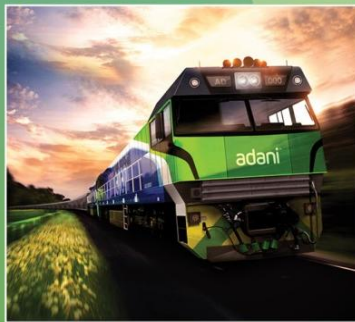




Adani Mining Pty Ltd

NORTH GALILEE BASIN RAIL PROJECT

Environmental Impact Statement

Appendix J Noise and vibration

November 2013

This North Galilee Basin Rail Project noise and vibration report (“the Report”) has been prepared by GHD Pty Ltd (“GHD”) on behalf of and for Adani Mining Pty Ltd (“Adani”) in accordance with an agreement between GHD and Adani.

The Report may only be used and relied on by Adani for the purpose of informing environmental assessments and planning approvals for the proposed North Galilee Basin Rail Project (“the Purpose”) and may not be used by, or relied on by any person other than Adani.

The services undertaken by GHD in connection with preparing the Report were limited to those specifically detailed in Section 1.2 of the Report.

The Report is based on conditions encountered and information reviewed, including assumptions made by GHD, at the time of preparing the Report. Assumptions made by GHD are contained through the Report, including (but not limited to) concept design and operations information provided by Adani.

To the maximum extent permitted by law GHD expressly disclaims responsibility for or liability arising from:

- *any error in, or omission in connection with assumptions, or*
- *reliance on the Report by a third party, or use of the Report other than for the Purpose.*

Executive summary

This noise and vibration report has been prepared to describe the existing acoustic environment and assess potential noise emissions related to construction and operation of the North Galilee Basin Rail Project (NGBR Project).

A baseline assessment is presented which describes the existing noise and vibration environment at representative sensitive receptor locations, which have then been utilised to establish criteria and target levels for the construction and operation phases of the NGBR Project.

Attended and unattended noise surveys were undertaken at four representative noise sensitive receptor locations near the NGBR Project. Noise monitoring results at all locations are typical of a rural environment with low background noise levels during day and night periods. The background noise levels were higher in the evening due to natural noise sources including birds, frogs, cattle and insects. At the storage tank location (monitoring location A), increased noise from road traffic travelling on the Bruce Highway contributed to higher evening background noise levels. Measured ground vibration results indicate very low ground vibration levels (less than or equal to 0.3 mm/s) at all locations, which confirms the lack of perceptible vibration at all sites.

In the absence of legislated noise level limits for construction in Queensland, the adopted construction noise criteria for the NGBR Project is the New South Wales Environmental Protection Authority (NSW EPA) Interim Construction Noise Guideline (ICNG). The ICNG provides noise management levels for construction noise at residential receptors. These management levels were calculated based on the Rating Background Level (RBL) at nearby residential locations.

In the absence of any specific Queensland or Australian noise and vibration guidelines relating to human comfort, vibration criteria were adopted from the British Standard BS6472: 2008, Guide to evaluation of human exposure to vibration in buildings Part 1: Vibration sources other than blasting. Vibration and airblast overpressure criteria for blasting were taken from the *Environmental Protection Act 1994*, Section 440 ZB and the guideline Noise and Vibration from Blasting (EPA 2006).

As the acoustic quality objectives of the *Environmental Protection (Noise) Policy 2008* does not apply to noise from the ordinary use of rail transport infrastructure, the adopted operational noise criteria for the NGBR Project is the NSW EPA Rail Infrastructure Noise Guideline (2013) (RING). The guideline provides day and night trigger levels for heavy rail noise at residences. The noise trigger levels for absolute levels of rail noise have two components, average (L_{Aeq}) and maximum (L_{Amax}). The L_{Aeq} contribution level of rail noise is assessed over the day or night period and the maximum noise level (L_{Amax}) from pass-by events. Typically, exceedances of the trigger values must occur to initiate an assessment of rail noise impacts and investigate mitigation measures.

Noise modeling was undertaken to predict noise levels expected at sensitive receptors in the vicinity of the NGBR Project. Construction noise modeling incorporated the indicative construction plant and equipment to be used, and sound power levels associated with each. The noise modeling also accounted for the road traffic noise associated with increased traffic volumes during the construction phase. Operational modeling incorporated the length, speed and frequency of trains.

Maximum predicted construction noise during the construction phase at a sensitive receptor was 51.6 dB(A) L_{Aeq} . Maximum predicted operational noise at a sensitive receptor was 57.5 dB $L_{Aeq,15h}$ during the day and 57.2 dB $L_{Aeq,9h}$ during the night.

The maximum predicted increase in construction generated road traffic noise was 10 dB(A) at three road sections (Stratford Road; Suttor Developmental Road/Suttor Road intersection; and Suttor Developmental Road/Glen Avon Road intersection).

Based on recent vibration testing for other coal train operations, vibration during operation was expected to be negligible at a distance greater than 40 m from the centerline of the final rail corridor. Vibration and airblast overpressure from blasting at sensitive receptors were considered on the worst case assumption that blasting would occur at the closest point of the final rail corridor (a nominal 100 m wide corridor) to a sensitive receptor. Maximum predicted airblast overpressure was between 101.6 and 122.7 dBL, depending on the site constant (k_a) applied. Maximum predicted ground vibration ranged from less than 0.1 to 0.5 peak particle velocity (mm/s), depending on ground constant (K_G).

Table of contents

1.	Introduction.....	1
1.1	Project overview	1
1.2	Scope of report.....	1
2.	Methodology	4
2.1	Study area.....	4
2.2	Data sources.....	4
2.3	Legislation and guidelines	4
2.4	Site assessment	5
2.4.1	Noise.....	5
2.4.2	Vibration	6
2.5	Desktop assessment	8
2.5.1	Sensitive receptors	8
2.5.2	Construction methods.....	9
2.5.3	Construction noise model	12
2.5.4	Operational noise model.....	14
2.5.5	Construction and operational vibration.....	15
2.5.6	Blasting.....	15
2.5.7	Low frequency noise.....	16
2.6	Limitations	17
3.	Existing environment	18
3.1	Sensitive receptors.....	18
3.2	Background noise	18
3.3	Background vibration.....	26
4.	Assessment criteria.....	27
4.1	Legislative context.....	27
4.2	Construction noise criteria.....	28
4.2.1	Environmental Protection Act	28
4.2.2	NSW Environmental Protection Agency Interim Construction Noise Guideline.....	28
4.3	Operational noise criteria.....	29
4.3.1	Rail operation	29
4.4	Vibration criteria.....	30
4.4.1	Human comfort vibration criteria	30
4.4.2	Structural vibration criteria	31
4.4.3	Blasting overpressure and vibration.....	33
5.	Emissions inventory.....	34
5.1	Construction noise and vibration levels.....	34
5.1.1	Rail construction noise.....	34
5.1.2	General construction vibration.....	35
5.2	Operational rail noise levels.....	35

5.3	Rail vibration	36
5.4	Maintenance facility.....	37
5.5	Blasting overpressure and ground vibration.....	37
6.	Key findings	39
7.	References	40

Table index

Table 2-1	Noise survey location details	5
Table 2-2	Unattended noise logger details.....	6
Table 2-3	Sensitive receptors	9
Table 2-4	Estimated sound power levels.....	11
Table 2-5	Typical vibration level of construction plant items	15
Table 3-1	Unattended noise monitoring results – Location A (Storage tank).....	19
Table 3-2	Unattended monitoring results – Location B (Bakara homestead).....	20
Table 3-3	Unattended noise monitoring results – Location C (Fig Tree homestead).....	21
Table 3-4	Unattended noise monitoring results – Location D (Stratford homestead)	22
Table 3-5	Summary of unattended noise monitoring results.....	23
Table 3-6	Attended noise monitoring results – Location A (Storage tank).....	24
Table 3-7	Attended noise monitoring results – Location B (Bakara homestead)	24
Table 3-8	Attended noise monitoring results – Location C (Fig Tree homestead)	25
Table 3-9	Attended noise monitoring results – Location D (Stratford homestead).....	25
Table 3-10	Vibration measurement results – peak particle velocity	26
Table 4-1	ICNG construction noise criteria at residential receptors, dB(A).....	28
Table 4-2	QR rail noise criteria.....	29
Table 4-3	RING noise trigger levels for a rail line development.....	30
Table 4-4	QR rail noise criteria.....	30
Table 4-5	Vibration dose value ranges and probabilities for adverse comment to intermittent vibration ($\text{m/s}^{1.75}$).....	31
Table 4-6	Guidance on the effects of vibration levels	31
Table 4-7	Guideline values for vibration velocity to be used when evaluating the effects of short-term vibration on structures.....	32
Table 4-8	DIN 4150 Part 3 – Damage to buried pipes – guidelines for short-term vibration.....	32
Table 4-9	Guideline blasting limits	33
Table 5-1	Predicted external construction noise levels - dB(A) L_{Aeq}	34

Table 5-2 Estimate construction vibration..... 35

Table 5-3 Predicted external rail noise levels dB(A) – includes 2.5dB façade correction..... 36

Table 5-4 Predicted blast impacts..... 38

Figure index

Figure 1-1 Project location.....	3
Figure 2-1 Sensitive receptors and monitoring locations.....	7

Appendices

Appendix A – Statistical ambient noise levels
Appendix B – Predicted rail operational noise contours (façade corrected)

Terms and abbreviations

Terms and abbreviations	Definition
Adani	Adani Mining Pty Ltd
Airblast overpressure	The energy transmitted from the blast site within the atmosphere in the form of pressure waves. The maximum excess pressure in this wave is known as the peak air overpressure, generally measured in decibels using linear frequency weighting
Blasting	The use of explosives to fracture rock, coal or other materials for later recovery
dB	Decibel is the unit used for expressing the sound pressure level (SPL) or power level (SWL) in acoustics
dB(A)	Frequency weighting filter used to measure 'A-weighted' sound pressure levels, which conforms approximately to the human ear response, as our hearing is less sensitive at very low and very high frequencies
Final NGBR Project footprint	The final rail corridor (nominal 100 m wide corridor) including all ancillary activities will be known as the final NGBR Project footprint. The final NGBR Project footprint will accommodate all rail infrastructure required for construction and operation, scalable to accommodate 100 mtpa product coal transport, including passing loops, a maintenance road, rolling stock maintenance (provisioning, fuel storage and refuelling, maintenance, etc.), water supply and pipeline, track and signalling maintenance facilities, staff crib, accommodation and training facilities and other necessary infrastructure associated with the operational functions of the NGBR Project. Temporary construction facilities are expected to include laydown areas, construction depots (warehousing, fuel storage, vehicle storage, administration facilities, etc.), sleeper manufacturing yards, construction accommodation camps, quarries and borrow pits, access tracks into the corridor and other necessary infrastructure associated with the construction functions of the NGBR Project. This terminology should be used in both the EIS chapter and the technical reports
Final rail corridor	The final rail corridor for the NGBR Project, with a nominal width of 100 m
$L_{A90(\text{period})}$	The sound pressure level that is exceeded for 90 per cent of the measurement period
$L_{Aeq(\text{period})}$	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_{Amax}	The maximum sound level recorded during the measurement period
mtpa	Million tonnes per annum
NGBR Project	North Galilee Basin Rail Project

Terms and abbreviations	Definition
Noise Sensitive Place/Receptor	With consideration to the <i>Environmental Protection (Noise) Policy 2008</i> and of relevance to the NGBR Project a noise sensitive place (that is a potential sensitive receptor) is defined as (amongst others): • A dwelling. • A library, childcare centre, kindergarten, school, college, university or other educational institution. • A hospital, surgery or other medical institution. • A protected area, or an area identified under a conservation plan as a critical habitat or an area of major interest under the <i>Nature Conservation Act 1992</i>. • A marine park under the <i>Marine Parks Act 1982</i>. A park or garden that is open to the public (whether or not on payment of money) for use other than for sport or organised entertainment
PPV	Peak particle velocity, a measure of the ground vibration magnitude and is the maximum instantaneous particle velocity at a point during a given time interval in mm/s
Preliminary investigation corridor	The preliminary investigation corridor for the NGBR Project, with a nominal width of 1,000 m
QR	Queensland Rail
RBL	Rating background level, The rating background level (RBL) or minLA90,1hour is the overall single-figure background noise level representing each assessment period (day/evening/night) over the whole monitoring period (as opposed to over each 24 hour period used for the assessment background level). This is the level used for assessment purposes. It is defined as the median value of: All the day assessment background levels over the monitoring period for the day (7:00 am to 6:00 pm) All the evening assessment background levels over the monitoring period for the evening (6:00 pm to 10:00 pm) All the night assessment background levels over the monitoring period for night (10:00 pm to 7:00 am)
VDV	Vibration Dose Value (VDV) – As defined in BS6472 – 2008, VDV is given by the fourth root of the integral of the fourth power of the frequency weighted acceleration
Vibration	The variation of the magnitude of a quantity which is descriptive of the motion or position of a mechanical system, when the magnitude is alternately greater and smaller than some average value or reference. Vibration can be measured in terms of its displacement, velocity or acceleration. The common units for velocity are millimetres per second (mm/s)

1. Introduction

1.1 Project overview

Adani Mining Pty Ltd (Adani) proposes the construction and operation of the North Galilee Basin Rail Project (NGBR Project), a multiuser, standard gauge, greenfield rail line that will transport coal from mines in the northern Galilee Basin to the Port of Abbot Point. The NGBR Project is approximately 300 km in length and connects the proposed Carmichael Coal Mine and Rail Project's east-west rail corridor, approximately 70 km east of the proposed Carmichael Coal Mine in the vicinity of Mistake Creek, with supporting infrastructure at the Port of Abbot Point (refer Figure 1-1). The NGBR Project will have an operational capacity of up to 100 million tonnes per annum (mtpa) of coal product expected to be sourced from both Adani and third-party mines in the northern Galilee Basin. Key features of the NGBR Project include:

- Approximately 300 km of standard gauge, bi-directional rail track located within a nominal 100 m wide rail corridor (the final rail corridor)
- A rail maintenance access road running parallel to the rail track for approximately 300 km and wholly within the final rail corridor
- Seven passing loops, each 4.3 km in length
- Signalling infrastructure
- Approximately 4.5 km of fill greater than 15 m in depth (11 locations) and approximately 3.4 km of cut greater than 15 m in depth (nine locations)
- At-grade and grade-separated road, rail, stock and occupational crossings
- Bridge and culvert structures at major waterways and drainage lines, and various other longitudinal and cross drainage structures
- A rolling stock maintenance facility near the Port of Abbot Point including provisioning line, train maintenance line, wagon and locomotive service sheds, wash bay and queuing line
- Five temporary accommodation camps for construction workers
- A temporary construction depot at the southern end of NGBR Project
- Temporary construction yards, concrete batching plants, bridge and track laydown areas and heavy vehicle turning circles.

During construction, quarries and borrow pits within acceptable haulage distances will be required to provide a cost effective source of fill, gravel, aggregate and ballast. The number and location of borrow pits and quarries will be investigated further during detailed design and each may require screening and crushing plants to process material.

1.2 Scope of report

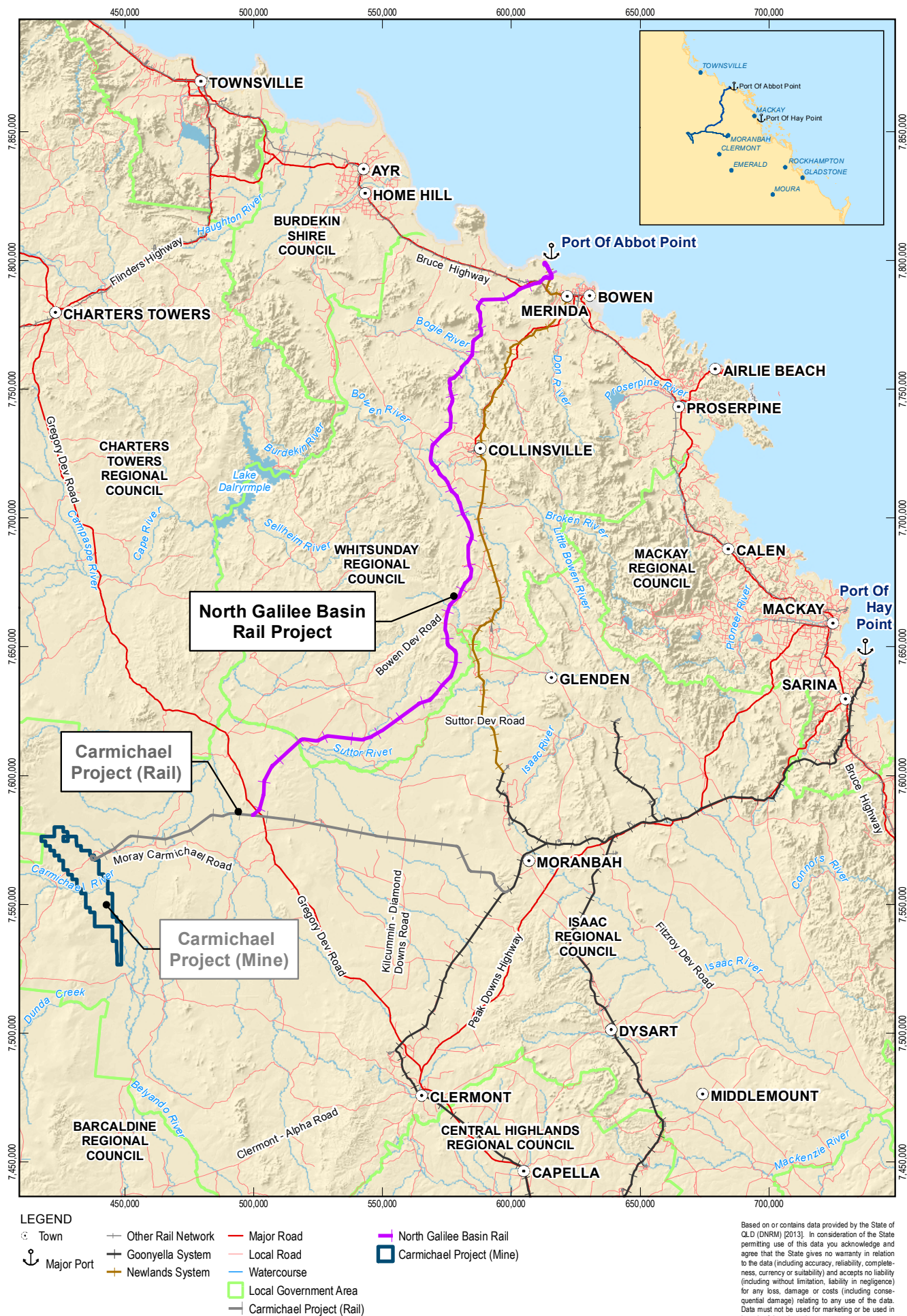
The objective of this noise and vibration report is to describe the acoustic environment and potential noise emissions of the NGBR Project. This report describes the existing noise and vibration levels at representative sensitive receptor locations, which have then been utilised where required to establish criteria and target levels for construction and operation of the NGBR Project. Potential noise emissions have been modeled using computational noise prediction software. Operational and construction modeling considers NGBR Project parameters including construction

activities, operational volumes and intervening terrain to estimate noise and vibration at nearby sensitive receptor locations.

The scope of the noise and vibration report was defined by the following tasks:

- Establish the noise and vibration related environmental values
- Determine appropriate environmental noise and vibration criteria
- Model noise and vibration emissions at nearby sensitive receptor locations.

This noise and vibration report was prepared in accordance with the Terms of Reference for the NGBR Project. A table cross referencing the contents of this report and the Terms of Reference is included as Volume 2 Appendix A Terms of reference cross-reference.



2. Methodology

2.1 Study area

The study area was defined as the area containing the NGBR Project final rail corridor (nominal 100 m wide corridor) and its nearest sensitive receptors (refer Section 3.1).

2.2 Data sources

The noise and vibration assessment relied on the following data sources:

- North Galilee Basin Rail Concept Design Report (Aarvee Associates 2013)
- Noise source data for modelling input including:
 - Nordic Rail Traffic Noise Prediction Method locomotive noise emission levels
 - BS5228-1:2009 Code of Practice for Noise and Vibration on Construction and Open Sites Part 1: Noise
 - AS2436: 1981 Guide to Noise Control on Construction, Maintenance and Demolition Sites
 - United States Department of Transportation Federal Highway Administration – Construction Equipment Noise Levels and Ranges
 - GHD's internal noise and vibration database
- Bureau of Meteorology (BOM) Moranbah Airport Automatic Weather Station data covering the background noise and vibration monitoring periods

2.3 Legislation and guidelines

Legislation and guidelines relevant to this noise and vibration report are as follows.

- *Environmental Protection Act 1994* (Qld)
- *Environmental Protection (Noise) Policy 2008* (Qld)
- Code of Practice for Railway Noise Management (QR, 2007)
- EPA Ecoaccess Guideline, Noise and Vibration from Blasting 2006 (Qld)
- EPA Ecoaccess Guideline, Planning for Noise Control (PNC) 2004 (Qld)
- Department of Environment and Heritage Protection Draft Low Frequency Noise Guideline (Qld)
- New South Wales Environmental Protection Authority (NSW EPA) Interim Construction Noise Guideline (ICNG)
- NSW EPA Rail Infrastructure Noise Guideline (RING)
- Australian Standard AS 2436:2010 Guide to Noise Control on Construction, Maintenance and Demolition Sites
- AS 2187.2 – 2006 Explosives – Storage and use Part 2: Use of explosives
- BS 6472-1:2008 Guide to evaluation of human exposure to vibration in buildings Part 1: Vibration sources other than blasting

- BS 5228-2:2009, Code of practice for noise and vibration on construction and open sites – Part 2: Vibration
- DIN 4150-3:1999 Structural vibration – Part 3: effects of vibration on structures.

The application of the above legislation and guidelines to develop assessment criteria for the NGBR Project is discussed in Section 4. An explanation of the above legislation is provided in Volume 1 Chapter 20 Legislation and approvals.

2.4 Site assessment

2.4.1 Noise

Ambient noise monitoring was conducted as part of this assessment to determine noise limits for the NGBR Project with consideration to the relevant guidelines and the TOR.

Background noise levels were assessed using a combination of unattended and attended noise monitoring. Monitoring was conducted at four locations in the vicinity of the NGBR Project. Noise monitoring site locations are provided in Table 2-1, and depicted in Figure 2-1. These sites were selected as they were at or near the nearest potentially sensitive receptors. Photographs of the monitoring sites are also provided as insets in Figure 2-1.

Unattended noise logging was conducted to establish representative background noise levels in the vicinity of the potentially most affected sensitive receptors. Attended monitoring was also undertaken in conjunction with the unattended noise logging at these locations to better understand the noise sources contributing to the overall existing noise levels.

Locations selected are considered representative of the acoustic environment for the nearest potential sensitive receptors located in the vicinity of the NGBR Project. Land access permission was also a factor that contributed to the final selection of the locations.

Table 2-1 Noise survey location details

Monitoring location	GPS coordinates	Description of noise survey location	Monitoring period
A	19° 57' 24.444"S 148° 4' 23.124"E	0.08 km from final rail corridor Storage tank	9 May – 29 May 2013
B	20°24'29.15"S 147°44'40.48"E	1.6 km away from final rail corridor In vicinity of homestead 1	8 May – 25 May 2013
C	20°57'56.12"S 147°46'48.04"E	2.7 km away from final rail corridor In vicinity of homestead 17	9 May – 30 May 2013
D	21° 35' 8.772"S 147° 11' 14.388"E	1.0 km away from final rail corridor In vicinity of homestead 22	29 May – 12 June 2013

Unattended monitoring

Unattended noise monitoring was undertaken using four Svan 955 environmental noise loggers between 8 May and 12 June 2013 at four locations in the vicinity of the NGBR Project. These loggers are capable of measuring continuous sound pressure levels and are able to record the sound pressure level that is exceeded for 90 per cent of the measurement period (L_{A90}), 10 per

cent of the measurement period (L_{A10}) and the equivalent sound level (L_{Aeq}) noise descriptors. The instruments were programmed to accumulate environmental noise data continuously over sampling periods of 15 minutes for the entire monitoring period.

Prior to deployment, the loggers were calibrated with a sound pressure level of 94 dB at one kHz using a B&K Type 4231 calibrator. At completion of the monitoring period, the loggers were retrieved and calibration was rechecked. The difference was found to be less than plus or minus (+/-) 0.5 dB. Table 2-2 provides details of the noise loggers at each monitoring location.

The data collected by the loggers was downloaded and analysed. Data where average wind speeds were greater than five metres per second (m/s), or when any rainfall occurred, was considered invalid and removed. Weather data over the monitoring period was collected from the BOM Moranbah Airport Automatic Weather Station. The weather conditions at Moranbah were considered representative of the wider area.

Table 2-2 Unattended noise logger details

Monitoring location	Logger serial No.	Measurement started	Measurement ceased	Pre Cal	Post Cal	Frequency weighting	Time response
Location A	27622	09/05/2013	29/05/2013	94.0	94.0	A	Fast
Location B	27625	08/05/2013	25/05/2013	94.0	94.0	A	Fast
Location C	27624	09/05/2013	30/05/2013	94.0	94.0	A	Fast
Location D	27621	29/05/2013	12/06/2013	94.0	94.0	A	Fast

Attended monitoring

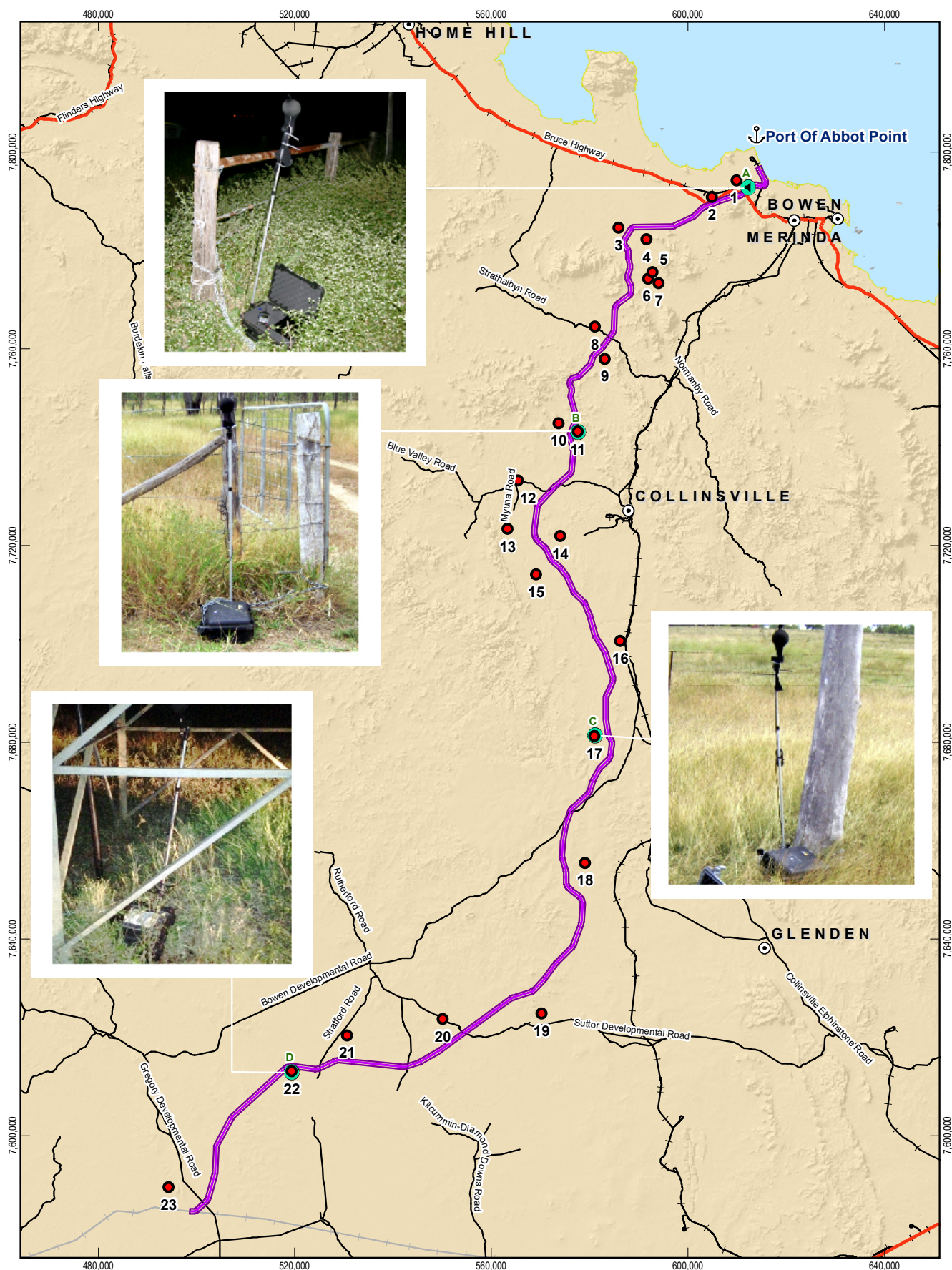
Attended measurements were conducted at unattended monitoring locations to supplement the logger data and identify noise sources. Attended noise measurements were conducted on 8 - 9 and 29 - 30 May 2013 using a B&K 2250 Sound Level Meter (SLM). This SLM is capable of measuring continuous sound pressure levels and is able to record L_{A90} , L_{A10} , L_{Aeq} and the maximum sound level recorded during the measurement period (L_{Amax}) noise descriptors.

Prior to deployment, the meter was calibrated using a B&K Type 4231 calibrator with a sound pressure level of 94 dB at one kilohertz. Calibration was checked prior to the commencement and at completion of the measurements. The difference was less than +/- 0.5 dB.

All sampling activities were undertaken with consideration to the specifications outlined in AS1055 (1997) Description and Measurement of Environmental Noise and the Queensland Noise Measurement Manual (EPA, 2000).

2.4.2 Vibration

Vibration measurements were undertaken at the monitoring locations in the vicinity of the NGBR Project as shown in Figure 2-1. Vibration measurements were conducted using an Instanetl Minimate Plus (serial number BE12721) vibration logger with a tri-axial geophone to monitor ground vibration peak particle velocity (PPV) in each axial direction. Measurements were undertaken concurrent to attended noise monitoring over a period of 20 to 30 minutes. The Instanetl Minimate Plus has a range of 31.7 mm per second and a sample rate of 2048 samples per second. The Minimate unit has an inbuilt data logger, downloadable to PC where analysis can be performed using Blastware software.



LEGEND

- Population Centres
- ⚓ Major Port
- Sensitive Receptor
- Monitoring Location
- Carmichael Project (Rail)
- Railway
- North Galilee Basin Rail 1000m Corridor
- North Galilee Basin Rail 100m Corridor

1:1,100,000
 0 10 20 40
 Kilometres
 Map Projection: Transverse Mercator
 Horizontal Datum: GDA 1994
 Grid: GDA 1994 MGA Zone 55



adani

Adani Mining Pty Ltd
 North Galilee Basin Rail Project

Job Number 41-26457
 Revision C
 Date 28 Aug 2013

Sensitive Receptors
 and Monitoring Locations

Figure 2-1

Based on or contains data provided by the State of QLD (DNRM) (2013). In consideration of the State permitting use of this data you acknowledge and agree that the State gives no warranty in relation to the data (including accuracy, reliability, completeness, currency or suitability) and accepts no liability (including without limitation, liability in negligence) for any loss, damage or costs (including consequential damage) relating to any use of the data. Data must not be used for marketing or be used in breach of the privacy laws.

G:\41\26457\06 GIS\Maps\MXD\0900_Noise_Vibration\41_26457_0901_rev_c.mxd

145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3300 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

© 2013. Whilst every care has been taken to prepare this map, GHD, GA, DNRM, Adani make no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and cannot accept liability and responsibility of any kind (whether in contract, tort or otherwise) for any expenses, losses, damages and/or costs (including indirect or consequential damage) which are or may be incurred by any party as a result of the map being inaccurate, incomplete or unsuitable in any way and for any reason.
 Data source: GA: Populated Places, Railway, Watercourse, Lakes/2007; Adani: NGBR Corridor 06/06/2013, NGBR Corridor 13/05/2013, Carmichael Project Rail/2013; DNRM: Roads/2010; GHD/Adani: Potential Sensitive Receptors/2013; GHD: Monitoring Locations/2013.

2.5 Desktop assessment

The desktop assessment involved the following tasks.

- Review of the North Galilee Basin Rail Concept Design Report (Aarvee Associates 2013)
- Collation and review of site assessment data (refer to Section 2.4)
- Identification of sensitive receptors
- Identification and characterisation of NGBR Project noise and vibration sources
- Development of noise and vibration assessment criteria and objectives
- Development of noise contours and quantification of noise and vibration levels at sensitive receptors.

2.5.1 Sensitive receptors

The study area is generally sparsely populated with the final rail corridor avoiding close contact with potential sensitive receptors. Nearest potential sensitive receptors were identified within approximately six kilometres of the 1,000 m preliminary investigation corridor for the NGBR Project. Twenty-three sensitive receptors were identified, all of which were homesteads. No other types of sensitive receptors, such as educational institutions, places of worship or medical facilities, were identified.

Locations of the nearest potentially affected residential receptors within the vicinity of the NGBR Project are given Table 2-3. The closest sensitive receptor was homestead 2, at a distance of approximately 1,202 m from the centreline of the final rail corridor.

Table 2-3 Sensitive receptors

Residential receptor	Easting	Northing	Distance to centreline of final rail corridor (m)
Homestead 1	609916	7794255	2,740
Homestead 2	604874	7790877	1,202
Homestead 3	585906	7784622	2,248
Homestead 4	591656	7782269	2,631
Homestead 5	592845	7775614	4,730
Homestead 6	591975	7774322	3,826
Homestead 7	594112	7773398	5,724
Homestead 8	581086	7764508	3,622
Homestead 9	583141	7758004	2,121
Homestead 10	573776	7744903	2,927
Homestead 11	577907	7743136	1,564
Homestead 12	565463	7733205	6,208
Homestead 13	563357	7723411	5,366
Homestead 14	574094	7721935	3,913
Homestead 15	569153	7714138	4,313
Homestead 16	586276	7700615	3,869
Homestead 17	580954	7681237	2,822
Homestead 18	579067	7655503	4,170
Homestead 19	570319	7624819	4,981
Homestead 20	550182	7623709	4,744
Homestead 21	530696	7620414	5,209
Homestead 22	519416	7613045	1,109
Homestead 23	494429	7589483	6,634

2.5.2 Construction methods

For the purposes of this noise and vibration report the construction methodology has been categorised into the following activities:

- Cut and fill earthworks
- Drainage construction
- Capping layer application

- Bridge construction
- Haul road and access road maintenance
- Track laying.

The primary intersections for transportation of construction staff and equipment to the NGBR Project occur at intersections of proposed access roads and existing roads, namely:

- A - Bruce Highway/New Access Road (near chainage 14 km)
- B - Glenore Road/New Access Road (near chainage 34 km)
- C - Strathalbyn Road/New Access Road (near NGBR chainage 62 km)
- D - Bowen Developmental Road/New Access Road (near chainage 120 km)
- E - Bowen Developmental Road/New Access Road (near chainage 170 km)
- F - Suttor Developmental Road/Stratford Road (near chainage 230 km)
- G - Stratford Road/New Access Road (near chainage 262 km)
- H - Gregory Developmental Road/New Access Road (near chainage 305 km).

A construction access and haulage track has also been allowed for, which will run adjacent to the NGBR Project within the final rail corridor. This track will subsequently serve as the rail maintenance access road during the operation of the NGBR Project. The final design, location and standard of the rail maintenance access road will be determined as part of the detail design.

An indicative list of construction equipment/plant that may be used during construction and corresponding sound power levels is provided in Table 2-4 (Aarvee Associates 2013). It should be noted that these are estimates only and the construction contractors will determine the actual type and number of vehicles.

Construction plant and equipment is based on an indicative make and model (refer Volume 1 Chapter 2 Project description).

Table 2-4 Estimated sound power levels

Activity	Equipment	Estimated Sound Power Level L_{eq} dB(Lin)
Cut and fill earthworks	D10 dozers	126
	D11 dozers	125
	651 open bowl scrapers	123
	631 open bowl scrapers	114
	623 elevating scrapers	120
	825 compactors	123
	16 G Graders	120
	30,000 L water carts	123
	85 tonne excavator	126
	740 rear dump trucks	125
Drainage construction	30 tonne excavators	107
	60 tonne rough terrain hydraulic cranes	105
	20 tonne rough terrain Franna type cranes	110
	front end loaders/backhoes	116
	20,000 L water carts	115
	10 tonne self-propelled pad-foot rollers	119
	miscellaneous small hand held compaction equipment	105
Capping layer application	140 G Graders	113
	825 compactors	114
	paving machines	119
	15 tonne vibrating smooth drum rollers	115
	20,000 litre water carts	113
Bridge construction	160/220 Tonne hydraulic cranes	117

Activity	Equipment	Estimated Sound Power Level L_{eq} dB(Lin)
	20 tonne rough terrain Franna type crane	110
	30 tonne excavator (part time)	107
	950 front end loader	116
	10 tonne self-propelled pad-foot roller	119
	front end loader/backhoe	116
	20,000 litre water carts	115
Haul road and access road maintenance	140 G grader	113
	30,000 L water carts x 4	123
	30 tonne excavator (part time)	107
Track laying	Flash butt welder	114 ¹
	Harsco New Track Construction tracklaying machine	107 ²
	CAT 954 Track excavator	107
	Tamper/regulator	111 ³
	Harsco sleeper gantry	100
	Cat 988H loaders	119
	16T track excavator	107
	Volvo 120F loaders	116

¹ Plasser K355-ZW flash butt welder; Plasser/Harsco/Holland mobile flash butt welder

² Noise level has been conservatively estimated

³ Plasser 09-3X main line tamper; UNIMAT 04-27C main line tamper; Plasser 08-16H switch tamper

2.5.3 Construction noise model

Noise modelling

Acoustic modelling was undertaken using Computer Aided Noise Abatement (CadnaA) to predict the effects of airborne construction noise from each construction task outlined in Table 2-3.

CadnaA is a computer program for the calculation, assessment and prognosis of noise propagation. Construction environmental noise propagation was calculated according to ISO 9613-2, Acoustics – Attenuation of sound during propagation outdoors. Ground absorption, reflection, terrain and relevant shielding objects are taken into account in the calculations.

Where possible, input sound power levels were sourced from British Standard (BS) 5228-1:2009 Code of Practice for Noise and Vibration Control on Construction and Open Sites – Part 1: Noise and Australian Standard (AS) 2436:2010 Guide to Noise Control on Construction, Maintenance and Demolition Sites. Data listed in BS 5228-1:2009 has the benefit of including spectral data, as opposed to most construction noise data published in other documentation.

The magnitude of noise impacts associated with construction is dependent upon a number of factors including:

- The intensity of construction activities
- The location of construction activities
- The type of equipment used
- Existing local noise sources
- Intervening terrain
- The prevailing weather conditions.

Each of the indicative sound power levels for the construction equipment listed in Table 2-4 were combined to provide a predicted impact at the identified sensitive receptors along the NGBR Project for a given activity. Sources of combined noise were located along the NGBR Project and projected locations for construction camps, batching plants, yards and compounds.

Model configuration

The following parameters were set while configuring the model:

- A general ground absorption coefficient of 0.5 was used throughout the model
- Atmospheric conditions of 10°C and 70% humidity were used.

A ground absorption coefficient of 1.0 represents highly absorptive ground covers (e.g. grass, porous soil), whereas a value of 0.0 represents highly reflective surfaces (e.g. concrete). The ground absorption coefficient of 0.5 was selected as a conservative representation of the absorptive capacity of the ground in the study area. Atmospheric conditions were selected from a finite range of model configurations, to close to the mean minima at Collinsville Post Office BOM, representing a 'worst case' scenario for noise propagation.

Modelling Assumptions

The following assumptions were made with regard to the model configuration.

- Construction equipment running at full load 75% of the time
- Noise propagation was based on natural surface topography, which discounts the mitigating effect of cuttings on noise levels. It was not expected that fills would significantly affect noise propagation in comparison to noise at natural surface level.
- In general, it is expected that the above configuration and assumptions would lead to a conservative assessment of potential noise impacts.

2.5.4 Operational noise model

Noise modelling

Acoustic modelling was undertaken using CadnaA to predict the effects of airborne rail traffic noise from the NGBR Project final rail corridor.

Rail traffic noise modelling was conducted using the Nordic Rail Traffic Noise Prediction Method for Diesel Goods Train (S-Goods) developed by Kilde (1996), which is representative of the anticipated rail vehicles to be used during NGBR Project operations. The Nordic method is commonly used in Australia and is capable of efficiently calculating both the L_{Amax} and L_{Aeq} noise levels.

The final rail corridor has been modelled based on available data at the time of the assessment, and as such, should be used for comparison purposes only. In particular, the model reflects the status of the design at the time of the assessment.

Ground contours and rail alignment

Digital terrain contours, cadastral data and rail alignment were sourced from the geographic information system database of the NGBR Project.

Earthworks terrain details were not available at the time of modelling, therefore calculations are based on natural surface ground topography.

Model Configuration

The following parameters were set while configuring the model:

The following assumptions were made with regard to the model configuration

- A general ground absorption coefficient of 0.5
- Atmospheric conditions of 10°C and 70% humidity.

A ground absorption coefficient of 1.0 represents highly absorptive ground covers (e.g. grass, porous soil), whereas a value of 0.0 represents highly reflective surfaces (e.g. concrete). The ground absorption coefficient of 0.5 was selected as a conservative representation of the absorptive capacity of the ground in the study area.

Atmospheric conditions were selected from a finite range of model configurations, to close to the mean minima at Collinsville Post Office BOM, representing a 'worst case' scenario for noise propagation.

Rail traffic assumptions

The following assumptions were made with regard to the modelled rail movements and configuration:

- Based on standard coal wagons each of 108 tonne payload capacity, about 240 wagons will be needed to be attached to each locomotive 4-unit set to carry the proposed 25,920 tonnes of coal per train, resulting in a total length of approximately four kilometres.
- The expected total of 28 coal train movements in a 24 hour period for peak production and transportation 100 mtpa, comprising:
 - nine loaded trains per day (7 am to 10 pm)

- nine unloaded trains per night (10 pm to 7 am)
- five loaded trains per day (7 am to 10 pm)
- five unloaded trains per night (10 pm to 7 am)
- The design speeds for the NGBR Project are:
 - 80km/h for loaded trains (mainline)
 - 100km/h for unloaded trains (mainline)
 - 50 km/hr in passing loops
 - 25 km/hr in maintenance sidings
- This assessment looks at the worst case scenario of maximum capacity operations (100 mtpa transported).

2.5.5 Construction and operational vibration

Vibration impacts focus on potential structural damage to properties in close proximity to the NGBR Project and/or potentially affected by construction activities.

Table 2-5 outlines typical vibration levels for different plant activities sourced from the Roads and Maritime Services (RMS) Environmental Noise Management Manual (2001).

Table 2-5 Typical vibration level of construction plant items

Plant Item	Range of PPV at 10 m (mm/s) ¹
Piling	12 – 30
15 tonne roller	seven – eight
Dozer	2.5 – four
7 tonne compactor	five – seven
Pavement breaker ²	4.5 – six
Backhoe	one

Source: RMS Environmental Noise Management Manual 2001.

¹ Mean PPV value adopted for this assessment.

² Given the material properties, a pavement breaker is considered to slightly underestimate vibration levels caused by a rock breaker. A PPV of 7 mm/s at 10 m was adopted for a rock breaker.

As stated in the RMS's Environmental Noise Management Manual, it can be assumed that the vibration level of a source is inversely proportional to the distance source-receptor. Field variations show that the distance relationship generally varies between $d^{-0.8}$ and $d^{-1.6}$, rather than d^{-1} . The vibration levels have been predicted based on $d^{-0.8}$ to provide a measure of conservatism.

2.5.6 Blasting

A general assessment of construction blasting has been undertaken to estimate noise emissions from blasting. Blasting estimations have been undertaken with consideration to AS2187.2 – 2006 Explosives – Storage and use Part 2: Use of explosives and have been based on available information. Blasting is non-linear in nature and variability in ground type and meteorological conditions makes it difficult to accurately predict ground vibration and airblast overpressure without site specific measurement data - therefore the blasting predictions are provided here as a guide.

Airblast overpressure can be estimated using the following equation:

$$P = K_a \left(\frac{R}{Q^{1/3}} \right)^a, \text{ where:}$$

- P is the pressure (kPa)
- R is the distance from charge (m)
- Q is the charge mass (kg)
- K_a is the site constant.
- a is the site exponent

Australian Standard AS2187.2 recommends site constant values in the range of 10 to 100 for confined blast-hole charges. A value of 50 has been adopted for this assessment. The recommended site exponent value of 1.45 was also adopted.

Airblast overpressure propagation can be increased with unfavourable meteorological conditions and decreased with topographic shielding. Unconfined surface charges will considerably increase the airblast overpressure propagation.

Ground vibration has been estimated using the following equation:

$$V = K_G \left(\frac{R}{Q^{1/2}} \right)^{-1.6}, \text{ where:}$$

- V is the peak vector sum ground vibration ppv (mm/s)
- R is the distance from charge (m)
- Q is the maximum instantaneous charge (MIC) (kg)
- K_G is the ground constant.

Australian Standard AS2187.2 gives a site constant for a free face in average field conditions of 1140 which has been used for the predictions. This value can vary between 240 and 4,400 depending on ground conditions and other factors.

Based on the type of blasts that would be required, it is not considered that a MIC of greater than 100 kg would be required and a charge of 50 kg or less is likely to be appropriate.

Reducing the charge mass or increasing the distance reduces the airblast overpressure and ground vibration. As ground vibration generally attenuates faster than airblast overpressure, the airblast overpressure is generally the critical factor which controls the distance in which blasting can occur.

2.5.7 Low frequency noise

The Department of Environment and Heritage Protection's Draft Low Frequency Noise Guideline defines criteria for noise sources with inherent dominant infrasound or (very) low frequency noise characteristics. As the construction and operation of the NGBR Project is not expected to produce low frequency noise, this guideline and low frequency noise are not considered further in this report.

2.6 Limitations

Construction noise has been modelled based on the construction methodology and indicative plant and equipment described in the North Galilee Basin Rail Concept Design Report (Aarvee Associates 2013), as summarised in Section 2.5.2.

3. Existing environment

3.1 Sensitive receptors

The land use surrounding the NGBR Project is primarily rural in nature with a limited number of potential sensitive receptors. Table 2-3 lists potential sensitive receptors identified within approximately six kilometres of the preliminary investigation corridor for the NGBR Project (refer Figure 2-1).

3.2 Background noise

Noise monitoring was undertaken at four monitoring sites (refer Section 2.4.1). Noise monitoring results at all locations are typical of a rural environment, with low background noise levels during day and night periods. The background noise levels are higher in the evening due to natural noise sources including birds, frogs, cattle and insects. At the storage tank, increased noise from road traffic travelling along the Bruce Highway contributed to the higher evening background noise levels, relative to other monitoring locations.

Attended noise monitoring results confirmed the unattended results and indicated the following:

At Location A, the dominant noise sources during daytime hours were wind through grass and trees. During night time hours, the dominant noise sources were birds and insects. During all measurement periods, a distinct traffic hum from the highway could be heard. Furthermore, train pass-bys could also be heard when they occurred.

At Location B, the primary noise sources were birds, insects and wind through the grass and trees. Wind and bird noise were the dominant noise sources during the day and insects and frogs were the dominant noise sources during evening and night. These contributed to the higher noise levels measured during the evening and night periods. A horse was also observed to roam around the homestead and contribute to the noise levels.

Primary noise sources at Location C were the same as those at Location B. Noise from cows and vehicle (cattle truck and 4WD) pass-bys were also audible during the day. During the evening and night, the dominant noise sources were insects, wind and a creaking windmill located approximately 500 m away

At Location D, noise sources observed during the evening included insects, frogs, wind through foliage, barking dogs and horses. Attended day and night time monitoring was not undertaken at this location.

Unattended monitoring results are summarised in Table 3-2 to Table 3-4 and are presented graphically in Appendix A. Overall unattended monitoring results are summarised in Table 3-5. Attended noise monitoring results are provided in Table 3-6 to Table 3-9.

Unattended monitoring results are presented as a rating background level (RBL), a single-figure representation of background noise during a given assessment period (day, evening or night). For a given monitoring location, RBL is calculated as follows:

- The median value of measurements between 7 am to 6 pm (day)
- The median value of measurements between 6 pm to 10 pm (evening)
- The median value of measurements between 10 pm to 7 am (night).

