# PACIFIC HIGHWAY UPGRADE KUNDABUNG TO KEMSPEY

## Operational noise management report

**JANUARY 2015**

ACOUSTICS AND AIR

# PACIFIC HIGHWAY UPGRADE
# KUNDABUNG TO KEMPSEY
## OPERATIONAL NOISE MANAGEMENT REPORT

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**PREPARED FOR**

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# GLOSSARY OF ACOUSTIC TERMS

Most environments are affected by environmental noise which continuously varies, largely as a result of road traffic. To describe the overall noise environment, a number of noise descriptors have been developed and these involve statistical and other analysis of the varying noise over sampling periods, typically taken as 15 minutes. These descriptors, which are demonstrated in the graph below, are here defined.

**Maximum Noise Level ($L_{Amax}$) –** The maximum noise level over a sample period is the maximum level, measured on fast response, during the sample period.

**$L_{A1}$ –** The $L_{A1}$ level is the noise level which is exceeded for 1% of the sample period. During the sample period, the noise level is below the $L_{A1}$ level for 99% of the time.

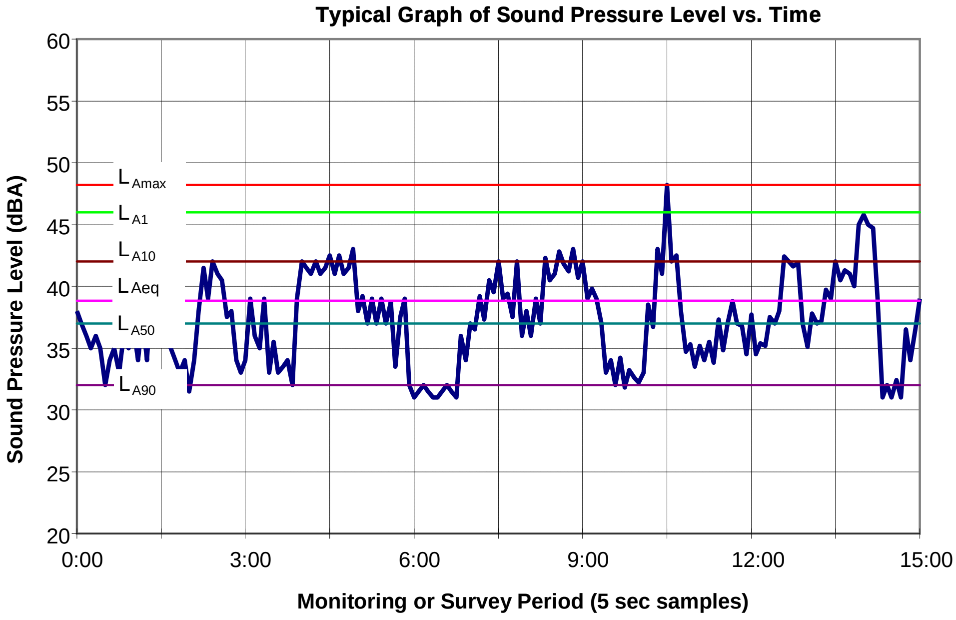
**$L_{A10}$ –** The $L_{A10}$ level is the noise level which is exceeded for 10% of the sample period. During the sample period, the noise level is below the $L_{A10}$ level for 90% of the time. The $L_{A10}$ is a common noise descriptor for environmental noise and road traffic noise.

**$L_{A90}$ –** The $L_{A90}$ level is the noise level which is exceeded for 90% of the sample period. During the sample period, the noise level is below the $L_{A90}$ level for 10% of the time. This measure is commonly referred to as the background noise level.

**$L_{Aeq}$ –** The equivalent continuous sound level ($L_{Aeq}$) is the energy average of the varying noise over the sample period and is equivalent to the level of a constant noise which contains the same energy as the varying noise environment. This measure is also a common measure of environmental noise and road traffic noise.

**ABL –** The Assessment Background Level is the single figure background level representing each assessment period (daytime, evening and night time) for each day. It is determined by calculating the 10th percentile (lowest 10th percent) background level ($L_{A90}$) for each period.

**RBL –** The Rating Background Level for each period is the median value of the ABL values for the period over all of the days measured. There is therefore an RBL value for each period – daytime, evening and night time.



# 1 INTRODUCTION

## 1.1 Background

The Oxley Highway to Kempsey Pacific Highway Upgrade (the Project) is 37 kilometres in length, commencing approximately 700 metres north of the Oxley Highway interchange, tying in with the existing dual carriageways to the south and continuing northwards to tie in at Stumpy Creek with the dual carriageways of the approved Kempsey to Eungai Pacific Highway upgrade. The Project involves the duplication of the existing highway, except for sections in the vicinity of the Hastings River and Wilson River which deviate from the existing highway, and a bypass of Telegraph Point. The existing highway would be retained wherever possible for use as a service road or local road connection.

On 8 December 2006, the Project was declared by the then Minister for Planning to be a project to which Part 3A of the Environmental Planning and Assessment Act 1979 applies. An environmental assessment was prepared and placed on public exhibition for 30 days between September and October 2010. Following consideration of submissions made during the exhibition period, the submissions report, including changes to the proposal following consideration of submissions, was submitted to the Minister for Planning and Infrastructure seeking approval. Approval of the Project was granted on 8 February 2012, subject to a number of Conditions of Approval.'

## 1.2 Project Staging

Due to the Project's length and funding models available, the Project will be essentially delivered in two main sections – from the Oxley Highway to Kundabung (approximately 24 kilometres) and from Kundabung to Kempsey (K2K) (approximately 14 kilometres). The delivery of these two sections will be undertaken in four stages as illustrated in Figure 2-1.

The four stages are:

- Sancrox Road traffic arrangement (stage 1).
- Kundabung to Kempsey (K2K) (Class A; stage 2).
- Oxley Highway to Kundabung (stage 3).
- Class A to Class M standard (stage 4).

A staging report reflecting the above staged delivery approach has been prepared (February 2013) and has been approved by the Department of Planning and Infrastructure.

This operational noise assessment focuses on the Kundabung to Kempsey section of the Project.

## 1.3 Scope of Report

This operational noise assessment addresses the requirements outlined in Condition of Approval (CoA) C13 for the K2K section of the Project based on Class A design. Table 1-1 provides an overview of how this operational noise assessment complies with the requirements of CoA 13.

Potential noise impacts have been assessed in accordance with the NSW Government's *Environmental Criteria for Road Traffic Noise (ECRTN)* and *the RTA Environmental Noise Management Manual (ENMM)*.

**Table 1-1 Compliance with CoA 13**

| Condition of Approval C13 | How addressed |
|---|---|
| *Unless otherwise agreed by the Director General, within six months of commencing construction, the Proponent shall, in consultation with the EPA, prepare and submit for the approval of the Director General, a review of the operational noise mitigation measures proposed to be implemented for the project. The review shall:* | This report |
| *(a) confirm the operational noise predictions of the project based on detailed design. This operational noise assessment shall be based on an appropriately calibrated noise model (which has incorporated additional noise monitoring, where necessary for calibration purposes). The assessment shall specifically include verification of noise levels at the Mingaletta Road rest areas, based on additional noise monitoring undertaken at this location;* | The assessment was undertaken using the SoundPlan program, implementing Calculation of Road Traffic Noise (CoRTN) algorithms. Discussion of the processes using supplied inputs and method of calibration is presented in section 5 of this report. Noise monitoring conducted to assist in calibration is outlined in section 4. The verification of noise levels at the Mingaletta Road rest area is discussed extensively in section 7. |
| *(b) review the suitability of the operational noise mitigation measures identified in the documents listed under condition A1 to achieve the criteria outlined in the Environmental Criteria for Road Traffic Noise (Environment Protection Authority, 1999), based on the operational noise performance of the project predicted under (a) above; and* | Results of the noise modelling conducted to address condition (a) were used to identify residences that may require treatment. Section 6 provides a comparison of the results obtained in the detailed design and environmental assessment. Reasons for differences are discussed extensively in section 6.3 and 6.4. Suitability of environmental assessment mitigation methods reviewed in section 6.6. |
| *(c) where necessary, investigate additional feasible and reasonable noise mitigation measures to achieve the criteria outlined in the Environmental Criteria for Road Traffic Noise (Environment Protection Authority, 1999).* | An analysis of alternatives to mitigation methods outlined in the environmental assessment is discussed in section 6. |

# 2 SITE DESCRIPTION

## 2.1 Road Alignment

The Project will involve upgrading the existing highway to a dual carriageway, median separated, controlled access highway to allow vehicles to travel continuously with a posted speed limit of 110km/hr.

Within the K2K section, the horizontal alignment generally follows the existing Pacific Highway from the southern extents near Mingaletta Road to the northern extents at the interface with the Kempsey Bypass project. An overpass and diamond interchange is proposed at Kundabung Road. This operational noise assessment has considered the Class A design as per the staging report as it is this design that will be constructed and be operational in 2026. A separate operational noise assessment will be undertaken by RMS for stage 4 of the Project at the appropriate time.

The proposed northbound carriageway is generally located on the alignment of the existing Pacific Highway with intermittent reuse areas (between Chainage 31km500 to 32km220) and the southbound carriageway operating alongside. The exception to this is the section through the Maria River State Forest (approximate Chainage 33km000 to 36km600) where the north and southbound carriageways are located to the east of the existing highway and the existing highway will form part of the Class M standard highway as part of stage 4 of the Project.

## 2.2 Land Use

Land uses within the K2K section generally consist of residential, rural, state forests, National Parks and reserves. Rural land use, state forests and National Parks are the dominant land use. Residential areas are largely restricted to Kundabung, with scattered residential and rural-residential development scattered intermittently along the highway. Kundabung is a small rural community spread over a relatively large area and is identified as a settlement activity cluster. The village straddles the existing Pacific Highway with residential/rural residential and business clusters located on both sides of the highway. Commercial land uses within Kundabung include a Post Office, a motor inn and service station. Other commercial land uses within the K2K section include a poultry business and a pet resort.

Maria River National Park is located to the east of the proposed alignment and Kumbatine National Park is located to the west. Neither National Park would be impacted by the proposal. Maria River State Forest is traversed by the alignment. The state forest has been divided into management zones, including general management zones, harvesting exclusion zones, special prescription and management zones and areas for further assessment. Harvesting within the State forest contributes to State wide logging production and access is via Scrubby Creek Road.

## Figure 2-1 Overview of the Project & Proposed Staging

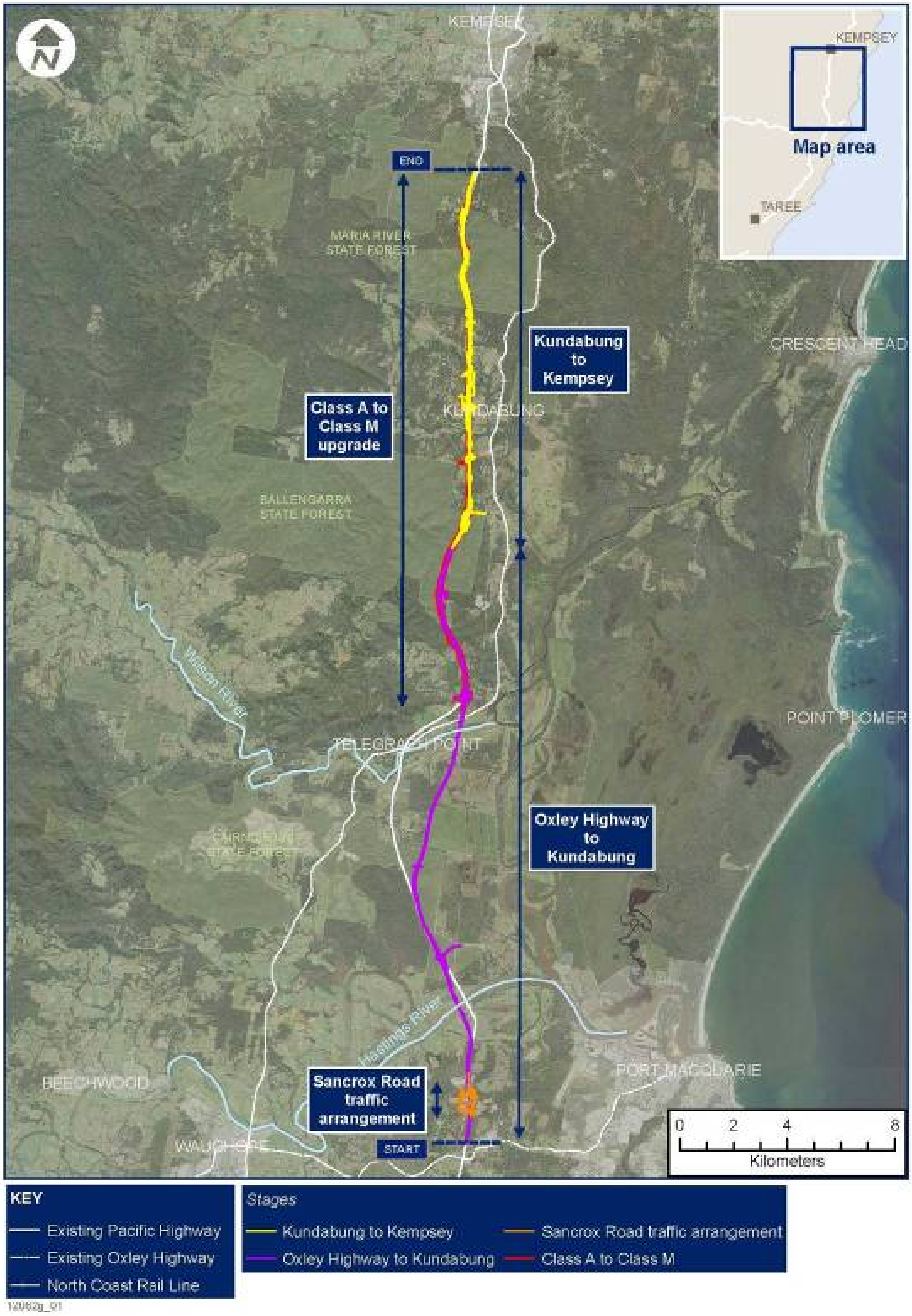
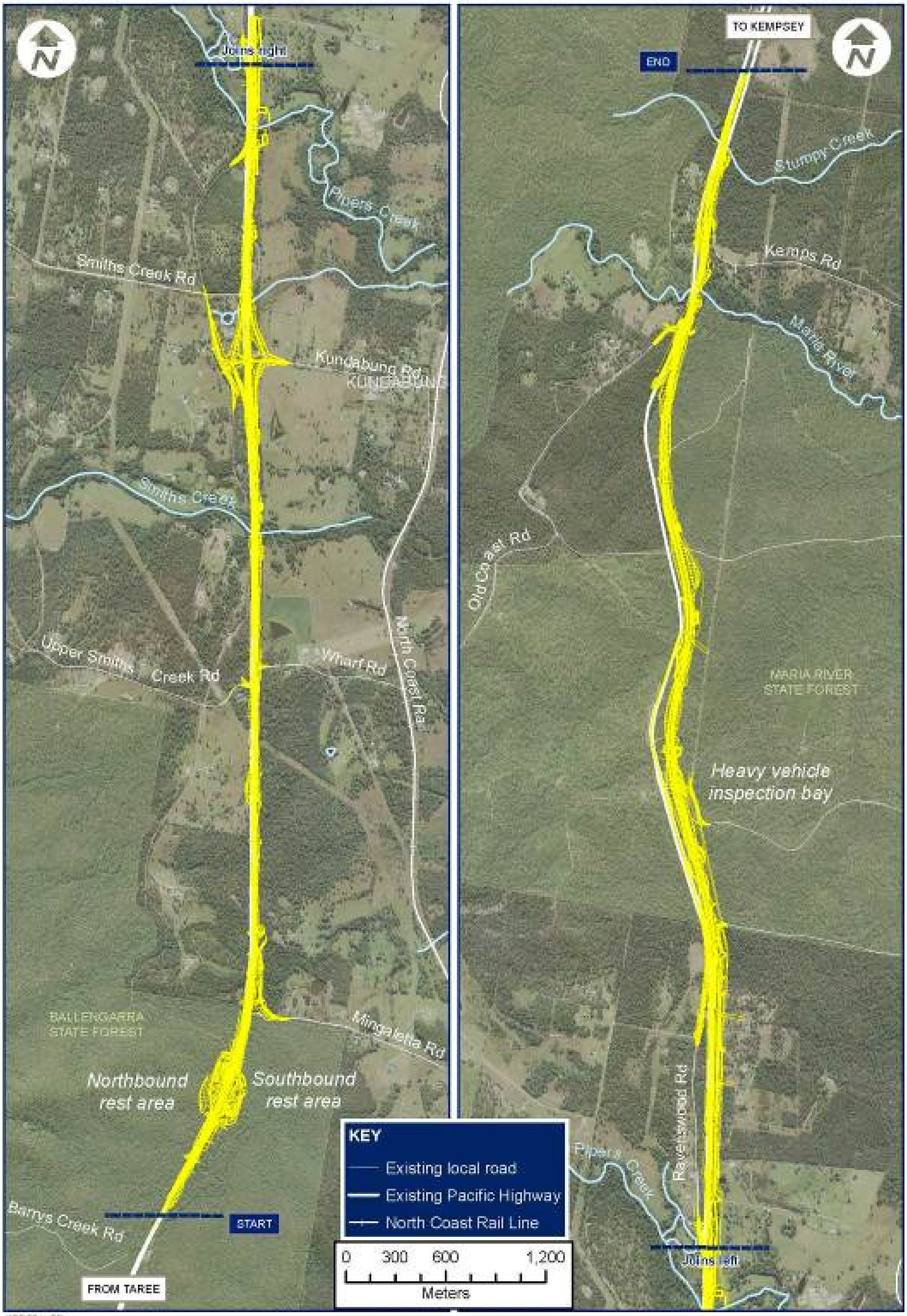


**Figure 2-2 Key features of the Kundabung to Kempsey Stage**



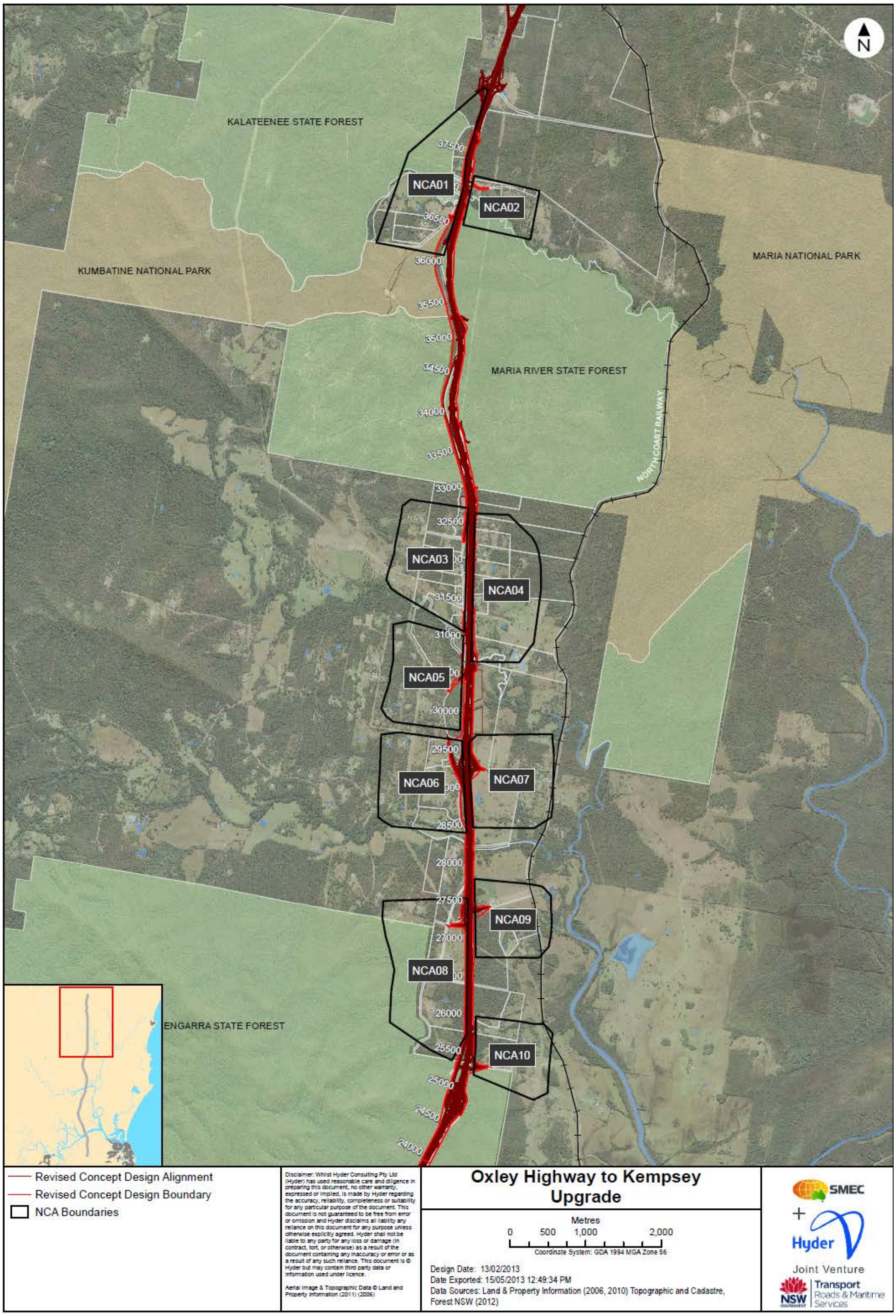
## 2.3 Noise Catchment Areas

All residential locations potentially affected by the upgrade are included in this noise assessment. Each location is identified by a unique number but for ease of reference, specific areas of the Project have been grouped together into noise catchment areas (NCAs). The K2K section of the Project considered in this report is associated with NCAs 1-10. Table 2-1 describes the location of each NCA, which are also shown in Figure 2-3.

### Table 2-1 Description of Noise Catchment Areas

| NCA | Location |
|---|---|
| 1 | North of Old Coast Road (Western side) |
| 2 | Kundabung Road to Kemps Road (Eastern side) |
| 3 | Pipers Creek to Beams Road (Western side) |
| 4 | Area north of Kundabung and across Ravenswood Road (Eastern side) |
| 5 | Upper Smiths Creek Road to Pipers Creek (Western side) |
| 6 | Smiths Creek to Upper Smiths Creek Road (Western side) |
| 7 | Kundabung area (Eastern side) |
| 8 | Mingaletta Road to Upper Smiths Creek Road (Western side) |
| 9 | Wharf Road area (Eastern side) |
| 10 | Mingaletta Road area (Eastern side) |

**Figure 2-3 Noise Catchment Areas (NCAs 1-10 applicable to K2K)**



# 3 PROJECT REQUIREMENTS & TRAFFIC NOISE CRITERIA

## 3.1 Project Requirements

Condition of Approval C13 addresses operational noise management requirements for the Project. Table 1-1 identifies the detail of CoA C13 and where within this report those requirements are addressed.

## 3.2 Operational Traffic Noise Criteria

Criteria for assessment of road traffic noise are set out in the NSW Government's *Environmental Criteria for Road Traffic Noise (ECRTN)*. The *ECRTN* was superseded by the Road Noise Policy *(RNP)* in July 2011 but is applied here as the environmental assessment was conducted prior to this date. RMS has also published the *Environmental Noise Management Manual (ENMM)* to assist in implementing the *ECRTN*.

Under the *ECRTN*, road developments for the Pacific Highway are classified as either 'new freeway' or 'redevelopment of an existing freeway'. The criteria set out in Table 3-1 would therefore apply.

**Table 3-1 *Environmental Criteria for Road Traffic Noise* Criteria for Operational Traffic Noise - Residences**

| Type of Development | Noise Level Criterion Day (7am-10pm) | Noise Level Criterion Night (10pm-7am) | Where Criteria are already Exceeded |
|---|---|---|---|
| New freeway or arterial road corridor | $L_{Aeq,15hr}$ 55dBA | $L_{Aeq,9hr}$ 50dBA | The new road should be designed as not to increase existing noise levels by more than 2dB.<br>Where feasible and reasonable, noise levels from existing roads should be reduced to meet the noise criteria. In many instances this may be achievable only through long-term strategies ... |
| Redevelopment of existing freeway/arterial road | $L_{Aeq,15hr}$ 60dBA | $L_{Aeq}$,9hr 55dBA | In all cases, the redevelopment should be designed so as not to increase existing noise levels by more than 2dB.<br>Where feasible and reasonable, noise levels from existing roads should be reduced to meet the noise criteria. In many instances this may be achievable only through long-term strategies ... |

In applying Table 3-1, the noise level criterion applies to the predicted noise level at opening of the Project (design year) and at a time 10 years after opening of the Project, which in this case is year 2026. Practice note (i) of the *Environmental Noise Management Manual* describes the circumstances under which the 'new freeway' and 'redevelopment of an existing freeway' criteria apply. Applying this practice note to the Project, the K2K section would be classified as being a '*redevelopment of existing freeway/arterial road*'.

