

Contractor



Forth Crossing Bridge Constructors

HOCHTIEF Solutions American Bridge International DRAGADOS Morrison Construction

Project

FORTH REPLACEMENT CROSSING

Document title

VIBRATION MONITORING REPORT MAY 2012 TO JULY 2012

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INTRODUCTION

- **1.1.** In accordance with the Code of Construction Practice (CoCP) and Noise and Vibration Management Plan, FCBC have risk assessed all construction activities through the PCNV process.
- **1.2.** During the preparation of the PCNVs, assessment/prediction of vibration levels showed that no plant or equipment used, or construction activity carried out was envisaged to induce any level of vibration at receptors that would exceed threshold levels of vibration in the CoCP. This assessment/prediction was confirmed by means of permanent vibration monitoring.



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2. MONITORING SUMMARY

- 2.1. Due to the location and sensitivity of vibration monitoring equipment, the exceedances presented in the graphs included in the appendices of this report do not represent levels generated by construction, but rather show local interference around the monitoring equipment. This can include doors being slammed or movement close to the location of the Vibrock causing elevated vibration levels.
- **2.2.** According to the BS5228-2 (2009) there is hardly any documented proof of actual damage to structures or their finishes, and damage resulting solely from well-controlled construction and demolition vibrations is rare. There are many other mechanisms which cause damage, especially in decorative finishes, and it is often incorrectly concluded that vibrations from construction and demolition sites are to blame. It is not possible to ascertain the exact cause of vibration, though it is possible to rule out construction as a cause on an activity basis.
- **2.3.** The works carried out in each construction area as well as vibration assessments of the works are summarised in Appendix A.
- **2.4.** Due to the distance between the works and the receptors and the methods of working the risk of damage to structures or nuisance to the residents due to vibration is highly unlikely.
- **2.5.** The number of exceedances during construction are shown in Table 1 below.



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Table 1- Exceedances of thresholds set out in the COCP

May

	PPV Exc	eedance	VDV Exc	eedance
Location	Continuous (5 mm.s ⁻¹)	Intermittent (10 mm.s ⁻¹)	Day (0.4 m.s ^{-1.75})	Night (0.2 m.s ^{-1.75})
Clufflat Brae	8	19	0	20
5 Linn Mill	4	8	1	15
Barracks West	0	0	0	0
Butlaw Fisheries	0	0	0	0
Dundas Home Farm	0	0	0	5
Echline	0	0	0	0
Inchgarvie Lodge	1	0	0	0
Springfield	0	0	5	13
Tigh ni Grian	1	0	0	0
Newton	0	3	5	4
Scotstoun	0	20	15	0
Whinnyhill	3	7	0	0

June

	PPV Exc	eedance	VDV Exc	eedance
Location	Continuous (5 mm.s ⁻¹)	Intermittent (10 mm.s ⁻¹)	Day (0.4 m.s ^{-1.75})	Night (0.2 m.s ^{-1.75})
Clufflat Brae	0	5	0	0
5 Linn Mill	1	2	0	4
Barracks West	0	0	0	0
Butlaw Fisheries	1	0	0	0
Dundas Home Farm	1	0	0	1
Inchgarvie Lodge	0	0	0	0
Springfield	2	0	5	12
Tigh ni Grian	3	2	0	0
Newton	0	31	21	30
Scotstoun	0	0	0	0
Whinnyhill	1	9	0	0

July

	PPV Exceedance VDV Ex		VDV Exc	ceedance	
Location	Continuous (5 mm.s ⁻¹)	Intermittent (10 mm.s ⁻¹)	Day (0.4 m.s ^{-1.75})	Night (0.2 m.s ^{-1.75})	
5 Linn Mill	1	12	0	0	
Barracks West	0	0	0	0	
Butlaw Fisheries	0	0	0	0	
Dundas Home Farm	2	0	1	1	
Inchgarvie Lodge	1	0	0	0	
Springfield	0	0	25	26	
Tigh ni Grian	7	6	5	4	
Scotstoun	0	0	0	0	

Forth Crossing Bridge Constructors - A Joint Venture of Hochtief Solutions AG, American Bridge International, Dragados, S.A. and Galliford Try Infrastructure Limited (Trading as Morrison Construction)



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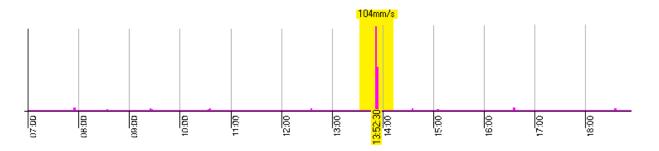
- 2.6. Peak Particle Velocity (PPV) is used to measure vibration through a solid surface. When a vibration is measured, the point at which the measurement takes place can be considered to have a particle velocity. This particle vibration will take place in three dimensions (x, y and z).
- **2.7.** The Peak Particle Velocity is the highest velocity that is recorded during a particular event, and as such is appropriate for the measurement of activities such as blasting and piling. The thresholds for the Forth Replacement Crossing are 5 mm.s⁻¹ for continuous construction (e.g. piling) and 10 mm.s⁻¹ for intermittent construction (i.e. blasting).
- **2.8.** These thresholds are set to protect against building damage. For this monitoring period, all the exceedances have been investigated thoroughly and seem to be generated due to standalone, instantaneous events most probably as a result of unknown local interferences. There was no construction activity within 300m of the receptors which could cause such exceedances.
- **2.9.** Vibration Dose Value (VDV) is a metric used in vibration monitoring. It is calculated by taking the fourth root of the integral of the fourth power of acceleration after it has been frequency-weighted. The frequency-weighted acceleration is measured in m.s⁻² and the time period over which the VDV is measured is in seconds. This yields VDVs in m.s^{-1.75}
- 2.10. During the monitoring period, vibratory rollers were used intermittently at several locations around the site in the construction of haul roads. Due to the distances of the rollers away from any receptors none of the exceedances in VDV levels can be associated with the use of vibratory rollers.
- 2.11. In addition, detailed investigation of all exceedances (i.e. review of PPV levels over 30 seconds periods) has shown that each resulted from isolated, non-construction related events, which occurred adjacent to the transducer. Below is an example of one of such investigation, an exceedance of 104



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mm.s⁻¹, which occurred on 23/11/11. As can be seen, this was an isolated event which appears to be due to sources other than construction activities.

	Calibrate by: SEP 12							
Ev 011				-				
Cont	Max	Time	Date					
Event	104mm/s	13:52:30	23/11/11					
Hour 1	.725mm/s	07:54:10	23/11/11					
Hour 2	.275mm/s	08:34:10	23/11/11					
Hour 3	.400mm/s	09:25:10	23/11/11					
Hour 4	.425mm/s	10:34:50	23/11/11					
Hour 5	.175mm/s	11:00:10	23/11/11					
Hour 6	.600mm/s	12:35:00	23/11/11					
Hour 7	104mm/s	13:52:30	23/11/11					
Hour 8	.475mm/s	14:35:10	23/11/11					
Hour 9	.325mm/s	15:05:30	23/11/11	-				
•			•					



- **2.12.** Within the Appendix B, there are short gaps of missing data in the PPV and VDV graphs. These occurred as a result of:
 - The occasional relocation of Vibrocks for rock blasts; or
 - Short power cuts, causing the Vibrock to power down until manually reset; or
 - Vibrocks being sent back to the supplier for emergency maintenance, as data could not be retrieved.



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3. Conclusion

- **3.1.** Considering the distance between construction works and the above receptors, and the methods of working utilised, the risk of damage to structures or nuisance to residents resulting from vibration is highly unlikely.
- **3.2.** Due to the location and sensitivity of vibration monitoring equipment, the exceedances presented in the graphs included in the appendices of this report do not represent levels generated by construction, but rather show local interference around the monitoring equipment. This may include, for example, the slamming of doors or other movements nearby the monitoring equipment location, which result in elevated vibration levels.

APPENDIX A – VIBRATION ASSESSMENTS OF RELEVANT PCNVs



Relevant PCNV No.	Relevant Date	PCNV Name	Particulars of works to be carried out	Vibration Assessment
PCNV0011 (Rev 02)	May 12 to Jun 12	Main Crossing- Bridge Works Area	 S7 Foundation – Construction of S7 foundation S8 Foundation – Construction of S8 foundation N2 Foundation – Construction of N2 foundation including drilling shot holes for blasting. Construction of Working Platform at S6 as well as Construction of S6 foundation. 	 PPV: Nearest property to the works is Inchgarvie House which is an average 64m from foundation S8. All other works are on average over 100m from the works. A predicted vibration level assessment is presented in Appendix 6. The highest levels of vibration are likely to be generated by the vibratory roller during the hard-standing preparation. Hydraulic rock breakers which would typically generate 4.5 mm/s @ 5m, 0.4 @ 20m, 0.1 @ 50m will not generated appreciable levels of vibration levels due to the distance from the closest receptor. Equipment to be used in all other activities do not generate appreciable levels of vibration and therefore no assessment has been undertaken. VDV: Nearest property to the works is Inchgarvie House which is on average 64m from foundation S8. Therefor this property has been assessed as it will be the most likely to have an effect on the human response to vibration. An estimated VDV assessment is presented in Appendix 6. The estimated VDV are calculated using the calculation methodology provided in DMRB Stage 3 Environmental Statement Chapter 19 Section 19.6.21. Assessment Criteria as defined in British Standard 6472:2008 and Tables 19.11 and 19.12 of DMRB Stage 3 Environmental Statement. This method will over-estimate VDV and therefore represents a conservative approach. Once works start these levels will be closely monitored and actual VDV levels will be taken from monitoring equipment.



Relevant PCNV No.	Relevant Date	PCNV Name	Particulars of works to be carried out	Vibration Assessment
PCNV0014	May 12 to July 12	Dredging Works	To enable the foundation of each bridge pier to be constructed the estuary bed will need to be dredged. It is anticipated that circa 122,000 cu m will need to be removed for the southern tower and piers S1 to S6 and 50,000 cu m from the northern tower and pier N1. The dredging will be completed by the following plant: • Spud dredger for works within the access channel. • Cable crawler excavator to remove soil from within the caissons.	Given the nature of the marine works there are no predicted vibration impacts from the proposed techniques for excavation of loosened material. Therefore no vibration assessment has been carried out.
PCNV0020	May 12 to July 12	Marine Foundation Works	Construction of the foundations for S2 to S5, N1 and the North, Central and South Towers.	Due to the distance between the works and the nearest sensitive properties and the method of working renders the risk of damage to structures due to vibration as highly unlikely.
PCNV0021	May 12 to July 12	South Earthworks	 Earthworks – cut and fill operations including excavation and deposition of rock Drainage – pre earthworks, temporary, outfall, attenuation, chambers, headwalls, culverts, carriageway Road work operations Utility diversions – electric, water, sewerage, gas, BT Site Clearance 	PPV: Nearest property to the works is Inchgarvie House which is an average 83m from work area. All other works are on average over 100m from the works. A predicted vibration level assessment is presented in Appendix 6. The highest levels of vibration are likely to be generated by the vibratory roller during the compaction of sub-base and various road layers. Hydraulic rock breakers which would typically generate 4.5 mm/s @ 5m, 0.4 @ 20m, 0.1 @ 50m will not generated appreciable levels of vibration levels due to the distance from the closest receptor. Equipment to be used in all other activities do not generate appreciable levels of vibration and therefore no assessment has been undertaken.



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Relevant PCNV No.	Relevant Date	PCNV Name	Particulars of works to be carried out	Vibration Assessment
PCNV0008 (Mod02)	May 12 to July 12	Construction of BP Protection Works	Extension to the programme of PCNV 0008 with the addition of Construction of BP Protection Works. These works are to allow BP Specialist Works to be carried out on the Oil Line.	As per PCNV 0008 Section 8, all equipment to be used in these activities do not generate appreciable levels of vibration and therefore no assessment has been undertaken.
PCNV0014	May 12 to July 12	Dredging Works	To enable the foundation of each bridge pier to be constructed the estuary bed will need to be dredged. It is anticipated that circa 122,000 cu m will need to be removed for the southern tower and piers S1 to S6 and 50,000 cu m from the northern tower and pier N1. The dredging will be completed by the following plant: • Spud dredger for works within the access channel. • Cable crawler excavator to remove soil from within the caissons.	Given the nature of the marine works there are no predicted vibration impacts from the proposed techniques for excavation of loosened material. Therefore no vibration assessment has been carried out.
PCNV0020	May 12 to July 12	Marine Foundation Works	Construction of the foundations for S2 to S5, N1 and the North, Central and South Towers.	Due to the distance between the works and the nearest sensitive properties and the method of working renders the risk of damage to structures due to vibration as highly unlikely.



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Springfield, Echline Relevant Conversion Con					
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PCNV0008 (Mod02)	May 12 to July 12	Construction of BP Protection Works	Extension to the programme of PCNV 0008 with the addition of Construction of BP Protection Works. These works are to allow BP Specialist Works to be carried out on the Oil Line.	As per PCNV 0008 Section 8, all equipment to be used in these activities do not generate appreciable levels of vibration and therefore no assessment has been undertaken.	
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PCNV0014	May 12 to July 12	Dredging Works	To enable the foundation of each bridge pier to be constructed the estuary bed will need to be dredged. It is anticipated that circa 122,000 cu m will need to be removed for the southern tower and piers S1 to S6 and 50,000 cu m from the northern tower and pier N1. The dredging will be completed by the following plant: • Spud dredger for works within the access channel. • Cable crawler excavator to remove soil from within the caissons.	Given the nature of the marine works there are no predicted vibration impacts from the proposed techniques for excavation of loosened material. Therefore no vibratior assessment has been carried out.
PCNV0015	May 12 to July 12	Blasting North Network	 4 blasts at St Margaret's Hope Traffic Management Loading of the explosives. Firing of the explosives to create a blast at St Margret's Hope. 	A protective vibration level of less than 10mm.s ⁻¹ has been maintained for the Queensferry Hotel. Queensferry Hotel has been identified as the only occupied receptor to be within sufficient distance to be effected by blasting at St Margret's Hope. A review of sensitive properties and structures identifies th following closest receptors to St Margret's Hope: Radar Station, Admiralty House, St Margaret's Hope Lodge, Queensferry Hotel. These receptors are deemed to conservatively protect other structures further away. Vibration monitors for air over pressure and ground vibration have been installed at each location.
PCNV0020	May 12 to July 12	Marine Foundation Works	Construction of the foundations for S2 to S5, N1 and the North, Central and South Towers.	Due to the distance between the works and the nearest sensitive properties and the method of working renders th risk of damage to structures due to vibration as highly unlikely.



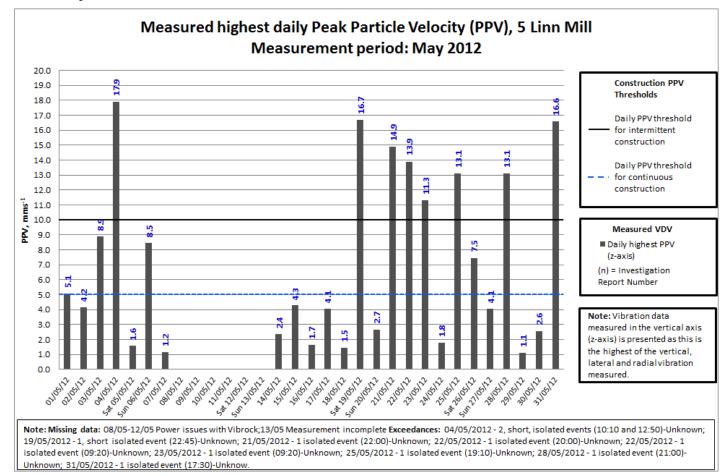
Tigh-ni Grian						
Relevant PCNV No.	Relevant Date	PCNV Name	Particulars of works to be carried out	Vibration Assessment		
PCNV0010	July 12 -	North 1 Works	Drilling Shot Holes; Removal of Blasted Rock; Structure; Filling; Removal of Blasted Rock; Soil Mixing; Piled Embankment; Sewer Diversions; Working Platform; Ground Improvement.	The equipment to be used in these activities do not generate appreciable levels of vibration, also the distances to the closest occupied receptors are over 300m so therefore no assessment has been undertaken.		



HOCHTIEF Solutions American Bridge International DRAGADOS Morrison Construction

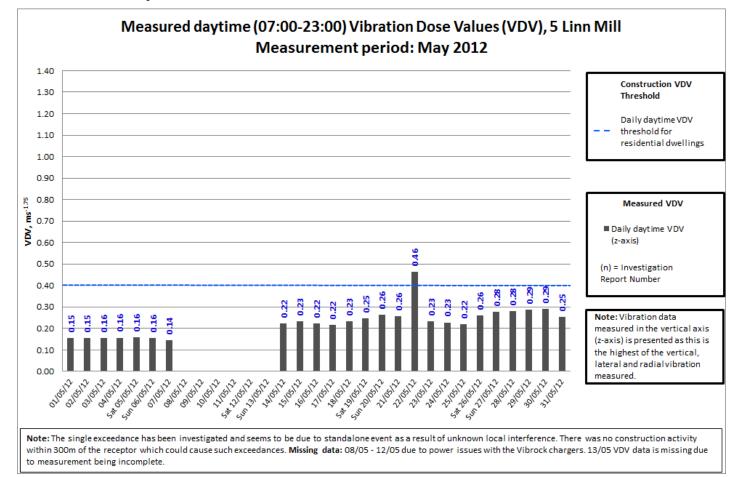
APPENDIX B – VIBRATION GRAPHS





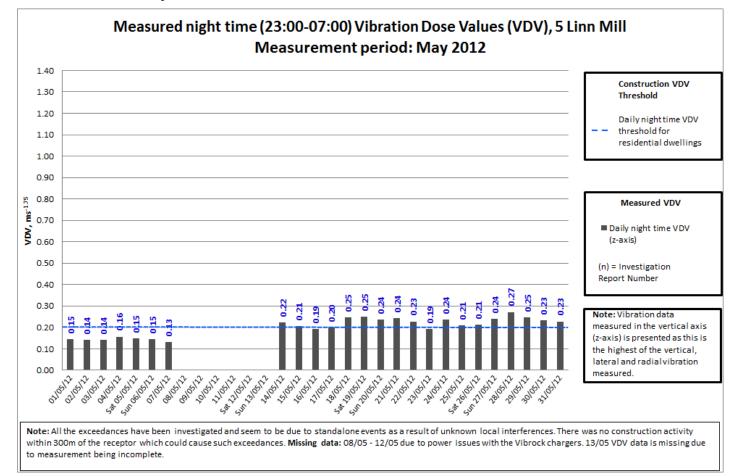
PPV at 5 Linn Mill – May 2012





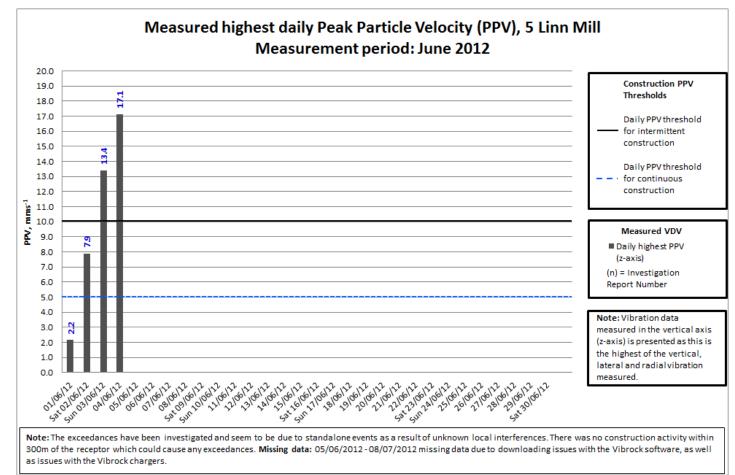
Daytime VDV at 5 Linn Mill – May 2012





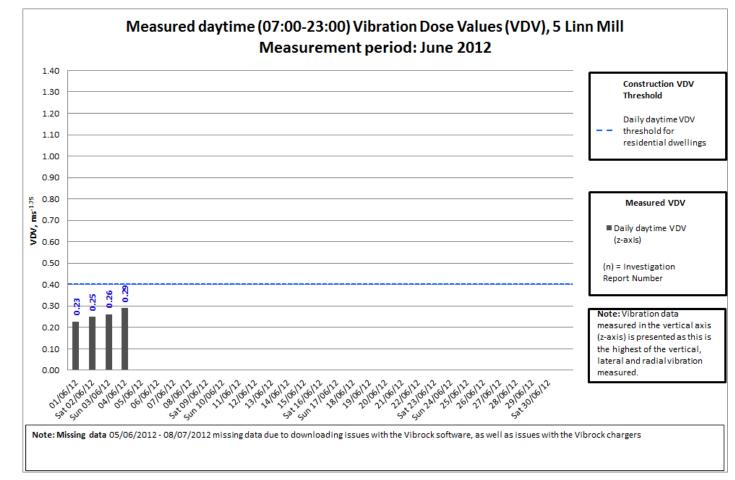
Night-time VDV at 5 Linn Mill – May 2012





