	January 2012	Mark Maclagan Principal Consultant	Joanna Bagley Associate Director	Joanna Bagley Associate Director

Comments

Comments

Content

1. Introduction	1
1.1 The Brief	1
1.2 Site Description and Description of Works	1
2. Baseline Conditions and Noise Assessment Criteria	2
3. Noise Monitoring Results	3
3.1 Specific Noise Measurements	3
3.2 Compliance Monitoring	5
4. Summary	7

Tables

Table 1	Noise Sensitive Receptors.....	1
Table 2	Noise Assessment Category Levels.....	2
Table 3:	Noise Monitoring Equipment.....	4
Table 4	Noise Assessment Category Levels.....	4

1. Introduction

1.1 The Brief

Waterman Energy, Environment & Design Limited (hereafter „Waterman“) was instructed by John Graham (Dromore) Limited to undertake an assessment of noise and vibration in support of the on-going Fife Intelligent Transport Scheme (ITS) in line with the Forth Replacement Crossing Code for Construction Practice (the CoCP) and Appendix 1/9 of the Employers Requirements (hereafter „the Employers Requirements“).

A Plan for the Control of Noise and Vibration has been submitted and approved for works to be undertaken at Gantry Site 19F which includes for potential noise effects associated with the initial site clearance including the removal and subsequent chipping of trees and vegetation.

All site clearance works would take place during the daytime period and would generate very little in the way of noise. Nonetheless in order to ensure compliance with Best Practicable Means (BPM) the approved PCNV, CoCP and the Employers Requirements noise monitoring has been undertaken at the closest location to site clearance works at Gantry Site 19F over a representative daytime period. Furthermore, specific noise measurements have been undertaken in order to validate the source noise levels used within the PCNV assessment.

1.2 Site Description and Description of Works

Gantry Site 19F is located in the northern section of the works area. The closest sensitive receptor to works at Gantry Site 19F is described in Table 1 below.

Table 1 Noise Sensitive Receptors

Noise Sensitive Receptor	Name	Description	Approximate Grid Reference	Distance from Works
NSR A	West Bank on Netherheath Road located off Kingseat Road	Two story residential dwelling	312726,689156	170m

In order to clear the site once traffic management has been installed the trees to be removed will be marked with paint and agreed with the client before their removal. They will be removed by a specialist tree clearance subcontractor with experienced and trained operatives. This will involve the use of chainsaws and wood chippers (no chippings are to be removed off site), the engines of which will only be running when being used. Topsoil will be stripped and stored close to its original location for reuse on site reducing lorry movements. A mini excavator will be used if any tree stumps are required to be removed.

2. Baseline Conditions and Noise Assessment Criteria

Baseline noise monitoring has been undertaken at a location representative of the closest existing sensitive receptor to Gantry Site 19F (see Table 1). The monitoring data is provided in full within the separately submitted baseline noise report (FRC-FITS-JG-NVMP-BMR-0001) and is summarised below. Following completion of the baseline monitoring exercise noise assessment category levels were set in compliance with the CoCP and the Employers Requirements. The assessment category levels in terms of $L_{Aeq,T}$ and L_{Amax} are presented as Table 2.

Table 2 Noise Assessment Category Levels

Period	Monitored Baseline		Assessment Category	Threshold Level
	$L_{Aeq, 1\text{ hour}}$	$L_{Amax,F}$	L_{Aeq}	L_{Amax}
Daytime	64	79	65	80

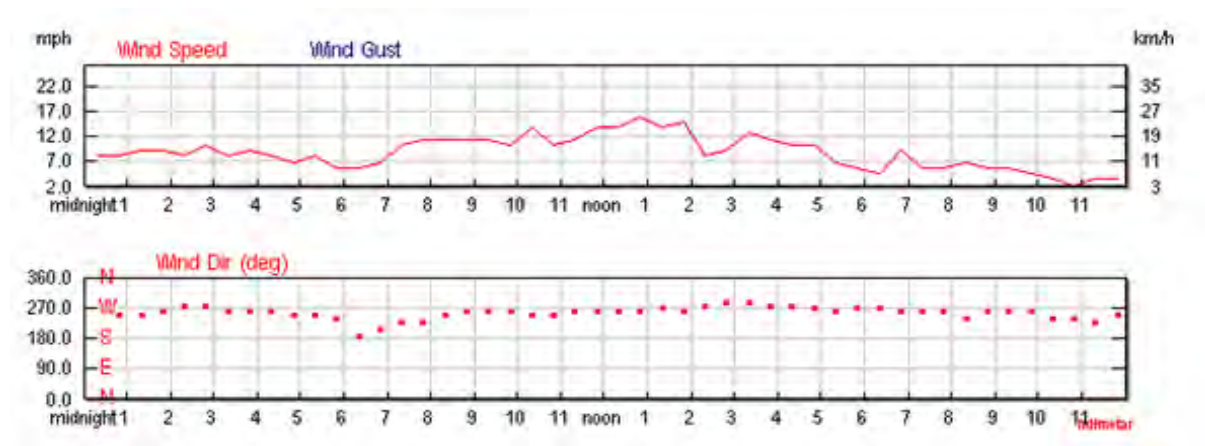
3. Noise Monitoring Results

3.1 Specific Noise Measurements

For the purposes of the PCNV, source sound power levels were obtained from the guidance provided in BS5228-1:2009 and Waterman’s in house noise database. In order to ensure that the source noise data used within the submitted PCNVs was representative of on-site conditions specific noise monitoring was undertaken at a location representative of each new work activity. Attended monitoring was undertaken at a location as close to the plant in question as safely possible by Gavin Spowage of Waterman, Energy Environment & Design. Photographs of each monitoring location are presented as Appendix B.

Monitored noise levels were recorded in terms of L_{Aeq} and L_{Amax} . The weather conditions throughout the survey period were south westerly winds of approximately 9m/s (see Figure 2). The temperature during the survey period was 12°C.

Figure 1 Meteorological Conditions



The monitoring equipment used during the survey period is described in Table 1. The sound level meter was calibrated in line with BS EN 60942 “Specification for Sound Calibrators”. The sound level meter was calibrated both before and after each monitoring period; no significant drift from the reference level of 94dB was recorded (93.9dB final calibration level).

Table 1 Noise Monitoring Equipment

Sound Level Meter	
Meter Mode	Rion NL-52
Serial Number	570397
Calibrator	
Calibrator Model	NC-74
Serial Number	35173533
Calibration Level at 1000Hz	94 dB

All measurements were undertaken in free field conditions at a height of approximately 1.5m, a wind shield was fitted to the monitoring equipment at all times.

The monitored noise levels for each item of plant are presented in Table 4 below.

Table 3 Noise Assessment Category Levels

Plant	Distance Monitoring Location from Source	Monitored L_{Aeq}	Monitored L_{Amax}
Chainsaw	2	89	99
Woodchipper	1	92	105
Mini Excavator	2	85	89

Noise levels were recorded over a period representative of a single cycle of works by each item of plant in line with the guidance provided in BS 4142:1997. The noise climate throughout the survey period was

Monitored noise levels have been corrected to an equivalent Sound Power Level (L_w) in line with Equation 1.

$$L_w = L_p + 20 \cdot \log(d) + 10 \cdot \log(4 \cdot \pi) \quad \text{Equation 1}$$

Where d is distance

Monitored noise levels in terms of L_{Amax} have been corrected to a reference distance of 10m using Equation 2.

$$L_{Amax,2} = L_{Amax,1} - 20 \cdot \log(d/D) \quad \text{Equation 2}$$

Where d is reference distance

D is distance source to receiver

A comparison of the calculated source noise levels and those presented within the approved PCNV is presented as Table 4. Given the high plant noise levels no correction for residual noise was considered necessary.

Table 4 Comparison of Source Noise Levels

Plant	Sound Power Level (L_w)			L_{Amax}		
	PCNV	Calculated	Difference	PCNV	Calculated	Difference
Chainsaw	107	106	-1	-	-	-
Woodchipper	101	103	+2	80	85	+5
Mini Excavator	101	102	+1	-	-	-

The assessment results indicate that for the most part the source noise levels presented within the PCNV and those that were actually experienced on site were broadly in agreement. As such it is considered that the findings of the PCNV provide an accurate representation of noise levels which would be experienced in the vicinity of the site clearance works.

With regards to the monitored L_{Amax} noise levels it can be seen that calculated L_{Amax} noise levels were approximately 5dB(A) higher than those used for the purposes of the PCNV. Although the calculated noise levels were higher than that used for calculation purposes the source was not noted to be constant and percussive in nature, as such any impact is considered to be negligible.