# 4 TRAFFIC NOISE MEASUREMENTS

Noise measurements of existing traffic were conducted to characterise the existing noise environment and to validate the traffic noise model. Unattended long-term noise monitoring was undertaken at three locations across a two-week-period between Wednesday, 9 August and Thursday, 23 August 2012. In addition, several short-term attended measurements were undertaken at satellite locations to assist in model validation. The specific location of these monitoring points and the results are discussed below.

## 4.1 Unattended Noise Monitoring Procedure

Unattended noise monitoring locations were selected based on a detailed inspection of potentially affected areas, giving considerations to other noise sources which may adversely influence the measurements, security issues for the noise monitoring devices and gaining permission for access from the residents or landowner. This also included using some façade locations and some free field locations. It is noted all criteria relate to façade locations and assessment is undertaken on this basis, albeit free field locations are appropriate for model validation.

Unattended noise loggers were deployed between Wednesday, 9 August and Thursday, 23 August 2012 at the locations outlined in Table 4-1.

**Table 4-1 Unattended Noise Monitoring Locations**

| Number | Location | Position |
|---|---|---|
| U1 | 87 Scrubby Creek Road | Façade |
| U2 | 106 Ravenswood Road | Free field |
| U3 | 61 Mingaletta Road | Façade |

The unattended noise monitoring equipment used for these measurements consisted of an environmental noise logger set to A-Weighted, fast response, continuously monitoring over 15-minute sampling periods. This equipment is capable of remotely monitoring and storing noise level descriptors for later analysis. The equipment calibration was checked before and after the survey and no significant disparity was observed.

The logger determines $L_{A1}$, $L_{A10}$, $L_{A90}$ and $L_{Aeq}$ levels of the existing noise environment. The $L_{A1}$, $L_{A10}$ and $L_{A90}$ levels are the levels exceeded for 1%, 10% and 90% of the sample time respectively. The $L_{A1}$ is indicative of maximum noise levels due to individual noise events such as the occasional pass by of a heavy vehicle. The $L_{A90}$ level is normally taken as the background noise level. The $L_{Aeq}$ level is the Equivalent Continuous Sound Level and has the same sound energy over the sampling period as the actual noise environment with its fluctuating sound levels. This descriptor is used to measure and assess road traffic noise.

Meteorological data for the relevant periods was obtained from the nearest weather station at Telegraph Point. Periods in which it was likely to be raining, or when wind speeds exceeded 5m/s at microphone height, were excluded from analysis, in accordance with principles agreed by the Environment Protection Authority (EPA).

All loggers were placed in a position with more than 130 degrees view of the existing Pacific Highway. Two were placed at their respective residential façade with the remaining being placed in a free field position with respect to traffic noise. The noise results are presented in graphical form in Appendix C.

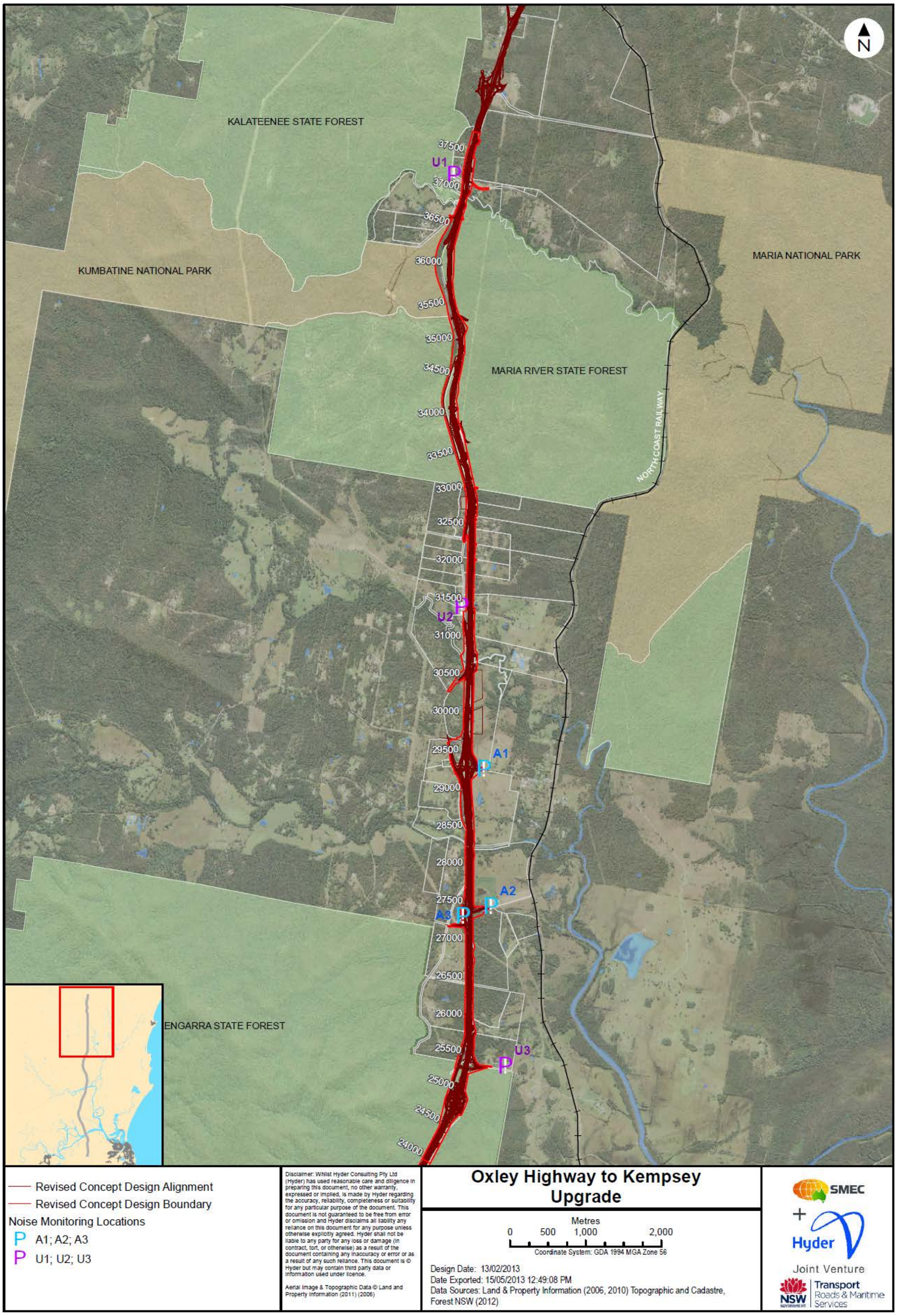
## 4.2 Attended Noise Measurements

Further to the unattended noise monitoring, attended noise measurements were made at appropriate "satellite" locations during the daytime period to provide more data for the traffic noise model validation process. Traffic volume and classifications were monitored concurrently during the attended noise monitoring periods. The locations were chosen to represent all potentially affected noise sensitive receivers along the route. The locations are listed in Table 4-2 and are depicted in Figure 4-1.

**Table 4-2 Attended Noise Monitoring Locations**

| Number | Location | Position |
|---|---|---|
| A1 | 31 Kundabung Road | Free field |
| A2 | 21 Upper Smiths Creek Road | Free field |
| A3 | 27 Wharf Road | Free field |

## Figure 4-1 Noise Monitoring Locations – Attended (A) and Unattended (U)



### 4.3 Noise Monitoring Results

A summary of the noise logger data is shown in Table 4-3. The additional attended measurement results are summarised in Table 4-4. Any short-term extraneous noise not assumed to be typical of traffic has been excluded. The results include some free field locations as well as façade locations.

**Table 4-3 Traffic Noise Summary**

| ID | Monitoring Location | Position | Setback Distance to the Edge of Road (m) | Daytime $L_{Aeq,15hr}$ (dBA) | Night Time $L_{Aeq,9hr}$ (dBA) |
|---|---|---|---|---|---|
| U1 | 87 Scrubby Creek Road | Façade | 140 | 55 | 54 |
| U2 | 106 Ravenswood Road | Free field | 28 | 55 | 54 |
| U3 | 61 Mingaletta Road | Façade | 510 | 49 | 50 |

**Table 4-4 Attended Noise Survey Results (All Free Field)**

| Location | Position | Time | Setback Distance to Road (m) | Approx. Angle of View | LAeq (dBA) | LAeq at Nearest Logger (dBA) |
|---|---|---|---|---|---|---|
| A1 | Free field | 15:45-16:00 | 240 | >150 | 52 | 55 (U2) |
| A2 | Free field | 08:00-08:15 | 275 | >150 | 51 | 49 (U3) |
| A3 | Free field | 15:00-15:15 | 77 | >150 | 62 | 55 (U2) |

# 5 TRAFFIC NOISE ASSESSMENT MODEL & VALIDATION

## 5.1 Methodology of Assessing Traffic Noise Impact

Detailed noise calculations have been carried out for the year of opening (2016) and 10 years after opening (2026). All calculations and modelling are based on the traffic volumes specified in the SHJV updated OH2K Traffic Forecasting Report (FDD-TRF-0001-OH2K R02). Geo-referenced aerials supplied by SHJV were used where applicable.

The following factors have been considered during the assessment process:

- Traffic volume and likely proportions of heavy vehicles;
- Topographical information along and surrounding the K2K section of the project corridor;
- Land use surrounding the K2K section of the project;
- Vehicle speed;
- Different noise emission levels and source heights;
- Location of potentially affected residences;
- Location of the noise sources on the motorway;
- Road surface types; and
- Road gradient.

## 5.2 Noise Modelling Procedures

Noise levels from the proposed road designs were calculated using procedures based on the *CoRTN (Calculation of Road Traffic Noise)* (UK Department of Transport, 1988) prediction algorithms. The standard prediction procedures were modified in the following ways:

- $L_{Aeq}$ values were calculated from the $L_{A10}$ values predicted by the *CoRTN* algorithms using the well-validated approximation $L_{Aeq,1hour} = L_{A10,1hr} - 3$ (NSW RTA, 2001). It is worth noting the predicted $L_{Aeq,1hr}$ is equivalent to the $L_{Aeq,period}$ as required by the noise criteria since the input is the “average” traffic flow per hour over the given daytime and night time periods;
- Noise source heights were set at 0.5m for cars, 1.5m for heavy vehicle engines and 3.6m for heavy vehicle exhausts, representative of typical values for Australian vehicles (Road Traffic Noise: Interim Traffic Noise Policy, 1992);
- Noise from a heavy vehicle exhaust is 8dBA lower than the (steady continuous) noise from the engine; and
- Previous research in Australia has established a negative correction to the *CoRTN* predictions of -1.7 dB for façade-corrected levels (Samuels and Saunders, 1982). Corrections for Australian conditions have been included in noise modelling for this project.

The model was implemented using SoundPLAN software (Version 7.1). Road design information was based on data supplied by RMS and SHJV.

Table 5-1 summarises other variables used in the noise model.

**Table 5-1 Variables used for Noise Modelling**

| Parameter | Comment |
|---|---|
| Traffic Speed | Existing road: Logarithmically weighted average based on hourly speed bins supplied by RMS.<br>Main carriageway (new sections): 115 km/h (day) and 120 km/h (night)<br>Local roads: 80 km/h on service roads. 60 km/h on access roads.<br>Ramps: 90 km/h. |
| Road Surface | Existing road: 0dBA for dense grade asphalt and +3dBA for chipseal. Specific sections verified by ground truthing.<br>Main carriageway (new sections): +3dBA for concrete & -2dBA for SMA<br>Ramps: +0dBA for DGAC.<br>Reuse area: Ch 24040 – 27780 NB & Ch 31500 – 32220 NB +3dBA chipseal |
| Façade Correction | +2.5dB in accordance with CoRTN and -1.7dB for ARRB's Australian condition correction at 1m from façade conditions. |
| Safety Factor Adjustments | +1.8dBA total adjustment to accommodate +1dBA risk allowance required by Pacific Highway projects and +0.8dBA for 20% adjustment of traffic volumes as requested by RMS. |
| Calibration Adjustments | -2.5dBA to daytime results to accommodate measured average day/night difference of 0.8dBA as requested by RMS. See section 5.5. |
| Traffic Volume | Supplied by SHJV / RMS. Based on surveys / modelling for existing and extrapolated to 2016 and 2026. |
| Terrain | Combination of 0.5m and 10m interval contours supplied by SHJV. |
| Ground Absorption | Ground absorption factor was set to 75% and has been applied over the full length of the K2K project site. |
| Calculation Settings | Grid space of 20m; height above ground = 1.5m; grid interpretation field size = 9 x 9; grid interpretation min/max = 2dBA; grid interpretation difference = 0.1dBA; angle increment = 1 degree; reflection depth = 0; number of reflections = 0; and maximal search radius = 3000m |

## 5.3 Modelling Scenarios

The following scenarios were modelled under both daytime and night time conditions.

- Existing road. Current noise levels were calculated based on a traffic survey conducted by RMS. This was used to validate the noise model by comparing predicted levels with those measured at corresponding noise logger locations. It was also used to determine current noise levels at all residences to set criteria.
- Year 2016. Noise levels were predicted based on provided traffic data.
- Year 2026. Noise levels were predicted based on provided traffic data. Results are compared with existing results and baseline criteria.

### 5.4 Existing Pavement Validation

Validation of the existing road pavement was undertaken at the same time as the noise monitoring in August 2012. The road pavement was visually inspected and pavement types recorded. Approximate distances of each pavement type were measured using a car odometer. Two pavement types were recorded. Dense grade asphalt was dominant with some small patches of chipseal also present. These features were incorporated into the noise model.

### 5.5 Traffic Data

Traffic inputs were provided by SHJV, are based on the Class A design, and are categorised as being associated with the main carriageway, ramps and local roads for the existing road as well as the year of opening, 2016, and 10 years after opening in 2026. The inputs are summarised below.

**Table 5-2 Existing Traffic Summary (Skyhigh South Kempsey ATC Report 2012)**

| Existing Traffic | Direction | Light Vehicles daytime (7am-10pm) | Heavy Vehicles daytime (7am-10pm) | Light Vehicles night time (10pm-7am) | Heavy Vehicles night time (10pm-7am) |
|---|---|---|---|---|---|
| Yarrabee Road to Mingaletta Road | NB | 4168 | 881 | 450 | 327 |
| Yarrabee Road to Mingaletta Road | SB | 4230 | 871 | 521 | 355 |
| Mingaletta Road to Wharf Road | NB | 3742 | 889 | 696 | 330 |
| Mingaletta Road to Wharf Road | SB | 3469 | 1347 | 681 | 302 |
| Wharf Road to Kundabung Road | NB | 4190 | 797 | 666 | 294 |
| Wharf Road to Kundabung Road | SB | 4400 | 815 | 750 | 274 |
| Kundabung Road to Ravenswood Road | NB | 4607 | 732 | 1009 | 256 |
| Kundabung Road to Ravenswood Road | SB | 4693 | 733 | 1072 | 206 |
| Ravenswood Road to Kemps Road | NB | 4070 | 834 | 605 | 299 |
| Ravenswood Road to Kemps Road | SB | 4121 | 1002 | 708 | 281 |
| Kemps Road to Stumpy Creek bridge | NB | 4027 | 1048 | 494 | 367 |
| Kemps Road to Stumpy Creek bridge | SB | 4256 | 1033 | 774 | 277 |

**Table 5-3 Traffic Volumes Year 2016 (Traffic Forecasting Report FDDTRF-0001-OH2K-R-02 Table F1, Table F2 and Table F3)**

| Year 2016 (Opening Completion) | Direction | Light Vehicles daytime (7am-10pm) | Heavy Vehicles daytime (7am-10pm) | Light Vehicles night time (10pm-7am) | Heavy Vehicles night time (10pm-7am) |
|---|---|---|---|---|---|
| Pacific Highway - Yarrabee Interchange to Kundabung Interchange | NB | 4210 | 980 | 550 | 420 |
| Pacific Highway - Yarrabee Interchange to Kundabung Interchange | SB | 4300 | 970 | 370 | 420 |
| Pacific Highway - North of Kundabung Interchange | NB | 4470 | 990 | 560 | 390 |
| Pacific Highway - North of Kundabung Interchange | SB | 4550 | 970 | 370 | 350 |
| Kundabung Interchange ramps | NB OFF | 180 | 40 | 80 | 50 |
| Kundabung Interchange ramps | NB ON | 430 | 50 | 90 | 30 |
| Kundabung Interchange ramps | SB OFF | 590 | 80 | 100 | 40 |
| Kundabung Interchange ramps | SB ON | 340 | 80 | 110 | 120 |
| Mingaletta Road Overpass | EB | 70 | 20 | 20 | 20 |
| Mingaletta Road Overpass | WB | 60 | 20 | 20 | 10 |
| Mobbs Drive | NB | 20 | 10 | 10 | 10 |
| Mobbs Drive | SB | 20 | 10 | 10 | 10 |
| Mingaletta Road to Upper Smith Creek Service Road | NB | 40 | 20 | 20 | 10 |
| Mingaletta Road to Upper Smith Creek Service Road | SB | 90 | 30 | 20 | 20 |
| Upper Smith Creek Road | EB | 60 | 20 | 20 | 10 |
| Upper Smith Creek Road | WB | 70 | 20 | 20 | 20 |
| Wharf Road Overpass | EB | 20 | 10 | 10 | 10 |
| Wharf Road Overpass | WB | 20 | 10 | 10 | 10 |
| Smith Creek Service Road | NB | 70 | 40 | 20 | 20 |
| Smith Creek Service Road | SB | 120 | 50 | 20 | 30 |
| Kundabung Road Overpass | EB | 310 | 80 | 110 | 100 |
| Kundabung Road Overpass | WB | 540 | 70 | 100 | 40 |
| Pipers Creek Service Road | NB | 40 | 10 | 10 | 10 |
| Pipers Creek Service Road | SB | 130 | 30 | 40 | 50 |

**Table 5-4 Traffic Volumes Year 2026 (Traffic Forecasting Report FDDTRF-0001-OH2K-R-02 Table F4, Table F5 and Table F6)**

| Year 2026 (10 years after Opening Completion) | Direction | Light Vehicles daytime (7am-10pm) | Heavy Vehicles daytime (7am-10pm) | Light Vehicles night time (10pm-7am) | Heavy Vehicles night time (10pm-7am) |
|---|---|---|---|---|---|
| Pacific Highway - Yarrabee Interchange to Kundabung Interchange | NB | 5340 | 1260 | 670 | 500 |
| Pacific Highway - Yarrabee Interchange to Kundabung Interchange | SB | 5430 | 1250 | 500 | 510 |
| Pacific Highway - North of Kundabung Interchange | NB | 5590 | 1240 | 670 | 470 |
| Pacific Highway - North of Kundabung Interchange | SB | 5670 | 1210 | 480 | 430 |
| Kundabung interchange ramps | NB OFF | 190 | 60 | 90 | 50 |
| Kundabung interchange ramps | NB ON | 440 | 40 | 90 | 20 |
| Kundabung interchange ramps | SB OFF | 600 | 60 | 110 | 40 |
| Kundabung interchange ramps | SB ON | 360 | 100 | 130 | 120 |
| Mingaletta Road Overpass | EB | 70 | 30 | 20 | 20 |
| Mingaletta Road Overpass | WB | 60 | 30 | 20 | 10 |
| Mobbs Drive | NB | 30 | 10 | 10 | 10 |
| Mobbs Drive | SB | 20 | 10 | 10 | 10 |
| Mingaletta Road to Upper Smith Creek Service Road | NB | 40 | 20 | 10 | 10 |
| Mingaletta Road to Upper Smith Creek Service Road | SB | 90 | 30 | 10 | 20 |
| Upper Smith Creek Road | EB | 60 | 30 | 20 | 20 |
| Upper Smith Creek Road | WB | 70 | 30 | 20 | 20 |
| Wharf Road Overpass | EB | 30 | 10 | 10 | 10 |
| Wharf Road Overpass | WB | 20 | 10 | 10 | 10 |
| Smith Creek Service Road | NB | 70 | 40 | 30 | 20 |
| Smith Creek Service Road | SB | 120 | 40 | 20 | 30 |
| Kundabung Road Overpass | EB | 330 | 90 | 130 | 110 |
| Kundabung Road Overpass | WB | 550 | 60 | 100 | 40 |
| Pipers Creek Service Road | NB | 40 | 10 | 10 | 10 |
| Pipers Creek Service Road | SB | 140 | 40 | 50 | 50 |

### 5.6 Validation of Noise Model

RMS requires that the noise modelling process used to predict existing and future noise levels is validated against existing noise levels and any calibration adjustments are included accordingly. The SoundPlan noise model (using *CoRTN*) has been established primarily on this basis. Measured results are compared with model predictions for the existing road using current traffic volumes provided by and using logarithmically weighted equivalent vehicle speeds based on each hour of the day and night to generate an avaergae daytime or night time speed. The measured noise levels will include traffic noise and possible other extraneous noise. Extraneous noise typically increases with distance from the road.

For example, at 61 Mingaletta Road an inspection of logger graphs indicate increases in noise levels which do not correspond to simultaneous increases in traffic volumes or speeds. This suggests at this location there are periods of extraneous noise affecting measured levels during the night time period. The measured noise levels at this location (which can be attributed to traffic noise) has been estimated based on assuming the quieter periods of day and night are all traffic noise and adjusting this data to the overall traffic volumes in the day and night time. Even this process is likely to over estimate the contribution of traffic noise.

Table 5-5 shows the difference between measured and predicted values of the measurement locations along the K2K section of the existing highway. The results are discussed below.

**Table 5-5 Model Validation Results**

| Location | Daytime measured | Daytime predicted | Daytime difference | Night time measured | Night time predicted | Night time difference |
|---|---|---|---|---|---|---|
| 87 Scrubby Creek Road | 55.1 | 57.6 | 2.5 | 54.4 | 54.1 | -0.3 |
| 106 Ravenswood Road | 54.7 | 58.2 | 3.5 | 53.9 | 54.7 | 0.9 |
| 61 Mingaletta Road | (49) 46.1 | 47.5 | 1.4 | (50) 46 | 43.1 | -2.9 |

Brackets denotes overall measured level including extraneous noise

Results to within 2dBA (measured vs. predicted) are generally considered acceptable given the expected accuracy of standard noise modelling procedures in conjunction with variability in traffic speeds along the whole alignment.

Predicted noise levels at daytime are generally outside this +/- 2dB range but are within this +/- 2dB range during the night time period with an exception at 61 Mingaletta Road. The residence at 61 Mingaletta Road is located at a distance of over 500m from the road, and here there is a discrepancy between predicted and measured noise levels. The *CoRTN* calculation routines are not designed for prediction at these distances, and meteorological effects can also have an important influence on noise levels.

Due to more stringent criteria applying at night time and the expectation of lower extraneous noise, the night time period is considered more important with respect to the traffic noise assessment and need for mitigation and is therefore the focus with regards to model validation.

To ensure that there is a difference between predicted daytime and night time levels which is consistent with the 0.8dB difference observed in the measured levels at those receivers close to the road (and is also consistent with recent findings for other projects along the Pacific

Highway), an average correction of -2.5dBA has been applied to all the daytime predictions when undertaking the noise assessment and presenting noise contours for the future scenarios.

Several attended measurements were also taken during the daytime to validate the noise model. The -2.5dBA daytime correction is reflected in these results and are summarised in Table 5-6.

**Table 5-6 Validation against Attended Measurements**

| Location | Position | Measured $L_{Aeq}$ (dBA) | Predicted $L_{Aeq}$ (dBA) | Difference (dBA) |
|---|---|---|---|---|
| A1 | Free field | 51.8 | 51.1 | -0.7 |
| A2 | Free field | 51 | 50.6 | -0.4 |
| A3 | Free field | 57.8 | 57 | -0.8 |

## 5.7 Ground Truthing of receivers

Ground-truthing of receivers identified in the noise model was undertaken in March/April 2013. This allowed differentiation between actual sensitive receivers, such as residences, and other structures such as sheds and garages. The results of this field study were used to identify the receivers requiring treatment as shown in Table 6–1.

