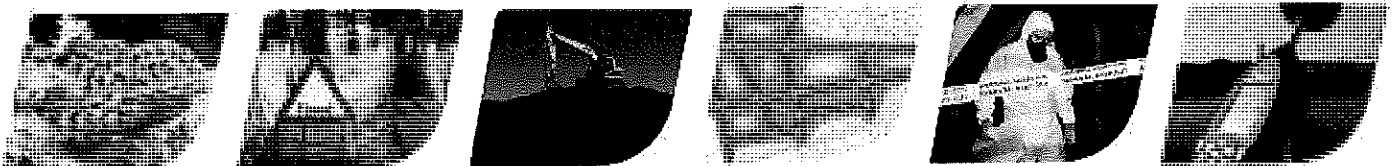


**M77/GSO  
ROAD NOISE SURVEY REPORT**

REC REFERENCE: AC101185-1R0

REPORT PREPARED FOR: CONNECT M77/GSO PLC

10<sup>TH</sup> MAY 2016



**QUALITY ASSURANCE**

Issue/revision	Issue 1	Revision 1	Revision 2
Remarks	Draft, for comment		
Date	10 <sup>th</sup> May 2016		
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Project number	AC101185-1r0		

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Appendix III	Noise Measurement Location Details
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## **1.0 INTRODUCTION**

### **1.1 Background**

Resource and Environmental Consultants Limited have been commissioned by Balfour Beatty Regional Civil Engineering Northern Division – Highway Maintenance on behalf of Connect M77/GSO plc to carry out noise measurements relating to the construction of the M77/GSO extension, Malletsheugh to Fenwick, and the Glasgow Southern Orbital (GSO) link from the M77 to East Kilbride.

The M77 and GSO roads were opened to traffic in April 2005. The contract documents for this project include the requirement to undertake noise surveys in accordance with the 'Memorandum on the Noise Insulation (Scotland) Regulations 1975 Regulations 3 and 6' (MNIR). These contract documents state that noise measurements should be taken 12 months after opening and further reassessments made in the 5th, 10th and 15th year following the original survey. The first noise measurement survey was carried out and reported by Mouchel Parkman Services Ltd in April 2006 with the second carried out and reported by Scotland Transerv in April 2012. This is the third noise survey report, undertaken in the 10th year after opening.

All acronyms used within this report are defined in the Glossary presented in Appendix II.

### **1.2 Location**

The extents of the noise survey included the GSO road from East Kilbride to Junction 5 of the M77, from Junction 5 of the M77 to the point where the M77 terminates and the A77 near Fenwick. The location of noise survey points can be seen on East Renfrewshire Council drawing numbers 96/006/48 and 96/018/137. Noise measurements were taken at 49 predetermined locations listed in the contract documents. A list of all measurement locations are provided in Table A3 of Appendix III.

### **1.3 Limitations**

The limitations of this report are presented in Appendix I.

### **1.4 Confidentiality**

REC has prepared this report solely for the use of the Client and those parties with whom a warranty agreement has been executed, or with whom an assignment has been agreed. Should any third party wish to use or rely upon the contents of the report, written approval must be sought from REC; a charge may be levied against such approval.

## 2.0 SURVEY METHODOLOGY

### 2.1 Equipment

Table 2.1 details the equipment used for the noise surveys.

Table 3.2: Noise and Vibration Measurement Equipment

Equipment Description	Manufacturer & Type No.	Serial No.	Calibration Due Date
Sound Level Meter	01dB-Metravib Fusion	10819	
Pre-amplifier	GRAS 40CE	10714	26 <sup>th</sup> May 2017
Microphone	01dB-Metravib	217637	
Calibrator	01dB-Metravib CAL-21	34554787	4 <sup>th</sup> June 2016
Sound Level Meter	01dB-Metravib Black Solo	65771	
Pre-amplifier	01dB-Metravib PRE 21 S	16539	19 <sup>th</sup> October 2017
Microphone	01dB Metravib MCE212	175280	
Calibrator	01dB-Metravib CAL-21	34634218	19 <sup>th</sup> October 2016

### 2.2 Methodology

REC has completed 15-minute sample measurements at each of the 49 locations in accordance with the MNIR.