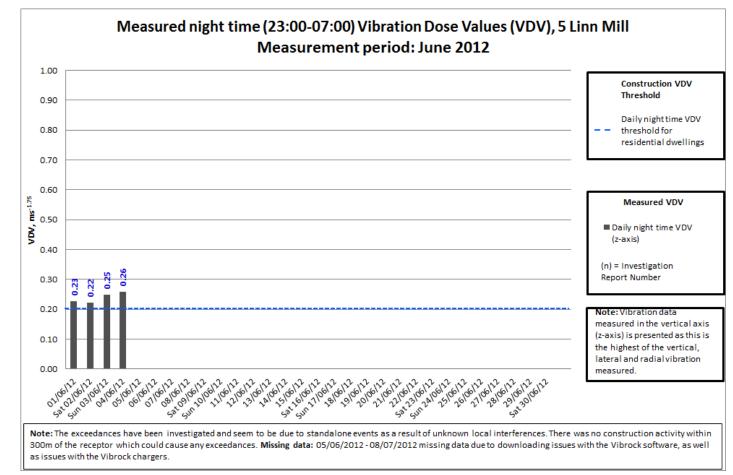
PPV at 5 Linn Mill – June 2012





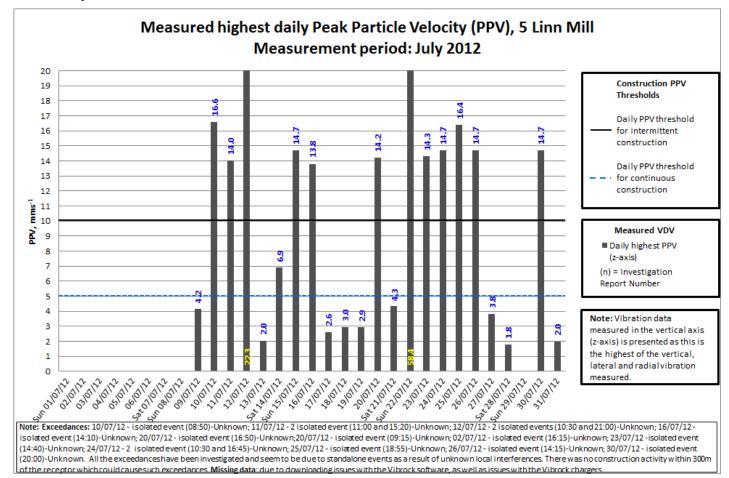
Daytime VDV at 5 Linn Mill – June 2012





Night-time VDV at 5 Linn Mill – June 2012

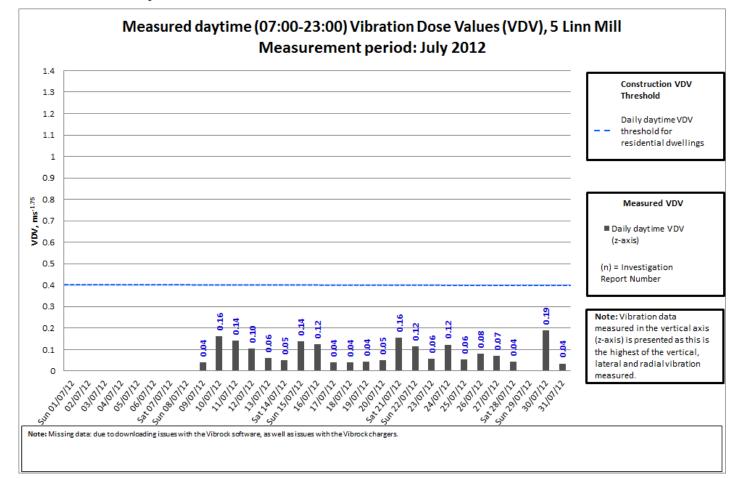




PPV at 5 Linn Mill – July 2012

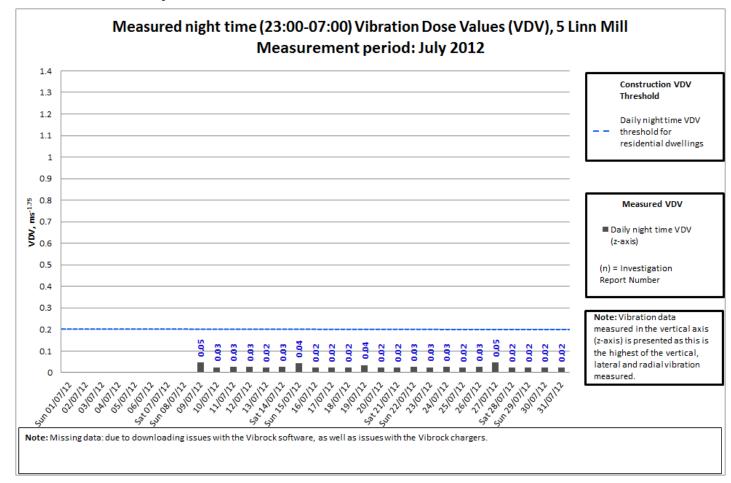
Forth Crossing Bridge Constructors - A Joint Venture of Hochtief Solutions AG, American Bridge International,





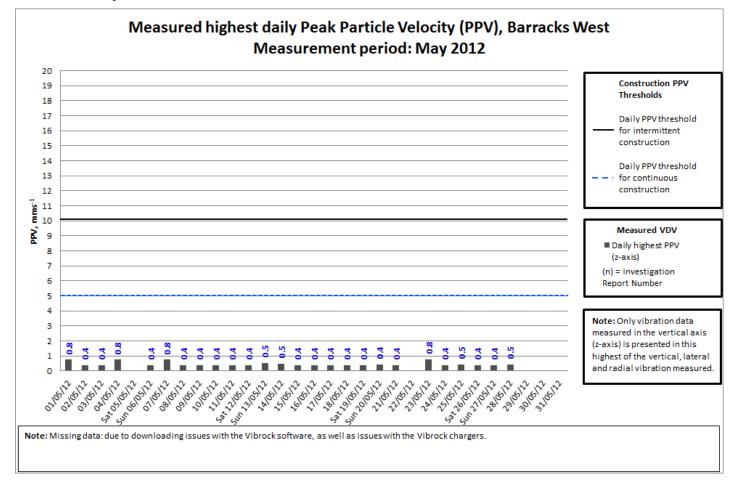
Daytime VDV at 5 Linn Mill – July 2012





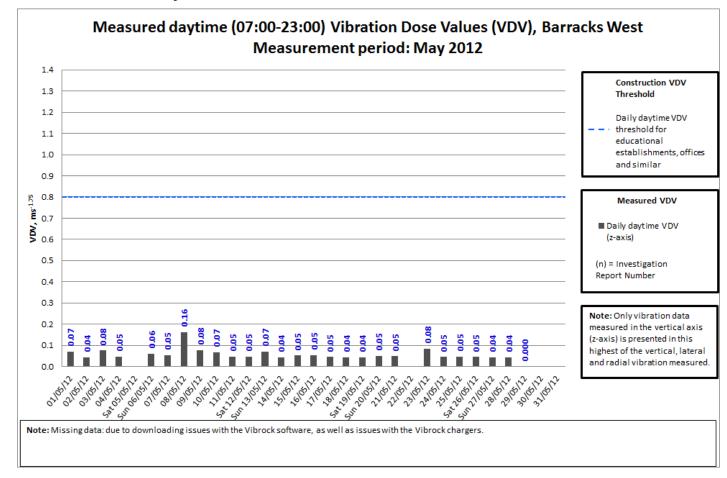
Night-time VDV at 5 Linn Mill – July 2012





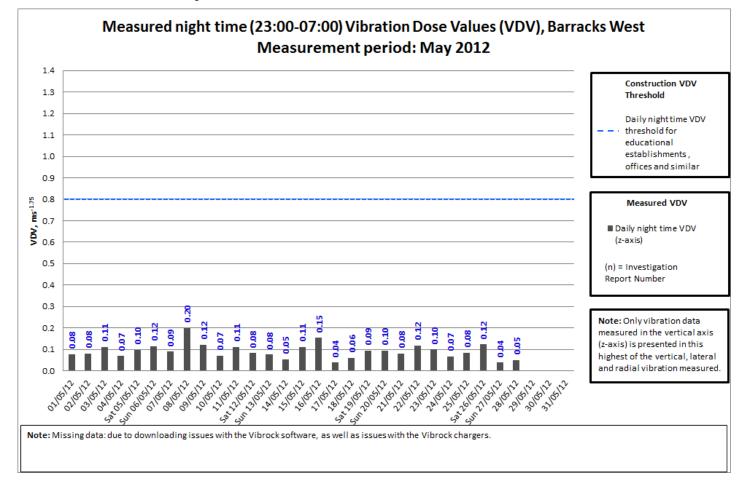
PPV at Barracks West – May 2012





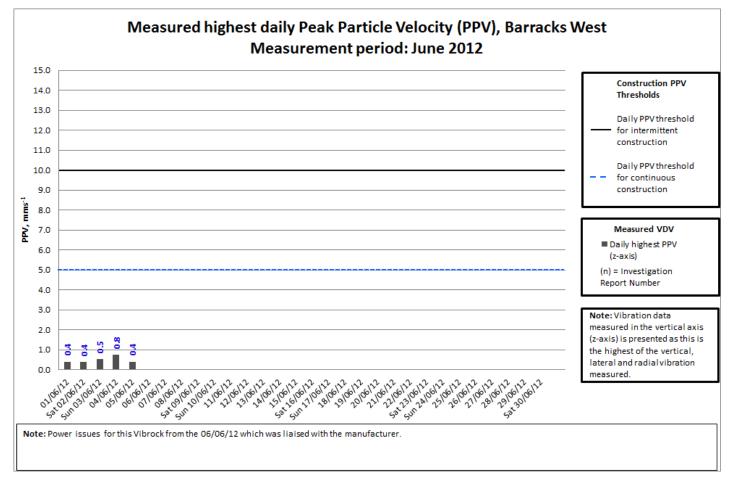
Daytime VDV at Barracks West – May 2012





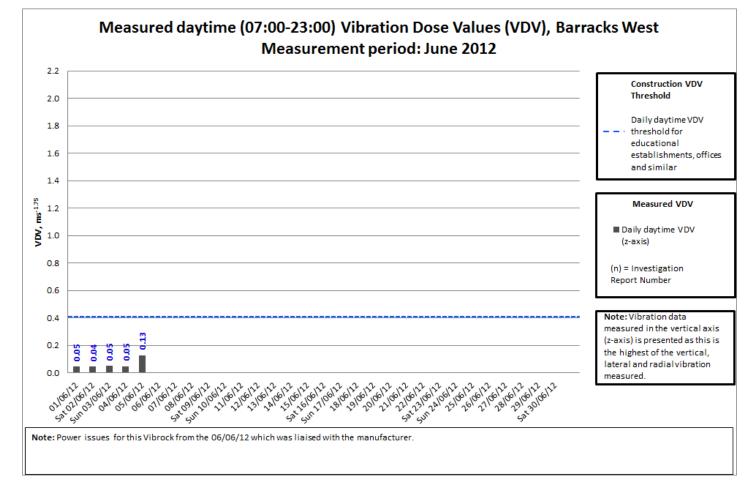
Night-time VDV at Barracks West – May 2012





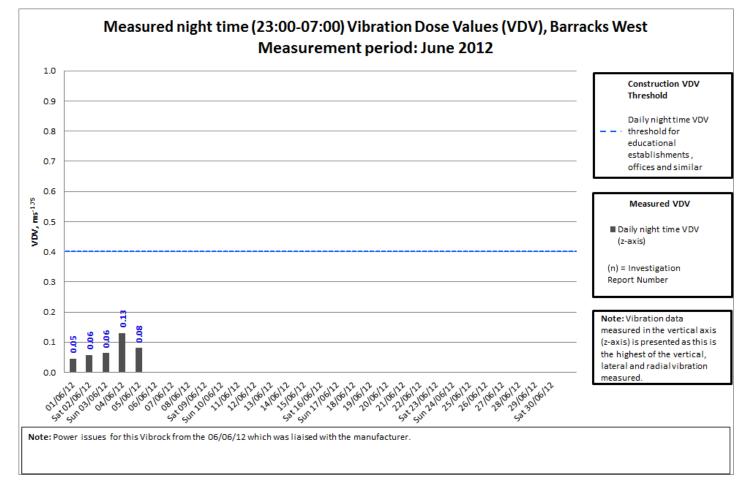
PPV at Barracks West – June 2012





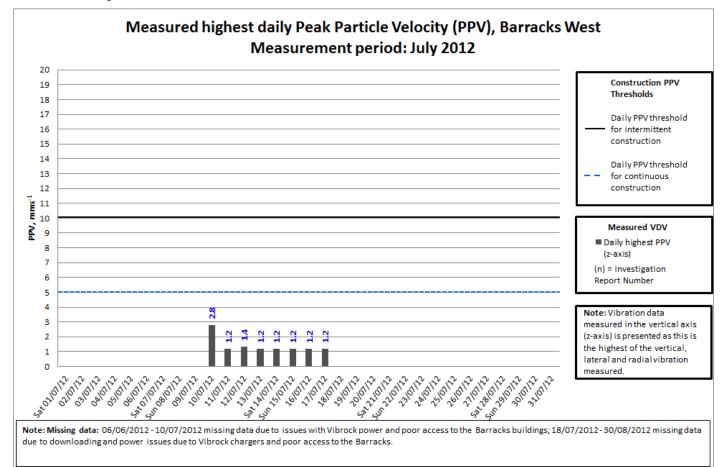
Daytime VDV at Barracks West – June 2012





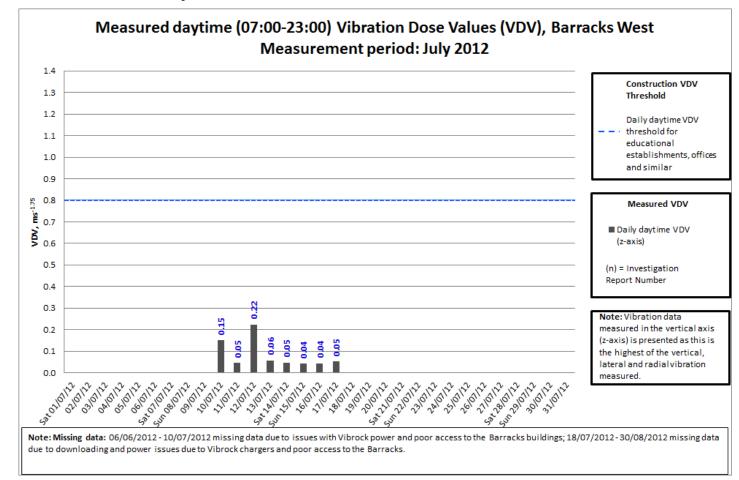
Night-time VDV at Barracks West – June 2012





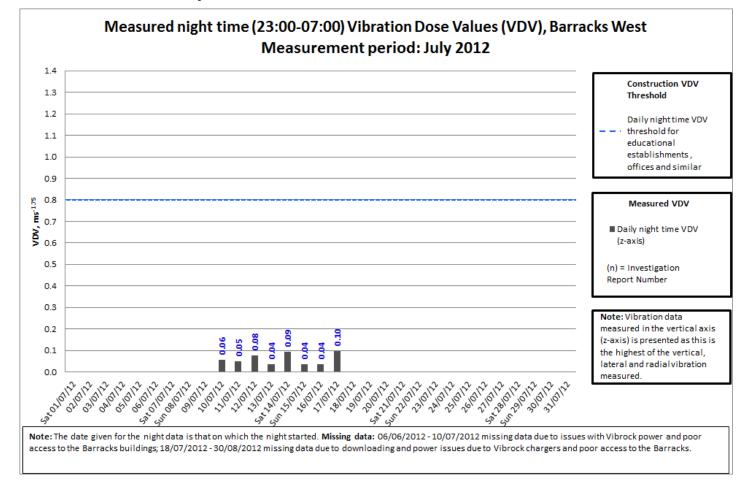
PPV at Barracks West – July 2012





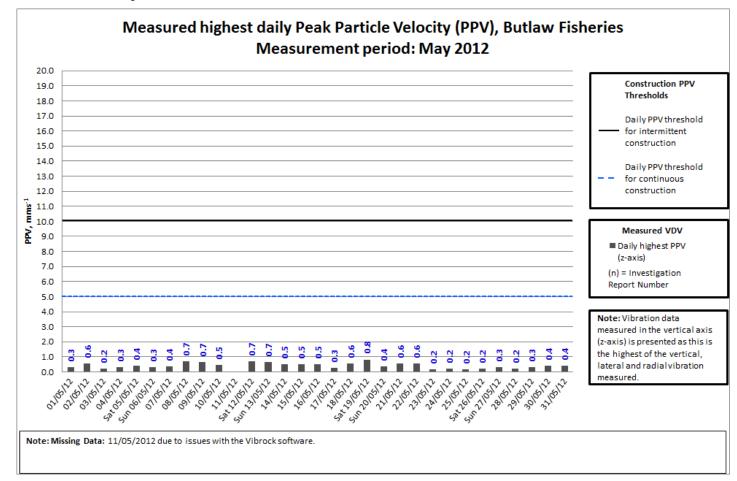
Daytime VDV at Barracks West – July 2012





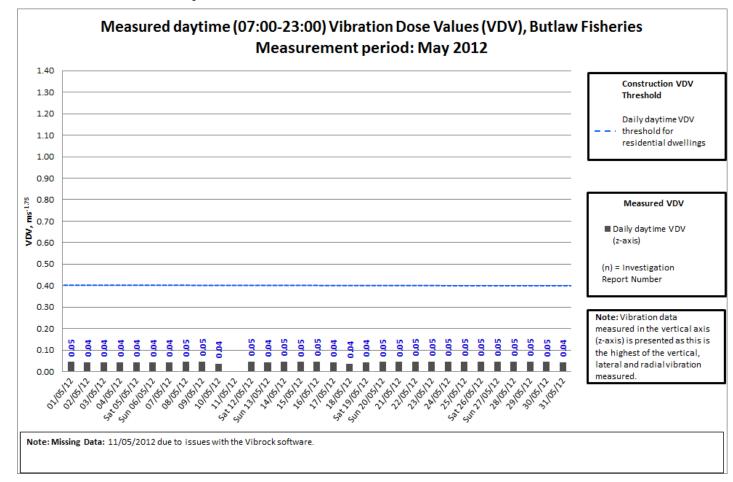
Night-time VDV at Barracks West – July 2012