Table 3-1 Unattended noise monitoring results – Location A (Storage tank)

Date	Background L _{A90} dB(A)			Ambient L _{Aeq} dB(A)		
	Day (7 am to 6 pm)	Evening (6 pm to 10 pm)	Night (10 pm to 7 am)	Day (7 am to 6 pm)	Evening (6 pm to 10 pm)	Night (10 pm to 7 am)
09/05/2013	-	-	41	-	-	49
10/05/2013	-	40	43	-	58	48
11/05/2013	-	-	33	-	-	43
12/05/2013	29	43	31	47	54	42
13/05/2013	26	41	27	40	48	50
14/05/2013	24	44	30	44	59	52
15/05/2013	25	44	30	42	59	52
16/05/2013	22	36	31	49	45	48
17/05/2013	28	45	31	49	61	51
18/05/2013	26	39	28	39	51	47
19/05/2013	25	44	31	44	53	42
20/05/2013	28	41	30	43	57	51
21/05/2013	25	40	30	50	61	50
22/05/2013	24	39	41	48	58	46
23/05/2013	-	-	32	-	-	43
24/05/2013	30	30	19	41	42	37
25/05/2013	26	29	27	40	44	43
26/05/2013	-	41	29	-	51	42
27/05/2013	31	40	28	43	49	42
28/05/2013	-	40	40	-	48	44
RBL/Leq Overall	26	40	31	46	56	48

(-) invalid data – interference of wind and/or rain

Table 3-2 Unattended monitoring results – Location B (Bakara homestead)

Date	Background L _{A90} dB(A)			Ambient L _{Aeq} dB(A)		
	Day (7 am to 6 pm)	Evening (6 pm to 10 pm)	Night (10 pm to 7 am)	Day (7 am to 6 pm)	Evening (6 pm to 10 pm)	Night (10 pm to 7 am)
08/05/2013	-	-	-	-	-	-
09/05/2013	28	35	28	48	46	44
10/05/2013	-	35	19	-	47	28
11/05/2013	-	34	19	-	46	34
12/05/2013	30	32	19	50	44	40
13/05/2013	20	42	19	51	47	40
14/05/2013	19	38	27	45	46	46
15/05/2013	21	44	23	44	49	45
16/05/2013	20	26	19	49	41	41
17/05/2013	21	35	19	48	45	39
18/05/2013	20	28	20	50	45	54
19/05/2013	21	37	19	48	47	44
20/05/2013	21	38	28	60	53	49
21/05/2013	20	43	38	51	50	51
22/05/2013	29	41	-	53	53	-
23/05/2013	29	26	19	54	41	47
24/05/2013	20	19	19	53	37	35
25/05/2013	20	19	-	52	43	-
RBL/Leq Overall	21	35	19	52	48	46

(-) invalid data – interference of wind and/or rain

Table 3-3 Unattended noise monitoring results – Location C (Fig Tree homestead)

Date	Background L _{A90} dB(A)			Ambient L _{Aeq} dB(A)		
	Day (7 am to 6 pm)	Evening (6 pm to 10 pm)	Night (10 pm to 7 am)	Day (7 am to 6 pm)	Evening (6 pm to 10 pm)	Night (10 pm to 7 am)
09/05/2013	28	29	30	58	39	37
10/05/2013	-	29	26	-	39	32
11/05/2013	-	31	19	-	36	32
12/05/2013	28	31	19	40	39	36
13/05/2013	22	35	21	49	40	38
14/05/2013	20	31	26	51	37	46
15/05/2013	20	29	30	45	39	41
16/05/2013	24	22	20	47	33	35
17/05/2013	21	31	19	39	40	37
18/05/2013	19	32	19	48	41	41
19/05/2013	20	33	19	44	40	35
20/05/2013	20	30	19	44	41	38
21/05/2013	21	32	23	46	39	38
22/05/2013	23	22	26	41	45	42
23/05/2013	24	36	19	48	43	34
24/05/2013	27	19	19	50	38	31
25/05/2013	23	19	19	42	37	38
26/05/2013	-	28	19	-	40	34
27/05/2013	21	27	22	46	38	32
28/05/2013	-	30	30	-	45	33
29/05/2013	-	-	-	-	-	-
30/05/2013	-	-	-	-	-	-
RBL/Leq Overall	21	30	20	49	40	39

(-) invalid data – interference of wind and/or rain

Table 3-4 Unattended noise monitoring results – Location D (Stratford homestead)

Date	Background L _{A90} dB(A)			Ambient L _{Aeq} dB(A)		
	Day (7 am to 6 pm)	Evening (6 pm to 10 pm)	Night (10 pm to 7 am)	Day (7 am to 6 pm)	Evening (6 pm to 10 pm)	Night (10 pm to 7 am)
29/05/2013	-	-	-	-	-	-
30/05/2013	-	30	24	-	41	34
31/05/2013	-	23	20	-	38	43
01/06/2013	24	20	20	53	39	44
02/06/2013	23	31	31	49	39	44
03/06/2013	28	20	20	53	44	43
04/06/2013	25	20	20	49	30	40
05/06/2013	31	20	20	52	41	32
06/06/2013	23	32	20	49	37	44
07/06/2013	23	26	20	48	42	44
08/06/2013	23	23	20	49	47	44
09/06/2013	-	24	20	-	33	43
10/06/2013	22	26	20	47	39	42
11/06/2013	24	29	20	51	44	40
12/06/2013	26	-	-	53	-	-
RBL/Leq Overall	24	24	20	51	41	42

(-) invalid data – interference of wind and/or rain

Table 3-5 Summary of unattended noise monitoring results

Location	Background L_{A90} dB(A)			Ambient L_{Aeq} dB(A)		
	Day (7 am to 6 pm)	Evening (6 pm to 10 pm)	Night (10 pm to 7 am)	Day (7 am to 6 pm)	Evening (6 pm to 10 pm)	Night (10 pm to 7 am)
Location A: Storage Tank	26	40	31	46	56	48
Location B: Bakara	21	35	19	52	48	46
Location C: Fig Tree	21	30	20	49	40	39
Location D: Stratford	24	24	20	51	41	42

Table 3-6 Attended noise monitoring results – Location A (Storage tank)

C – Storage Tank	Day		Evening		Night	
	#1	#2	#1	#2	#1	#2
Date	09/05/2013		09/05/2013		30/05/2013	
L _{Aeq,(15min)}	41	48	52	53	58	45
L _{A90}	36	39	50	50	46	41
Measurement commenced	17:38	17:55	18:16	18:33	22:54	23:14
Measurement ceased	17:53	18:11	18:31	18:48	23:09	23:29
Pre-calibration	94.0	94.0	94.0	94.0	94.0	94.0
Post-calibration	94.0	94.0	94.0	94.0	94.0	94.0

Table 3-7 Attended noise monitoring results – Location B (Bakara homestead)

A – Bakara Homestead	Day		Evening		Night	
	#1	#2	#1	#2	#1	#2
Date	08/05/2013		08/05/2013		08/05/2013	
L _{Aeq,(15min)}	39	40	45	46	45	44
L _{A90}	32	32	41	41	39	37
Measurement commenced	9:53	10:45	21:16	21:37	22:09	22:26
Measurement ceased	10:08	11:00	21:31	21:52	22:24	22:41
Pre-calibration	94.0	94.0	94.0	94.0	94.0	94.0
Post-calibration	94.0	94.0	94.0	94.0	94.0	94.0

Table 3-8 Attended noise monitoring results – Location C (Fig Tree homestead)

B – Fig Tree Homestead	Day		Evening		Night	
	#1	#2	#1	#2	#1	#2
Date	09/05/2013		09/05/2013		09/05/2013	
L _{Aeq,(15min)}	47	43	37	37	36	36
L _{A90}	35	35	34	34	33	33
Measurement commenced	13:55	14:15	21:36	21:52	22:09	22:26
Measurement ceased	14:10	14:30	21:51	22:08	22:24	22:41
Pre-calibration	94.0	94.0	94.0	94.0	94.0	94.0
Post-calibration	94.0	94.0	94.0	94.0	94.0	94.0

Table 3-9 Attended noise monitoring results – Location D (Stratford homestead)

Date	L _{Aeq,(15min)}	L _{A90}	Measurement commenced	Measurement ceased	Pre-calibration	Post-calibration
29/05/2013 ¹	45	40	19:15	19:30	94.0	94.0

¹ Evening monitoring

3.3 Background vibration

Measured ground vibration results indicate very low ground vibration levels (less than or equal to 0.3 mm/s) at all locations which confirms the lack of perceptible vibration (refer to Section 4.4.1) at all sites. Table 3-10 details the baseline vibration results.

Table 3-10 Vibration measurement results – peak particle velocity

Location	Date	Time	Direction (PPV) (mm/s)			Sum	Observations
			Trans	Vert	Long		
Location A	09/05/2013	18:29-18:50	0.095	0.064	0.079	0.102	No perceivable ground vibration
Location B	08/05/2013	10:43-11:09	0.159	0.079	0.175	0.237	No perceivable ground vibration
Location C	09/05/2013	14:14-14:35	0.079	0.064	0.079	0.093	No perceivable ground vibration
Location D	29/05/2013	18:59-19:28	0.095	0.064	0.079	0.093	No perceivable ground vibration

4. Assessment criteria

4.1 Legislative context

Environmental Protection Act 1994 and Environmental Protection Policy 2008 (Noise)

The *Environmental Protection Act 1994* (EP Act) provides for protection of environmental values, including environmental values relating to maintenance of public amenity. In relation to noise, the EP Act is supported by the *Environmental Protection (Noise) Policy 2008* (EPP Noise).

The key environmental values for the acoustic environment are outlined within Section 7 of the EPP Noise as follows.

The environmental values to be enhanced or protected under this policy are-

- a. *The qualities of the acoustic environment that are conducive to protecting the health and biodiversity of ecosystems; and*
- b. *The qualities of the acoustic environment that are conducive to human health and wellbeing, including by ensuring a suitable acoustic environment for individuals to do any of the following –*
 - i) *Sleep*
 - ii) *Study or learn*
 - iii) *Be involved in recreation, including relaxation and conversation; and*
- c. *The qualities of the acoustic environment that are conducive to protecting the amenity of the community.*

The EP Act, and EPP Noise do not prescribe criteria for construction activity, other than setting general building work hours (refer to Section 4.2.1). In the absence of legislated limits, and in the interest of providing a point of comparison for construction noise emissions, construction criteria determined by the NSW Environmental Protection Agency (EPA), have been considered. These criteria are contained in the ICNG (refer to Section 4.2.2).

To further assist in determining noise levels consistent with the identified environmental values, the EPP Noise sets out acoustic quality objectives. However, in accordance with Clause 8(4)(a) of the policy, acoustic quality objectives for sensitive receptors do not apply to (amongst others) noise from a warning signal for a railway crossing and noise from the ordinary use of rail transport infrastructure.

As such, operational noise associated with the NGBR Project is not assessed against the EPP Noise acoustic quality objectives. The RING (NSW EPA, 2013) provides average (L_{Aeq}) and maximum (L_{Amax}) heavy rail noise trigger levels for day and night impacts on residential land uses and is used for this assessment (refer Section 4.3).

Ecoaccess Planning for Noise Control Guideline

The QLD EPA's Ecoaccess Planning for Noise Control (PNC) guideline includes both noise criteria that are designed to protect receivers from industrial noise significantly louder than the background level and to limit the total noise level from all sources near a receiver. In the absence of existing industrial noise, noise from continuous sources should be limited to three dB(A) above the background noise level where noise is non-impulsive or tonal. The PNC criteria

are not applicable to construction or rail noise; however, they are applicable to non-rail noise emissions from the rolling stock maintenance facility.

4.2 Construction noise criteria

4.2.1 Environmental Protection Act

In Queensland, it is generally accepted that construction activities should be in accordance with general building work hours as described under Section 440R of the EP Act. Under the EP Act, no audible noise from construction is permitted:

- 6:30 pm to 6:30 am – Monday to Saturday
- Sundays and public holidays.

The time restrictions are designed to strike a balance between protecting noise amenity and the need to start construction activities early in the morning.

4.2.2 NSW Environmental Protection Agency Interim Construction Noise Guideline

The ICNG provides recommended standard hours for construction activities as follows:

- Monday to Friday: 7 am to 6 pm
- Saturday: 8 am to 1 pm
- No work on Sundays or public holidays.

The ICNG acknowledges that the following activities have justification to be undertaken outside the recommended construction hours:

- The delivery of oversized plant or structure
- Emergency work
- Works for which it can be demonstrated that there is a need to operate outside the recommended standard hours.

The ICNG provides noise management levels for construction noise at residential receptors. These management levels are calculated based on the RBL at nearby residential locations, as shown in Table 4-1. The ICNG specifies an industrial external noise criteria of $L_{Aeq(15min)}$ 75dB(A).

Table 4-1 ICNG construction noise criteria at residential receptors, dB(A)

Time Period	Background Level $L_{A90(15min)}$	Management Level $L_{Aeq(15 min)}$
Recommended standard hours	< 30 dB(A) ¹	Noise affected level: 30 + 10 = 40 dB(A) Highly noise affected level: 75 dB(A)
Outside recommended standard hours	< 30 dB(A) ¹	Noise affected level: 30 + five = 35 dB(A)

¹ Minimum RBL = 30 dB(A) as per NSW Industrial Noise Policy

The above levels apply at the property boundary of a residence or within 30 m from the residence where the property boundary is more than 30 m from the residence.

The noise affected level represents the point above which there may be some community reaction to noise. The noise affected level is the background noise level plus 10 dB(A) during recommended standard hours and the background noise level plus five dB(A) outside of recommended standard hours.

The highly noise affected level represents the point above which there may be strong community reaction to noise and is set at 75 dB(A).

4.3 Operational noise criteria

4.3.1 Rail operation

The NSW EPA RING provides heavy rail noise trigger levels for day and night impacts on residential land uses.

The noise trigger levels for absolute levels of rail noise have two components, L_{Aeq} and L_{Amax} . The L_{Aeq} contribution level of rail noise is assessed over the day or night period and the maximum noise level (L_{Amax}) from pass-by events. Trigger levels defined in RING are listed in Table 4-3.

As the RING provides a noise target for day and night periods, the 'new rail line development' trigger levels presented in Table 4-3 have been adopted as the relevant rail noise criteria for the NGBR Project.

Queensland Rail's Code of Practice for Railway Noise Management (QR, 2007) gives consideration to the assessment of railway airborne noise emissions and outlines operational "planning levels" that can be suitably applied to rail line developments as shown in Table 4-2.

Table 4-2 QR rail noise criteria

Noise trigger level dB(A) (external)	Description
65 dB(A)	Assessed as the 24 hour L_{Aeq} average equivalent continuous A-weighted sound pressure level
87 dB(A)	Assessed as a single event maximum sound pressure level (L_{Amax}) - defined as the arithmetic average of maximum levels from the highest 15 single events over a given 24 hour period

The Queensland Rail (QR) criteria are assessed one metre in front of the most exposed part of an affected noise sensitive place. Where maintenance activities are undertaken during night periods, the code recommends that these activities are not carried out at locations within 500 m of a noise sensitive place.

The RING criteria have been adopted for the NGBR Project as it is more stringent than the QR criteria.

Table 4-3 RING noise trigger levels for a rail line development

Noise trigger level dB(A) (external)	
Day (7 am to 10 pm)	Night (10 pm to 7 am)
60 $L_{Aeq}(15\text{hour})$	55 $L_{Aeq}(9\text{hour})$
80 L_{AFmax}	80 L_{AFmax}

Table 4-4 QR rail noise criteria

Noise trigger level dB(A) (external)	Description
65 dB(A)	Assessed as the 24 hour L_{Aeq} average equivalent continuous A-weighted sound pressure level
87 dB(A)	Assessed as a single event maximum sound pressure level (L_{Amax}) - defined as the arithmetic average of maximum levels from the highest 15 single events over a given 24 hour period

4.4 Vibration criteria

4.4.1 Human comfort vibration criteria

In the absence of any specific Queensland or Australian vibration guidelines relating to human comfort, criteria have been adopted with consideration to the British Standard BS6472: 2008, Guide to evaluation of human exposure to vibration in buildings Part 1: Vibration sources other than blasting, and is recognised as the preferred standard for assessing the “human comfort criteria” for residential building types.

Typically, rail activities generate ground vibration of an intermittent nature. Under BS 6472-1: 2008, intermittent vibration is assessed using the vibration dose value (VDV). Table 4-5 includes acceptable values of vibration dose for residential receptors for daytime and night-time periods

These values represent the best judgement available at the time the standard was published and may be used for both vertical and horizontal vibration, providing that they are correctly weighted. Because there is a range of values for each category, it is clear that the judgement can never be precise.

Table 4-5 Vibration dose value ranges and probabilities for adverse comment to intermittent vibration ($\text{m/s}^{1.75}$)

Location	Low probability of adverse comment ¹	Adverse comment possible	Adverse comment probable ²
Residential buildings 16 hour day (0700 – 2300 hrs)	0.2 to 0.4	0.4 to 0.8	0.8 to 1.6
Residential buildings eight hour night (2300 to 0700 hrs)	0.1 to 0.2	0.2 to 0.4	0.4 to 0.8

Notes:

¹ Below these ranges adverse comment is not expected.

² Above these ranges adverse comment is very likely.

Whilst the assessment of response to vibration in BS 6472-1:2008 is based on VDV and weighted acceleration, for construction related vibration, it is considered more appropriate to provide guidance in terms of peak particle velocity (PPV), since this parameter is likely to be more routinely measured, based on the more usual concern over potential building damage.

Humans are capable of detecting vibration at levels which are well below those causing risk of damage to a building. The degrees of perception for humans are suggested by the vibration level categories given in BS 5228-2:2009, Code of practice for noise and vibration on construction and open sites – Part 2: Vibration, as shown in Table 4-6.

Table 4-6 Guidance on the effects of vibration levels

Approximate Vibration Level	Degree of Perception
0.14 mm/s	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction.
0.30 mm/s	Vibration might be just perceptible in residential environments.
1.0 mm/s	It is likely that vibration of this level in residential environments will cause complaint, but can be tolerated if prior warning and explanation has been given to residents.
10 mm/s	Vibration is likely to be intolerable for any more than a very brief exposure to this level.

4.4.2 Structural vibration criteria

Currently, there is no Australian Standard that sets the criteria for the assessment of building damage caused by vibration. Guidance of limiting vibration values is attained from reference to German Standard 4150-3: 1999, Structural Vibration – Part 3: Effects of vibration on structures. Table 4-7 presents the short-term vibration guideline values.

Table 4-7 Guideline values for vibration velocity to be used when evaluating the effects of short-term vibration on structures

Type of structure	Vibration at foundation $v_i(t)^1$ (mm/s)		
	1 to 10 Hz	10 to 50 Hz	50 to 100 Hz ²
Buildings used for commercial purposes, industrial buildings, and buildings of similar design.	20	20 to 40	40 to 50
Dwellings and buildings of similar design and/or occupancy	5	5 to 15	15 to 20
Structures that, because of their particular sensitivity to vibration, cannot be classified under lines 1 and 2 and are of great intrinsic value (e.g. listed buildings under preservation order)	3	3 to 8	8 to 10

¹ The term v_i refers to vibration levels in any of the x, y or z axes.

² At frequencies above 100 Hz the values given in this column may be used as minimum values.

The vibration criteria presented in German Standard DIN 4150-3: 1999 exceed the human comfort criteria presented above (refer Table 4-5 and Table 4-6). Therefore, as indicated above, the human comfort criteria should be the over-riding criteria for the assessment of any vibration. Vibration due to the construction process also has the potential to affect services such as buried pipes, electrical and telecommunication cables. German Standard DIN 4150-2: 1999 provides guidance on safe vibration levels for buried pipe work. Table 10 within DIN 4150-2 details the limits for short-term vibration, as presented in Table 4-8. The levels apply on the wall of the pipe. For long-term vibration the guideline levels presented in Table 4-8 should be halved. Recommended vibration criteria for electrical cables and telecommunication services such as fibre optic cables range from between 50 mm/s and 100 mm/s.

Table 4-8 DIN 4150 Part 3 – Damage to buried pipes – guidelines for short-term vibration

Pipe Material	Guideline values for velocity measured on the pipe (mm/s)
Steel (including welded pipes)	100
Clay, concrete, reinforced concrete, metal (with or without flange)	80
Masonry, plastic	50

4.4.3 Blasting overpressure and vibration

Section 440ZB Blasting of the EP Act provides criteria for the assessment of blasting impacts.

The EP Act states that blasting must not be conducted if:

- a. *the airblast overpressure is more than 115dB Z Peak for four out of any five consecutive blasts;*
- b. *the airblast overpressure is more than 120dB Z Peak for any blast; or*
- c. *the ground vibration is —*
 - (i) *for vibrations of more than 35Hz--more than 25 mm a second ground vibration, peak particle velocity.*
 - (ii) *for vibrations of no more than 35Hz--more than 10 mm a second ground vibration, peak particle velocity.*

Additional blasting criteria are referred to in the Noise and Vibration from Blasting (EPA 2006) guideline. The guideline recommends that blasting should generally only be permitted during the hours of:

- Monday to Friday: 9 am to 3 pm
- Saturday: 9 am to 1 pm
- No blasting on Sundays or public holidays.

Blasting outside these recommended times should be undertaken only where:

- Blasting during the preferred times is clearly impracticable (in such situations blasts should be limited in number and stricter airblast overpressure and ground vibration limits should apply)
- There is no likelihood of persons in a noise-sensitive place being affected because of the remote location of the blast site.

The guideline provides assessment criteria for blasting noise and vibration limits as shown in Table 4-9. The guideline values have been adopted for this assessment.

Table 4-9 Guideline blasting limits

Airblast overpressure	Ground vibration
115 dB(lin) peak	5 mm/s Peak Particle Velocity (PPV)
Must not be more than 115 dB(lin) peak for nine out of any ten consecutive blasts initiated, regardless of the interval between blasts, but never over 120 dB(lin) peak for any blast.	Must not exceed a peak particle velocity (PPV) of five millimetres per second for nine out of any ten consecutive blasts initiated, regardless of the interval between blasts, but never over 10 mm/s for any blast.

5. Emissions inventory

5.1 Construction noise and vibration levels

5.1.1 Rail construction noise

A summary of predicted noise at identified sensitive receptors for each construction activity are shown in Table 5-1. The noise levels outlined in the table would typically be short-term, lasting for the duration of the time when works are conducted in the vicinity of each receptor.

Table 5-1 Predicted external construction noise levels - dB(A) L_{Aeq}

Sensitive receptor ID	Construction Activity					
	Earthworks	Drainage	Capping	Structures	Haul Roads	Track work
Homestead 1	39.8	20.8	20.9	22.4	21.9	22.7
Homestead 2	50.5¹	31.0	31.5	32.5	32.7	34.9
Homestead 3	41.1¹	21.9	22.2	23.5	23.1	24.1
Homestead 4	37.2	16.7	18.2	17.9	19.5	20.1
Homestead 5	31.3	14.3	13.8	16.0	14.6	14.2
Homestead 6	34.3	16.4	16.1	18.0	17.0	17.0
Homestead 7	27.0	11.7	10.9	13.4	11.6	10.9
Homestead 8	35.4	17.2	17.0	18.8	17.9	18.0
Homestead 9	43.4¹	24.0	24.4	25.6	25.4	26.7
Homestead 10	35.7	15.1	16.5	16.3	17.9	18.3
Homestead 11	43.9¹	23.9	25.1	25.2	26.6	28.0
Homestead 12	23.2	4.0	4.5	5.6	6.1	5.5
Homestead 13	25.9	6.9	6.9	8.7	8.4	7.9
Homestead 14	31.3	13.4	12.8	15.1	13.6	13.4
Homestead 15	32.9	15.4	15.0	17.1	15.8	15.6
Homestead 16	31.7	14.6	14.1	16.2	14.9	14.5
Homestead 17	38.1	19.3	19.3	20.9	20.2	20.8
Homestead 18	30.3	10.8	11.1	12.5	12.5	12.3
Homestead 19	27.3	7.2	8.2	8.6	9.7	9.2

Sensitive receptor ID	Construction Activity					
	Earthworks	Drainage	Capping	Structures	Haul Roads	Track work
Homestead 20	31.3	14.3	13.8	16.0	14.6	14.2
Homestead 21	26.5	10.7	9.8	12.4	10.5	9.7
Homestead 22	51.6¹	32.2	32.7	33.7	33.9	36.3
Homestead 23	25.3	10.7	9.9	12.5	10.5	9.7

¹ Exceeds ICNG criteria for work within recommended construction hours

5.1.2 General construction vibration

The peak particle velocity at distances from construction vibration sources are in Table 5-2.

Table 5-2 Estimate construction vibration

Source	Peak particle velocity (mm/s) at distance							
	5 m	10 m	20 m	50 m	100 m	150 m	200 m	300 m
Piling (vibratory)	52.2	30.0	17.2	8.3	4.8	3.4	2.7	2.0
15 tonne roller	13.9	8.0	4.6	2.2	1.3	0.9	0.7	0.5
15 tonne compactor	13.9	8.0	4.6	2.2	1.3	0.9	0.7	0.5
7 tonne compactor	10.4	6.0	3.4	1.7	1.0	0.7	0.5	0.4
Dozer	7.0	4.0	2.3	1.1	0.6	0.5	0.4	0.3
Excavator	4.4	2.5	1.4	0.7	0.4	0.3	0.2	0.2
Grader	4.4	2.5	1.4	0.7	0.4	0.3	0.2	0.2
Backhoe	1.7	1.0	0.6	0.3	0.2	0.1	0.1	0.1
Piling (boring)	1.4	0.8	0.5	0.2	0.1	0.1	0.1	0.1

5.2 Operational rail noise levels

The predicted operational noise of the NGBR Project at the identified sensitive receptors is shown in Table 5-3. These results include a +2.5 dB(A) façade correction as required by the RING. The 60dB(A) daytime $L_{Aeq,15h}$, 55dB(A) night-time $L_{Aeq,9h}$ and 80dB(A) L_{AFmax} contours in the vicinity of potentially sensitive receptors are provided in Appendix B.

Table 5-3 Predicted external rail noise levels dB(A) – includes 2.5dB façade correction

Sensitive receptor ID	Day 60 dB $L_{Aeq,15h}$	Night 55dB $L_{Aeq,9h}$	Maximum 80dB L_{AFmax}
Homestead 1	49.3	49	60.0
Homestead 2	56	55.7¹	69.3
Homestead 3	49.4	49.1	62.3
Homestead 4	49.6	49.3	60.4
Homestead 5	40.5	40.2	50.7
Homestead 6	43.3	43	54.3
Homestead 7	36.1	35.8	46.9
Homestead 8	45.1	44.8	55.5
Homestead 9	50.7	50.3	63.2
Homestead 10	46.6	46.3	58.5
Homestead 11	54.1	53.8	66.7
Homestead 12	35.3	34.9	45.8
Homestead 13	37.4	37.1	48.5
Homestead 14	43.1	42.7	53.9
Homestead 15	41.8	41.5	52.3
Homestead 16	42.9	42.5	54.4
Homestead 17	46.4	46	58.7
Homestead 18	42.3	42	53.0
Homestead 19	38.4	38.1	49.3
Homestead 20	40.4	40	51.0
Homestead 21	38.1	37.8	49.4
Homestead 22	57.5	57.2¹	70.9
Homestead 23	32.1	31.7	43.4

¹ Exceeds RING noise criteria

5.3 Rail vibration

Recent vibration testing of coal trains in the Hunter Valley has indicated that there is low probability of human comfort or structural vibration criteria being reached at structures located more than 40 m from the centre of the rail line (Hunter8 Alliance 2010). The vibration monitoring was completed on the Australian Rail Track Corporation rail network, where both Pacific National and Aurizon (formerly QR National) trains operate.

Measurements of pass-by vibration levels of trains similar to what would be used for the NGBR Project resulted in similar findings, with negligible vibration levels at distances greater than approximately 50 m from the centre of the rail line (Hunter8 Alliance 2010). These reports are considered to represent typical rail vibration levels from the NGBR Project.

5.4 Maintenance facility

Based on previous noise assessments of a rolling stock maintenance facilities in Queensland (GHD 2009) and New South Wales (Umwelt 2013), noise emissions were predicted to be less than the minimum PNC noise criteria at sensitive receptors at a distance of greater than one kilometre from the facility.

5.5 Blasting overpressure and ground vibration

Predicted ground vibration and airblast overpressure levels associated with blasting at an assumed charge size of 50 kg at identified sensitive receptors are provided in Table 5-4. Distances between sensitive receptors and the nearest edge of the final rail corridor are provided, on the worst case assumption that blasting would occur at these locations.

Table 5-4 Predicted blast impacts

Sensitive receptor	Distance from final rail corridor (m)	Estimated airblast overpressure, dB(Linear) ¹		Estimated ground vibration, PPV (mm/s)*	
		ka = 10	ka = 100	Kg = 800	Kg = 1600
Homestead 1	2,690	90.9	110.9	0.1	0.1
Homestead 2	1,152	101.6	121.6²	0.2	0.5
Homestead 3	2,198	93.5	113.5	0.1	0.2
Homestead 4	2,582	91.5	111.5	0.1	0.1
Homestead 5	4,680	84.0	104.0	0.0	0.0
Homestead 6	3,777	86.7	106.7	0.0	0.1
Homestead 7	5,674	81.5	101.5	0.0	0.0
Homestead 8	3,573	87.4	107.4	0.0	0.1
Homestead 9	2,071	94.2	114.2	0.1	0.2
Homestead 10	2,878	90.1	110.1	0.1	0.1
Homestead 11	1,515	98.2	118.2²	0.1	0.3
Homestead 12	6,159	80.5	100.5	0.0	0.0
Homestead 13	5,317	82.4	102.4	0.0	0.0
Homestead 14	3,863	86.4	106.4	0.0	0.1
Homestead 15	4,263	85.1	105.1	0.0	0.1
Homestead 16	3,819	86.5	106.5	0.0	0.1
Homestead 17	2,772	90.6	110.6	0.1	0.1
Homestead 18	4,121	85.6	105.6	0.0	0.1
Homestead 19	4,931	83.3	103.3	0.0	0.0
Homestead 20	4,694	83.9	103.9	0.0	0.0
Homestead 21	5,160	82.7	102.7	0.0	0.0
Homestead 22	1,059	102.7	122.7²	0.3	0.5
Homestead 23	6,585	79.7	99.7	0.0	0.0

¹ Based on maximum instantaneous charge 50 kg² Exceed EP Act criteria

6. Key findings

The land use surrounding the NGBR Project is primarily rural in nature with a limited number of potential sensitive receptors. Nearest potential sensitive receptors were identified within approximately six kilometres of the 1,000 m preliminary investigation corridor for the NGBR Project. In addition, eight key road intersections with the potential to generate additional road traffic noise during the construction of the NGBR Project were identified.

Maximum predicted construction noise during the construction phase at a sensitive receptor was $51.6 \text{ dB(A)}_{L_{Aeq}}$. Maximum predicted operational noise at a sensitive receptor was $57.5 \text{ dBL}_{Aeq,15h}$ during the day and $57.2 \text{ dBL}_{Aeq,9h}$ during the night. The maximum predicted increase in construction generated road traffic noise was 10 dB(A) at three road sections (Glenore Road near chainage 34 km, Suttor Developmental Road near change 230 km; and Stratford Road near chainage 262 km).

Based on recent vibration testing for other coal train operations, vibration during operation was expected to be negligible at a distance greater than 40 m from the final rail corridor centreline. Vibration and airblast overpressure at sensitive receptors were considered on the worst case assumption that blasting would occur at the closest point of the final rail corridor to a sensitive receptor. Maximum predicted airblast overpressure was between 101.6 and 122.7 dBL, depending on the site constant (k_a) applied and assuming blasting occurs at the closest point in the 100 m final rail corridor to a given sensitive receptor. Maximum predicted ground vibration ranged from less than 0.1 to 0.5 peak particle velocity (mm/s), depending on ground constant (K_G).

7. References

Guidelines and legislation

Australian and New Zealand Environment Council, Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration, 1990

Department of Environment and Resource Management (DERM), Planning for Noise Control Guideline, 2004.

New South Wales Roads and Maritime Services Environmental Noise Management Manual 2001

Office of the Queensland Parliamentary Council, Environmental Protection Act 1994, current as 1 July 2013.

Queensland Department of Environment and Heritage Protection (DEHP) Draft Low Frequency Noise Guideline

Queensland EPA Ecoaccess guideline, Noise and Vibration from Blasting, 2006

Queensland Parliamentary Counsel, Environmental Protection (Noise) Policy 2008, 1 January 2009.

Queensland Rail, Code of Practice – Railway Noise Management Version 2, November 2007.

Standards

AS2187.2 – 2006 *Explosives* – Storage and use Part 2: Use of explosives

AS2436:1981 Guide to Noise Control on Construction, Maintenance and Demolition Sites

British Standard 6472 – 2008, Guide to evaluation of human exposure to vibration in buildings Part 1: Vibration sources other than blasting

BS5228-1:2009 Code of Practice for Noise and Vibration on Construction and Open Sites Part 1: Noise

German Standard DIN 4150-3: 1999 Structural Vibration – Part 3: Effects of vibration on structures

Publications

Aarvee Associates 2013, North Galilee Basin Rail Concept Design Report. Cat no. 055/Adani, Aarvee Associates 2013.

Adani, 2013, North Galilee Basin Railway, Design Criteria Summary NGBRXXX-PDC-0010, Rev A, May 2013.

GHD, 2009, Report for Project Cyclone – Nebo Maintenance and Provisioning Facility – Noise Assessment, for Asciano Pty Ltd.

Hunter8 Alliance (2010), Maitland to Minimbah Third Track Noise and Vibration Impact Assessment, May 2010, report to Australian Rail Track Corporation.

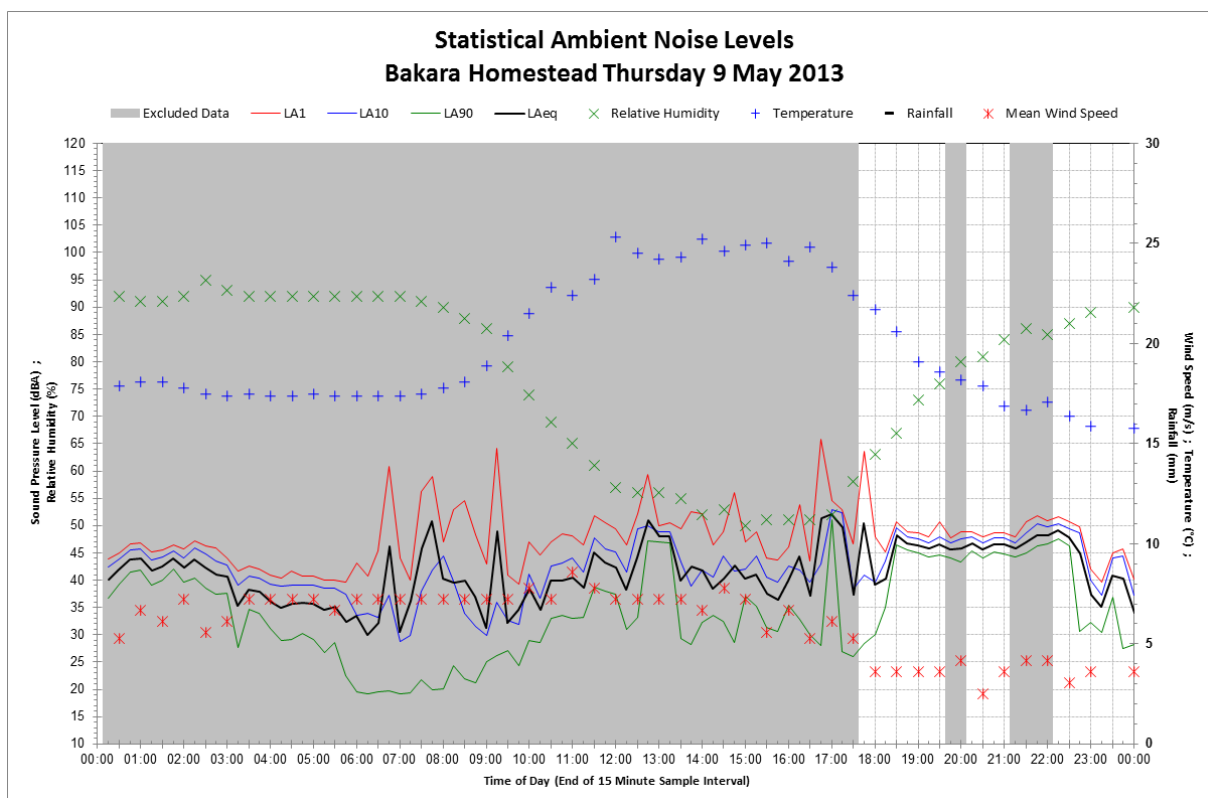
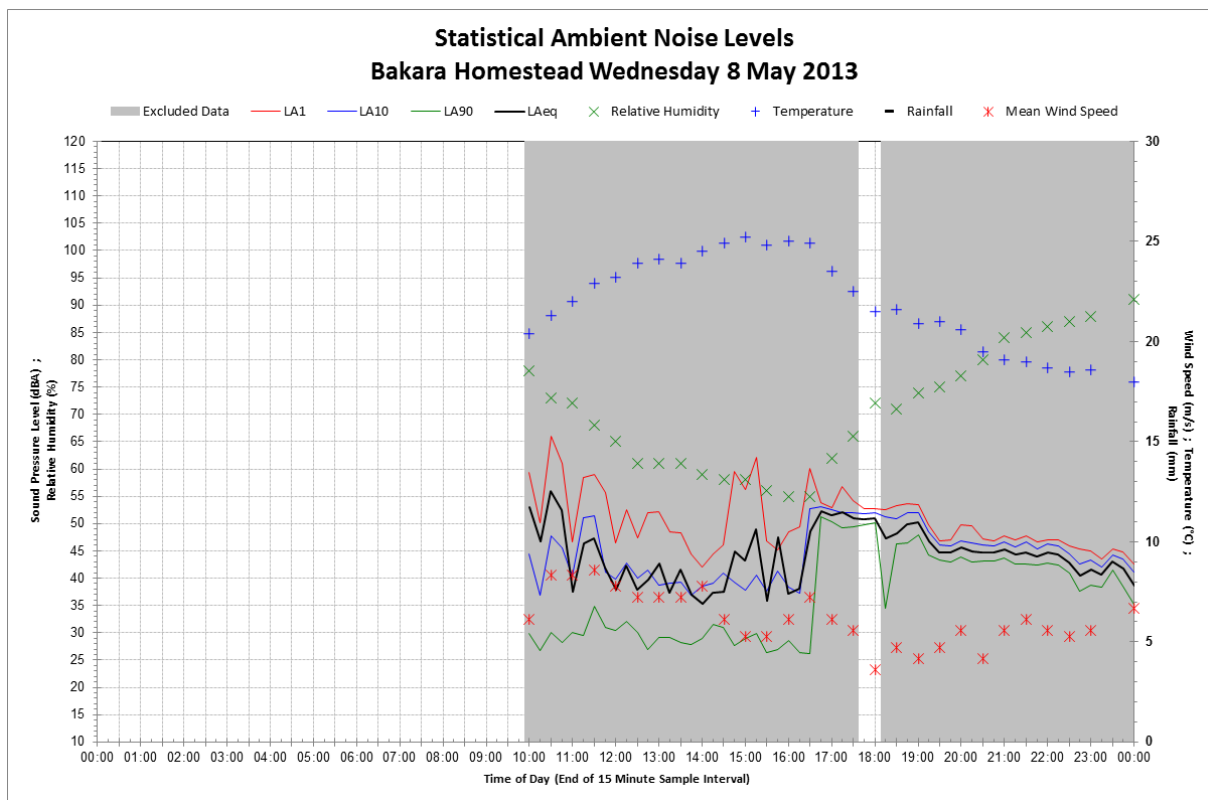
Nordic Council of Ministers, Railway Traffic Noise- The Nordic Prediction Method, TemaNord 1996:524.

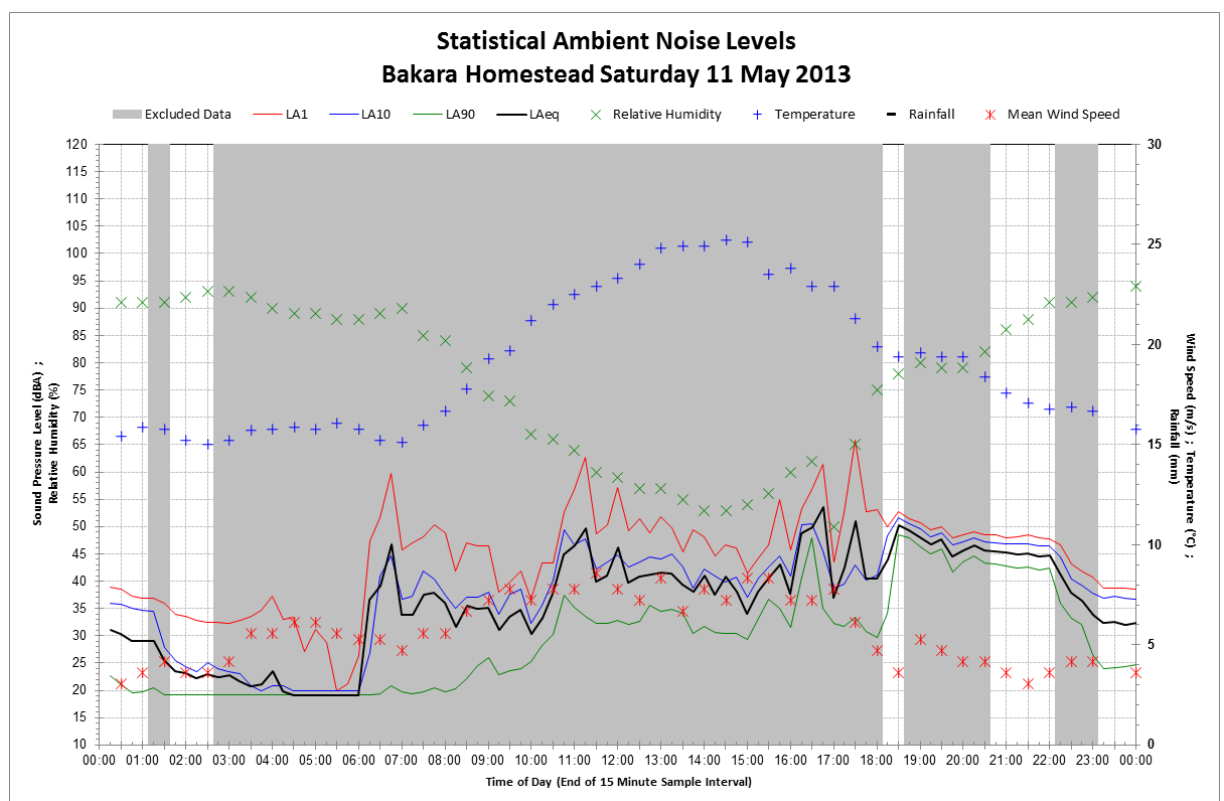
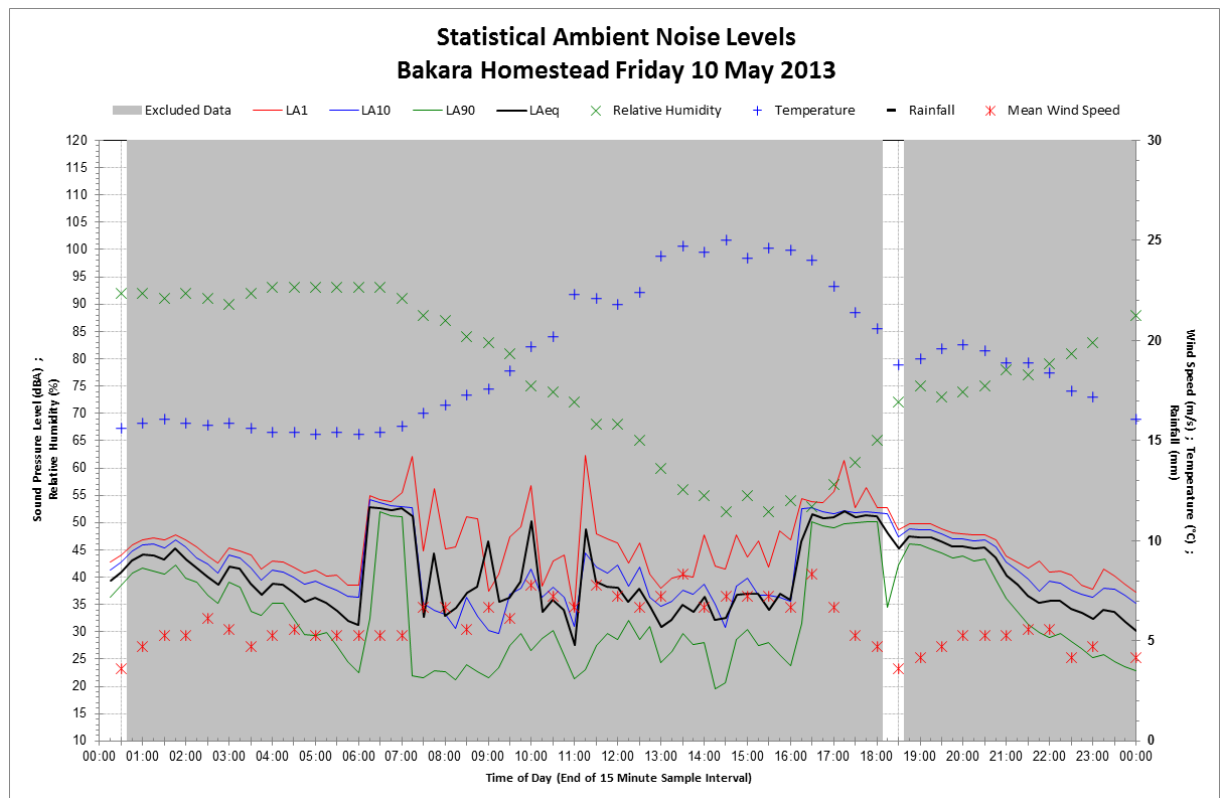
Umwelt 2013, Operational noise and vibration review – train support facility, Greta, prepared for Pacific National.