# 6 PREDICTED FUTURE OPERATIONAL NOISE LEVELS

## 6.1 General Assessment Methodology

Noise level predictions for the year 2016 (year of opening) and 2026 (10 years after opening) have been calculated at all potentially affected residential locations for the K2K section of the Project. Details concerning noise levels for relevant receivers in 2016 and 2026 are shown in Appendix A, with noise contour maps presented in Appendix B.

The receiver numbers used to identify residences are similar to those applied in the Environmental Assessment. Aerial photographs showed that there were additional receivers that were not included in the Environmental Assessment. Additional receivers have been included that are within the 55dBA contour line as residences below this level would meet the more stringent night time criteria. The additional receivers are given IDs 1000-1055. All receivers included in the assessment have been confirmed by a ground truthing survey conducted by RMS.

Based on the outputs of the noise model, night time noise levels exceed the base criteria by the highest margin and also exhibit the largest increase when compared to existing noise levels. Consequently, most receivers exceeding *ECRTN* criteria are either only during the night, or in combination with the day. Mitigation measures designed to meet relevant criteria at night will also meet them during the daytime.

## 6.2 Determining Feasible and Reasonable Noise Mitigation

Where the 'base' criteria in Table 3-1 are already exceeded, Practice Note (iv) of the RMS's *Environmental Noise Management Manual (ENMM)* provides further discussion of situations where provision of additional controls would be considered 'feasible and reasonable'. It should be acknowledged that these considerations apply only if it can be demonstrated that all 'feasible and reasonable' traffic management and other road design opportunities for reducing traffic noise have been exhausted.

For road 'redevelopments' where existing noise levels already exceed the base noise levels, it is generally not considered reasonable to apply additional treatments (after opportunities for noise control have been incorporated into the road design) if predicted design year noise levels:

- Do not exceed the *ECRTN* allowance of 2dBA over 'existing' noise levels, and
- Will not be 'acute' (i.e. do not exceed 65dBA $L_{Aeq,15h}$ and 60dBA $L_{Aeq,9h}$).

Two further points should be noted in applying the guidelines in the *ENMM*. Firstly, *ECRTN* indicates (technical note ix) that if the existing noise level is below the criterion but within 2dB of the criterion, then the 2dB allowance may also be applied. Hence, the exclusion above is also taken to apply to cases where an existing noise level below the 'base' criterion is predicted to increase by 2dB or less.

## 6.3 Predicted Noise Levels for 2026 (10 Years after Opening)

For the K2K section of the Project, a total of 49 residences in 10 noise catchment areas have been identified as requiring mitigation in accordance with guidelines set out in the *ENMM*.

In addition, one residence was identified in the Environmental Assessment as requiring treatment that was not found to require mitigation in the present assessment (see Table 6-3). Based on commitments made at the EA stage, this residence remains among residences requiring treatment as reflected in Table 6-1.

A detailed breakdown of all receivers in the Project is provided in Appendix A. Noise Contours are shown in Appendix B.

### Table 6-1 Receivers Requiring Mitigation

| NCA | Receiver No | Noise Goal Day | Noise Goal Night | Existing Noise Level Day | Existing Noise Level Night | 2016 Design Noise Levels Day | 2016 Design Noise Levels Night | 2026 Design Noise Levels Day | 2026 Design Noise Levels Night | 2026 Design Noise Acute? Day | 2026 Design Noise Acute? Night |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 493 | 60 | 55 | 45.9 | 44.8 | 48.9 | 48.1 | 49.9 | 48.9 | N | N |
| **1** | **502** | **60** | **55** | **58** | **57** | **61.4** | **60.8** | **62.2** | **61.6** | **N** | **Y** |
| **1** | **503** | **60** | **55** | **63.2** | **62.3** | **67.2** | **66.7** | **68.1** | **67.5** | **Y** | **Y** |
| 1 | 1000 | 60 | 55 | 57.1 | 56.1 | 59.7 | 59.1 | 60.6 | 59.9 | N | N |
| **1** | **1027** | **60** | **55** | **60.8** | **59.9** | **62.8** | **62.1** | **63.7** | **62.9** | **N** | **Y** |
| **1** | **1028** | **60** | **55** | **58.9** | **57.9** | **61** | **60.4** | **62** | **61.2** | **N** | **Y** |
| **2** | **498** | **60** | **55** | **56.7** | **55.5** | **60.4** | **59.6** | **61.4** | **60.5** | **N** | **Y** |
| **3** | **466** | **60** | **55** | **59.3** | **58.3** | **64.1** | **64** | **65** | **64.7** | **Y** | **Y** |
| **3** | **467** | **60** | **55** | **56.9** | **54.9** | **62** | **61.8** | **63** | **62.6** | **N** | **Y** |
| **3** | **475** | **60** | **55** | **56.1** | **54.9** | **61.4** | **61.3** | **62.4** | **62** | **N** | **Y** |
| 3 | 488 | 60 | 55 | 54 | 52.8 | 59.1 | 58.5 | 60.1 | 59.3 | N | N |
| **3** | **746** | **60** | **55** | **58.9** | **55.1** | **64.4** | **64.5** | **65.3** | **65.1** | **Y** | **Y** |
| 3 | 818 | 60 | 55 | 53.5 | 52.2 | 58.4 | 57.7 | 59.4 | 58.5 | N | N |
| **3** | **821** | **60** | **55** | **56.7** | **55.5** | **61.3** | **61.5** | **62.3** | **62.2** | **N** | **Y** |
| 3 | 1013 | 60 | 55 | 50.1 | 48.8 | 55.7 | 55.1 | 56.6 | 55.8 | N | N |
| 3 | 1014 | 60 | 55 | 51.1 | 49.9 | 56.3 | 55.8 | 57.3 | 56.5 | N | N |
| **3** | **1015** | **60** | **55** | **56.7** | **53.3** | **61.7** | **61.5** | **62.6** | **62.2** | **N** | **Y** |
| 3 | 1016 | 60 | 55 | 53.1 | 50.7 | 57.9 | 57.6 | 58.9 | 58.3 | N | N |
| **4** | **471** | **60** | **55** | **58.4** | **57.4** | **65.4** | **64.8** | **66.4** | **65.6** | **Y** | **Y** |
| **4** | **478** | **60** | **55** | **54.5** | **53.3** | **60** | **59.2** | **60.9** | **60** | **N** | **Y** |
| **4** | **484** | **60** | **55** | **56.1** | **54.8** | **61.3** | **60.6** | **62.3** | **61.4** | **N** | **Y** |
| **4** | **486** | **60** | **55** | **57.1** | **55.9** | **62.6** | **61.9** | **63.6** | **62.7** | **N** | **Y** |
| 4 | 763 | 60 | 55 | 51.8 | 50.7 | 57.2 | 56.5 | 58.1 | 57.2 | N | N |
| 4 | 817 | 60 | 55 | 53.9 | 52.7 | 59.1 | 58.4 | 60 | 59.2 | N | N |
| **4** | **1012** | **60** | **55** | **57.4** | **56.3** | **62.7** | **62** | **63.7** | **62.8** | **N** | **Y** |
| **5** | **448** | **60** | **55** | **56.1** | **55.1** | **61.2** | **60.4** | **62.1** | **61.2** | **N** | **Y** |
| 5 | 459 | 60 | 55 | 52.3 | 51.3 | 57.7 | 58 | 58.6 | 58.6 | N | N |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 5 | 1003 | 60 | 55 | 49.6 | 48.5 | 54.9 | 54.6 | 55.8 | 55.2 | N | N |
| 5 | 1039 | 60 | 55 | 50.7 | 49.5 | 55.7 | 55.1 | 56.6 | 55.7 | N | N |
| 5 | 1040 | 60 | 55 | 52 | 51 | 57 | 56.5 | 58 | 57.3 | N | N |
| 5 | 1041 | 60 | 55 | 52.5 | 51.4 | 57.4 | 56.9 | 58.3 | 57.6 | N | N |
| **6** | **409** | **60** | **55** | **62** | **61.2** | **63.6** | **63.1** | **64.6** | **64** | **N** | **Y** |
| **6** | **436** | **60** | **55** | **57.2** | **56.5** | **62.8** | **63.7** | **63.6** | **64.1** | **N** | **Y** |
| 6 | 712 | 60 | 55 | 51.9 | 51.1 | 55.1 | 54.6 | 56.1 | 55.5 | N | N |
| 6 | 729 | 60 | 55 | 53.5 | 52.6 | 57.5 | 57.9 | 58.4 | 58.5 | N | N |
| 6 | 809 | 60 | 55 | 52.7 | 51.8 | 56.4 | 56 | 57.4 | 56.6 | N | N |
| **6** | **1004** | **60** | **55** | **60.1** | **59.3** | **61.8** | **61.4** | **62.7** | **62.1** | **N** | **Y** |
| 7 | 438 | 60 | 55 | 54.1 | 53.2 | 58.9 | 58.5 | 59.7 | 59.2 | N | N |
| 7 | 439 | 60 | 55 | 50.6 | 49.7 | 55.5 | 55.1 | 56.4 | 55.6 | N | N |
| **8** | **397** | **60** | **55** | **56.6** | **55.6** | **59.5** | **59.1** | **60.5** | **60** | **N** | **Y** |
| **8** | **398** | **60** | **55** | **56.3** | **55.3** | **59.5** | **59.2** | **60.7** | **60** | **N** | **Y** |
| **8** | **399** | **60** | **55** | **62.2** | **61.2** | **65.2** | **64.8** | **66.2** | **65.6** | **Y** | **Y** |
| **8** | **1023** | **60** | **55** | **56.7** | **55.8** | **60.1** | **59.7** | **61.1** | **60.6** | **N** | **Y** |
| 8 | 1024 | 60 | 55 | 53.4 | 52.4 | 57 | 56.6 | 58.1 | 57.5 | N | N |
| 8 | 1034 | 60 | 55 | 51.9 | 51 | 56 | 55.7 | 57 | 56.5 | N | N |
| **8** | **1046** | **60** | **55** | **57.1** | **56.2** | **61** | **60.7** | **62** | **61.5** | **N** | **Y** |
| **8** | **1047** | **60** | **55** | **58.5** | **57.6** | **62.4** | **62.1** | **63.5** | **63** | **N** | **Y** |
| **9** | **396** | **60** | **55** | **56** | **55** | **61.1** | **61** | **61.9** | **61.6** | **N** | **Y** |
| 9 | 405 | 60 | 55 | 53.1 | 52.1 | 57.8 | 57.5 | 58.7 | 58.3 | N | N |
| 10 | 688 | 60 | 55 | 53.5 | 52.5 | 58.9 | 58.6 | 60 | 59.4 | N | N |

**Bold** figures are receivers experiencing acute noise levels.

## 6.4 Discrepancies with the Environmental Assessment

The modelling identified 49 receivers requiring mitigation according to the guidelines set in the *ENMM*. This is compared to 31 receivers identified in the Environmental Assessment.

Reasons for the discrepancies in results relate to differing inputs into the respective noise models and can be attributed to a combination of:

- **Road Surface:** Concrete was modelled in both the detailed design and the EA. While +3dB was implemented in the detailed design, the EA only applied this correction for the night time scenario. A +2.5dB correction was applied during the daytime scenario because of a lower percentage of heavy vechicles. Reuse areas, as outlined in Table 5-1, consisting of sections of SMA (-2dB correction) were also new additions to the detailed design.

- **Vehicle Speed:** The EA modelled heavy vehicle speeds as being lower than light vehicle speeds i.e. 105km/h day and 110km/h night. Speeds of 115km/h and 120km/h were applied to light vehicles at day and night respectively. These speeds were used for both heavy vehicles and light vehicles in the noise model for the detailed design.

- **Topography & Road Detail:** The horizontal alignment has been developed in detailed design and has been used for the analysis. In some areas there are roadside differences that result in different levels of shielding towards nearby residences. In some cases these differences were associated with areas around interchanges that had been modelled to a greater level of detail compared to the EA. At locations further from the road there were some differences in receiver heights caused by differences in topography between the two models. In most cases these were minor with the exception of some that were in the order of 3-5m.

- **Traffic:** 2026 total traffic volumes were 30% higher in the EA compared to the detailed design. Heavy vehicle percentages were identical during the daytime but differed at night. EA heavy vehicle percentages were consistently about 60% whereas the detailed design modelled 40-50%.

- **Receivers:** Receivers numbered 1000-1055 were not included in the EA modelling, as discussed in section 6.1. Some of these receivers have been identified for mitigation. There are 22 residences requiring mitigation according to the detailed design that were not identified in the EA. Eighteen of the 22 residences are newly identified receivers that were not included in the EA model. Moreover, some receivers identified for mitigation in the EA have been excluded from the detailed design model based on results of the ground truthing survey. There are four receivers identified in the EA as requiring treatment that, based on the detailed design, three have since been excluded from the detailed design after the groundtruthing survey (refer Table 6-3).

**Table 6-2 Additional Residences Identified for Mitigation in the Detailed Design**

| NCA | Receiver ID | Remarks |
|---|---|---|
| 1 | 502 | - |
| 1 | 1000 | Not modelled in EA |
| 1 | 1027 | Not modelled in EA |
| 1 | 1028 | Not modelled in EA |
| 3 | 818 | - |
| 3 | 1013 | Not modelled in EA |
| 3 | 1014 | Not modelled in EA |
| 3 | 1015 | Not modelled in EA |
| 3 | 1016 | Not modelled in EA |
| 4 | 763 | - |
| 4 | 817 | - |
| 4 | 1012 | Not modelled in EA |
| 5 | 1003 | Not modelled in EA |
| 5 | 1039 | Not modelled in EA |
| 5 | 1040 | Not modelled in EA |
| 5 | 1041 | Not modelled in EA |
| 6 | 1004 | Not modelled in EA |
| 8 | 1023 | Not modelled in EA |
| 8 | 1024 | Not modelled in EA |
| 8 | 1034 | Not modelled in EA |
| 8 | 1046 | Not modelled in EA |
| 8 | 1047 | Not modelled in EA |

**Table 6-3 Residences Identified for Mitigation in the EA that are not in the Detailed Design**

| NCA | Receiver ID | Remarks |
|---|---|---|
| 1 | 493 | Did not meet ENMM guidelines for treatment. Included in Table 6-1. |
| 4 | 480 | Excluded after ground truthing |
| 8 | 683 | Excluded after ground truthing |
| 8 | 695 | Excluded after ground truthing |

### 6.5 Design of Operational Noise Mitigation Measures

For all locations where noise mitigation would be required, guidance is taken from the *ENMM* which was published to assist in interpretation of the *Environmental Criteria for Road Traffic Noise (ECRTN)* and in particular, provides guidance on the selection of appropriate mitigation measures. It should be noted that the *ENMM* states that community views should be fully taken into account in following the processes for evaluating and selecting noise treatments.

In the *ECRTN* the EPA recommends the priority for treatment as follows:

- Road design and traffic management;
- Quiet pavement surface;
- In corridor noise barriers / mounds; and
- At property treatments or localised barriers/ mounds.

In considering road pavement, with the exception of areas where the existing Pacific Highway pavement is being reused, the remainder of the K2K section of the Project consists of a concrete road surface for both north and southbound lanes. A reduction in noise level generation of approximately 5dB may be expected through the application of low noise pavements such as Stone Mastic Asphalt (SMA) instead of concrete.

The *ENMM* states that noise barriers must achieve a noise reduction of at least 5dB at the most affected residence to be considered a viable noise treatment option. For barriers higher than 4m a 10dB reduction is expected. This requirement determines a minimum height and length for every barrier.

Practice note IV of the *ENMM* outlines a process to evaluate noise treatment options on the basis of “feasibility” and “reasonableness”. “Feasibility” relates to engineering considerations while “reasonableness” relates to the application of wider judgements. The ENMM states that the following factors to be considered for a “reasonable” solution are:

- The noise reduction provided and the number of people protected
- The cost of mitigation, including the total cost (including life cycle costs) and cost variations with different benefits provided
- Community views and wishes
- Visual impacts
- Existing and future noise levels, including changes in noise levels
- The benefits arising from the proposed road or road redevelopment

The cost and benefit of “at road” (noise barriers or quiet pavements) is highly dependent on the residential density throughout the Project. Residential areas are largely restricted to Kundabung, with scattered residential and rural-residential development spread intermittently along the highway. Kundabung is a small rural community spread over a relatively large area and is identified as a settlement activity cluster.

The *ENMM* suggests that where residences are closely grouped in numbers of 3 or less, then “at road” treatment would not be cost effective.

Areas of higher density are generally set back at distances of typically 200-300m. In order to provide a reduction in noise level of at approximately 5dBA or more at these residences, significant lengths (in excess of 1km) of “at road” treatments are required so that the angle of view to the “at road” treatment is sufficient enough to each residence. This significantly, diminishes the cost effectiveness per residence.

In addition, there are potential visual implications associated with barriers for both the community and motorists perspective which are addressed in the RMS publication “Beyond the pavement”.

Consequently, all these considerations do not make “at road” treatments a “reasonable” solution for this Project.

For this section of the Pacific Highway it is considered most “feasible” and “reasonable” to apply architectural treatments to affected residences. For these properties, where the exceedances of the base criteria are up to 10dB, provision of fresh air ventilation, sealing of wall vents and upgraded window and door seals is generally considered appropriate, but should be considered on a case by case basis with considerations of cost and practicality. RMS may spend up to $15,000 for each resident requiring treatment and incurs a lower total cost compared to other treatment options. The EA contains information, as a guide, which cross-references the noise control options with the level of noise reduction required. This information is reproduced in Table 6-4.

**Table 6-4 Architectural Treatment Guide**

***Option 1 Mechanical ventilation only***

*<5dB(A) reduction* — *Where external noise levels are less than 5dB(A) above the ECRTN ‘base’ criteria, the internal ‘base’ criteria may be achieved with windows closed. A light framed building with single glazed windows will provide a minimum noise reduction of up to 15dB(A) from outside to inside when windows are closed. If the ECRTN internal ‘base’ criteria can only be achieved with windows closed, then mechanical ventilation or air conditioning must be provided to ensure fresh airflow inside the dwelling so to meet the requirements of the Building Code of Australia.*

***Option 2 Mechanical ventilation and sealing of wall vents***

*5-10 dB(A) reduction* — *Where external noise levels are less than 10dB(A) above the ECRTN ‘base’ criteria, the internal ‘base’ criteria may be achieved with windows closed. A light framed building with single glazed windows will provide a minimum noise reduction of up to 20dB(A) from outside to inside (RTA Noise Management Manual p20) when windows are closed and wall vents are sealed. If the ECRTN internal ‘base’ criteria can only be achieved with windows closed, then mechanical ventilation or air conditioning must be provided to ensure fresh airflow inside the dwelling so to meet the requirements of the Building Code of Australia.*

*It is important to ensure that mechanical ventilation does not provide a new noise leakage path into the dwelling and does not create a noise nuisance to neighbouring residential premises.*

***Option 3 Upgraded windows, glazing and doors***

| | |
|---|---|
| *>10 dB(A) reduction* | *Where the predicted external noise level exceeds the ECRTN 'base' criteria by significantly more than 10dB(A), then upgraded windows and glazing and the provision of solid core doors will be required on the facades exposed to the proposed Upgrade, in addition to the mechanical ventilation described in Option 1. Note that these upgrades are only suitable for masonry buildings. It is unlikely that this degree of upgrade would provide significant benefits to light framed structures should there be no acoustic insulation in the walls.* |

On the basis that the feasible and reasonable form of mitigation relies on architectural treatment, no assessment of maximum noise levels is warranted as it would not result in any change to the mitigation design.

## 6.6 Review of Suitability of Environmental Assessment Operational Noise Mitigation

The EA recommends architectural treatment for residences requiring mitigation according to *ENMM* guidelines (for the same reasons discussed in section 6.5 above) above. Although there are some changes in the specific number of receivers requiring treatment as discussed in section 6.4, there are no significant departures regarding land use and distribution of receivers that would require a change in the mitigation measures proposed as proposed in the EA.

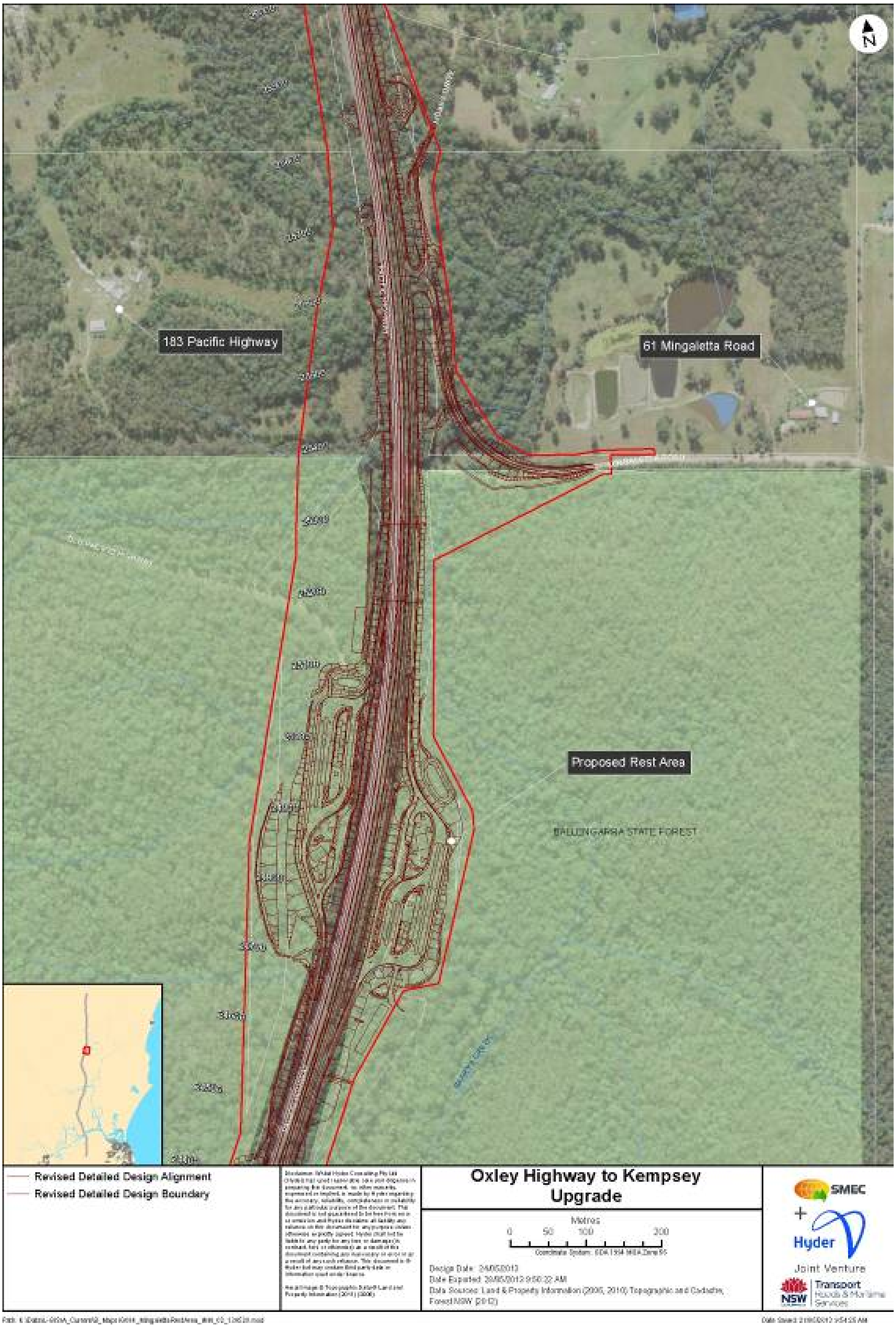
# 7 MINGALETTA ROAD REST AREA

Northbound and southbound rest areas are proposed to the south of Mingaletta road. The identified nearest potentially affected residential receivers are listed below:

- 183 Pacific Highway – Approximately 700m northwest of the proposed rest area;
- 61 Mingaletta Road – Approximately 800m northeast of the proposed rest area.

The receiver locations and proposed road and rest area are displayed in Figure 7-1.

## Figure 7-1 Proposed Rest Area Location



## 7.1 Operational Noise Criteria – Rest Areas

The *ECRTN* is primarily concerned with the assessment of noise from continually flowing traffic and does not specifically address rest areas adjacent to roads or freeways.

The relevant procedure is to consider the rest area as if it were an "industrial" operation and assess the noise levels generated in accordance with the *Industrial Noise Policy (INP)*. This policy requires criterion that limits the permissible level of noise from mechanical plant at commercial or industrial premises to no more than the background noise plus 5dBA when measured over a 15-minute period ($L_{Aeq,15\ min}$).