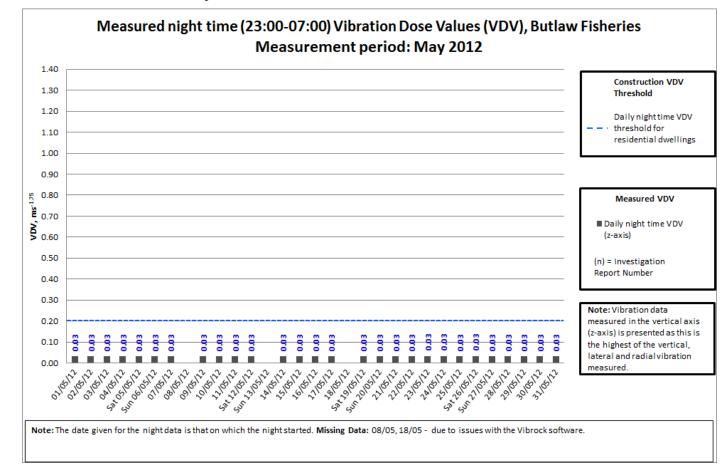
PPV at Butlaw Fisheries – May 2012





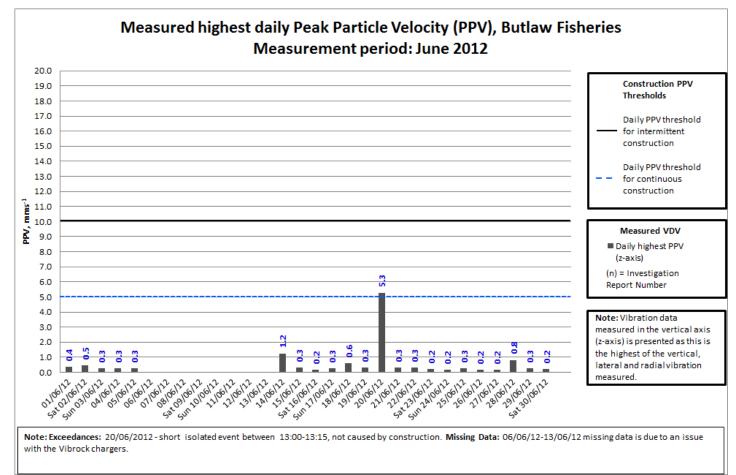
Daytime VDV at Butlaw Fisheries – May 2012





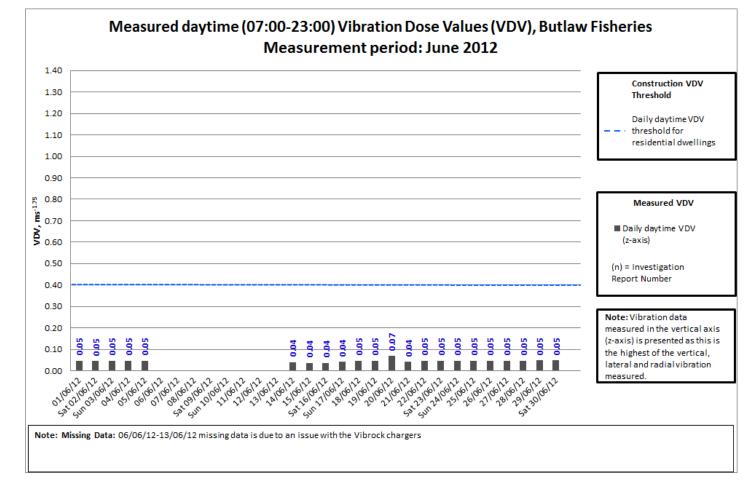
Night-time VDV at Butlaw Fisheries – May 2012





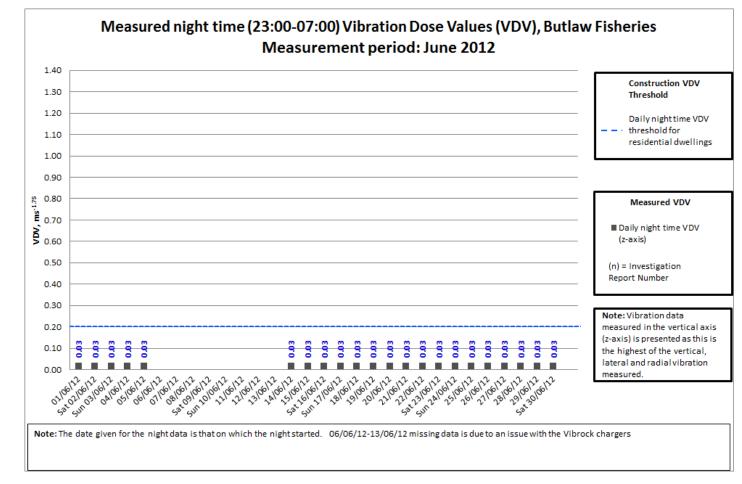
PPV at Butlaw Fisheries – June 2012





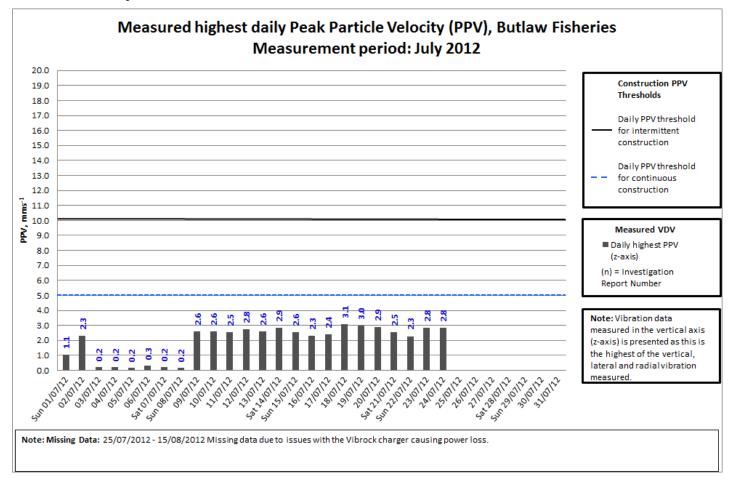
Daytime VDV at Butlaw Fisheries – June 2012





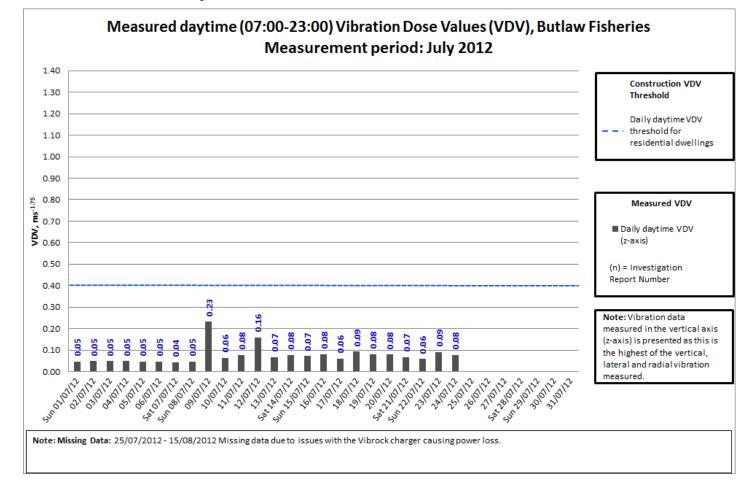
Night-time VDV at Butlaw Fisheries – June 2012





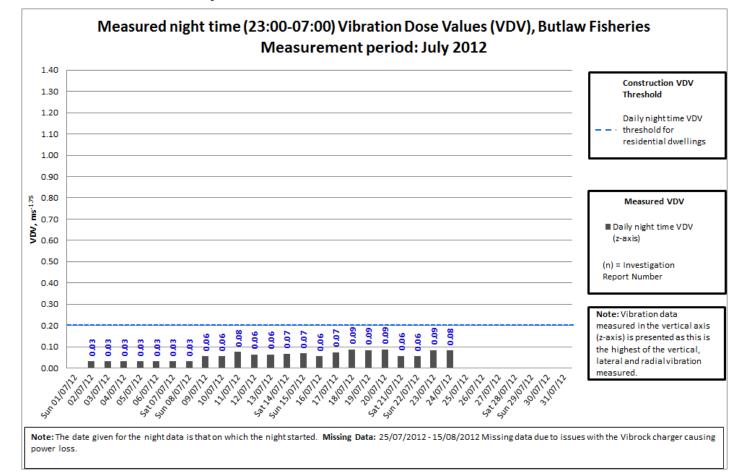
PPV at Butlaw Fisheries – July 2012





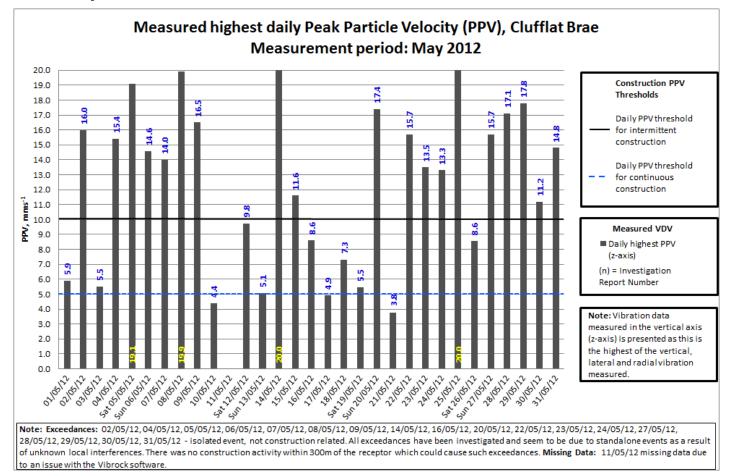
Daytime VDV at Butlaw Fisheries – July 2012





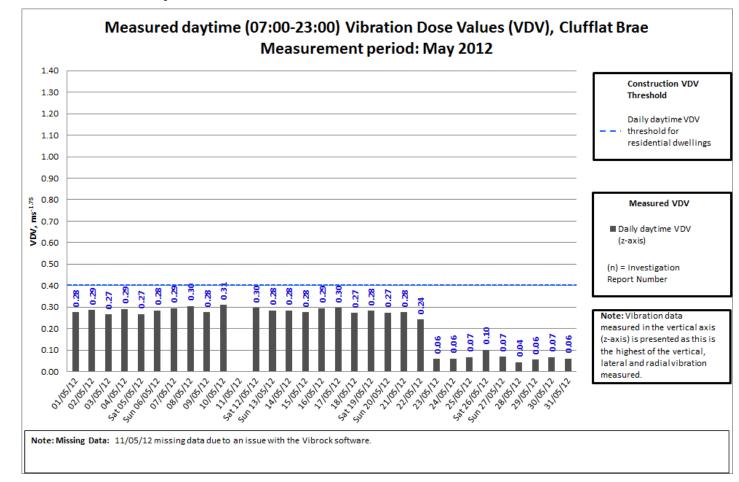
Night-time VDV at Butlaw Fisheries – July 2012





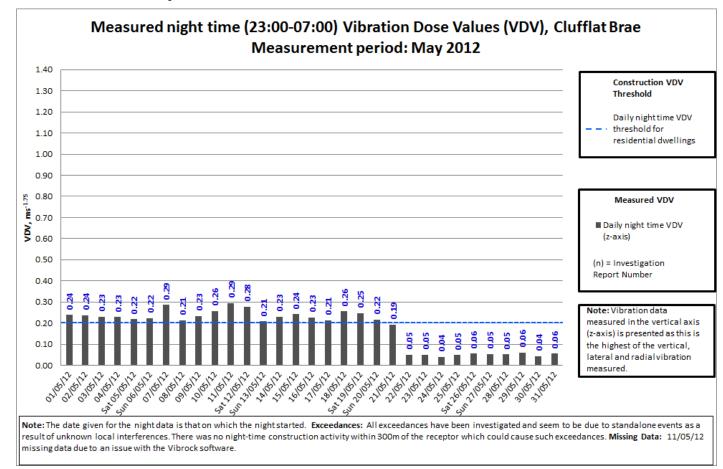
PPV at Cufflat Brae – May 2012





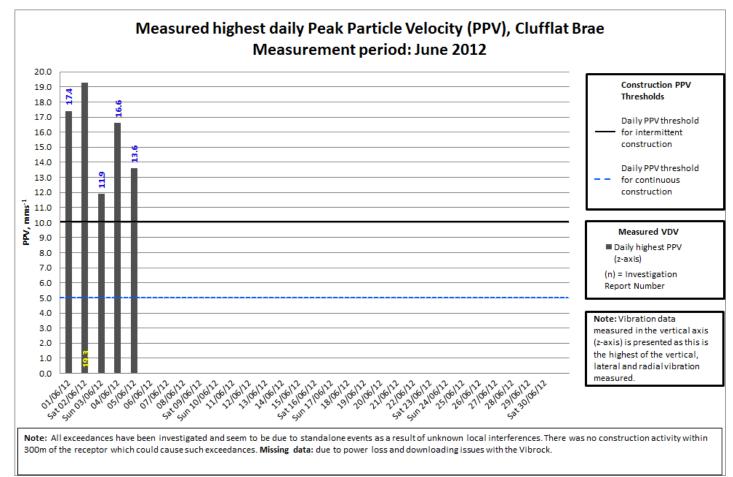
Daytime VDV at Cufflat Brae – May 2012





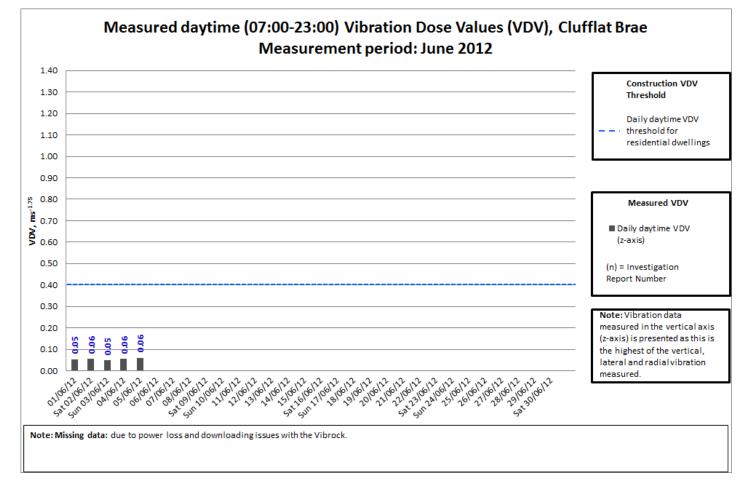
Night-time VDV at Cufflat Brae – May 2012





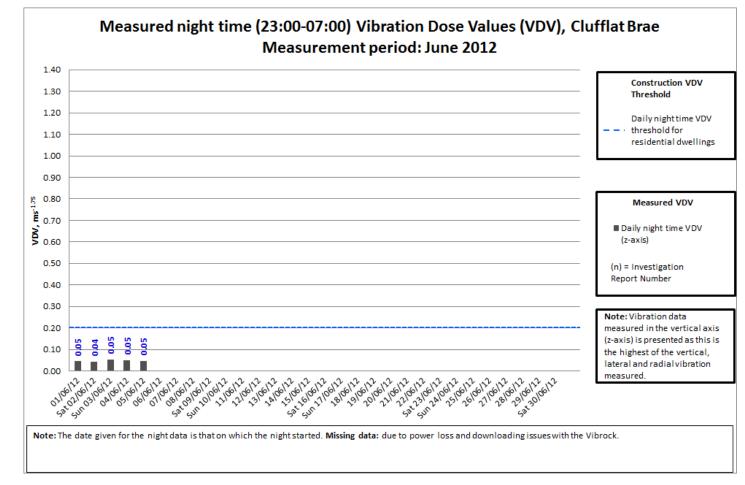
PPV at Cufflat Brae – June 2012





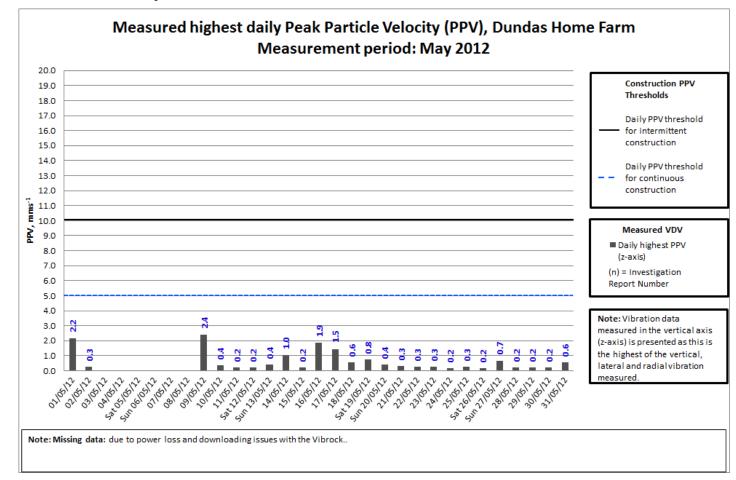
Daytime VDV at Cufflat Brae – June 2012





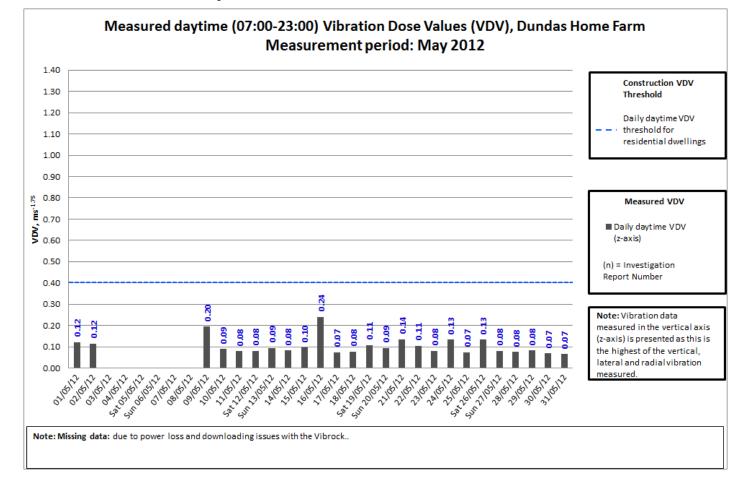
Night-time VDV at Cufflat Brae – June 2012