3.2 Compliance Monitoring

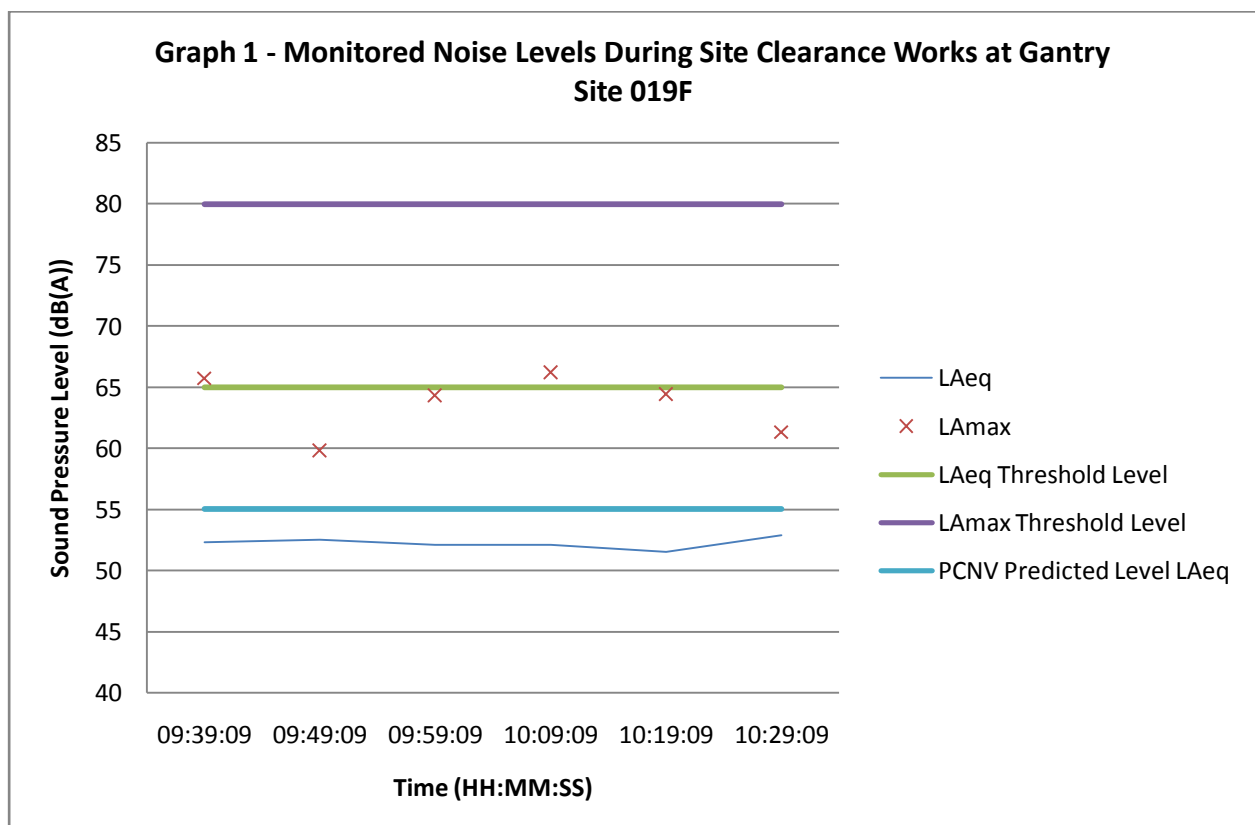
In order to determine the potential effects of site clearance upon nearby sensitive receptors noise monitoring was undertaken at the closest sensitive receptor to Gantry Site 19F. Monitoring was undertaken over a one hour period when site clearance works were taking place.

Noise levels were monitored at five minute intervals throughout the survey period. The parameters logged throughout the survey period were L_{Aeq} , L_{Amax} , L_{Amin} , L_{A90} and L_{A10} . The L_{Aeq} level is the equivalent continuous sound pressure level over the measurement period; L_{Amax} is an indicator of the highest sound level during the measurement period; the L_{Amin} is the lowest level during the measurement period; L_{A90} is used as a descriptor of background noise levels and L_{A10} is the noise level which is achieved for 10% of the monitoring period and is often used to describe road traffic noise.

The monitoring equipment used during the survey period is described in Table 3. The sound level meters were calibrated both before and after each monitoring period; no significant drift from the reference level of 94 dB was recorded.

The weather throughout the survey period was as described in Section 3.1.

All measurements were undertaken under free-field conditions and a wind shield was fitted to the monitoring equipment at all times. The monitored noise levels experienced throughout the survey period and relevant threshold levels are set out as Graph 1 below.



Monitored noise levels throughout the survey period were dominated by road traffic noise associated with the distant M90. Although some noise associated with the site clearance works was noted, from Graph 1 it can be seen that monitored noise levels throughout the survey period fell below the adopted threshold levels at this location



4. Summary

The survey results presented in Section 3 of this report indicate that there were no exceedences of the adopted threshold levels attributable to the site clearance works. Furthermore no complaints or adverse comment was received from local residents as a result of the works. As such, it is considered that all works were completed in line with the approved PCNV (FRC-FITS-JG-PCNV-0007 Rev 2) and no further action would be required.



Appendices

- Appendix A Glossary of Acoustic Terminology
- Appendix B Noise Measurement Locations



Appendix A Glossary of Acoustic Terminology

Ambient sound	The totally encompassing sound in a given situation at a given time, usually composed of sound from all sources near and far.																		
Assessment period	The period in a day over which assessments are made.																		
A-weighting	A frequency weighting applied to measured or predicted sounds levels in order to compensate for the non-linearity of human hearing.																		
Background noise	Background noise is the term used to describe the noise measured in the absence of the noise under investigation. It is described as the average of the minimum noise levels measured on a sound level meter and is measured statistically as the A-weighted noise level exceeded for ninety percent of a sample period. This is represented as the L_{90} noise level (see below).																		
Broadband	Containing the full range of frequencies.																		
Decibel [dB]	<p>The level of noise is measured objectively using a Sound Level Meter. This instrument has been specifically developed to mimic the operation of the human ear. The human ear responds to minute pressure variations in the air. These pressure variations can be likened to the ripples on the surface of water but of course cannot be seen. The pressure variations in the air cause the eardrum to vibrate and this is heard as sound in the brain. The stronger the pressure variations, the louder the sound is heard.</p> <p>The range of pressure variations associated with everyday living may span over a range of a million to one. On the top range may be the sound of a jet engine and on the bottom of the range may be the sound of a pin dropping.</p> <p>Instead of expressing pressure in units ranging from a million to one, it is found convenient to condense this range to a scale 0 to 120 and give it the units of decibels. The following are examples of the decibel readings of every day sounds;</p> <table border="0" style="width: 100%;"> <tr> <td>Four engine jet aircraft at 100m</td> <td style="text-align: right;">120 dB</td> </tr> <tr> <td>Riveting of steel plate at 10m</td> <td style="text-align: right;">105 dB</td> </tr> <tr> <td>Pneumatic drill at 10m</td> <td style="text-align: right;">90 dB</td> </tr> <tr> <td>Circular wood saw at 10m</td> <td style="text-align: right;">80 dB</td> </tr> <tr> <td>Heavy road traffic at 10m</td> <td style="text-align: right;">75 dB</td> </tr> <tr> <td>Telephone bell at 10m</td> <td style="text-align: right;">65 dB</td> </tr> <tr> <td>Male speech, average at 10m</td> <td style="text-align: right;">50 dB</td> </tr> <tr> <td>Whisper at 10m</td> <td style="text-align: right;">25 dB</td> </tr> <tr> <td>Threshold of hearing, 1000 Hz</td> <td style="text-align: right;">0 dB</td> </tr> </table>	Four engine jet aircraft at 100m	120 dB	Riveting of steel plate at 10m	105 dB	Pneumatic drill at 10m	90 dB	Circular wood saw at 10m	80 dB	Heavy road traffic at 10m	75 dB	Telephone bell at 10m	65 dB	Male speech, average at 10m	50 dB	Whisper at 10m	25 dB	Threshold of hearing, 1000 Hz	0 dB
Four engine jet aircraft at 100m	120 dB																		
Riveting of steel plate at 10m	105 dB																		
Pneumatic drill at 10m	90 dB																		
Circular wood saw at 10m	80 dB																		
Heavy road traffic at 10m	75 dB																		
Telephone bell at 10m	65 dB																		
Male speech, average at 10m	50 dB																		
Whisper at 10m	25 dB																		
Threshold of hearing, 1000 Hz	0 dB																		
dB(A): A-weighted decibels	The ear is not as effective in hearing low frequency sounds as it is hearing high frequency sounds. That is, low frequency sounds of the same dB level are not heard as loud as high frequency sounds. The sound level meter replicates the human response of the ear by using an electronic filter which is called the „A“ filter.																		

A sound level measured with this filter switched on is denoted as dB(A). Practically all noise is measured using the A filter. The sound pressure level in dB(A) gives a close indication of the subjective loudness of the noise.

Façade Noise Level	A noise level measured or predicted at the façade of a building, typically at a distance of 1m, containing a contribution made up of reflections from the façade itself (+3dB).
Free Field	Free field noise levels are measured or predicted such that there is no contribution made up of reflections from nearby building façades.
Heavy vehicle	Heavy vehicles are assumed to be buses, rigid trucks and semi trailer trucks with a weight greater than 3 tonnes. Also heavy vehicles can be defined in terms of length as buses, or trucks with a length exceeding 5.25 metres.
L₁₀	The sound pressure level that is exceeded for 10% of the time for which the given sound is measured.
L₉₀	The level of noise exceeded for 90% of the time. The bottom 10% of the sample is the L ₉₀ noise level expressed in units of dB(A).
L_{eq}	Equivalent sound pressure level - the steady sound level that, over a specified period of time, would produce the same energy equivalence as the fluctuating sound level actually occurring.
L_{max}	The maximum measured sound pressure level recorded during the monitoring period.
Noise	Sound which a listener does not wish to hear.
Noise monitor	See „sound level meter“.
R	Sound Reduction Index
R_w	Weighted sound reduction index
Rating Noise Level (L_{Ar,Tr})	The specific noise level as corrected for distance and acoustic feature.
Sound	A fluctuation of air pressure which is propagated as a wave through air.
Sound level meter (SLM)	An instrument consisting of a microphone, amplifier and indicating device, having a declared performance and designed to measure sound pressure levels.
Specific Noise Level	The monitored/calculated noise level as a result of a noise source excluding the impacts of any extraneous noise sources.