The MNIR permits a shortened measurement methodology to undertake traffic noise surveys and this approach was adopted for the survey. The MNIR advises that road traffic noise measurement for periods lasting 15 minutes are sufficient at each location stating that:

*'For busy main roads it is usual to find that, apart from the morning and evening peak flows, there is a period between 10 am and 4 pm when the flow could be comparatively uniform. If in doubt in any particular case a check on traffic flow will be needed. Assuming however that this point is established a sample should be taken lasting 15 minutes and containing at least 200 readings. The L10 result so obtained would normally be about 2 dB(A) above that obtained from a survey covering the period 6 am to midnight.'*

This allows the 15 minute measurement to be factored to produce a L10 18 hour level which is used in the Noise Insulation (Scotland) Regulations 1975.

Letters were sent to each of the property owners to inform them of the survey works. These survey works were carried out over the following periods:

☞ Thursday 14<sup>th</sup> April 2016 – Thursday 21<sup>st</sup> April 2016 between 10:00 and 16:00.

At each measurement location the tripod mounted microphone was positioned 1 metre from the façade of the building with the microphone diaphragm aligned horizontally (grazing incidence). The weather protection system was put in place for each measurement. The microphone was calibrated to a reference tone of 94.0 dB before and after each measurement to check for drift. All calibrations were satisfactory.

The weather conditions during the Noise Surveys were conducive towards the measurement of environmental noise, being fine and dry with wind speeds of less than 5.0m/s. Details recorded at each location including time and date, weather and notes on the local environment can be seen in Table A3 in Appendix III.

### 3.0 RESULTS AND DISCUSSION

#### 3.1 Results

The  $L_{10}$  and  $L_{Aeq}$  results obtained at each measurement location can be found in Table A4 of Appendix IV. The  $L_{10}$  results were adjusted in accordance with the MNIR by subtracting 2dB to simulate an  $L_{10,18hour}$  noise level, these are also displayed in Table A4 of Appendix IV as "Adjusted  $L_{A10}$ ".

#### 3.2 Discussion

Regulation 3 of the Noise Insulation (Scotland) Regulations 1975 imposes a duty to carry out insulation work or to make grants in respect of carrying out such work where 'the use of a highway causes, or is expected to cause, noise at a level of not less than the specified level.' The specified level is stated as a L10 18hour value of 68 dB(A).

The measurement data shows that 2 corrected (-2dB) noise level measurements taken at properties are greater than or equal to the specified level set out in the regulations. The properties with recorded values above the specified level are shown in Table 3.1 below:

**Table 3.1: Properties with adjusted (-2dB)  $L_{A10}$  values above the specified level**

Location	$L_{Aeq}$ (dB)	Adjusted $L_{A10}$ (dB)
[Redacted]	72.2	74.6
[Redacted]	75.9	77.6
[Redacted]	70.8	72.5

Regulation 3 also states that along with exceeding the specified level of 68dB (A), the relevant noise level must also be greater by at least 1dB(A) than the prevailing noise level immediately before works for the construction of a highway or an additional carriageway were begun. The regulations also set out conditions relating to the eligibility of specific buildings and state that they apply specifically to 'residential buildings' or 'other buildings used for residential purposes'.

No preconstruction noise levels were made available to REC and so no conclusion about eligibility under the Noise Insulation (Scotland) Regulations 1975 can be reached.