Wiss, J., 1981, Construction Vibrations: State of the Art Heggies (2009), Caval Ridge Coal Mine Project Environmental Impact Assessment, report to BHP Billiton Mitsubishi Alliance

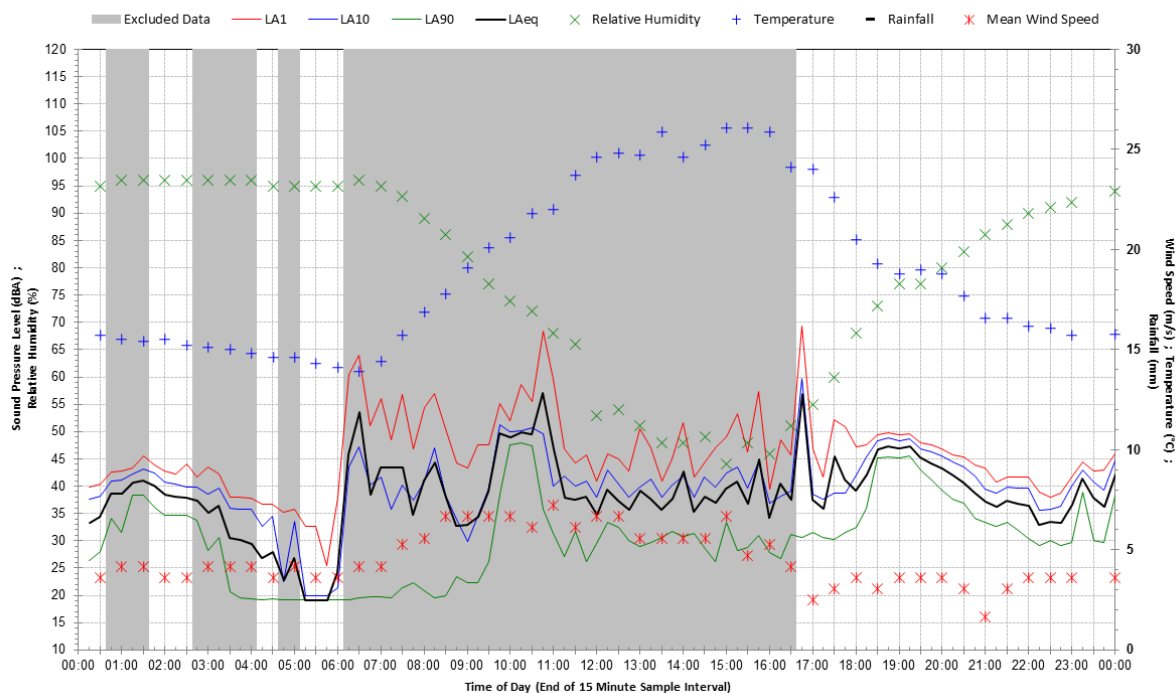
Appendices

Appendix A – Statistical ambient noise levels

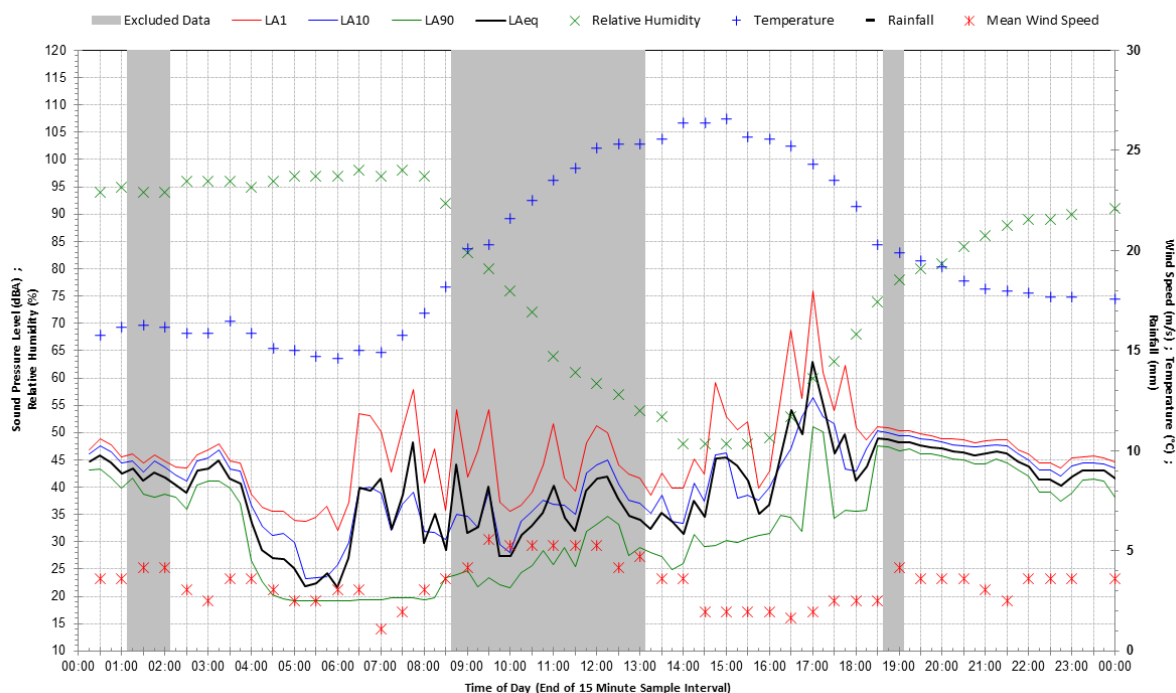


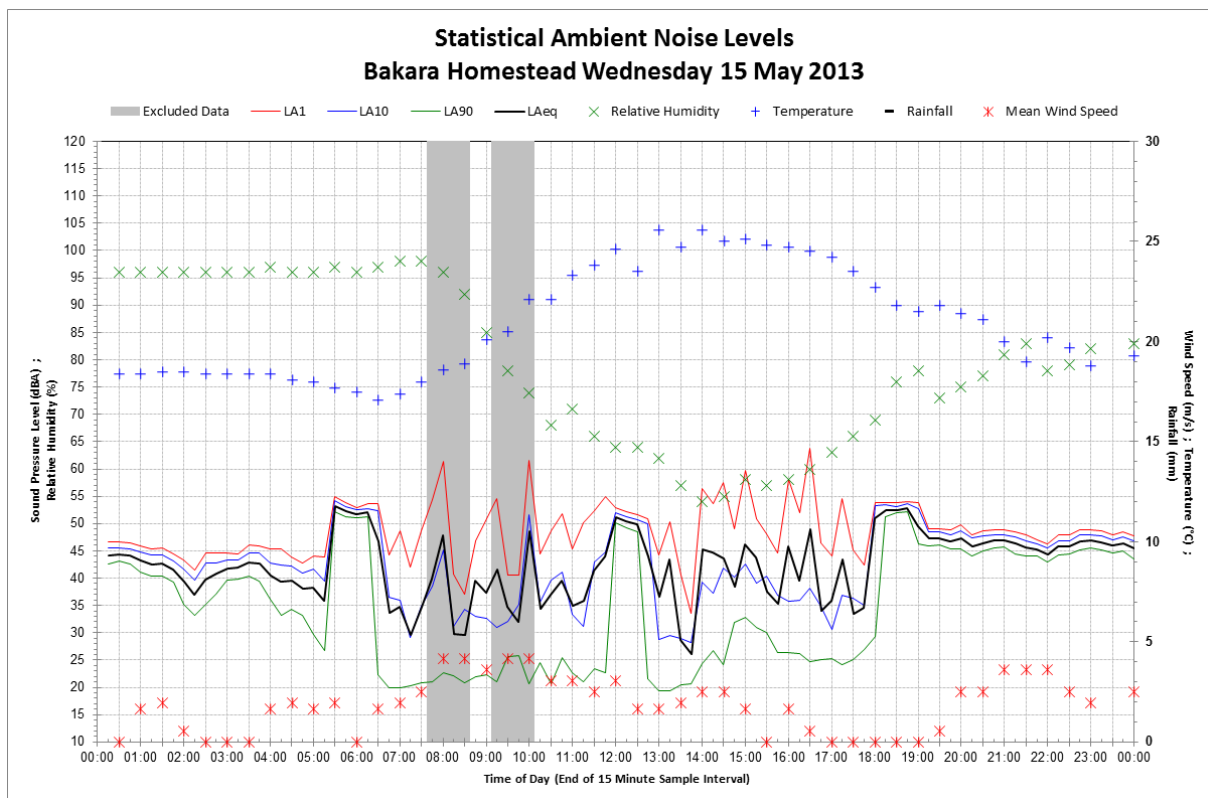
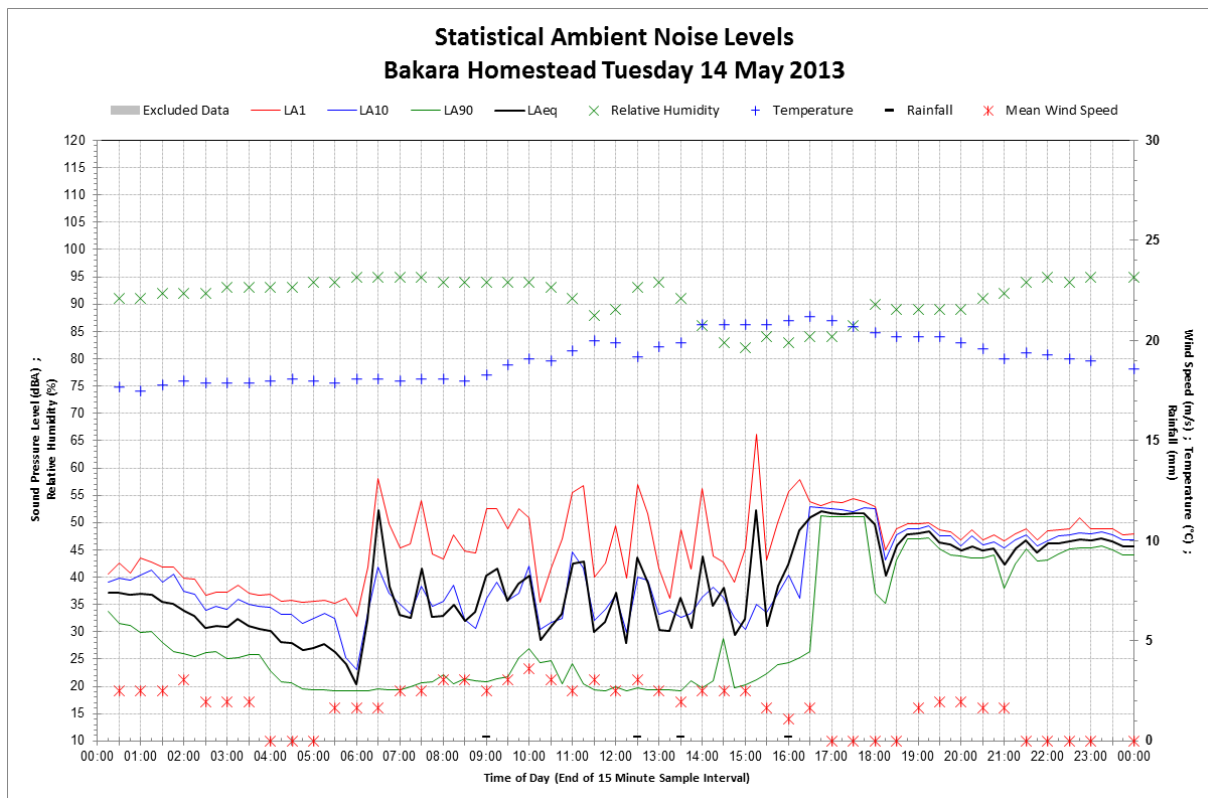


Statistical Ambient Noise Levels Bakara Homestead Sunday 12 May 2013

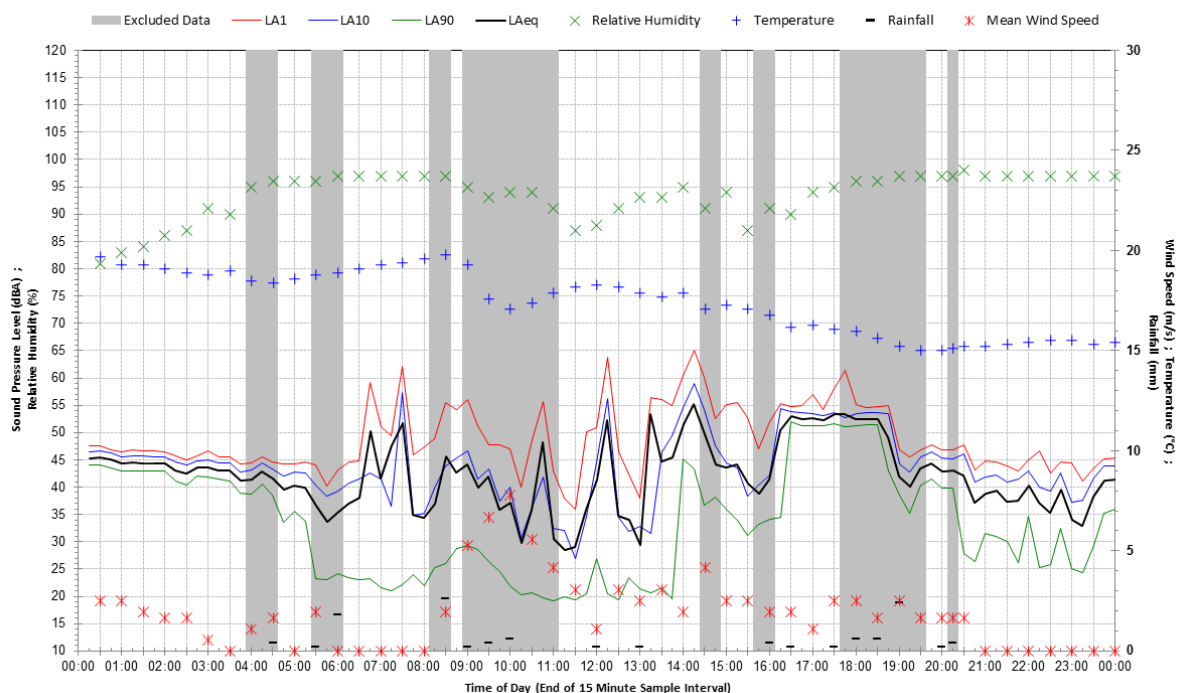


Statistical Ambient Noise Levels Bakara Homestead Monday 13 May 2013

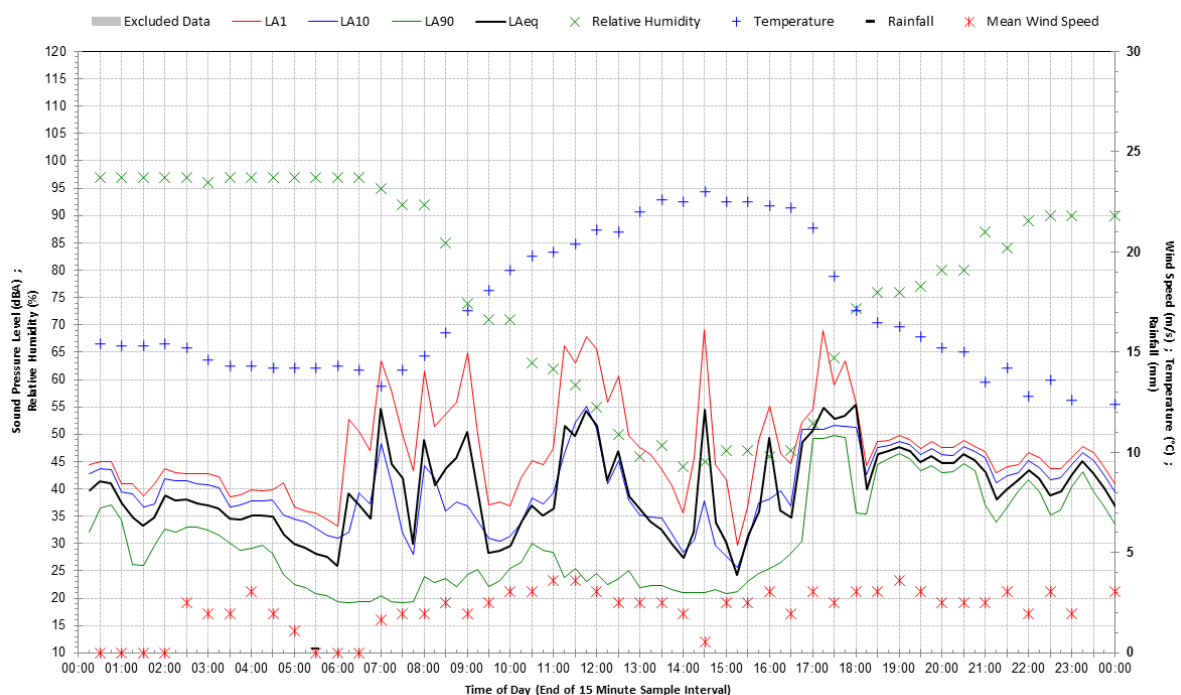




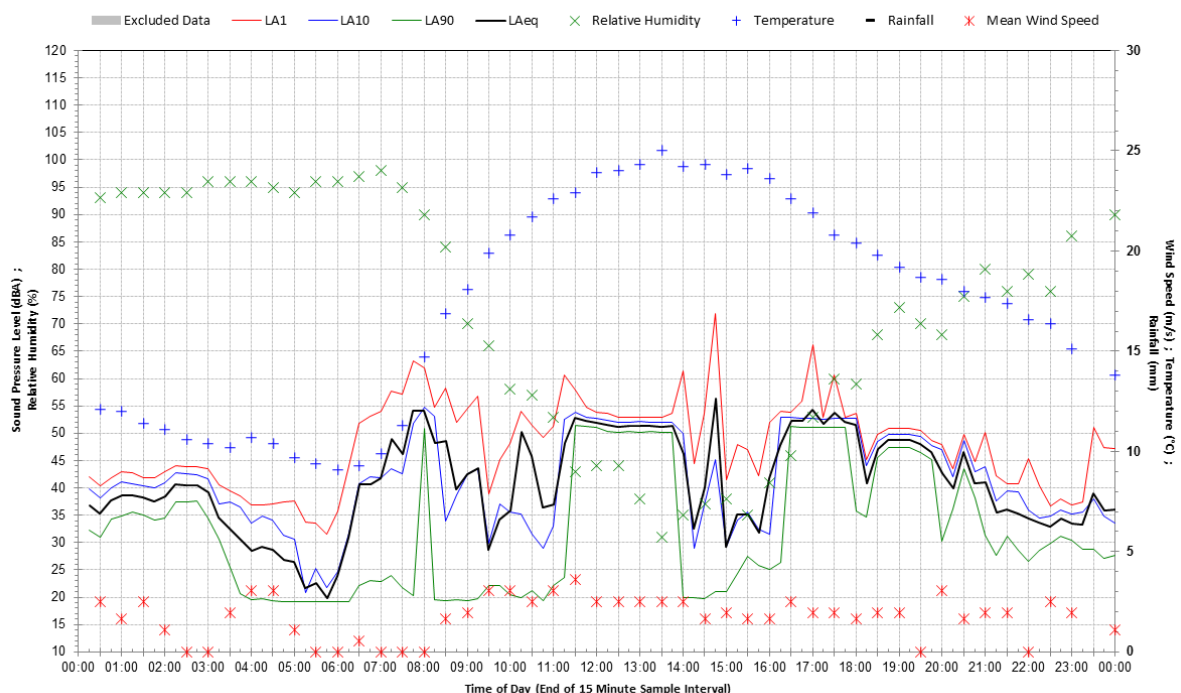
Statistical Ambient Noise Levels Bakara Homestead Thursday 16 May 2013



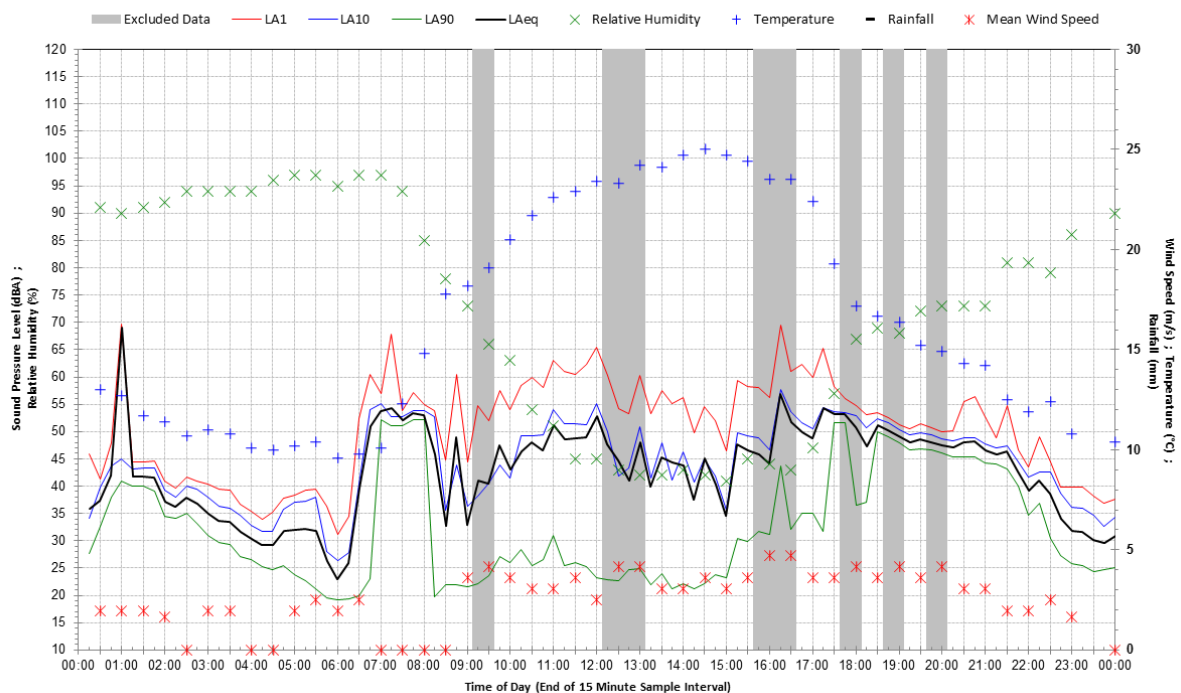
Statistical Ambient Noise Levels Bakara Homestead Friday 17 May 2013



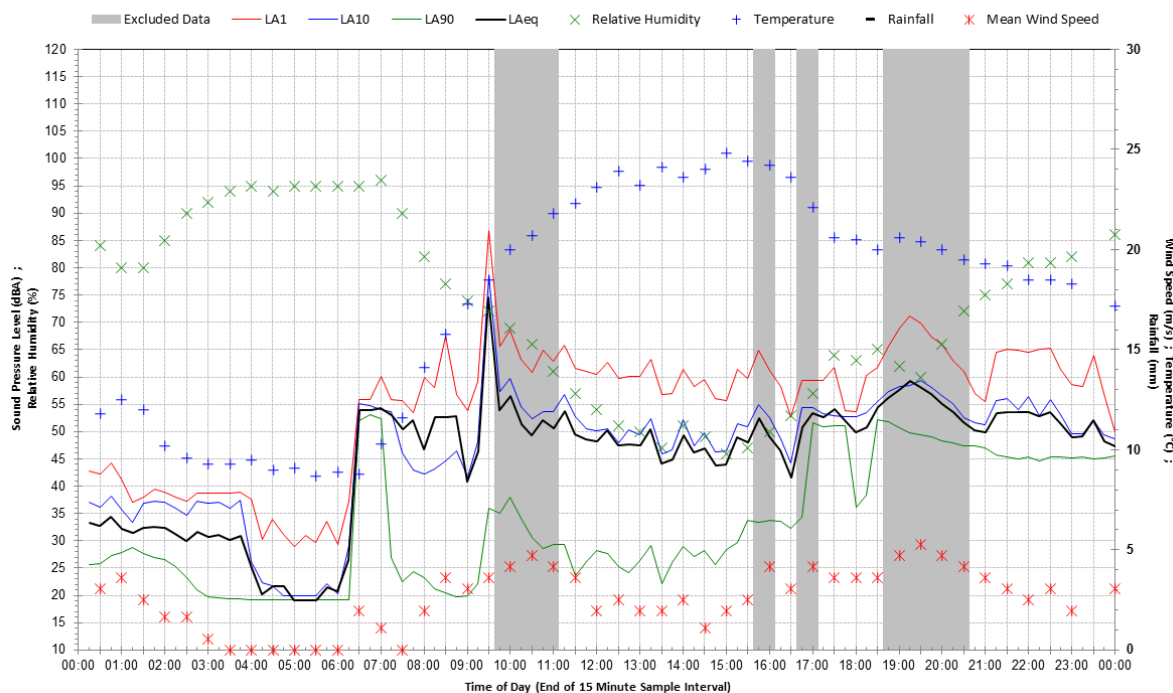
Statistical Ambient Noise Levels Bakara Homestead Saturday 18 May 2013



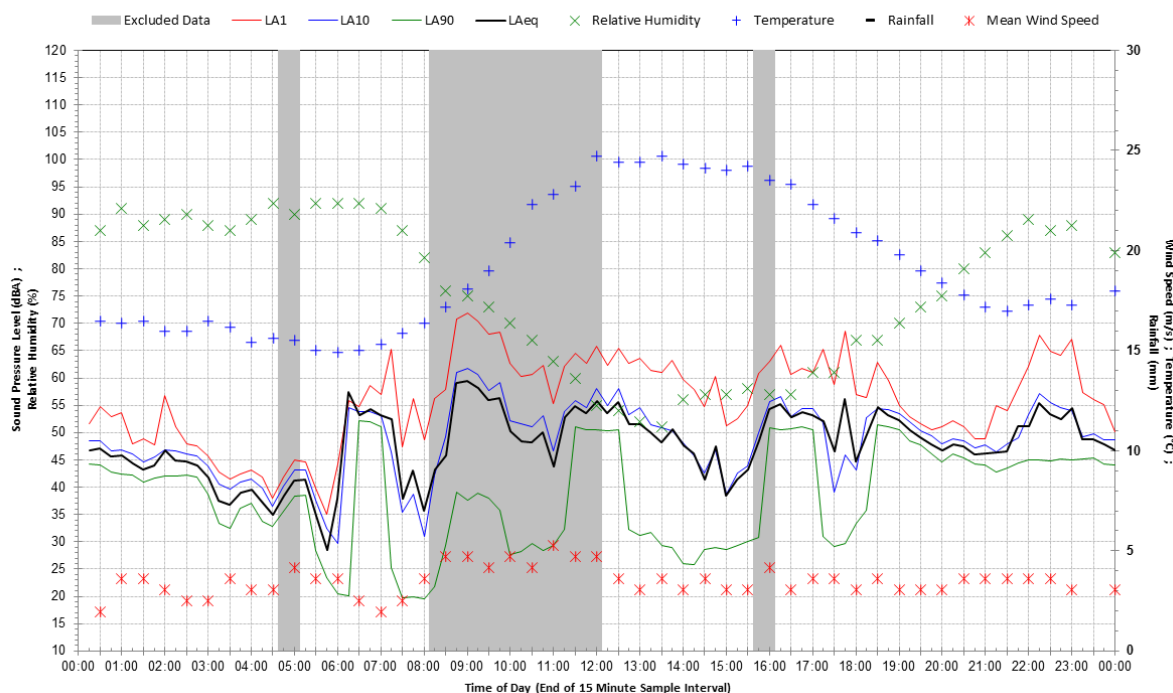
Statistical Ambient Noise Levels Bakara Homestead Sunday 19 May 2013

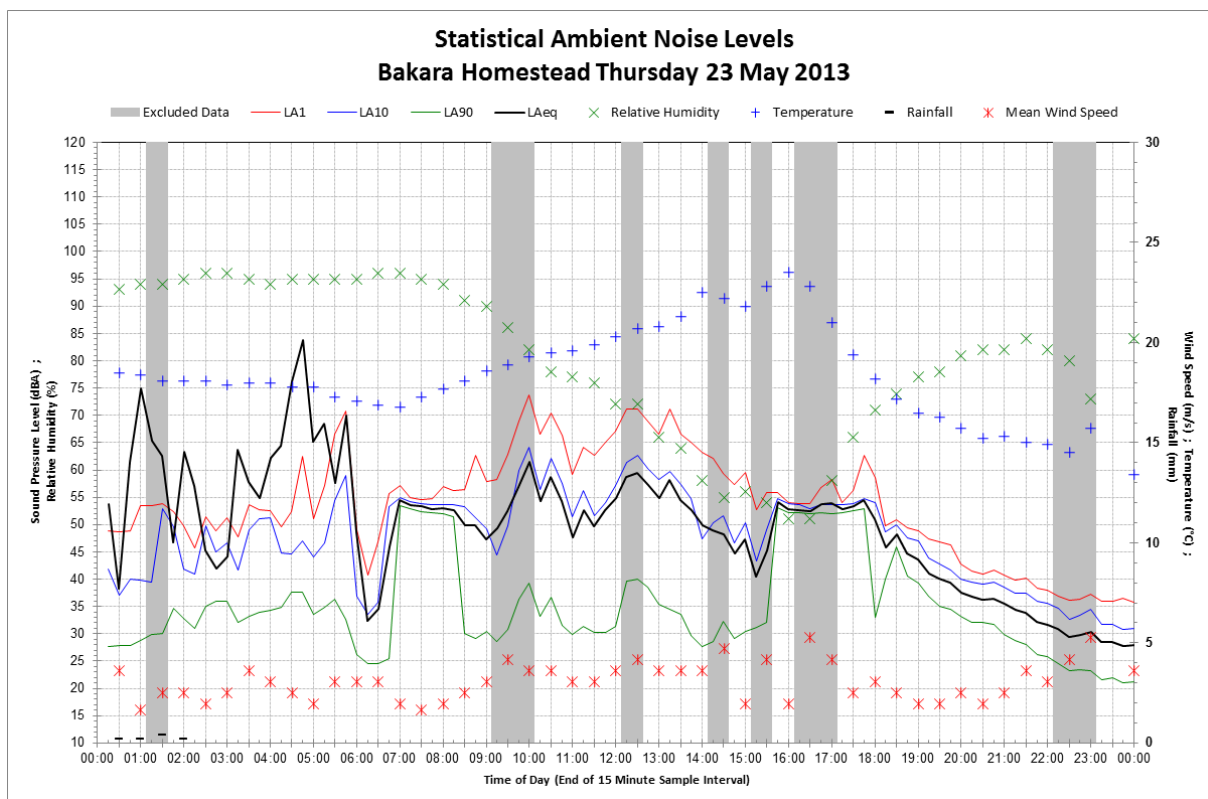
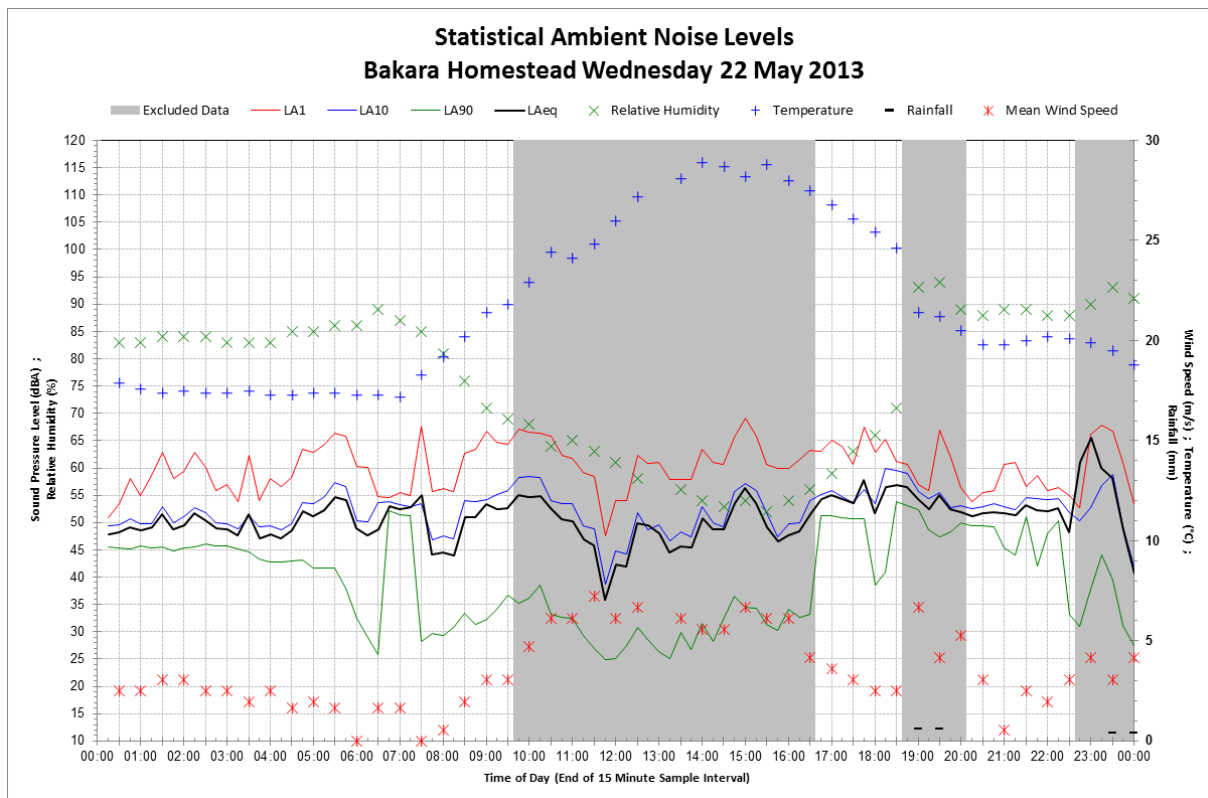


Statistical Ambient Noise Levels Bakara Homestead Monday 20 May 2013

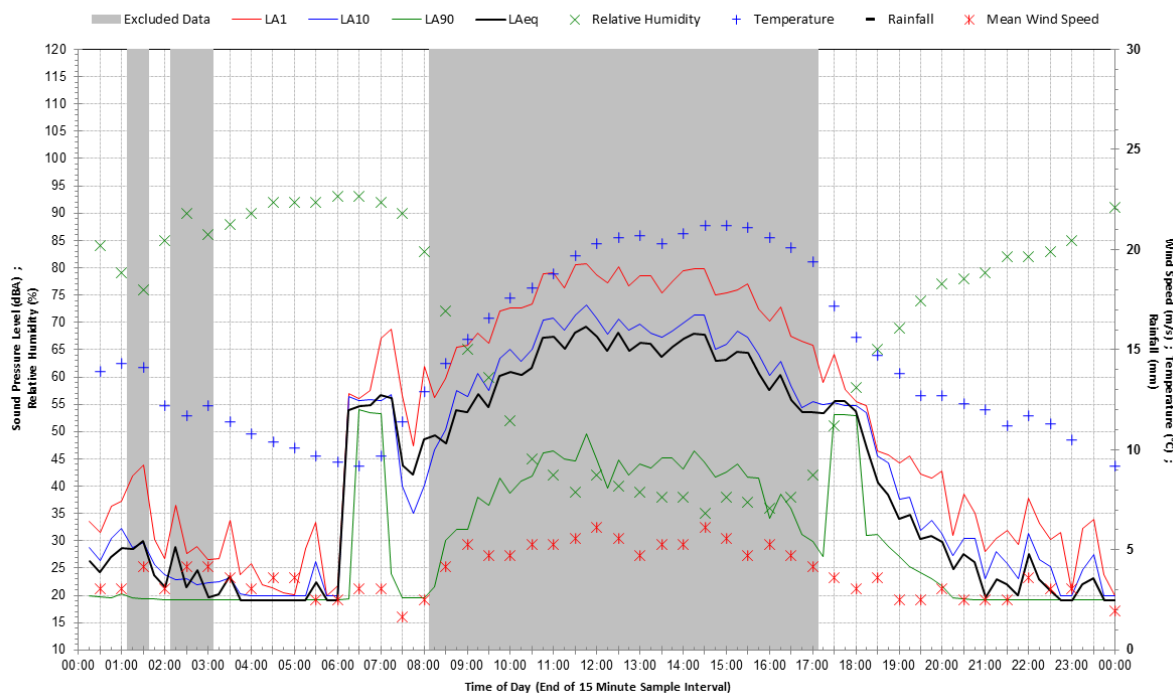


Statistical Ambient Noise Levels Bakara Homestead Tuesday 21 May 2013

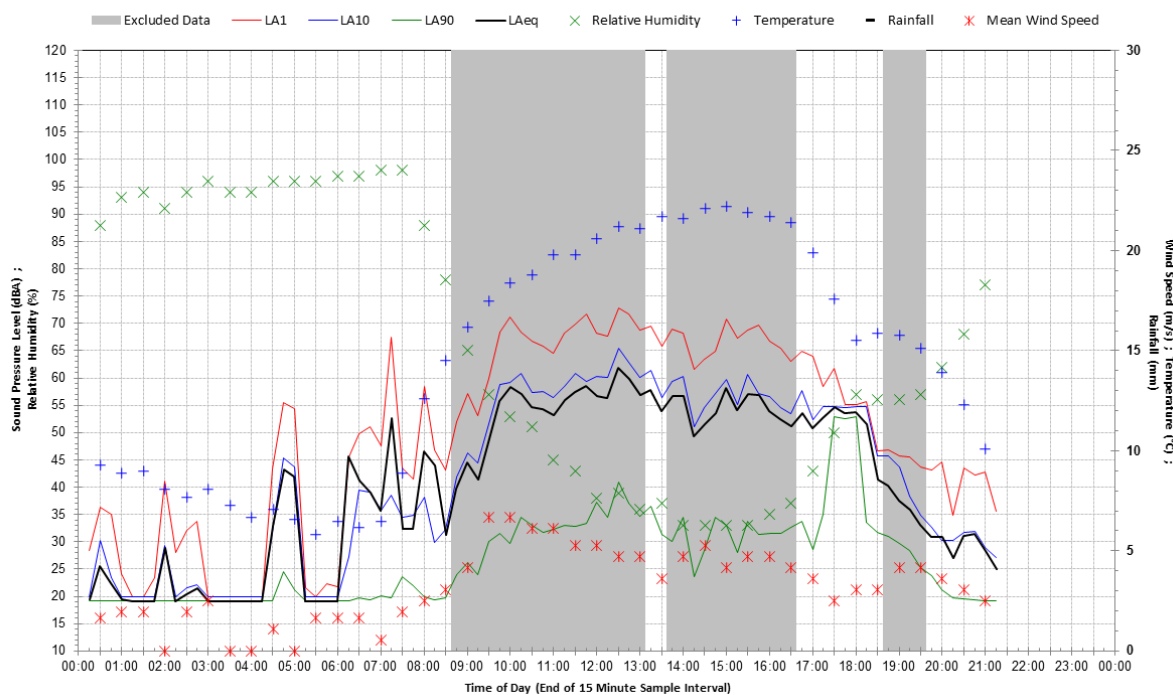


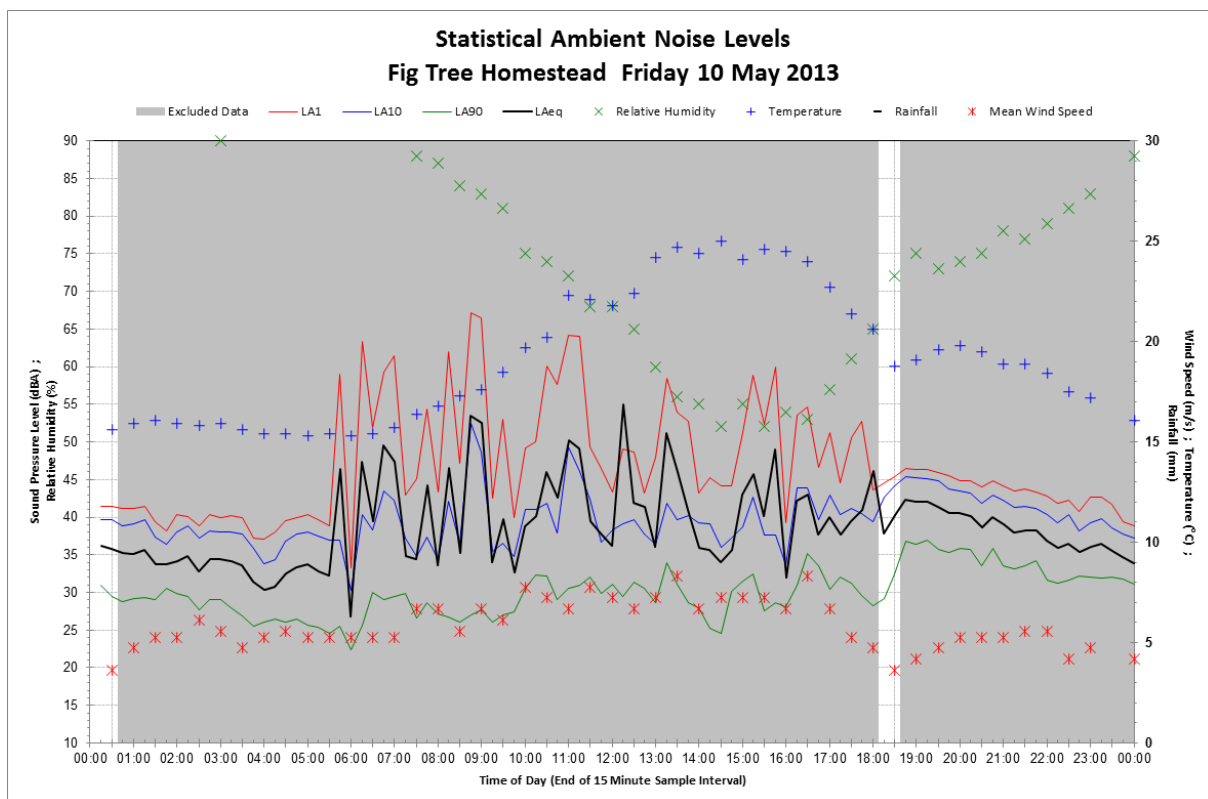
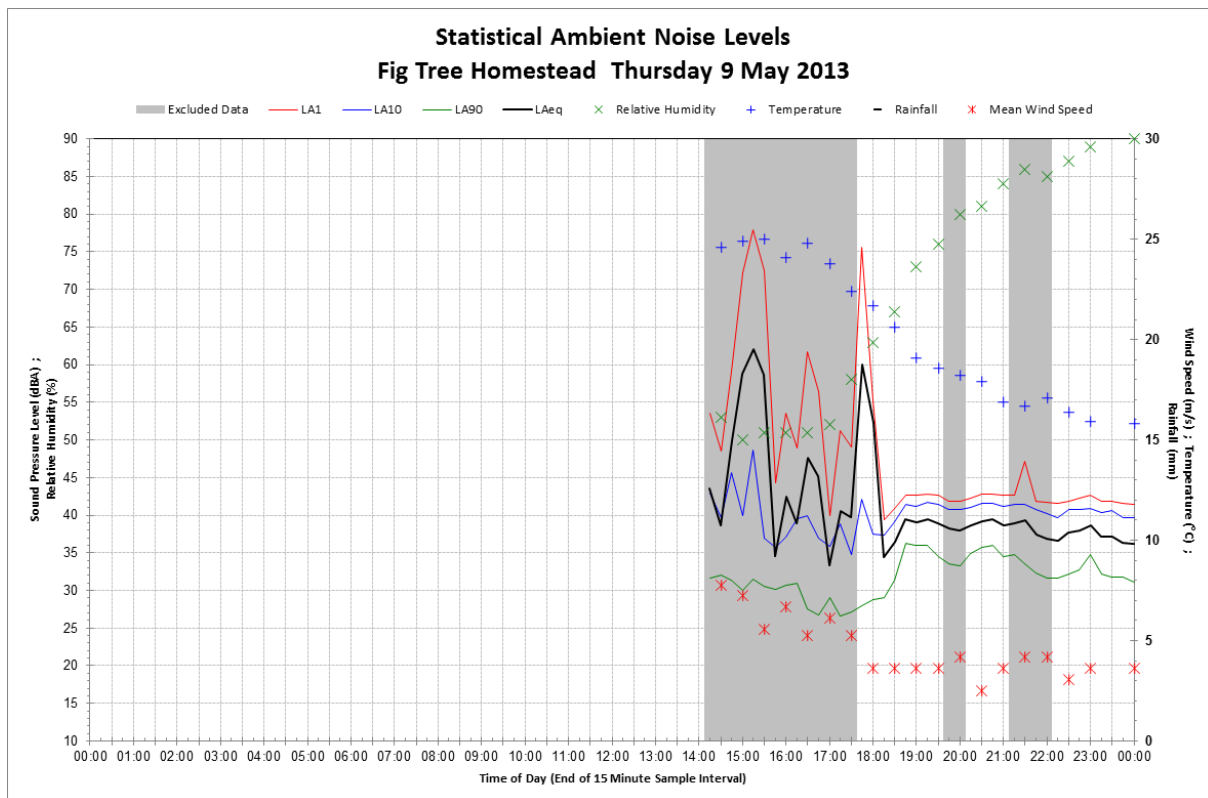


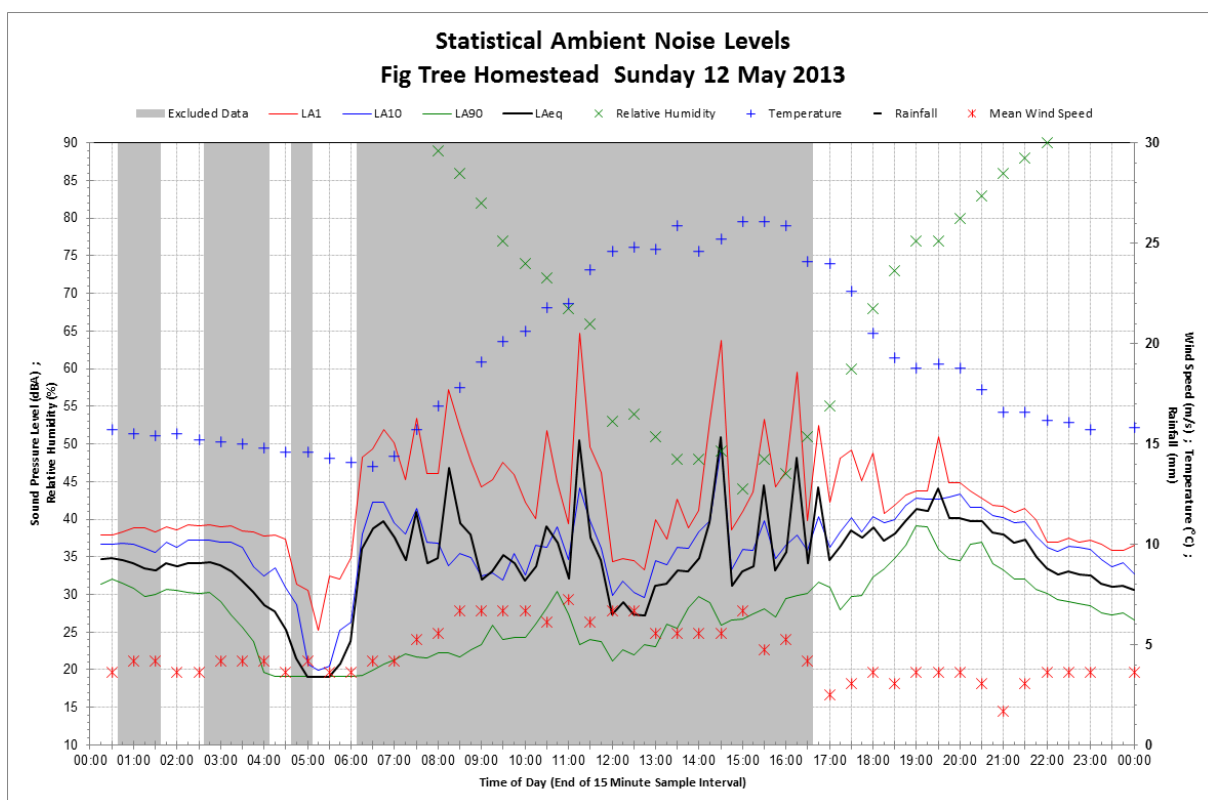
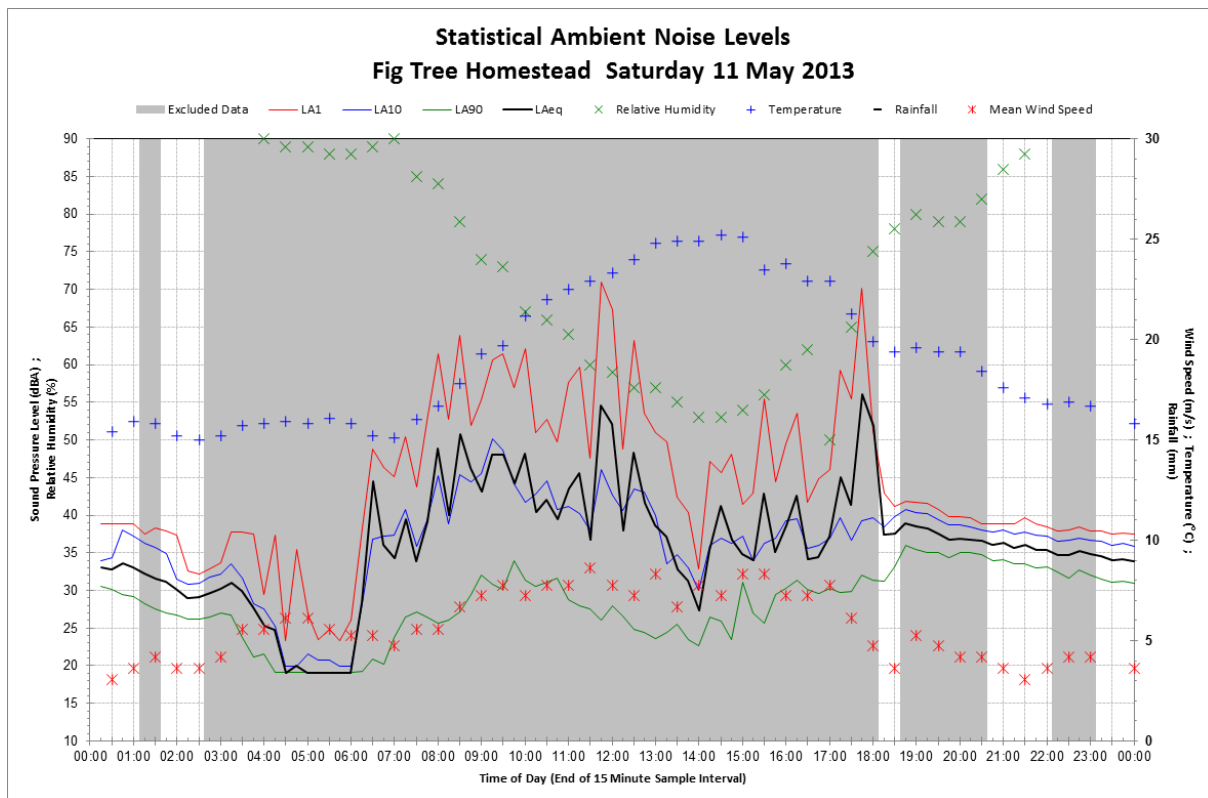
Statistical Ambient Noise Levels Bakara Homestead Friday 24 May 2013

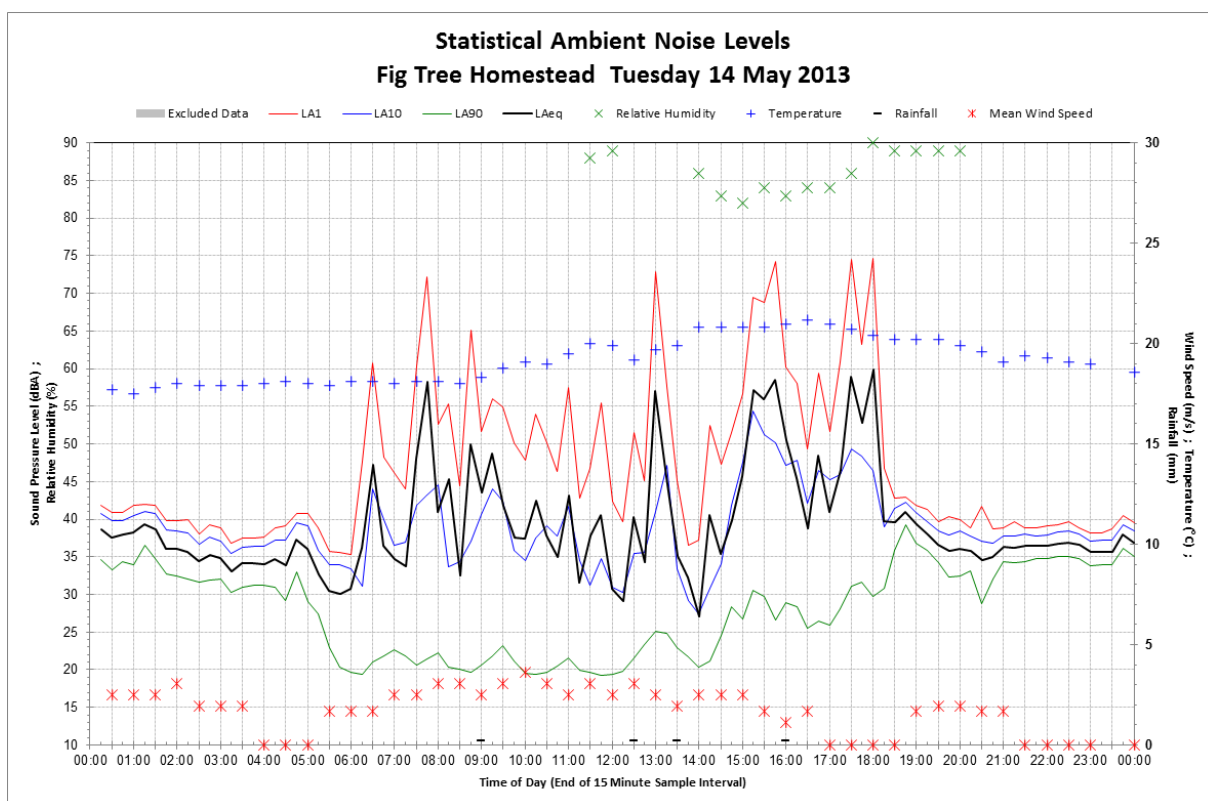
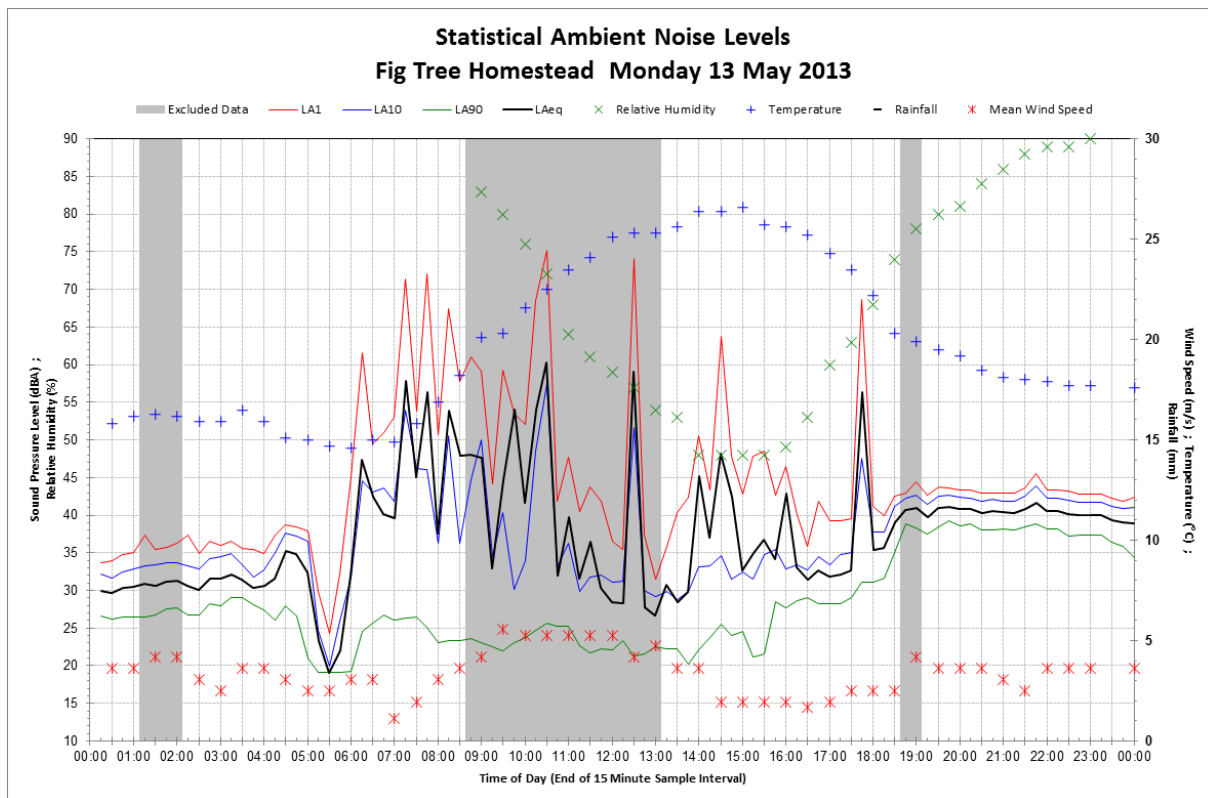