Appendix B Noise Measurement Locations and Data

Chainsaw



Address	Start Time	L _{Aeq}	L _{Amax}	L _{Amin}	L _{A10}	L _{A90}
1	11/10/2011 08:29	89.2	99.1	64.9	93.9	72.1

Chipper and Telescopic boom



Address	Start Time	L _{Aeq}	L _{Amax}	L _{Amin}	L _{A10}	L _{A90}
1	11/10/2011 08:59	92.1	102.4	88.5	98	99.9

West Back Monitoring Location



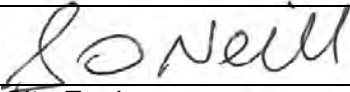
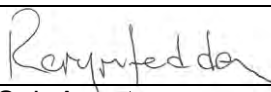


GRAHAM

CONSTRUCTION

FORTH REPLACEMENT CROSSING – FIFE ITS

FRC/FITS/JG/PCNV/CP/0004 Rev 1

SITE INVESTIGATION COMPLIANCE REPORT.

Completed by:	Sean O'Neill	Reviewed by:	Rory McFadden		
Signed:		Signed:			
Position:	Site Engineer	Position:	Sub Agent		
Date:	30/11/2011	Date:	30/11/2011		
Comments:		 			
Revision Record					
Revision	Date	By	Summary of Changes	Checked	Approved
1	11/01/12	SON	Changes following EDT comments.	RMcF	RMcF

MEMORANDUM

TO: Sean O'Neil
FROM: Mark Maclagan
CC: Rory McFadden
REF: E12317-100-R-8.1.2-MM
DATE: 11th January 2012
SUBJECT: Gantry Site 015F Bore Hole Drilling Specific Noise Monitoring

Introduction

As requested a noise monitoring exercise was undertaken during the drilling of boreholes during site investigation works at Gantry Site 015F of the Fife Intelligent Transport Scheme. The potential effects of Borehole Drilling at this location upon nearby sensitive receptors has been assessed within PCNV FRC-FITS-JG-PCNV-007. This document sets out details of specific noise monitoring undertaken to confirm the accuracy of source noise data used for the purpose of the approved PCNV.

Monitoring Methodology

In order to ensure that source noise data presented within future PCNVs is representative of on-site conditions, specific noise monitoring was undertaken at a location representative of a bore hole drilling rig in operation. Noise monitoring was undertaken in line with the guidance provided in BS 4142:1997 'Rating of Industrial Noise Affecting Mixed Residential and Industrial Areas'.

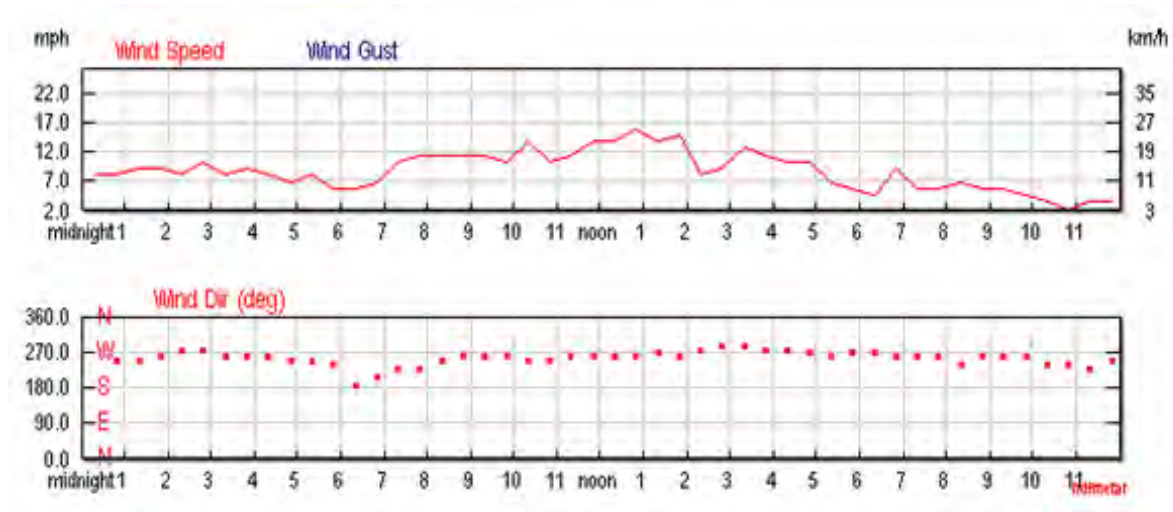
Attended noise monitoring was undertaken by Gavin Spowage of Waterman Energy, Environment & Design on the 11th October 2011. Monitoring was undertaken at a single location 2m from the drill rig when working at full power (specific noise level) and without the drill rig in operation (residual noise level). The monitoring location is illustrated by Figure 1 below.

Figure 1 Noise Monitoring Location



Monitored noise levels were recorded in terms of L_{Aeq} and L_{Amax} throughout each survey period. The weather conditions throughout the survey period were south westerly winds of approximately 9m/s (see Figure 2). The temperature during the survey period was 12°C.

Figure 2 Meteorological Conditions



The monitoring equipment used during the survey period is described in Table 1. The sound level meter was calibrated in line with BS EN 60942 “Specification for Sound Calibrators”. The sound level meter was calibrated both before and after each monitoring period; no significant drift from the reference level of 94dB was recorded (93.9dB final calibration level).

Table 1 Noise Monitoring Equipment

Sound Level Meter	
Meter Mode	Rion NL-52
Serial Number	570397
Calibrator	
Calibrator Model	NC-74
Serial Number	35173533
Calibration Level at 1000Hz	94 dB

All measurements were undertaken in free field conditions at a height of approximately 1m, a wind shield was fitted to the monitoring equipment at all times.

Monitoring Results

As previously discussed noise monitoring was undertaken at a single location representative of noise generated by a bore hill drilling. The monitoring results are presented in Table 2 below.

Table 2 Monitored Noise Levels

Noise Level	Date Start Time	Measurement Period	L_{Aeq}	L_{Amax}	Notes
Specific Noise Level	11/10/2011 11:22	05:00	88.9	95.4	Monitoring period dominated by noise associated with drilling rig engine and drill biting into earth.
Residual Noise Level	11/10/2011 11:30	05:00	87.9	92.4	Drill rig switched off residual noise climate dominated by road traffic noise.
Specific Noise Level (corrected for residual)			82.0		

Calculated Sound Power Levels

In order to determine the accuracy of the source data utilised for both previous and future PCNVs the monitored L_{Aeq} noise levels have been corrected to an equivalent sound power level using Equation 1.

$$L_w = L_p + 20 \cdot \log(d) + 10 \cdot \log(4\pi)$$

Where d is distance

L_p is specific noise level (corrected for background)

With regards to the monitored L_{Amax} level this has been corrected to a 10m reference level using equation 2.

$$L_{Amax,2} = L_{Amax,1} + 20 \cdot \log(r/R)$$

Where $L_{Amax,2}$ is the corrected maximum noise level

$L_{Amax,1}$ is the monitored maximum noise level

r is the distance between source and monitoring location

R is the reference distance

The calculated equivalent sound power level and L_{Amax} for the operation of the drill rig are presented in Table 3 and a comparison of predicted levels and those used for the purposes of PCNV preparation are presented as Table 4.

Table 3 Source Noise levels

Activity	Monitored		Calculated	
	L_{Aeq}	L_{Amax}	L_w	L_{Amax}
Bore Hole Drilling Rig	82.0	95.4	99.0	81

Table 4 Comparison of Predicted Source Noise Levels

Activity	Source noise levels presented within PCNV		Predicted		Difference	
	L_w	L_{Amax}	L_w	L_{Amax}	L_w	L_{Amax}
Bore Hole Drilling Rig	114	108	99	81	-15	-27

The assessment results indicate that the specific on site monitored noise levels fall significantly below those presented within the approved PCNV. As such, it is considered that the corrected noise levels presented within the approved PCNV are likely to over predict noise levels and as such are representative of a worst case scenario.