The unattended noise monitoring conducted at 61 Mingaletta Road is indicative of background levels at the rest area and nearby residences. The measured Rating Background Levels (RBLs) are shown in Table 7-1. The permissible level of noise of the rest area over a 15-minute period is shown in Table 7-2.

For night time use of the rest area it is also relevant to consider the Department of Environment and Climate Change sleep arousal guidelines contained in the *Environmental Noise Control Manual (ENCM)*. This requires that the typical maximum noise level (denoted as $L_{A1}$ in the *ENCM*) associated with noise from heavy vehicles at the rest area (engines starting/doors closing) should not exceed the background $L_{A90}$ noise level by more than 15dBA.

**Table 7-1 Summary of Background Noise Monitoring Results**

| Time Period | RBL (dBA) |
|---|---|
| Daytime (7.00am–6.00pm) | 38 |
| Evening (6.00–10.00pm) | 40 |
| Night time (10.00pm–7.00am) | 37 |

Table 7-2 outlines the permissible noise level of the rest area applying the background noise plus 5dBA methodology. It should be noted that the evening level has been restricted to be no higher than the daytime level as per the *INP* application notes which states:

*"In determining project-specific noise levels from the RBLs, the community's expectations also need to be considered. The community generally expects greater control of noise during the more sensitive evening and night-time periods than the less sensitive daytime period. Therefore, in determining project-specific noise levels for a particular development, it is generally recommended that the intrusive noise level for evening be set at no greater than the intrusive noise level for daytime. "*

**Table 7-2 Residential Noise Criteria**

| Time Period | Intrusiveness Criteria ($L_{Aeq,15\ minute}$ dBA) | Sleep Arousal ($L_{Amax}$ dBA) |
|---|---|---|
| Daytime (7am to 6pm) | 43 | - |
| Evening (6pm to 10pm) | 43 | - |
| Night Time (10pm to 7am) | 42 | 52 |

## 7.2 Noise Level Predictions and Assessment

For noise within the rest area the following source noise levels have been assumed. These are based on previous measurements conducted by Wilkinson Murray of similar facilities and infrastructure.

**Table 7-3 Noise Source**

| Noise Source | Noise Level |
|---|---|
| Truck Idle | 66dBA $L_{Aeq,15minute}$ @ 7m |
| Truck Movement | 80dBA $L_{Aeq,15minute}$ @ 7m |
| Truck Refrigeration Unit | 73dBA $L_{Aeq,15minute}$ @ 7m |
| Truck Door Close | 75dBA $L_{A1,1min}$ @ 7m |
| Truck Start | 85dBA $L_{A1,1min}$ @ 7m |
| Engine Brake | 98dBA $L_{A1,1min}$ @ 7m |

The assumptions presented below in Table 7-4 have been used regarding the usage of the rest area and are assumed to apply for the combined north and southbound rest areas collectively. The assumptions have been extracted from the Teven Truck Rest Area Noise Assessment (ref. 60027048.JD002.REP.01) on the basis of similar traffic levels and layout.

**Table 7-4 Rest Area Usage Assumptions**

| Activity | Number of Trucks Day (7am-6pm) | Number of Trucks Evening (6pm-10pm) | Number of Trucks Night (10pm-7am) |
|---|---|---|---|
| Refrigeration Trucks | 1 | 2 | 3 |
| Trucks Idling | 7 | 9 | 5 |
| Trucks Arriving | 1 | 1 | 2 |
| Trucks Departing | 1 | 1 | 2 |

It is assumed that trucks moving within the rest area would travel at 20kph over a maximum possible distance of 200m. Moreover, refrigeration units as well as idling truck engines are assumed to be in operation constantly over any 15 minute period. A conservative approach has been implemented to provide an upper limit for predicted levels. Therefore, assessment with respect to ‘F class Pasquill stability’ (i.e. temperature inversion) with no wind has been adopted for the assessment of noise during the night time period.

There are only two residences located within 800 metres of the proposed rest areas, 183 Pacific Highway (700 metres from rest area) and 61 Mingaletta Road (800 metres from rest area). The calculated $L_{Aeq, 15 min}$ noise levels for day, evening and night time periods for those residences are provided in Table 7-5.

**Table 7-5 Predicted Noise Levels At Residences Due to Rest Area (dBA)**

| Location | Criteria $L_{Aeq,15 minute}$ Daytime | Criteria $L_{Aeq,15 minute}$ Evening | Criteria $L_{Aeq,15 minute}$ Night | Predicted $L_{Aeq,15min}$ Daytime | Predicted $L_{Aeq,15min}$ Evening | Predicted $L_{Aeq,15min}$ Night |
|---|---|---|---|---|---|---|
| 183 Pacific Highway | 43 | 43 | 42 | 26 | 28 | 33 |
| 61 Mingaletta Road | 43 | 43 | 42 | 23 | 25 | 30 |

Noise levels are predicted to be within *INP* intrusiveness criterion at both locations. Calculated $L_{Amax}$ noise levels due to various activities at the rest area are shown in Table 7-6. Predicted noise levels for acoustically neutral weather conditions are displayed in brackets.

**Table 7-6 Predicted Noise Levels for Sleep Disturbance Assessment (dBA)**

| Location | Sleep Arousal Criteria | Predicted $L_{Amax}$ Noise Level - Truck Door Close | Predicted $L_{Amax}$ Noise Level - Truck Start | Predicted $L_{Amax}$ Noise Level - Engine Brake Noise |
|---|---|---|---|---|
| 183 Pacific Highway | 52 | 28 (25) | 37 (34) | 50 (47) |
| 61 Mingaletta Road | 52 | 25 (23) | 34 (32) | 47 (44) |

() indicates values where temperature inversions have been excluded

External levels comply with the “screening” criterion of 52dBA for the three sleep disturbance scenarios considered. In addition, the *ECRTN* offers guidance in terms of acceptable noise levels which are:

- *Maximum internal noise levels below 50-55dBA are unlikely to cause awakening reactions*
- *One or two noise events per night with maximum internal noise levels of 65-70dBA are not likely to significantly affect health and wellbeing.*

## 7.3 Assessment of Rest Area usage in conjunction with Traffic Noise

To determine the relative impact of the rest area, a cumulative noise level is determined by including the impact of future traffic noise in conjunction with that of the rest area usage. These levels are segregated into noise from the upgraded highway and shown without the rest area in operation in Table 7-7 below.

**Table 7-7 2026 Calculated $L_{Aeq}$ Traffic Noise Level with no Rest Area**

| Residence | $L_{eq,9hr}$ Level (dBA) |
|---|---|
| 183 Pacific Highway | 54 |
| 61 Mingaletta Road | 52 |

When comparing rest area impacts from Table 7-5 with noise from traffic on the highway in Table 7-7, traffic noise is dominant at both locations. The cumulative noise level is calculated with the maximum predicted rest area usage (night time scenario) to the predicted traffic noise and shown in Table 7-8.

**Table 7-8 2026 Calculated $L_{Aeq}$ noise level with rest area in operation**

| Residence | $L_{eq,9hr}$ Level (dBA) |
|---|---|
| 183 Pacific Highway | 54 |
| 61 Mingaletta Road | 52 |

When the contributions of the rest area noise is added to that of the highway traffic, the overall level changes by a negligible amount due to the significant difference in contributions between the traffic and rest area. As a result, it is highly unlikely that the rest area would have any impact on nearby affected residences. In addition, given that the predicted maximum levels would be lower than maximum noise levels from heavy vehicles using the Pacific Highway, it is therefore unlikely that activity at the proposed rest area would cause awakenings.

# 8 CONCLUSION

For the K2K section of the Project, a total of 50 residences across 10 noise catchment areas have been identified from aerial photography and subsequent ground truthing exercise as requiring mitigation from operational (traffic) noise in accordance with the *ENMM* guidelines in reference to the *ECRTN*.

Suitability of mitigation measures identified in the EA has been assessed to address CoA 13. The exceedances at the relevant noise sensitive receivers have been quantified and where required, mitigation measures through architectural treatments have been proposed to minimise the potential impact. Overall, there are 22 additional receivers that have been identified for treatment compared to the environmental assessment, mostly due to those not being modelled at the EA stage. No significant departure from the original mitigation measures is deemed necessary.

An assessment of the Mingaletta Road rest areas has been undertaken. Predicted noise levels comply with the requirements of the *INP*. They are predicted to comply with the sleep disturbance “screening” criteria and acceptable maximum noise levels suggested in the *ECRTN* and would be lower than maximum noise levels from heavy vehicles using the Pacific Highway.

# APPENDIX A

## NOISE MODEL RESULTS

| NCA | Receiver No | Noise Goal - Day | Noise Goal - Night | Existing Noise Level - Day | Existing Noise Level - Night | 2016 Design Noise Levels - Day | 2016 Design Noise Levels - Night | 2026 Design Noise Levels - Day | 2026 Design Noise Levels - Night | 2026 Noise Levels Exceed Criteria? Day | 2026 Noise Levels Exceed Criteria? Night | Is Difference Greater Than 2dB? Day | Is Difference Greater Than 2dB? Night | 2026 Design Noise Acute? Day | 2026 Design Noise Acute? Night |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 492 | 60 | 55 | 52.4 | 51.3 | 54.8 | 54.1 | 55.8 | 54.9 | N | N | Y | Y | N | N |
| 1 | 493 | 60 | 55 | 45.9 | 44.8 | 48.9 | 48.1 | 49.9 | 48.9 | N | N | Y | Y | N | N |
| 1 | 502 | 60 | 55 | 58 | 57 | 61.4 | 60.8 | 62.2 | 61.6 | Y | Y | Y | Y | N | Y |
| 1 | 503 | 60 | 55 | 63.2 | 62.3 | 67.2 | 66.7 | 68.1 | 67.5 | Y | Y | Y | Y | Y | Y |
| 1 | 767 | 60 | 55 | 47.5 | 46.4 | 50 | 49.4 | 51 | 50 | N | N | Y | Y | N | N |
| 1 | 816 | 60 | 55 | 46.8 | 45.6 | 49.9 | 49.2 | 50.8 | 50 | N | N | Y | Y | N | N |
| 1 | 1000 | 60 | 55 | 57.1 | 56.1 | 59.7 | 59.1 | 60.6 | 59.9 | Y | Y | Y | Y | N | N |
| 1 | 1027 | 60 | 55 | 60.8 | 59.9 | 62.8 | 62.1 | 63.7 | 62.9 | Y | Y | Y | Y | N | Y |
| 1 | 1028 | 60 | 55 | 58.9 | 57.9 | 61 | 60.4 | 62 | 61.2 | Y | Y | Y | Y | N | Y |
| 1 | 1044 | 60 | 55 | 46 | 44.8 | 49.2 | 48.5 | 50.2 | 49.3 | N | N | Y | Y | N | N |
| 1 | 1045 | 60 | 55 | 45.8 | 44.7 | 49 | 48.3 | 50 | 49.1 | N | N | Y | Y | N | N |
| 1 | 1055 | 60 | 55 | 44.9 | 43.8 | 47.7 | 47 | 48.6 | 47.7 | N | N | Y | Y | N | N |
| 2 | 495 | 60 | 55 | 46.2 | 45.1 | 49.3 | 48.6 | 50.1 | 49.2 | N | N | Y | Y | N | N |
| 2 | 498 | 60 | 55 | 56.7 | 55.5 | 60.4 | 59.6 | 61.4 | 60.5 | Y | Y | Y | Y | N | Y |
| 2 | 500 | 60 | 55 | 51.5 | 50.3 | 54.2 | 53.5 | 55.2 | 54.3 | N | N | Y | Y | N | N |
| 3 | 466 | 60 | 55 | 59.3 | 58.3 | 64.1 | 64 | 65 | 64.7 | Y | Y | Y | Y | Y | Y |
| 3 | 467 | 60 | 55 | 56.9 | 54.9 | 62 | 61.8 | 63 | 62.6 | Y | Y | Y | Y | N | Y |
| 3 | 474 | 60 | 55 | 47.4 | 46.2 | 52.7 | 52.1 | 53.6 | 52.8 | N | N | Y | Y | N | N |
| 3 | 475 | 60 | 55 | 56.1 | 54.9 | 61.4 | 61.3 | 62.4 | 62 | Y | Y | Y | Y | N | Y |
| 3 | 482 | 60 | 55 | 47.5 | 46.3 | 52.9 | 52.3 | 53.9 | 53 | N | N | Y | Y | N | N |
| 3 | 483 | 60 | 55 | 48.9 | 47.6 | 54 | 53.3 | 54.9 | 53.9 | N | N | Y | Y | N | N |
| 3 | 488 | 60 | 55 | 54 | 52.8 | 59.1 | 58.5 | 60.1 | 59.3 | Y | Y | Y | Y | N | N |
| 3 | 490 | 60 | 55 | 48.7 | 47.4 | 53.7 | 53 | 54.6 | 53.6 | N | N | Y | Y | N | N |
| 3 | 746 | 60 | 55 | 58.9 | 55.1 | 64.4 | 64.5 | 65.3 | 65.1 | Y | Y | Y | Y | Y | Y |
| 3 | 755 | 60 | 55 | 43.9 | 42.6 | 48.9 | 48.2 | 49.7 | 48.7 | N | N | Y | Y | N | N |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 | 818 | 60 | 55 | 53.5 | 52.2 | 58.4 | 57.7 | 59.4 | 58.5 | N | Y | Y | Y | N | N |
| 3 | 821 | 60 | 55 | 56.7 | 55.5 | 61.3 | 61.5 | 62.3 | 62.2 | Y | Y | Y | Y | N | Y |
| 3 | 822 | 60 | 55 | 45.9 | 44.7 | 51 | 50.3 | 51.9 | 50.9 | N | N | Y | Y | N | N |
| 3 | 1001 | 60 | 55 | 47.5 | 46.2 | 52.4 | 51.7 | 53.4 | 52.3 | N | N | Y | Y | N | N |
| 3 | 1013 | 60 | 55 | 50.1 | 48.8 | 55.7 | 55.1 | 56.6 | 55.8 | N | Y | Y | Y | N | N |
| 3 | 1014 | 60 | 55 | 51.1 | 49.9 | 56.3 | 55.8 | 57.3 | 56.5 | N | Y | Y | Y | N | N |
| 3 | 1015 | 60 | 55 | 56.7 | 53.3 | 61.7 | 61.5 | 62.6 | 62.2 | Y | Y | Y | Y | N | Y |
| 3 | 1016 | 60 | 55 | 53.1 | 50.7 | 57.9 | 57.6 | 58.9 | 58.3 | N | Y | Y | Y | N | N |
| 4 | 460 | 60 | 55 | 48.8 | 47.7 | 54.6 | 53.9 | 55.5 | 54.7 | N | N | Y | Y | N | N |
| 4 | 471 | 60 | 55 | 58.4 | 57.4 | 65.4 | 64.8 | 66.4 | 65.6 | Y | Y | Y | Y | Y | Y |
| 4 | 478 | 60 | 55 | 54.5 | 53.3 | 60 | 59.2 | 60.9 | 60 | Y | Y | Y | Y | N | Y |
| 4 | 480 | 60 | 55 | 56.2 | 54.9 | 61.4 | 60.7 | 62.3 | 61.4 | Y | Y | Y | Y | N | Y |
| 4 | 484 | 60 | 55 | 56.1 | 54.8 | 61.3 | 60.6 | 62.3 | 61.4 | Y | Y | Y | Y | N | Y |
| 4 | 486 | 60 | 55 | 57.1 | 55.9 | 62.6 | 61.9 | 63.6 | 62.7 | Y | Y | Y | Y | N | Y |
| 4 | 738 | 60 | 55 | 47.1 | 46.1 | 52.8 | 52.1 | 53.6 | 52.8 | N | N | Y | Y | N | N |
| 4 | 763 | 60 | 55 | 51.8 | 50.7 | 57.2 | 56.5 | 58.1 | 57.2 | N | Y | Y | Y | N | N |
| 4 | 817 | 60 | 55 | 53.9 | 52.7 | 59.1 | 58.4 | 60 | 59.2 | N | Y | Y | Y | N | N |
| 4 | 1007 | 60 | 55 | 46.9 | 45.9 | 52.7 | 52 | 53.5 | 52.5 | N | N | Y | Y | N | N |
| 4 | 1009 | 60 | 55 | 54.1 | 52.9 | 59.4 | 58.6 | 60.3 | 59.4 | Y | Y | Y | Y | N | N |
| 4 | 1010 | 60 | 55 | 56.4 | 55.2 | 61.8 | 61.1 | 62.8 | 61.9 | Y | Y | Y | Y | N | Y |
| 4 | 1011 | 60 | 55 | 54.1 | 52.9 | 59.4 | 58.7 | 60.3 | 59.4 | Y | Y | Y | Y | N | N |
| 4 | 1012 | 60 | 55 | 57.4 | 56.3 | 62.7 | 62 | 63.7 | 62.8 | Y | Y | Y | Y | N | Y |
| 4 | 1017 | 60 | 55 | 55.8 | 54.8 | 61.8 | 61.1 | 62.8 | 61.9 | Y | Y | Y | Y | N | Y |
| 4 | 1018 | 60 | 55 | 54.7 | 53.6 | 60.7 | 60 | 61.7 | 60.8 | Y | Y | Y | Y | N | Y |
| 4 | 1019 | 60 | 55 | 47.1 | 46 | 52.6 | 51.9 | 53.4 | 52.5 | N | N | Y | Y | N | N |
| 4 | 1021 | 60 | 55 | 46.4 | 45.4 | 52 | 51.3 | 52.7 | 51.9 | N | N | Y | Y | N | N |
| 4 | 1043 | 60 | 55 | 44.8 | 43.7 | 49.9 | 49.2 | 50.8 | 49.4 | N | N | Y | Y | N | N |
| 5 | 446 | 60 | 55 | 48.7 | 47.7 | 53.5 | 53.7 | 54.3 | 54.1 | N | N | Y | Y | N | N |
| 5 | 448 | 60 | 55 | 56.1 | 55.1 | 61.2 | 60.4 | 62.1 | 61.2 | Y | Y | Y | Y | N | Y |