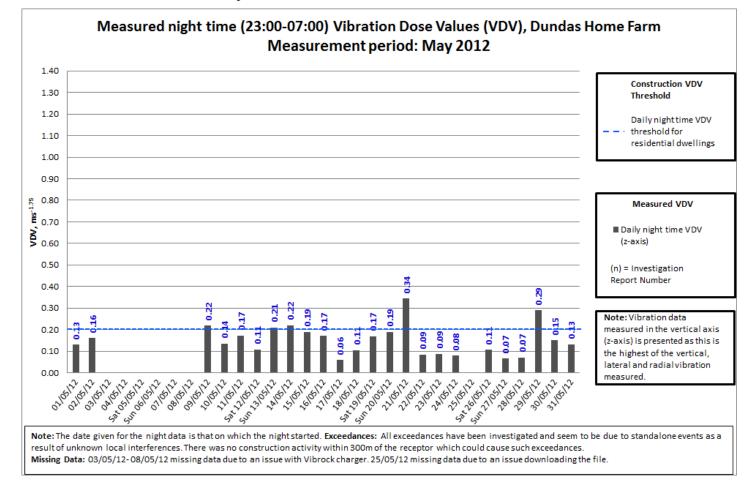
PPV at Dundas Home Farm – May 2012





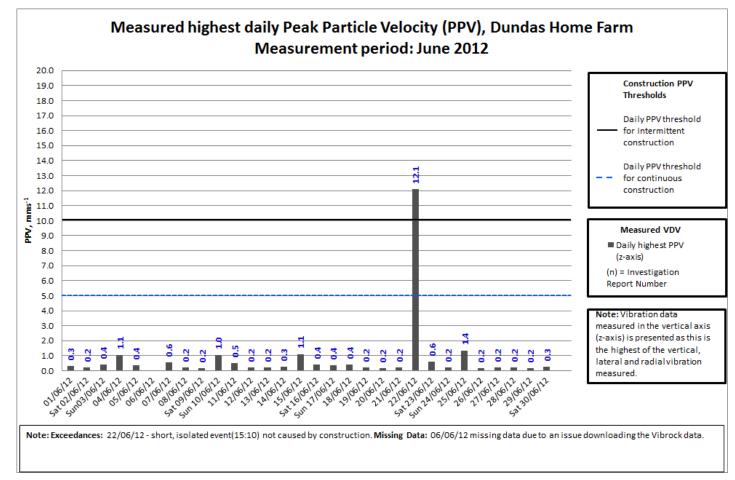
Daytime VDV at Dundas Home Farm – May 2012





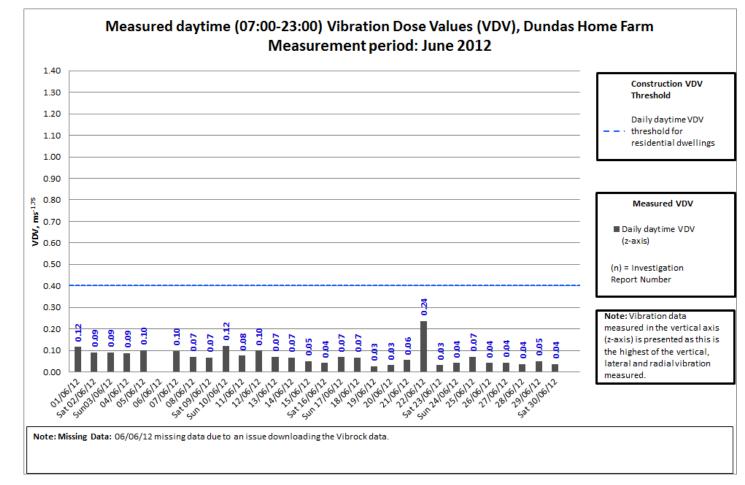
Night-time VDV at Dundas Home Farm – May 2012





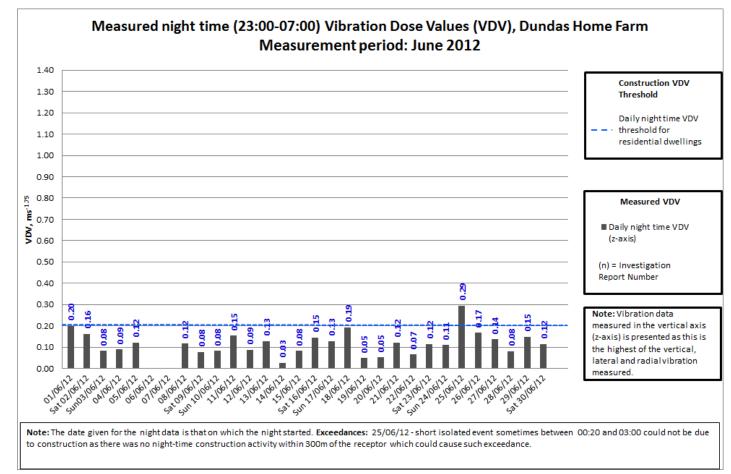
PPV at Dundas Home Farm – June 2012





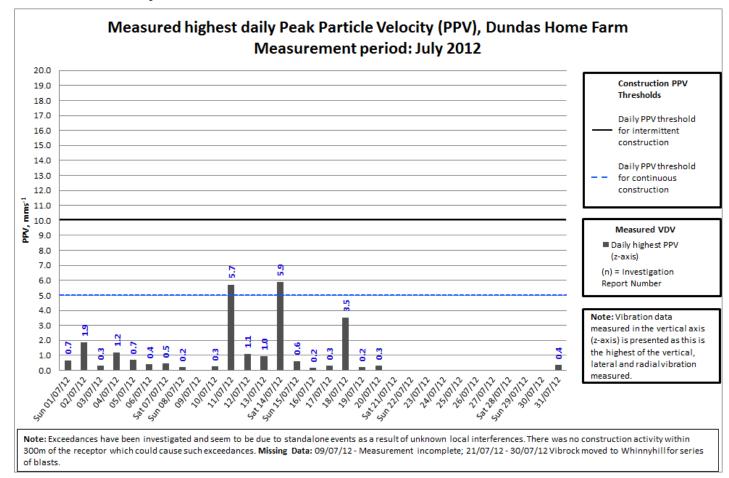
Daytime VDV at Dundas Home Farm – June 2012





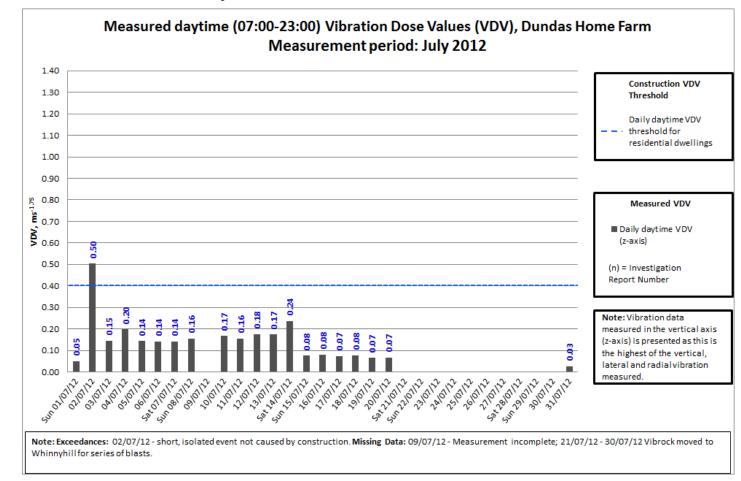
Night-time VDV at Dundas Home Farm – June 2012





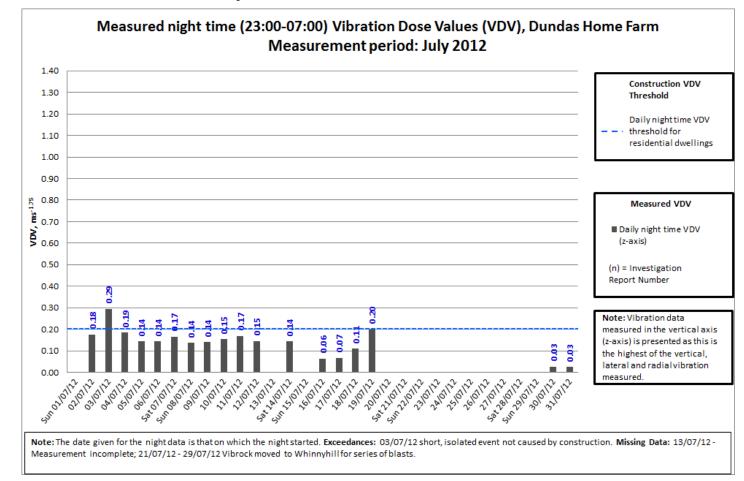
PPV at Dundas Home Farm – July 2012





Daytime VDV at Dundas Home Farm – July 2012





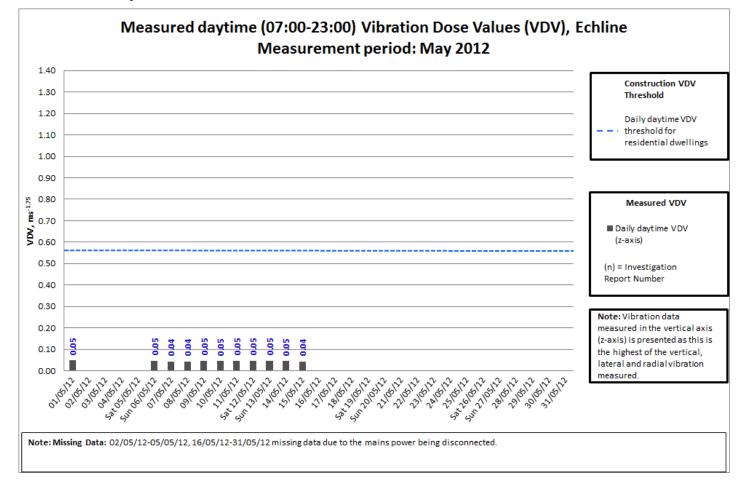
Night-time VDV at Dundas Home Farm – July 2012



Measured highest daily Peak Particle Velocity (PPV), Echline Measurement period: May 2012 20.0 Construction PPV 19.0 Thresholds 18.0 17.0 Daily PPV threshold 16.0 for intermittent construction 15.0 14.0 Daily PPV threshold 13.0 for continuous 12.0 construction 11.0 10.0 **Ad** 9.0 Measured VDV Daily highest PPV 8.0 (z-axis) 7.0 (n) = Investigation 6.0 Report Number 5.0 4.0 Note: Vibration data 3.0 measured in the vertical axis 2.0 (z-axis) is presented as this is the highest of the vertical, 1.0 lateral and radial vibration 0.0 53105/05/12 Sunologial 531310512 540201512 53126/09/12 Sun TIOSIA measured. 01/05/12 02105/12 04/05/12 15/05/12 13/05/12 22/05/12 31/05/12 03/05/12 07105122 16/05/122 1105122 21/05/12 23/05/12 24/05/12 25/05/12 28/05/122 08/05/122 581210512 2910201021 03/05/12 10/05/12 11/05/12 541 20512 TAIOSIT Note: Missing Data: 02/05/12-05/05/12, 16/05/12-31/05/12 missing data due to the mains power being disconnected.

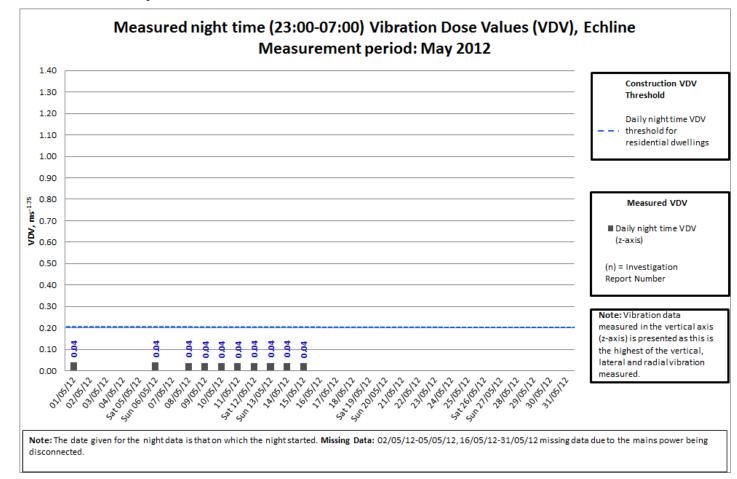
PPV at Echline – May 2012





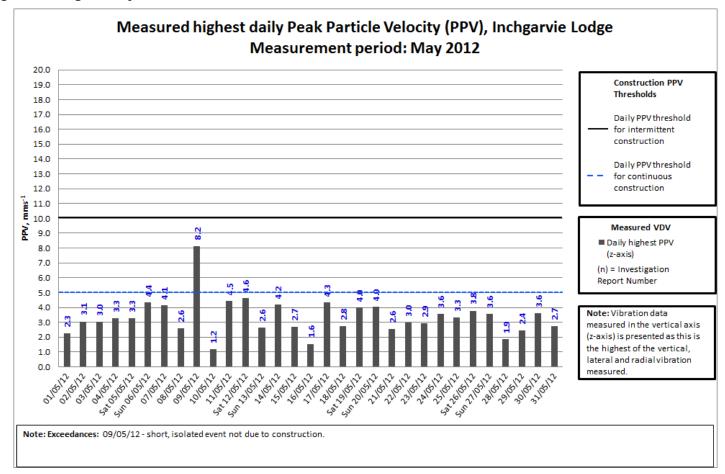
Daytime VDV at Echline – May 2012





Night-time VDV at Echline – May 2012





PPV at Inchgarvie Lodge – May 2012



Measured daytime (07:00-23:00) Vibration Dose Values (VDV), Inchgarvie Lodge Measurement period: May 2012 1.40 Construction VDV 1.30 Threshold 1.20 Daily daytime VDV threshold for 1.10 residential dwellings 1.00 0.90 ខ្ល<u>ុ</u> 0.80 Measured VDV . ٤ 0.70 Daily daytime VDV Å 0.60 (z-axis) 0.50 (n) = Investigation Report Number 0.40 0.30 Note: Vibration data c 0.20 measured in the vertical axis 2 (z-axis) is presented as this is 0.10 the highest of the vertical, lateral and radial vibration 0.00 68/65/13/6112 53105/12 Surrologia 5312105112 Sur 20012 measured. 10/05/122 1105122 01/05/12 04/05/12 07105112 Albha 15/05/12 16/05/12 24/05/12 02/05/12 212 2012 00 21012 1105/12 23/05/12 0310511 13/05/12 Sun 2010511 58121011 2102202

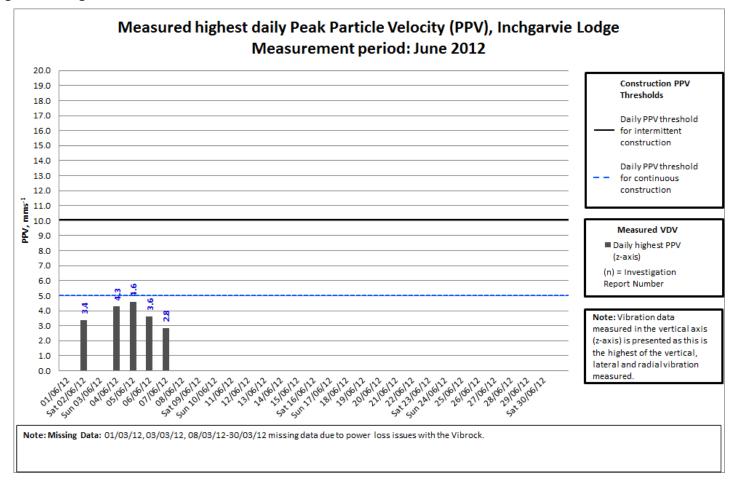
Daytime VDV at Inchgarvie Lodge – May 2012



Measured night time (23:00-07:00) Vibration Dose Values (VDV), Inchgarvie Lodge Measurement period: May 2012 1.40 Construction VDV 1.30 Threshold 1.20 Daily night time VDV threshold for 1.10 residential dwellings 1.00 0.90 ក្ត 0.80 Measured VDV . ٤ 0.70 Å 0.60 Daily night time VDV (z-axis) 0.50 (n) = Investigation Report Number 0.40 0.30 Note: Vibration data measured in the vertical axis 0.20 (z-axis) is presented as this is 0.10 the highest of the vertical, lateral and radial vibration 0.00 54100/08/12 5812105122 541210512 5412010312 measured. 52105/05/122 10/05/12 1105/12 01/05/12 07105122 09/05/12 14/05/12 15/05/12 21/05/12 31/05/12 08/05/12 26/05/12 5813105/12 02/05/12 110512 18/05/12 22/05/12 532610512 Sunzilositz OAIOSIT 23/05/12 25/05/12 2210512 28/05/1 03/05/17 29/05/12 2010512 Note: The date given for the night data is that on which the night started. Missing Data: 31/05/12 missing data due to issues downloading Vibrock data.

Night-time VDV at Inchgarvie Lodge – May 2012





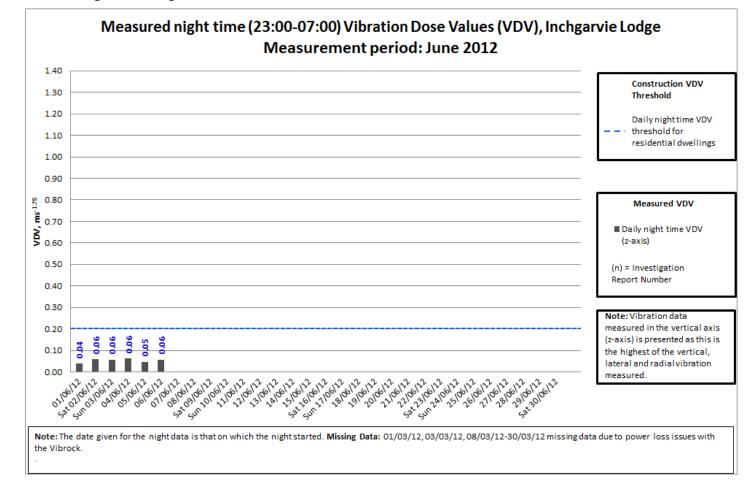
PPV at Inchgarvie Lodge – June 2012



Measured daytime (07:00-23:00) Vibration Dose Values (VDV), Inchgarvie Lodge Measurement period: June 2012 1.40 Construction VDV 1.30 Threshold 1.20 Daily daytime VDV threshold for 1.10 residential dwellings 1.00 0.90 ក្ត 0.80 Measured VDV Ë 0.70 Daily daytime VDV A 0.60 (z-axis) 0.50 (n) = Investigation Report Number 0.40 0.30 Note: Vibration data 0.20 measured in the vertical axis (z-axis) is presented as this is 0.10 the highest of the vertical, 0 lateral and radial vibration 0.00 53130106112 52109/06/12 54710/06/12 53116/06/12 53123/06/12 Sun 24/06/12 53102/06/12 11/06/12 SUN 17/06/12 measured. 01/06/12 08/06/12 12/06/12 13/06/12 14/06/12 15/06/12 18/06/122 21/06/12 22106122 25/06/12 28/06/12 23/06/12 06/06/12 07106/12 19/06/122 20106/122 26/06/12 27/06/12 sun03/06/1 04/06/1 0510612 Note: Missing Data: 01/03/12, 03/03/12, 08/03/12-30/03/12 missing data due to power loss issues with the Vibrock.