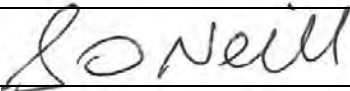
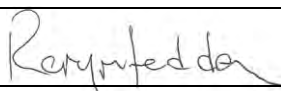



 GRAHAM


 CONSTRUCTION

FORTH REPLACEMENT CROSSING – FIFE ITS

FRC/FITS/JG/PCNV/CR/0005 - Rev 2

COMPLIANCE REPORT FOR GROUTING @ GANTRY 08F

Completed by:	Sean O'Neill	Reviewed by:	Rory McFadden		
Signed:		Signed:			
Position:	Site Engineer	Position:	Sub Agent		
Date:	15/12/2011	Date:	15/12/2011		
Comments:		 			
Revision Record					
Revision	Date	By	Summary of Changes	Checked	Approved
1	15/12/11	SON	W/C 5/12/12 DATA INCLUDED.	RMcF	RMcF
2	10/01/12	SON	W/C 19/12/12 DATA INCLUDED.	RMcF	RMcF

Fife ITS - Mineworking Compliance Monitoring Gantry Site 08F

Dates: 28/11/2011 - 21/12/2011

Author: Jon Lee MIOA



Checker: Mark Maclagan MIOA



Approver: Mark Maclagan MIOA



Version: Second
Issue

10th January 2011

Introduction

The Brief

Waterman Energy, Environment & Design Limited (hereafter 'Waterman') was instructed by John Graham (Dromore) Limited to undertake an assessment of noise and vibration in support of the on-going Fife Intelligent Transport Scheme (ITS) in line with the Forth Replacement Crossing Code of Construction Practice (the CoCP) and Appendix 1/9 of the Employers Requirements (hereafter 'the Employers Requirements').

A Plan for the Control of Noise and Vibration has been submitted and approved for works to be undertaken during the grouting of mine works (FRC-FITS-JG-PCNV0007) which assessed the potential noise impacts associated with mine workings including borehole drilling and grouting. This document sets out the findings of a compliance monitoring exercise during the grouting of mine workings on the northbound hard shoulder at Gantry Site 08F. Works were continuous on the site between 28th November 2011 and 21st December 2012.

In order to ensure compliance with Best Practicable Means (BPM) the approved PCNV, CoCP and the Employers Requirements noise monitoring has been undertaken at the closest location to the works throughout the survey period.

Site Description and Description of Works

The closest NSRs to the works are those located off Masterson Road, Rosyth (refer to Table 1). During the works a number of boreholes were drilled and a grout mixture pumped into the hole in order to stabilise existing mine workings.

Table 1 Noise Sensitive Receptors

Noise Sensitive Receptor	Name	Description	Grid Reference	Distance from Works
NSR A	Properties off Masterson Road	Two story residential dwellings	313011,684 754	50m

Baseline Conditions and Noise Assessment Criteria

Baseline noise monitoring has been undertaken at a location representative of the closest existing sensitive receptor to the works (see Table 1). The monitoring data is provided in full within the separately submitted baseline noise report (FRC-FITS-JG-NVMP-BMR-0001) and is summarised below. Following completion of the baseline monitoring exercise noise assessment category levels were set in compliance with the CoCP and the Employers Requirements. The assessment category levels in terms of $L_{Aeq,T}$ and L_{Amax} are presented as Table 2.

Table 2 Noise Assessment Category Levels

Period	Monitored Baseline		Assessment Category	
	$L_{Aeq, 1\text{ hour}}$	$L_{Amax,F}$	L_{Aeq}	L_{Amax}
Daytime	66	70	75	90

Monitoring Methodology

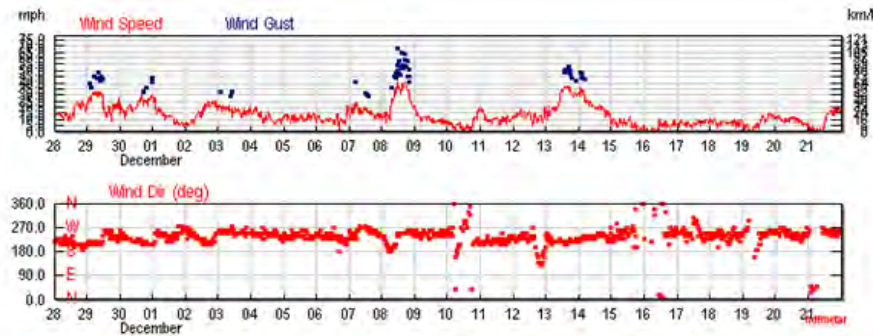
Noise monitoring was undertaken throughout mine grouting works at Gantry Site 08F. The monitoring was undertaken in line with the guidance provided in BS 4142:1997 and the approved PCNV (FRC-FITS-JG-PCNV-0007).

Unattended noise monitoring was undertaken between the 28th November 2011 and 21st December 2011 by trained and competent staff holding corporate membership of the institute of acoustics (IOA). A single monitoring location was selected so as to be representative of the closest sensitive receptors to the works. All measurements were undertaken under free field conditions (i.e. there were no nearby reflecting surfaces, other than the ground). The measurement location is described in Table 1 below. A member of the Waterman Noise and Vibration Team visited the site on a weekly basis so as to change batteries and take site notes.

Table 1: Noise Monitoring Location

Location	Description	Subjective Observations
Properties off Masterson Road	Residential dwellings located at the top of a steep cutting approximately 50m from grouting works. Monitoring location set in free field conditions at a height of 1.5m.	Noise climate dominated by road traffic noise from the adjacent M90

The weather throughout the survey period was noted to be predominantly dry with some periods of snowfall. The wind direction throughout the survey period was noted to be predominantly from the south west with wind speeds of up to 40mph, average wind speeds throughout the survey period were 21mph. The average temperature throughout the survey was noted to be 3°C.



The monitoring equipment used during the survey period is described in Table 2. The sound level meters were calibrated both before and after each monitoring period; no significant drift from the reference level of 94 dB was recorded. The sound level meter was also calibrated in the last year to BS EN 60942.

Table 2: Noise Monitoring Equipment

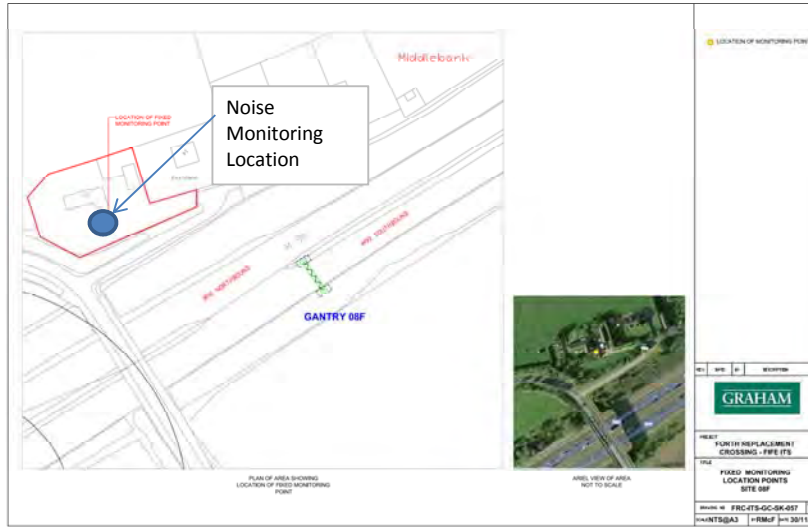
Sound Level Meter	LT1
Meter Mode	Rion NL-32
Serial Number	00503263
Calibrator	
Calibrator Model	NC-74
Serial Number	35173533
Calibration Level at 1000 Hz	94 dB
Microphone	
Microphone Type	UC-53A
Microphone Serial Number	316668

Noise levels were monitored at five minute intervals throughout the survey period. The parameters logged throughout the survey period were L_{Aeq} , L_{Amax} , L_{Amin} , L_{A90} and L_{A10} . The L_{Aeq} level is the equivalent continuous sound pressure level over the measurement period; L_{Amax} is an indicator of the highest sound level during the measurement period; the L_{Amin} is the lowest level during the measurement period; L_{A90} is used as a descriptor of background noise levels and L_{A10} is the noise level which is achieved for 10% of the monitoring period and is often used to describe road traffic noise.