#### 4.0 CONCLUSIONS AND RECOMMENDATIONS

Three properties, [Redacted] and [Redacted] were found to have factored  $L_{10,18\text{hour}}$  values of greater than or equal to the specified level of 68dB(A) set out in the Noise Insulation (Scotland) Regulations. It is recommended that the eligibility of these properties is further investigated in line with guidance provided in the regulations and the MNIR. Comparison should be made with preconstruction noise levels and a full 18 hour noise measurement could be used to provide more accurate results.

In line with the original contract requirements, further reassessments should be made in the 15<sup>th</sup> year following the original assessment.



1. This report and its findings should be considered in relation to the terms of reference and objectives agreed between REC Limited and the Client as indicated in Section 1.2.
2. REC cannot be held responsible for any use of the report or its contents for any purpose other than that for which it was prepared. The copyright in this report and other plans and documents prepared by REC is owned by them and no such plans or documents may be reproduced, published or adapted without written consent. Complete copies of this may, however, be made and distributed by the client as is expected in dealing with matters related to its commission. Should the client pass copies of the report to other parties for information, the whole report should be copied, but no professional liability or warranties shall be extended to other parties by REC in this connection without their explicit written agreement there to by REC.

## Noise

Noise is defined as unwanted sound. Human ears are able to respond to sound in the frequency range 20 Hz (deep bass) to 20,000 Hz (high treble) and over the audible range of 0 dB (the threshold of perception) to 140 dB (the threshold of pain). The ear does not respond equally to different frequencies of the same magnitude, but is more responsive to mid-frequencies than to lower or higher frequencies. To quantify noise in a manner that approximates the response of the human ear, a weighting mechanism is used. This reduces the importance of lower and higher frequencies, in a similar manner to the human ear.

Furthermore, the perception of noise may be determined by a number of other factors, which may not necessarily be acoustic. In general, the impact of noise depends upon its level, the margin by which it exceeds the background level, its character and its variation over a given period of time. In some cases, the time of day and other acoustic features such as tonality or impulsiveness may be important, as may the disposition of the affected individual. Any assessment of noise should give due consideration to all of these factors when assessing the significance of a noise source.

The most widely used weighting mechanism that best corresponds to the response of the human ear is the 'A'-weighting scale. This is widely used for environmental noise measurement, and the levels are denoted as dB(A) or  $L_{Aeq}$ ,  $L_{A90}$  etc., according to the parameter being measured.

The decibel scale is logarithmic rather than linear, and hence a 3 dB increase in sound level represents a doubling of the sound energy present. Judgement of sound is subjective, but as a general guide a 10 dB(A) increase can be taken to represent a doubling of loudness, whilst an increase in the order of 3 dB(A) is generally regarded as the minimum difference needed to perceive a change under normal listening conditions.

An indication of the range of sound levels commonly found in the environment is given in the following table.

**Table A1: Typical Sound Pressure Levels**

Sound Pressure Level dB(A)	Location
0	Threshold of hearing
20 - 30	Quiet bedroom at night
30 - 40	Living room during the day
40 - 50	Typical office
50 - 60	Inside a car
60 - 70	Typical high street
70 - 90	Inside factory
100 - 110	Burglar alarm at 1m away
110 - 130	Jet aircraft on take off
140	Threshold of pain