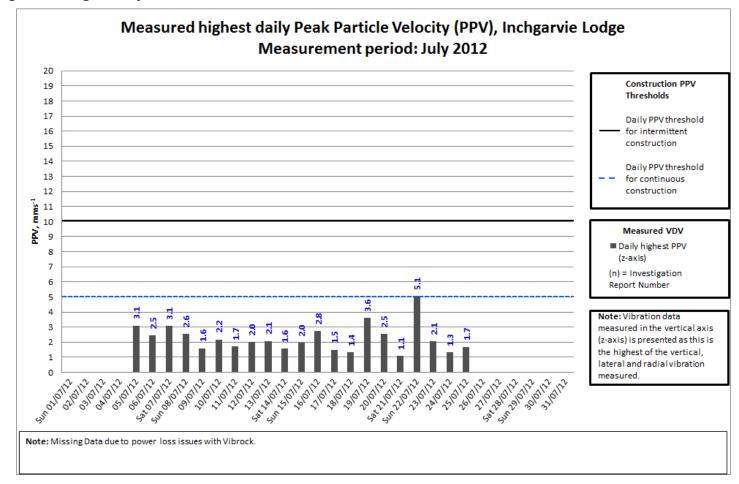
Daytime VDV at Inchgarvie Lodge – June 2012





Night-time VDV at Inchgarvie Lodge – June 2012





PPV at Inchgarvie Lodge – July 2012



Measured daytime (07:00-23:00) Vibration Dose Values (VDV), Inchgarvie Lodge Measurement period: July 2012 1.4 Construction VDV 1.3 Threshold 1.2 Daily daytime VDV threshold for 1.1 residential dwellings 1 0.9 1.75 0.8 Measured VDV . E 07 Daily daytime VDV **Å** 0.6 (z-axis) 0.5 (n) = Investigation Report Number 0.4 -0.3 Note: Vibration data 0.2 measured in the vertical axis o. 200 0.08 0.08 0.08 80 õ 8 8 8 5 (z-axis) is presented as this is 0.1 the highest of the vertical, lateral and radial vibration 0 measured. 5402101122 53101101 5408/01/12 03/07/122 05/07/122 06107122 suntspillt 0210112 04107112 09101122 20101122 27107122 12101122 22101122 1310112 531210112 16/07/122 582210112 23/01/12 24/01/122 25/07/122 26101122 540210112 27107122 18/07/12 29/07/12 2010112 Note: Missing Data due to power loss issues with Vibrock.

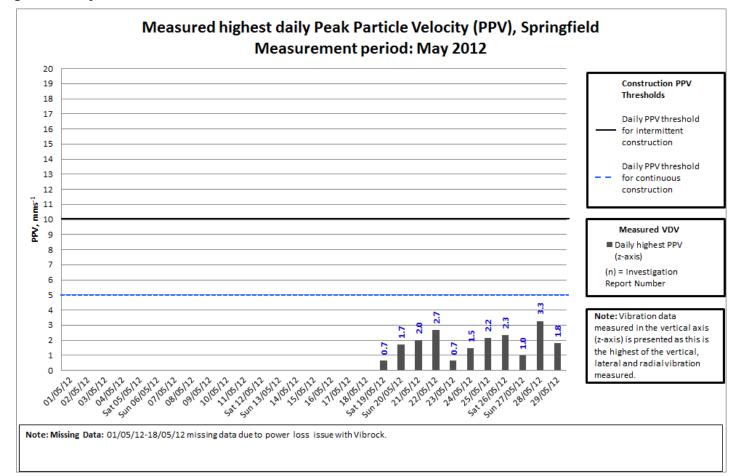
Daytime VDV at Inchgarvie Lodge – July 2012



Measured night time (23:00-07:00) Vibration Dose Values (VDV), Inchgarvie Lodge Measurement period: July 2012 1.4 Construction VDV 1.3 Threshold 1.2 Daily night time VDV threshold for 1.1 residential dwellings 1 0.9 20.8 51.5 0.7 Measured VDV Daily night time VDV Å 0.6 (z-axis) 0.5 (n) = Investigation Report Number 0.4 0.3 Note: Vibration data 0.2 measured in the vertical axis 0.08 500 8 5 5 90 5 5 5 5 5 5 5 5 ö (z-axis) is presented as this is 0.1 the highest of the vertical, lateral and radial vibration 0 04/01/27/01/12 Sunololla measured. 02107122 03/07/122 5408/01/12 Suntifility 5417210112 25/07/12 06/07/122 5810110112 09/01/12 10101122 2101122 22101122 581210112 23/07/122 24/01/122 2610112 581210112 16/01/12 13/01/12 27107122 1.8/07/12 29/01/2 2010112 Note: Missing Data due to power loss issues with Vibrock.

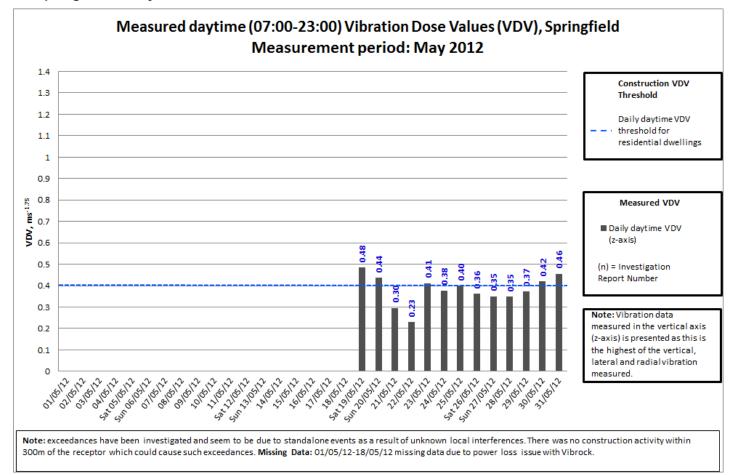
Night-time VDV at Inchgarvie Lodge – July 2012





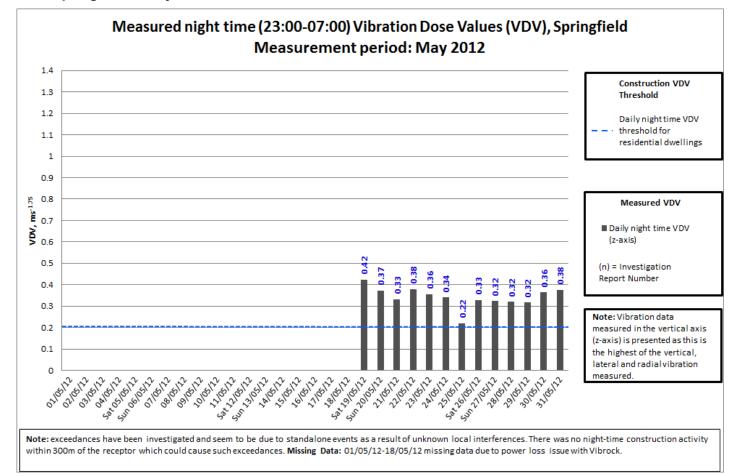
PPV at Springfield – May 2012





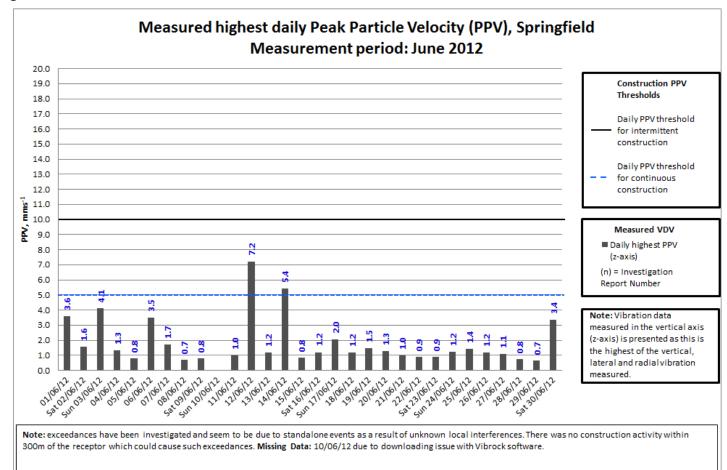
Daytime VDV at Springfield – May 2012





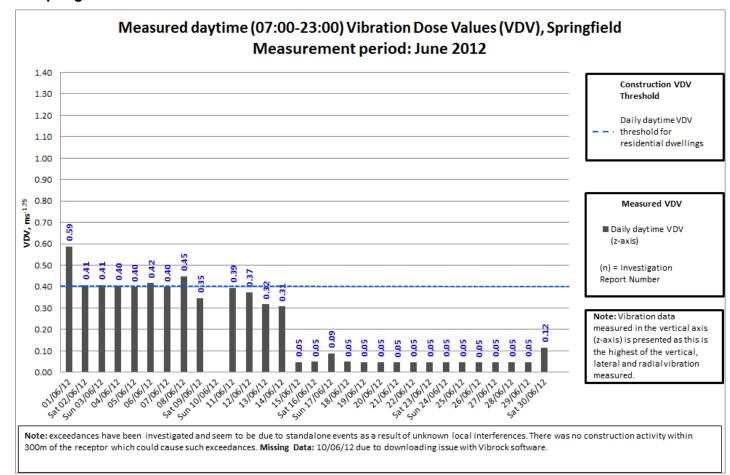
Night-time VDV at Springfield – May 2012





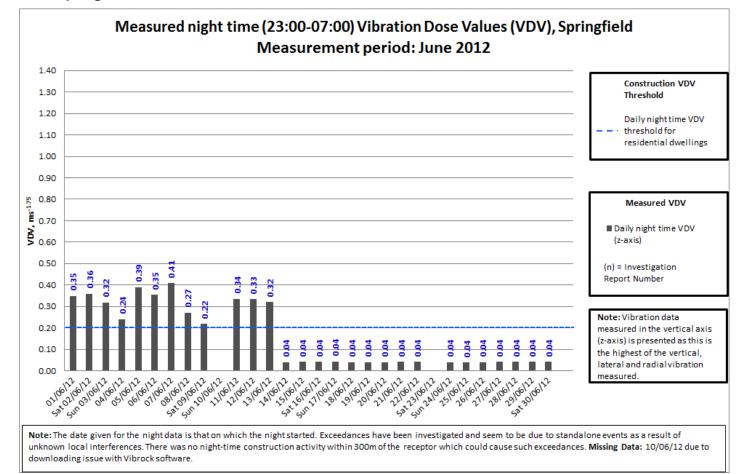
PPV at Springfield – June 2012





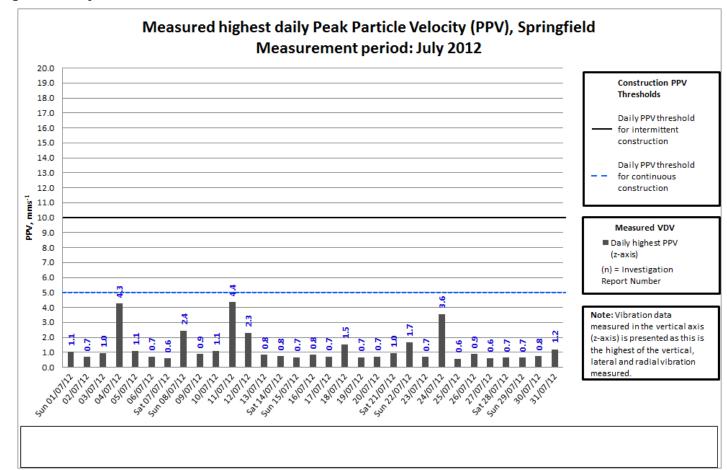
Daytime VDV at Springfield – June 2012





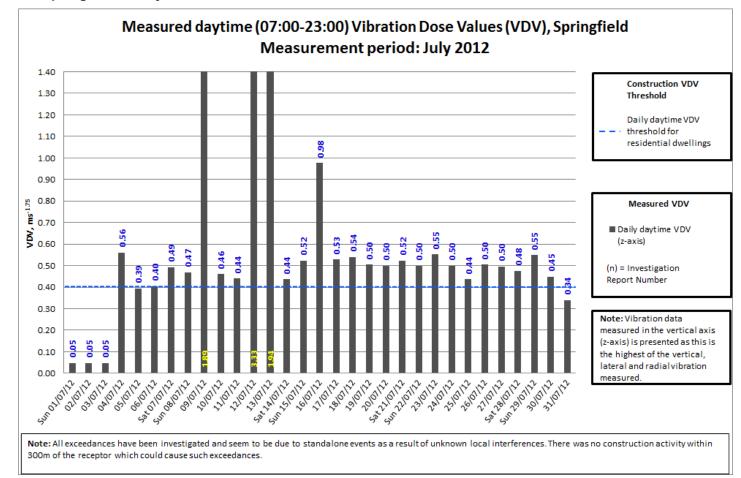
Night-time VDV at Springfield – June 2012





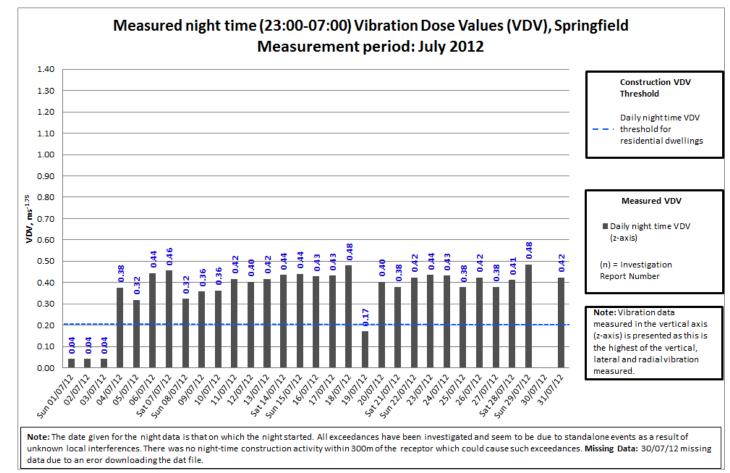
PPV at Springfield – July 2012





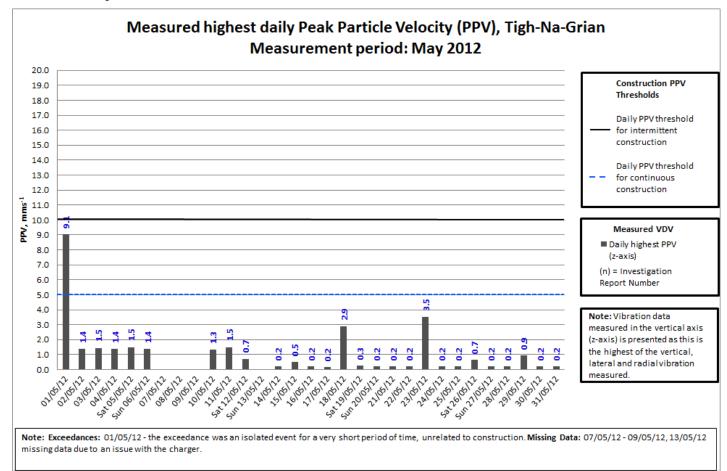
Daytime VDV at Springfield – July 2012





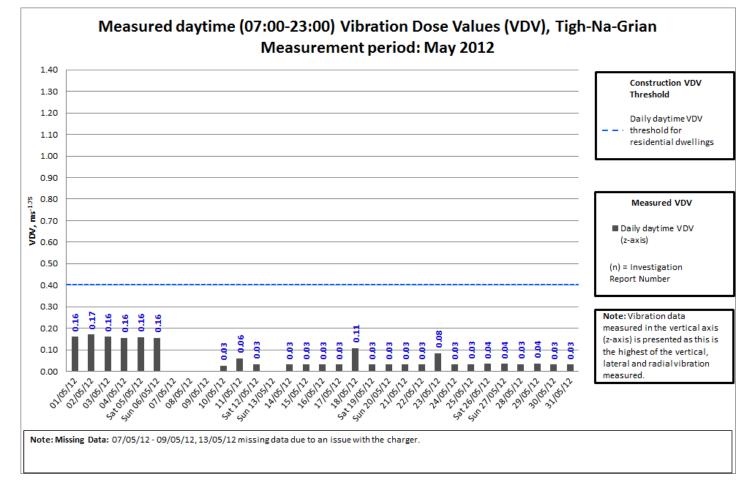
Night-time VDV at Springfield – July 2012





PPV at Tigh-Na-Grian – May 2012





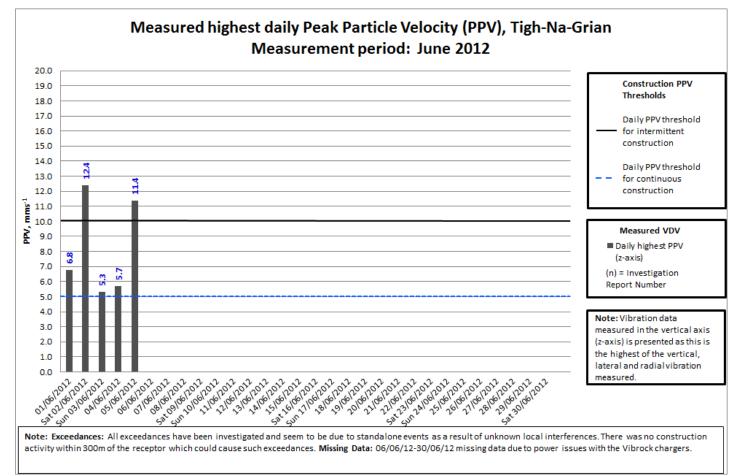
Daytime VDV at Tigh-Na-Grian – May 2012



Measured night time (23:00-07:00) Vibration Dose Values (VDV) **Tigh-Na-Grian** Measurement period: May 2012 1.4 Construction VDV Threshold 1.3 Daily night time VDV 1.2 threshold for residential dwellings 1.1 1.0 0.9 Measured VDV <u>ප</u> 0.8 Ë 0.7 Daily night time VDV Å 0.6 (z-axis) (n) = Investigation 0.5 Report Number 0.4 0.3 Note: Vibration data measured in the vertical axis 0.2 5 (z-axis) is presented as this is 0.1 the highest of the vertical, lateral and radial vibration 0.0 measured. Surobloght 01/05/12 53105/05/122 5822609122 02/05/12 01105/122 12105/12 5312105112 25/05/12 31/05/122 512 610 910 101 11 5417310512 21/05/12 sunzilositz 03/05/12 16/05/12 2210512 15/05/12 1105/12 23/05/12 28/05/1 04/05/12 14/05/12 13/05/1 531310511 54n 2010511 24/05/12 29/05/ 201051 Note: The date given for the night data is that on which the night started. Missing Data: 07/05/12 - 09/05/12, 13/05/12 missing data due to an issue with the charger.

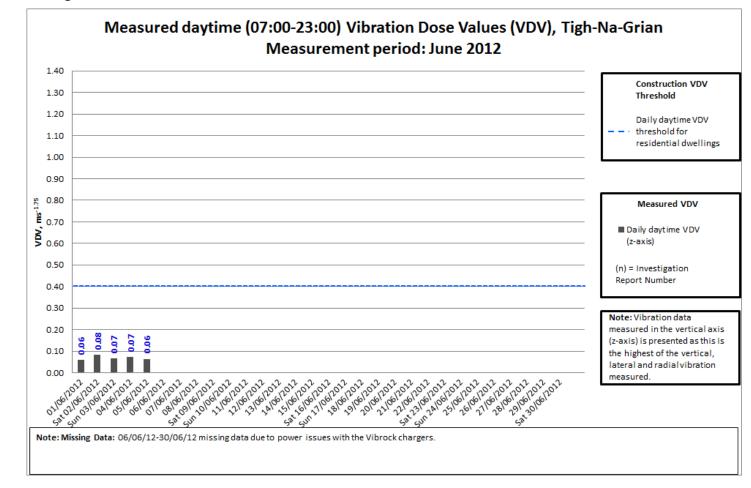
Night-time VDV at Tigh-Na-Grian – May 2012





PPV at Tigh-Na-Grian – June 2012





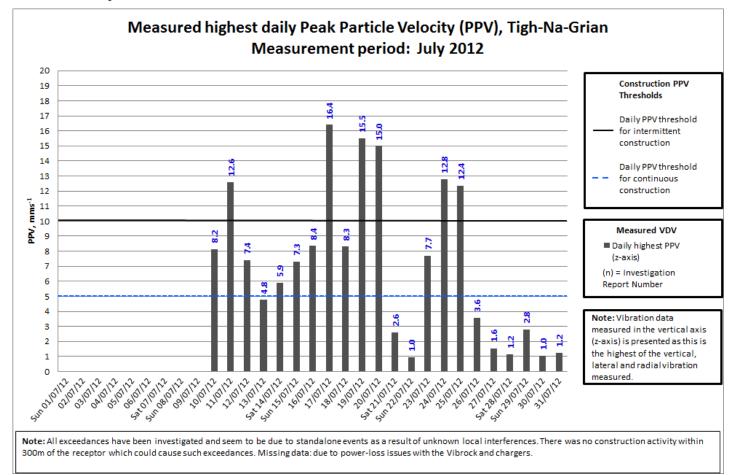
Daytime VDV at Tigh-Na-Grian – June 2012



Measured night time (23:00-07:00) Vibration Dose Values (VDV) **Tigh-Na-Grian** Measurement period: June 2012 1.4 Construction VDV Threshold 1.3 Daily night time VDV 1.2 threshold for residential dwellings 1.1 1.0 0.9 Measured VDV 2 0.8 Ë 0.7 Daily night time VDV 0.6 (z-axis) 0.5 (n) = Investigation Report Number 0.4 0.3 Note: Vibration data 0.2 measured in the vertical axis 5 90 (z-axis) is presented as this is 0.1 the highest of the vertical, lateral and radial vibration 0.0 18/06/2012/2014 58130106/2012 01/06/2012 11/06/2012 12/06/2012 13/06/2012 5816/06/2012 2910612012 measured. 1510612012 5417106/2012 20106/2012 21/06/2012 2210612012 07/06/2012 52102106/2014 06/06/2012 14/06/2012 58123106/2012 Sun 24/06/2014 106/2012 sun03/06/201. 28/06/2014 1061201 04/06/201 051061201 25/06/201 Note: The date given for the night data is that on which the night started. Missing Data: 06/06/12-30/06/12 missing data due to power issues with the Vibrock chargers.