Forth Replacement Crossing Fide ITS

Activities: Mine Workings Gantry Site 08F

Surveyors Gavin Spowage, Jon Lee



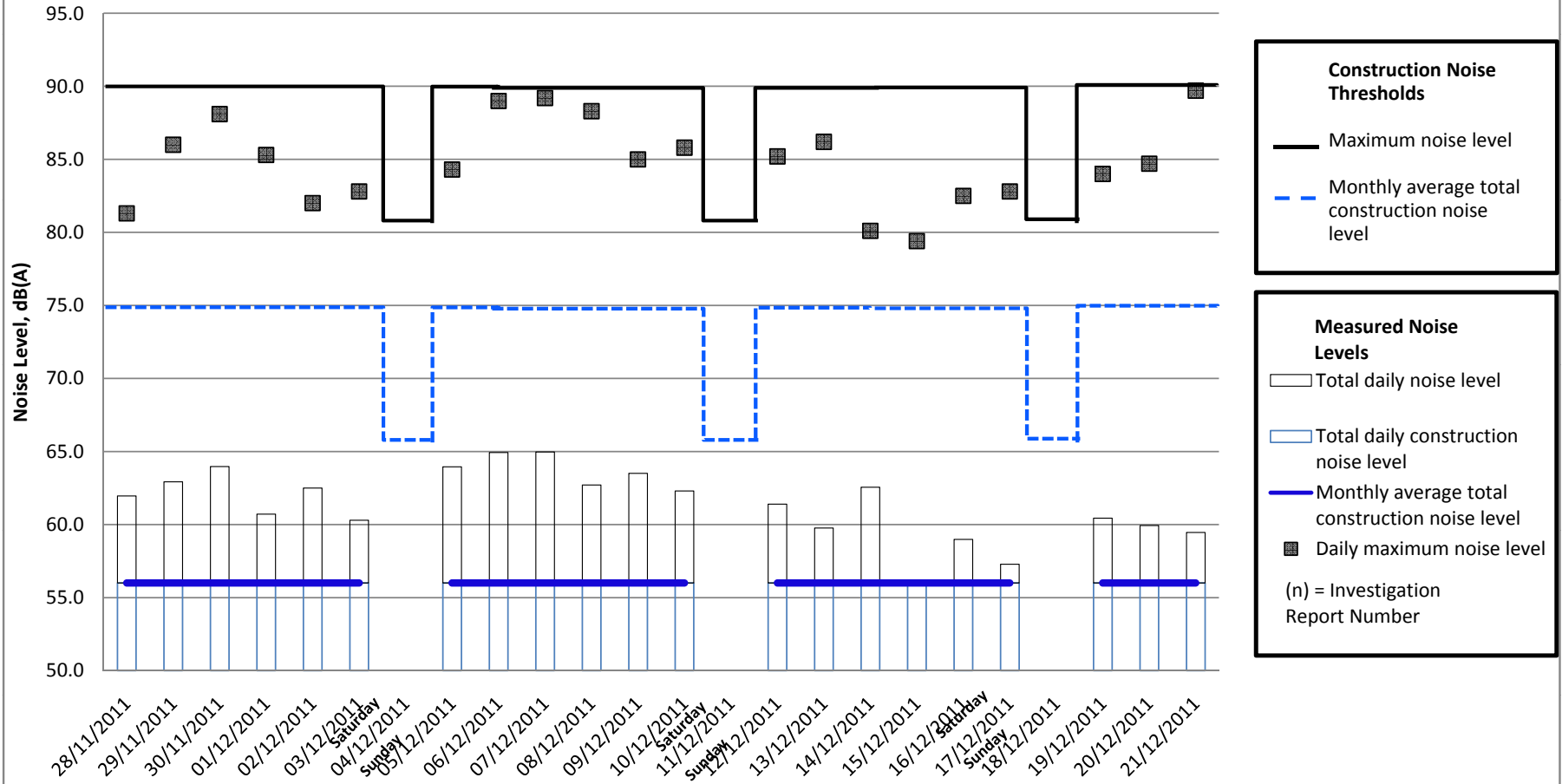
Site Summary Noise Data

Week	Summary Text	Site Indicator
1	Monitored noise levels recorded during this survey period fell consistently below both the construction noise threshold level and the baseline noise level during this survey period. Furthermore no exceedences of the L_{Amax} limit criteria where recorded. As such, it is considered that during the first week of works all activities where completed in accordance with the approved PCNV and as such, no additional action is required.	Green
2	Monitored noise levels recorded during this survey period fell consistently below both the construction noise threshold level and the baseline noise level during this survey period. Furthermore no exceedences of the L_{Amax} limit criteria where recorded. As such, it is considered that during the second week of works all activities where completed in accordance with the approved PCNV and as such, no additional action is required.	Green
3	Monitored noise levels recorded during this survey period fell consistently below both the construction noise threshold level and the baseline noise level during this survey period. Furthermore no exceedences of the L_{Amax} limit criteria where recorded. As such, it is considered that during the third week of works all activities where completed in accordance with the approved PCNV and as such, no additional action is required.	Green
4	Monitored noise levels recorded during this survey period fell consistently below both the construction noise threshold level and the baseline noise level during this survey period. Furthermore no exceedences of the L_{Amax} limit criteria where recorded. As such, it is considered that during the final week of works all activities where completed in accordance with the approved PCNV and as such, no additional action is required.	Green

Site Indicator

	Classification	Mitigation Working no apparent noise problems
	Description	Noise levels throughout the week are below the adopted threshold level throughout the survey period. No exceedences of L_{Amax} criteria attributable to the works.
	Action	Continue following best practice guidance as outlined in site environment plan
	Classification	Check Mitigation
	Description	Noise levels have increased to approaching the adopted threshold level and/or there have been a small number of exceedences of the L_{Amax} criteria attributable to the works.
	Action	Check mitigation is operating as anticipated and if further measures are appropriate.
	Classification	Further Review of Mitigation
	Description	Noise levels have exceeded the adopted threshold level and/or the L_{Amax} criteria are regularly exceeded during the survey period.
	Action	Review mitigation measures with Environmental Manager or Adviser to ensure current mitigation operating as intended and identify any other practicable mitigation measures

Measured daytime noise levels, Properties off Masterson Road Measurement period 28th-November 2011 to 21st-December-2011





Note to Contractors: Daily L_{Aeq} values represent L_{Aeq} (10 hour Saturday, 11 hour Weekday) from total noise (construction and existing ambient). Monthly value is the logarithmic average construction noise over the calendar month, assessed against the threshold level. Daily $L_{Amax,F}$ represents the highest single event value over the daytime period, investigative reports into exceedances identify whether or not these values correspond to construction noise. Assessment category lines should be amended for each location. Sunday data have not been included as no construction works have been conducted during these hours. Data affected by adverse



FORTH REPLACEMENT CROSSING – FIFE ITS

FRC/FITS/JG/PCNV/CP/0006 Rev 1

DRAINAGE & DUCTING COMPLIANCE MONITORING REPORT.

Completed by:	Sean O'Neill	Reviewed by:	Rory McFadden		
Signed:	<i>SONeill</i>	Signed:	<i>RoryMcFadden</i>		
Position:	Site Engineer	Position:	Sub Agent		
Date:	06/12/11	Date:	06/12/11		
Comments:		 			
Revision Record					
Revision	Date	By	Summary of Changes	Checked	Approved
1	12/01/12	SON	Changes following EDT Compliance Report CR 00223.	RMcF	RMcF



Fife ITS Compliance Monitoring Report

Ducting and Drainage (FRC-FITS-JG-PCNV-008)

December 2011

Waterman Energy, Environment & Design Limited

2ND Floor , South Central, 11 Peter Street, Manchester, M2 5QR , United Kingdom

www.watermangroup.com



Client Name: Graham Construction
Document Reference: EED12317-100-R-6-1-2
Project Number: EED12317

Quality Assurance – Approval Status

This document has been prepared and checked in accordance with
Waterman Group's IMS (BS EN ISO 9001: 2008 and BS EN ISO 14001: 2004)

Issue	Date	Prepared by	Checked by	Approved by
First	December 2011	Mark Maclagan Principal Consultant	Joanna Bagley Associate Director	Joanna Bagley Associate Director

Comments

Comments

Content

1. Introduction	1
1.1 The Brief	1
1.2 Site Description and Description of Works	1
2. Baseline Conditions and Noise Assessment Criteria	2
3. Noise Monitoring Results	3
3.1 Specific Noise Measurements	3
3.2 Compliance Monitoring	5
4. Summary	7

Tables

Table 1	Noise Sensitive Receptors.....	1
Table 2	Noise Assessment Category Levels.....	2
Table 3:	Noise Monitoring Equipment.....	3
Table 4	Noise Assessment Category Levels.....	4

1. Introduction

1.1 The Brief

Waterman Energy, Environment & Design Limited (hereafter 'Waterman') was instructed by John Graham (Dromore) Limited to undertake an assessment of noise and vibration in support of the on-going Fife Intelligent Transport Scheme (ITS) in line with the Forth Replacement Crossing Code of Construction Practice (the CoCP) and Appendix 1/9 of the Employers Requirements (hereafter 'the Employers Requirements').

A Plan for the Control of Noise and Vibration has been submitted and approved for works to be undertaken during ducting and drainage works (FRC-FITS-JG-PCNV008) which includes for potential noise effects associated with the installation of ducting chambers, installation of ITS Cables and installation of mainline drainage. This document sets out the findings of a compliance monitoring exercise during the excavation of ducting and drainage channels on the hard shoulder adjacent to existing sensitive receptors in the vicinity of Duloch House. By its nature ducting and drainage installation is transient with works progressing approximately 200m per day. As such long term monitoring is not possible; therefore, attended short term monitoring has been undertaken over a period when typical works were being undertaken.

All ducting and drainage works would take place during the daytime period and would generate very little in the way of noise. Nonetheless in order to ensure compliance with Best Practicable Means (BPM) the approved PCNV, CoCP and the Employers Requirements noise monitoring has been undertaken at the closest location to drainage and ducting works over a representative daytime period. Furthermore, specific noise measurements have been undertaken in order to validate the source noise levels used within the PCNV assessment.

1.2 Site Description and Description of Works

As previously discussed the closest NSR to the works was Duloch House (refer to Table 1). During the works a trench was excavated to a minimum depth of 1.0m using an 8T Excavator. Bedding sand (or similar) was then be placed in the bottom of the trench followed by the 4-way ducts and then the trench back filled to a depth of 0.5m surrounding the ducts with sand to protect them. The material excavated from the trench was then be used to backfill up to formation level. The drainage and ducting teams were capable of installing approximately 200 linear metres per day, therefore any works adjacent to the sensitive receptor were completed over in a very short period of time.