Statistical Ambient Noise Levels Bakara Homestead Saturday 25 May 2013

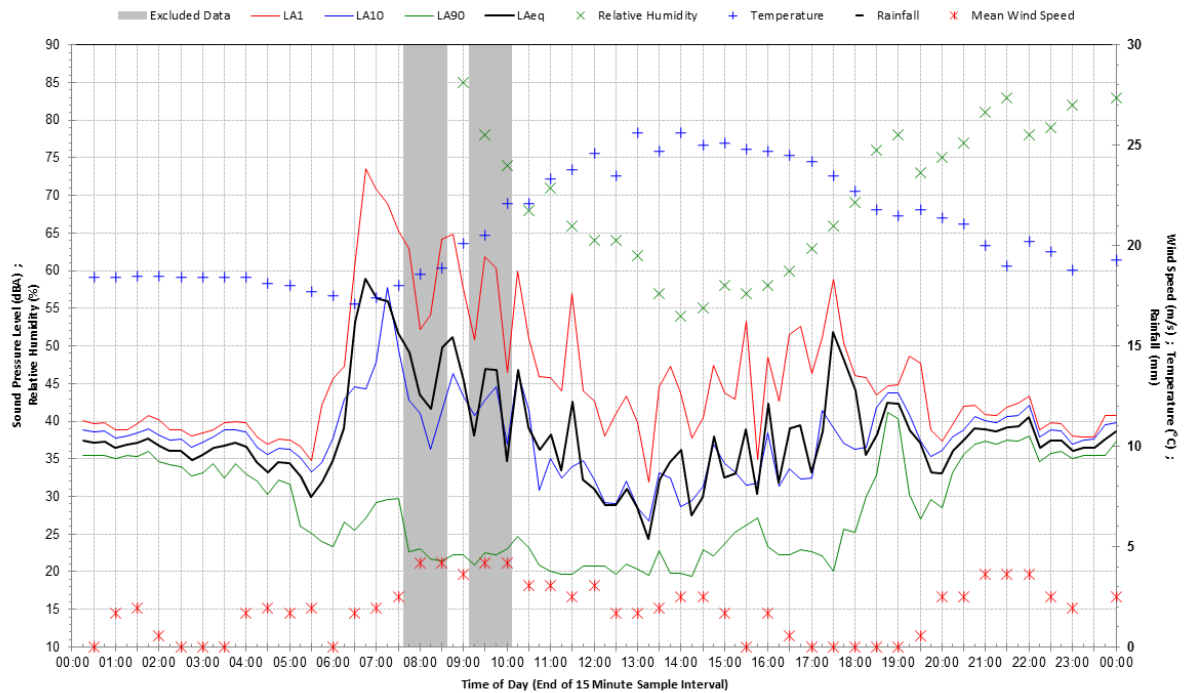




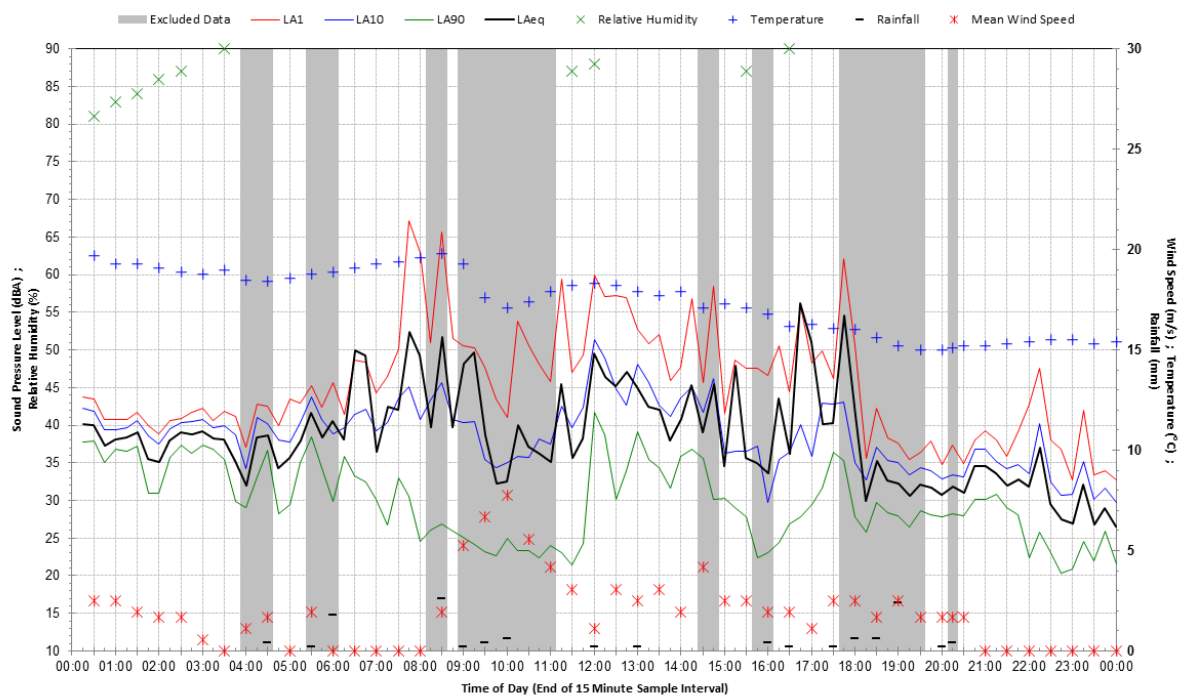


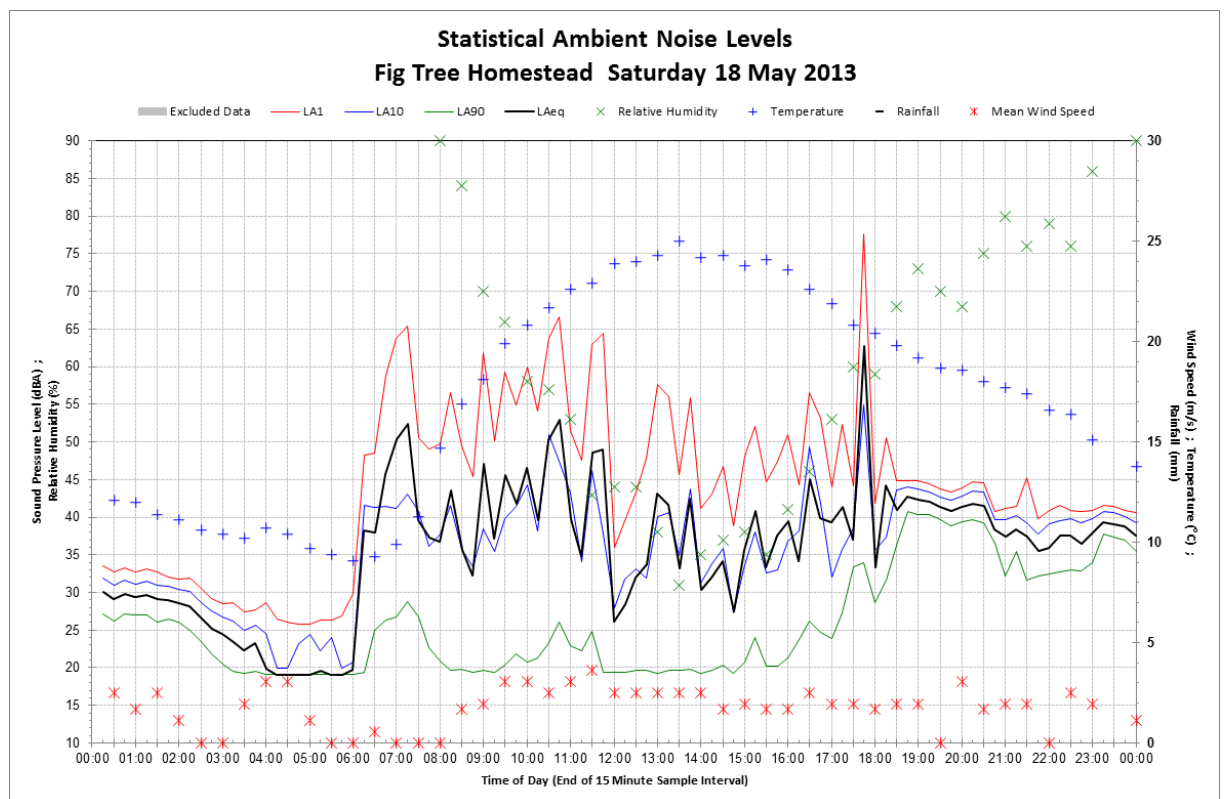
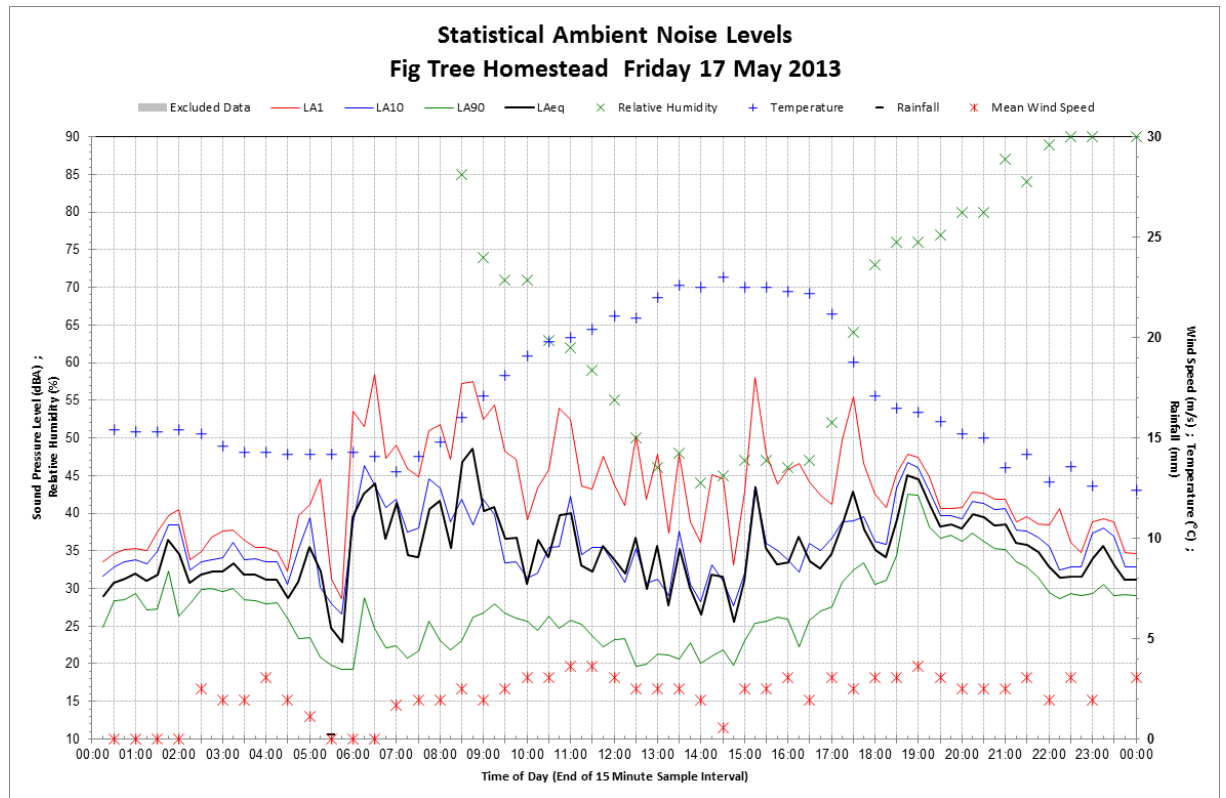


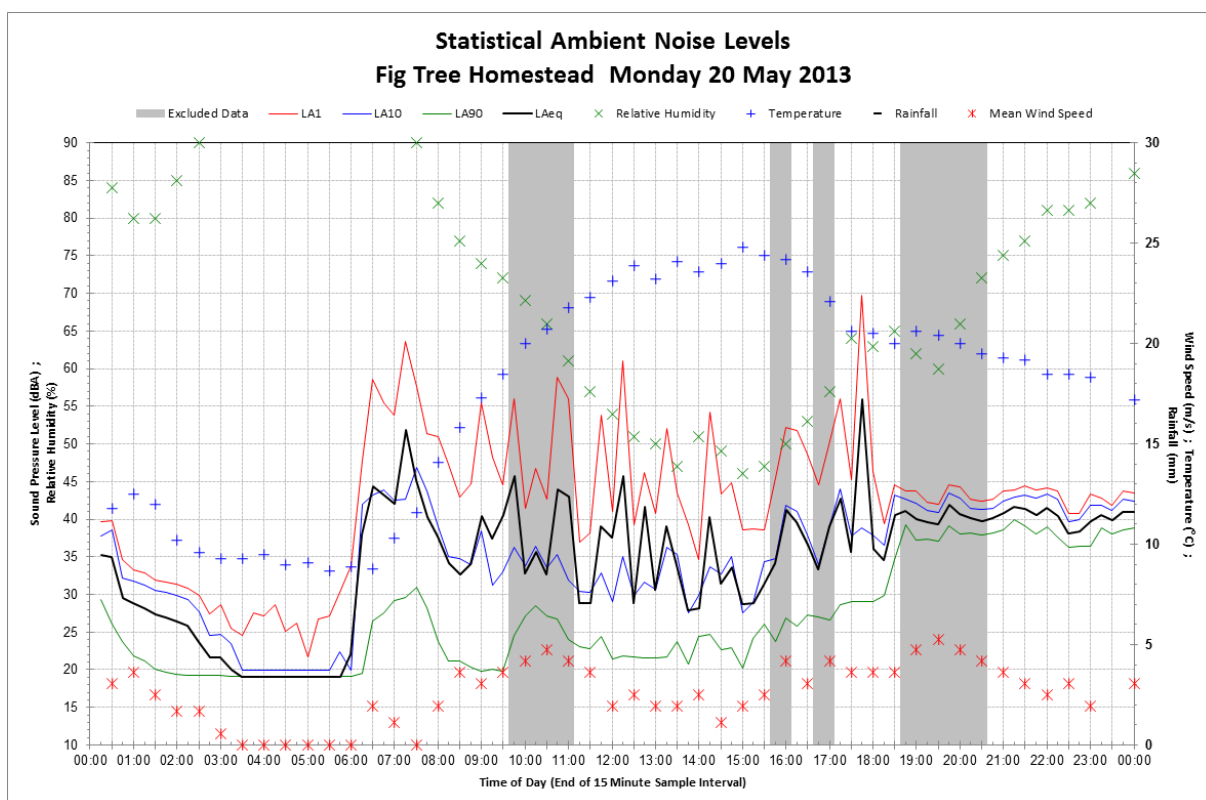
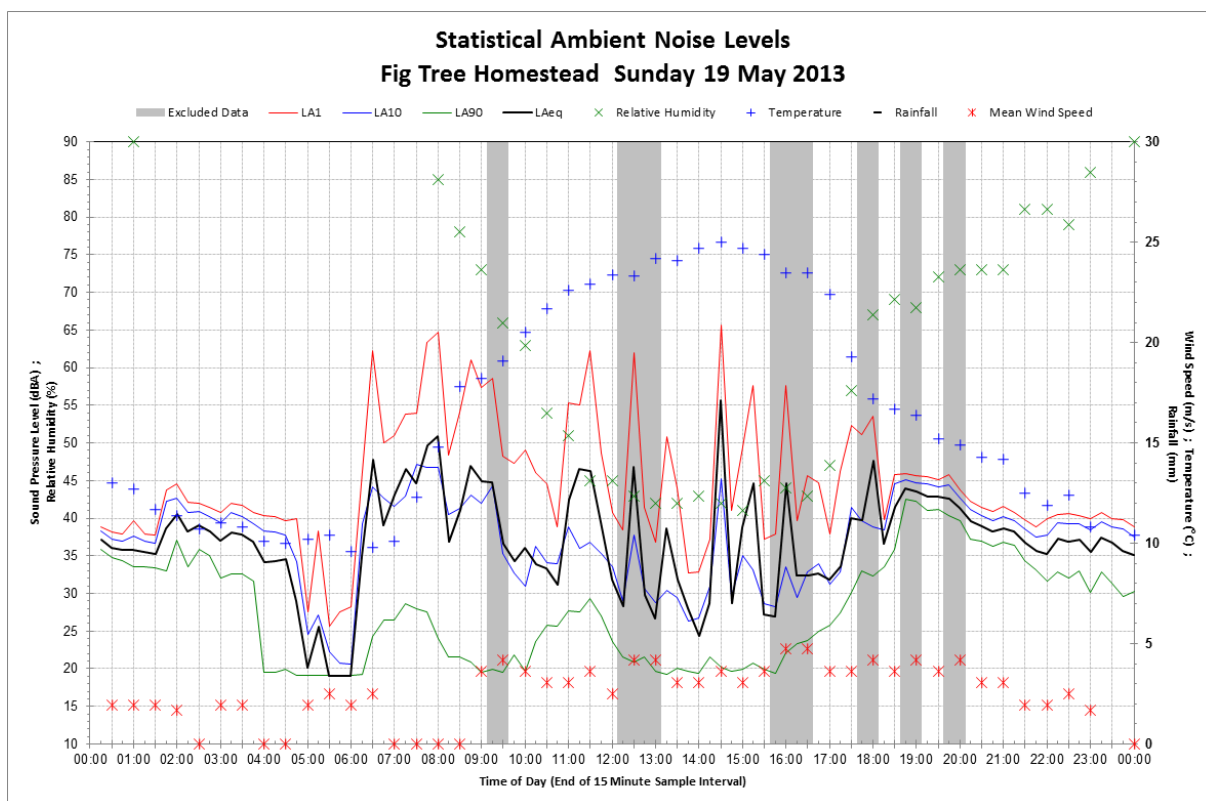
Statistical Ambient Noise Levels
Fig Tree Homestead Wednesday 15 May 2013

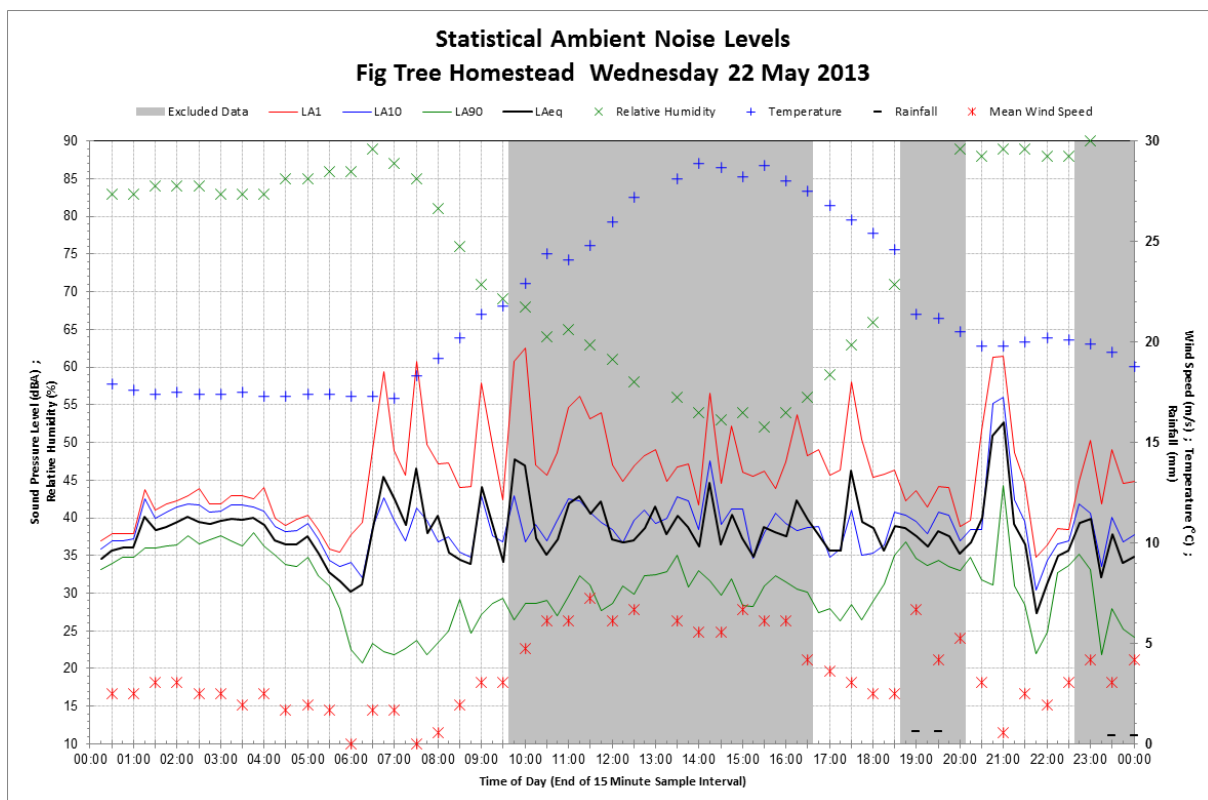
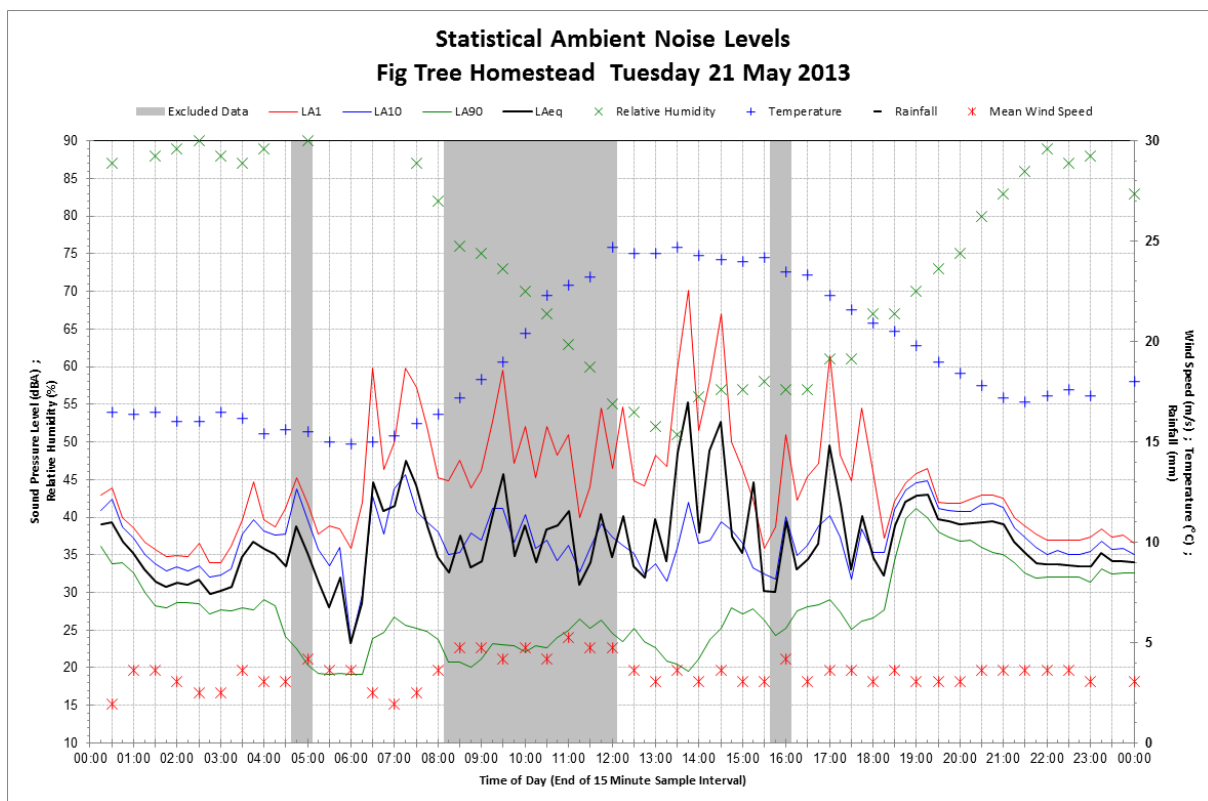


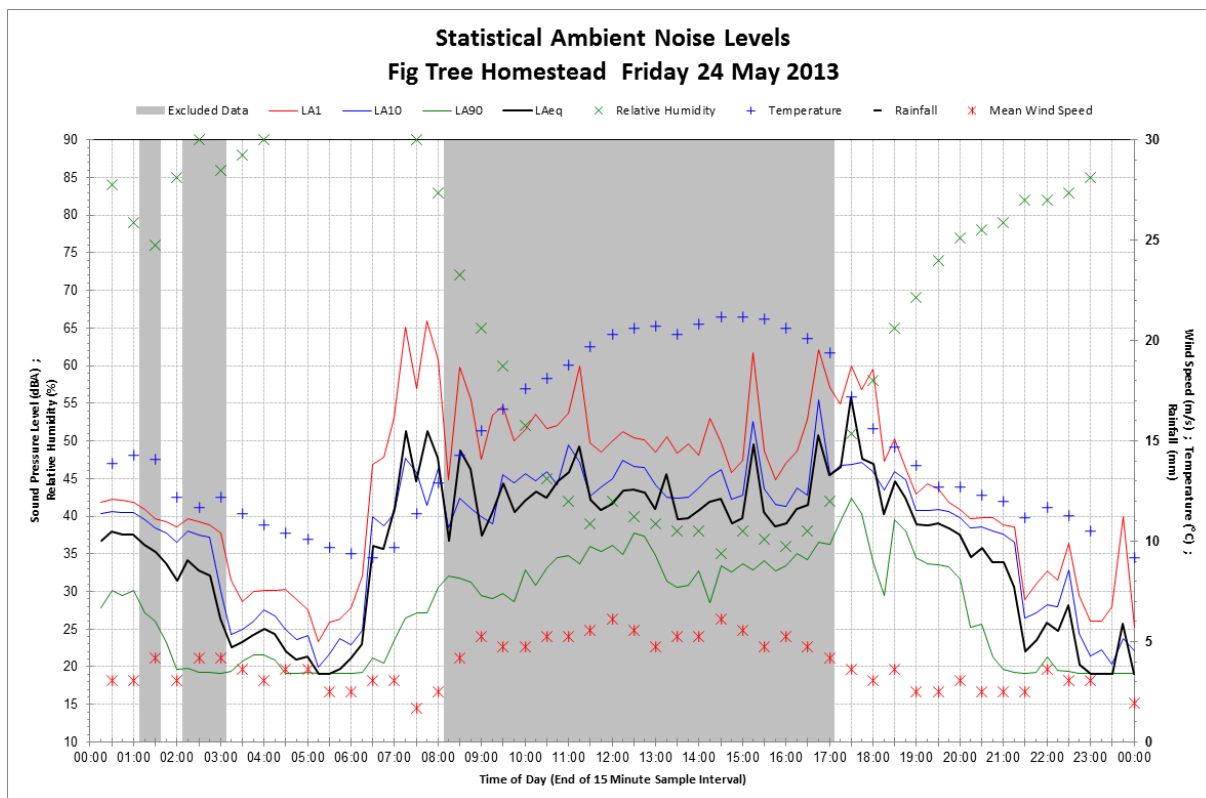
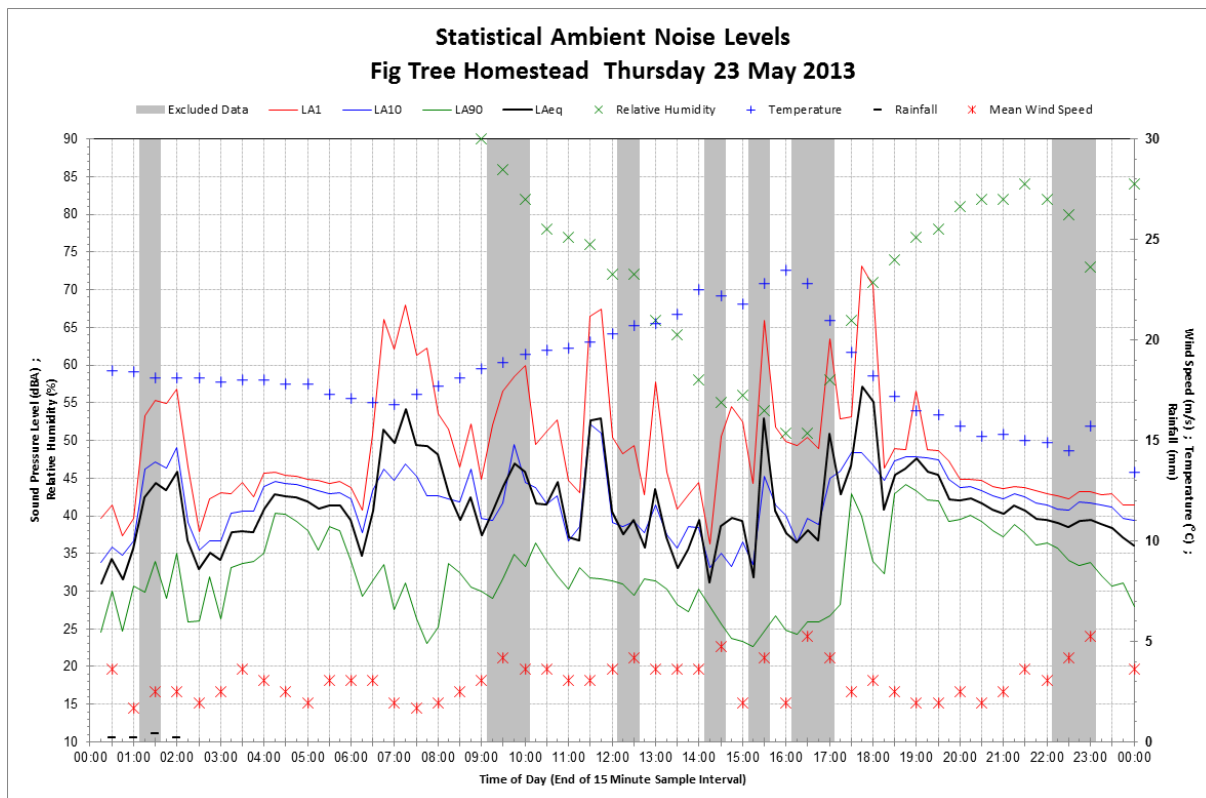
Statistical Ambient Noise Levels
Fig Tree Homestead Thursday 16 May 2013

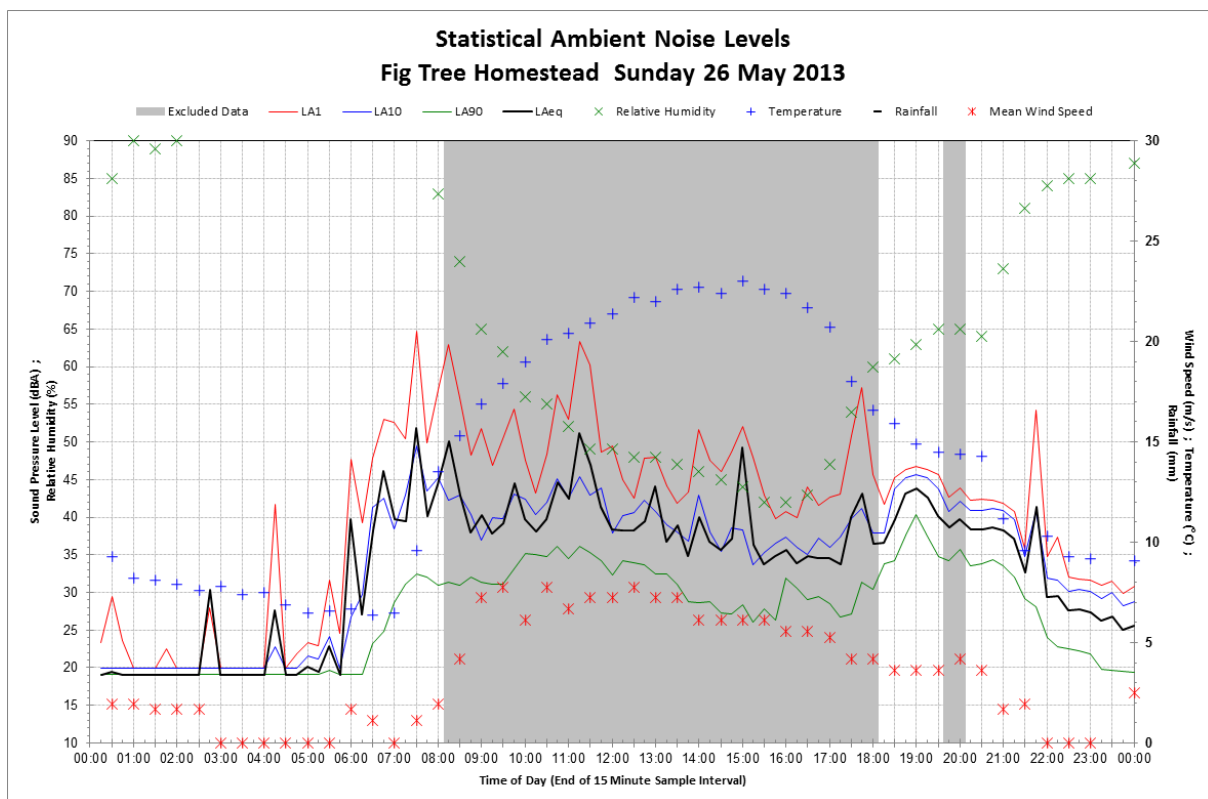
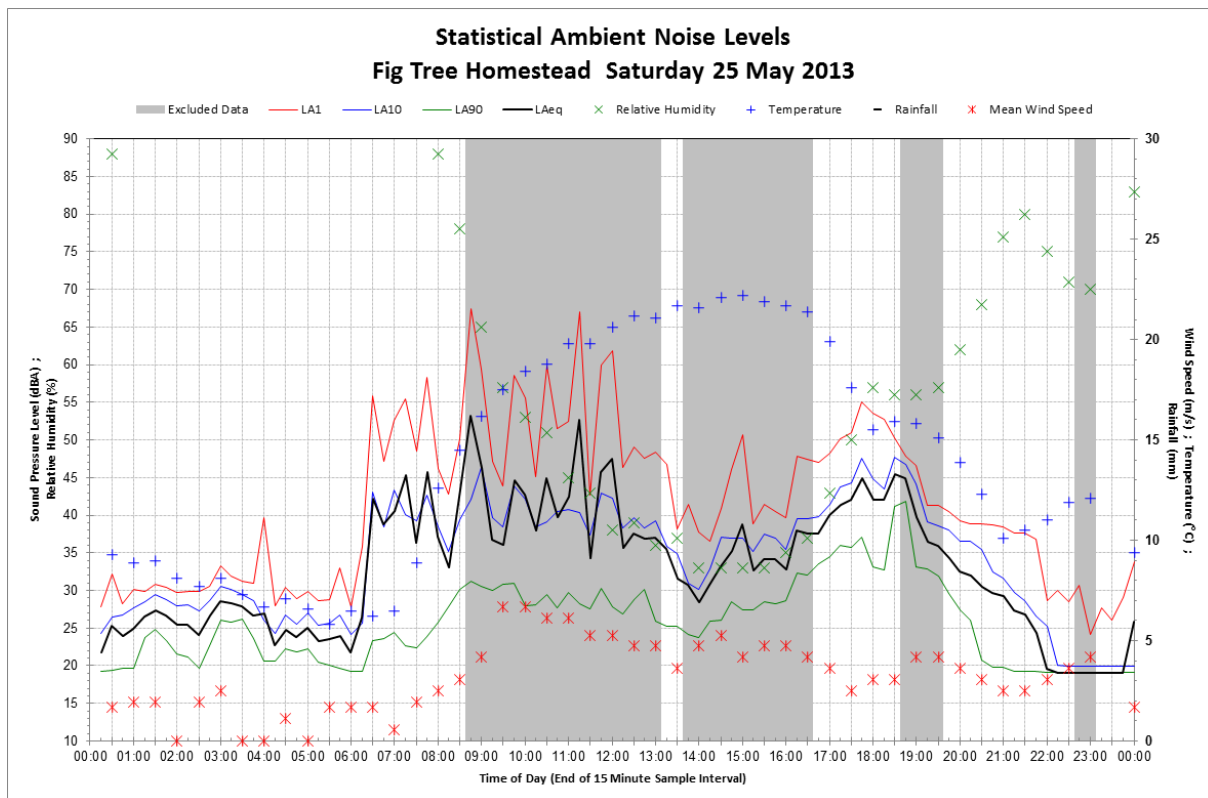




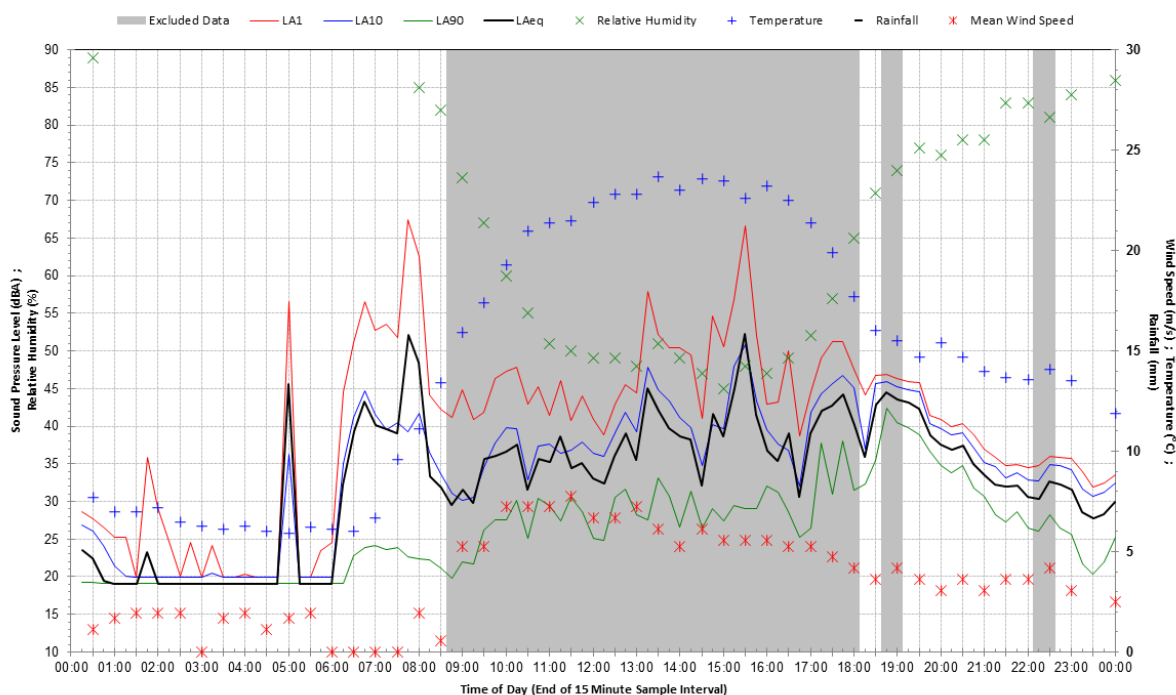




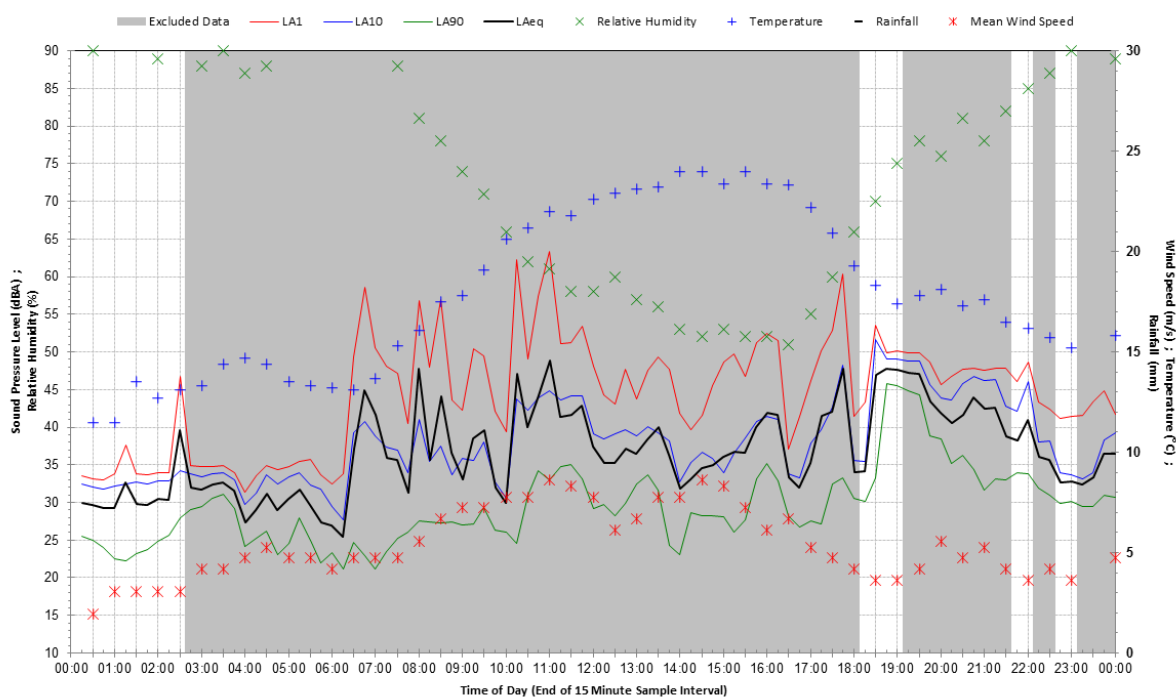


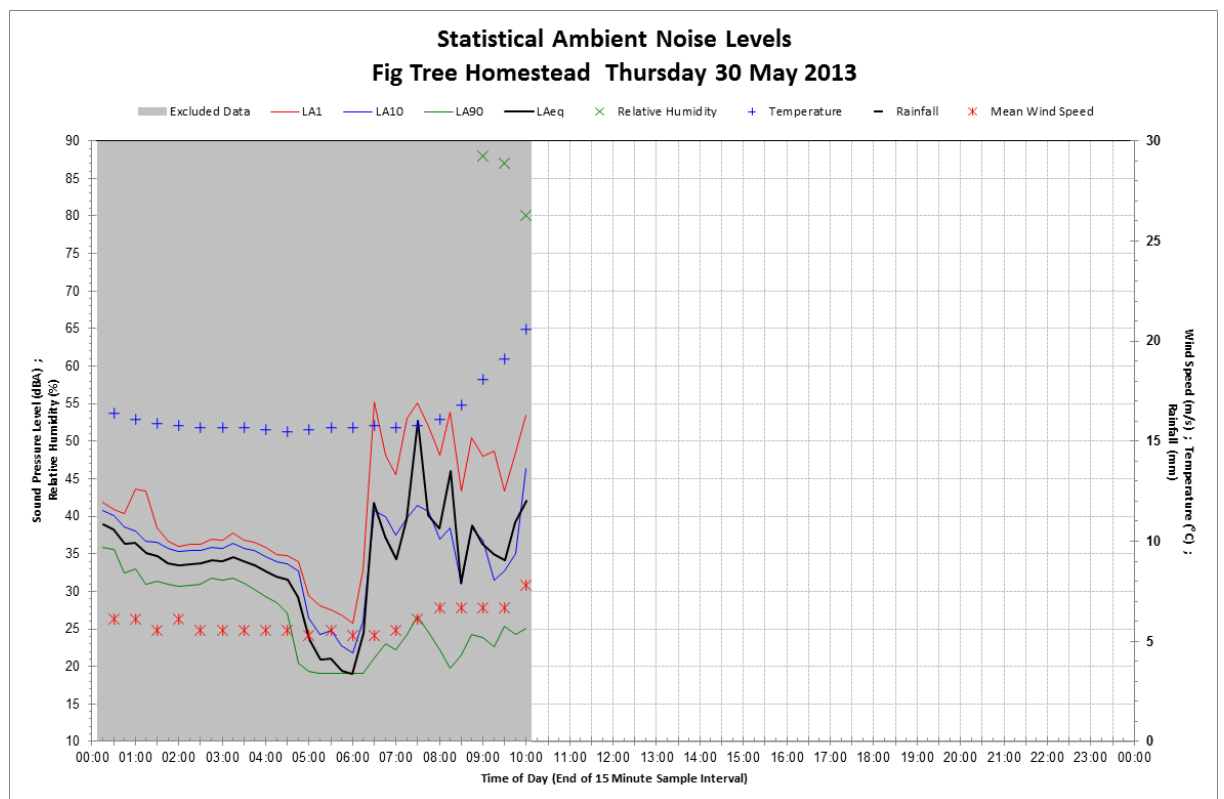
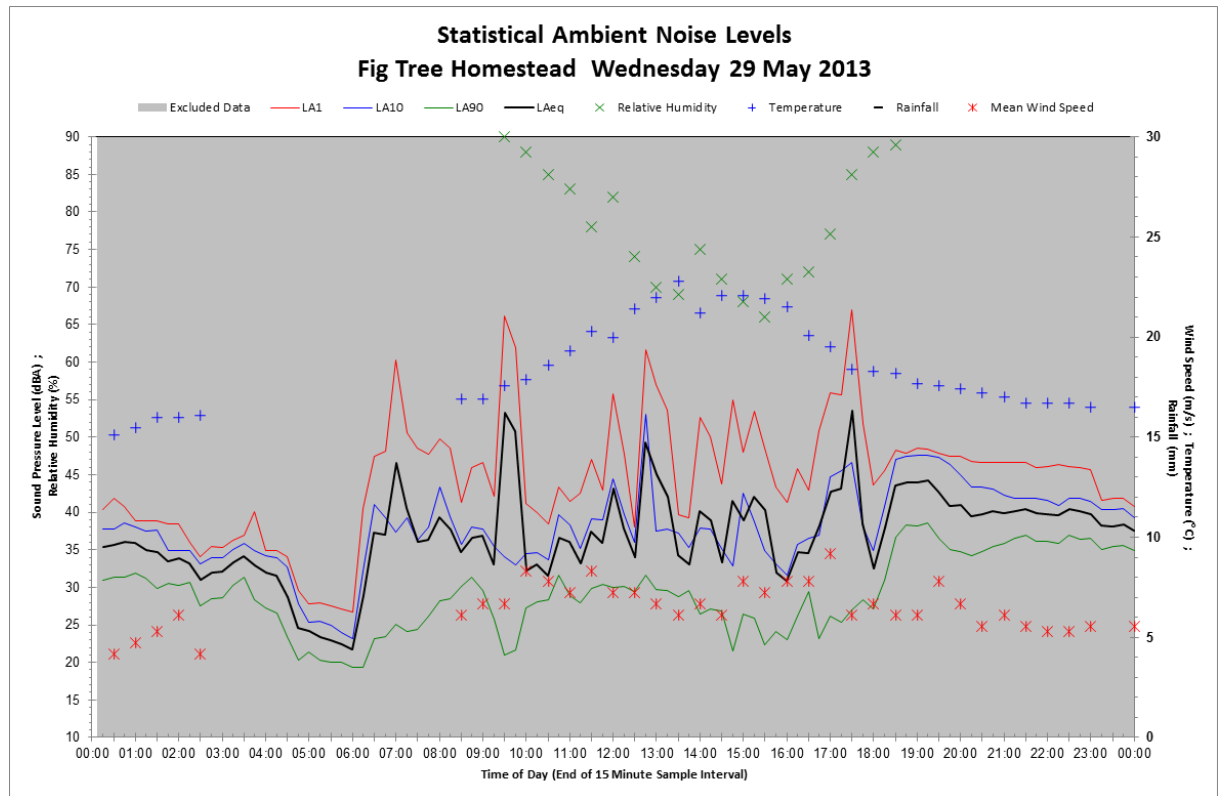


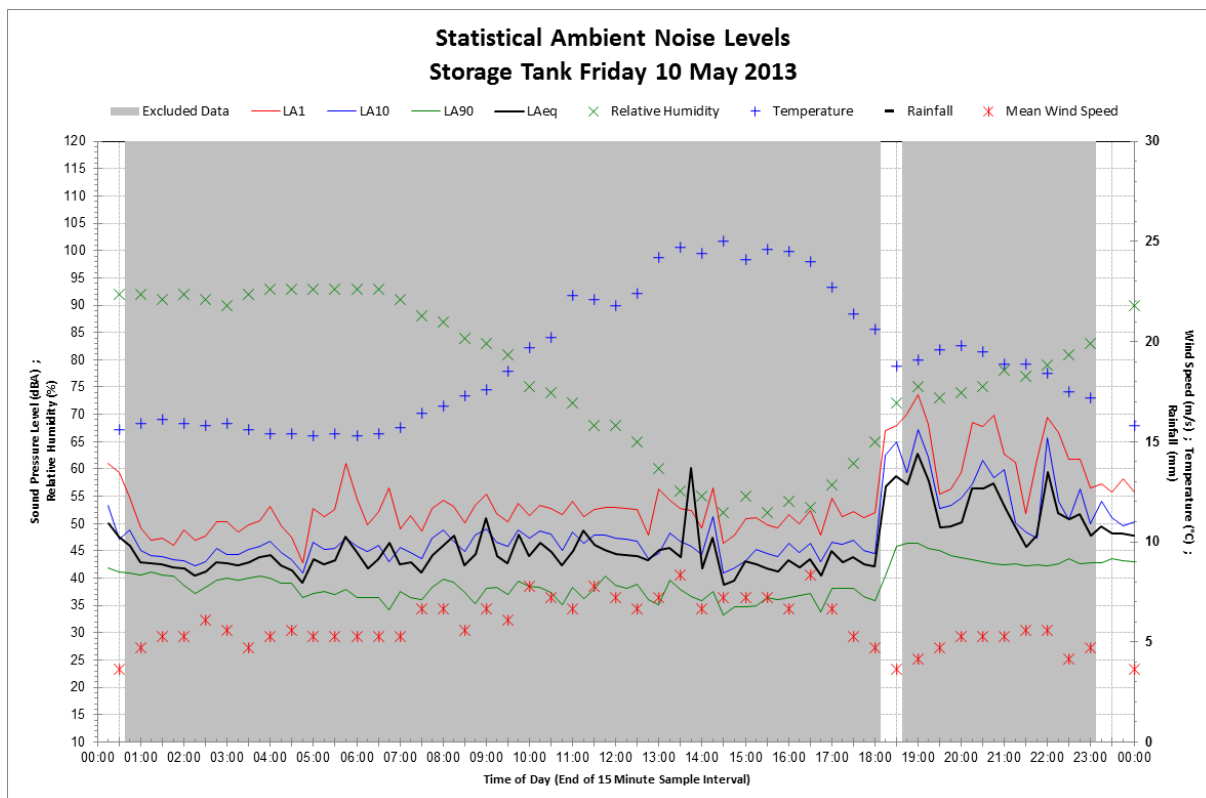
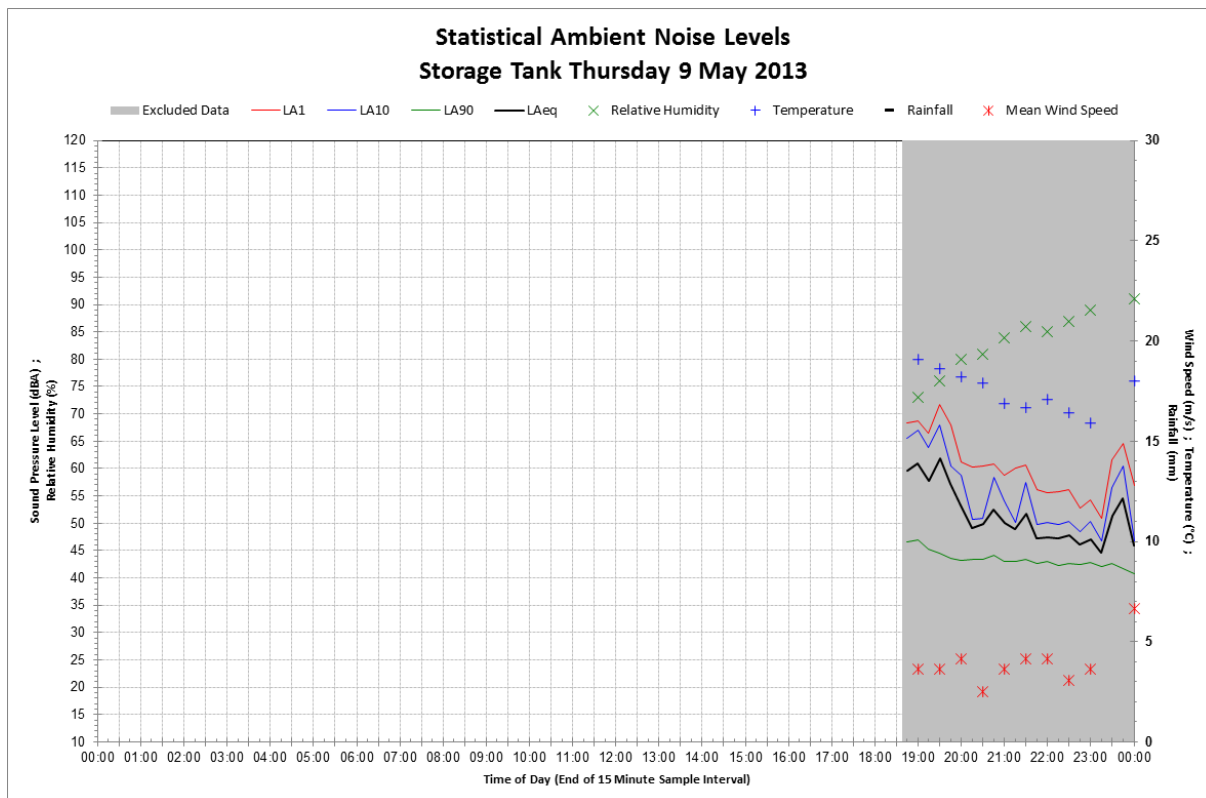
Statistical Ambient Noise Levels
Fig Tree Homestead Monday 27 May 2013