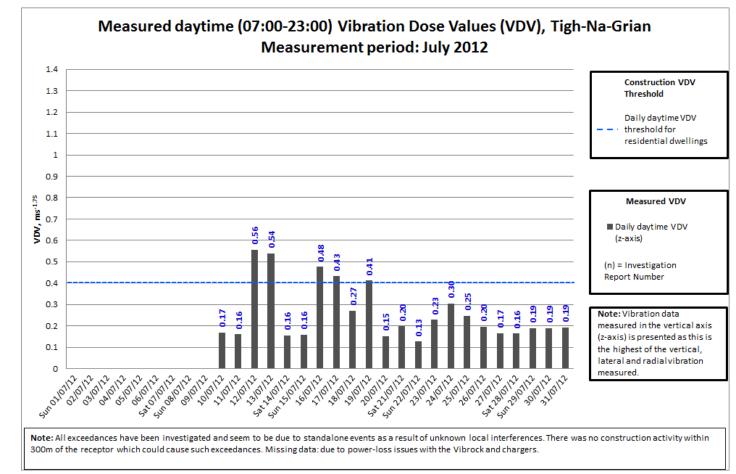
Night-time VDV at Tigh-Na-Grian – June 2012





PPV at Tigh-Na-Grian – July 2012





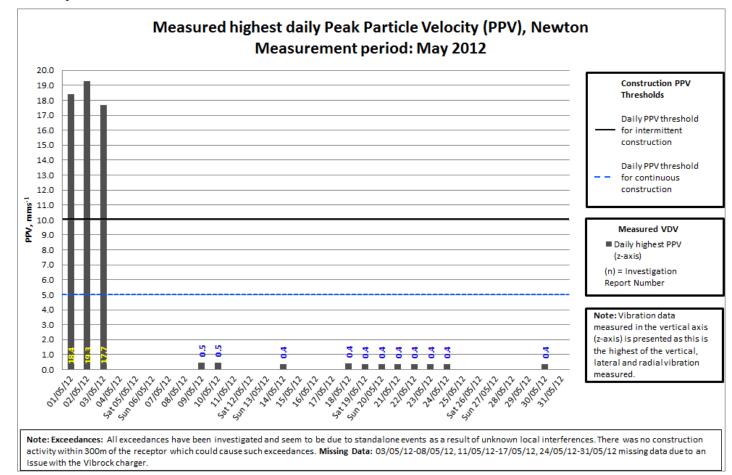
Daytime VDV at Tigh-Na-Grian – July 2012



Measured night time (23:00-07:00) Vibration Dose Values (VDV) **Tigh-Na-Grian** Measurement period: July 2012 1.4 Construction VDV Threshold 1.3 Daily night time VDV 1.2 threshold for residential dwellings 1.1 1.0 0.9 Measured VDV 2 0.8 Ë 0.7 Daily night time VDV Å 0.6 (z-axis) 0.5 (n) = Investigation Report Number 0.4 0.3 Note: Vibration data 0.2 measured in the vertical axis (z-axis) is presented as this is 0.1 the highest of the vertical, lateral and radial vibration 0.0 5210110112 54008/07/122 581210112 05/07/122 0610112 Sun 2/01/12 23/07/122 measured. 02107122 A101122 09/07/122 24107122 25/07/122 26107122 01/07/122 3101122 20101122 16/07/122 13/07/122 19/07/122 201071122 3107122 2101122 27107122 271071122 58228107122 2210717 sunsports sun29/01/12 13/07/1 Satalolla 2010112 Note: The date given for the night data is that on which the night started. All exceedances have been investigated and seem to be due to standalone events as a result of unknown local interferences. There was no night-time construction activity within 300m of the receptor which could cause such exceedances. Missing data: due to power-loss issues with the Vibrock and chargers

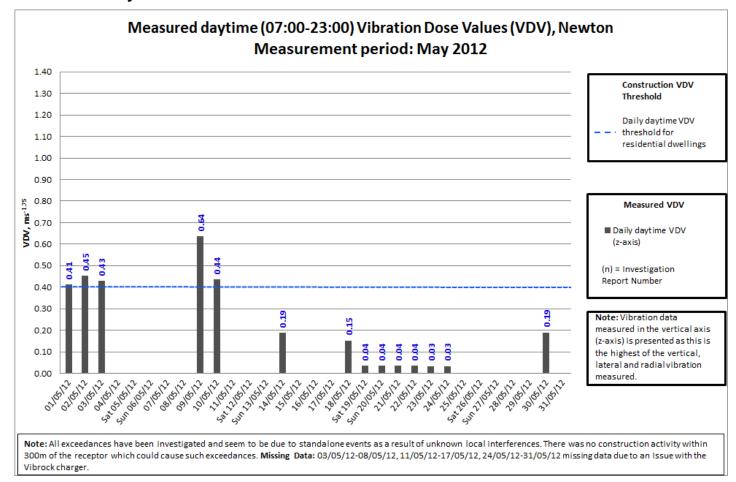
Night-time VDV at Tigh-Na-Grian – July 2012