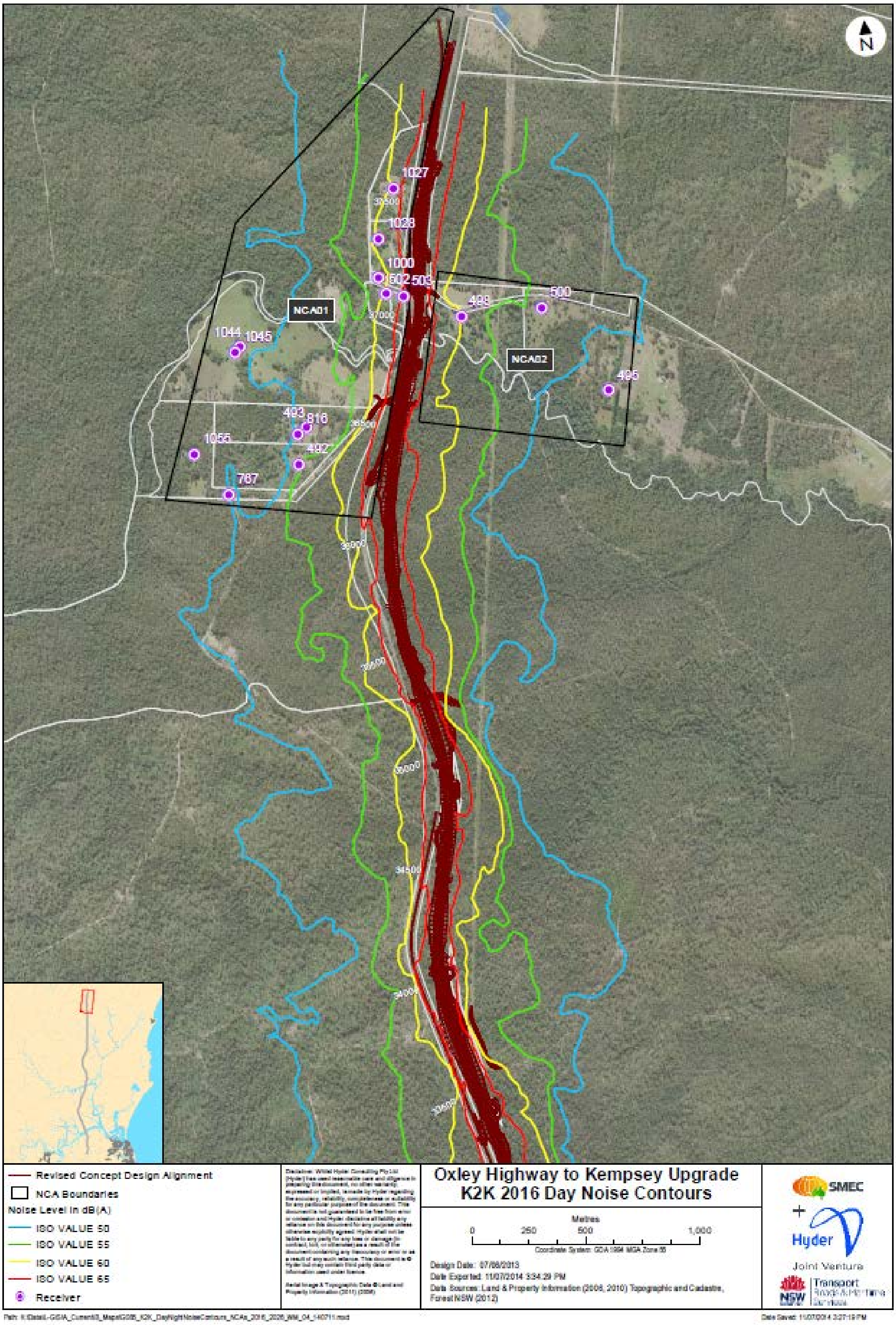
| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5 | 450 | 60 | 55 | 48.5 | 47.4 | 53.7 | 53.3 | 54.5 | 53.5 | N | N | Y | Y | N | N |
| 5 | 455 | 60 | 55 | 46.1 | 44.9 | 51 | 50.4 | 51.7 | 50.2 | N | N | Y | Y | N | N |
| 5 | 457 | 60 | 55 | 48.5 | 47.4 | 53.8 | 53.3 | 54.6 | 53.6 | N | N | Y | Y | N | N |
| 5 | 459 | 60 | 55 | 52.3 | 51.3 | 57.7 | 58 | 58.6 | 58.6 | N | Y | Y | Y | N | N |
| 5 | 462 | 60 | 55 | 47.9 | 46.7 | 52.5 | 51.9 | 53.4 | 52.6 | N | N | Y | Y | N | N |
| 5 | 463 | 60 | 55 | 48 | 46.8 | 52.9 | 52.3 | 53.9 | 52.8 | N | N | Y | Y | N | N |
| 5 | 735 | 60 | 55 | 47.4 | 46.5 | 52.6 | 52.5 | 53.4 | 52.9 | N | N | Y | Y | N | N |
| 5 | 1003 | 60 | 55 | 49.6 | 48.5 | 54.9 | 54.6 | 55.8 | 55.2 | N | Y | Y | Y | N | N |
| 5 | 1039 | 60 | 55 | 50.7 | 49.5 | 55.7 | 55.1 | 56.6 | 55.7 | N | Y | Y | Y | N | N |
| 5 | 1040 | 60 | 55 | 52 | 51 | 57 | 56.5 | 58 | 57.3 | N | Y | Y | Y | N | N |
| 5 | 1041 | 60 | 55 | 52.5 | 51.4 | 57.4 | 56.9 | 58.3 | 57.6 | N | Y | Y | Y | N | N |
| 5 | 1050 | 60 | 55 | 48.9 | 47.7 | 54.1 | 53.4 | 55 | 54 | N | N | Y | Y | N | N |
| 5 | 1051 | 60 | 55 | 47.9 | 46.7 | 53.1 | 52.5 | 54.1 | 53.2 | N | N | Y | Y | N | N |
| 5 | 1052 | 60 | 55 | 45.1 | 43.8 | 50.3 | 49.6 | 51.1 | 49.7 | N | N | Y | Y | N | N |
| 5 | 1053 | 60 | 55 | 46 | 44.8 | 51.3 | 50.7 | 52.3 | 51 | N | N | Y | Y | N | N |
| 5 | 1054 | 60 | 55 | 45.6 | 44.3 | 50.8 | 50.2 | 51.7 | 50.6 | N | N | Y | Y | N | N |
| 6 | 407 | 60 | 55 | 45.4 | 44.5 | 49.2 | 48.7 | 50 | 49.2 | N | N | Y | Y | N | N |
| 6 | 408 | 60 | 55 | 49.7 | 48.9 | 53.1 | 52.7 | 54.1 | 53.4 | N | N | Y | Y | N | N |
| 6 | 409 | 60 | 55 | 62 | 61.2 | 63.6 | 63.1 | 64.6 | 64 | Y | Y | Y | Y | N | Y |
| 6 | 413 | 60 | 55 | 47.9 | 47.1 | 51.5 | 51 | 52.5 | 51.7 | N | N | Y | Y | N | N |
| 6 | 414 | 60 | 55 | 45.1 | 44.2 | 48.8 | 48.3 | 49.6 | 48.7 | N | N | Y | Y | N | N |
| 6 | 435 | 60 | 55 | 49.4 | 48.4 | 53.1 | 52.7 | 54 | 53.2 | N | N | Y | Y | N | N |
| 6 | 436 | 60 | 55 | 57.2 | 56.5 | 62.8 | 63.7 | 63.6 | 64.1 | Y | Y | Y | Y | N | Y |
| 6 | 443 | 60 | 55 | 44.7 | 43.7 | 49 | 48.5 | 50 | 48.8 | N | N | Y | Y | N | N |
| 6 | 703 | 60 | 55 | 46.6 | 45.8 | 50.3 | 49.9 | 51.1 | 50.5 | N | N | Y | Y | N | N |
| 6 | 704 | 60 | 55 | 45.8 | 45 | 49.3 | 48.8 | 50.2 | 49.4 | N | N | Y | Y | N | N |
| 6 | 705 | 60 | 55 | 47.6 | 46.8 | 50.9 | 50.4 | 51.9 | 51.1 | N | N | Y | Y | N | N |
| 6 | 707 | 60 | 55 | 48.8 | 48 | 52.2 | 51.8 | 53.3 | 52.5 | N | N | Y | Y | N | N |
| 6 | 708 | 60 | 55 | 48.7 | 47.9 | 52.1 | 51.7 | 53.2 | 52.4 | N | N | Y | Y | N | N |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6 | 709 | 60 | 55 | 49.8 | 49 | 53.1 | 52.6 | 54.2 | 53.4 | N | N | Y | Y | N | N |
| 6 | 712 | 60 | 55 | 51.9 | 51.1 | 55.1 | 54.6 | 56.1 | 55.5 | N | Y | Y | Y | N | N |
| 6 | 729 | 60 | 55 | 53.5 | 52.6 | 57.5 | 57.9 | 58.4 | 58.5 | N | Y | Y | Y | N | N |
| 6 | 809 | 60 | 55 | 52.7 | 51.8 | 56.4 | 56 | 57.4 | 56.6 | N | Y | Y | Y | N | N |
| 6 | 830 | 60 | 55 | 47.4 | 46.5 | 51.2 | 50.8 | 52.1 | 51.1 | N | N | Y | Y | N | N |
| 6 | 1004 | 60 | 55 | 60.1 | 59.3 | 61.8 | 61.4 | 62.7 | 62.1 | Y | Y | Y | Y | N | Y |
| 6 | 1005 | 60 | 55 | 50.9 | 50 | 54.3 | 53.8 | 55.4 | 54.6 | N | N | Y | Y | N | N |
| 6 | 1022 | 60 | 55 | 57.8 | 57.1 | 62.9 | 63.7 | 63.9 | 64.2 | Y | Y | Y | Y | N | Y |
| 6 | 1036 | 60 | 55 | 43.9 | 43 | 47.8 | 47.2 | 48.5 | 47.4 | N | N | Y | Y | N | N |
| 6 | 1038 | 60 | 55 | 46.3 | 45.3 | 50.5 | 50 | 51.4 | 49.9 | N | N | Y | Y | N | N |
| 6 | 1048 | 60 | 55 | 43 | 42 | 47.4 | 46.8 | 48 | 45.8 | N | N | Y | Y | N | N |
| 6 | 1049 | 60 | 55 | 43.8 | 42.8 | 48.3 | 47.8 | 49.2 | 47.1 | N | N | Y | Y | N | N |
| 7 | 434 | 60 | 55 | 43.8 | 42.8 | 48.3 | 47.7 | 49 | 47.5 | N | N | Y | Y | N | N |
| 7 | 438 | 60 | 55 | 54.1 | 53.2 | 58.9 | 58.5 | 59.7 | 59.2 | N | Y | Y | Y | N | N |
| 7 | 439 | 60 | 55 | 50.6 | 49.7 | 55.5 | 55.1 | 56.4 | 55.6 | N | Y | Y | Y | N | N |
| 8 | 384 | 60 | 55 | 48.1 | 47.1 | 53.3 | 53 | 54.3 | 53.8 | N | N | Y | Y | N | N |
| 8 | 388 | 60 | 55 | 48.7 | 47.6 | 53.2 | 52.8 | 54.2 | 53.6 | N | N | Y | Y | N | N |
| 8 | 390 | 60 | 55 | 46.9 | 45.8 | 51.2 | 50.8 | 52.2 | 51.1 | N | N | Y | Y | N | N |
| 8 | 397 | 60 | 55 | 56.6 | 55.6 | 59.5 | 59.1 | 60.5 | 60 | Y | Y | Y | Y | N | Y |
| 8 | 398 | 60 | 55 | 56.3 | 55.3 | 59.5 | 59.2 | 60.7 | 60 | Y | Y | Y | Y | N | Y |
| 8 | 399 | 60 | 55 | 62.2 | 61.2 | 65.2 | 64.8 | 66.2 | 65.6 | Y | Y | Y | Y | Y | Y |
| 8 | 402 | 60 | 55 | 46.6 | 45.6 | 50.9 | 50.6 | 51.8 | 51 | N | N | Y | Y | N | N |
| 8 | 404 | 60 | 55 | 48.1 | 47.1 | 52.4 | 52 | 53.3 | 52.6 | N | N | Y | Y | N | N |
| 8 | 683 | 60 | 55 | 50.3 | 49.4 | 55.3 | 55 | 56.4 | 55.8 | N | Y | Y | Y | N | N |
| 8 | 695 | 60 | 55 | 53.6 | 52.5 | 58 | 57.5 | 59.1 | 58.3 | N | Y | Y | Y | N | N |
| 8 | 833 | 60 | 55 | 49.5 | 48.4 | 54.2 | 53.8 | 55.1 | 54.6 | N | N | Y | Y | N | N |
| 8 | 834 | 60 | 55 | 48.7 | 47.7 | 53.5 | 53.1 | 54.5 | 53.9 | N | N | Y | Y | N | N |
| 8 | 1006 | 60 | 55 | 50.2 | 49.3 | 53.4 | 53 | 54.5 | 53.9 | N | N | Y | Y | N | N |
| 8 | 1023 | 60 | 55 | 56.7 | 55.8 | 60.1 | 59.7 | 61.1 | 60.6 | Y | Y | Y | Y | N | Y |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8 | 1024 | 60 | 55 | 53.4 | 52.4 | 57 | 56.6 | 58.1 | 57.5 | N | Y | Y | Y | N | N |
| 8 | 1032 | 60 | 55 | 42.6 | 41.5 | 47.1 | 46.7 | 48.1 | 47.3 | N | N | Y | Y | N | N |
| 8 | 1033 | 60 | 55 | 43.6 | 42.6 | 48 | 47.5 | 48.7 | 47.5 | N | N | Y | Y | N | N |
| 8 | 1034 | 60 | 55 | 51.9 | 51 | 56 | 55.7 | 57 | 56.5 | N | Y | Y | Y | N | N |
| 8 | 1046 | 60 | 55 | 57.1 | 56.2 | 61 | 60.7 | 62 | 61.5 | Y | Y | Y | Y | N | Y |
| 8 | 1047 | 60 | 55 | 58.5 | 57.6 | 62.4 | 62.1 | 63.5 | 63 | Y | Y | Y | Y | N | Y |
| 9 | 392 | 60 | 55 | 47.4 | 46.4 | 52.1 | 51.7 | 53.1 | 52.3 | N | N | Y | Y | N | N |
| 9 | 394 | 60 | 55 | 47.7 | 46.7 | 52.2 | 51.8 | 53.1 | 52.5 | N | N | Y | Y | N | N |
| 9 | 395 | 60 | 55 | 47.9 | 46.9 | 52.4 | 52.1 | 53.3 | 52.8 | N | N | Y | Y | N | N |
| 9 | 396 | 60 | 55 | 56 | 55 | 61.1 | 61 | 61.9 | 61.6 | Y | Y | Y | Y | N | Y |
| 9 | 405 | 60 | 55 | 53.1 | 52.1 | 57.8 | 57.5 | 58.7 | 58.3 | N | Y | Y | Y | N | N |
| 9 | 406 | 60 | 55 | 44.9 | 44 | 49.4 | 49 | 50.3 | 49.4 | N | N | Y | Y | N | N |
| 9 | 1025 | 60 | 55 | 50.7 | 49.7 | 55.3 | 55 | 56.2 | 55.7 | N | Y | Y | Y | N | N |
| 9 | 1026 | 60 | 55 | 50.1 | 49.2 | 54.9 | 54.7 | 55.6 | 55.3 | N | Y | Y | Y | N | N |
| 9 | 1035 | 60 | 55 | 46.3 | 45.3 | 51 | 50.6 | 52 | 51.1 | N | N | Y | Y | N | N |
| 10 | 381 | 60 | 55 | 40.8 | 39.8 | 46.2 | 46.1 | 46.8 | 46.3 | N | N | Y | Y | N | N |
| 10 | 382 | 60 | 55 | 42.8 | 41.8 | 49.6 | 50.5 | 50.5 | 51.3 | N | N | Y | Y | N | N |
| 10 | 383 | 60 | 55 | 46.7 | 45.6 | 52.5 | 52.8 | 53.5 | 53.6 | N | N | Y | Y | N | N |
| 10 | 386 | 60 | 55 | 45.8 | 44.7 | 51.1 | 50.8 | 52 | 51.6 | N | N | Y | Y | N | N |
| 10 | 688 | 60 | 55 | 53.5 | 52.5 | 58.9 | 58.6 | 60 | 59.4 | N | Y | Y | Y | N | N |

# APPENDIX B

## NOISE CONTOURS


N
NCA01
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1027
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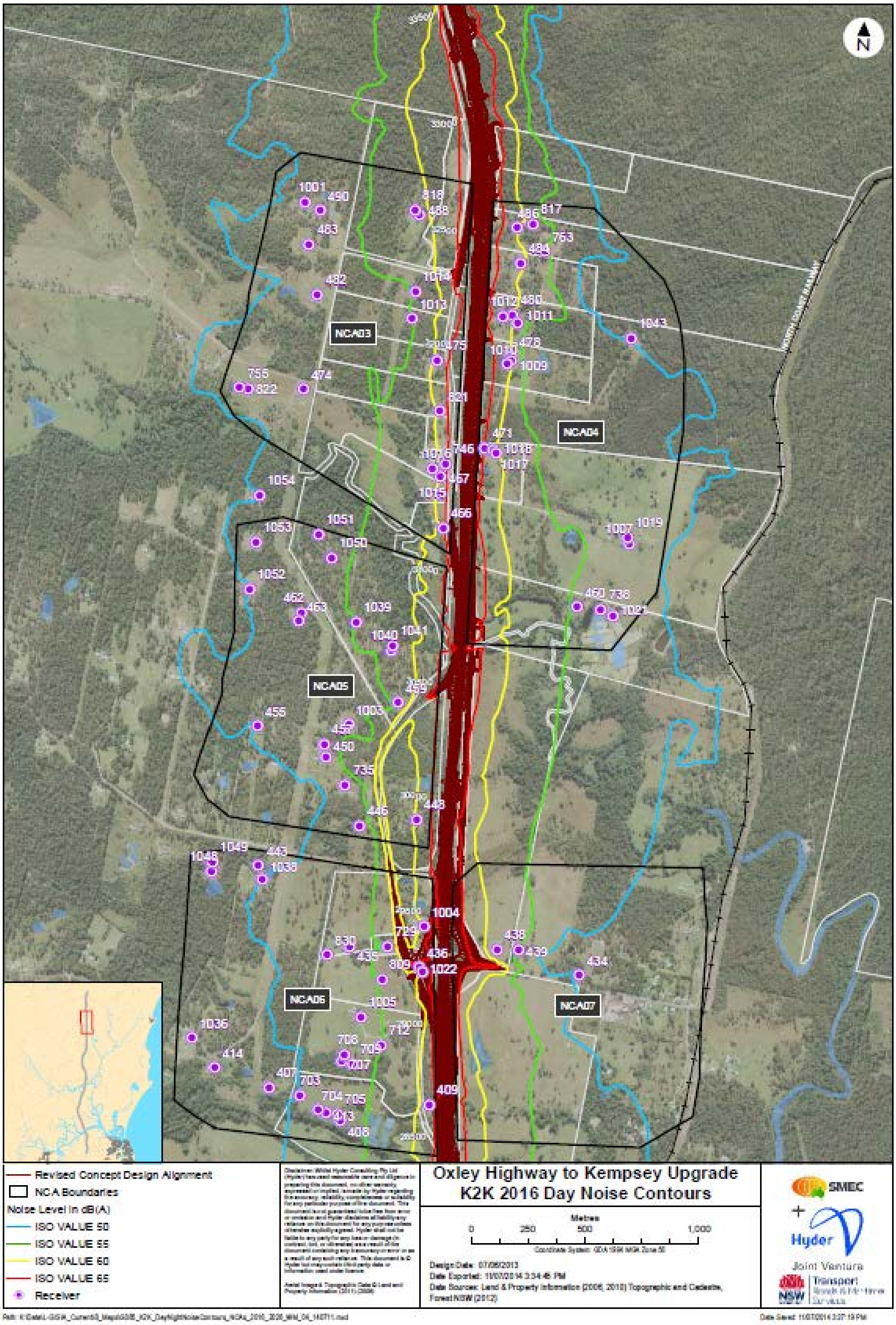
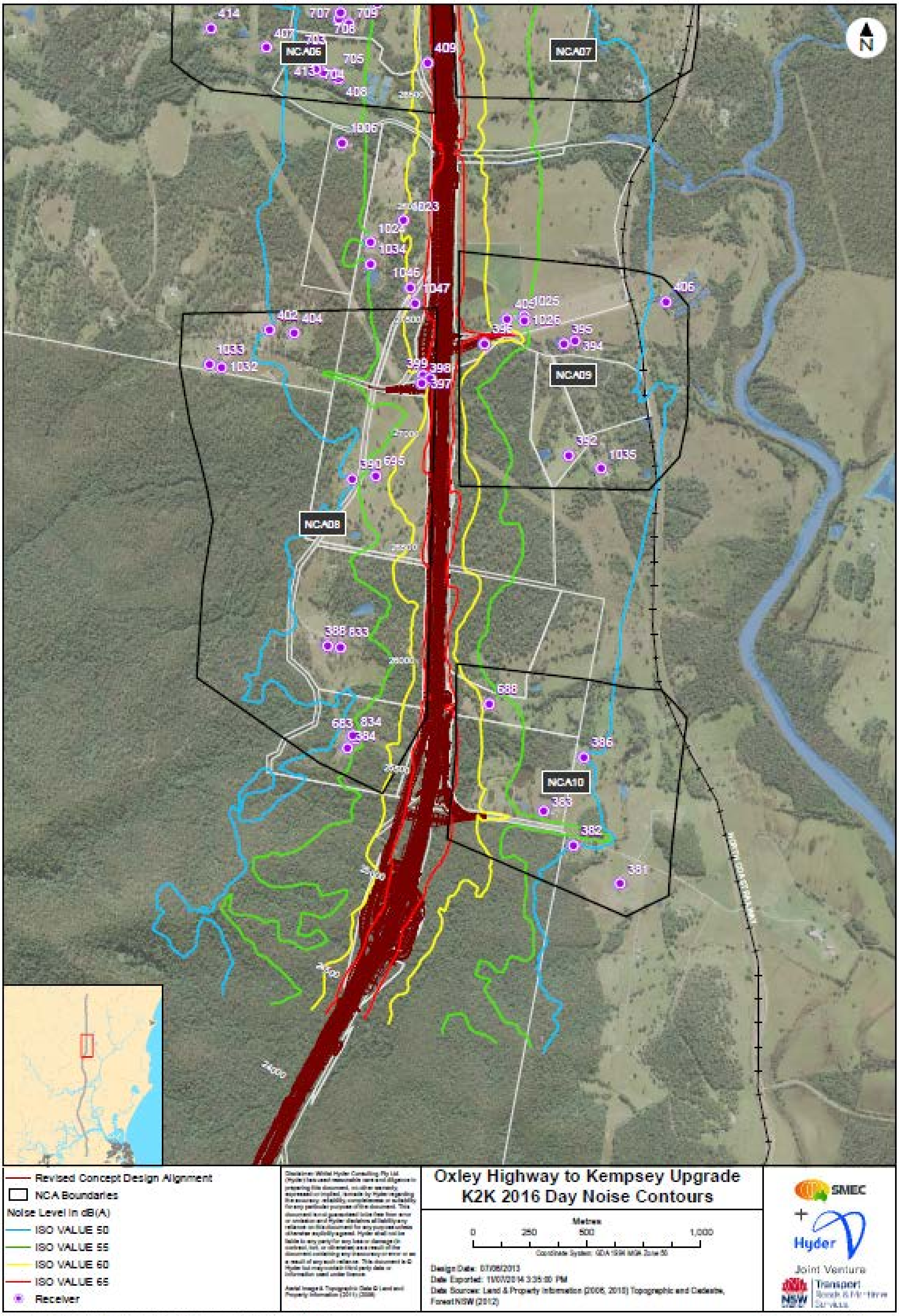
816
492
1055
787
Revised Concept Design Alignment
NCA Boundaries
Noise Level in dB(A)
ISO VALUE 50
ISO VALUE 55
ISO VALUE 60
ISO VALUE 65
Receiver
Oxley Highway to Kempsey Upgrade
K2K 2016 Day Noise Contours
Metres
0
250
500
1,000
Design Date: 07/08/2013
Date Exported: 11/07/2014 3:34:29 PM
Data Sources: Land & Property Information (2008, 2010) Topographic and Cadastre, Forest NSW (2012)
SMEC
Hyder
Joint Venture
Transport
Roads & Maritime Services