Table 1 Noise Sensitive Receptors

Noise Sensitive Receptor	Name	Description	Approximate Grid Reference	Distance from Works
NSR A	Duloch House	Two story residential dwelling	313426,685470	220m

2. Baseline Conditions and Noise Assessment Criteria

Baseline noise monitoring has been undertaken at a location representative of the closest existing sensitive receptor to the works (see Table 1). The monitoring data is provided in full within the separately submitted baseline noise report (FRC-FITS-JG-NVMP-BMR-0001) and is summarised below. Following completion of the baseline monitoring exercise noise assessment category levels were set in compliance with the CoCP and the Employers Requirements. The assessment category levels in terms of $L_{Aeq,T}$ and L_{Amax} are presented as Table 2.

Table 2 Noise Assessment Category Levels

Period	Monitored Baseline		Assessment Category	
	$L_{Aeq, 1 \text{ hour}}$	$L_{Amax,F}$	L_{Aeq}	L_{Amax}
Daytime	65	82	70	85

3. Noise Monitoring Results

A noise monitoring exercise has been undertaken in order to determine the specific noise levels generated by operational site on the plant and determine the potential effects of ducting and drainage works upon nearby noise sensitive receptors. The noise monitoring exercise was undertaken by Mark Maclagan Principal Acoustic Consultant for Waterman Energy Environment and Design and completed in line with the guidance provided within Part 10 of BS 4142:1997. The surveyor was on in attendance throughout the survey periods.

3.1 Specific Noise Measurements

For the purposes of the PCNV, source sound power levels were obtained from the guidance provided in BS5228-1:2009 and Waterman's in house noise database. In order to ensure that the source noise data used within the submitted PCNVs was representative of on-site conditions specific noise monitoring was undertaken at a location representative of each new work activity. Monitoring was undertaken at a location as close to the plant in question as safely possible over a representative period on the 3rd November 2011. Photographs of each monitoring location are presented as Appendix B

Monitored noise levels were recorded in terms of L_{Aeq} and L_{Amax} . The weather throughout the survey period was noted to be dry although the highway was slightly damp with a light north easterly wind and approximately 70% cloud cover. The monitoring equipment used during the survey period is described in Table 3. The sound level meter was calibrated both before and after each monitoring period; no significant drift from the reference level of 94 dB was recorded (93.9 final calibration level).

Table 3: Noise Monitoring Equipment

Sound Level Meter	
Meter Mode	Rion NA-28
Serial Number	660018
Calibrator	
Calibrator Model	NC-74
Serial Number	35173533
Calibration Level at 1000 Hz	94 dB
Date of last calibration in accordance with BS EN 60942	06/08/2011

All measurements were undertaken under free-field conditions and a wind shield was fitted to the monitoring equipment at all times. The monitored noise levels for each item of plant are presented in Table 4 below.

Table 4 Noise Assessment Category Levels

Plant	Distance Monitoring Location from Source	Monitored L_{Aeq}^*	Monitored L_{Amax}
Mini Excavator with Pulveriser when breaking out Rock	3	89	101
8 ton Tracked Excavator	2	79	98
Bomag 1200 Roller when rolling surface	5	82	89

Note: Monitored noise levels corrected to a residual noise level of 79dB(A) obtained at a hard shoulder location away from on-going works.

Noise levels were recorded over a period representative of a single cycle of works by each item of plant in line with the guidance provided in BS 4142:1997.

Monitored noise levels have been corrected to an equivalent Sound Power Level (L_w) in line with Equation 1.

$$L_w = L_p + 20 \cdot \log(d) + 10 \cdot \log(4 \cdot \pi) \quad \text{Equation 1}$$

Where d is distance

Monitored noise levels in terms of L_{Amax} have been corrected to a reference distance of 10m using Equation 2.

$$L_{Amax,2} = L_{Amax,1} - 20 \cdot \log(d/D) \quad \text{Equation 2}$$

Where d is reference distance

D is distance source to receiver

A comparison of the calculated source noise levels and those presented within the approved PCNV is presented as Table 5.

Table 5 Comparison of Source Noise Levels

Plant	Sound Power Level (L_w)			L_{Amax}		
	PCNV	Calculated	Difference	PCNV	Calculated	Difference
Mini Excavator with Pulveriser	105	107	+2	85	87	+2
8 ton Tracked Excavator	99	96	-3	80	84	+4
Bomag 1200 Roller	105	106	+1	82	83	+1

The assessment results indicate that for the most part the source noise levels presented within the PCNV and those that were actually experienced on site were broadly in agreement. As such it is considered that the findings of the PCNV provide an accurate representation of noise levels which would be experienced in the vicinity of the site clearance works.

With regards to the monitored L_{Amax} noise levels it can be seen that calculated L_{Amax} noise levels were approximately 2-4dB(A) higher than those used for the purposes of the PCNV. Although the calculated noise levels were higher than that used for calculation purposes extrapolation of the calculated noise levels back to the closest sensitive receptors indicates that levels would remain below the required threshold level during ducting and drainage works.

3.2 Compliance Monitoring

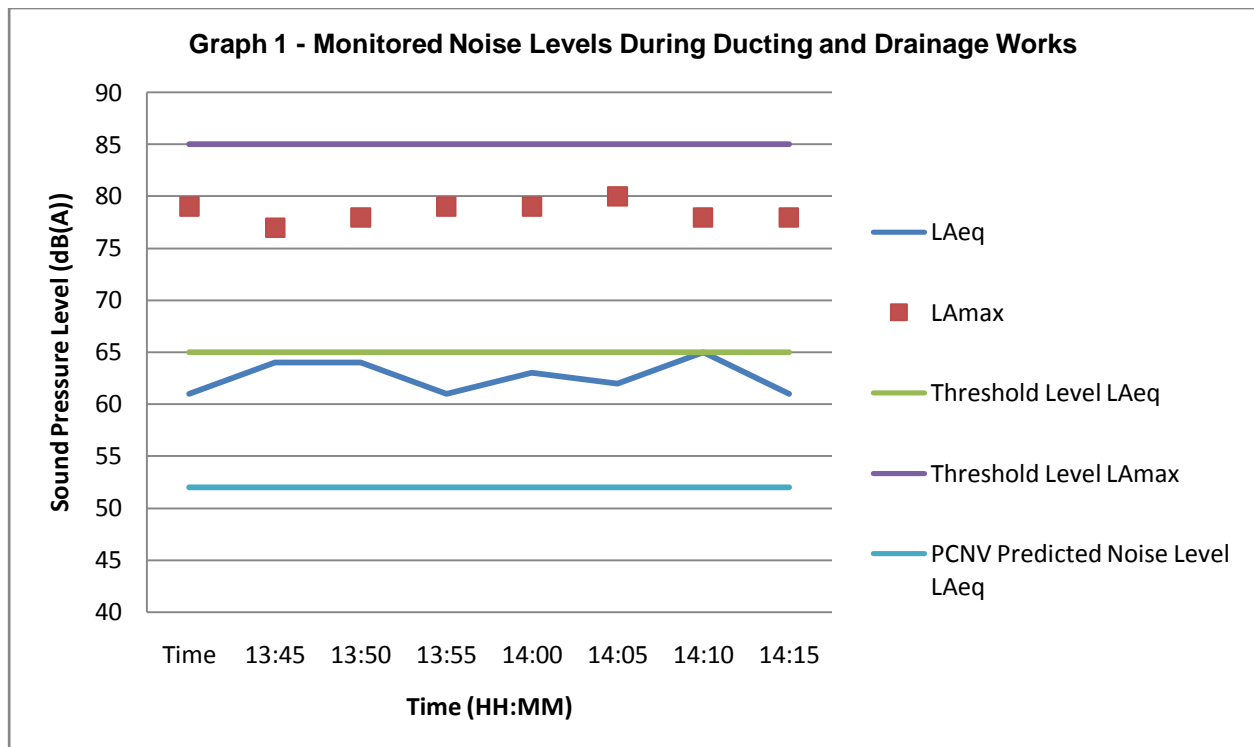
In order to determine the potential effects of drainage and ducting works upon nearby sensitive receptors noise monitoring was undertaken at the closest sensitive receptor to the works (Old Duloch). Monitoring was undertaken over a one hour period when site clearance works were taking place.

Noise levels were monitored at five minute intervals throughout the survey period. The parameters logged throughout the survey period were L_{Aeq} , L_{Amax} , L_{Amin} , L_{A90} and L_{A10} . The L_{Aeq} level is the equivalent continuous sound pressure level over the measurement period; L_{Amax} is an indicator of the highest sound level during the measurement period; the L_{Amin} is the lowest level during the measurement period; L_{A90} is used as a descriptor of background noise levels and L_{A10} is the noise level which is achieved for 10% of the monitoring period and is often used to describe road traffic noise.

The monitoring equipment used during the survey period is described in Table 3. The sound level meters were calibrated both before and after each monitoring period; no significant drift from the reference level of 94 dB was recorded.

The weather throughout the survey period was noted to be dry although the highway was slightly damp with a light north easterly wind and approximately 70% cloud cover.

All measurements were undertaken under free-field conditions and a wind shield was fitted to the monitoring equipment at all times. The monitored noise levels experienced throughout the survey period and relevant threshold levels are set out as Graph 1 below.



Monitored noise levels throughout the survey period were dominated by road traffic noise associated with the distant M90. Although some noise associated with the construction of a nearby housing development was noted.