Acoustic Terminology

Table A2: Terminology

Descriptor	Definition
dB (decibel)	The scale on which sound pressure level is expressed. It is defined as 20 times the logarithm of the ratio between the root-mean-square pressure of the sound field and a reference pressure (2x10 <sup>-5</sup> Pa).
dB(A)	A-weighted decibel. This is a measure of the overall level of sound across the audible spectrum with a frequency weighting (i.e. 'A' weighting) to compensate for the varying sensitivity of the human ear to sound at different frequencies.
L <sub>Aeq, T</sub>	L <sub>Aeq</sub> is defined as the notional steady sound level which, over a stated period of time (T), would contain the same amount of acoustical energy as the A-weighted fluctuating sound measured over that period.
L <sub>Amax</sub>	L <sub>Amax</sub> is the maximum A-weighted sound pressure level recorded over the period stated. L <sub>Amax</sub> is sometimes used in assessing environmental noise where occasional loud noises occur, which may have little effect on the overall L <sub>eq</sub> noise level but will still affect the noise environment. Unless described otherwise, it is measured using the 'fast' sound level meter response.
L <sub>10</sub> & L <sub>90</sub>	If a non-steady noise is to be described it is necessary to know both its level and the degree of fluctuation. The L <sub>n</sub> indices are used for this purpose, and the term refers to the level exceeded for n% of the time. Hence L <sub>10</sub> is the level exceeded for 10% of the time and as such can be regarded as the 'average maximum level'. Similarly, L <sub>90</sub> is the 'average minimum level' and is often used to describe the background noise. It is common practice to use the L <sub>10</sub> index to describe traffic noise.
Free-field Level	A sound field determined at a point away from reflective surfaces other than the ground with no significant contributions due to sound from other reflective surfaces. Generally as measured outside and away from buildings.
Fast	A time weighting used in the root mean square section of a sound level meter with a 125 millisecond time constant.
Slow	A time weighting used in the root mean square section of a sound level meter with a 1000 millisecond time constant.

Table A3: Noise Measurement Location Details

Station	Location	Date/Time	Weather/Wind Speed	
M77 1	[Redacted]	14/04/2016 10:33	Sunny/dry 1.9m/s	The A77 runs k
M77 2	[Redacted]	14/04/2016 10:59	Sunny/dry 2.3m/s	The M77 has been built separa
M77 3	Kilmaurs Road	21/04/2016 13:24	Sunny/dry 1.3m/s	The house was in close pro which was used intermit
M77 4	Langside Fenwick	21/04/2016 15:00	Sunny/dry 2.8m/s	Open plan fields ran to the f and were hea
M77 5	Little Fenwick	14/04/2016 11:32	Sunny/dry 2.3m/s	Sheep could be heard in t
M77 6	[Redacted] Stewarton Road, Fenwick	21/04/2016 14:00	Sunny/dry 1.6m/s	The M77 was slightly raised fence
M77 7	Glaister Bridge	21/04/2016 13:43	Sunny/dry 2m/s	The M77 is built on
M77 8	[Redacted] Island Drive, Fenwick	21/04/2016 14:21	Sunny/dry 1.5m/s	Downward embankment bet
M77 9	[Redacted] Blackfauld Gardens, Fenwick	21/04/2016 14:40	Sunny/dry 1.8m/s	Open plan field
M77 10	Townend	21/04/2016 11:45	Sunny/dry 1.9m/s	Open plan field
M77 11	[Redacted]	21/04/2016 11:22	Sunny/dry 1.8m/s	Open plan fields ran downw running
M77 12	[Redacted]	21/04/2016 11:01	Sunny/dry 2.4m/s	[Redacted] was being use
M77 13	[Redacted]	21/04/2016 10:40	Sunny/dry 1m/s	The A77 runs b
M77 14	[Redacted]	20/04/2016 15:10	Sunny/dry 2.7m/s	The A77 runs along the f dc