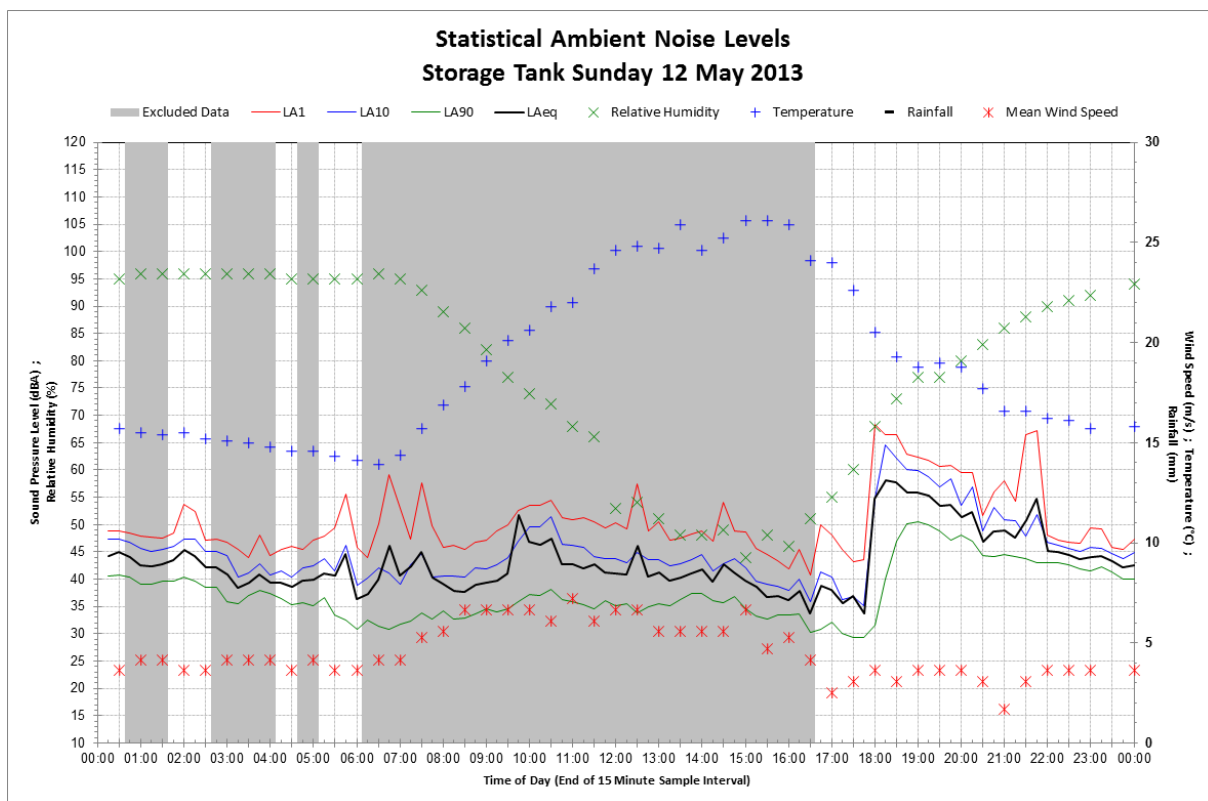
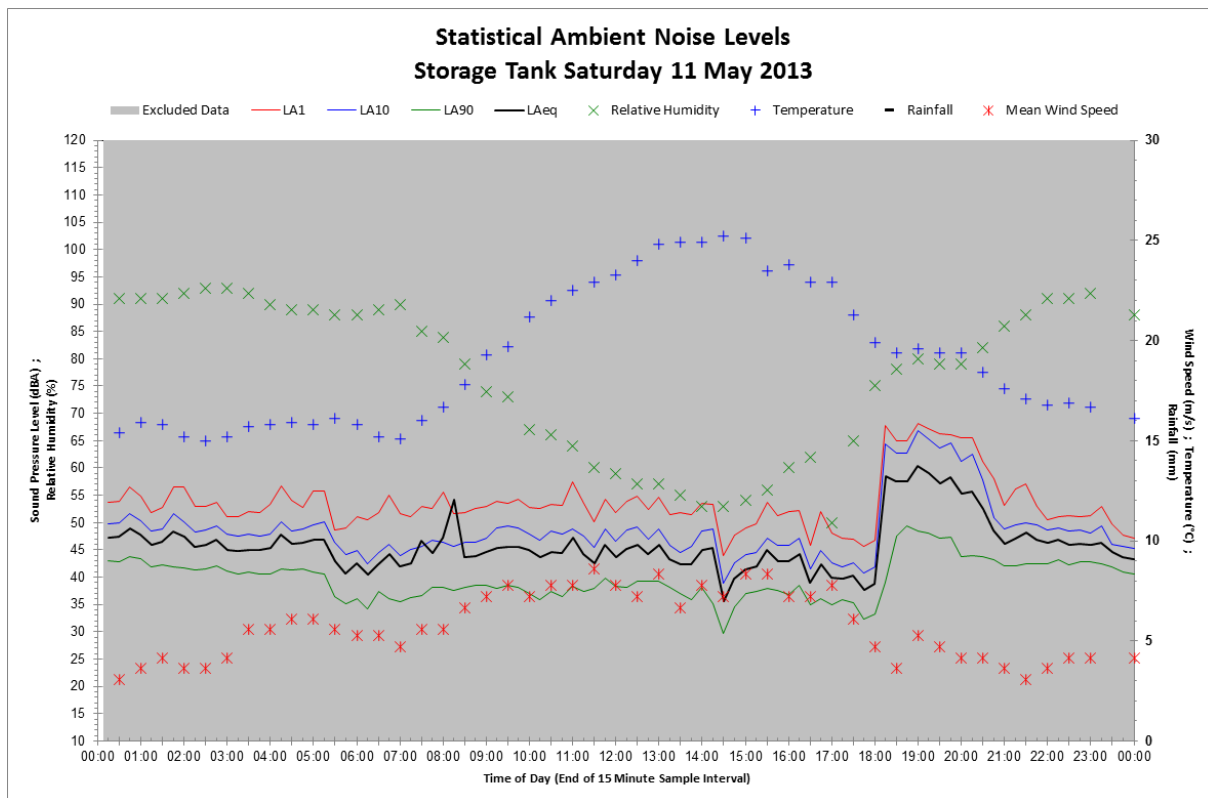


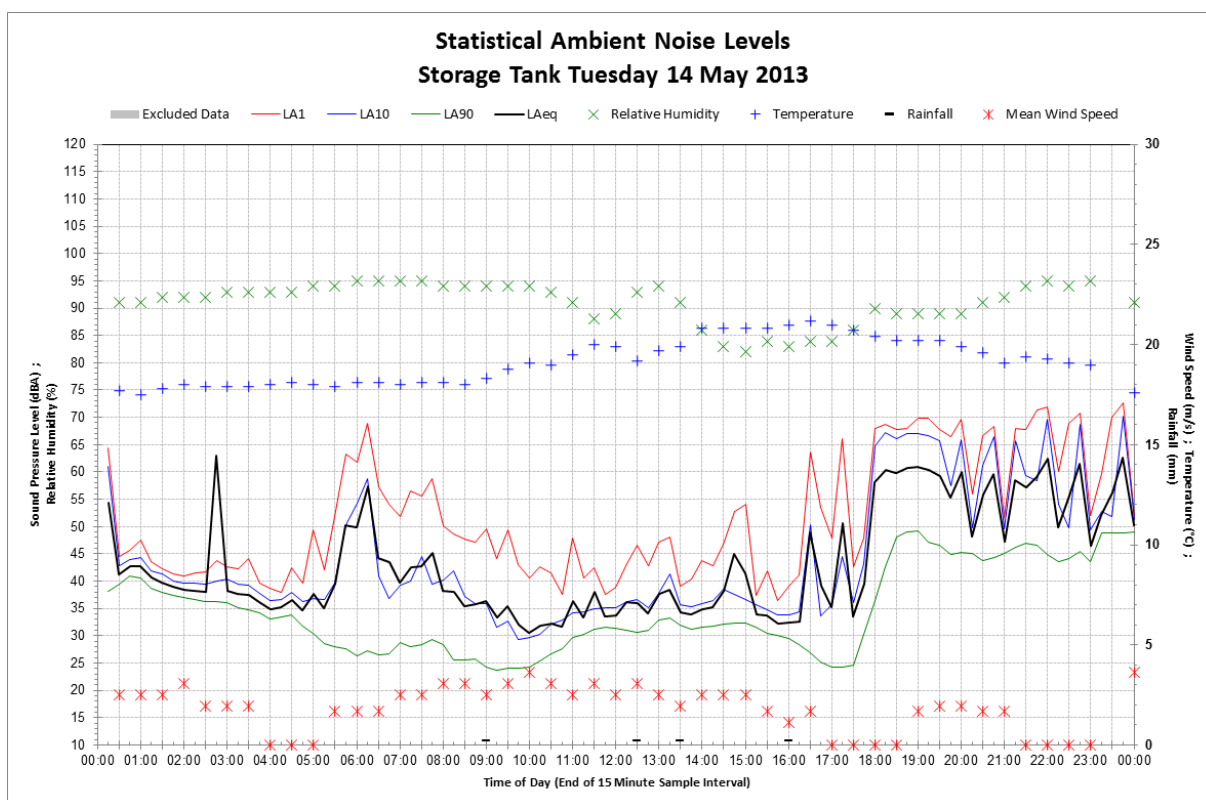
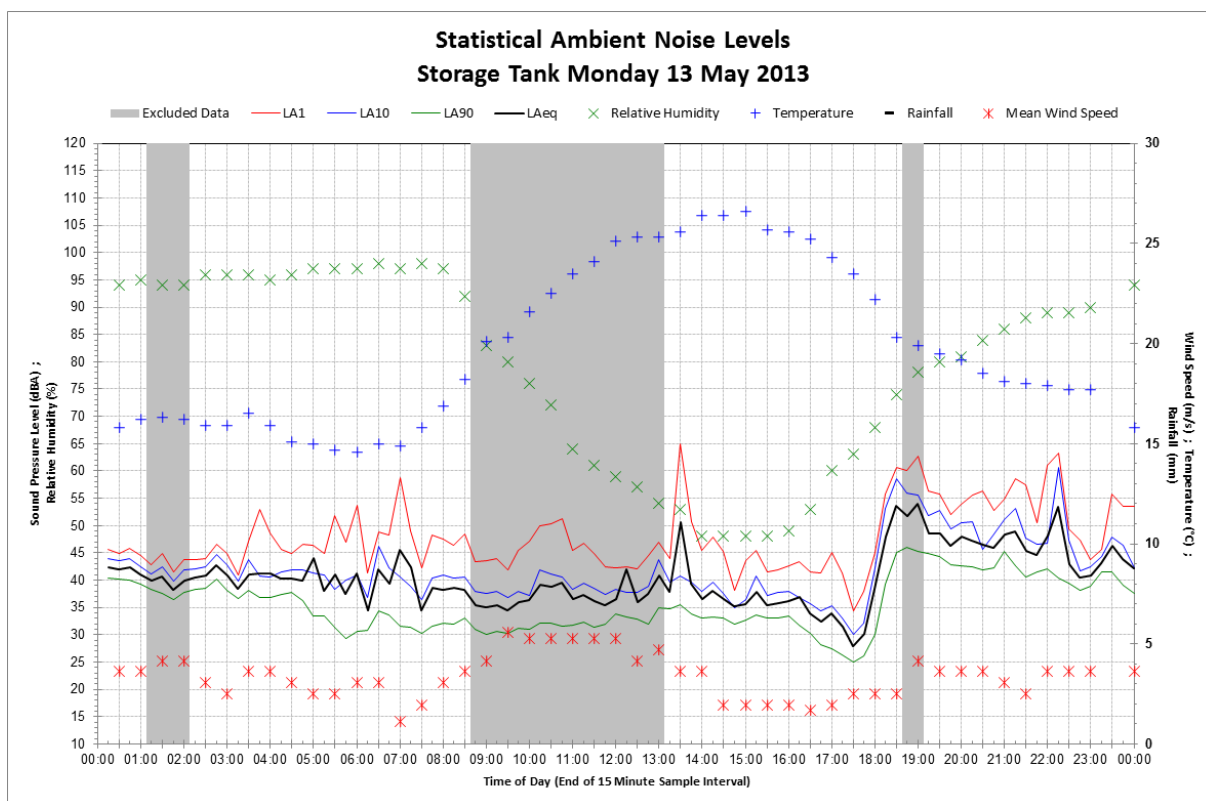
Statistical Ambient Noise Levels
Fig Tree Homestead Tuesday 28 May 2013

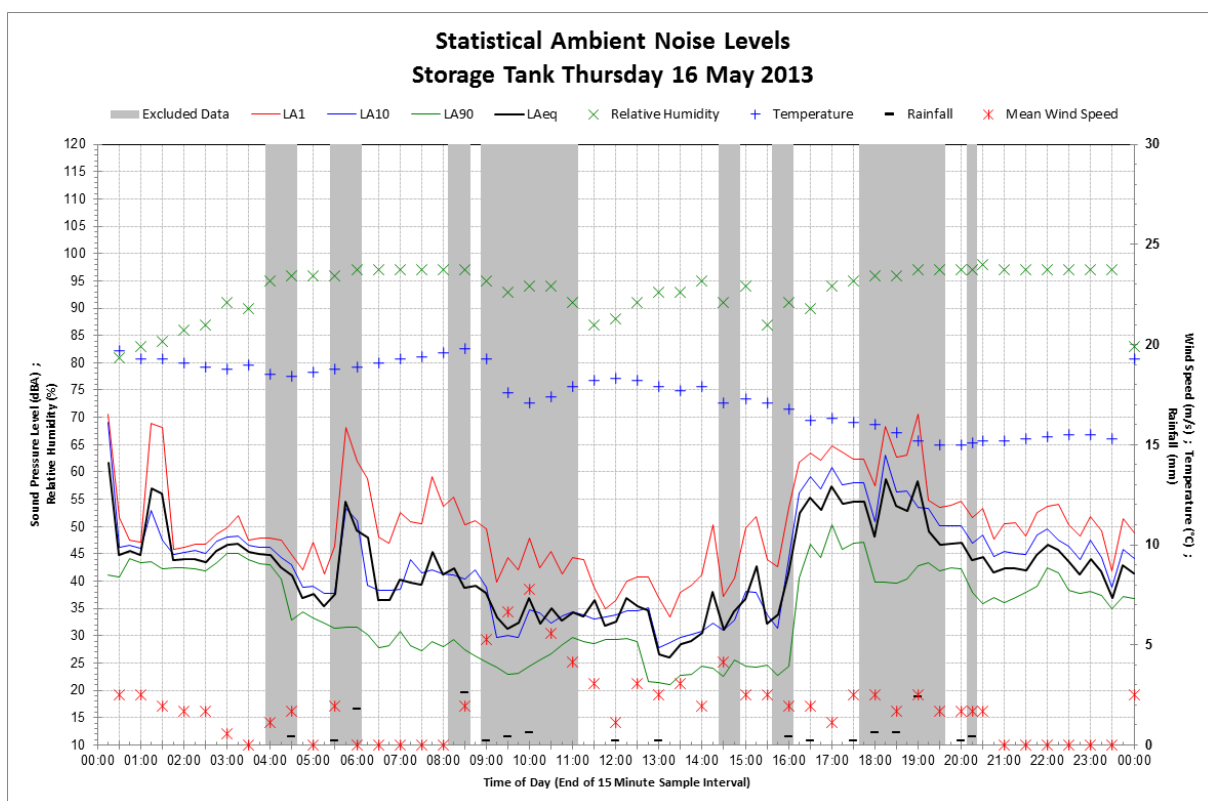
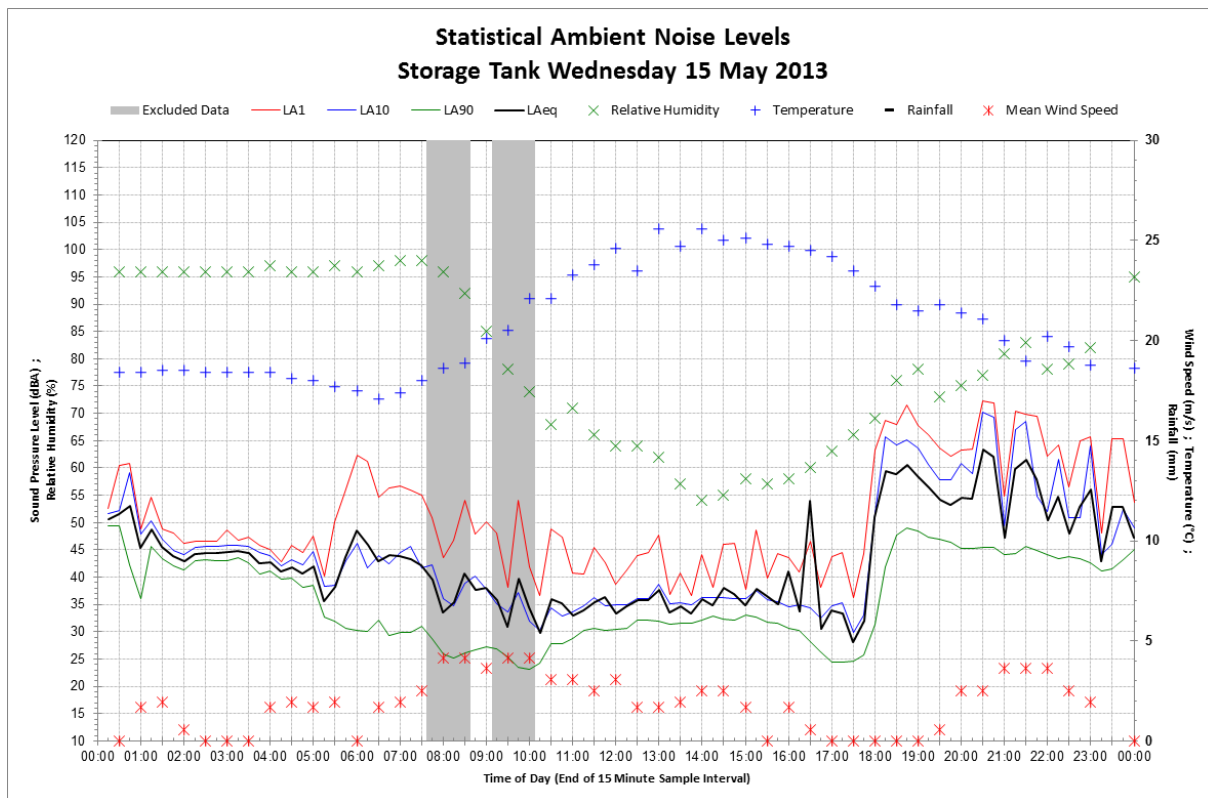


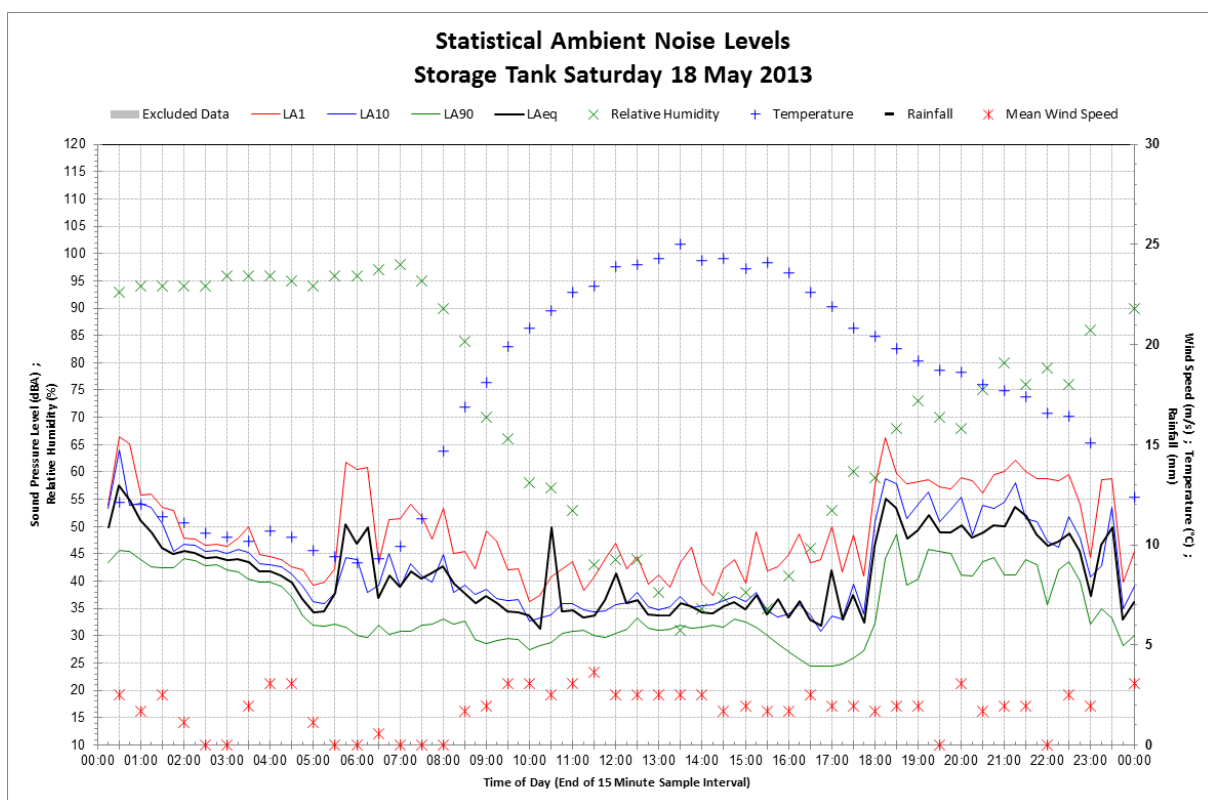
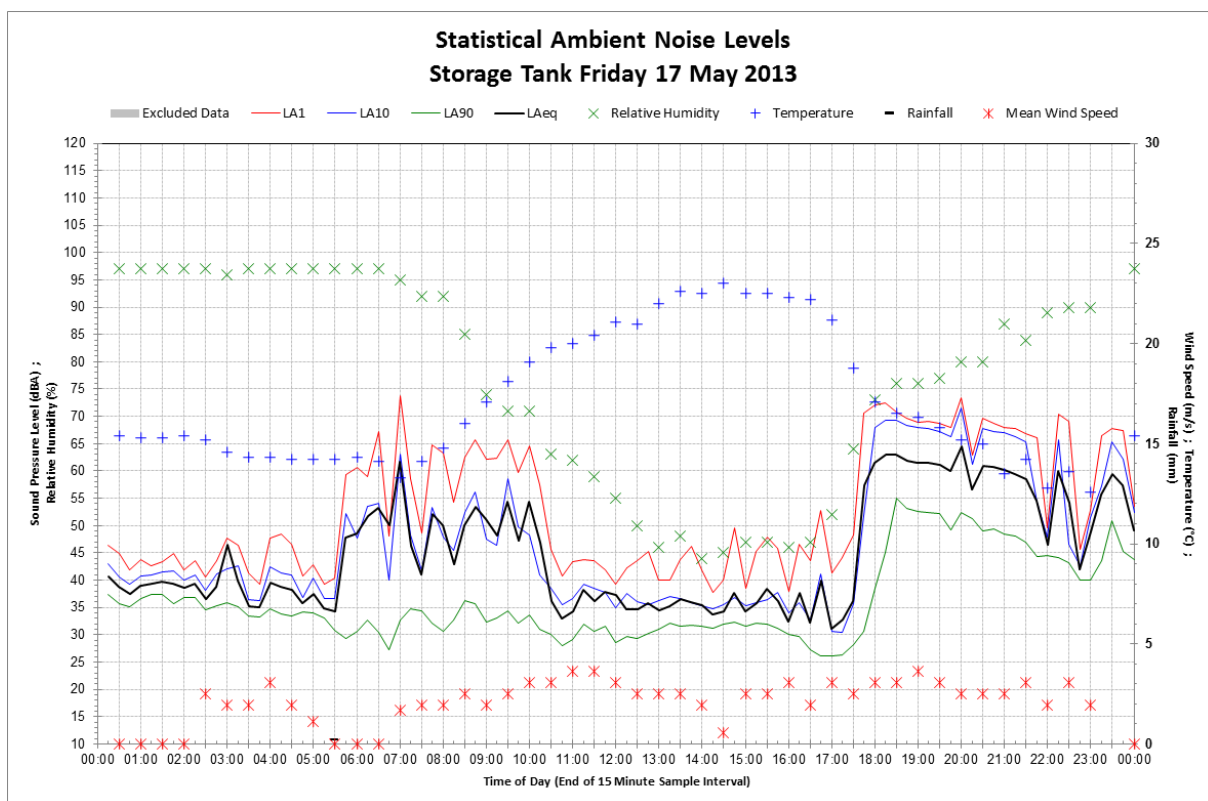


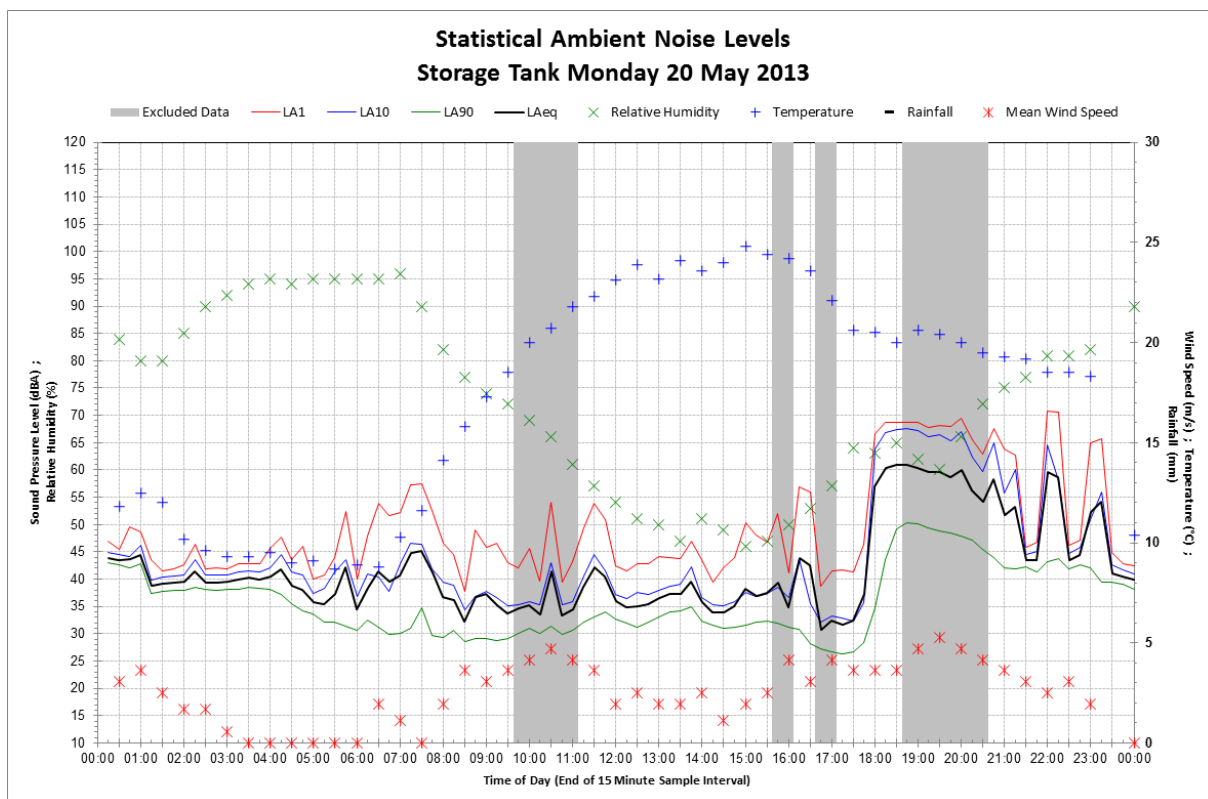
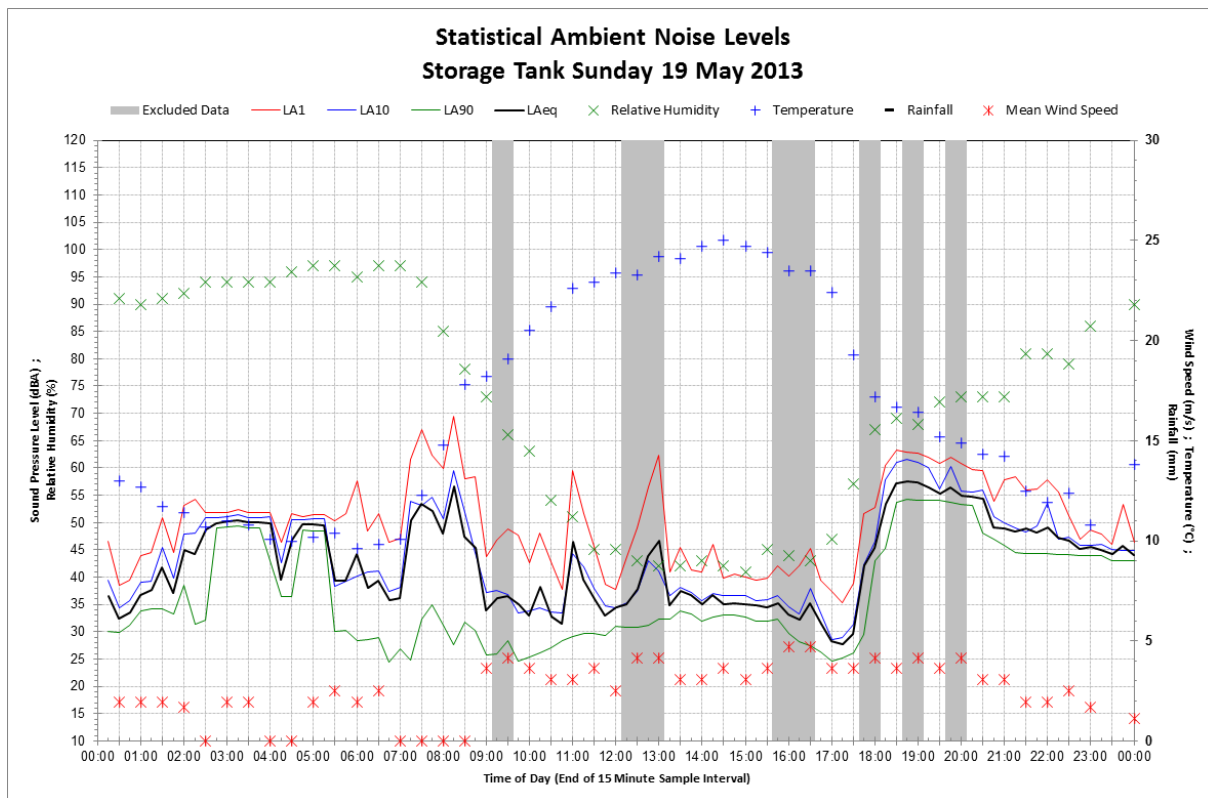


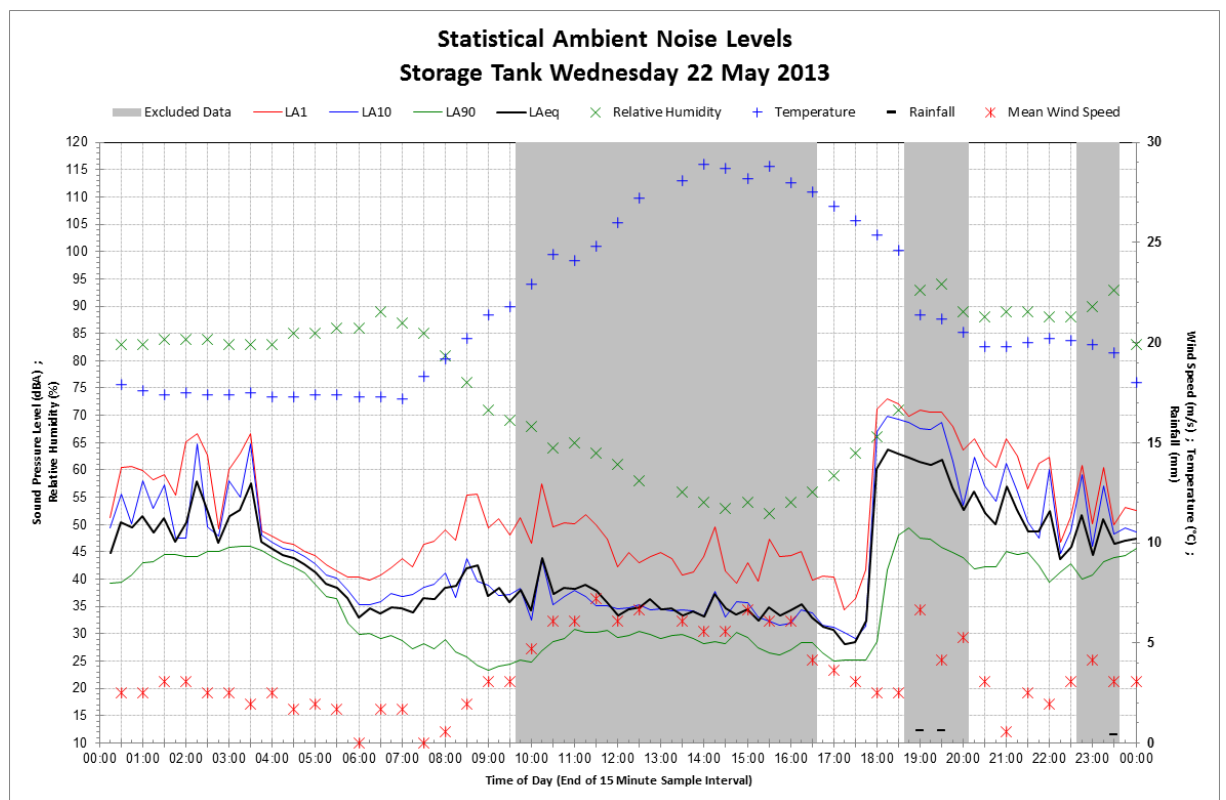
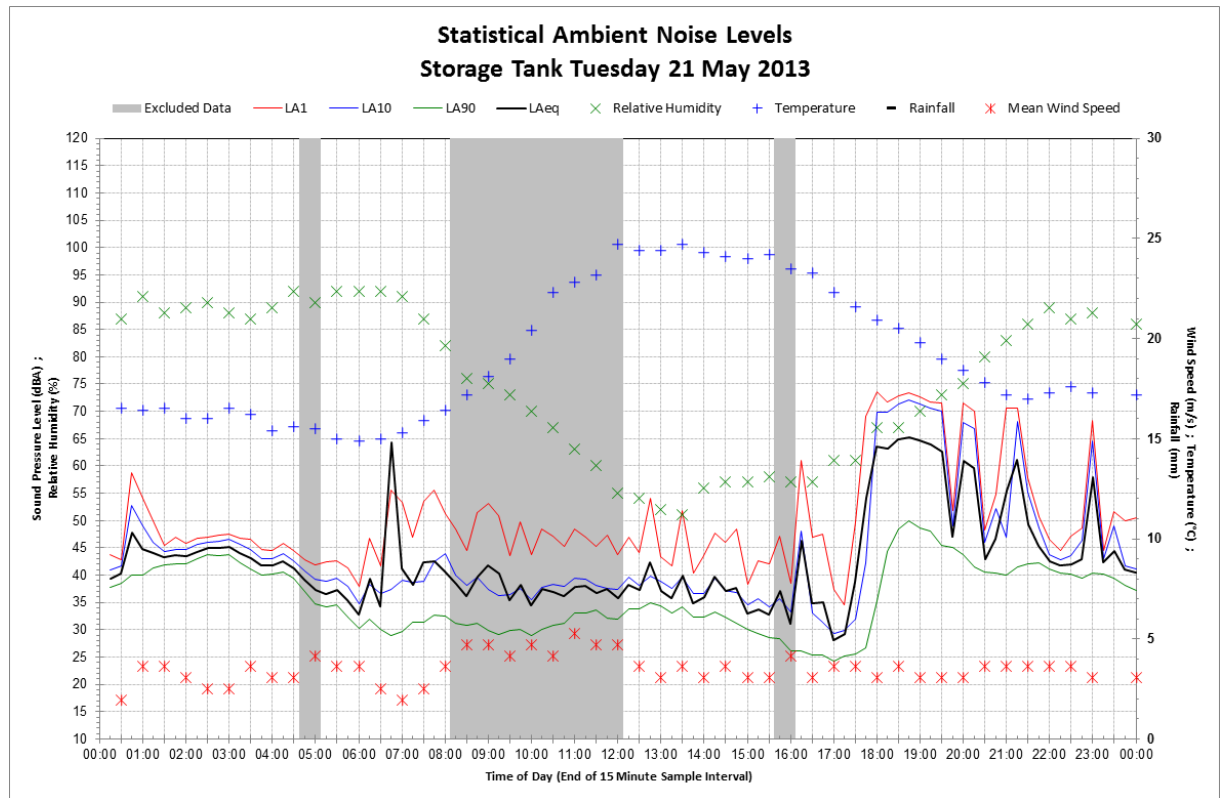


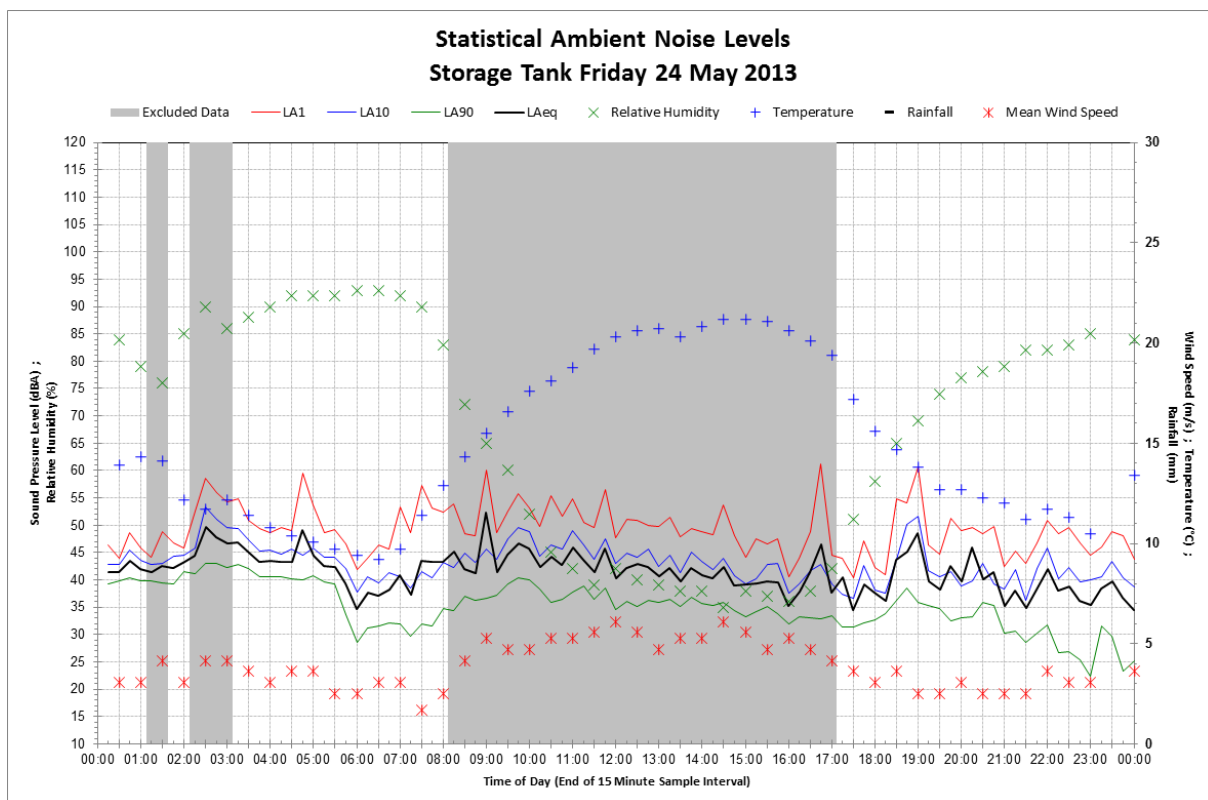
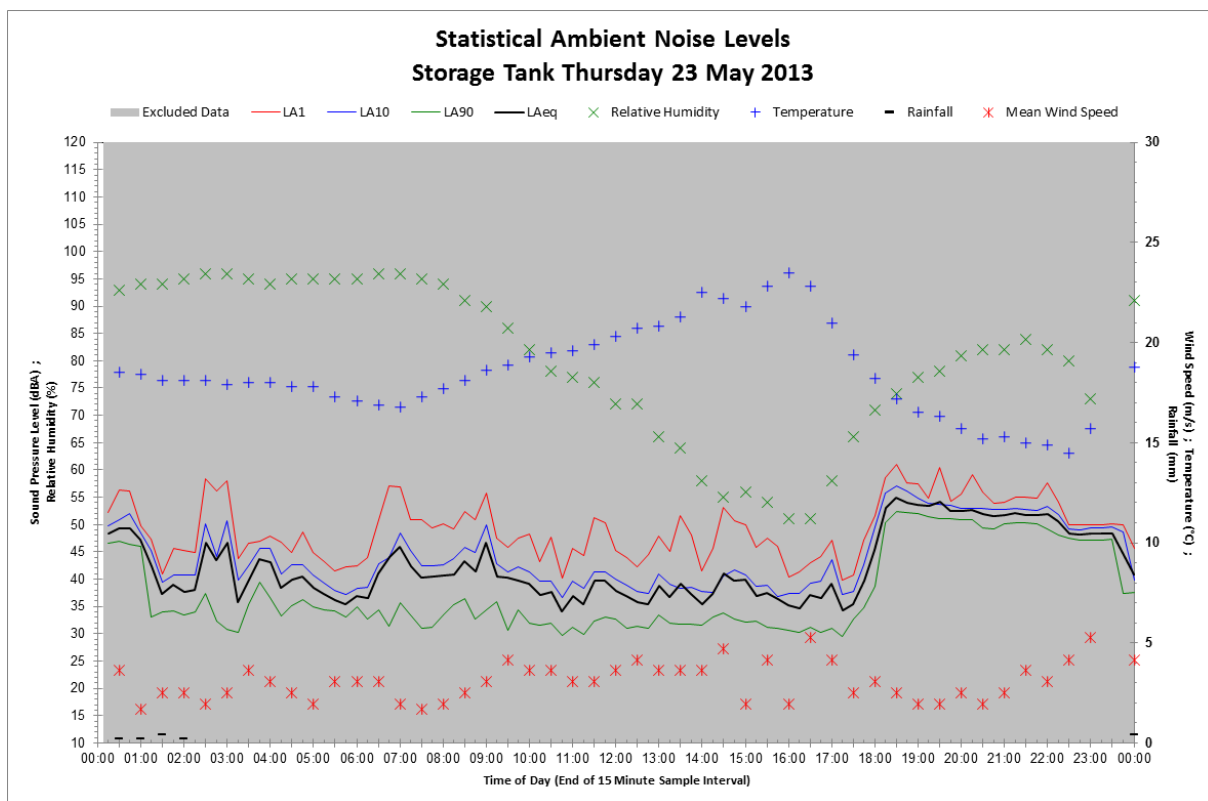


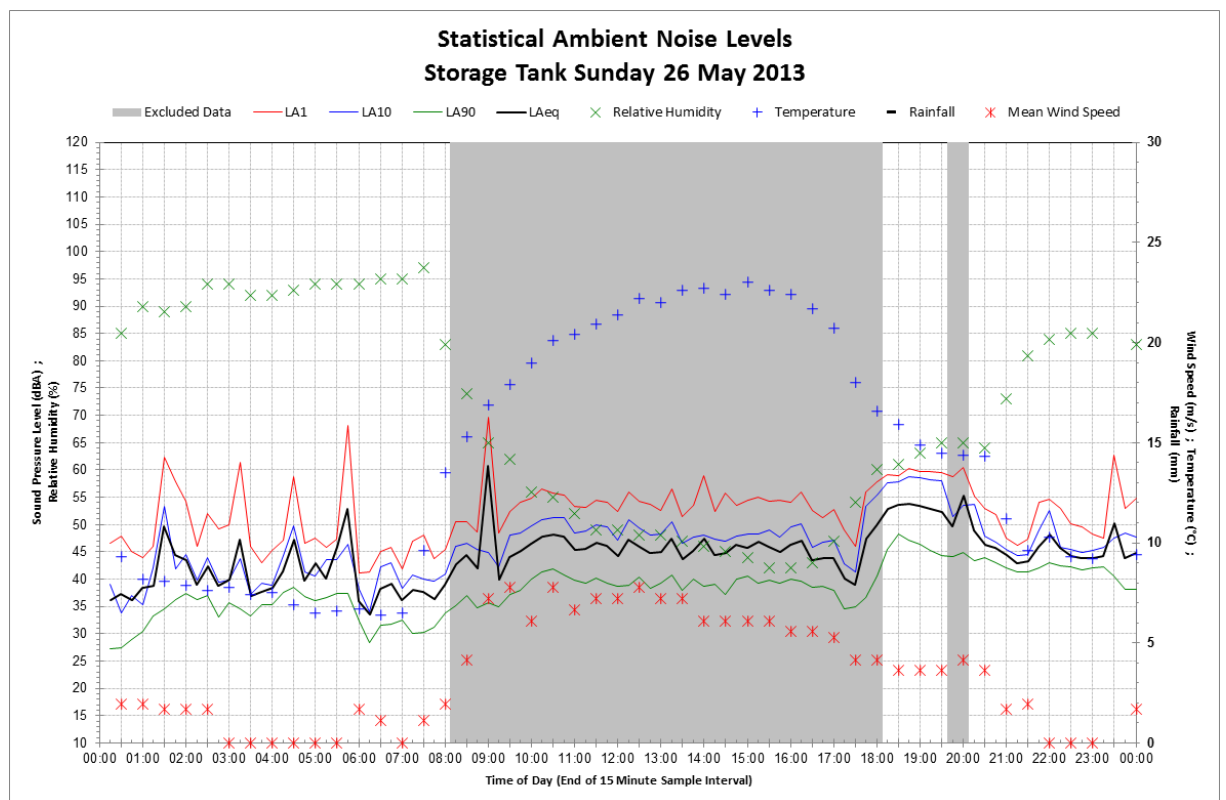
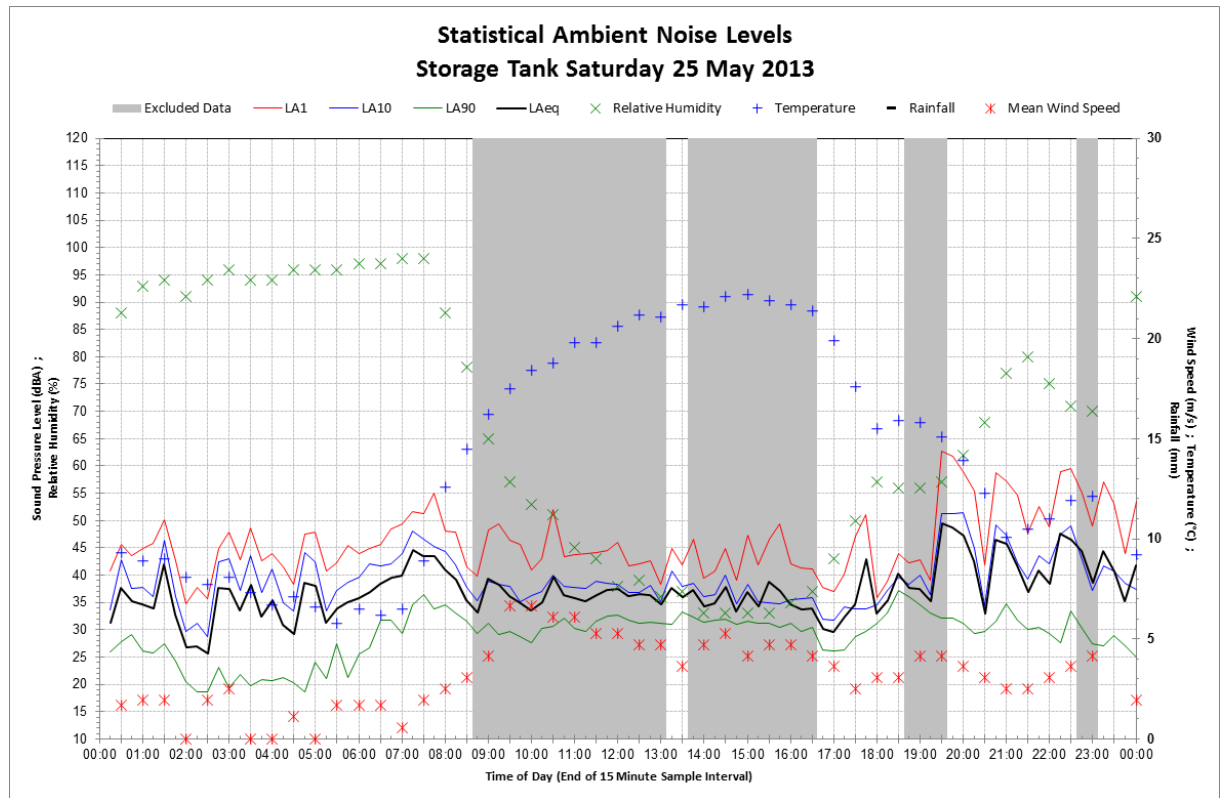