Oxley Highway to Kempsey Upgrade
K2K 2016 Day Noise Contours
N
NCA03
NCA04
NCA05
NCA06
NCA07
Revised Concept Design Alignment
NCA Boundaries
Noise Level in dB(A)
ISO VALUE 50
ISO VALUE 55
ISO VALUE 60
ISO VALUE 65
Receiver
Metres
0
250
500
1,000
Design Date: 07/06/2013
SMEC
Hyder
Joint Ventura
Transport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1032
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397
392
1035
390
695
388
833
688
683
834
384
386
383
382
381
Revised Concept Design Alignment
NCA Boundaries
Noise Level in dB(A)
ISO VALUE 50
ISO VALUE 55
ISO VALUE 60
ISO VALUE 65
Receiver
Oxley Highway to Kempsey Upgrade
K2K 2016 Day Noise Contours
Metres
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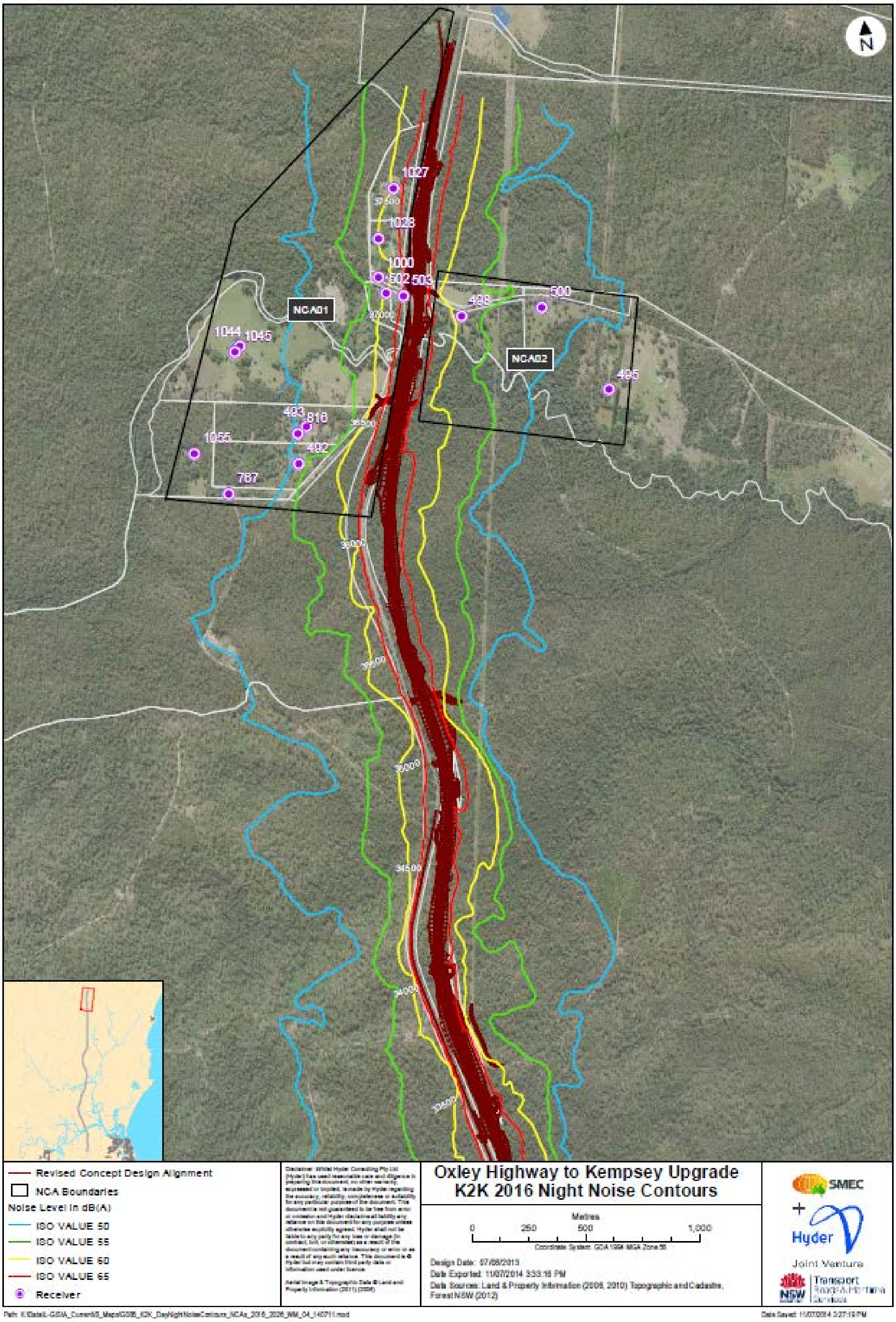
Hyder
Joint Venture
Transport
NSW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816
1055
492
767
Revised Concept Design Alignment
NCA Boundaries
Noise Level in dB(A)
ISO VALUE 50
ISO VALUE 55
ISO VALUE 60
ISO VALUE 65
Receiver
Oxley Highway to Kempsey Upgrade
K2K 2016 Night Noise Contours
Metres
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1,000
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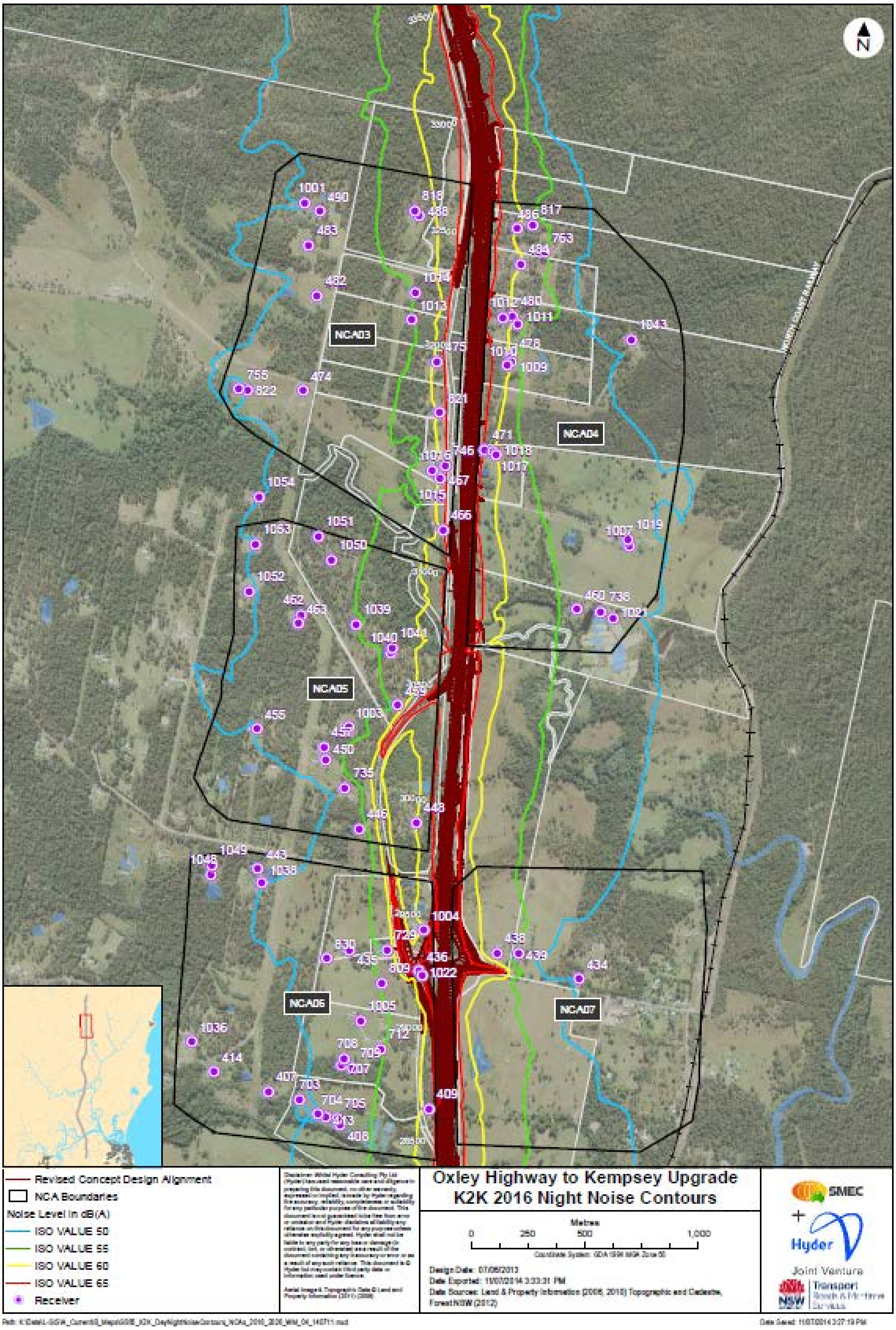
Joint Venture
Transport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NCA07
Revised Concept Design Alignment
NCA Boundaries
Noise Level in dB(A)
ISO VALUE 50
ISO VALUE 55
ISO VALUE 60
ISO VALUE 65
Receiver
Oxley Highway to Kempsey Upgrade
K2K 2016 Night Noise Contours
Metres
0
250
500
1,000
Design Date: 07/06/2013
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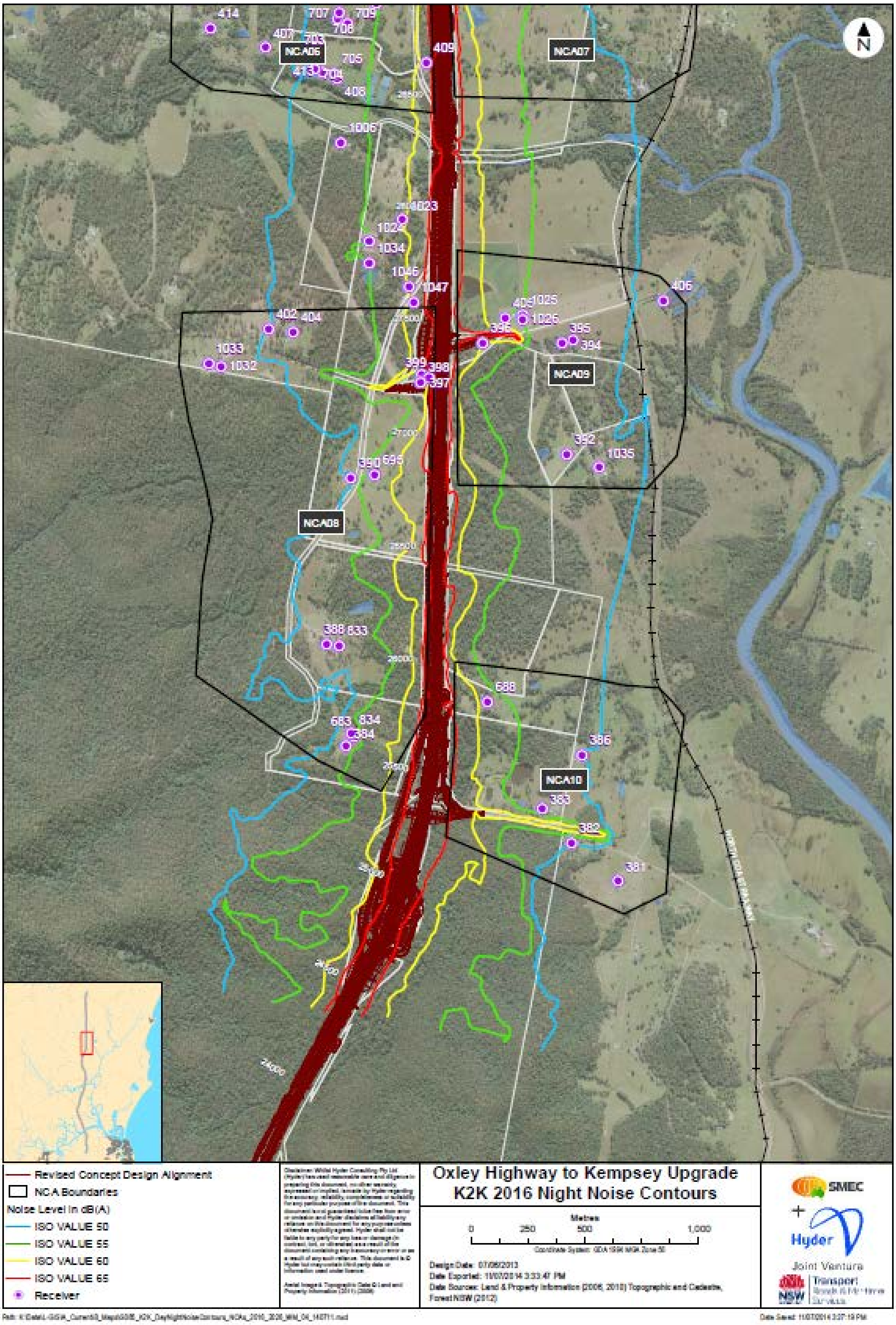
SMEC
Hyder
Joint Venture
Transport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1006
1023
1024
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1025
1026
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395
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406
392
1035
390
695
388
833
688
683
834
384
386
383
382
381
Revised Concept Design Alignment
NCA Boundaries
Noise Level in dB(A)
ISO VALUE 50
ISO VALUE 55
ISO VALUE 60
ISO VALUE 65
Receiver
Oxley Highway to Kempsey Upgrade
K2K 2016 Night Noise Contours
Metres
0
250
500
1,000
Design Date: 07/08/2013
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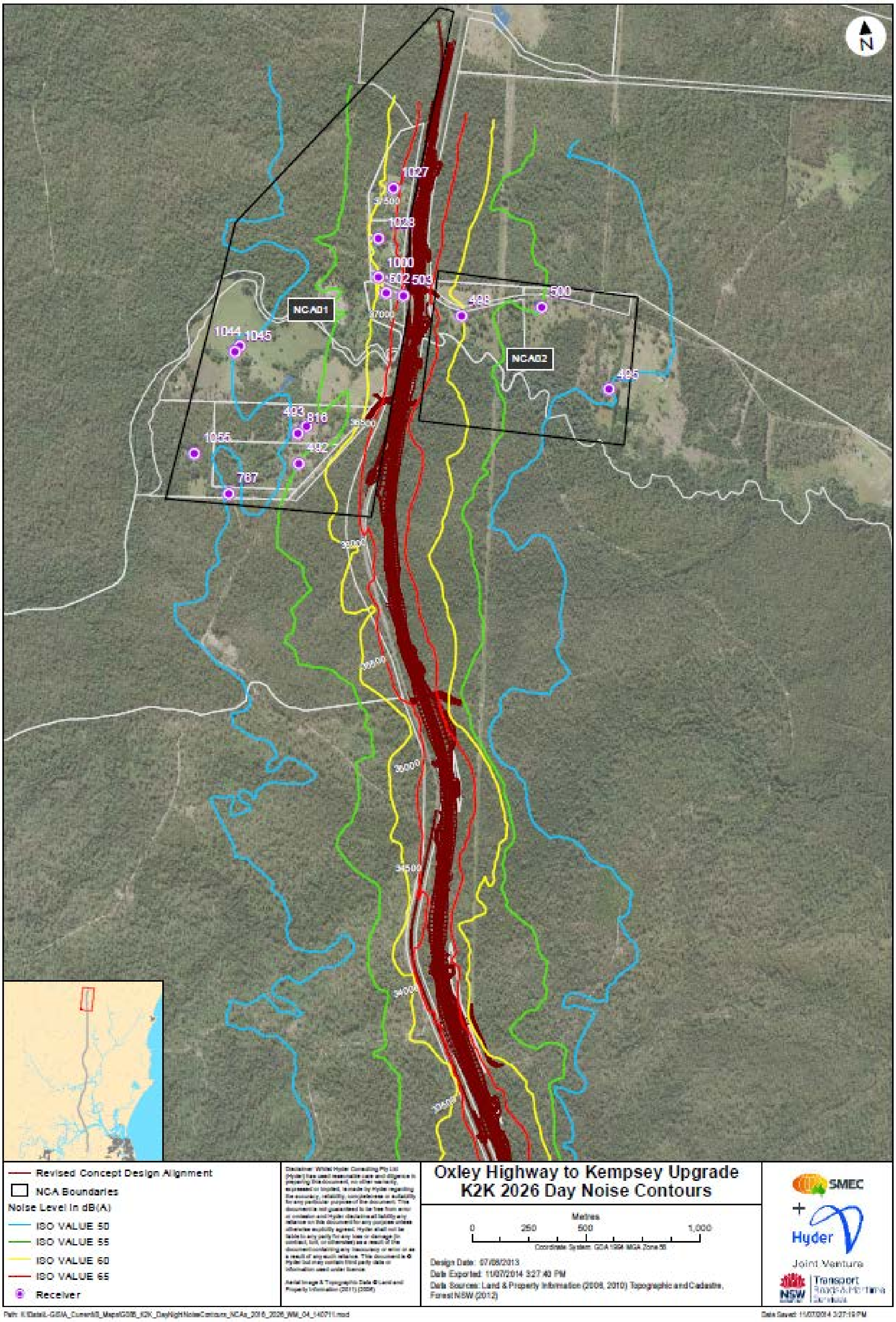
SMEC
Hyder
Joint Venture
Transport
NSW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816
36500
1055
492
767
36000
35500
35000
34500
34000
33500
Revised Concept Design Alignment
NCA Boundaries
Noise Level in dB(A)
ISO VALUE 50
ISO VALUE 55
ISO VALUE 60
ISO VALUE 65
Receiver
Oxley Highway to Kempsey Upgrade
K2K 2026 Day Noise Contours
Metres
0
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500
1,000
Coordinate System: GDA 1994 MGA Zone 56
Design Date: 07/08/2013
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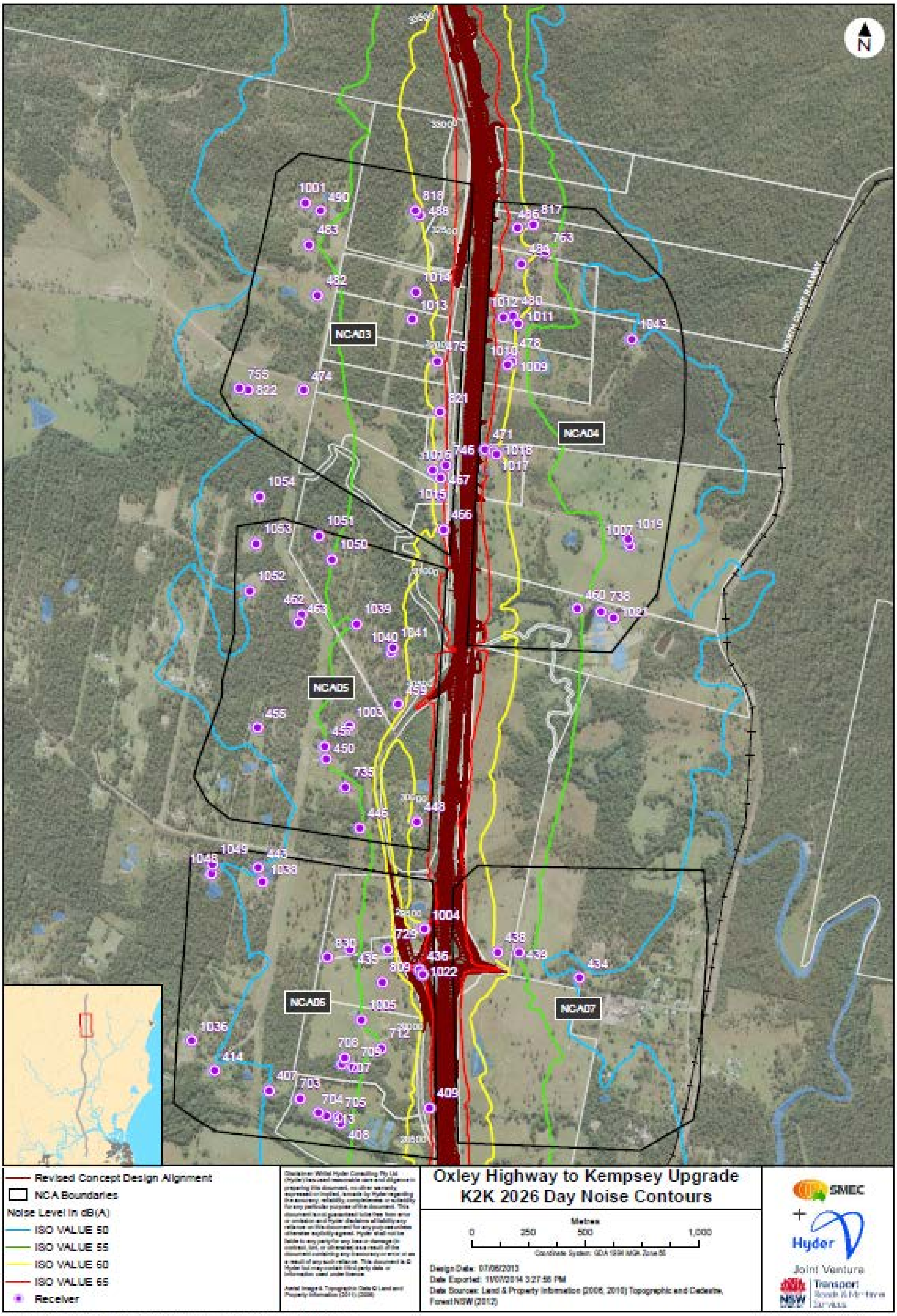
Joint Venture
Transport
NSW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NCA06
NCA07
Revised Concept Design Alignment
NCA Boundaries
Noise Level in dB(A)
ISO VALUE 50
ISO VALUE 55
ISO VALUE 60
ISO VALUE 65
Receiver
Oxley Highway to Kempsey Upgrade
K2K 2026 Day Noise Contours
Metres
0
250
500
1,000
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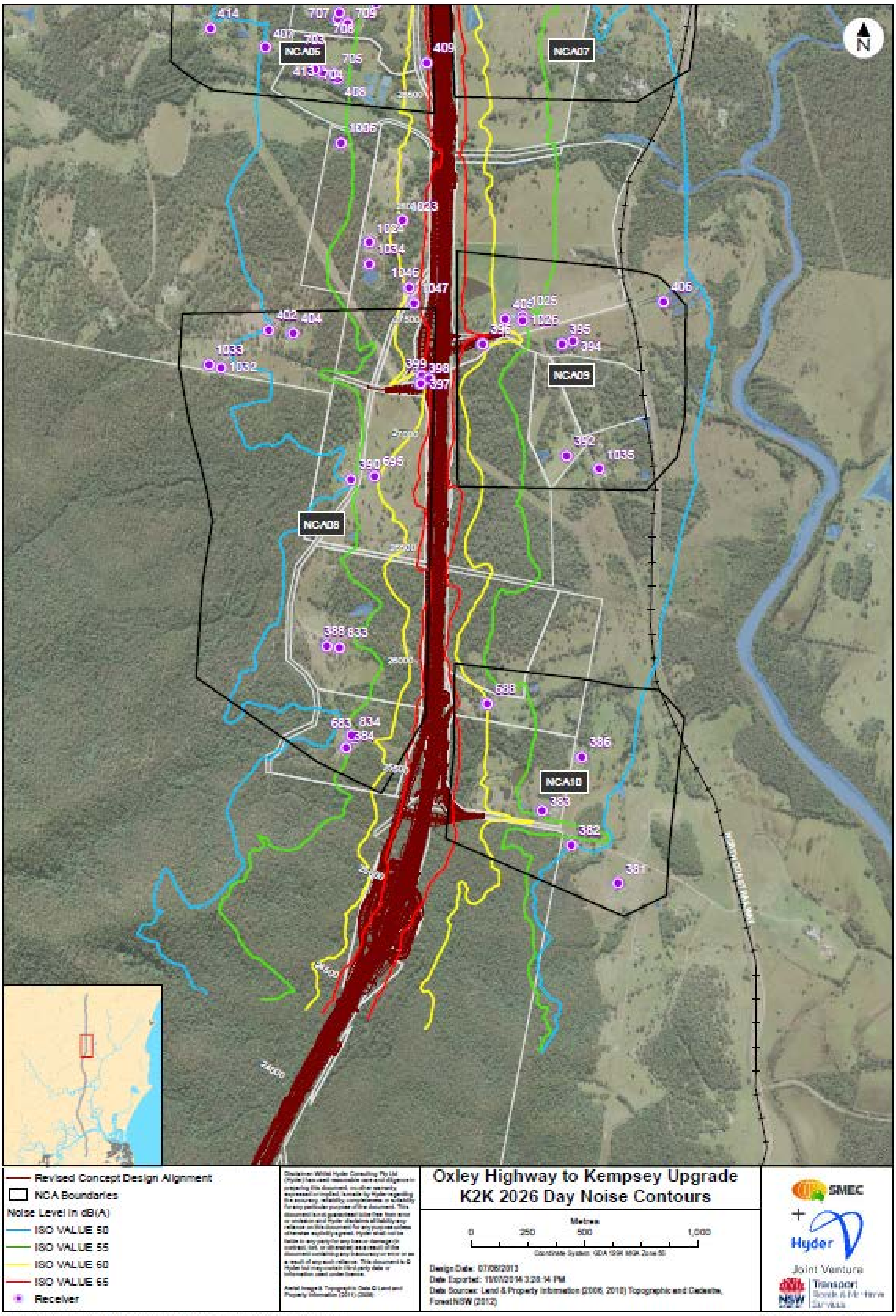
SMEC
Hyder
Joint Venture
Transport
Roads & Maritime Services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Revised Concept Design Alignment
NCA Boundaries
Noise Level in dB(A)
ISO VALUE 50
ISO VALUE 55
ISO VALUE 60
ISO VALUE 65
Receiver
Oxley Highway to Kempsey Upgrade
K2K 2026 Day Noise Contours
Metres
0
250
500
1,000
Design Date: 07/08/2013
Date Exported: 11/07/2014 3:28:34 PM
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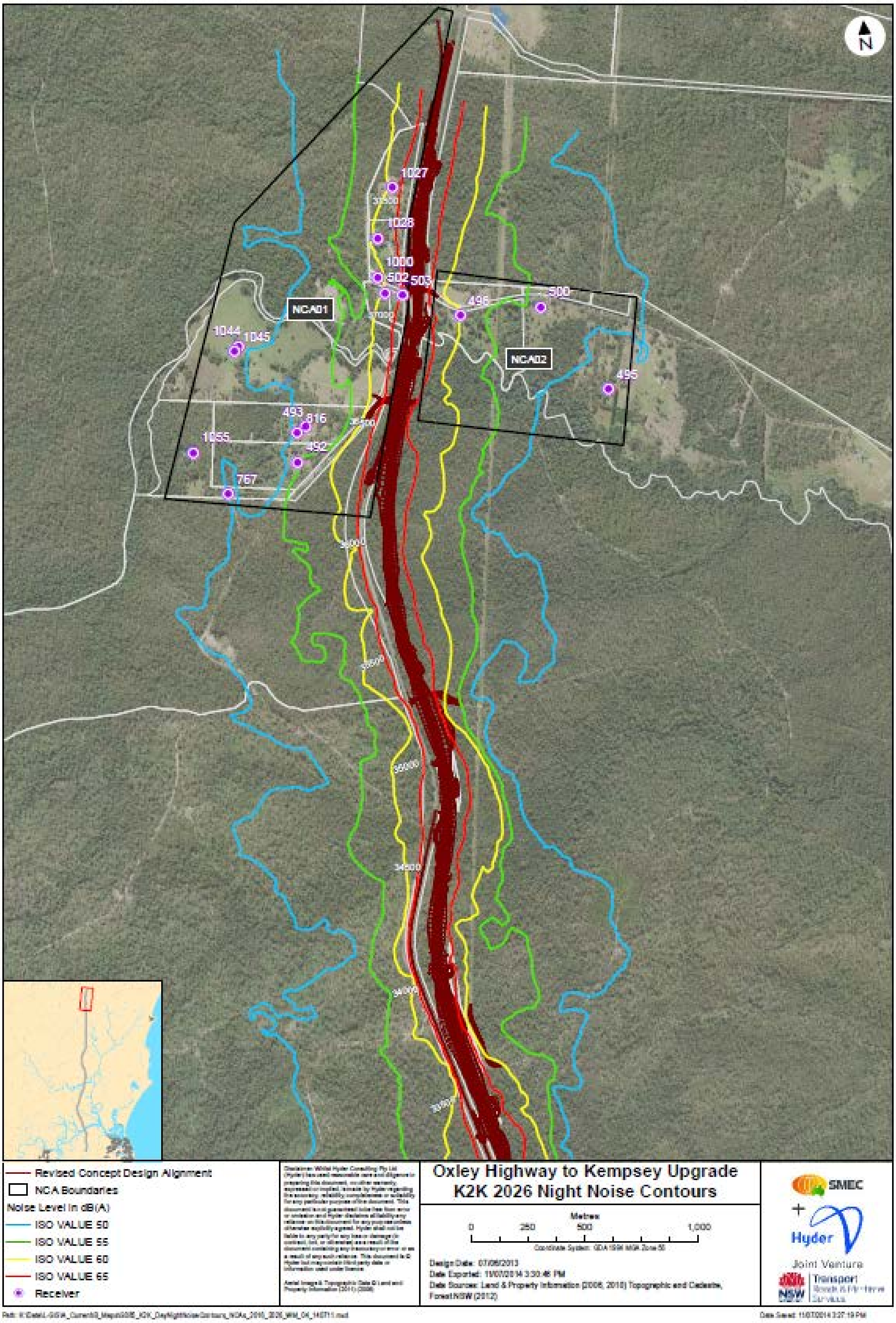
SMEC
Hyder
Joint Venture
Transport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502
503
496
500
NCA01
NCA02
1044
1045
495
493
816
492
1055
767
Revised Concept Design Alignment
NCA Boundaries
Noise Level in dB(A)
ISO VALUE 50
ISO VALUE 55
ISO VALUE 60
ISO VALUE 65
Receiver
Oxley Highway to Kempsey Upgrade
K2K 2026 Night Noise Contours
Metres
0
250
500
1,000
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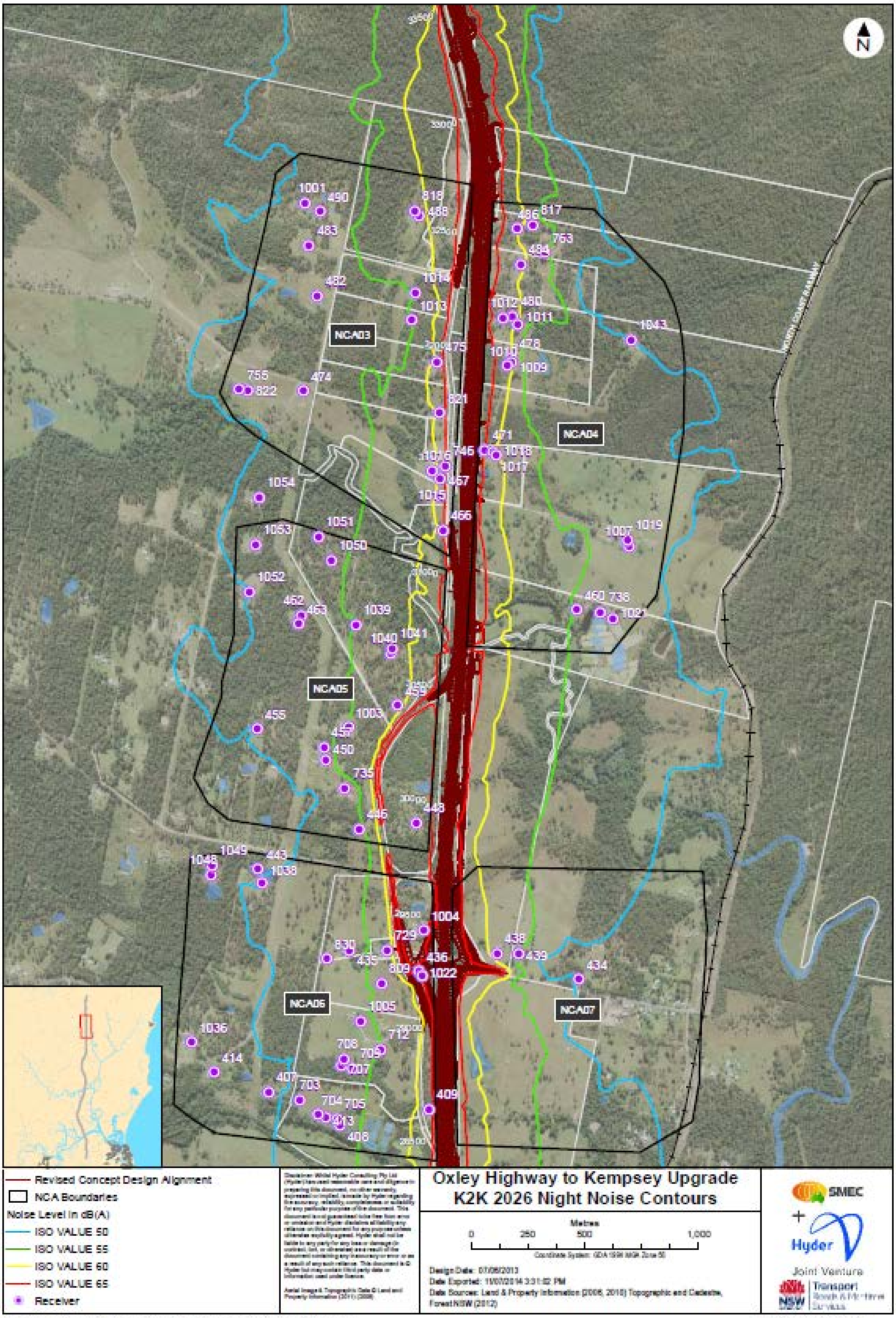
Joint Venture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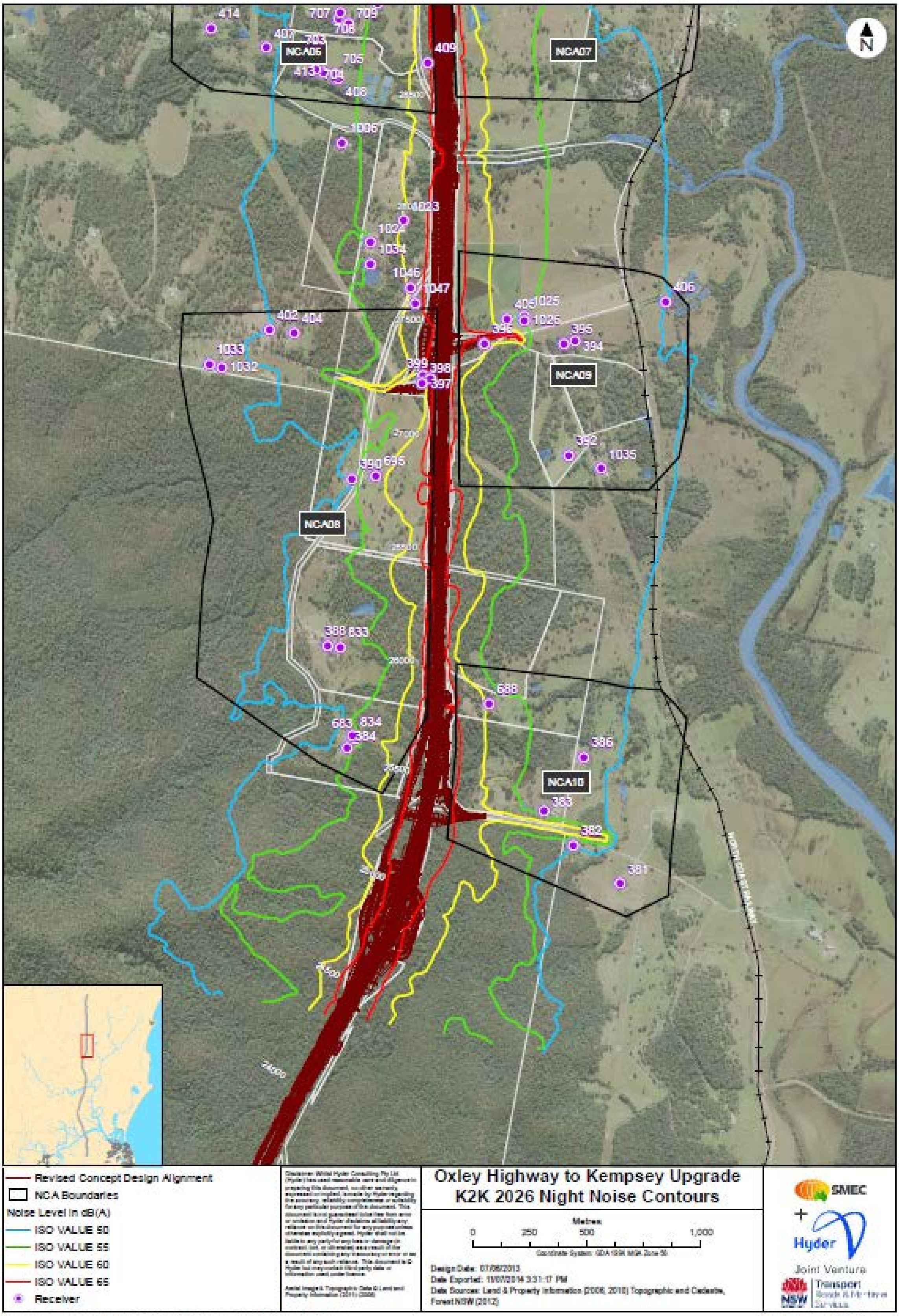
NCA07
Revised Concept Design Alignment
NCA Boundaries
Noise Level in dB(A)
ISO VALUE 50
ISO VALUE 55
ISO VALUE 60
ISO VALUE 65
Receiver
Oxley Highway to Kempsey Upgrade
K2K 2026 Night Noise Contours
Metres
0
250
500
1,000
Design Date: 07/08/2013
Date Exported: 11/07/2014 3:31:02 PM
Date Sources: Land & Property Information (2006, 2010) Topographic and Cadastre, Forest NSW (2012)
SMEC
Hyder
Joint Venture
Transport
Roads & Maritime
Services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Revised Concept Design Alignment
NCA Boundaries
Noise Level in dB(A)
ISO VALUE 50
ISO VALUE 55
ISO VALUE 60
ISO VALUE 65
Receiver
Oxley Highway to Kempsey Upgrade
K2K 2026 Night Noise Contours
Metres
0
250
500
1,000
Design Date: 07/06/2013
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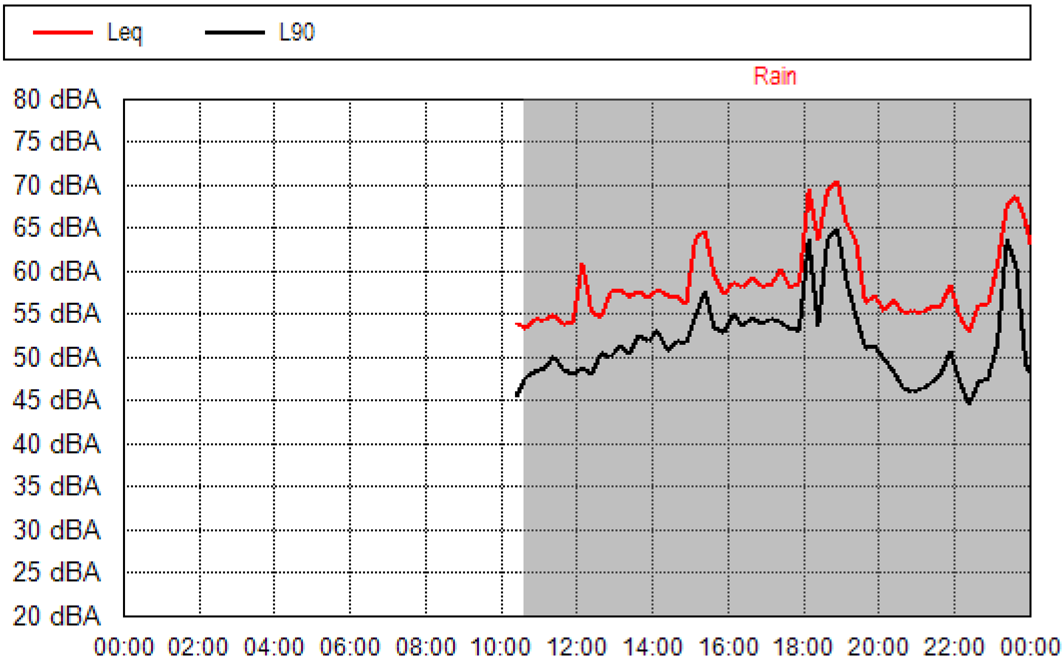
Date Sources: Land & Property Information (2006, 2010) Topographic and Cadastre, Forest NSW (2012)
SMEC
Hyder
Joint Venture
Transport
NSW