The data presented in Graph 1 indicates that the noise threshold level were not exceeded during the survey period. However, it is noted that the monitored noise levels were in excess of the predicted level for this stage of works presented in the PCNV (FRC-FITS-JG-PCNV-008). However, with reference to Table 2 and baseline monitoring report FRC-FITS-JG-NVMP-BMR-0001 it can be seen that monitored noise levels are consistent with those monitored during the baseline noise survey. As such it is considered that no further consideration is required to the potential effects of excavation and site restoration during the ducting and drainage stage at this location.

4. Summary

The survey results presented in Section 3 of this report indicate that there were no exceedences of the adopted threshold levels attributable to the site clearance works. Furthermore no complaints or adverse comment was received from local residents as a result of the works. As such, it is considered that all works were completed in line with the approved PCNV (FRC-FITS-JG-PCNV-0008) and no further action would be required.



Appendices

- Appendix A Glossary of Acoustic Terminology
- Appendix B Noise Measurement Locations



Appendix A Glossary of Acoustic Terminology

Ambient sound	The totally encompassing sound in a given situation at a given time, usually composed of sound from all sources near and far.																		
Assessment period	The period in a day over which assessments are made.																		
A-weighting	A frequency weighting applied to measured or predicted sounds levels in order to compensate for the non-linearity of human hearing.																		
Background noise	Background noise is the term used to describe the noise measured in the absence of the noise under investigation. It is described as the average of the minimum noise levels measured on a sound level meter and is measured statistically as the A-weighted noise level exceeded for ninety percent of a sample period. This is represented as the L_{90} noise level (see below).																		
Broadband	Containing the full range of frequencies.																		
Decibel [dB]	<p>The level of noise is measured objectively using a Sound Level Meter. This instrument has been specifically developed to mimic the operation of the human ear. The human ear responds to minute pressure variations in the air. These pressure variations can be likened to the ripples on the surface of water but of course cannot be seen. The pressure variations in the air cause the eardrum to vibrate and this is heard as sound in the brain. The stronger the pressure variations, the louder the sound is heard.</p> <p>The range of pressure variations associated with everyday living may span over a range of a million to one. On the top range may be the sound of a jet engine and on the bottom of the range may be the sound of a pin dropping.</p> <p>Instead of expressing pressure in units ranging from a million to one, it is found convenient to condense this range to a scale 0 to 120 and give it the units of decibels. The following are examples of the decibel readings of every day sounds;</p> <table border="0" style="width: 100%;"> <tr> <td>Four engine jet aircraft at 100m</td> <td style="text-align: right;">120 dB</td> </tr> <tr> <td>Riveting of steel plate at 10m</td> <td style="text-align: right;">105 dB</td> </tr> <tr> <td>Pneumatic drill at 10m</td> <td style="text-align: right;">90 dB</td> </tr> <tr> <td>Circular wood saw at 10m</td> <td style="text-align: right;">80 dB</td> </tr> <tr> <td>Heavy road traffic at 10m</td> <td style="text-align: right;">75 dB</td> </tr> <tr> <td>Telephone bell at 10m</td> <td style="text-align: right;">65 dB</td> </tr> <tr> <td>Male speech, average at 10m</td> <td style="text-align: right;">50 dB</td> </tr> <tr> <td>Whisper at 10m</td> <td style="text-align: right;">25 dB</td> </tr> <tr> <td>Threshold of hearing, 1000 Hz</td> <td style="text-align: right;">0 dB</td> </tr> </table>	Four engine jet aircraft at 100m	120 dB	Riveting of steel plate at 10m	105 dB	Pneumatic drill at 10m	90 dB	Circular wood saw at 10m	80 dB	Heavy road traffic at 10m	75 dB	Telephone bell at 10m	65 dB	Male speech, average at 10m	50 dB	Whisper at 10m	25 dB	Threshold of hearing, 1000 Hz	0 dB
Four engine jet aircraft at 100m	120 dB																		
Riveting of steel plate at 10m	105 dB																		
Pneumatic drill at 10m	90 dB																		
Circular wood saw at 10m	80 dB																		
Heavy road traffic at 10m	75 dB																		
Telephone bell at 10m	65 dB																		
Male speech, average at 10m	50 dB																		
Whisper at 10m	25 dB																		
Threshold of hearing, 1000 Hz	0 dB																		
dB(A): A-weighted decibels	The ear is not as effective in hearing low frequency sounds as it is hearing high frequency sounds. That is, low frequency sounds of the same dB level are not heard as loud as high frequency sounds. The sound level meter replicates the human response of the ear by using an electronic filter which is called the 'A' filter.																		

A sound level measured with this filter switched on is denoted as dB(A). Practically all noise is measured using the A filter. The sound pressure level in dB(A) gives a close indication of the subjective loudness of the noise.

Façade Noise Level	A noise level measured or predicted at the façade of a building, typically at a distance of 1m, containing a contribution made up of reflections from the façade itself (+3dB).
Free Field	Free field noise levels are measured or predicted such that there is no contribution made up of reflections from nearby building façades.
Heavy vehicle	Heavy vehicles are assumed to be buses, rigid trucks and semi trailer trucks with a weight greater than 3 tonnes. Also heavy vehicles can be defined in terms of length as buses, or trucks with a length exceeding 5.25 metres.
L₁₀	The sound pressure level that is exceeded for 10% of the time for which the given sound is measured.
L₉₀	The level of noise exceeded for 90% of the time. The bottom 10% of the sample is the L ₉₀ noise level expressed in units of dB(A).
L_{eq}	Equivalent sound pressure level - the steady sound level that, over a specified period of time, would produce the same energy equivalence as the fluctuating sound level actually occurring.
L_{max}	The maximum measured sound pressure level recorded during the monitoring period.
Noise	Sound which a listener does not wish to hear.
Noise monitor	See 'sound level meter'.
R	Sound Reduction Index
R_w	Weighted sound reduction index
Rating Noise Level (L_{Ar,Tr})	The specific noise level as corrected for distance and acoustic feature.
Sound	A fluctuation of air pressure which is propagated as a wave through air.
Sound level meter (SLM)	An instrument consisting of a microphone, amplifier and indicating device, having a declared performance and designed to measure sound pressure levels.
Specific Noise Level	The monitored/calculated noise level as a result of a noise source excluding the impacts of any extraneous noise sources.

Appendix B Noise Measurement Locations and Data

Excavator with Pulveriser



Residual Noise Monitoring Location



Excavator



Duloch House



Time	L _{Aeq}	L _{Amax}	Threshold Level L _{Aeq}	Threshold Level L _{Amax}	PCNV Predicted Noise Level L _{Aeq}
13:45	61	79	65	85	52
13:50	64	77	65	85	52
13:55	64	78	65	85	52
14:00	61	79	65	85	52
14:05	63	79	65	85	52
14:10	62	80	65	85	52
14:15	65	78	65	85	52
14:20	61	78	65	85	52

services

buildings services
civil engineering
energy & environmental
secondment & outsourcing
structural engineering
transport planning

sectors

aviation
commercial
communication & technology
conservation / historic
education
energy
government & defence
healthcare
highways
hotels
industrial
marine
rail
residential
retail
sports & leisure
transportation
urban regeneration
waste
water

united kingdom

belfast
birmingham
brentwood
bristol
cardiff
derby
dundee
edinburgh
glasgow
inverness
leads
lingfield
london
manchester
newcastle-upon-tyne
nottingham
sheffield

head office

pickfords wharf
clink street
london
SE1 9DG
t +44 20 7928 7888
f +44 20 7928 3033



*Project Office

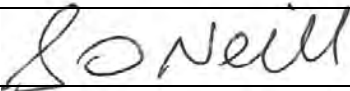
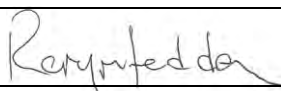



 GRAHAM


 CONSTRUCTION

FORTH REPLACEMENT CROSSING – FIFE ITS

FRC/FITS/JG/PCNV/CR/0007 Rev 1

COMPLIANCE REPORT FOR EARTHWORK OPERATIONS @ GANTRY 01F.