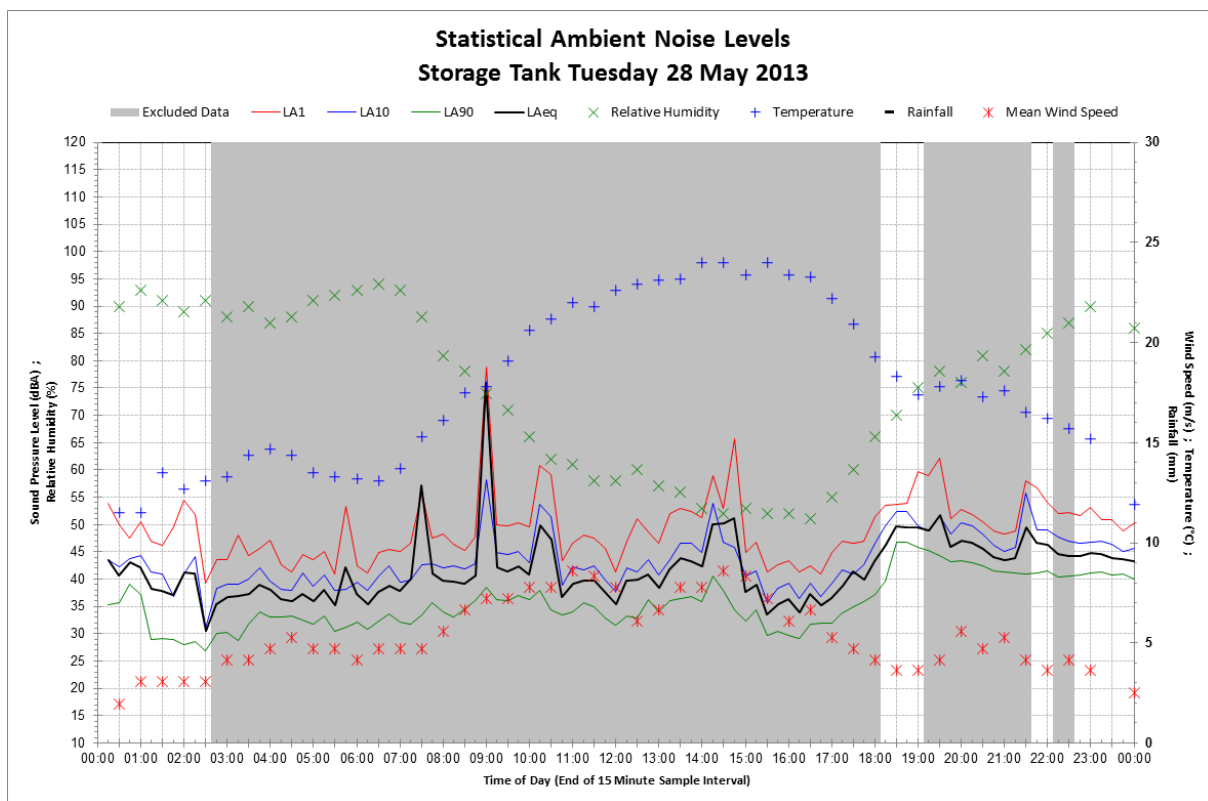
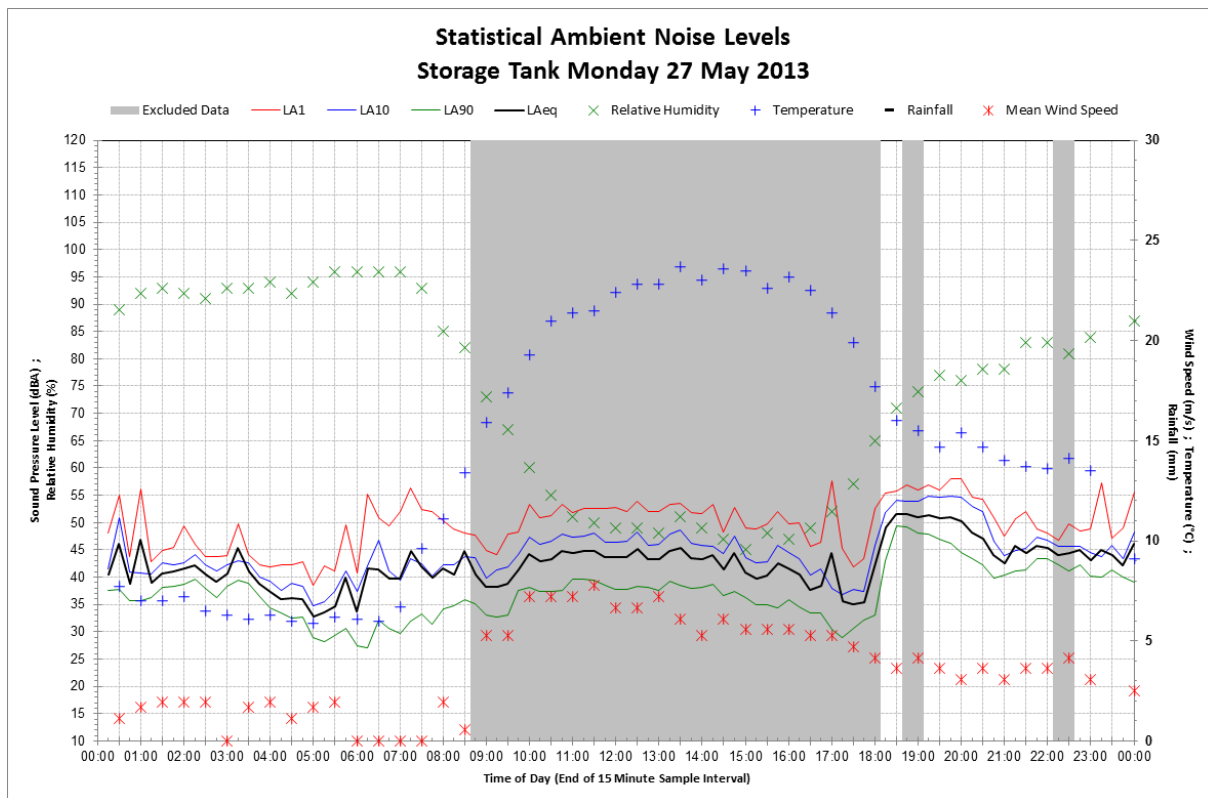


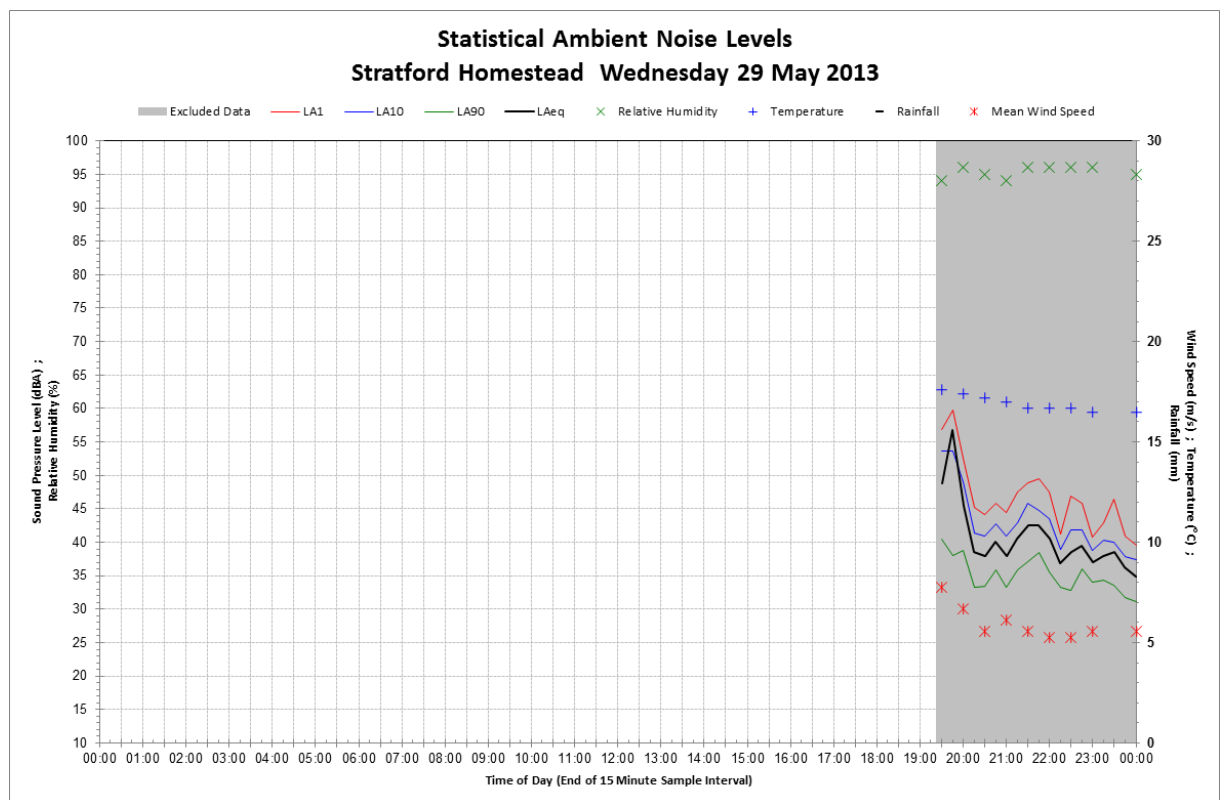
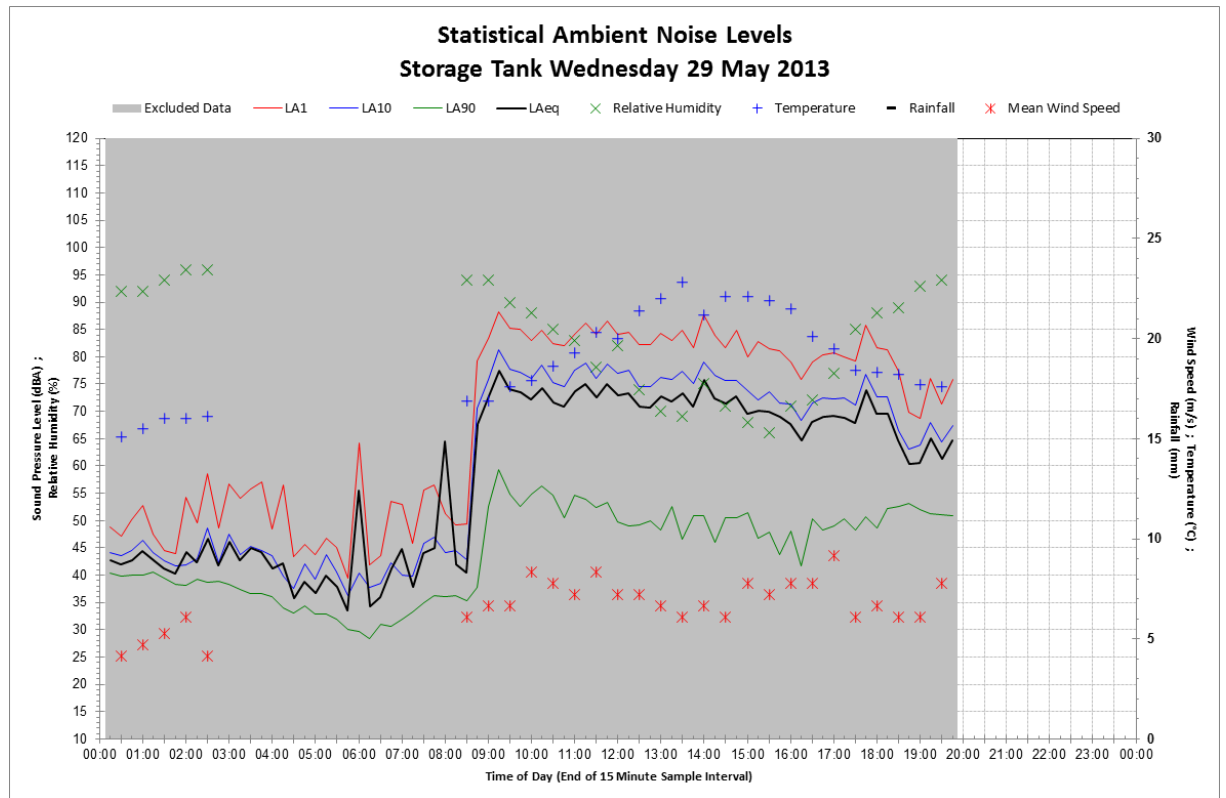


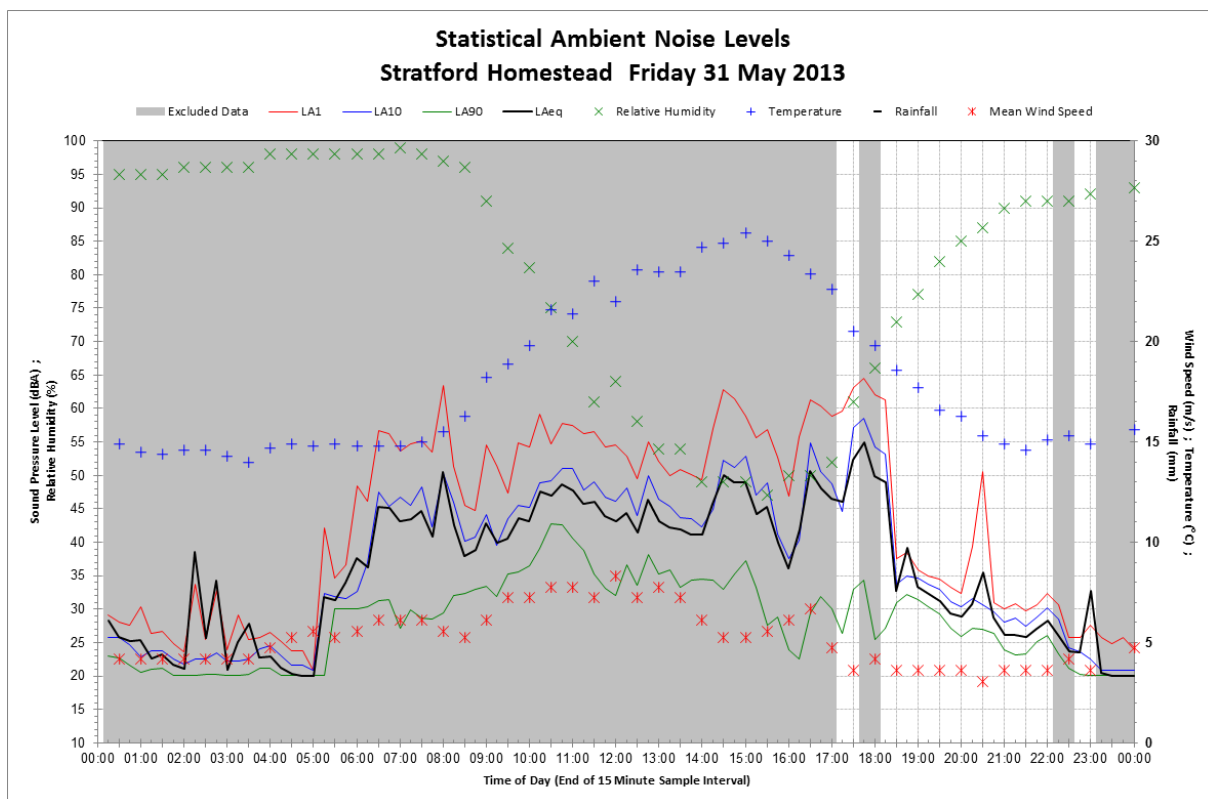
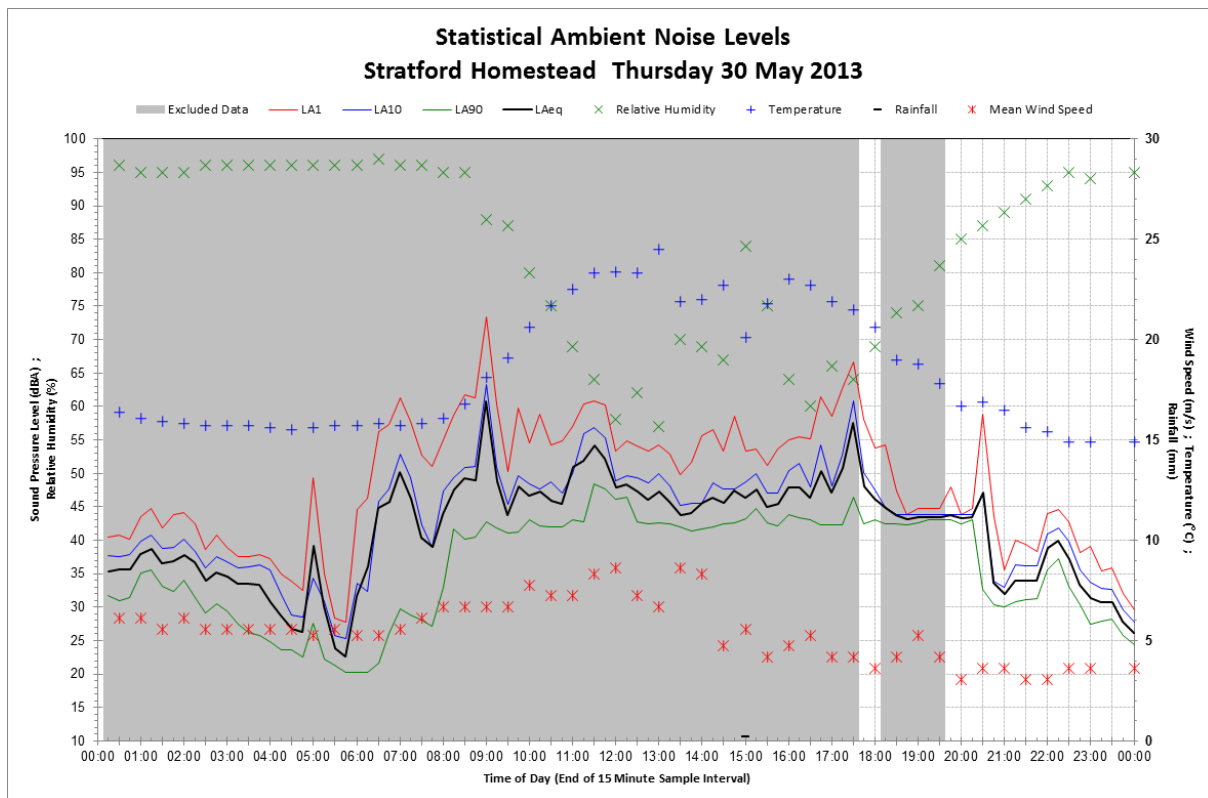


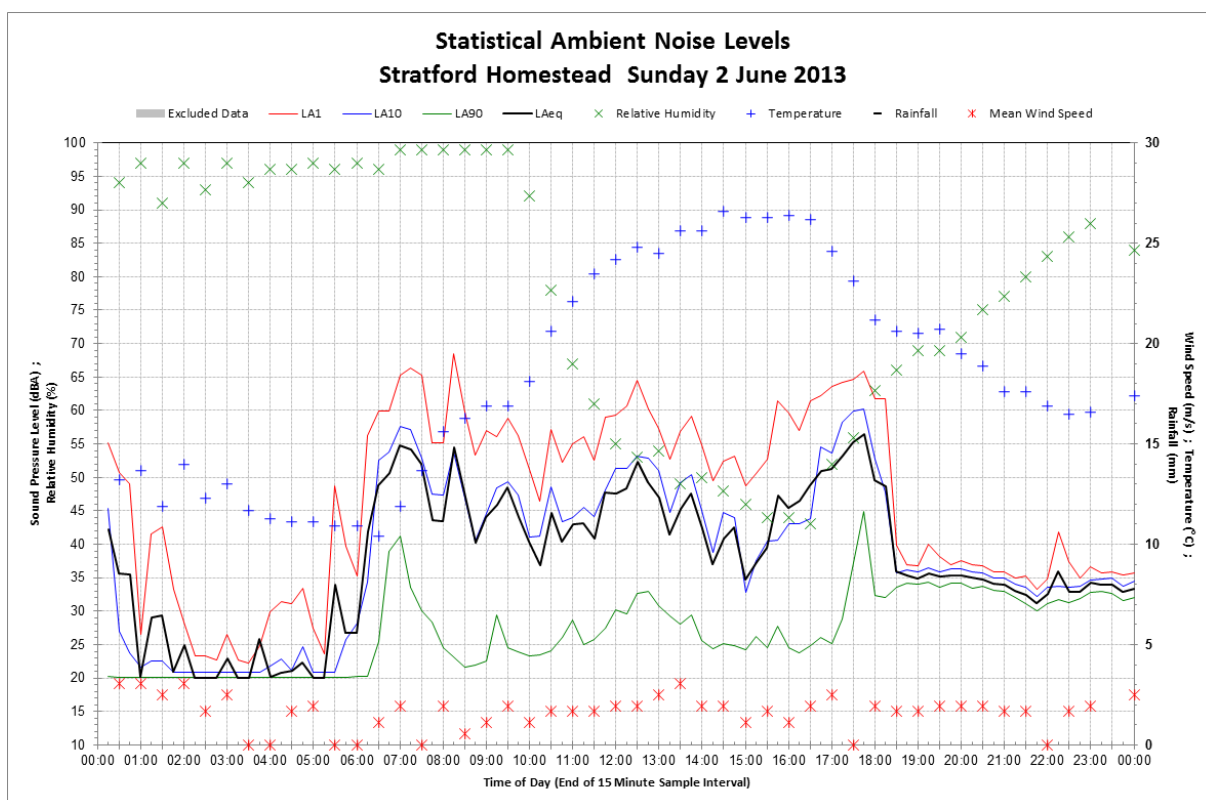
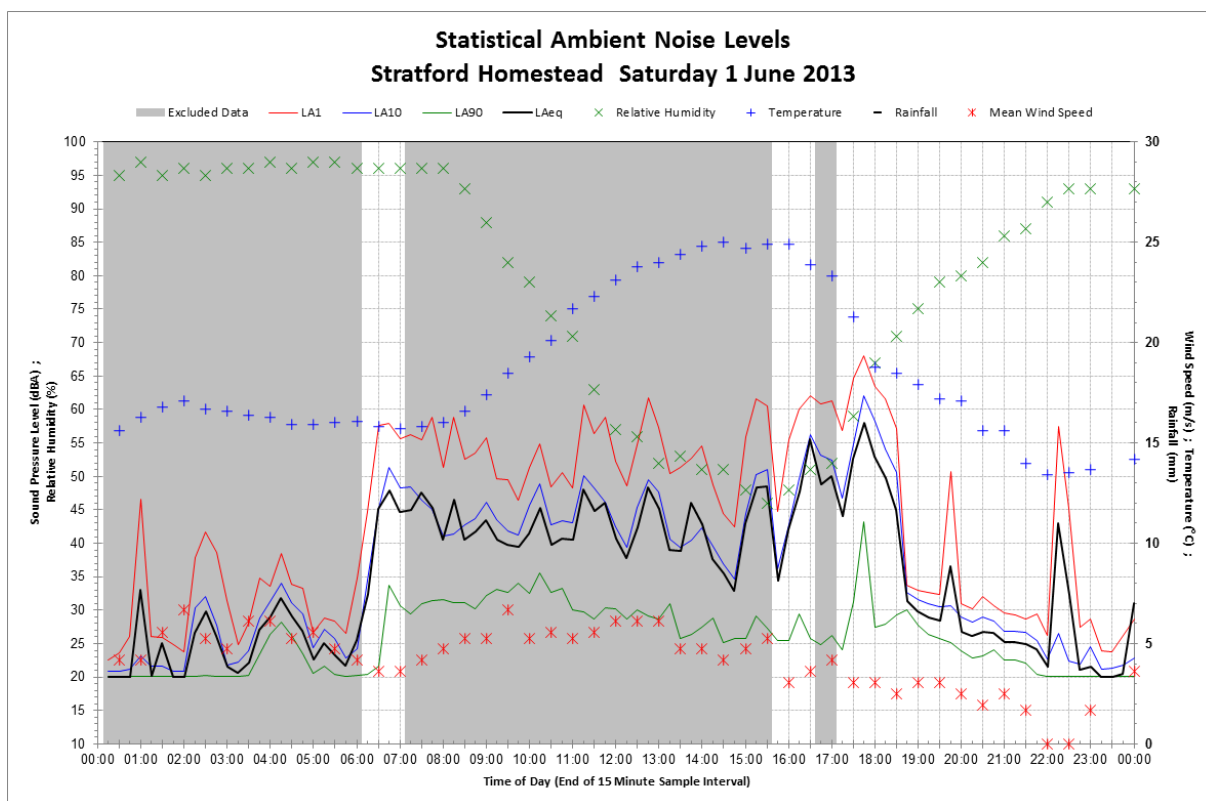


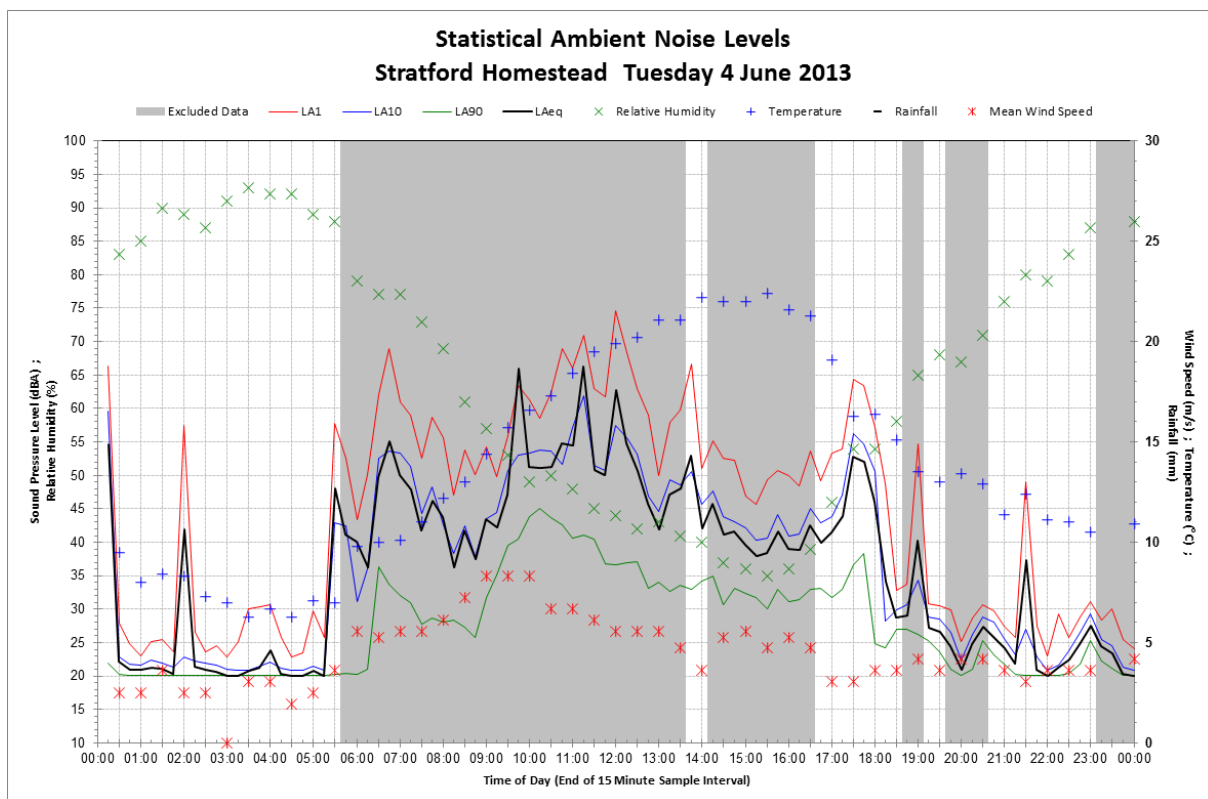
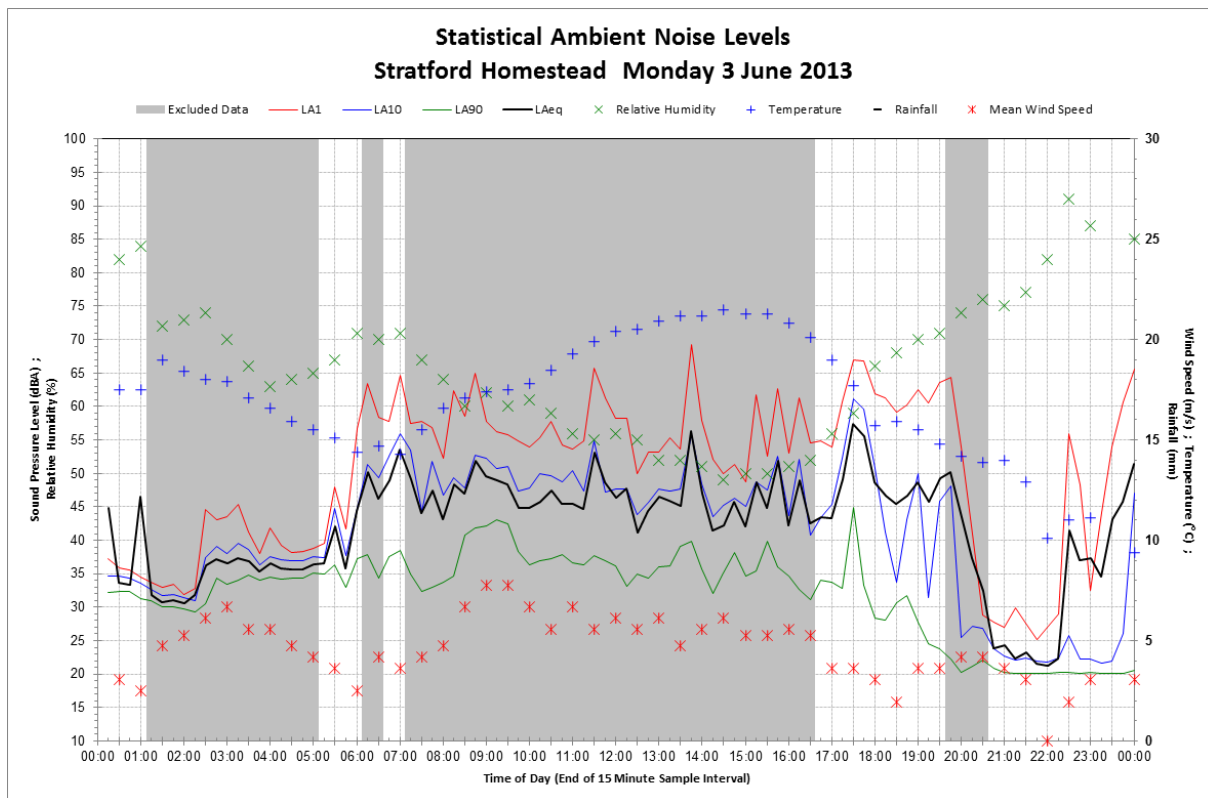


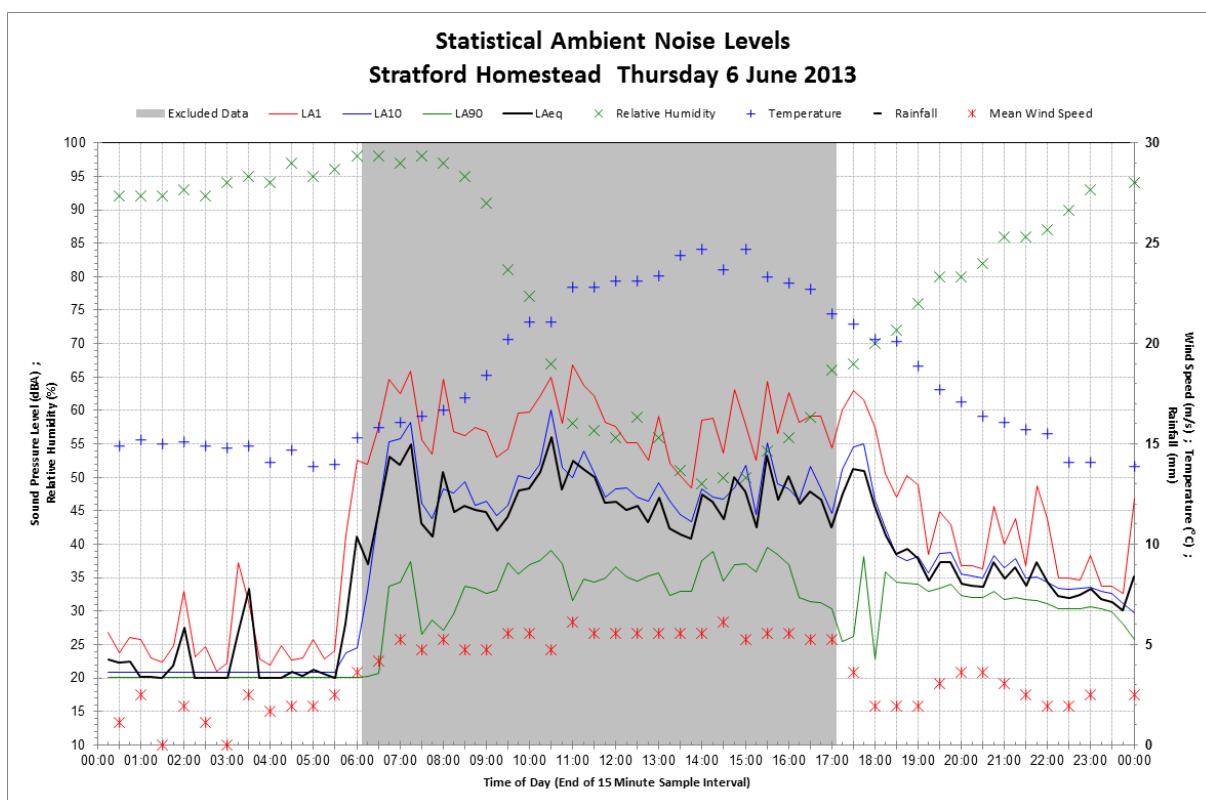
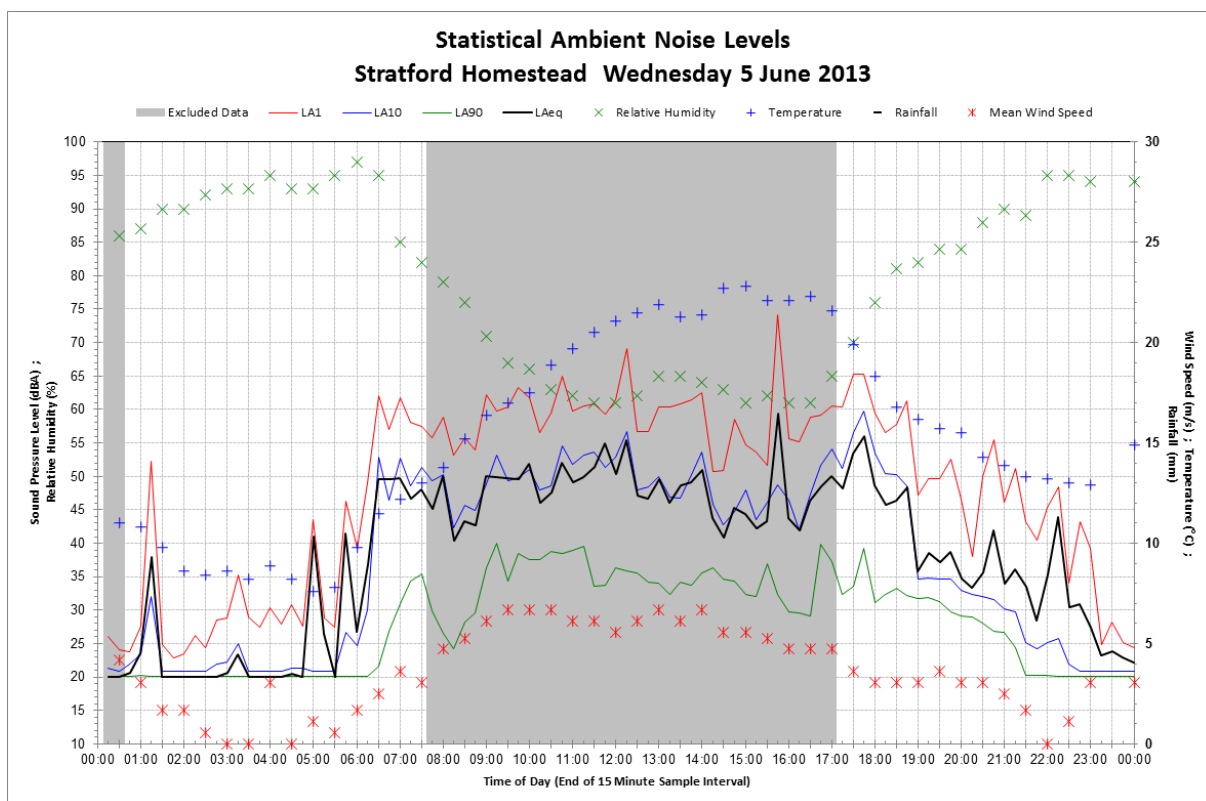


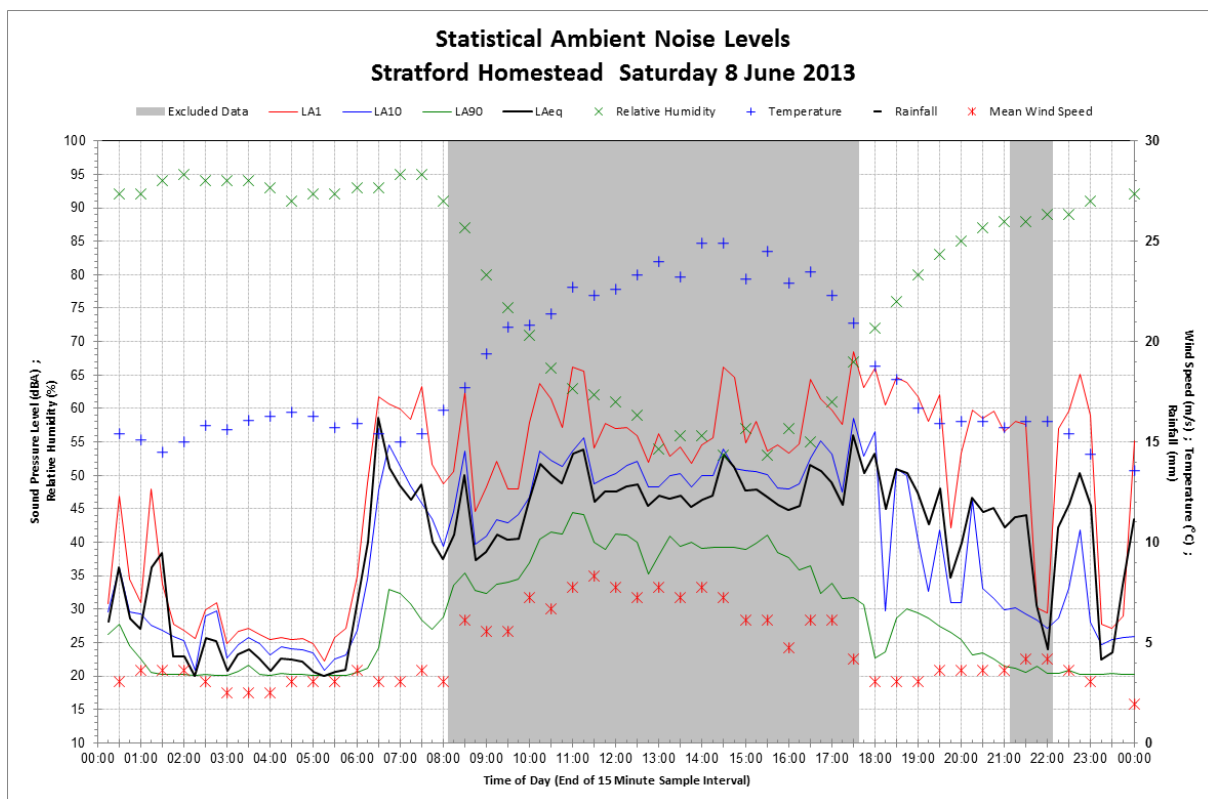
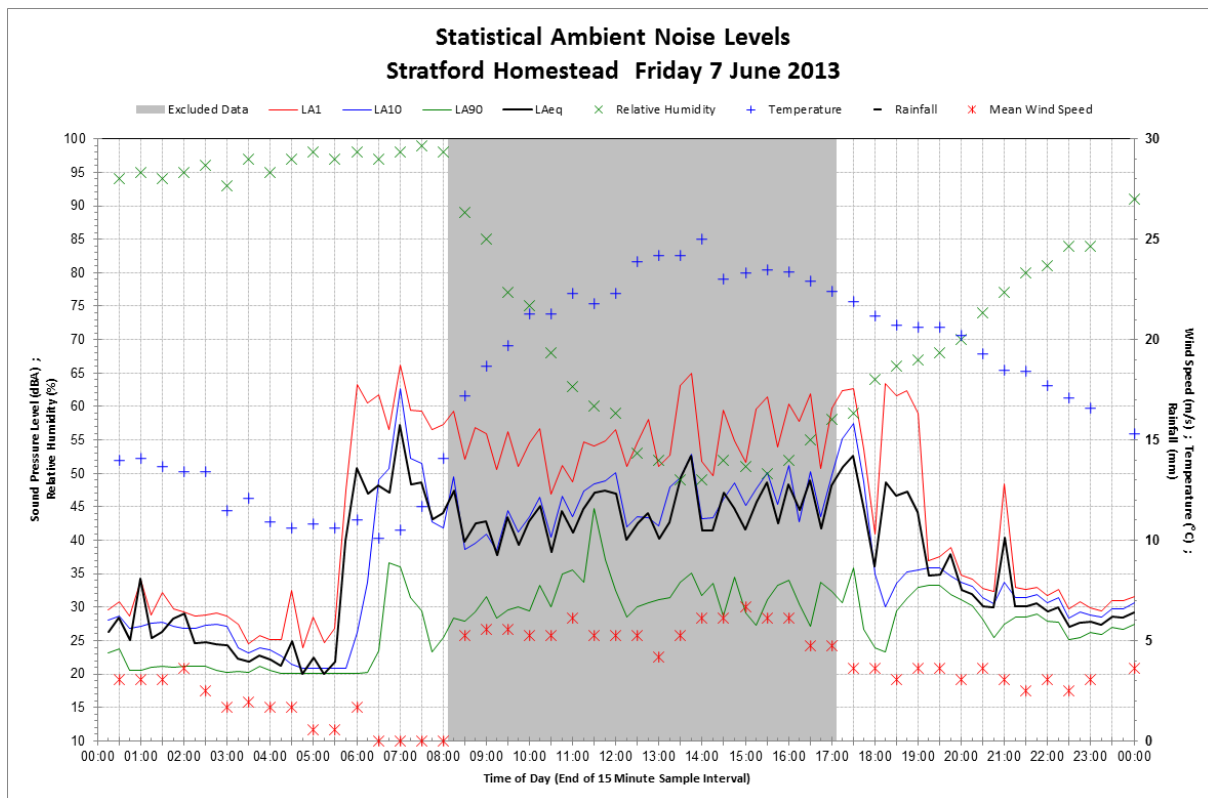


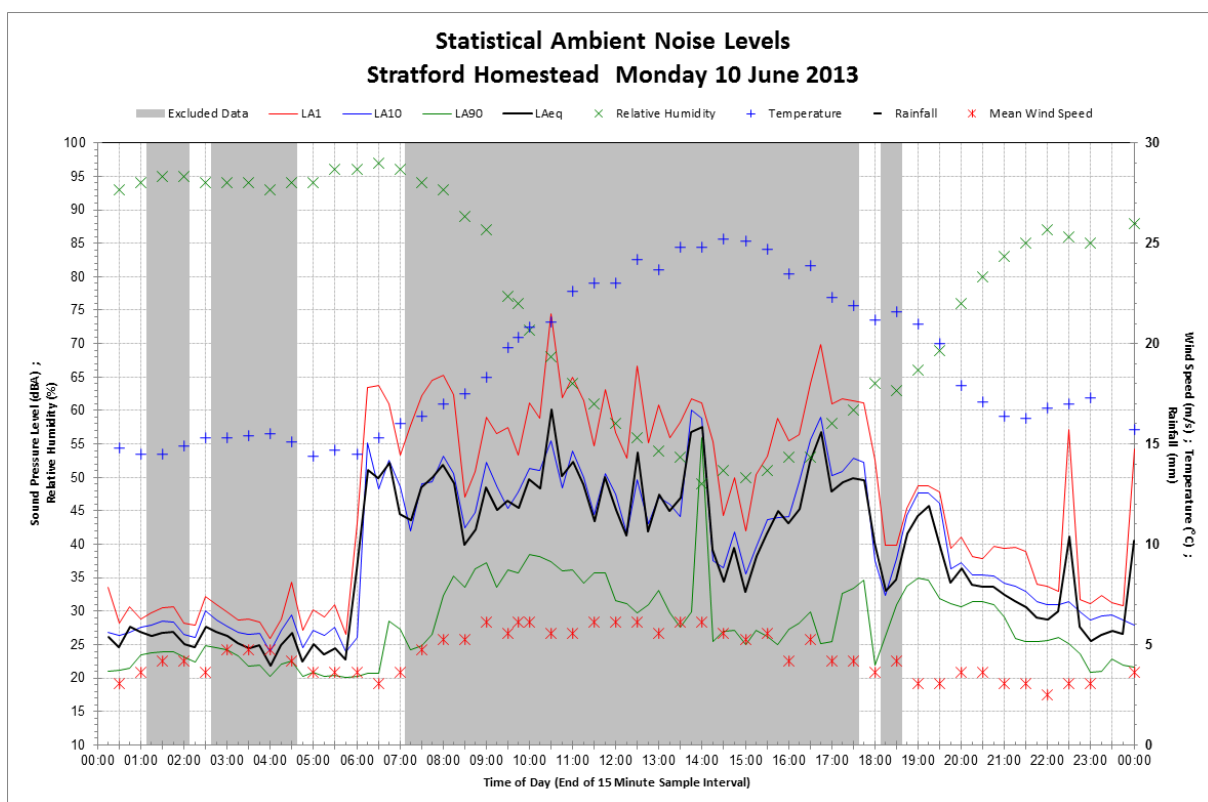
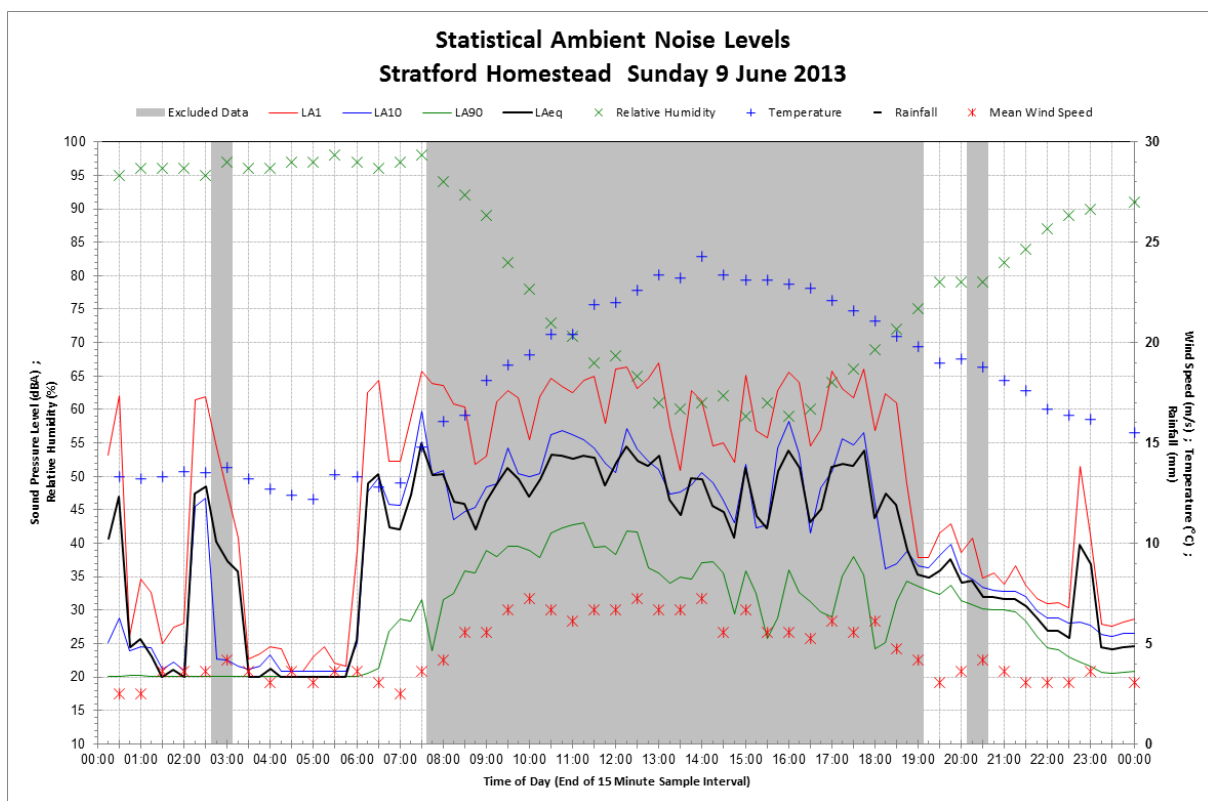