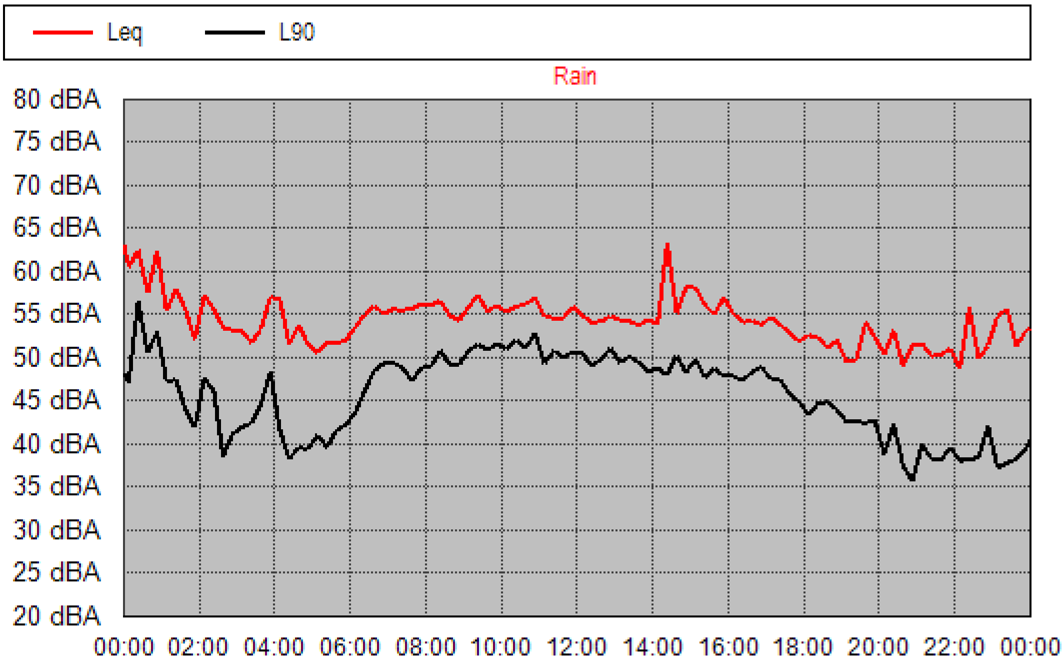
# APPENDIX C

## UNATTENDED MEASUREMENT RESULTS

**Project: Oxley to Kempsey, Pacific Highway**
**Location: U1 - 87 Scrubby Creek Road**

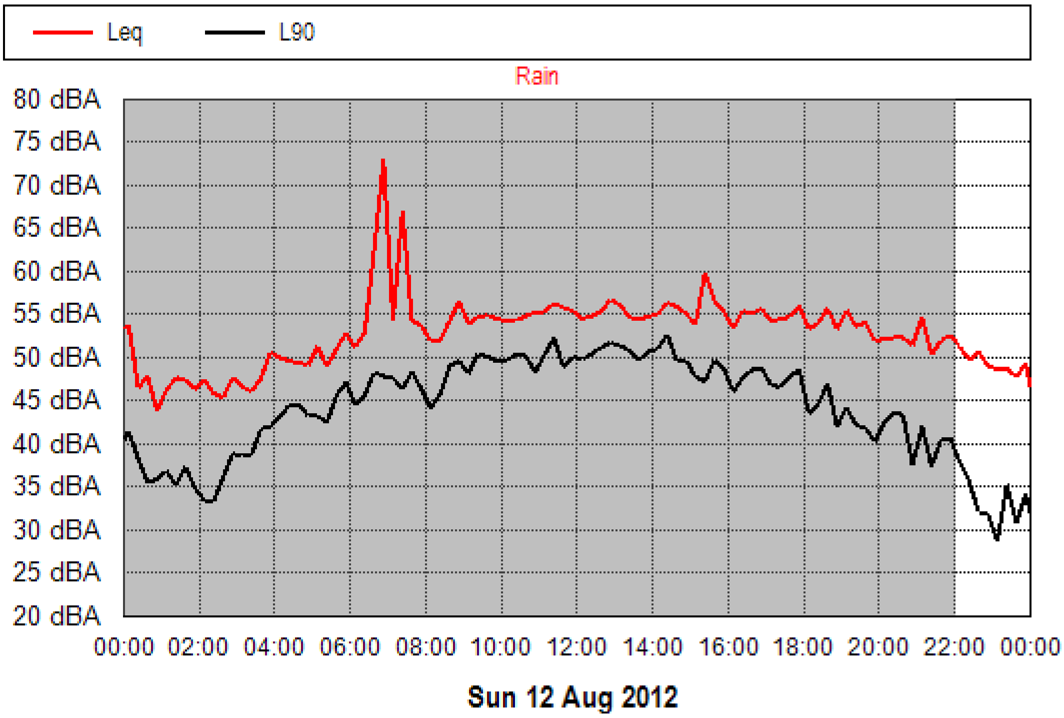


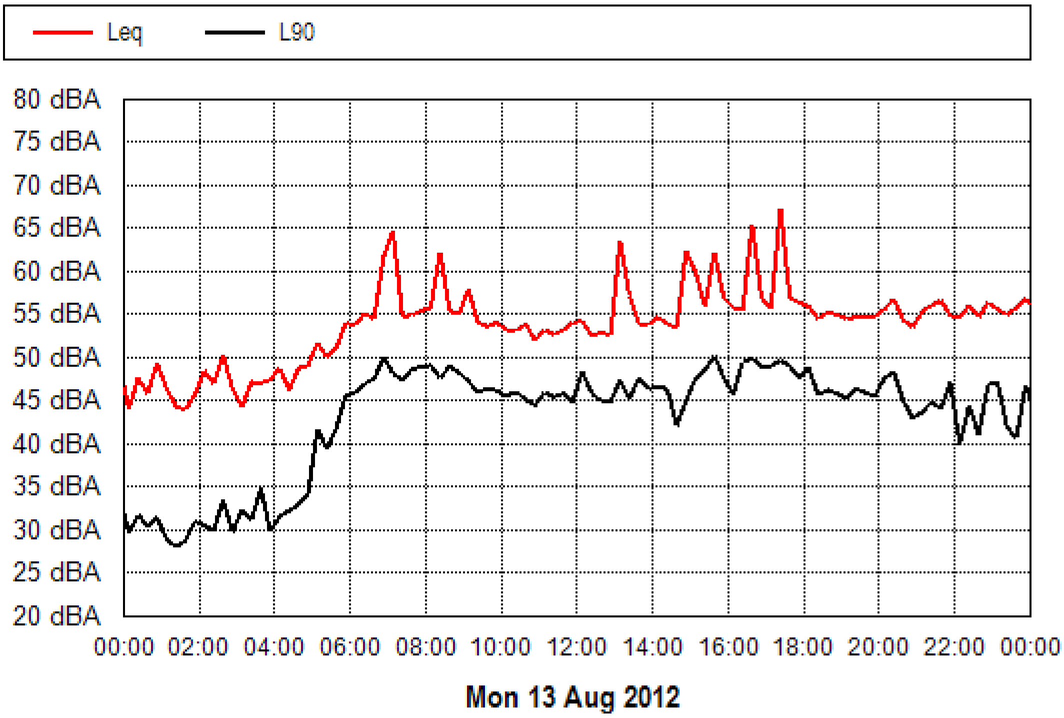

**Fri 10 Aug 2012**



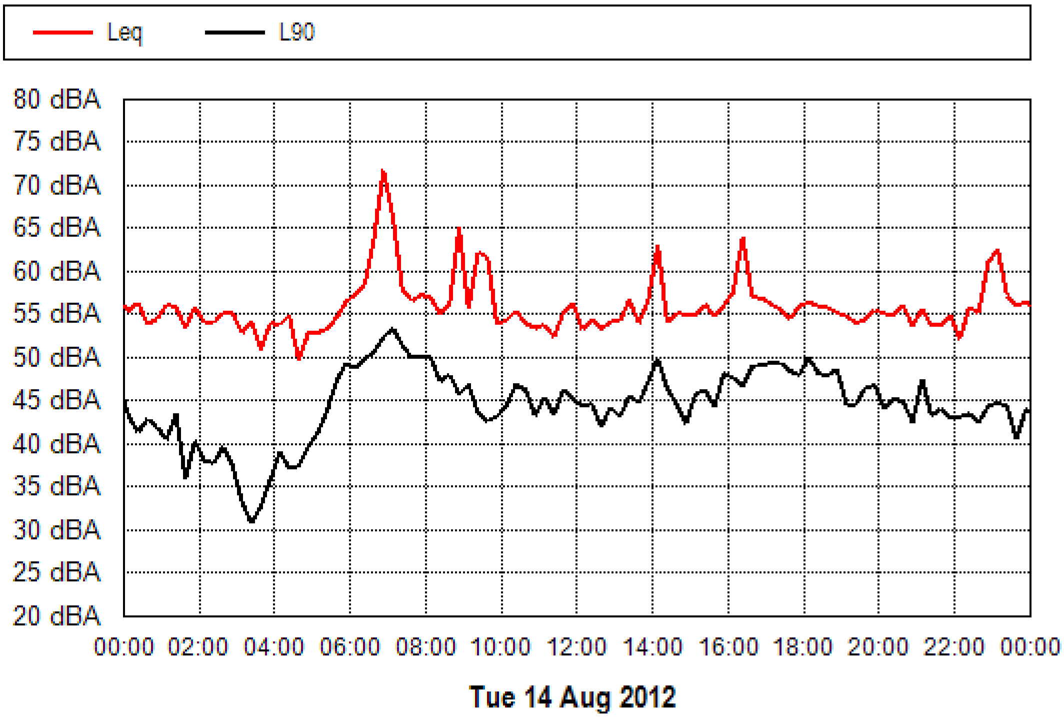

**Sat 11 Aug 2012**

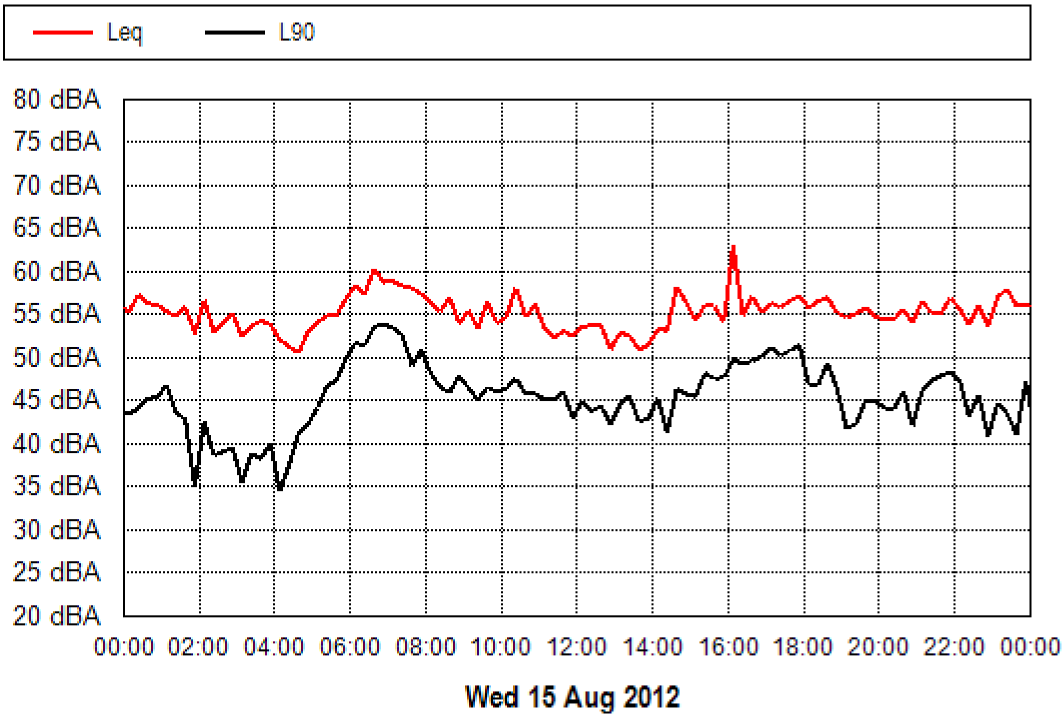
**Project: Oxley to Kempsey, Pacific Highway**
**Location: U1 - 87 Scrubby Creek Road**