M77 15	[Redacted]	20/04/2016 14:49	Sunny/dry 1m/s	Open plan field
M77 16	[Redacted]	14/04/2016 12:50	Sunny/dry 2.6m/s	The property was shi
M77 17	[Redacted]	14/04/2016 11:56	Sunny/dry 2.7m/s	The M77 was raised on a betwe
M77 18	[Redacted]	14/04/2016 13:11	Sunny/dry 2.2m/s	The M77 ran behind the hou
M77 19	[Redacted]	14/04/2016 13:36	Sunny/dry 2.3m/s	The M77 ran behind the hou
M77 20	[Redacted]	14/04/2016 14:01	Sunny/dry 2.2m/s	Open plan fields ran to the M and bar
M77 21	[Redacted]	14/04/2016 14:23	Sunny/dry 1.2m/s	Open plan field
M77 22	[Redacted]	19/04/2016 10:00	Sunny/dry 2.5m/s	The M77 was located to th
M77 23	[Redacted]	14/04/2016 15:00	Sunny/dry 2.6m/s	The M77 was located t
M77 24	[Redacted]	14/04/2016 15:21	Sunny/dry 1.7m/s	The A77 and M77 were loca of
M77 25	[Redacted]	14/04/2016 15:44	Sunny/dry 0.9m/s	The building was located on the bc
GSO 1	[Redacted] Mearnskir	19/04/2016 10:28	Sunny/dry 2.2m/s	The property was screened b
GSO 2	[Redacted] M'kirk	19/04/2016 11:10	Sunny/dry 1.3m/s	The property was screened b
GSO 3	[Redacted] Titwood Road	19/04/2016 11:32	Sunny/dry 0.6m/s	Propert
GSO 4	[Redacted] , Titwood Road	19/04/2016 11:53	Sunny/dry 1.5m/s	There was a quiet road
GSO 5	[Redacted]	19/04/2016 12:16	Sunny/dry 0.8m/s	Open plan fields ran

GSO 6	[Redacted]	19/04/2016 12:38	Sunny/dry 2.2m/s	Open plan fields ran
GSO 7	[Redacted]	19/04/2016 13:03	Sunny/dry 2.8m/s	Open plan fields ran f
GSO 8	[Redacted]	19/04/2016 13:29	Sunny/dry 1.3m/s	Mostly open plan f
GSO 9	[Redacted]	19/04/2016 13:50	Sunny/dry 2.3m/s	Open plan field
GSO 10	[Redacted]	19/04/2016 14:16	Sunny/dry 2.4m/s	Open plan fields ran
GSO 11	[Redacted]	19/04/2016 14:57	Sunny/dry 1.7m/s	Open plan field
GSO 12	[Redacted]	19/04/2016 14:38	Sunny/dry 1m/s	Glasgow Road ran to the e; north with an open pla
GSO 13	[Redacted]	19/04/2016 15:18	Sunny/dry 2.2m/s	Glasgow Road ran to the e; south mitigate
GSO 14	[Redacted]	19/04/2016 15:43	Sunny/dry 1.4m/s	Large back garden wit
GSO 15	[Redacted]	20/04/2016 10:00	Sunny/dry 1.3m/s	There were sheep in the fron the survey. The GSC
GSO 16	[Redacted]	-	-	Property has bi
GSO 17	[Redacted]	20/04/2016 10:26	Sunny/dry 1.3m/s	There was a row of tree
GSO 18	[Redacted]	20/04/2016 10:48	Sunny/dry 2.4m/s	There was open plan lands
GSO 19	[Redacted]	-	Sunny/dry 1.7m/s	Replaced by row of 1
GSO 20	[Redacted]	20/04/2016 11:09	Sunny/dry 1.3m/s	There is a railway located b pa
GSO 21	[Redacted]	20/04/2016 11:29	Sunny/dry 0.5m/s	The building was next

GSO 22	[Redacted]	20/04/2016 11:48	Sunny/dry 2.3m/s	A car park was located betwe
GSO 23	[Redacted]	20/04/2016 12:15	Sunny/dry 1.5m/s	The On-ramp for the GSO at to the building. [Redacted]
GSO 24	[Redacted]	20/04/2016 12:15	Sunny/dry 1.3m/s	There was a raised ca
GSO 25	[Redacted]	20/04/2016 13:41	Sunny/dry 1.2m/s	There was a car park sui or
GSO 26	[Redacted]	20/04/2016 14:10	Sunny/dry 1.2m/s	The building had a car park occasio