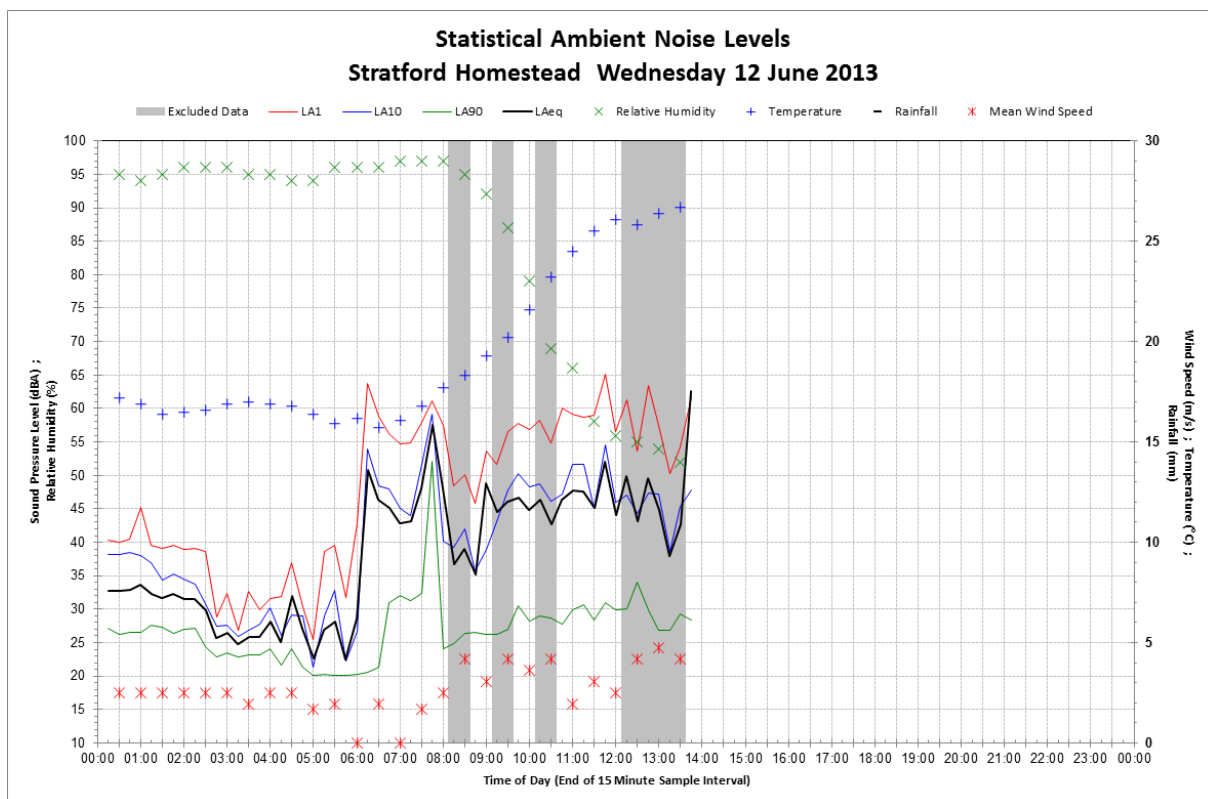
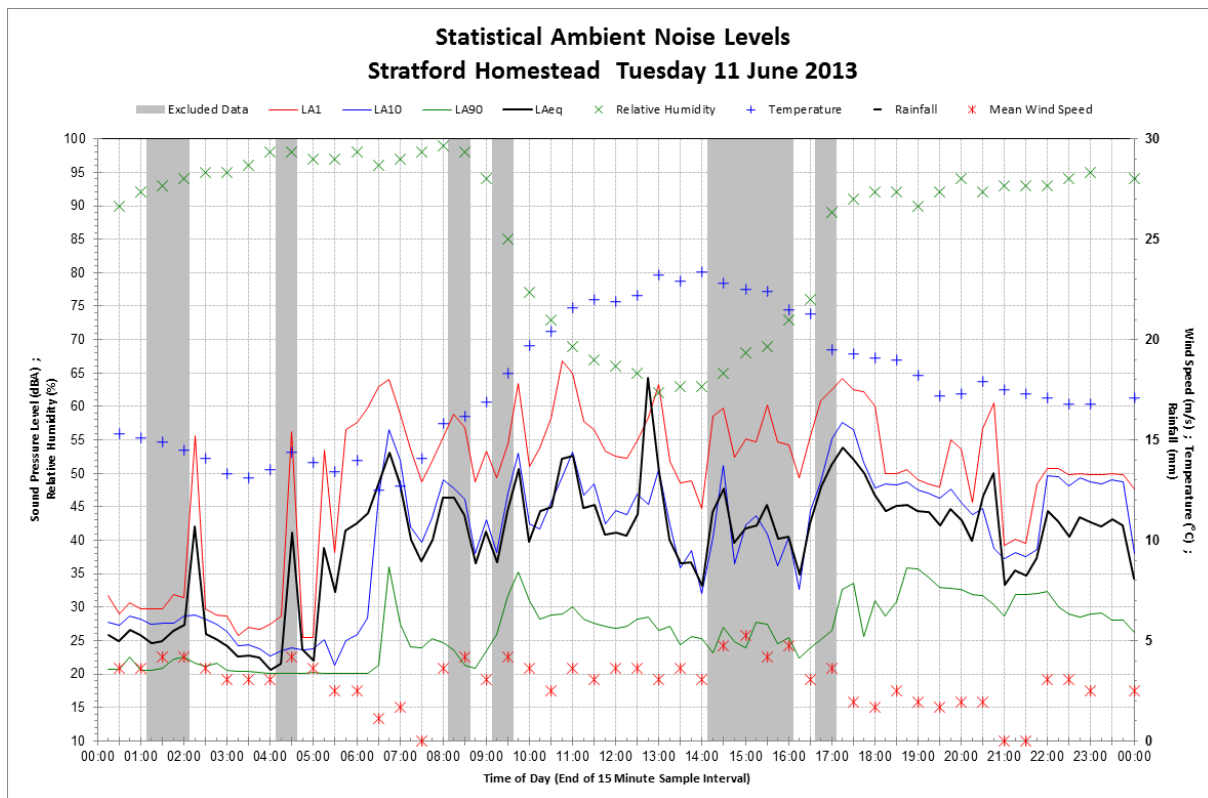




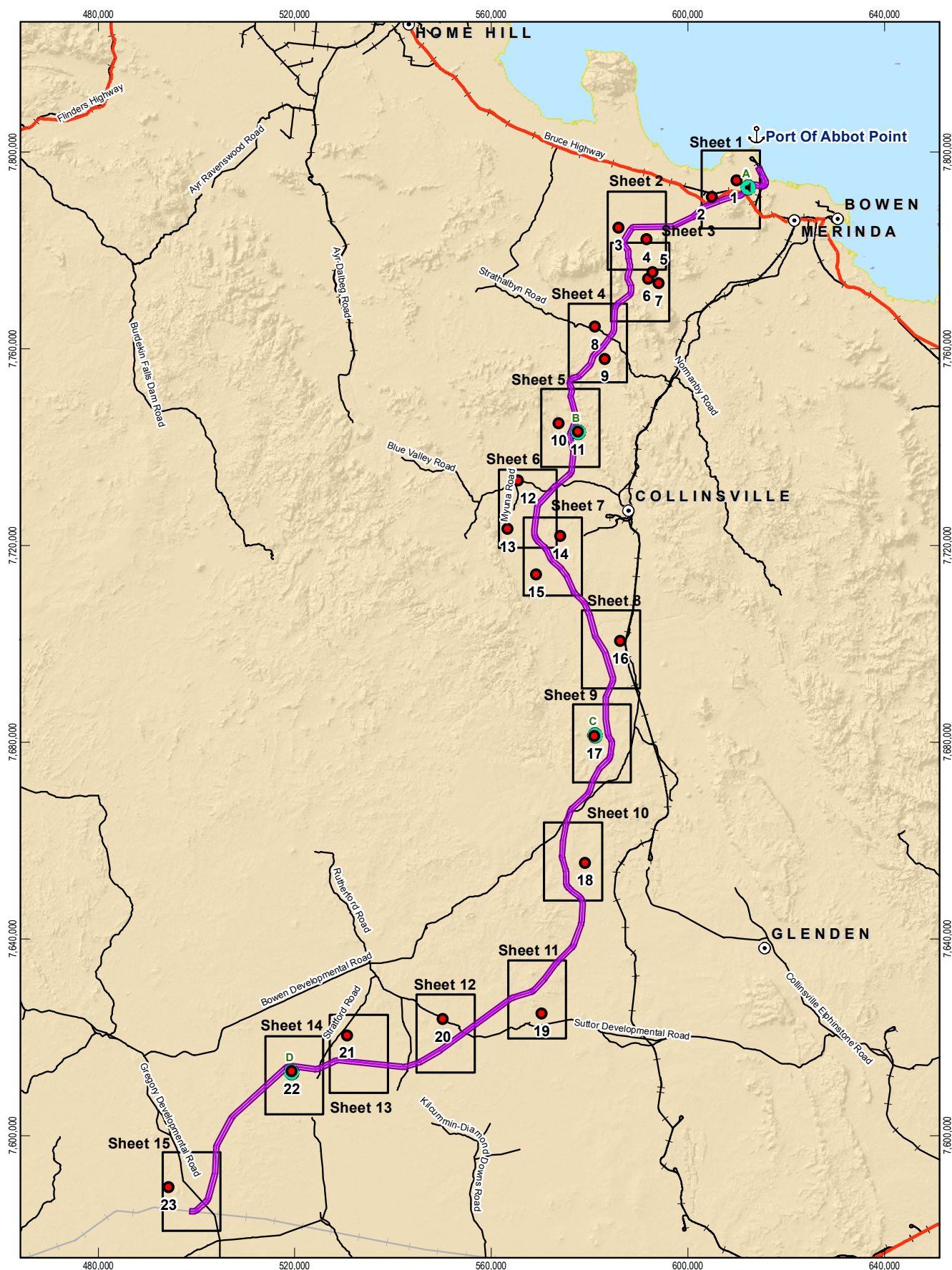








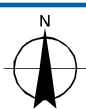
Appendix B – Predicted rail operational noise contours (façade corrected)



LEGEND

- Population Centres
- Monitoring Locations
- ⚓ Major Port
- Sensitive Receptor
- Highway
- Main Road
- Carmichael Project (Rail)
- Railway
- North Galilee Basin Rail 1000m Corridor
- North Galilee Basin Rail 100m Corridor

1:1,100,000 Paper Size A4
 0 10 20 40
 Kilometres
 Map Projection: Transverse Mercator
 Horizontal Datum: GDA 1994
 Grid: GDA 1994 MGA Zone 55



Adani Mining Pty Ltd
 North Galilee Basin Rail Project
 Predicted Rail Operational
 Noise Contours (Façade
 Corrected) - Overview

Job Number 41-26457
 Revision B
 Date 28 Aug 2013

Figure B-0

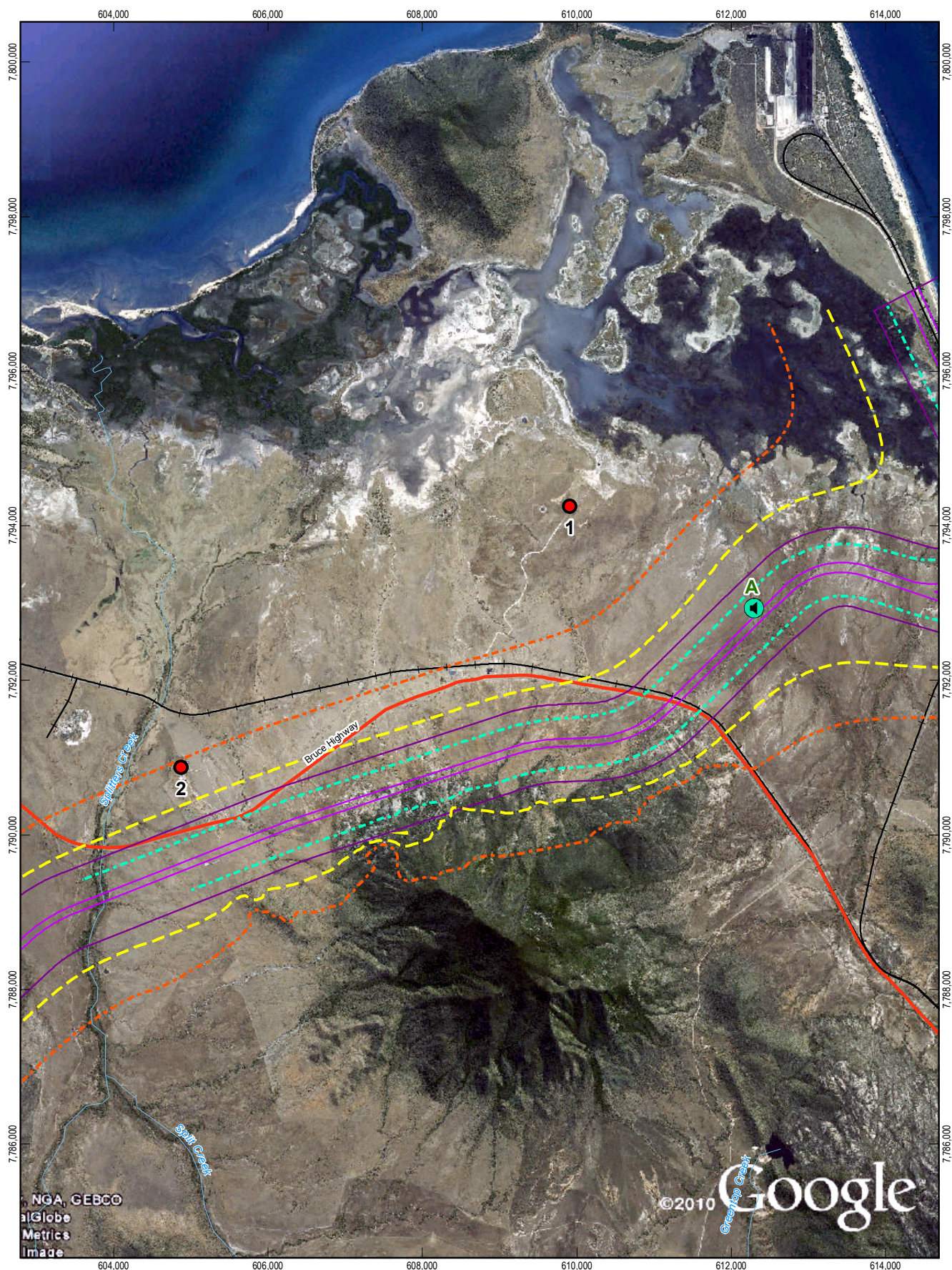
Based on or contains data provided by the State of QLD (DNRM) (2013). In consideration of the State permitting use of this data you acknowledge and agree that the State gives no warranty in relation to the data (including accuracy, reliability, completeness, currency or suitability) and accepts no liability (including without limitation, liability in negligence) for any loss, damage or costs (including consequential damage) relating to any use of the data. Data must not be used for marketing or be used in breach of the privacy laws.

G:\41\26457\06 GIS\Maps\MXD\0900_Noise_Vibration\41_26457_0903_rev_b.mxd

145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

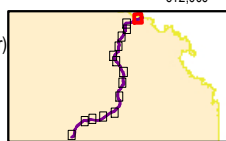
© 2013. Whilst every care has been taken to prepare this map, GHD, GA, DNRM, Adani make no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and cannot accept liability and responsibility of any kind (whether in contract, tort or otherwise) for any expenses, losses, damages and/or costs (including indirect or consequential damage) which are or may be incurred by any party as a result of the map being inaccurate, incomplete or unsuitable in any way and for any reason.

Data source: GA: Populated Places, Railway, Watercourse, Lakes/2007; Adani: NGBR Corridor 06/06/2013, NGBR Corridor 13/05/2013, Carmichael Project Rail/2013; DNRM: Roads/2010; GHD/Adani: Potential Sensitive Receptors/2013; GHD: Monitoring Locations/2013.



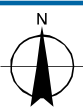
LEGEND

- Sensitive Receptor
- Monitoring Location
- Highway
- - - LAeq9hr(night): 55 dB (A)
- - - LAeq15hr(day): 60 dB (A)
- LAmax: 80 dB (A)
- - - North Galilee Basin Rail 1000m Corridor
- - - North Galilee Basin Rail 100m Corridor
- Watercourse (Minor)



Based on or contains data provided by the State of QLD (DNRM) [2013]. In consideration of the State permitting use of this data you acknowledge and agree that the State gives no warranty in relation to the data (including accuracy, reliability, completeness, currency or suitability) and accepts no liability (including without limitation, liability in negligence) for any loss, damage or costs (including consequential damage) relating to any use of the data. Data must not be used for marketing or be used in breach of the privacy laws.

1:70,000
0 0.5 1 2
Kilometres
Paper Size A4
Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55



adani

Adani Mining Pty Ltd
North Galilee Basin Rail Project
Predicted Rail Operational
Noise Contours (Facade
Corrected)

Job Number 41-26457
Revision C
Date 28 Aug 2013

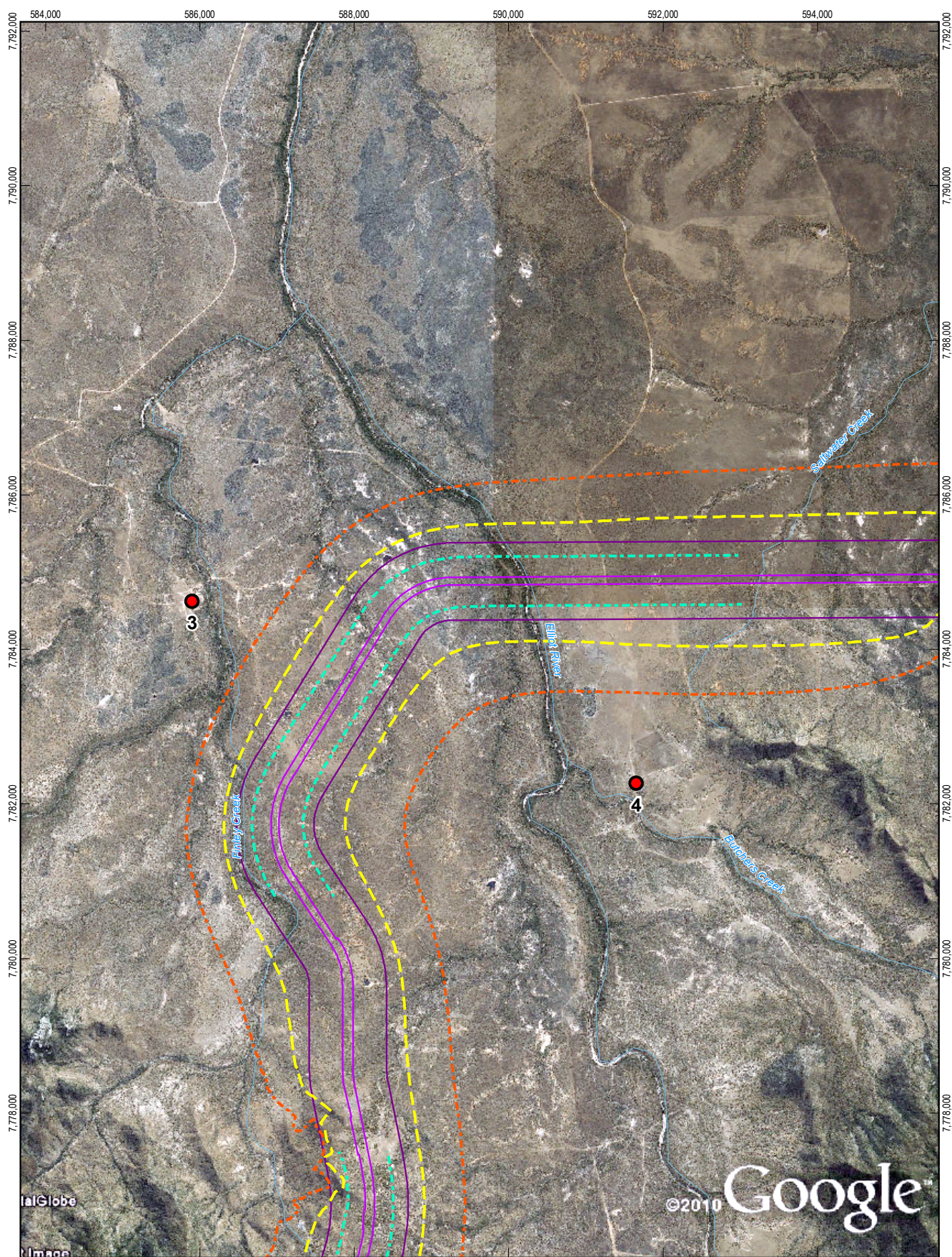
Figure B-1

G:\4126457\06 GIS\Maps\MXD\0900_Noise_Vibration\41_26457_0902_rev_c.mxd

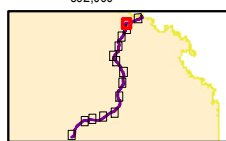
145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

© 2013. Whilst every care has been taken to prepare this map, GHD, GA, DNRM, GE, DigitalGlobe/Cnes/Spot Image, Adani make no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and cannot accept liability and responsibility of any kind (whether in contract, tort or otherwise) for any expenses, losses, damages and/or costs (including indirect or consequential damage) which are or may be incurred by any party as a result of the map being inaccurate, incomplete or unsuitable in any way and for any reason.

Data source: GA: Populated Places, Railway, Watercourse, Lakes/2007; Adani: NGBR Corridor 06/06/2013, NGBR Corridor 13/05/2013, Camichael Project Rail/2013; DNRM: Roads/2010; GHD/Adani: Potential Sensitive Receptors/2013; GHD: Monitoring Location/2013, Noise Contours/2013, DigitalGlobe/Cnes/Spot Image: Google Imagery Extracted 15/07/2013.

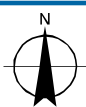


- LEGEND**
- Sensitive Receptor
 - LAeq9hr(night): 55 dB (A)
 - LAeq15hr(day): 60 dB (A)
 - LAmass: 80 dB (A)
 - North Galilee Basin Rail 1000m Corridor
 - North Galilee Basin Rail 100m Corridor
 - Watercourse (Minor)



Based on or contains data provided by the State of QLD (DNRM) [2013]. In consideration of the State permitting use of this data you acknowledge and agree that the State gives no warranty in relation to the data (including accuracy, reliability, completeness, currency or suitability) and accepts no liability (including without limitation, liability in negligence) for any loss, damage or costs (including consequential damage) relating to any use of the data. Data must not be used for marketing or be used in breach of the privacy laws.

1:70,000
Paper Size A4
0 0.5 1 2
Kilometres
Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55



adani

Adani Mining Pty Ltd
North Galilee Basin Rail Project
Predicted Rail Operational
Noise Contours (Facade
Corrected)

Job Number 41-26457
Revision C
Date 28 Aug 2013

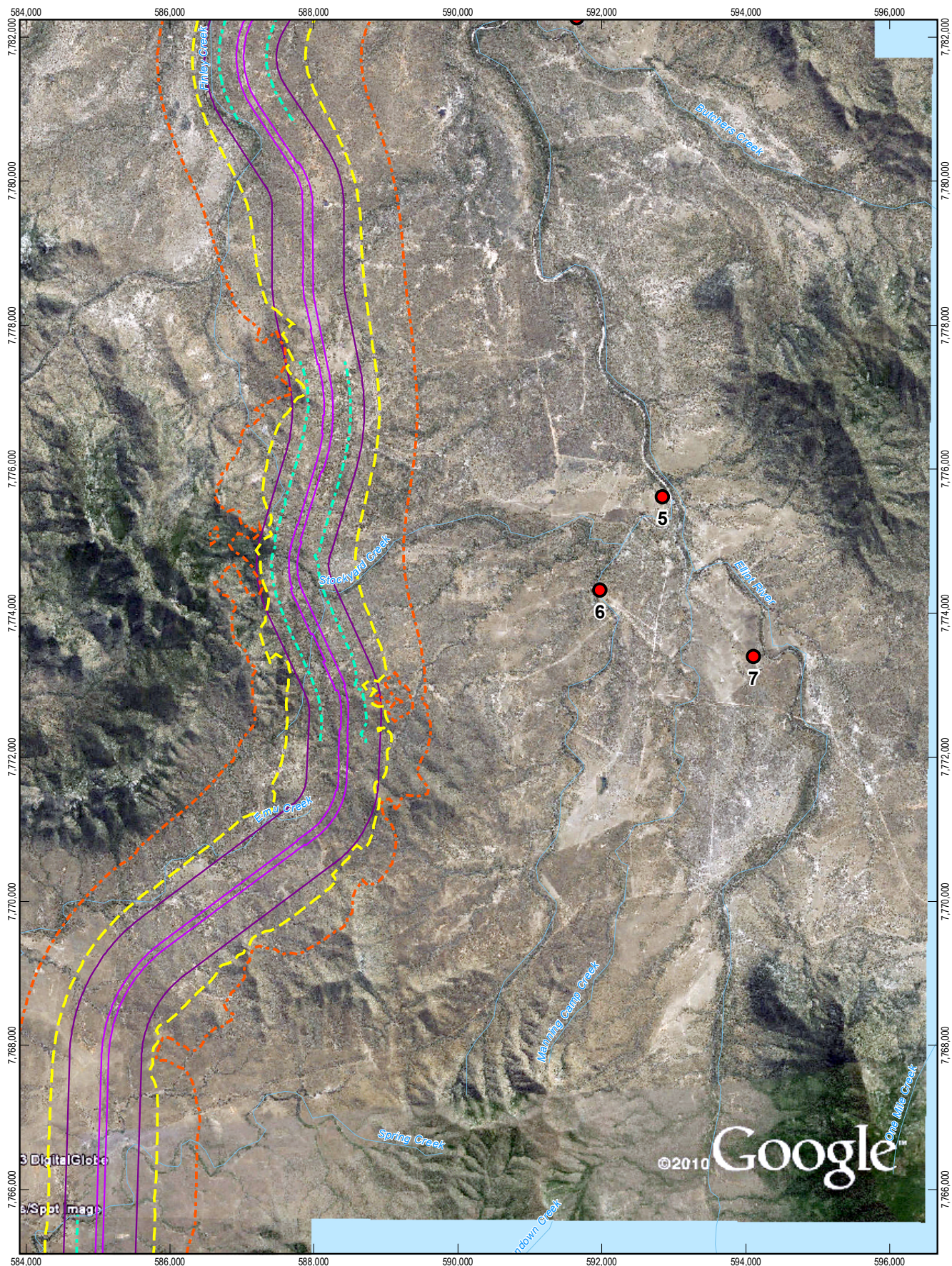
Figure B-2

G:\41\26457\06 GIS\Maps\MXD\0900_Noise_Vibration\41_26457_0902_rev_c.mxd

145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

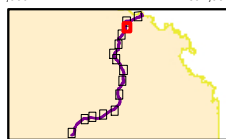
© 2013. Whilst every care has been taken to prepare this map, GHD, GA, DNRM, GE, DigitalGlobe/Cnes/Spot Image, Adani make no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and cannot accept liability and responsibility of any kind (whether in contract, tort or otherwise) for any expenses, losses, damages and/or costs (including indirect or consequential damage) which are or may be incurred by any party as a result of the map being inaccurate, incomplete or unsuitable in any way and for any reason.

Data source: GA: Populated Places, Railway, Watercourse, Lakes/2007; Adani: NGBR Corridor 06/06/2013, NGBR Corridor 13/05/2013, Camichael Project Rail/2013; DNRM: Roads/2010; GHD/Adani: Potential Sensitive Receptors/2013; GHD: Monitoring Location/2013, Noise Contours/2013, DigitalGlobe/Cnes/Spot Image: Google Imagery Extracted 15/07/2013.



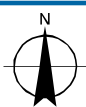
LEGEND

- Sensitive Receptor
- - - LAeq9hr(night): 55 dB (A)
- - - LAeq15hr(day): 60 dB (A)
- - - Lmax: 80 dB (A)
- North Galilee Basin Rail 1000m Corridor
- North Galilee Basin Rail 100m Corridor
- Watercourse (Minor)



Based on or contains data provided by the State of QLD (DNRM) (2013). In consideration of the State permitting use of this data you acknowledge and agree that the State gives no warranty in relation to the data (including accuracy, reliability, completeness, currency or suitability) and accepts no liability (including without limitation, liability in negligence) for any loss, damage or costs (including consequential damage) relating to any use of the data. Data must not be used for marketing or be used in breach of the privacy laws.

1:75,000 Paper Size A4
 0 0.5 1 2
 Kilometres
 Map Projection: Transverse Mercator
 Horizontal Datum: GDA 1994
 Grid: GDA 1994 MGA Zone 55



adani

Adani Mining Pty Ltd
 North Galilee Basin Rail Project
 Predicted Rail Operational
 Noise Contours (Facade
 Corrected)

Job Number 41-26457
 Revision C
 Date 28 Aug 2013

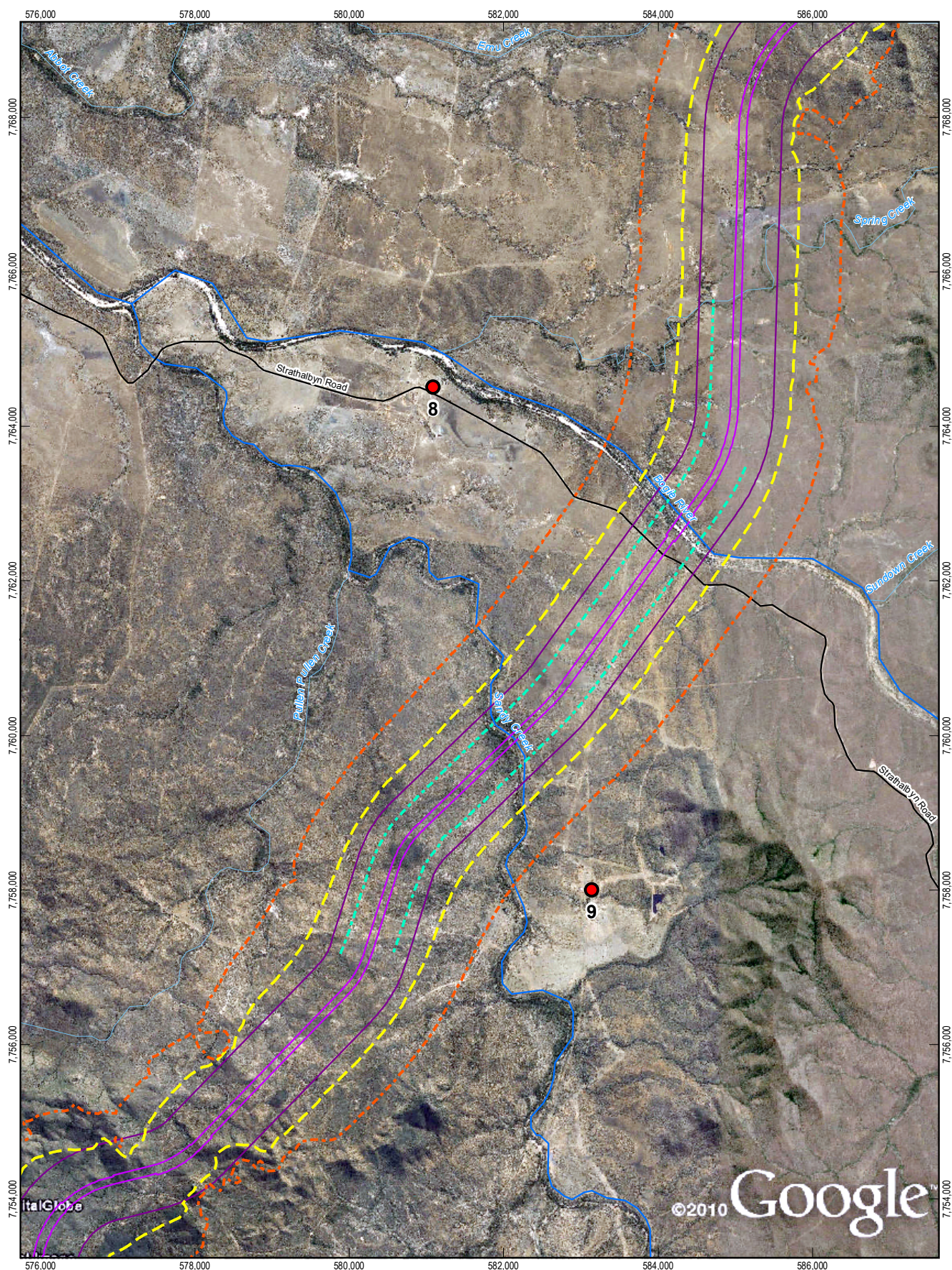
Figure B-3

G:\41\26457\06 GIS\Maps\MXD\0900_Noise_Vibration\41_26457_0902_rev_c.mxd

145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

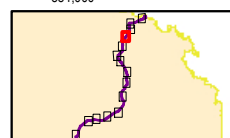
© 2013. Whilst every care has been taken to prepare this map, GHD, GA, DNRM, GE, DigitalGlobe/Cnes/Spot Image, Adani make no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and cannot accept liability and responsibility of any kind (whether in contract, tort or otherwise) for any expenses, losses, damages and/or costs (including indirect or consequential damage) which are or may be incurred by any party as a result of the map being inaccurate, incomplete or unsuitable in any way and for any reason.

Data source: GA: Populated Places, Railway, Watercourse, Lakes/2007; Adani: NGBR Corridor 06/06/2013, NGBR Corridor 13/05/2013, Camichael Project Rail/2013; DNRM: Roads/2010; GHD/Adani: Potential Sensitive Receptors/2013; GHD: Monitoring Location/2013, Noise Contours/2013, DigitalGlobe/Cnes/Spot Image: Google Imagery Extracted 15/07/2013.



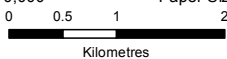
LEGEND

- Sensitive Receptor
- - - LAeq9hr(night): 55 dB (A)
- - - LAeq15hr(day): 60 dB (A)
- - - LAmaz: 80 dB (A)
- North Galilee Basin Rail 1000m Corridor
- North Galilee Basin Rail 100m Corridor
- Main Road
- Watercourse (Major)
- Watercourse (Minor)

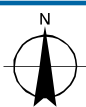


Based on or contains data provided by the State of QLD (DNRM) (2013). In consideration of the State permitting use of this data you acknowledge and agree that the State gives no warranty in relation to the data (including accuracy, reliability, completeness, currency or suitability) and accepts no liability (including without limitation, liability in negligence) for any loss, damage or costs (including consequential damage) relating to any use of the data. Data must not be used for marketing or be used in breach of the privacy laws.

1:70,000 Paper Size A4



Horizontal Datum: GDA 1994
Grid: GCS GDA 1994



adani

Adani Mining Pty Ltd
North Galilee Basin Rail Project
Predicted Rail Operational
Noise Contours (Facade
Corrected)

Job Number 41-26457
Revision C
Date 28 Aug 2013

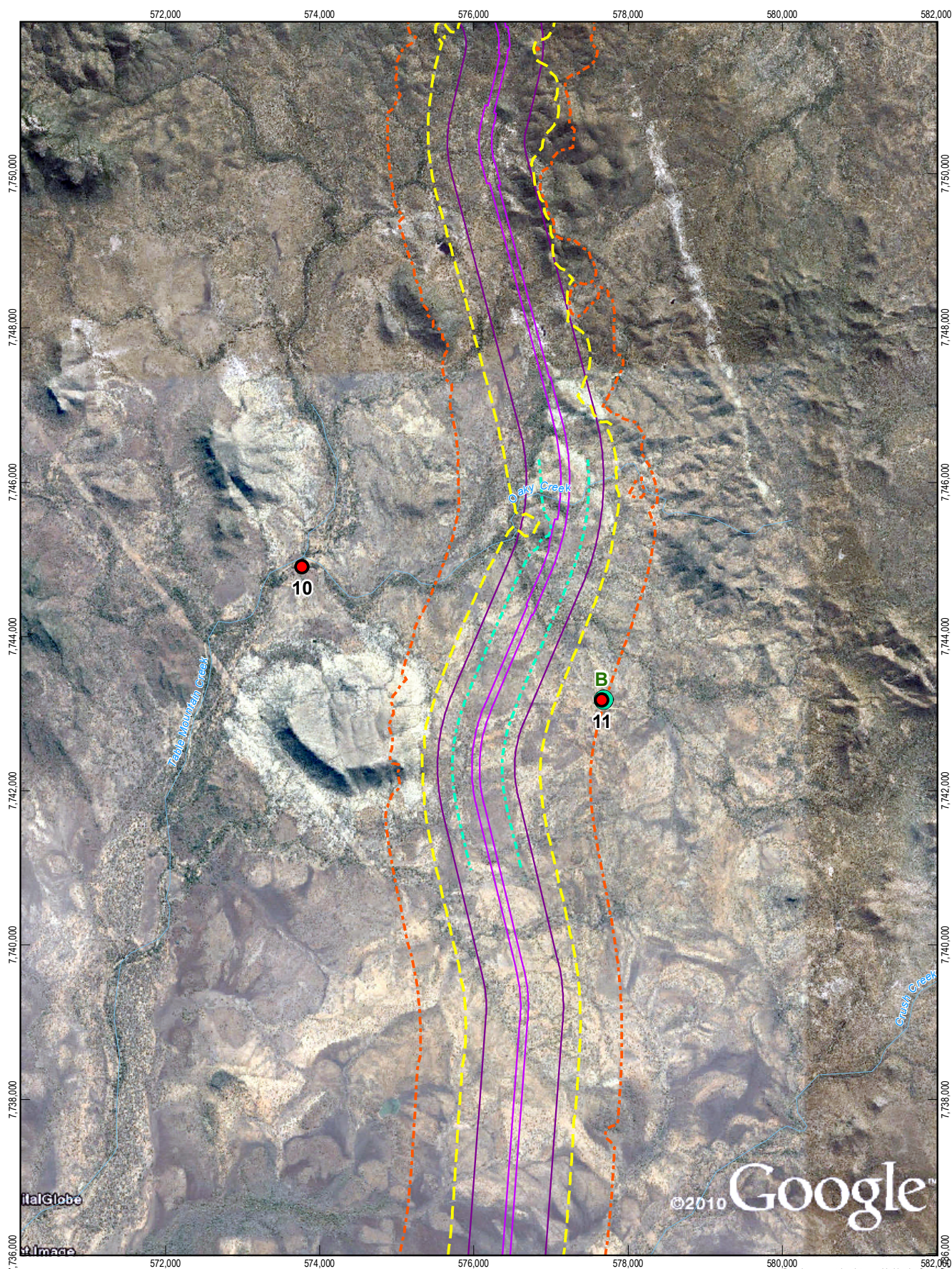
Figure B-4

G:\41\26457\06 GIS\Maps\MXD\0900_Noise_Vibration\41_26457_0902_rev_c.mxd

145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

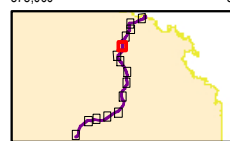
© 2013. Whilst every care has been taken to prepare this map, GHD, GA, DNRM, GE, DigitalGlobe/Cnes/Spot Image, Adani make no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and cannot accept liability and responsibility of any kind (whether in contract, tort or otherwise) for any expenses, losses, damages and/or costs (including indirect or consequential damage) which are or may be incurred by any party as a result of the map being inaccurate, incomplete or unsuitable in any way and for any reason.

Data source: GA: Populated Places, Railway, Watercourse, Lakes/2007; Adani: NGBR Corridor 06/06/2013, NGBR Corridor 13/05/2013, Camichael Project Rail/2013; DNRM: Roads/2010; GHD/Adani: Potential Sensitive Receptors/2013; GHD: Monitoring Location/2013, Noise Contours/2013, DigitalGlobe/Cnes/Spot Image: Google Imagery Extracted 15/07/2013.



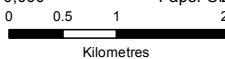
LEGEND

- Sensitive Receptor
- Monitoring Location
- LAeq9hr(night): 55 dB (A)
- LAeq15hr(day): 60 dB (A)
- Lmax: 80 dB (A)
- North Galilee Basin Rail 1000m Corridor
- North Galilee Basin Rail 100m Corridor
- Watercourse (Minor)

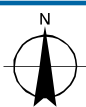


Based on or contains data provided by the State of Queensland (DNRM) [2013]. In consideration of the State permitting use of this data you acknowledge and agree that the State gives no warranty in relation to the data (including accuracy, reliability, completeness, currency or suitability) and accepts no liability (including without limitation, liability in negligence) for any loss, damage or costs (including consequential damage) relating to any use of the data. Data must not be used for marketing or be used in breach of the privacy laws.

1:70,000 Paper Size A4



Horizontal Datum: GDA 1994
Grid: GCS GDA 1994



adani

Adani Mining Pty Ltd
North Galilee Basin Rail Project
Predicted Rail Operational
Noise Contours (Facade
Corrected)

Job Number 41-26457
Revision C
Date 28 Aug 2013

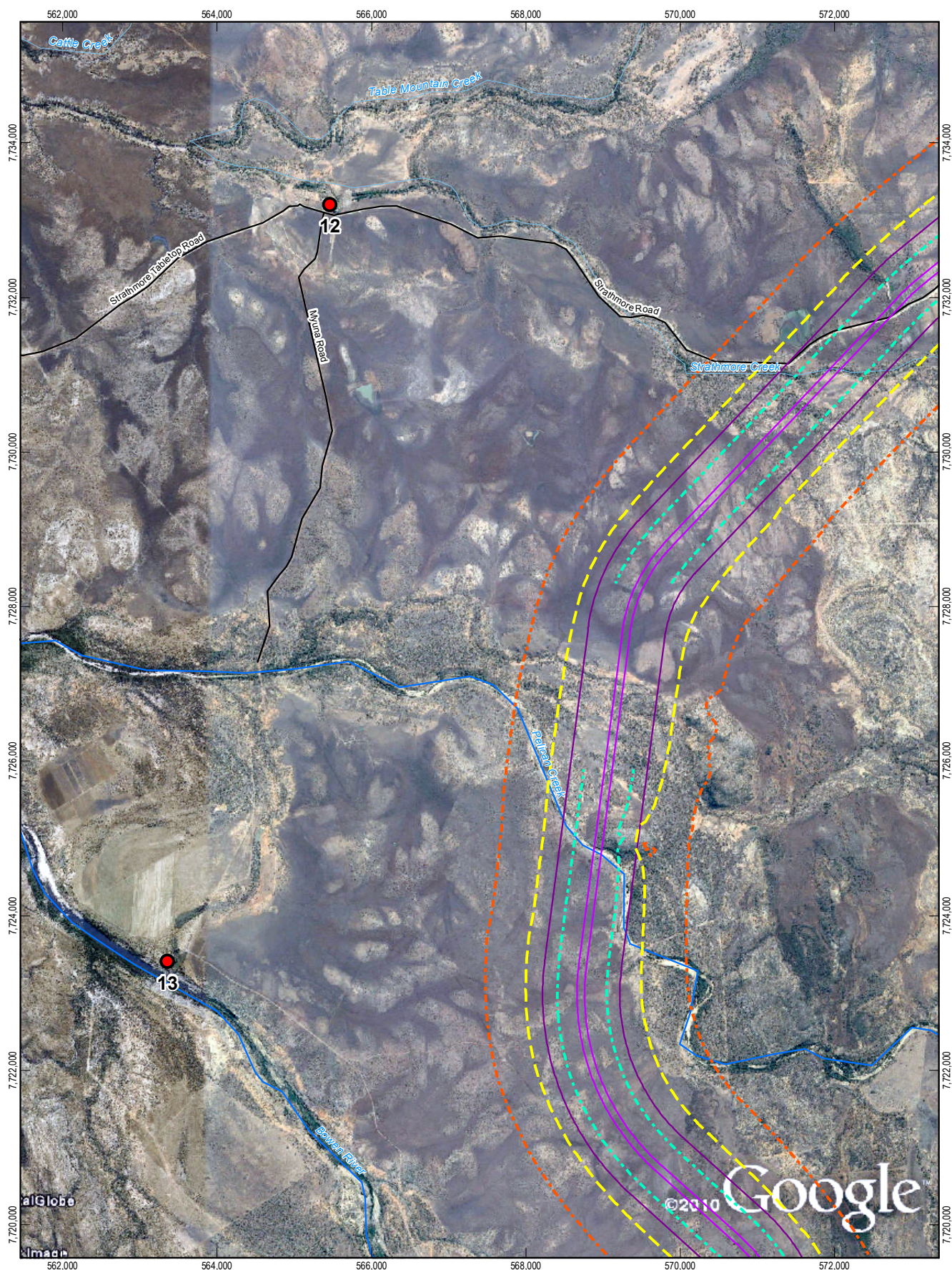
Figure B-5

G:\4126457\06 GIS\Maps\MXD\0900_Noise_Vibration\41_26457_0902_rev_c.mxd

145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

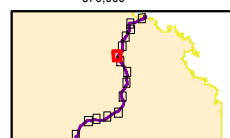
© 2013. Whilst every care has been taken to prepare this map, GHD, GA, DNRM, GE, DigitalGlobe/Cnes/Spot Image, Adani make no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and cannot accept liability and responsibility of any kind (whether in contract, tort or otherwise) for any expenses, losses, damages and/or costs (including indirect or consequential damage) which are or may be incurred by any party as a result of the map being inaccurate, incomplete or unsuitable in any way and for any reason.

Data source: GA: Populated Places, Railway, Watercourse, Lakes/2007; Adani: NGBR Corridor 06/06/2013, NGBR Corridor 13/05/2013, Camichael Project Rail/2013; DNRM: Roads/2010; GHD/Adani: Potential Sensitive Receptors/2013; GHD: Monitoring Location/2013, Noise Contours/2013, DigitalGlobe/Cnes/Spot Image: Google Imagery Extracted 15/07/2013.



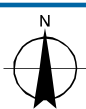
LEGEND

- Sensitive Receptor
- LAeq9hr(night): 55 dB (A)
- LAeq15hr(day): 60 dB (A)
- Lmax: 80 dB (A)
- North Galilee Basin Rail 1000m Corridor
- North Galilee Basin Rail 100m Corridor
- Main Road
- Watercourse (Major)
- Watercourse (Minor)



Based on or contains data provided by the State of QLD (DNRM) [2013]. In consideration of the State permitting use of this data you acknowledge and agree that the State gives no warranty in relation to the data (including accuracy, reliability, completeness, currency or suitability) and accepts no liability (including without limitation, liability in negligence) for any loss, damage or costs (including consequential damage) relating to any use of the data. Data must not be used for marketing or be used in breach of the privacy laws.

1:70,000 Paper Size A4
0 0.5 1 2
Kilometres
Horizontal Datum: GDA 1994
Grid: GCS GDA 1994



adani

Adani Mining Pty Ltd
North Galilee Basin Rail Project
Predicted Rail Operational
Noise Contours (Facade
Corrected)

Job Number 41-26457
Revision C
Date 28 Aug 2013

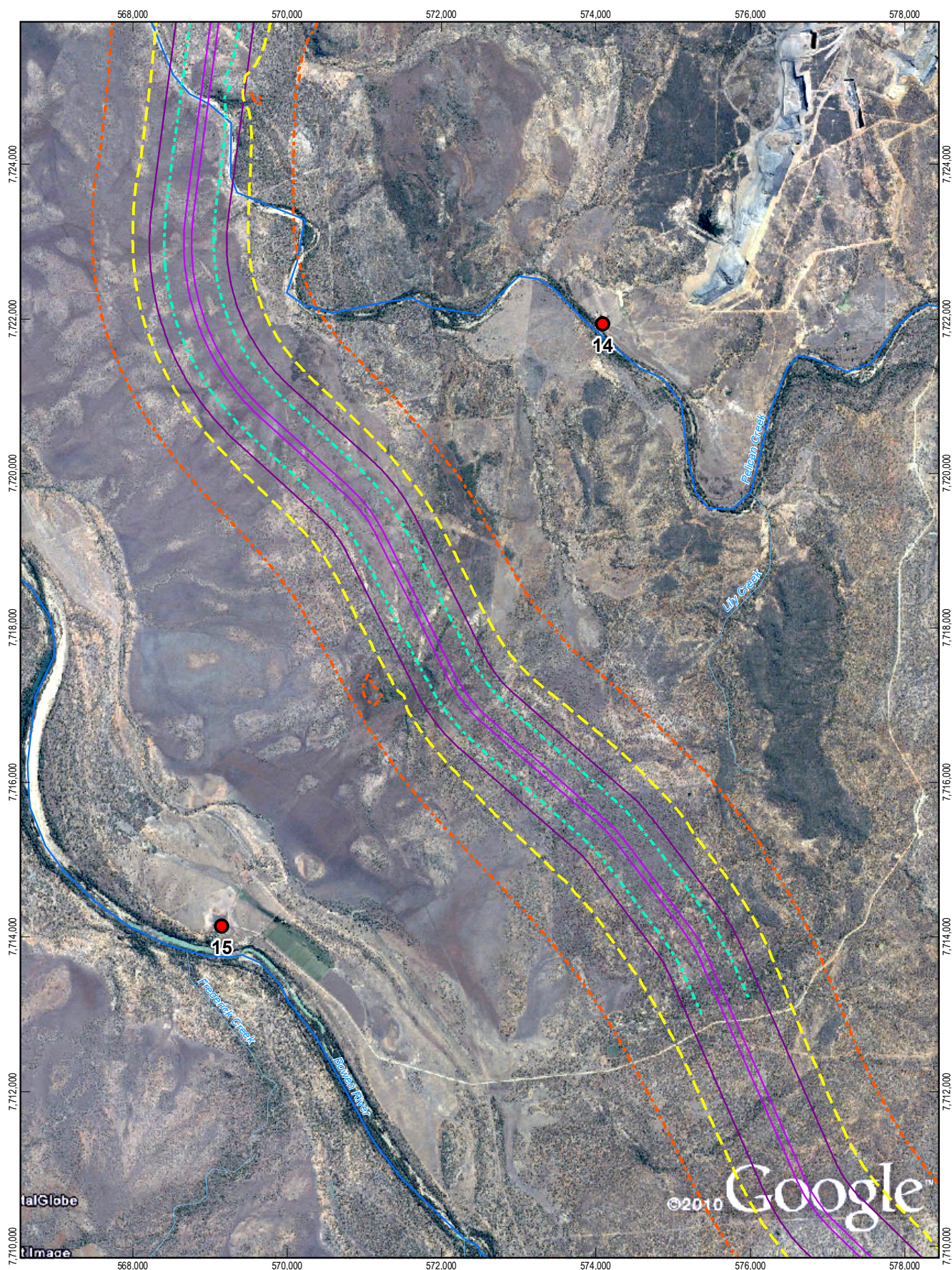
Figure B-6

G:\4126457\06 GIS\Maps\MXD\0900_Noise_Vibration\41_26457_0902_rev_c.mxd

145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

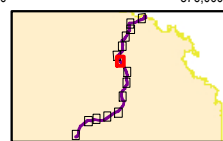
© 2013. Whilst every care has been taken to prepare this map, GHD, GA, DNRM, GE, DigitalGlobe/Cnes/Spot Image, Adani make no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and cannot accept liability and responsibility of any kind (whether in contract, tort or otherwise) for any expenses, losses, damages and/or costs (including indirect or consequential damage) which are or may be incurred by any party as a result of the map being inaccurate, incomplete or unsuitable in any way and for any reason.

Data source: GA: Populated Places, Railway, Watercourse, Lakes/2007; Adani: NGBR Corridor 06/06/2013, NGBR Corridor 13/05/2013, Camichael Project Rail/2013; DNRM: Roads/2010; GHD/Adani: Potential Sensitive Receptors/2013; GHD: Monitoring Location/2013, Noise Contours/2013, DigitalGlobe/Cnes/Spot Image: Google Imagery Extracted 15/07/2013.



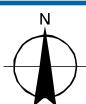
LEGEND

- Sensitive Receptor
- - - LAeq9hr(night): 55 dB (A)
- - - LAeq15hr(day): 60 dB (A)
- - - Lmax: 80 dB (A)
- North Galilee Basin Rail 1000m Corridor
- North Galilee Basin Rail 100m Corridor
- Watercourse (Major)
- Watercourse (Minor)



Based on or contains data provided by the State of QLD (DNRM) (2013). In consideration of the State permitting use of this data you acknowledge and agree that the State gives no warranty in relation to the data (including accuracy, reliability, completeness, currency or suitability) and accepts no liability (including without limitation, liability in negligence) for any loss, damage or costs (including consequential damage) relating to any use of the data. Data must not be used for marketing or be used in breach of the privacy laws.