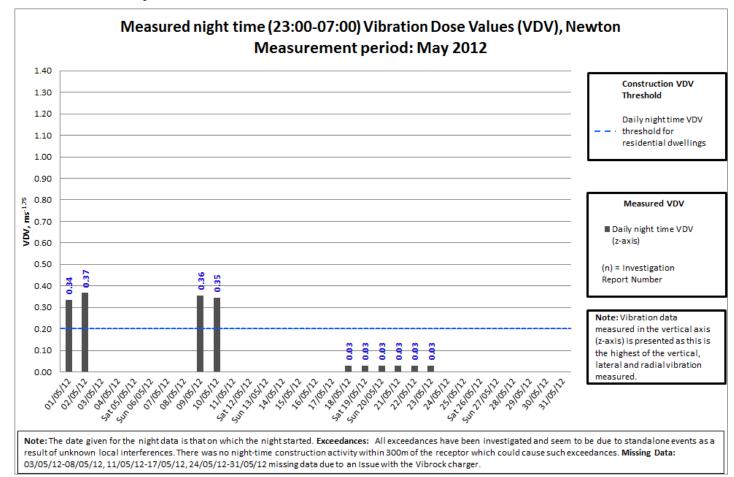
PPV at Newton – May 2012





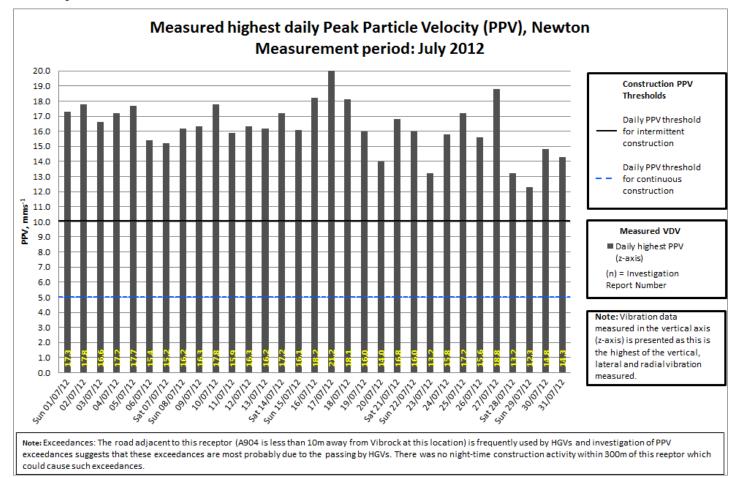
Daytime VDV at Newton – May 2012





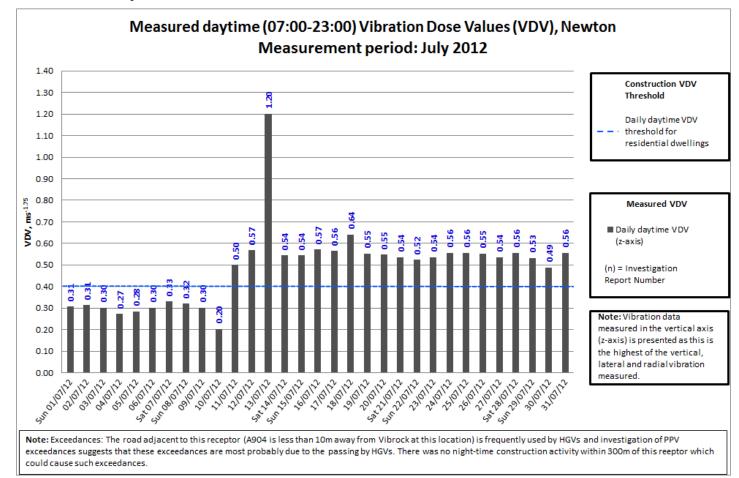
Night-time VDV at Newton – May 2012





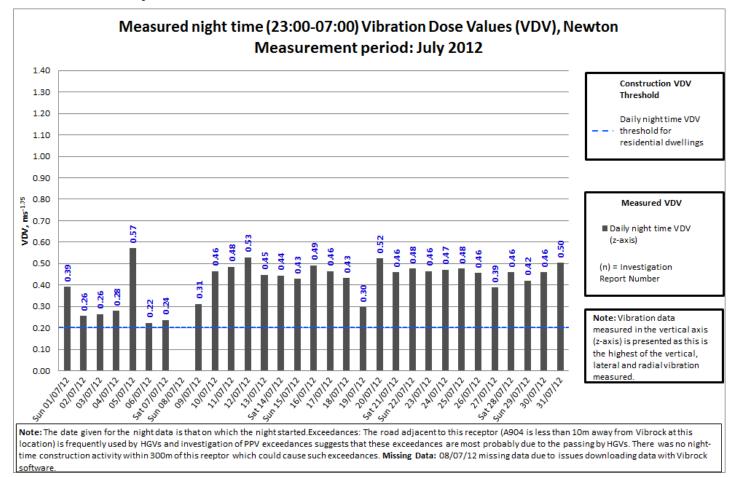
PPV at Newton – July 2012





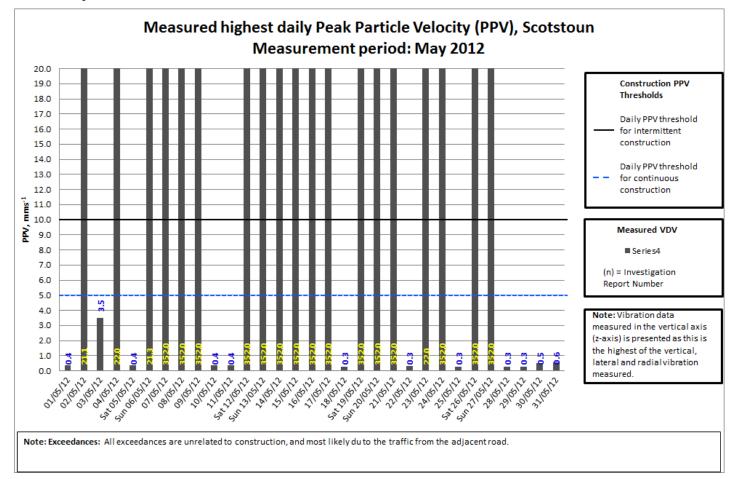
Daytime VDV at Newton – July 2012





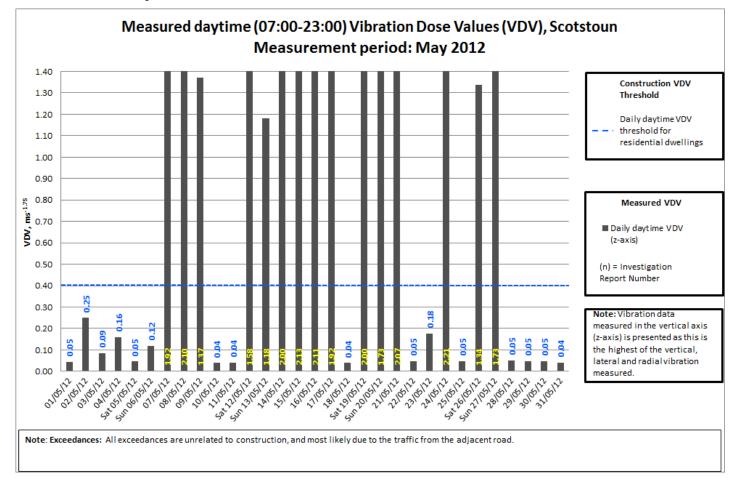
Night-time VDV at Newton – July 2012





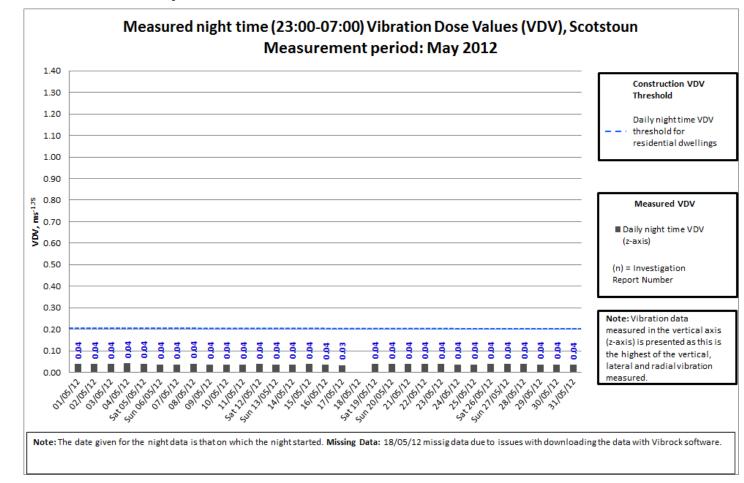
PPV at Scotstoun – May 2012





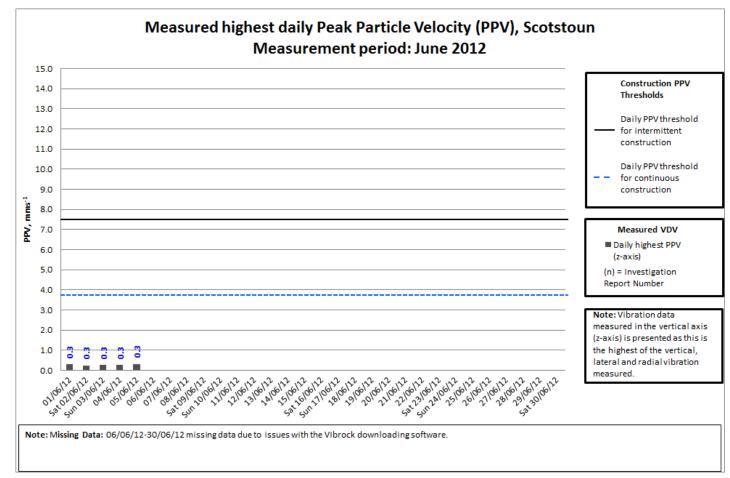
Daytime VDV at Scotstoun – May 2012





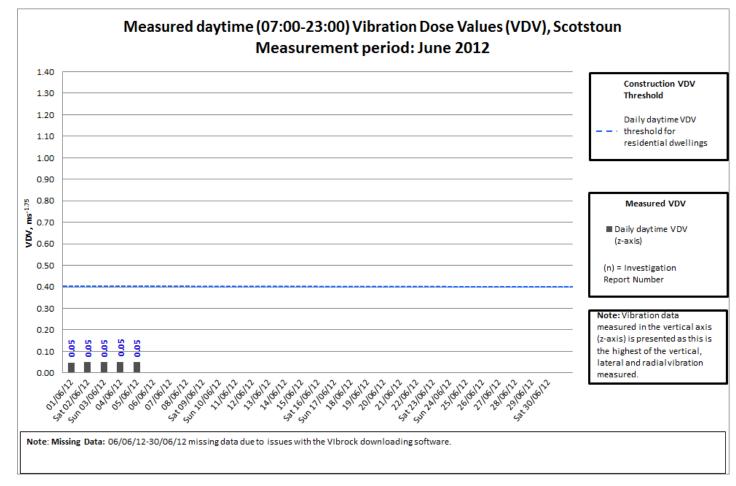
Night-time VDV at Scotstoun – May 2012





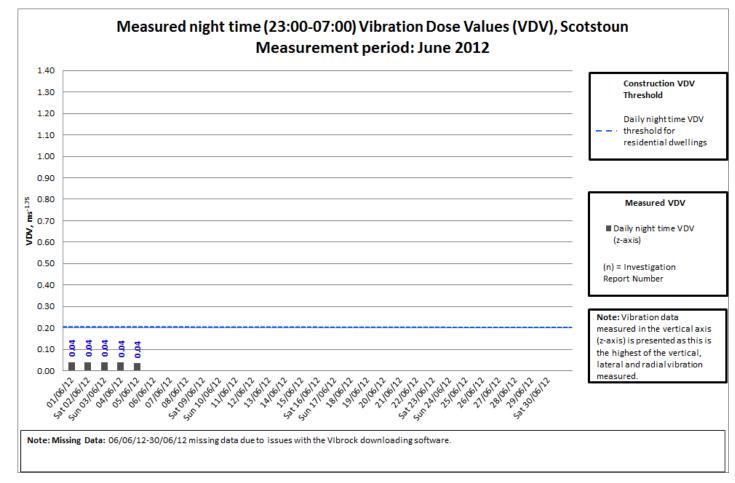
PPV at Scotstoun – June 2012





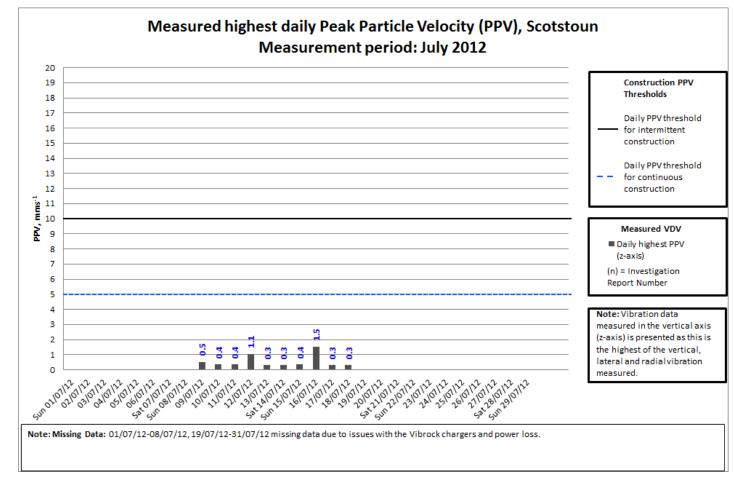
Daytime VDV at Scotstoun – June 2012





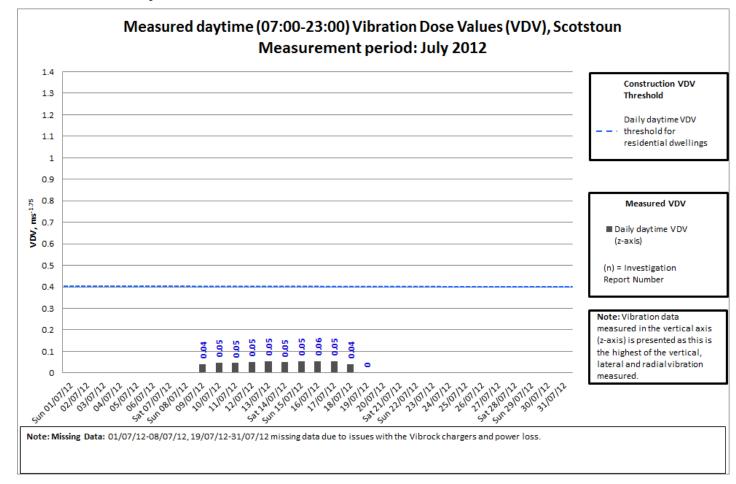
Night-time VDV at Scotstoun – June 2012





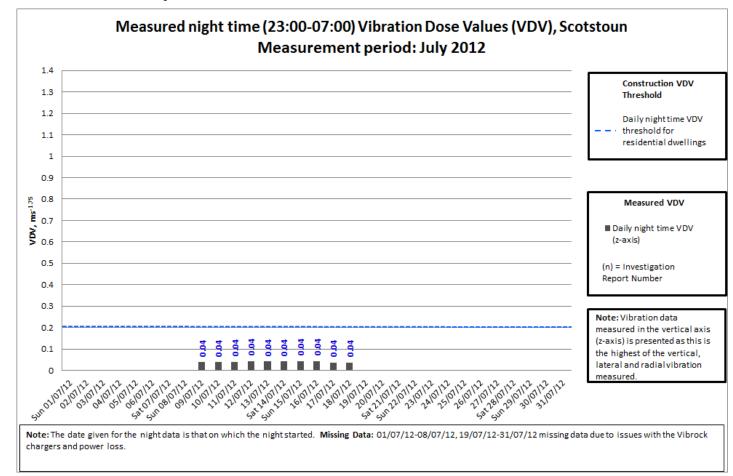
PPV at Scotstoun – July 2012





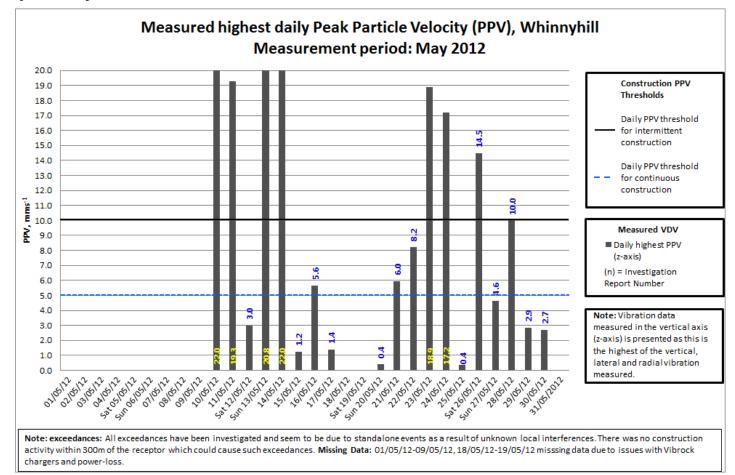
Daytime VDV at Scotstoun – July 2012





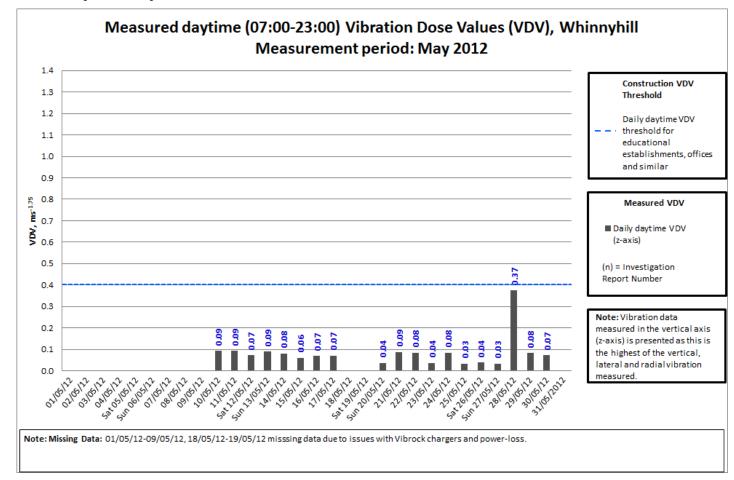
Night-time VDV at Scotstoun – July 2012





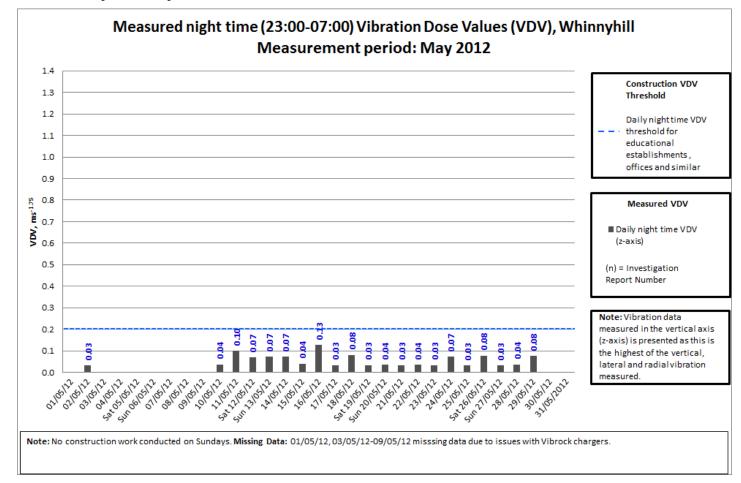
PPV at Whinnyhill – May 2012





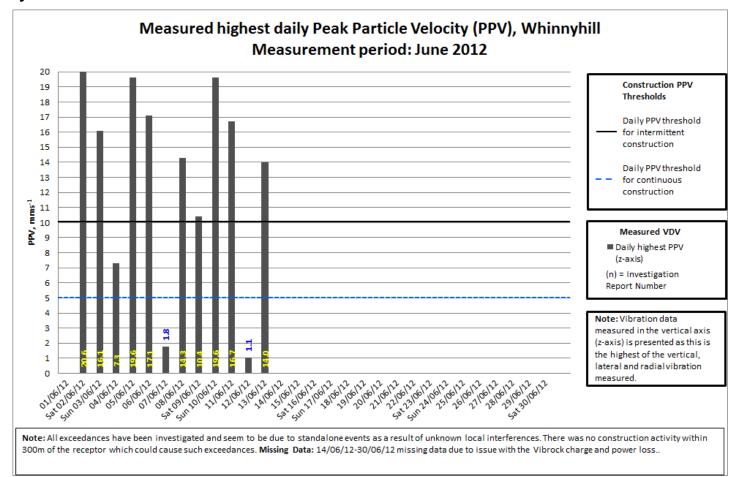
Daytime VDV at Whinnyhill – May 2012





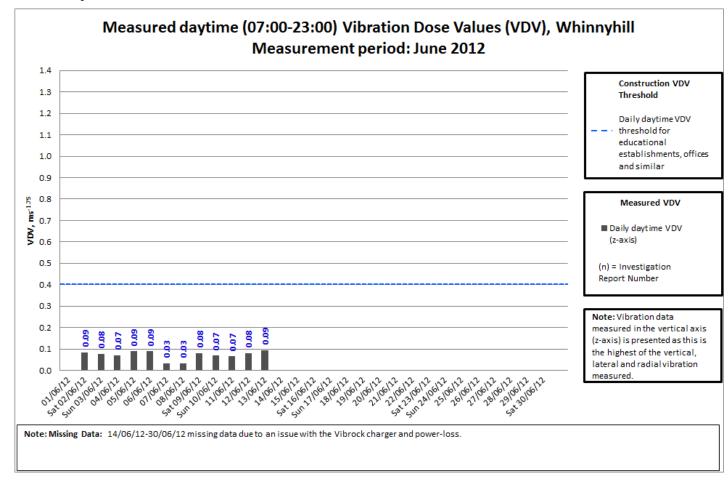
Night-time VDV at Whinnyhill – May 2012





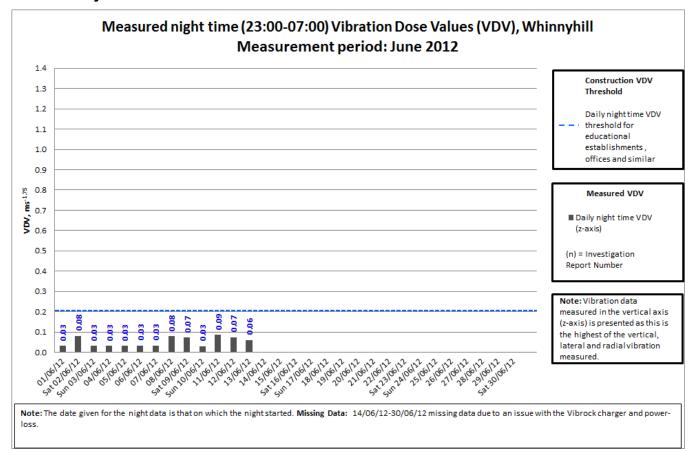
PPV at Whinnyhill – June 2012





Daytime VDV at Whinnyhill – June 2012



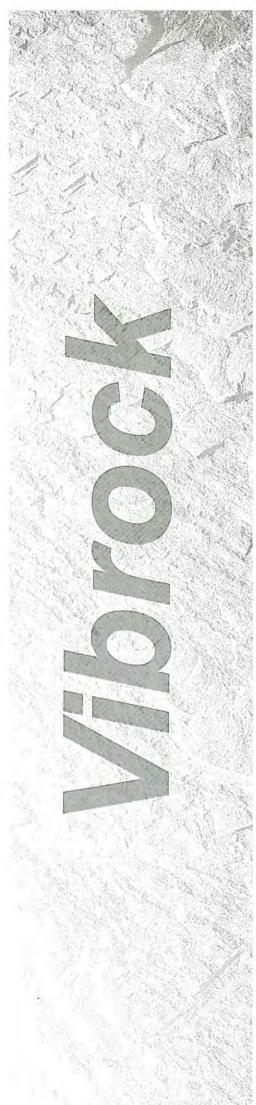


Night-time VDV at Whinnyhill – June 2012



HOCHTIEF Solutions American Bridge International DRAGADOS Morrison Construction

APPENDIX C – VIBROCK CALIBRATION CERTIFICATES



CALIBRATION CERTIFICATE NO.: CLIENT: INSTRUMENT TYPE: SERIAL NUMBER: CALIBRATION DATE: CALIBRATED BY: **08121562 Forth Crossing Bridge Constructors 1901-GSM 1901-GSM 1901-GSM 1901-GSM 1901-GSM 1901-GSM 1900-GSM 190**

CALIBRATION ACCURACY:-

	A channel	B channel	VDV channel
Peak Particle Velocity L	±5_%	<u>±5</u> %	X <u>±5</u> %
Peak Particle Velocity V	<u>±5_%</u>	<u>ts</u> %	Y <u> ±</u> 5 %
Peak Particle Velocity T	±5_%	<u>+</u> 5- %	z <u>±s</u> %

AIR OVERPRESSURE CHANNEL - Peak Level Unweighted MA dB(Lin)

WE HEREBY CERTIFY THAT THIS SEISMOGRAPH FULLY COMPLIES WITH THE MANUFACTURERS SPECIFICATION

CERTIFIED BY:

14TH AUGUST 2012

DATE:

THIS CERTIFICATE IS VALID FOR 12 MONTHS

The above calibration was carried out using equipment calibrated as follows:-Pulsar Acoustic Calibrator 100B, serial number 60796, calibrated March 2012 ISO-TECH IFG 100 Oscillator, serial number 300351, calibrated June 2012 Monitran Vibration Meter, serial number 213608, calibrated June 2012 Precision Gold PG012 Multimeter, serial number 09000182, calibrated June 2012

THIS CALIBRATION IS TRACEABLE TO NATIONAL STANDARDS

VIBROCK LIMITED Shanakiel Ilkeston Road Heanor Derbyshire DE75 7DR Tel: 01773 711211 Fax: 01773 711311 Email: vibrock@vibrock.com Web: www.vibrock.com





CALIBRATION CERTIFICATE NO .:

CLIENT: INSTRUMENT TYPE: SERIAL NUMBER: CALIBRATION DATE: CALIBRATED BY: 08121563 Forth Crossing Bridge Constructors V901-GSM 1563 14TH AUGUST 2012

DENNIS LORD

CALIBRATION ACCURACY:-

	A channel	B channel	VDV channel
Peak Particle Velocity L	<u>±5_%</u>	<u>±5</u> %	X <u>±5</u> %
Peak Particle Velocity V	±5_%	<u>±</u> 5_%	Y = 1- %
Peak Particle Velocity T	±5- %	±5_%	Z <u>±</u> 5%

AIR OVERPRESSURE CHANNEL - Peak Level Unweighted <u>MA</u> dB(Lin)

WE HEREBY CERTIFY THAT THIS SEISMOGRAPH FULLY COMPLIES WITH THE MANUFACTURERS SPECIFICATION

CERTIFIED BY:

14TH AUGUST 2012

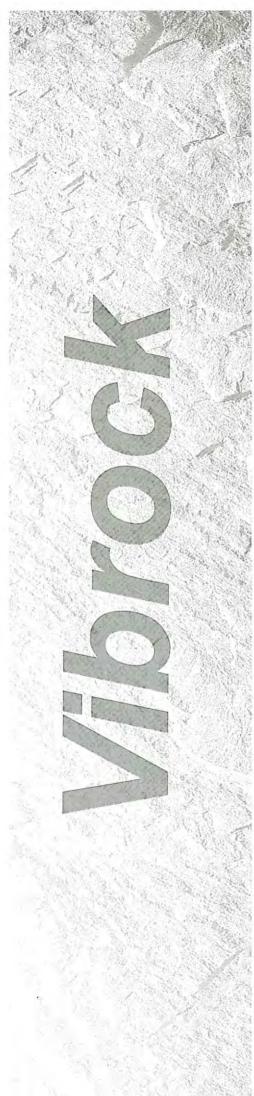
DATE:

THIS CERTIFICATE IS VALID FOR 12 MONTHS

The above calibration was carried out using equipment calibrated as follows:-Pulsar Acoustic Calibrator 100B, serial number 60796, calibrated March 2012 ISO-TECH IFG 100 Oscillator, serial number 300351, calibrated June 2012 Monitran Vibration Meter, serial number 213608, calibrated June 2012 Precision Gold PG012 Multimeter, serial number 09000182, calibrated June 2012

THIS CALIBRATION IS TRACEABLE TO NATIONAL STANDARDS

VIBROCK LIMITED Shanakiel Ilkeston Road Heanor Derbyshire DE75 7DR Tel: 01773 711211 Fax: 01773 711311 Email: vibrock@vibrock.com Web: www.vibrock.com



CALIBRATION CERTIFICATE NO .:

CLIENT: INSTRUMENT TYPE: SERIAL NUMBER: CALIBRATION DATE: CALIBRATED BY:

TE NO.	08121564
IL NO.	Forth Crossing Bridge Constructors
	V901-GSM
	1564
	14TH AUGUST 2012
	DENNIS LORD

CALIBRATION ACCURACY:-

	A channel	B channel	VDV channel
Peak Particle Velocity L	<u>±5_%</u>	<u>±5</u> %	X <u>±</u> _%
Peak Particle Velocity V	<u>±5_%</u>	±5_%	Y <u>+5 %</u>
Peak Particle Velocity T	±5_%	<u>±5_%</u>	z <u>+</u> 5%

AIR OVERPRESSURE CHANNEL - Peak Level Unweighted <u>N/A</u> dB(Lin)

WE HEREBY CERTIFY THAT THIS SEISMOGRAPH FULLY COMPLIES WITH THE MANUFACTURERS SPECIFICATION

CERTIFIED BY:

14TH AUGUST 2012

DATE:

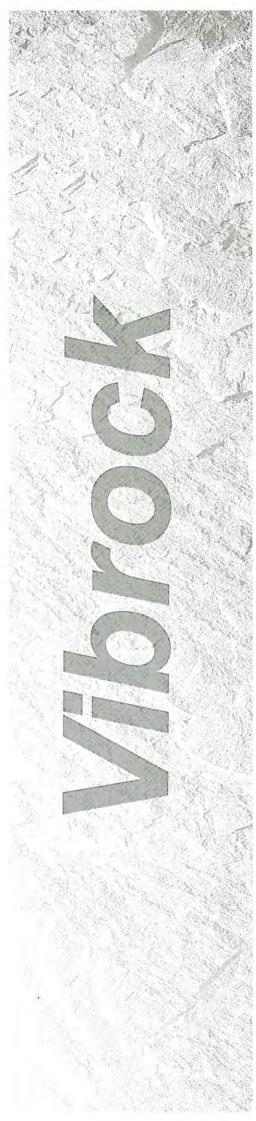
THIS CERTIFICATE IS VALID FOR 12 MONTHS

The above calibration was carried out using equipment calibrated as follows:-Pulsar Acoustic Calibrator 100B, serial number 60796, calibrated March 2012 ISO-TECH IFG 100 Oscillator, serial number 300351, calibrated June 2012 Monitran Vibration Meter, serial number 213608, calibrated June 2012 Precision Gold PG012 Multimeter, serial number 09000182, calibrated June 2012

THIS CALIBRATION IS TRACEABLE TO NATIONAL STANDARDS

VIBROCK LIMITED Shanakiel Ilkeston Road Heanor Derbyshire DE75 7DR Tel: 01773 711211 Fax: 01773 711311 Email: vibrock@vibrock.com Web: www.vibrock.com





CALIBRATION CERTIFICATE NO.: CLIENT: INSTRUMENT TYPE: SERIAL NUMBER: CALIBRATION DATE: CALIBRATED BY: **08121565 Forth Crossing Bridge Constructors 1091-GSM 1565 14TH AUGUST 2012 DENNIS LORD**

CALIBRATION ACCURACY:-

	A channel	B channel	VDV channel
Peak Particle Velocity L	±5_%	<u>±5</u> %	X <u>±5</u> %
Peak Particle Velocity V	<u>±5_%</u>	<u>±5</u> %	Y <u>+ 5 %</u>
Peak Particle Velocity T	<u>±5</u> %	<u>+j-</u> %	z <u>*</u> %

AIR OVERPRESSURE CHANNEL - Peak Level Unweighted <u>N/A</u> dB(Lin)