Completed by:	Sean O'Neill	Reviewed by:	Rory McFadden		
Signed:		Signed:			
Position:	Site Engineer	Position:	Sub Agent		
Date:	15/12/2011	Date:	15/12/2011		
Comments:		 			
Revision Record					
Revision	Date	By	Summary of Changes	Checked	Approved
1	09/01/12	SON	Changes following EDT comments.	RMcF	RMcF

Fife ITS - Minor Excavation Works Gantry Site 01F

Dates: 07/12/2011 - 12/12/2011

Author: Jon Lee MIOA



Checker: Mark Maclagan MIOA



Approver: Mark Maclagan MIOA



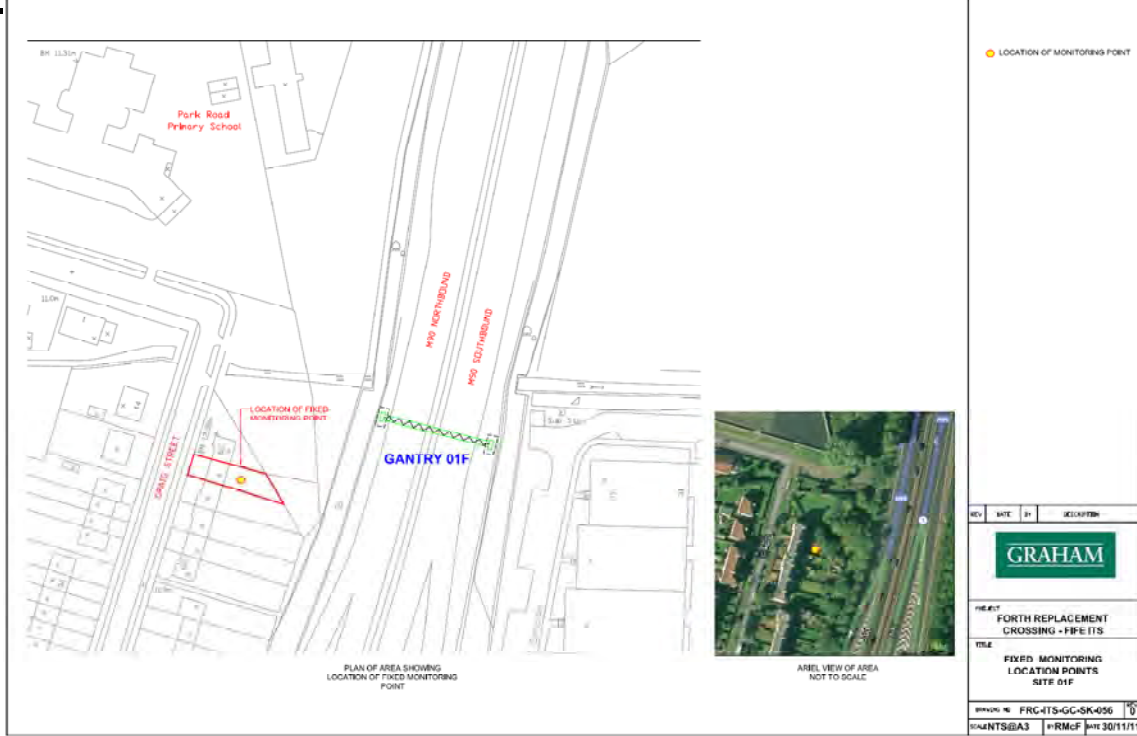
Version: First

Date: 15-Dec-11



Forth Replacement Crossing Fife ITS

Activities: Minor Excavation Work adjacent to Site 01F using mini digger



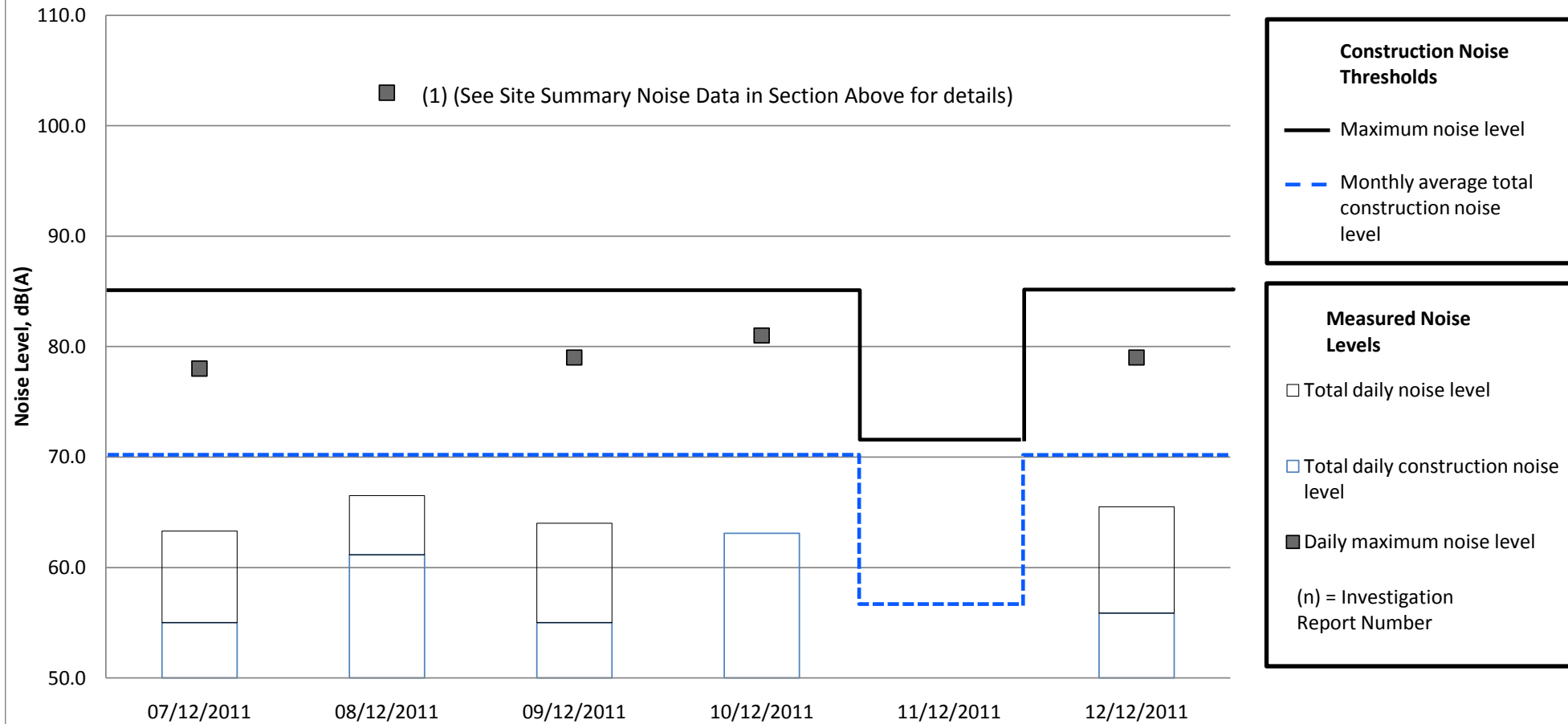
Site Summary Noise Data

Week	Summary Text	Site Indicator
1	<p>Monitored noise levels recorded during this survey period fell consistently below both the construction noise threshold level and the baseline noise level during this survey period. A single exceedance of the L_{Amax} threshold level was recorded on Thursday 8th December.</p> <p>Further investigation indicated very high winds periods during this period as such no site work was taking place. It was also noted that loose fence panel was banging against a fence post throughout this period which would explain the elevated noise levels. As such, it is considered that during the first week of works all activities were completed in accordance with the approved PCNV and as such, no additional action is required.</p>	

Site Indicator

	Classification	Mitigation Working no apparent noise problems
	Description	Noise levels throughout the week are below the adopted threshold level throughout the survey period. No exceedences of L_{Amax} criteria attributable to the works.
	Action	Continue following best practice guidance as outlined in site environment plan
	Classification	Check Mitigation
	Description	Noise levels have increased to approaching the adopted threshold level and/or there have been a small number of exceedences of the L_{Amax} criteria attributable to the works.
	Action	Check mitigation is operating as anticipated and if further measures are appropriate.
	Classification	Further Review of Mitigation
	Description	Noise levels have exceeded the adopted threshold level and/or the L_{Amax} criteria are regularly exceeded during the survey period.
	Action	Review mitigation measures with Environmental Manager or Adviser to ensure current mitigation operating as intended and identify any other practicable mitigation measures

Measured daytime noise levels, Craig Street Measurement period 7th-December 2011 to 12th-December-2011



Construction Noise Thresholds

- Maximum noise level
- - - Monthly average total construction noise level

Measured Noise Levels

- Total daily noise level
- Total daily construction noise level
- Daily maximum noise level

(n) = Investigation Report Number

Note to Contractors: Daily L_{Aeq} values represent L_{Aeq} (10 hour Saturday, 11 hour Weekday) from total noise (construction and existing ambient). Monthly value is the logarithmic average construction noise over the calendar month, assessed against the threshold level. Daily $L_{Amax,F}$ represents the highest single event value over the daytime period, investigative reports into exceedances identify whether or not these values correspond to construction noise. Assessment category lines should be amended for each location. Sunday data have not been included as no construction works have been conducted during these hours. Data affected by adverse weather includes the following dates: 7-Dec to 10-Dec.

Day	Date	L _{Aeq}							L _{Amax}	
		Measured Baseline (NOTE: From ES or if new receptor as measured)	Daytime, L _{Aeq} (11 hour weekday, 10 hour Saturday) (NOTE: As measured during construction)	Inferred construction levels (See note below)	10 ^Δ Lp/10	Measured - Construction (difference)	Assessment Category Threshold (Daytime)	Monthly Average Construction (Logarithmic)	Daytime Lmax	Lmax Threshold
Wednesda	07/12/2011	65	63.3	55.0	316227.8	8	70	59	78	85
Thursday	08/12/2011	65	66.5	61.2	1304558.3	5	70	59	103	85
Friday	09/12/2011	65	64.0	55.0	316227.8	9	70	59	79	85
Saturday	10/12/2011	65	63.1	55.	2041736.9	0	70	59	81	85
Sunday	11/12/2011									
Monday	12/12/2011	65	65.5	55.9	385856.2	10	70	59	79	85

Average monthly construction noise (Logarithmic)

58.84