1:70,000 Paper Size A4
0 0.5 1 2
Kilometres



adani

Adani Mining Pty Ltd
North Galilee Basin Rail Project
Predicted Rail Operational
Noise Contours (Facade
Corrected)

Job Number 41-26457
Revision C
Date 28 Aug 2013

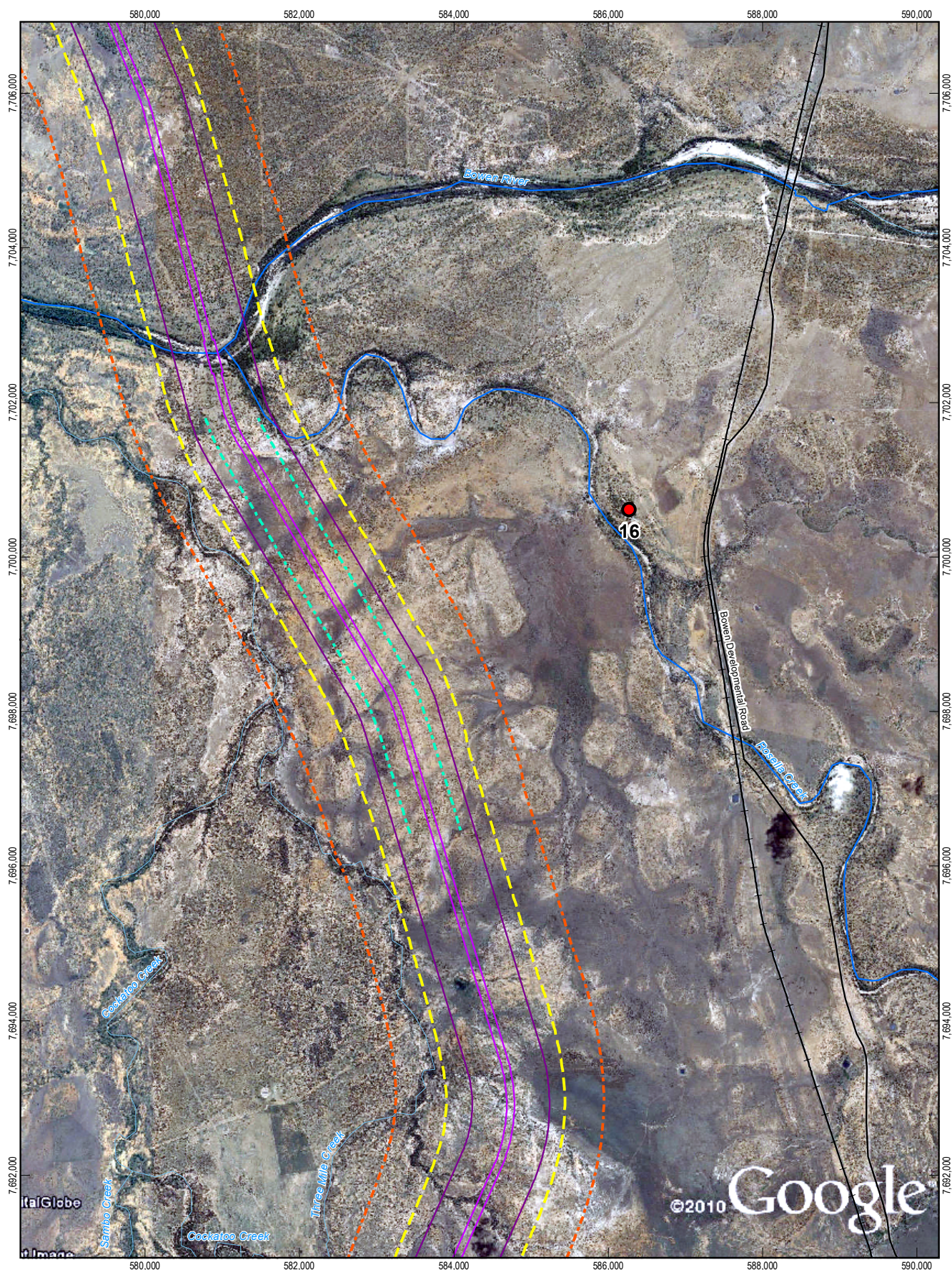
Figure B-7

G:\4126457\06 GIS\Maps\MXD\0900_Noise_Vibration\41_26457_0902_rev_c.mxd

145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

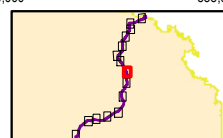
© 2013. Whilst every care has been taken to prepare this map, GHD, GA, DNRM, GE, DigitalGlobe/Cnes/Spot Image, Adani make no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and cannot accept liability and responsibility of any kind (whether in contract, tort or otherwise) for any expenses, losses, damages and/or costs (including indirect or consequential damage) which are or may be incurred by any party as a result of the map being inaccurate, incomplete or unsuitable in any way and for any reason.

Data source: GA: Populated Places, Railway, Watercourse, Lakes/2007; Adani: NGBR Corridor 06/06/2013, NGBR Corridor 13/05/2013, Camichael Project Rail/2013; DNRM: Roads/2010; GHD/Adani: Potential Sensitive Receptors/2013; GHD: Monitoring Location/2013, Noise Contours/2013, DigitalGlobe/Cnes/Spot Image: Google Imagery Extracted 15/07/2013.



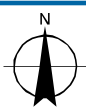
LEGEND

- Sensitive Receptor
- - - LAeq9hr(night): 55 dB (A)
- - - LAeq15hr(day): 60 dB (A)
- - - LAmaz: 80 dB (A)
- North Galilee Basin Rail 1000m Corridor
- North Galilee Basin Rail 100m Corridor
- Main Road
- Railway
- Watercourse (Major)
- Watercourse (Minor)



Based on or contains data provided by the State of QLD (DNRM) (2013). In consideration of the State permitting use of this data you acknowledge and agree that the State gives no warranty in relation to the data (including accuracy, reliability, completeness, currency or suitability) and accepts no liability (including without limitation, liability in negligence) for any loss, damage or costs (including consequential damage) relating to any use of the data. Data must not be used for marketing or be used in breach of the privacy laws.

1:70,000 Paper Size A4
 0 0.5 1 2
 Kilometres
 Map Projection: Transverse Mercator
 Horizontal Datum: GDA 1994
 Grid: GDA 1994 MGA Zone 55



adani

Adani Mining Pty Ltd
 North Galilee Basin Rail Project
 Predicted Rail Operational
 Noise Contours (Facade
 Corrected)

Job Number 41-26457
 Revision C
 Date 28 Aug 2013

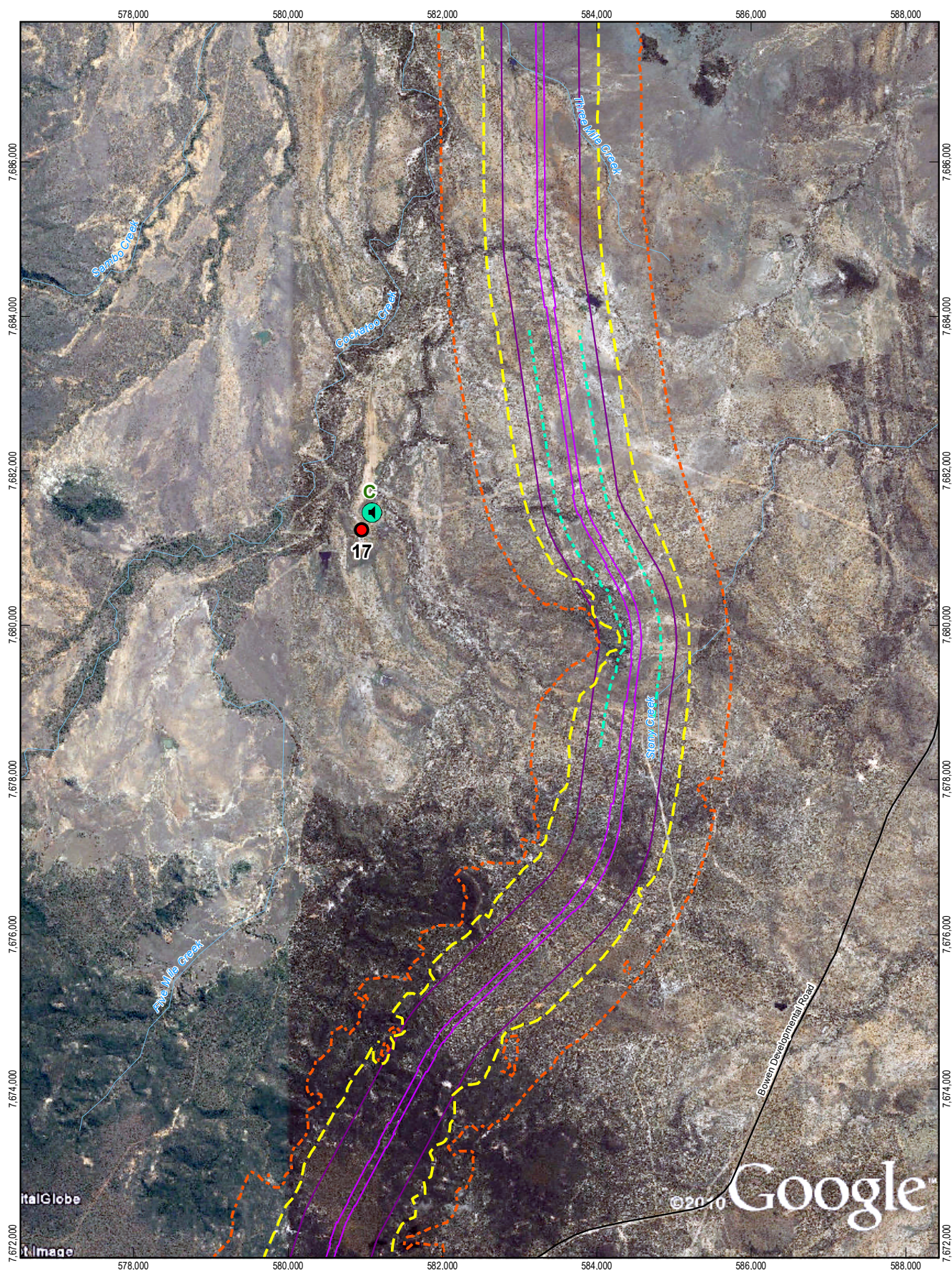
Figure B-8

G:\41\26457\06 GIS\Maps\MXD\0900_Noise_Vibration\41_26457_0902_rev_c.mxd

145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

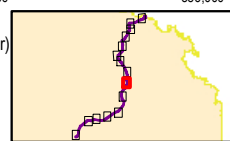
© 2013. Whilst every care has been taken to prepare this map, GHD, GA, DNRM, GE, DigitalGlobe/Cnes/Spot Image, Adani make no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and cannot accept liability and responsibility of any kind (whether in contract, tort or otherwise) for any expenses, losses, damages and/or costs (including indirect or consequential damage) which are or may be incurred by any party as a result of the map being inaccurate, incomplete or unsuitable in any way and for any reason.

Data source: GA: Populated Places, Railway, Watercourse, Lakes/2007; Adani: NGBR Corridor 06/06/2013, NGBR Corridor 13/05/2013, Camichael Project Rail/2013; DNRM: Roads/2010; GHD/Adani: Potential Sensitive Receptors/2013; GHD: Monitoring Location/2013, Noise Contours/2013, DigitalGlobe/Cnes/Spot Image: Google Imagery Extracted 15/07/2013.



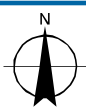
LEGEND

- Sensitive Receptor
- Monitoring Location
- LAeq9hr(night): 55 dB (A)
- LAeq15hr(day): 60 dB (A)
- Lmax: 80 dB (A)
- North Galilee Basin Rail 1000m Corridor
- North Galilee Basin Rail 100m Corridor
- Main Road
- Watercourse (Minor)



Based on or contains data provided by the State of QLD (DNRM) (2013). In consideration of the State permitting use of this data you acknowledge and agree that the State gives no warranty in relation to the data (including accuracy, reliability, completeness, currency or suitability) and accepts no liability (including without limitation, liability in negligence) for any loss, damage or costs (including consequential damage) relating to any use of the data. Data must not be used for marketing or be used in breach of the privacy laws.

1:70,000 Paper Size A4
 0 0.5 1 2
 Kilometres
 Map Projection: Transverse Mercator
 Horizontal Datum: GDA 1994
 Grid: GDA 1994 MGA Zone 55



Adani Mining Pty Ltd
 North Galilee Basin Rail Project
 Predicted Rail Operational
 Noise Contours (Facade
 Corrected)

Job Number 41-26457
 Revision C
 Date 28 Aug 2013

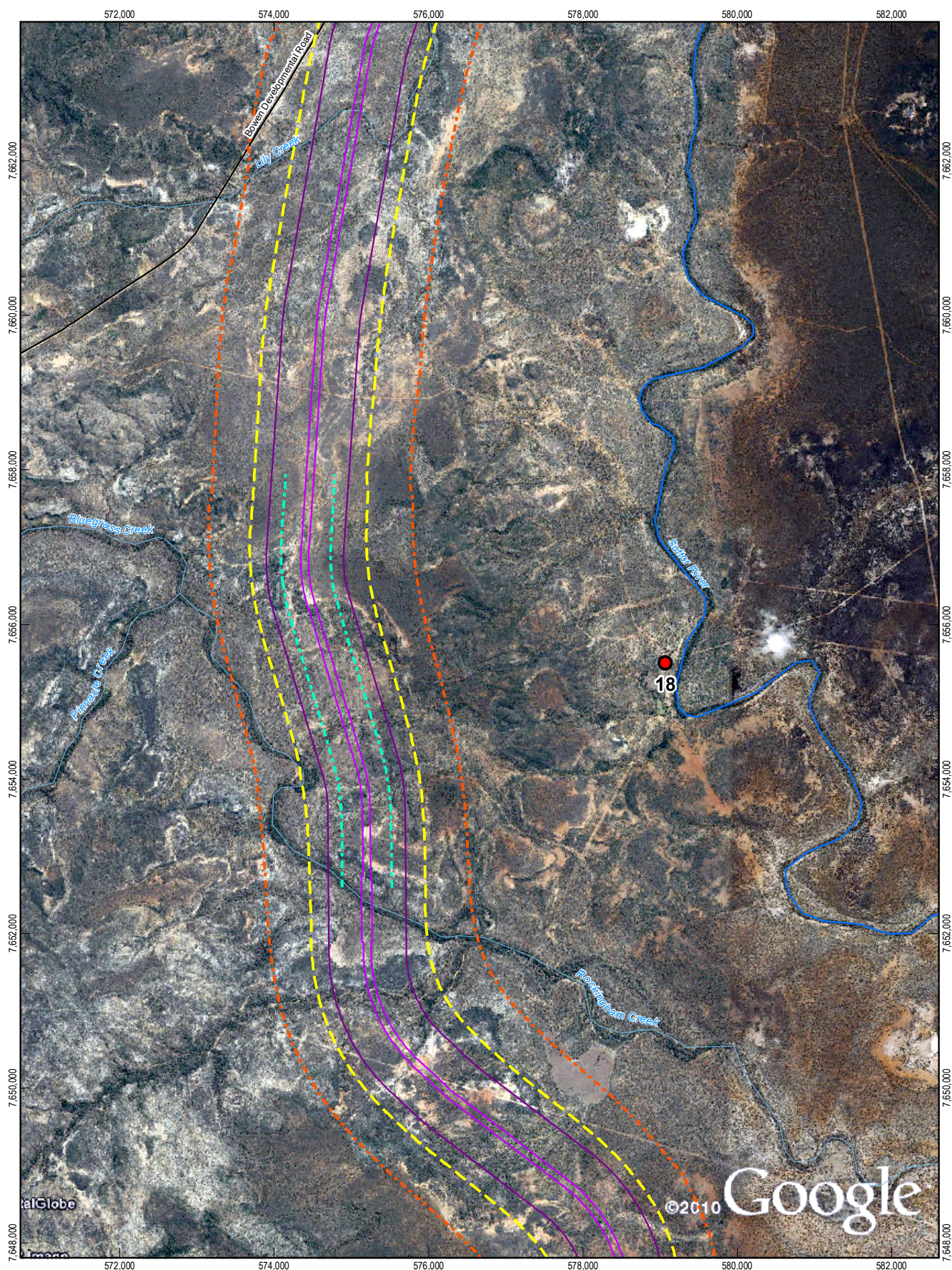
Figure B-9

G:\41\26457\06 GIS\Maps\MXD\0900_Noise_Vibration\41_26457_0902_rev_c.mxd

145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

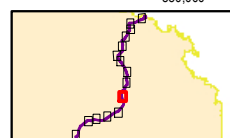
© 2013. Whilst every care has been taken to prepare this map, GHD, GA, DNRM, GE, DigitalGlobe/Cnes/Spot Image, Adani make no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and cannot accept liability and responsibility of any kind (whether in contract, tort or otherwise) for any expenses, losses, damages and/or costs (including indirect or consequential damage) which are or may be incurred by any party as a result of the map being inaccurate, incomplete or unsuitable in any way and for any reason.

Data source: GA: Populated Places, Railway, Watercourse, Lakes/2007; Adani: NGBR Corridor 06/06/2013, NGBR Corridor 13/05/2013, Camichael Project Rail/2013; DNRM: Roads/2010; GHD/Adani: Potential Sensitive Receptors/2013; GHD: Monitoring Location/2013, Noise Contours/2013, DigitalGlobe/Cnes/Spot Image: Google Imagery Extracted 15/07/2013.



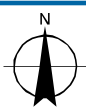
LEGEND

- Sensitive Receptor
- - - LAeq9hr(night): 55 dB (A)
- - - LAeq15hr(day): 60 dB (A)
- - - LAmax: 80 dB (A)
- North Galilee Basin Rail 1000m Corridor
- North Galilee Basin Rail 100m Corridor
- Main Road
- Watercourse (Major)
- Watercourse (Minor)



Based on or contains data provided by the State of QLD (DNRM) (2013). In consideration of the State permitting use of this data you acknowledge and agree that the State gives no warranty in relation to the data (including accuracy, reliability, completeness, currency or suitability) and accepts no liability (including without limitation, liability in negligence) for any loss, damage or costs (including consequential damage) relating to any use of the data. Data must not be used for marketing or be used in breach of the privacy laws.

1:70,000
Paper Size A4
0 0.5 1 2
Kilometres
Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55



Adani Mining Pty Ltd
North Galilee Basin Rail Project
Predicted Rail Operational
Noise Contours (Facade
Corrected)

Job Number 41-26457
Revision C
Date 28 Aug 2013

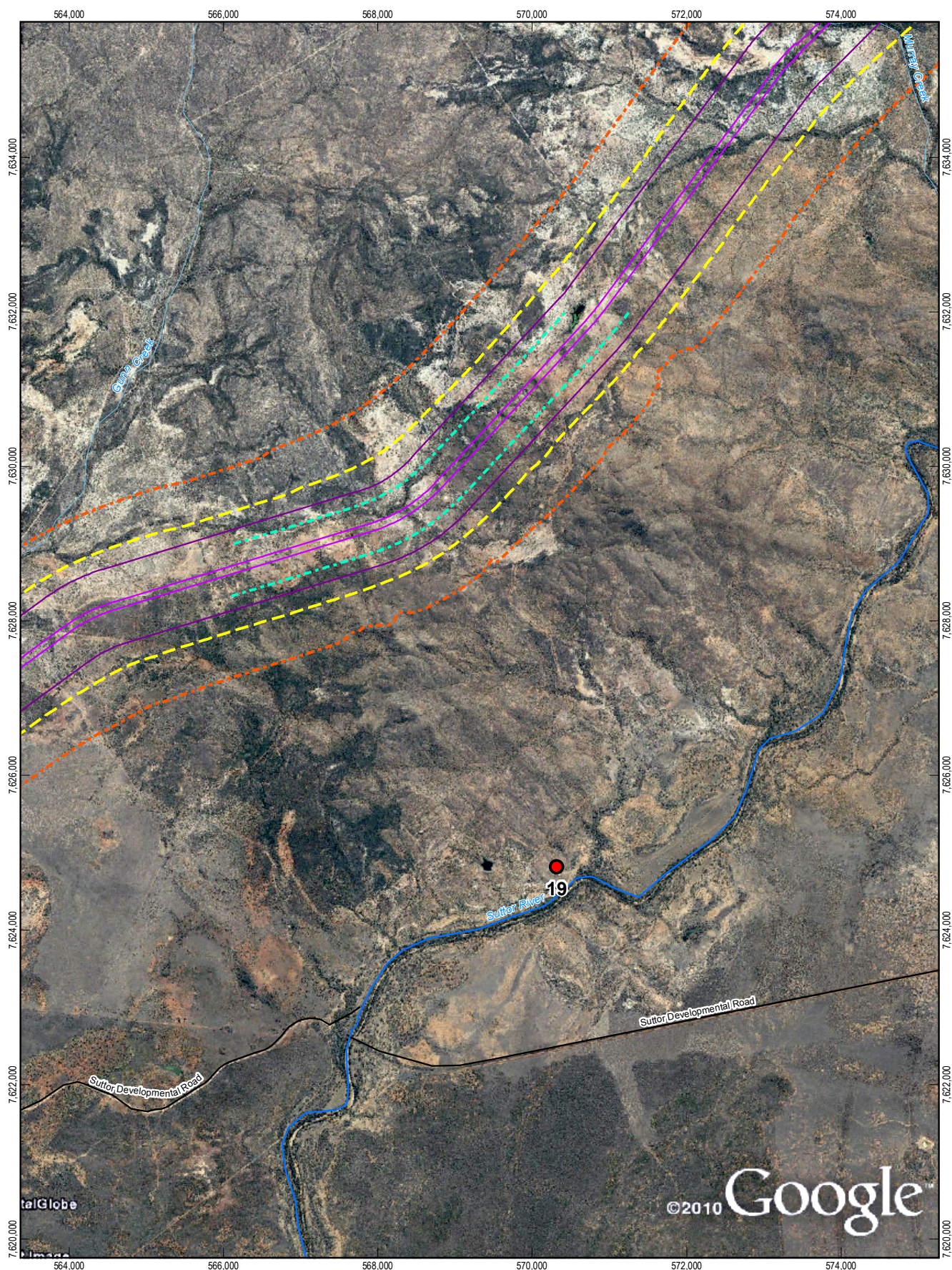
Figure B-10

G:\4126457\06 GIS\Maps\MXD\0900_Noise_Vibration\41_26457_0902_rev_c.mxd

145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

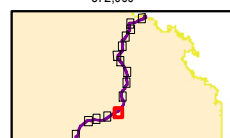
© 2013. Whilst every care has been taken to prepare this map, GHD, GA, DNRM, GE, DigitalGlobe/Cnes/Spot Image, Adani make no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and cannot accept liability and responsibility of any kind (whether in contract, tort or otherwise) for any expenses, losses, damages and/or costs (including indirect or consequential damage) which are or may be incurred by any party as a result of the map being inaccurate, incomplete or unsuitable in any way and for any reason.

Data source: GA: Populated Places, Railway, Watercourse, Lakes/2007; Adani: NGBR Corridor 06/06/2013, NGBR Corridor 13/05/2013, Camichael Project Rail/2013; DNRM: Roads/2010; GHD/Adani: Potential Sensitive Receptors/2013; GHD: Monitoring Location/2013, Noise Contours/2013, DigitalGlobe/Cnes/Spot Image: Google Imagery Extracted 15/07/2013.



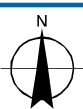
LEGEND

- Sensitive Receptor
- - - LAeq9hr(night): 55 dB (A)
- - - LAeq15hr(day): 60 dB (A)
- - - Lmax: 80 dB (A)
- North Galilee Basin Rail 1000m Corridor
- North Galilee Basin Rail 100m Corridor
- Main Road
- Watercourse (Major)
- Watercourse (Minor)



Based on or contains data provided by the State of QLD (DNRM) [2013]. In consideration of the State permitting use of this data you acknowledge and agree that the State gives no warranty in relation to the data (including accuracy, reliability, completeness, currency or suitability) and accepts no liability (including without limitation, liability in negligence) for any loss, damage or costs (including consequential damage) relating to any use of the data. Data must not be used for marketing or be used in breach of the privacy laws.

1:70,000 Paper Size A4
 0 0.5 1 2
 Kilometres
 Map Projection: Transverse Mercator
 Horizontal Datum: GDA 1994
 Grid: GDA 1994 MGA Zone 55



Adani Mining Pty Ltd
 North Galilee Basin Rail Project
 Predicted Rail Operational
 Noise Contours (Facade
 Corrected)

Job Number 41-26457
 Revision C
 Date 28 Aug 2013

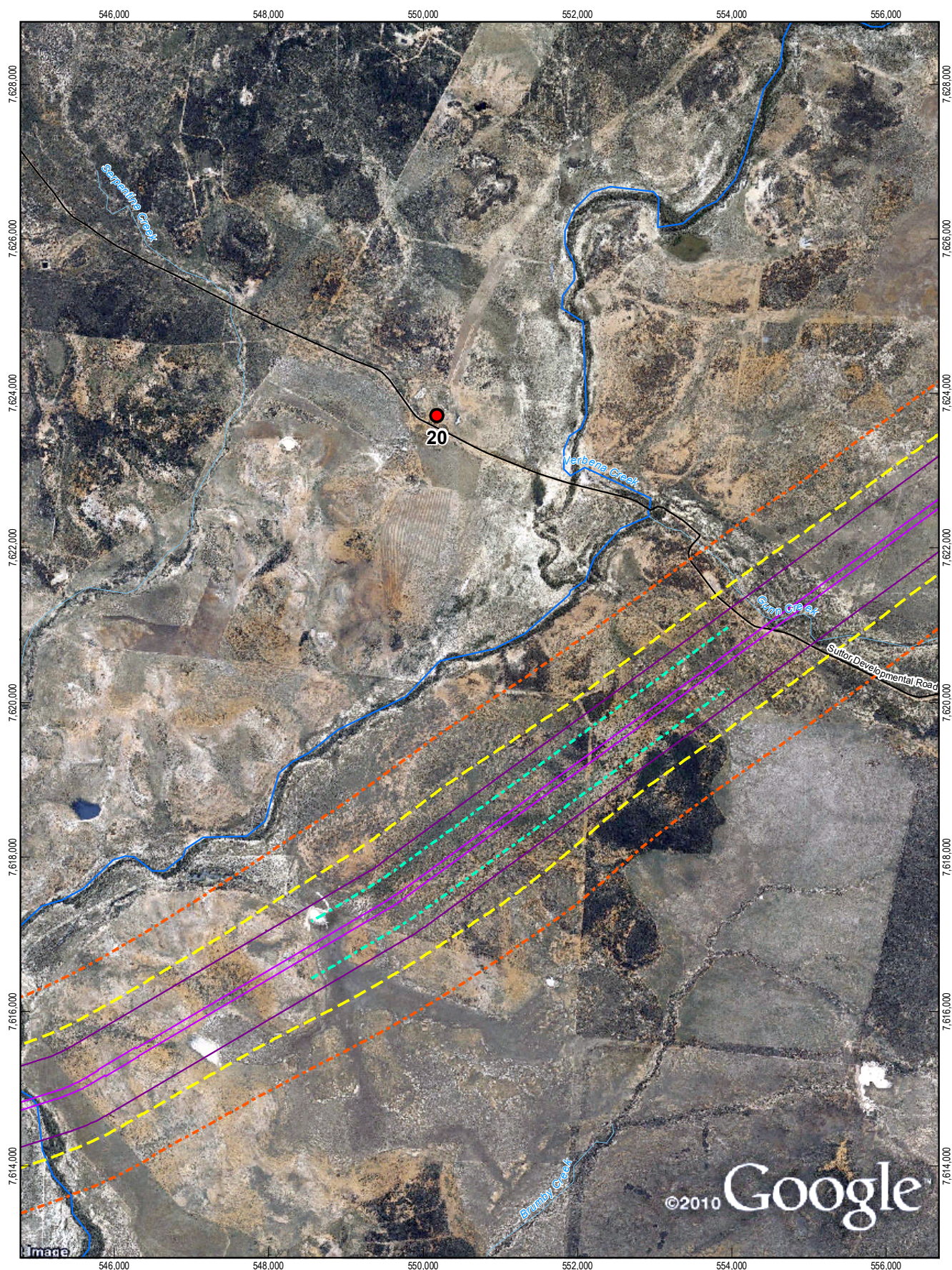
Figure B-11

G:\4126457\06 GIS\Maps\MXD\0900_Noise_Vibration\41_26457_0902_rev_c.mxd

145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

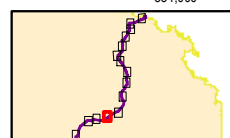
© 2013. Whilst every care has been taken to prepare this map, GHD, GA, DNRM, GE, DigitalGlobe/Cnes/Spot Image, Adani make no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and cannot accept liability and responsibility of any kind (whether in contract, tort or otherwise) for any expenses, losses, damages and/or costs (including indirect or consequential damage) which are or may be incurred by any party as a result of the map being inaccurate, incomplete or unsuitable in any way and for any reason.

Data source: GA: Populated Places, Railway, Watercourse, Lakes/2007; Adani: NGBR Corridor 06/06/2013, NGBR Corridor 13/05/2013, Camichael Project Rail/2013; DNRM: Roads/2010; GHD/Adani: Potential Sensitive Receptors/2013; GHD: Monitoring Location/2013, Noise Contours/2013, DigitalGlobe/Cnes/Spot Image: Google Imagery Extracted 15/07/2013.



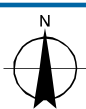
LEGEND

- Sensitive Receptor
- - - LAeq9hr(night): 55 dB (A)
- - - LAeq15hr(day): 60 dB (A)
- - - L_{Amax}: 80 dB (A)
- North Galilee Basin Rail 1000m Corridor
- North Galilee Basin Rail 100m Corridor
- Main Road
- Watercourse (Major)
- Watercourse (Minor)



Based on or contains data provided by the State of QLD (DNRM) (2013). In consideration of the State permitting use of this data you acknowledge and agree that the State gives no warranty in relation to the data (including accuracy, reliability, completeness, currency or suitability) and accepts no liability (including without limitation, liability in negligence) for any loss, damage or costs (including consequential damage) relating to any use of the data. Data must not be used for marketing or be used in breach of the privacy laws.

1:70,000 Paper Size A4
 0 0.5 1 2
 Kilometres
 Map Projection: Transverse Mercator
 Horizontal Datum: GDA 1994
 Grid: GDA 1994 MGA Zone 55



Adani Mining Pty Ltd
 North Galilee Basin Rail Project
 Predicted Rail Operational
 Noise Contours (Facade
 Corrected)

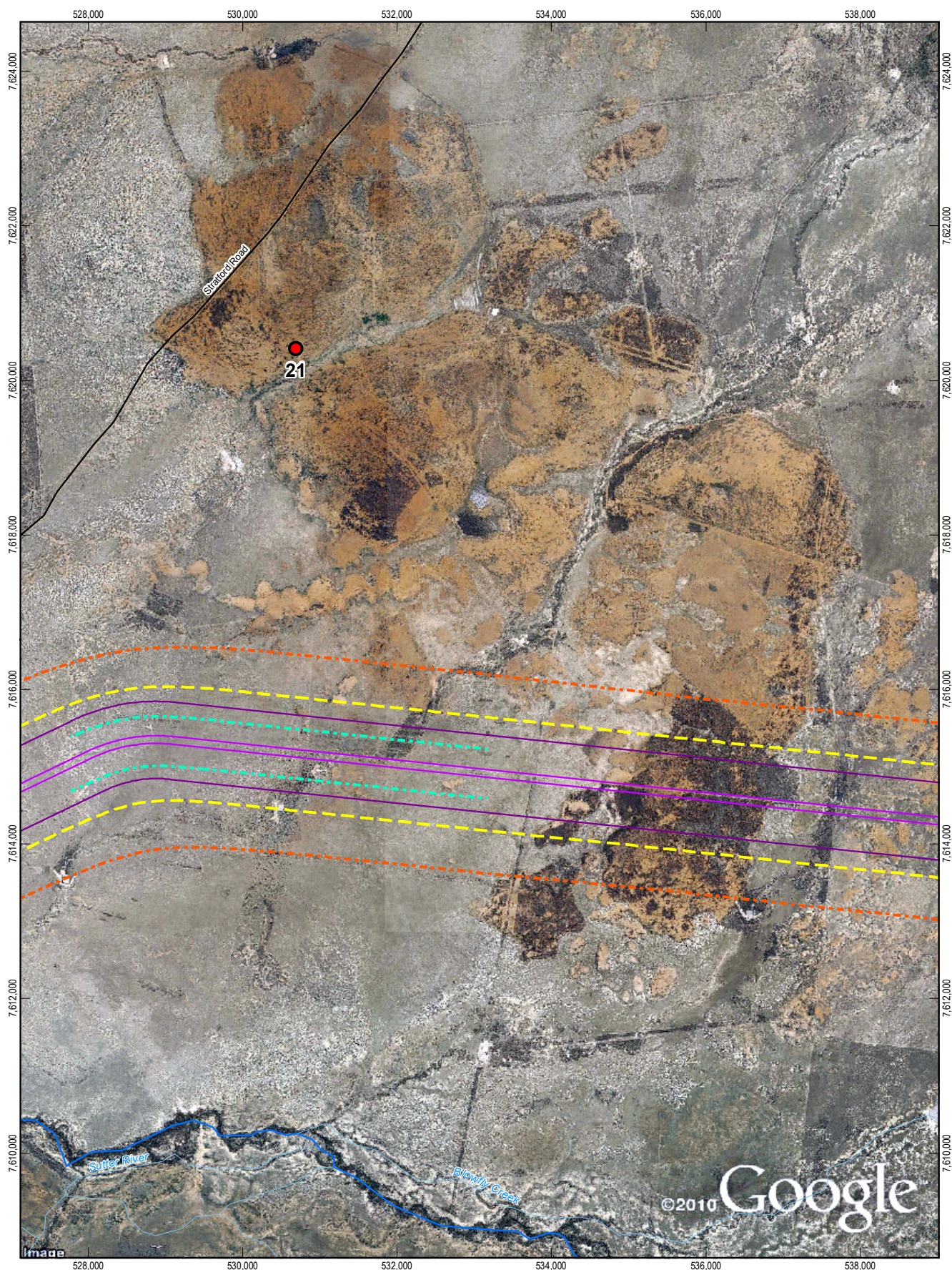
Job Number 41-26457
 Revision C
 Date 28 Aug 2013

Figure B-12

G:\4126457\06 GIS\Maps\MXD\0900_Noise_Vibration\41_26457_0902_rev_c.mxd

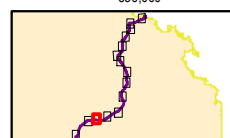
145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

© 2013. Whilst every care has been taken to prepare this map, GHD, GA, DNRM, GE, DigitalGlobe/Cnes/Spot Image, Adani make no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and cannot accept liability and responsibility of any kind (whether in contract, tort or otherwise) for any expenses, losses, damages and/or costs (including indirect or consequential damage) which are or may be incurred by any party as a result of the map being inaccurate, incomplete or unsuitable in any way and for any reason.
 Data source: GA: Populated Places, Railway, Watercourse, Lakes/2007; Adani: NGBR Corridor 06/06/2013, NGBR Corridor 13/05/2013, Camichael Project Rail/2013; DNRM: Roads/2010; GHD/Adani: Potential Sensitive Receptors/2013; GHD: Monitoring Location/2013, Noise Contours/2013, DigitalGlobe/Cnes/Spot Image: Google Imagery Extracted 15/07/2013.



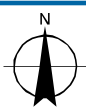
LEGEND

- Sensitive Receptor
- - - LAeq9hr(night): 55 dB (A)
- - - LAeq15hr(day): 60 dB (A)
- - - Lmax: 80 dB (A)
- North Galilee Basin Rail 1000m Corridor
- North Galilee Basin Rail 100m Corridor
- Main Road
- Watercourse (Major)
- Watercourse (Minor)



Based on or contains data provided by the State of QLD (DNRM) (2013). In consideration of the State permitting use of this data you acknowledge and agree that the State gives no warranty in relation to the data (including accuracy, reliability, completeness, currency or suitability) and accepts no liability (including without limitation, liability in negligence) for any loss, damage or costs (including consequential damage) relating to any use of the data. Data must not be used for marketing or be used in breach of the privacy laws.

1:70,000 Paper Size A4
 0 0.5 1 2
 Kilometres
 Map Projection: Transverse Mercator
 Horizontal Datum: GDA 1994
 Grid: GDA 1994 MGA Zone 55



adani

Adani Mining Pty Ltd
 North Galilee Basin Rail Project
 Predicted Rail Operational
 Noise Contours (Facade
 Corrected)

Job Number 41-26457
 Revision C
 Date 28 Aug 2013

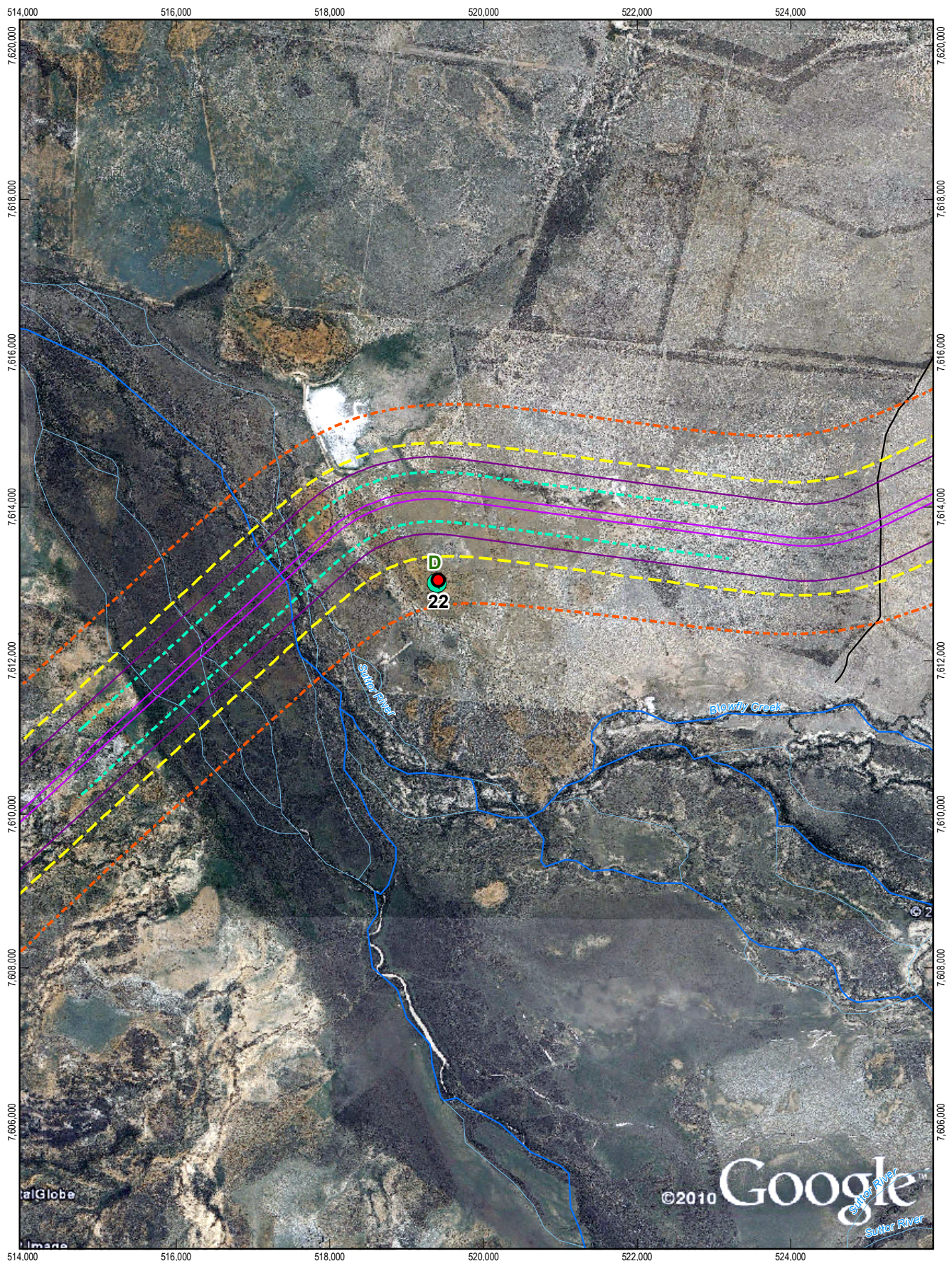
Figure B-13

G:\4126457\06 GIS\Maps\MXD\0900_Noise_Vibration\41_26457_0902_rev_c.mxd

145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

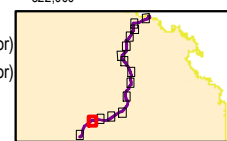
© 2013. Whilst every care has been taken to prepare this map, GHD, GA, DNRM, GE, DigitalGlobe/Cnes/Spot Image, Adani make no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and cannot accept liability and responsibility of any kind (whether in contract, tort or otherwise) for any expenses, losses, damages and/or costs (including indirect or consequential damage) which are or may be incurred by any party as a result of the map being inaccurate, incomplete or unsuitable in any way and for any reason.

Data source: GA: Populated Places, Railway, Watercourse, Lakes/2007; Adani: NGBR Corridor 06/06/2013, NGBR Corridor 13/05/2013, Camichael Project Rail/2013; DNRM: Roads/2010; GHD/Adani: Potential Sensitive Receptors/2013; GHD: Monitoring Location/2013, Noise Contours/2013, DigitalGlobe/Cnes/Spot Image: Google Imagery Extracted 15/07/2013.



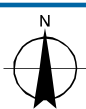
LEGEND

- Sensitive Receptor
- Monitoring Location
- LAeq9hr(night): 55 dB (A)
- LAeq15hr(day): 60 dB (A)
- LAmix: 80 dB (A)
- North Galilee Basin Rail 1000m Corridor
- North Galilee Basin Rail 100m Corridor
- Main Road
- Watercourse (Major)
- Watercourse (Minor)



Based on or contains data provided by the State of QLD (DNRM) (2013). In consideration of the State permitting use of this data you acknowledge and agree that the State gives no warranty in relation to the data (including accuracy, reliability, completeness, currency or suitability) and accepts no liability (including without limitation, liability in negligence) for any loss, damage or costs (including consequential damage) relating to any use of the data. Data must not be used for marketing or be used in breach of the privacy laws.

1:70,000 Paper Size A4
 0 0.5 1 2
 Kilometres
 Map Projection: Transverse Mercator
 Horizontal Datum: GDA 1994
 Grid: GDA 1994 MGA Zone 55



Adani Mining Pty Ltd
 North Galilee Basin Rail Project
 Predicted Rail Operational
 Noise Contours (Facade
 Corrected)

Job Number 41-26457
 Revision C
 Date 28 Aug 2013

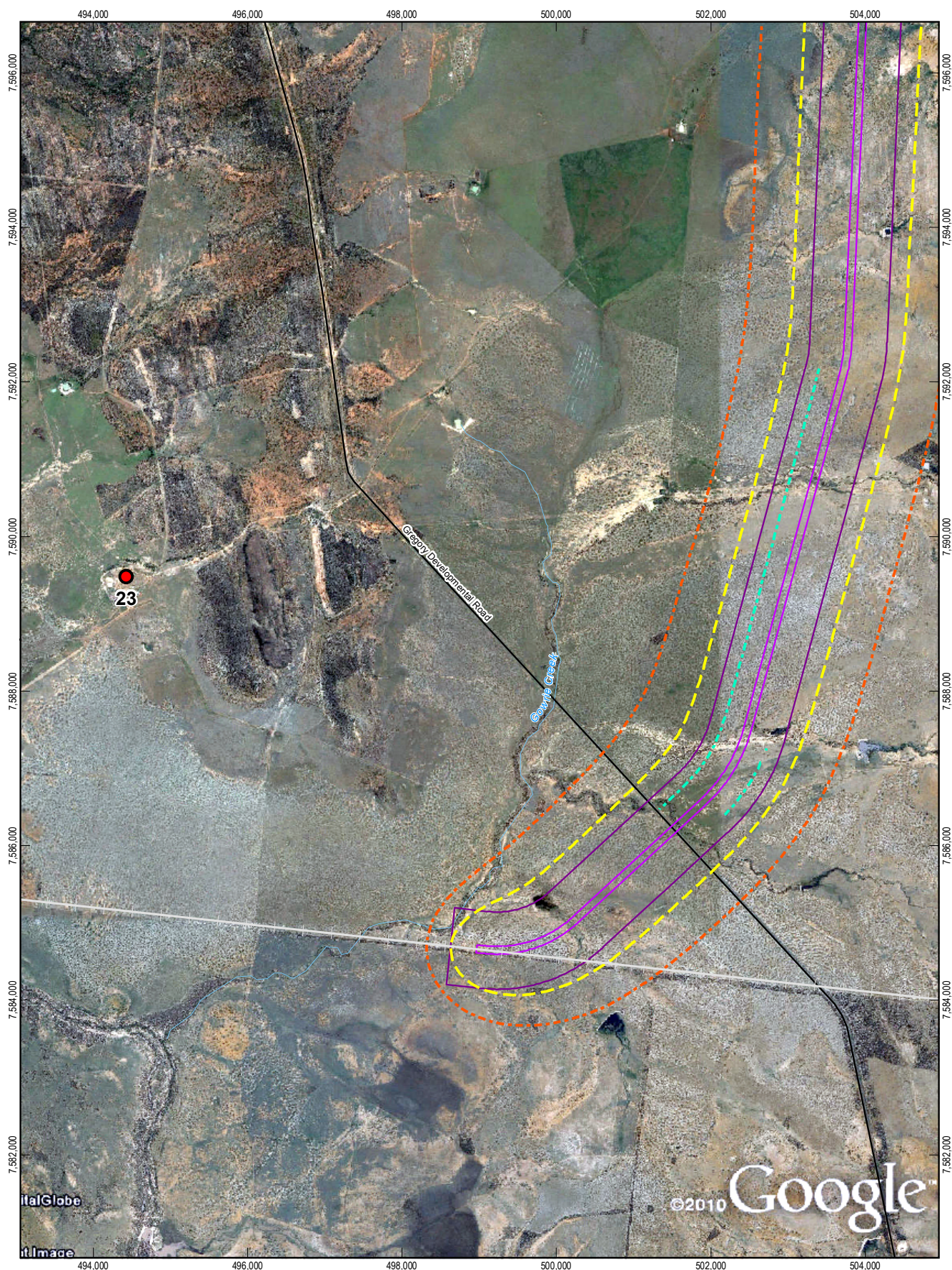
Figure B-14

G:\41\26457\06 GIS\Maps\MXD\0900_Noise_Vibration\41_26457_0902_rev_c.mxd

145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

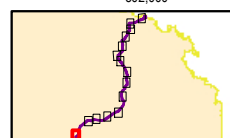
© 2013. Whilst every care has been taken to prepare this map, GHD, GA, DNRM, GE, DigitalGlobe/Cnes/Spot Image, Adani make no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and cannot accept liability and responsibility of any kind (whether in contract, tort or otherwise) for any expenses, losses, damages and/or costs (including indirect or consequential damage) which are or may be incurred by any party as a result of the map being inaccurate, incomplete or unsuitable in any way and for any reason.

Data source: GA: Populated Places, Railway, Watercourse, Lakes/2007; Adani: NGBR Corridor 06/06/2013, NGBR Corridor 13/05/2013, Camichael Project Rail/2013; DNRM: Roads/2010; GHD/Adani: Potential Sensitive Receptors/2013; GHD: Monitoring Location/2013, Noise Contours/2013, DigitalGlobe/Cnes/Spot Image: Google Imagery Extracted 15/07/2013.



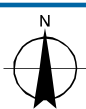
LEGEND

- Sensitive Receptor
- Carmichael Project (Rail)
- LAeq9hr(night): 55 dB (A)
- LAeq15hr(day): 60 dB (A)
- LAmx: 80 dB (A)
- North Galilee Basin Rail 1000m Corridor
- North Galilee Basin Rail 100m Corridor
- Main Road
- Watercourse (Minor)



Based on or contains data provided by the State of QLD (DNRM) (2013). In consideration of the State permitting use of this data you acknowledge and agree that the State gives no warranty in relation to the data (including accuracy, reliability, completeness, currency or suitability) and accepts no liability (including without limitation, liability in negligence) for any loss, damage or costs (including consequential damage) relating to any use of the data. Data must not be used for marketing or be used in breach of the privacy laws.

1:70,000
Paper Size A4
0 0.5 1 2
Kilometres
Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55



adani

Adani Mining Pty Ltd
North Galilee Basin Rail Project
Predicted Rail Operational
Noise Contours (Facade
Corrected)

Job Number 41-26457
Revision C
Date 28 Aug 2013

Figure B-15

G:\4126457\06 GIS\Maps\MXD\0900_Noise_Vibration\41_26457_0902_rev_c.mxd

145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

© 2013. Whilst every care has been taken to prepare this map, GHD, GA, DNRM, GE, DigitalGlobe/Cnes/Spot Image, Adani make no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and cannot accept liability or responsibility of any kind (whether in contract, tort or otherwise) for any expenses, losses, damages and/or costs (including indirect or consequential damage) which are or may be incurred by any party as a result of the map being inaccurate, incomplete or unsuitable in any way and for any reason.

Data source: GA: Populated Places, Railway, Watercourse, Lakes/2007; Adani: NGBR Corridor 06/06/2013, NGBR Corridor 13/05/2013, Carmichael Project Rail/2013; DNRM: Roads/2010; GHD/Adani: Potential Sensitive Receptors/2013; GHD: Monitoring Location/2013, Noise Contours/2013, DigitalGlobe/Cnes/Spot Image: Google Imagery Extracted 15/07/2013.

GHD

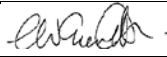
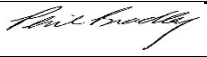
145 Ann Street Brisbane QLD 4000
 GPO Box 668 Brisbane QLD 4001
 T: (07) 3316 3000 F: (07) 3316 3333 E: bnemail@ghd.com

© GHD 2013

This document is and shall remain the property of GHD. The document may only be used for the purpose for which it was commissioned and in accordance with the Terms of Engagement for the commission. Unauthorised use of this document in any form whatsoever is prohibited.

N:\AU\Brisbane\Projects\41\26457\WP\447433.docx

Document Status

Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
A	P Pandey S Ritchie	C Evenden	Draft	P. Bradley	Draft	12/07/2013
B	P Pandey S Ritchie	C Evenden	Draft	P Bradley	Draft	05/08/2013
0	P Pandey S Ritchie	C Evenden		P Bradley		22/08/2013

www.ghd.com