Table A4: Noise Measurement Results

Survey ID	Location	Sound Level (L <sub>50</sub> - Statistical Measurement (dB))		
		Leq	Lmax	Reference L <sub>50</sub>
M77 1	[Redacted]	49.1	50	48
M77 2	[Redacted]	72.2	74.6	72.6
M77 3	Kilmaurs Road	61.9	63.3	61.3
M77 4	Langside Fenwick	53.7	56.1	54.1
M77 5	Little Fenwick	54.4	55.7	53.7
M77 6	[Redacted] Stewarton Road, Fenwick	63.6	66.9	64.9
M77 7	Glaister Bridge	58.5	62.9	60.9
M77 8	[Redacted] Rysland Drive, Fenwick	60.4	62.2	60.2
M77 9	[Redacted] Blackfauld Gardens, Fenwick	57.5	60.6	58.6
M77 10	Townend	45.2	46.7	44.7
M77 11	[Redacted]	57.6	60.8	58.8
M77 12	[Redacted]	63.2	65.2	63.2
M77 13	[Redacted]	58.9	59.6	57.6
M77 14	[Redacted]	61.8	64.3	62.3
M77 15	[Redacted]	53.9	56.9	54.9
M77 16	[Redacted]	55.5	58.9	56.9
M77 17	[Redacted]	58.2	60.2	58.2
M77 18	[Redacted]	52.5	55.2	53.2
M77 19	[Redacted]	52.8	56.8	54.8
M77 20	[Redacted]	56	58.1	56.1
M77 21	[Redacted]	53.1	55.2	53.2
M77 22	[Redacted]	49.8	52.5	50.5



M77 23	[Redacted]	60.1	61.7	59.7
M77 24	[Redacted]	75.9	77.6	75.6
M77 25	[Redacted]	70.8	72.5	70.5
GSO 1	[Redacted] Mearnskirk	52.8	55.1	53.1
GSO 2	[Redacted] , M'kirk	56	58.3	56.3
GSO 3	[Redacted] Titwood Road	57.4	60.1	58.1
GSO 4	[Redacted] , Titwood Road	52.6	54.6	52.6
GSO 5	[Redacted]	56.7	59	57
GSO 6	[Redacted]	58.9	61.7	59.7
GSO 7	[Redacted]	56.7	59	57
GSO 8	[Redacted]	52.2	54	52
GSO 9	[Redacted]	50.5	53	51
GSO 10	[Redacted]	47	50.2	48.2
GSO 11	[Redacted]	46.8	47.2	45.2
GSO 12	[Redacted]	57.5	59.7	57.7
GSO 13	[Redacted]	62.6	66.4	64.4
GSO 14	[Redacted]	54.7	55.4	53.4
GSO 15	[Redacted]	49.6	52.4	50.4
GSO 16	Property has been rebuilt, no measurement taken			-2
GSO 17	[Redacted]	54	56	54
GSO 18	[Redacted]	54.3	55.7	53.7
GSO 19	Replaced by row of terraced houses, no measurement taken			-2
GSO 20	[Redacted]	56.4	56.1	54.1
GSO 21	[Redacted]	57.4	60.3	58.3
GSO 22	[Redacted]	60	61.4	59.4

GSO 23	[Redacted]	56.7	58.6	56.6
GSO 24	[Redacted]	58.2	60.6	58.6
GSO 25	[Redacted]	60.5	62.9	60.9
GSO 26	[Redacted]	64	67.9	65.9