WE HEREBY CERTIFY THAT THIS SEISMOGRAPH FULLY COMPLIES WITH THE MANUFACTURERS SPECIFICATION

CERTIFIED BY:

14TH AUGUST 2012

DATE:

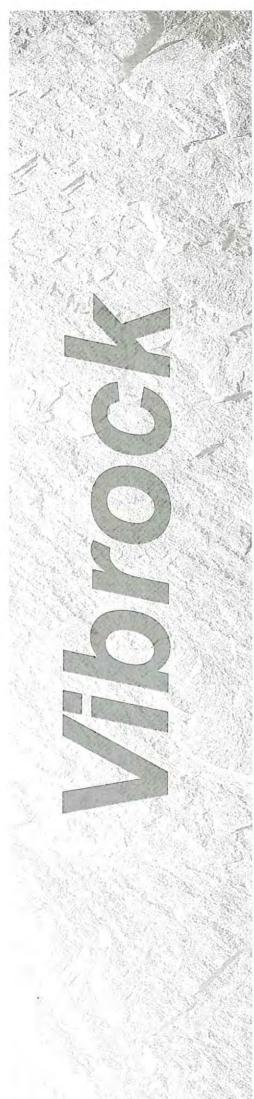
THIS CERTIFICATE IS VALID FOR 12 MONTHS

The above calibration was carried out using equipment calibrated as follows:-Pulsar Acoustic Calibrator 100B, serial number 60796, calibrated March 2012 ISO-TECH IFG 100 Oscillator, serial number 300351, calibrated June 2012 Monitran Vibration Meter, serial number 213608, calibrated June 2012 Precision Gold PG012 Multimeter, serial number 09000182, calibrated June 2012

THIS CALIBRATION IS TRACEABLE TO NATIONAL STANDARDS

VIBROCK LIMITED Shanakiel Ilkeston Road Heanor Derbyshire DE75 7DR Tel: 01773 711211 Fax: 01773 711311 Email: vibrock@vibrock.com Web: www.vibrock.com





08121567CALIBRATION CERTIFICATE NO.:CLIENT:Forth Crossing Bridge ConstructorsINSTRUMENT TYPE:V901-GSMSERIAL NUMBER:1567CALIBRATION DATE:14TH AUGUST 2012CALIBRATED BY:DENNIS LORD

CALIBRATION ACCURACY:-

	A channel	B channel	VDV channel	
Peak Particle Velocity L	<u>±5_%</u>	<u>±5</u> %	X_ <u>ts_</u> %	
Peak Particle Velocity V	<u>±5_%</u>	<u>±5</u> %	Y <u>≠」</u> %	
Peak Particle Velocity T	<u>±5</u> %	±5_%	Z <u>≠</u> √%	

AIR OVERPRESSURE CHANNEL - Peak Level Unweighted _//A dB(Lin)

WE HEREBY CERTIFY THAT THIS SEISMOGRAPH FULLY COMPLIES WITH THE MANUFACTURERS SPECIFICATION

CERTIFIED BY:

14TH AUGUST 2012

DATE:

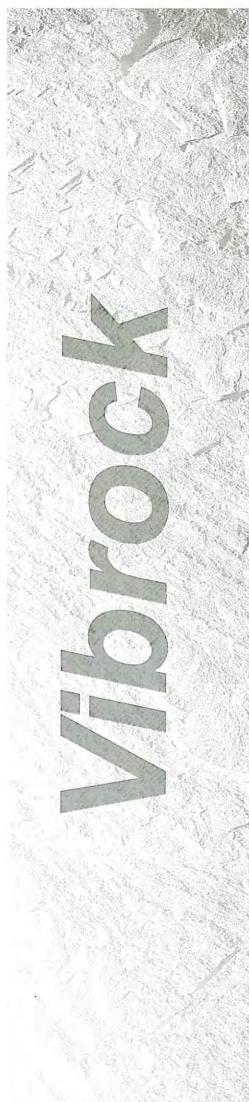
THIS CERTIFICATE IS VALID FOR 12 MONTHS

The above calibration was carried out using equipment calibrated as follows:-Pulsar Acoustic Calibrator 100B, serial number 60796, calibrated March 2012 ISO-TECH IFG 100 Oscillator, serial number 300351, calibrated June 2012 Monitran Vibration Meter, serial number 213608, calibrated June 2012 Precision Gold PG012 Multimeter, serial number 09000182, calibrated June 2012

THIS CALIBRATION IS TRACEABLE TO NATIONAL STANDARDS

VIBROCK LIMITED Shanakiel Ilkeston Road Heanor Derbyshire DE75 7DR Tel: 01773 711211 Fax: 01773 711311 Email: vibrock@vibrock.com Web: www.vibrock.com





08121568
IO.:
Forth Crossing Bridge Constructors
V901-GSM
1568
14TH AUGUST 2012
DENNIS LORD
DENNIS LORD

CALIBRATION ACCURACY:-

	A channel	B channel	VDV channel	
Peak Particle Velocity L	<u>±</u> 5_%	<u>%</u>	X <u>ts</u> %	
Peak Particle Velocity V	±5_%	tr %	Y 15 %	
Peak Particle Velocity T	<u>±5 %</u>	±5 %	z <u>=5</u> %	

AIR OVERPRESSURE CHANNEL - Peak Level Unweighted <u>AA</u> dB(Lin)

WE HEREBY CERTIFY THAT THIS SEISMOGRAPH FULLY COMPLIES WITH THE MANUFACTURERS SPECIFICATION

CERTIFIED BY:

14TH AUGUST 2012

DATE:

THIS CERTIFICATE IS VALID FOR 12 MONTHS

The above calibration was carried out using equipment calibrated as follows:-Pulsar Acoustic Calibrator 100B, serial number 60796, calibrated March 2012 ISO-TECH IFG 100 Oscillator, serial number 300351, calibrated June 2012 Monitran Vibration Meter, serial number 213608, calibrated June 2012 Precision Gold PG012 Multimeter, serial number 09000182, calibrated June 2012

THIS CALIBRATION IS TRACEABLE TO NATIONAL STANDARDS

VIBROCK LIMITED Shanakiel Ilkeston Road Heanor Derbyshire DE75 7DR Tel: 01773 711211 Fax: 01773 711311 Email: vibrock@vibrock.com Web: www.vibrock.com





CALIBRATION CERTIFICATE NO	08121569
CLIENT:	Forth Crossing Bridge Constructors
INSTRUMENT TYPE:	V901-GSM
SERIAL NUMBER:	1569
CALIBRATION DATE:	14TH AUGUST 2012
CALIBRATED BY:	DENNIS LORD

CALIBRATION ACCURACY:-

	A channel	B channel	VDV channel
Peak Particle Velocity L	<u>ts</u> %	<u>t5</u> %	X <u>≠厂</u> %
Peak Particle Velocity V	<u>±5 %</u>	<u>±</u> 5_%	Y =5 %
Peak Particle Velocity T	±5_%	<u>±5</u> %	z <u>±s</u> %

AIR OVERPRESSURE CHANNEL - Peak Level Unweighted _N/A_ dB(Lin)

WE HEREBY CERTIFY THAT THIS SEISMOGRAPH FULLY COMPLIES WITH THE MANUFACTURERS SPECIFICATION

CERTIFIED BY:

14TH AUGUST 2012

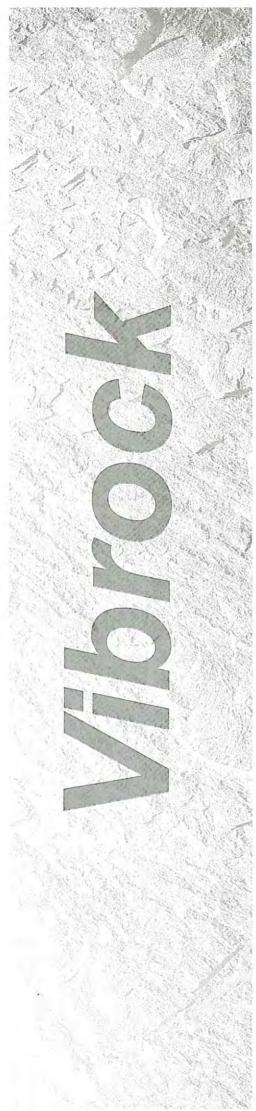
DATE:

THIS CERTIFICATE IS VALID FOR 12 MONTHS

The above calibration was carried out using equipment calibrated as follows:-Pulsar Acoustic Calibrator 100B, serial number 60796, calibrated March 2012 ISO-TECH IFG 100 Oscillator, serial number 300351, calibrated June 2012 Monitran Vibration Meter, serial number 213608, calibrated June 2012 Precision Gold PG012 Multimeter, serial number 09000182, calibrated June 2012

THIS CALIBRATION IS TRACEABLE TO NATIONAL STANDARDS

VIBROCK LIMITED Shanakiel Ilkeston Road Heanor Derbyshire DE75 7DR Tel: 01773 711211 Fax: 01773 711311 Email: vibrock@vibrock.com Web: www.vibrock.com



CALIBRATION CERTIFICATE NO .:

CLIENT: INSTRUMENT TYPE: SERIAL NUMBER: CALIBRATION DATE: CALIBRATED BY: 08121570

Forth Crossing Bridge Constructors
V901-GSM
1570
14TH AUGUST 2012

DENNIS LORD

CALIBRATION ACCURACY:-

	A channel	B channel	VDV channel
Peak Particle Velocity L	<u>±5</u> %	<u>±5</u> %	X <u>±5</u> %
Peak Particle Velocity V	<u>±5</u> %	<u>*</u> 5%	Y <u>*</u> 5%
Peak Particle Velocity T	<u>ts</u> %	<u>±5</u> %	Z <u>±s</u> %

AIR OVERPRESSURE CHANNEL - Peak Level Unweighted _____ dB(Lin)

WE HEREBY CERTIFY THAT THIS SEISMOGRAPH FULLY COMPLIES WITH THE MANUFACTURERS SPECIFICATION

CERTIFIED BY:

14TH AUGUST 2012

DATE:

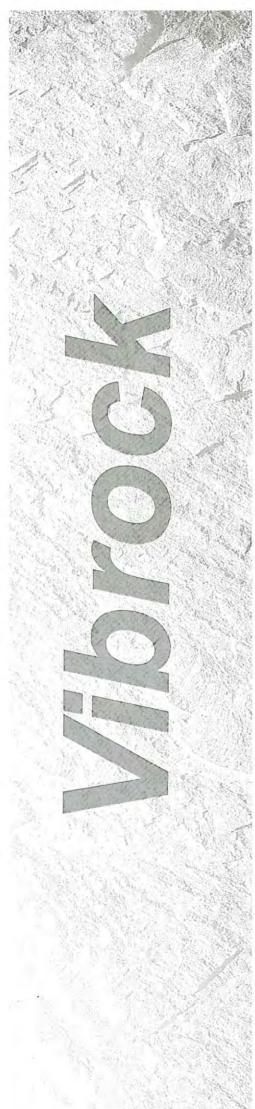
THIS CERTIFICATE IS VALID FOR 12 MONTHS

The above calibration was carried out using equipment calibrated as follows:-Pulsar Acoustic Calibrator 100B, serial number 60796, calibrated March 2012 ISO-TECH IFG 100 Oscillator, serial number 300351, calibrated June 2012 Monitran Vibration Meter, serial number 213608, calibrated June 2012 Precision Gold PG012 Multimeter, serial number 09000182, calibrated June 2012

THIS CALIBRATION IS TRACEABLE TO NATIONAL STANDARDS

VIBROCK LIMITED Shanakiel Ilkeston Road Heanor Derbyshire DE75 7DR Tel: 01773 711211 Fax: 01773 711311 Email: vibrock@vibrock.com Web: www.vibrock.com





CALIBRATION CERTIFICATE NO .:

CLIENT: INSTRUMENT TYPE: SERIAL NUMBER: CALIBRATION DATE: CALIBRATED BY:

ATE NO.:	08121571
	Forth Crossing Bridge Constructors
	V901-GSM
	1571
	14TH AUGUST 2012
	DENNIS LORD

CALIBRATION ACCURACY:-

	A channel	B channel	VDV channel
Peak Particle Velocity L	±5_%	<u>±5</u> %	X <u>≠5</u> %
Peak Particle Velocity V	±5_%	±5_%	Y ±5 %
Peak Particle Velocity T	±5_%	t5 %	<u>z ± √</u> %

AIR OVERPRESSURE CHANNEL - Peak Level Unweighted <u>AA</u> dB(Lin)

WE HEREBY CERTIFY THAT THIS SEISMOGRAPH FULLY COMPLIES WITH THE MANUFACTURERS SPECIFICATION

CERTIFIED BY:

14TH AUGUST 2012

DATE:

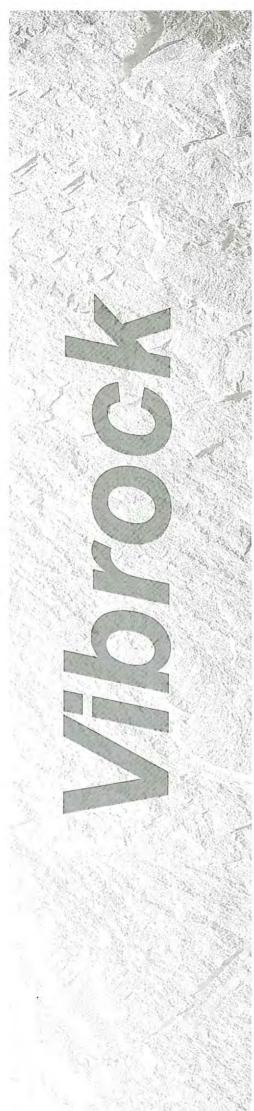
THIS CERTIFICATE IS VALID FOR 12 MONTHS

The above calibration was carried out using equipment calibrated as follows:-Pulsar Acoustic Calibrator 100B, serial number 60796, calibrated March 2012 ISO-TECH IFG 100 Oscillator, serial number 300351, calibrated June 2012 Monitran Vibration Meter, serial number 213608, calibrated June 2012 Precision Gold PG012 Multimeter, serial number 09000182, calibrated June 2012

THIS CALIBRATION IS TRACEABLE TO NATIONAL STANDARDS

VIBROCK LIMITED Shanakiel Ilkeston Road Heanor Derbyshire DE75 7DR Tel: 01773 711211 Fax: 01773 711311 Email: vibrock@vibrock.com Web: www.vibrock.com





CALIBRATION CERTIFICATE NO.: _

CLIENT: INSTRUMENT TYPE: SERIAL NUMBER: CALIBRATION DATE: CALIBRATED BY:

orth Crossing Bridge Constructo
V901-GSM
1572
14TH AUGUST 2012

DENNIS LORD

CALIBRATION ACCURACY:-

	A channel	B channel	VDV channel
Peak Particle Velocity L	±5_%	±5 %	X <u>+5</u> %
Peak Particle Velocity V	±5 %	<u>*2*</u> %	Y%
Peak Particle Velocity T	±5_%	±5_%	z <u>+</u> 5%

AIR OVERPRESSURE CHANNEL - Peak Level Unweighted N/A dB(Lin)

WE HEREBY CERTIFY THAT THIS SEISMOGRAPH FULLY COMPLIES WITH THE MANUFACTURERS SPECIFICATION

CERTIFIED BY:

DATE:

14TH AUGUST 2012

THIS CERTIFICATE IS VALID FOR 12 MONTHS

The above calibration was carried out using equipment calibrated as follows:-Pulsar Acoustic Calibrator 100B, serial number 60796, calibrated March 2012 ISO-TECH IFG 100 Oscillator, serial number 300351, calibrated June 2012 Monitran Vibration Meter, serial number 213608, calibrated June 2012 Precision Gold PG012 Multimeter, serial number 09000182, calibrated June 2012

THIS CALIBRATION IS TRACEABLE TO NATIONAL STANDARDS

VIBROCK LIMITED Shanakiel Ilkeston Road Heanor Derbyshire DE75 7DR Tel: 01773 711211 Fax: 01773 711311 Email: vibrock@vibrock.com Web: www.vibrock.com





 08121612

 CALIBRATION CERTIFICATE NO.:

 Forth Crossing Bridge Constructors

 CLIENT:

 INSTRUMENT TYPE:
 V901-GSM

 SERIAL NUMBER:
 1612

 CALIBRATION DATE:
 14TH AUGUST 2012

 CALIBRATED BY:
 DENNIS LORD

CALIBRATION ACCURACY:-

	A channel	B channel	VDV channel
Peak Particle Velocity L	<u>±5_%</u>	<u>±5</u> %	x <u>±5</u> %
Peak Particle Velocity V	±5_%	<u>±5</u> %	Y <u>= 5</u> %
Peak Particle Velocity T	±5_%	±5-%	z <u>≠5</u> %

AIR OVERPRESSURE CHANNEL - Peak Level Unweighted <u>A</u> dB(Lin)

WE HEREBY CERTIFY THAT THIS SEISMOGRAPH FULLY COMPLIES WITH THE MANUFACTURERS SPECIFICATION

CERTIFIED BY:

14TH AUGUST 2012

DATE:

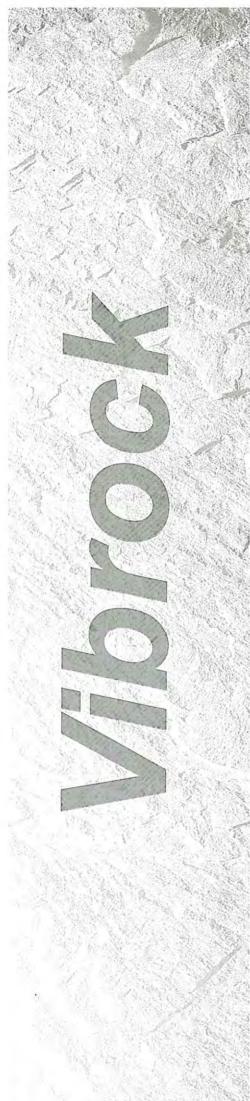
THIS CERTIFICATE IS VALID FOR 12 MONTHS

The above calibration was carried out using equipment calibrated as follows:-Pulsar Acoustic Calibrator 100B, serial number 60796, calibrated March 2012 ISO-TECH IFG 100 Oscillator, serial number 300351, calibrated June 2012 Monitran Vibration Meter, serial number 213608, calibrated June 2012 Precision Gold PG012 Multimeter, serial number 09000182, calibrated June 2012

THIS CALIBRATION IS TRACEABLE TO NATIONAL STANDARDS

VIBROCK LIMITED Shanakiel Ilkeston Road Heanor Derbyshire DE75 7DR Tel: 01773 711211 Fax: 01773 711311 Email: vibrock@vibrock.com Web: www.vibrock.com





 08121613

 CALIBRATION CERTIFICATE NO.:

 Forth Crossing Bridge Constructors

 CLIENT:

 INSTRUMENT TYPE:
 V901-GSM

 SERIAL NUMBER:
 1613

 CALIBRATION DATE:
 14TH AUGUST 2012

 CALIBRATED BY:
 DENNIS LORD

CALIBRATION ACCURACY:-

	A channel	B channel	VDV channel
Peak Particle Velocity L	±5 %	±5 %	X <u>±5</u> %
Peak Particle Velocity V	±5_%	±1_%	Y <u>±s</u> %
Peak Particle Velocity T	±5_%	<u>±5</u> %	Z <u>* 1</u> %

AIR OVERPRESSURE CHANNEL - Peak Level Unweighted <u>A</u> dB(Lin)

WE HEREBY CERTIFY THAT THIS SEISMOGRAPH FULLY COMPLIES WITH THE MANUFACTURERS SPECIFICATION

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