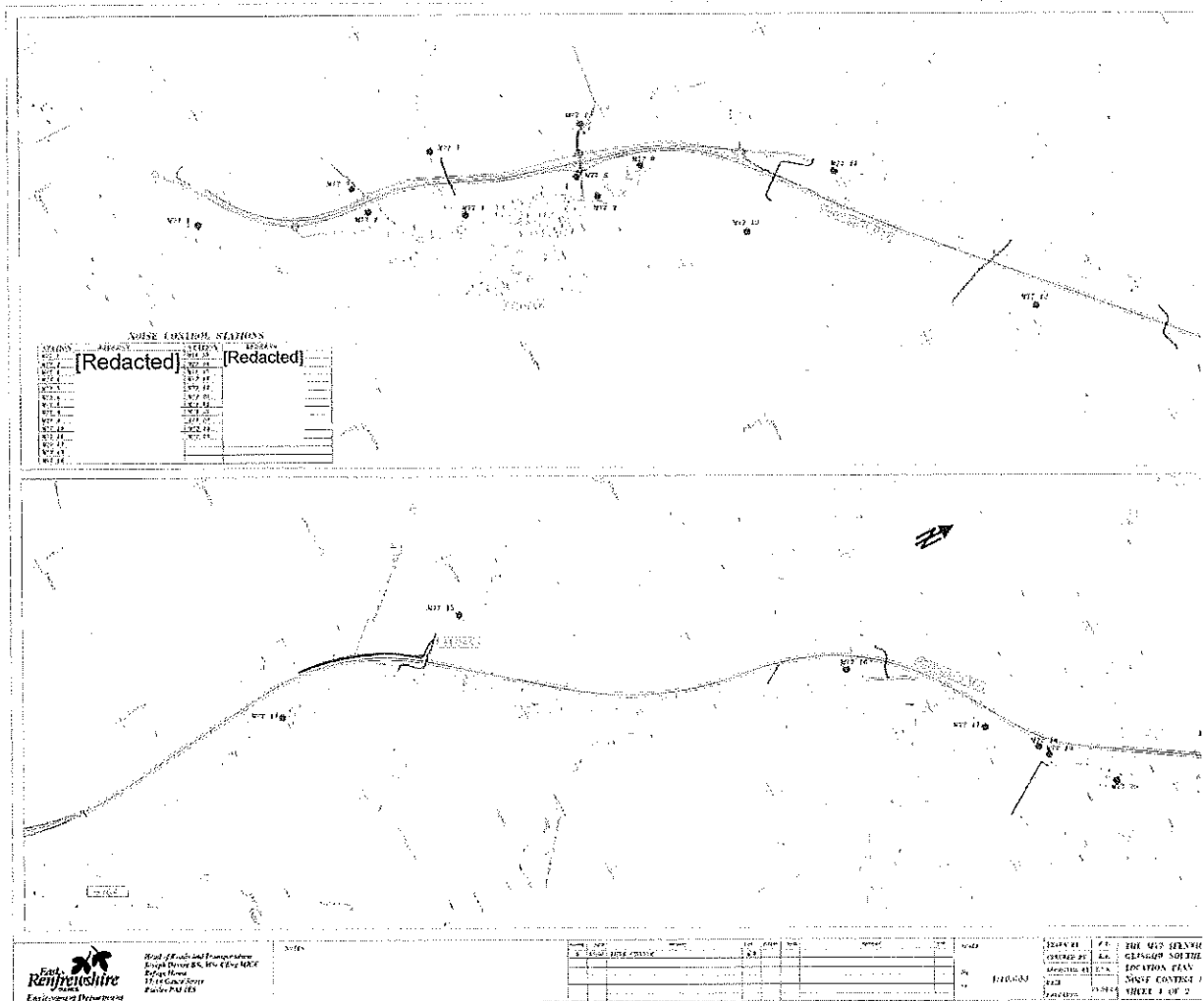
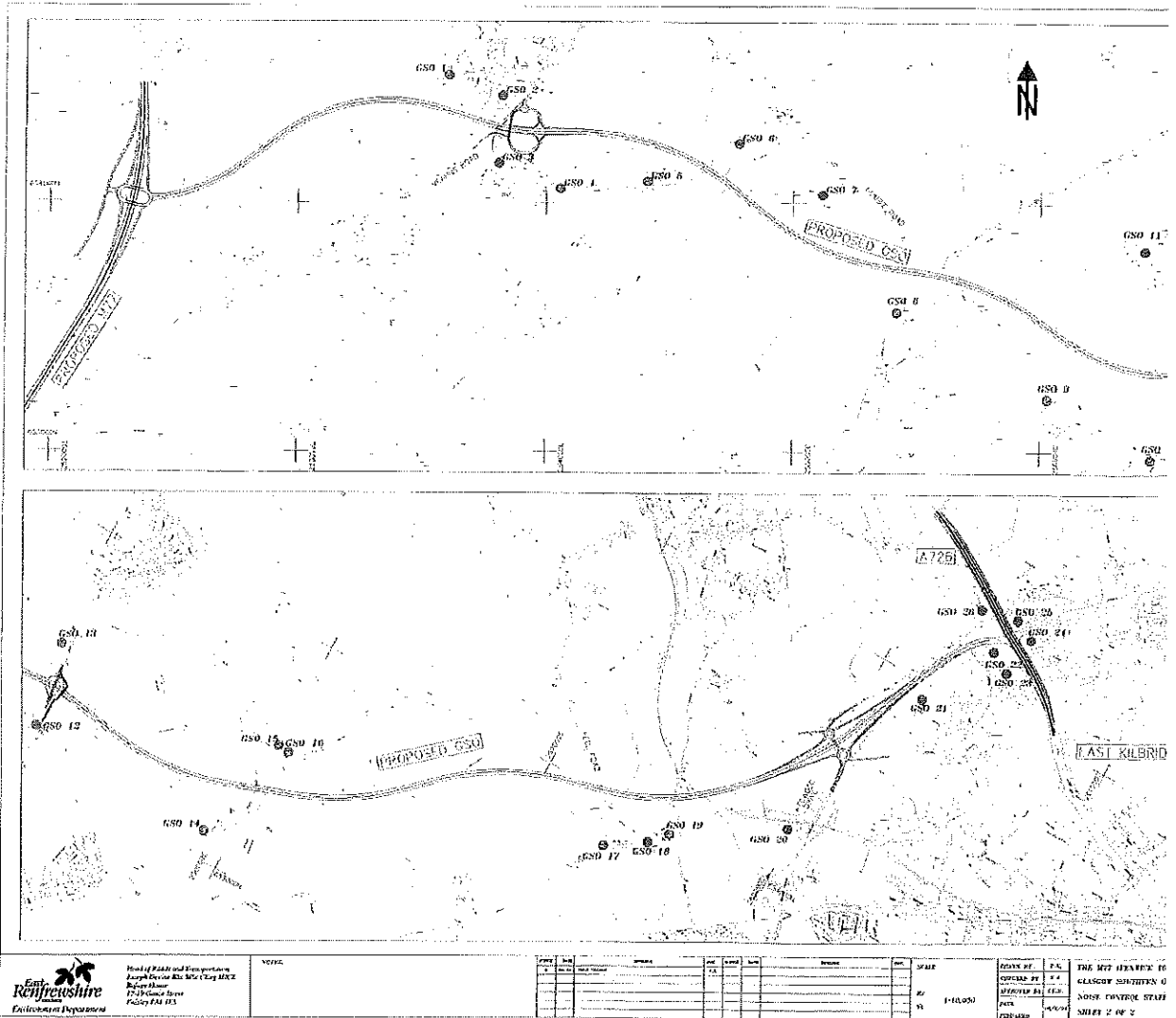


Figure 17.2 - SECTION OF W17.2 NOISE CONTOUR PREDICTIONS



**East Kintyre**  
 Environmental Department

Head of Public and Environmental  
 Department  
 12/12/2014  
 12/12/2014

NOTE:

NOISE	DATE	BY	REVISION	DESCRIPTION
1	12/12/2014	...	...	...

SCALE: 1:10,000  
 DATE: 12/12/2014  
 PROJECT: ...  
 SHEET 2 OF 2