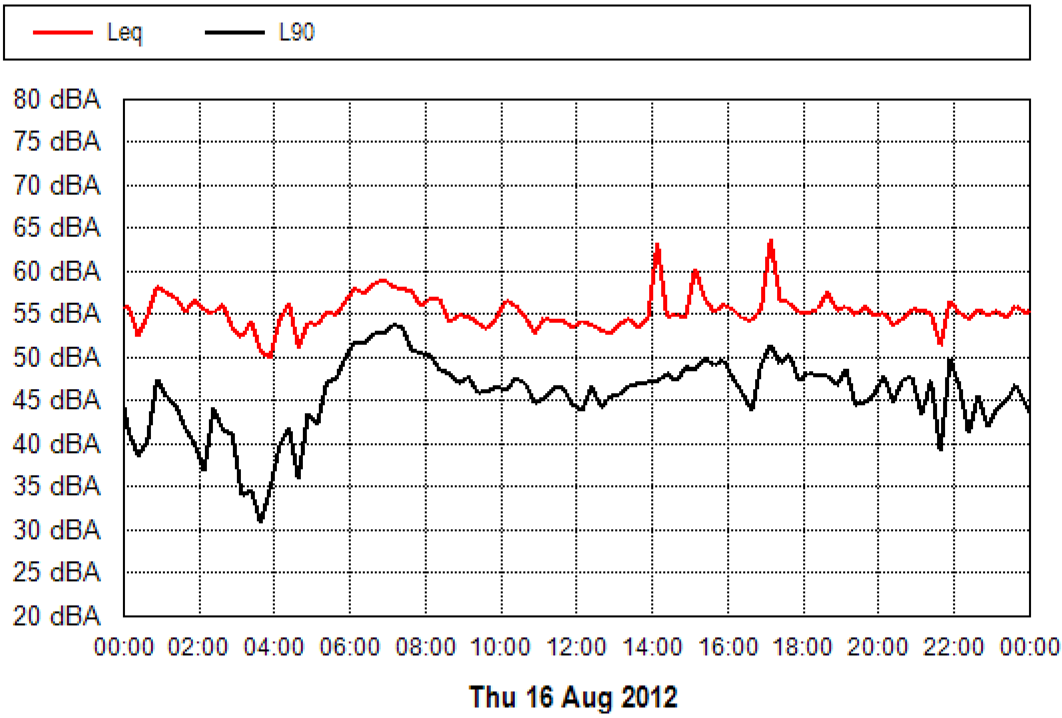



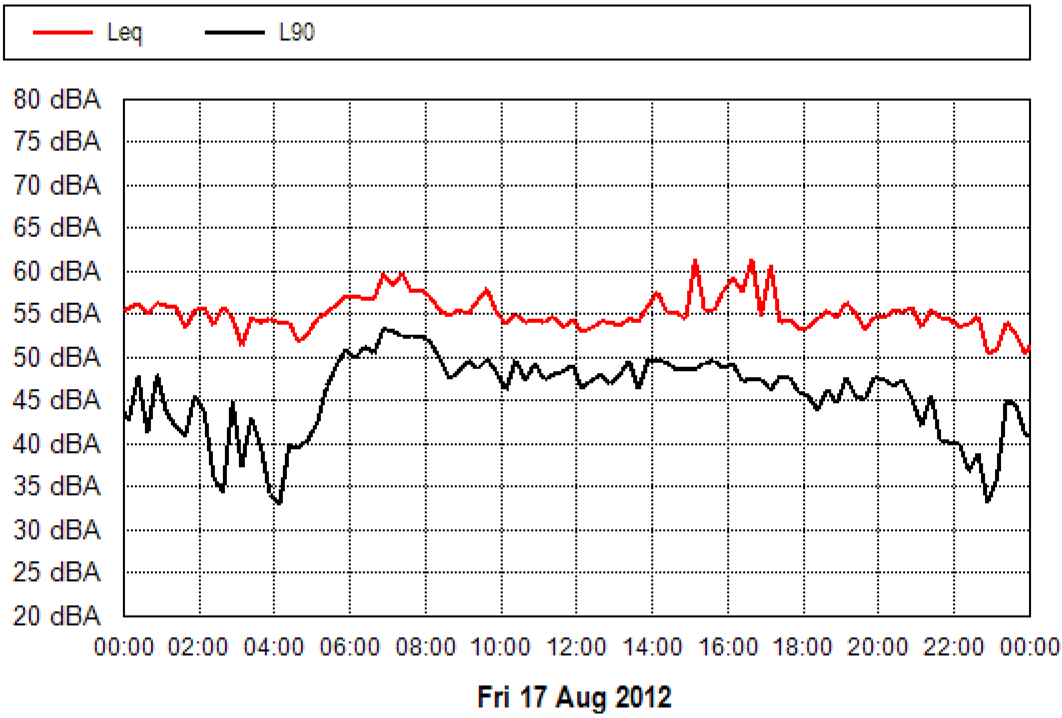
**Project: Oxley to Kempsey, Pacific Highway**
**Location: U1 - 87 Scrubby Creek Road**



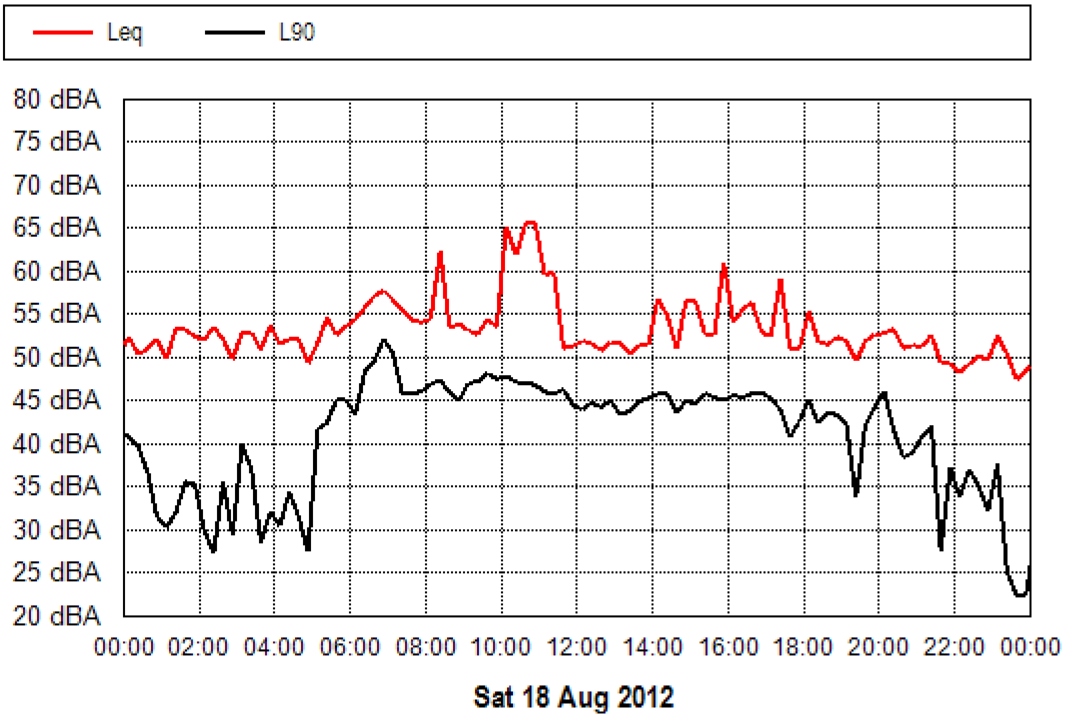



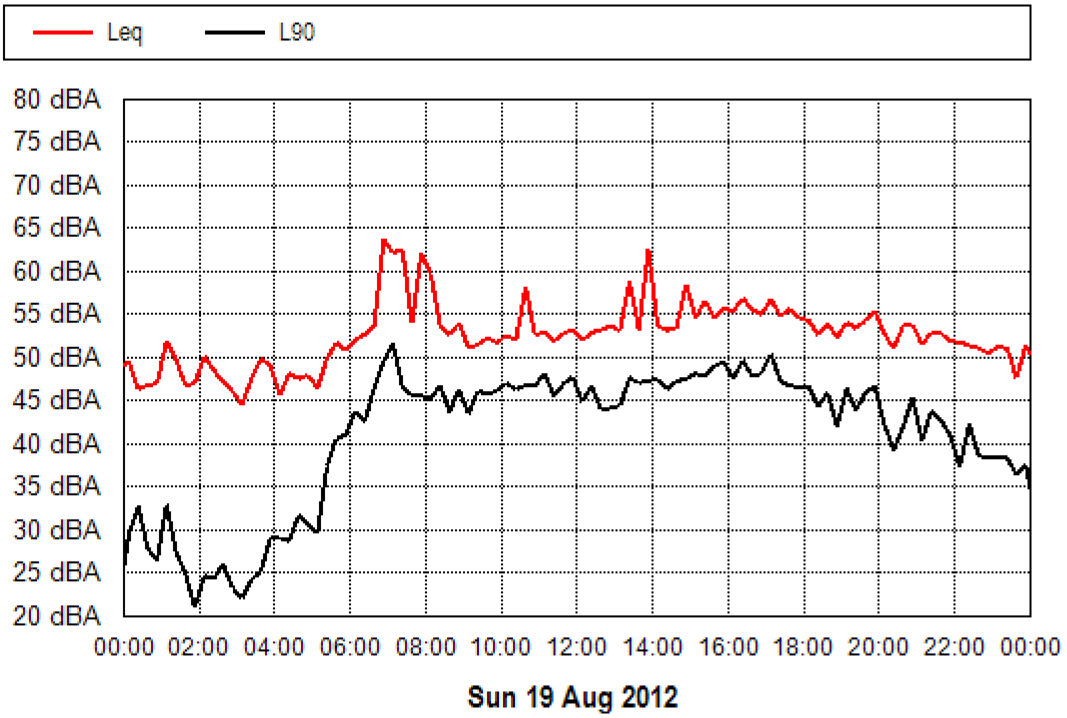
**Project: Oxley to Kempsey, Pacific Highway**
**Location: U1 - 87 Scrubby Creek Road**



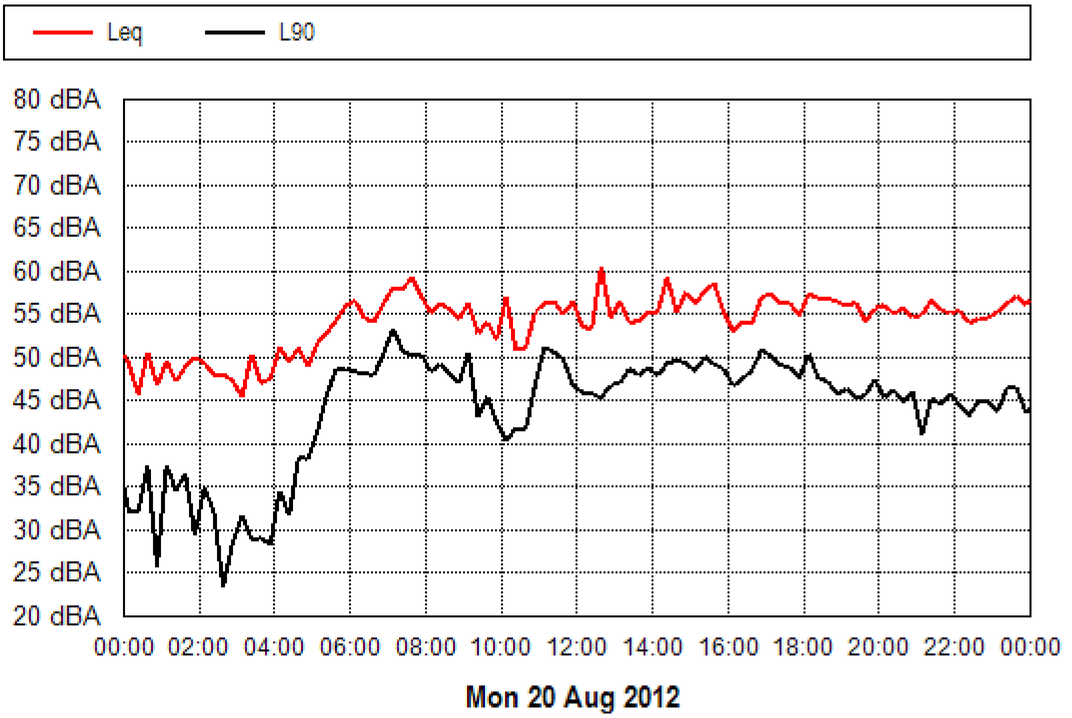



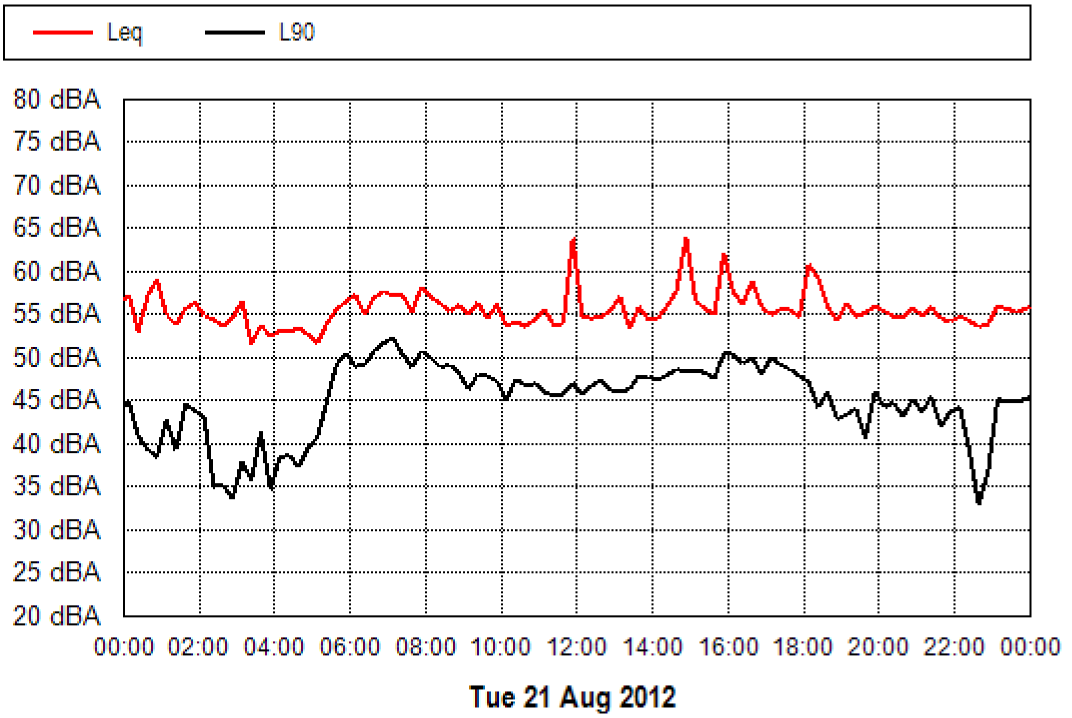
**Project: Oxley to Kempsey, Pacific Highway**
**Location: U1 - 87 Scrubby Creek Road**



**Project: Oxley to Kempsey, Pacific Highway**
**Location: U1 - 87 Scrubby Creek Road**



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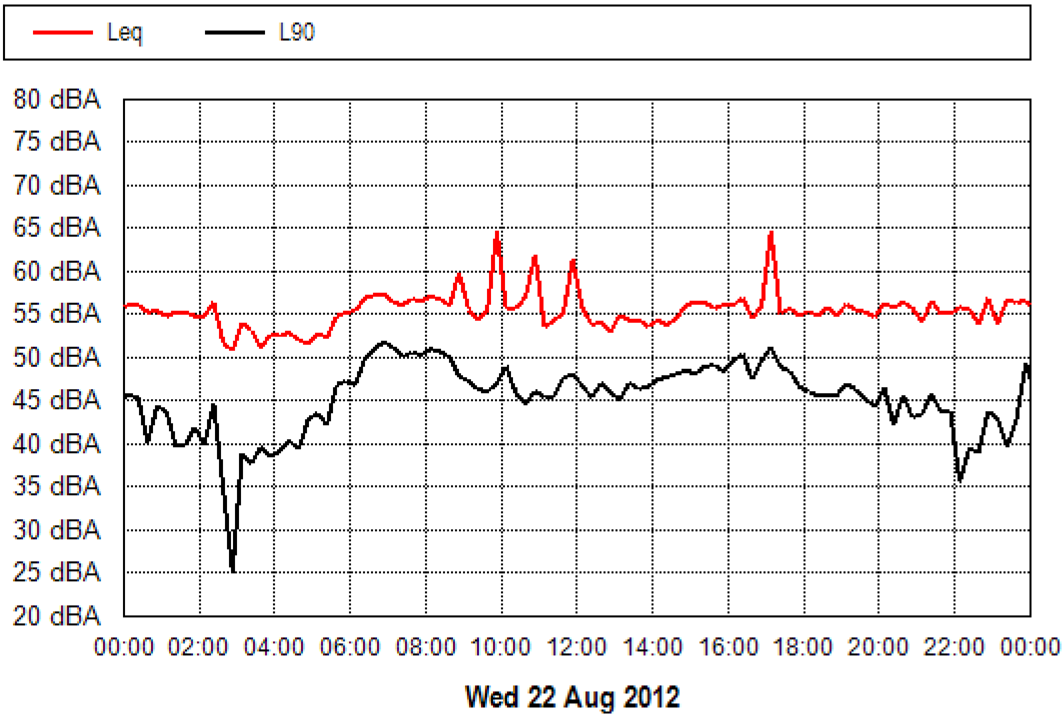
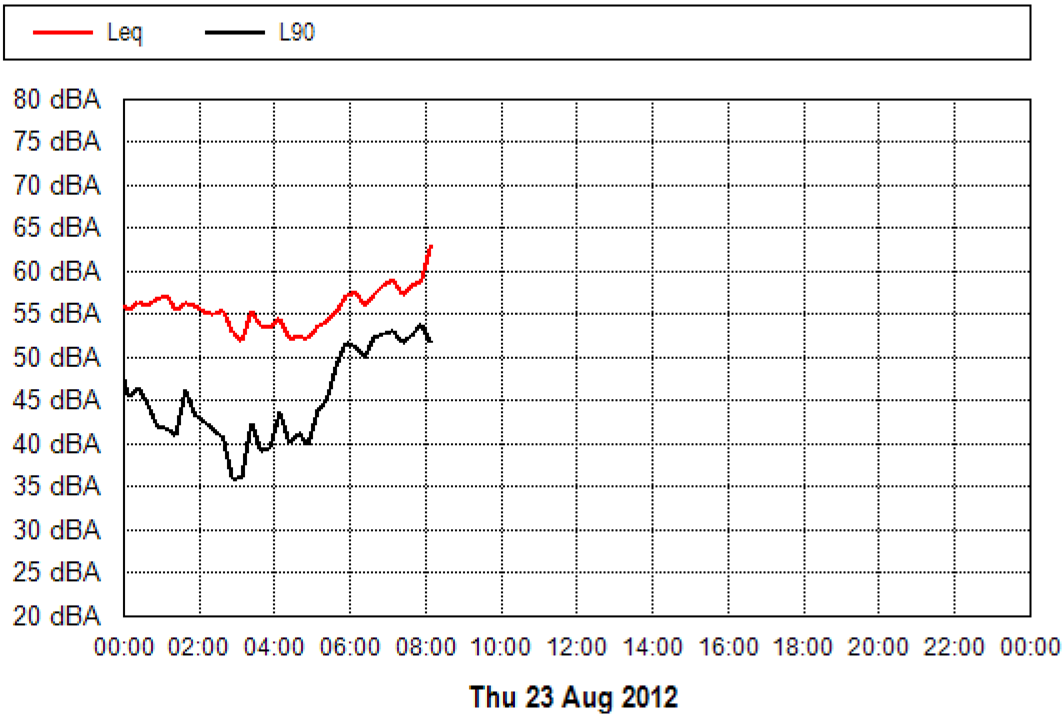
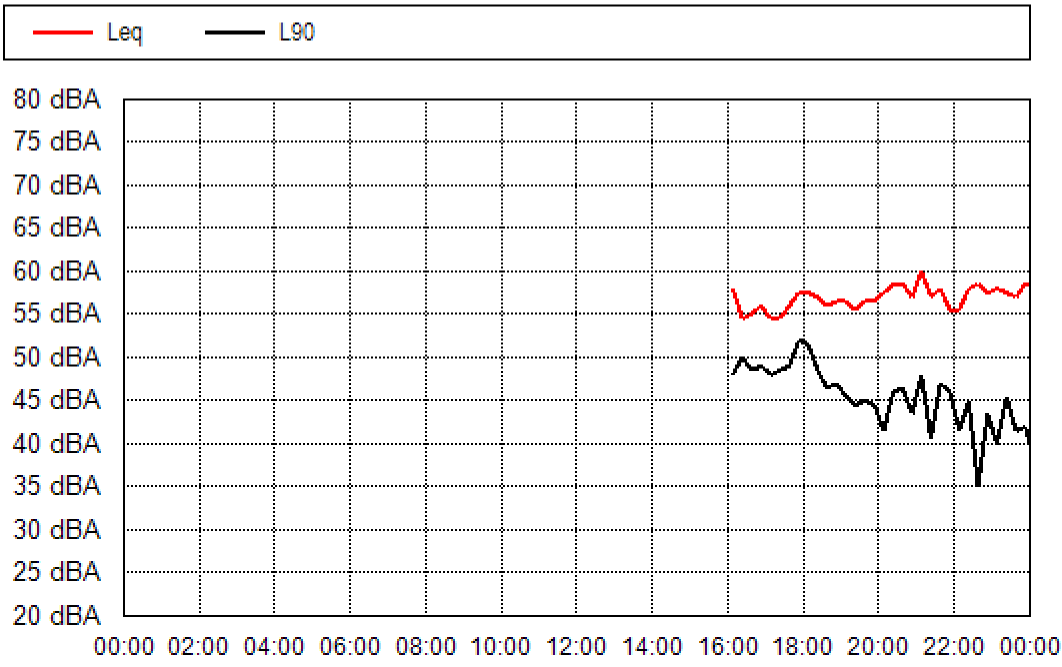
**Location: U1 - 87 Scrubby Creek Road**

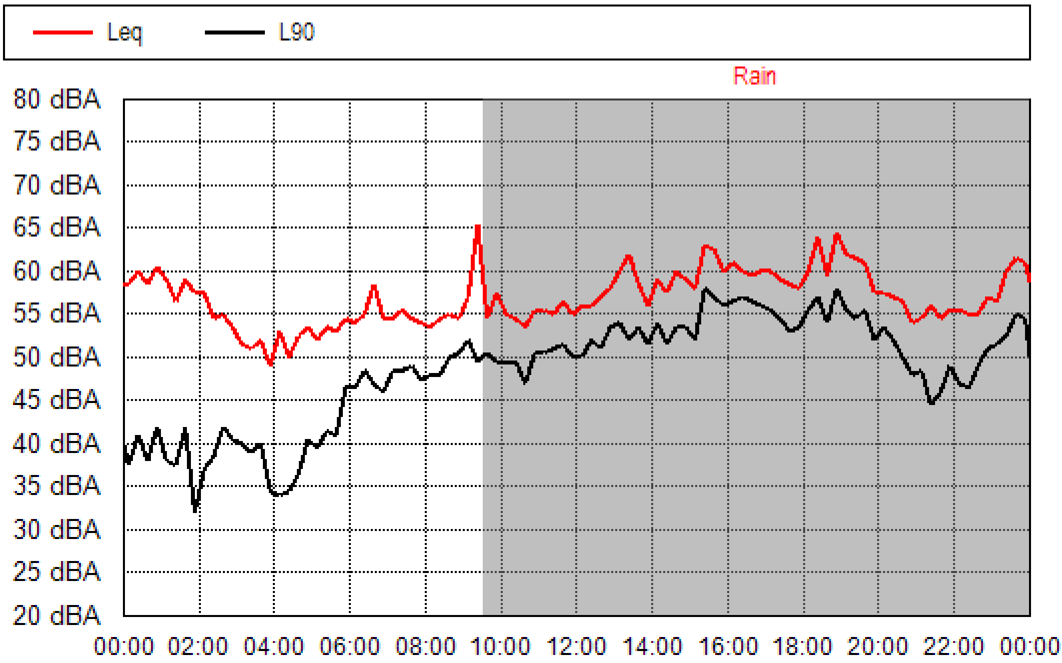


**Project: Oxley to Kempsey, Pacific Highway**
**Location: U2 - 106 Ravenswood Road**

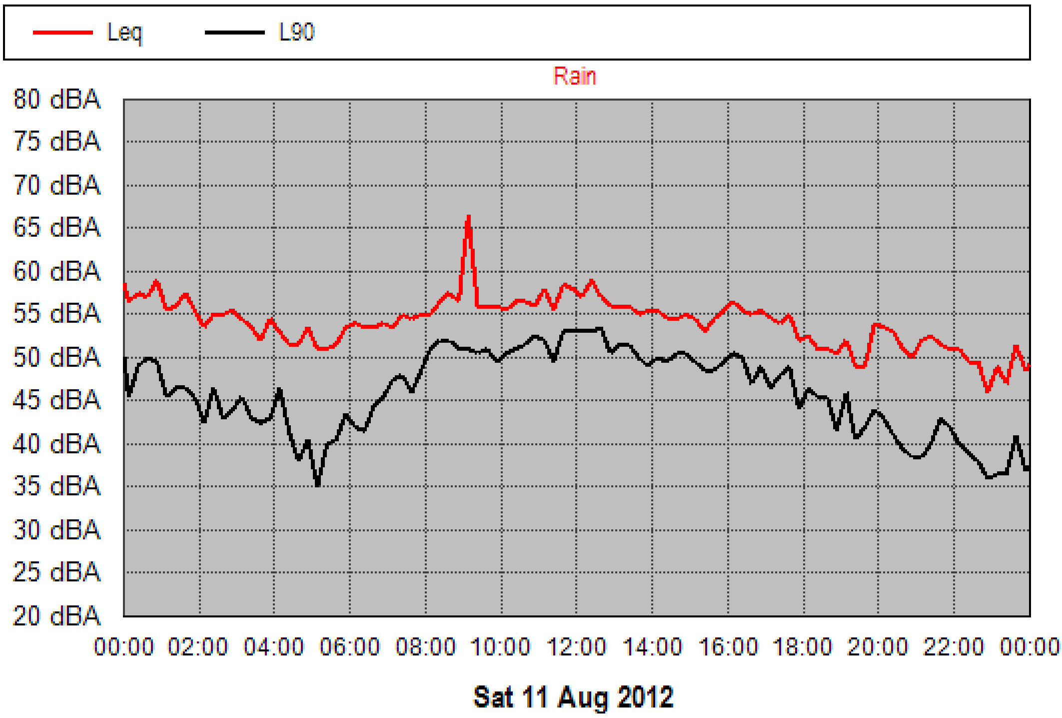


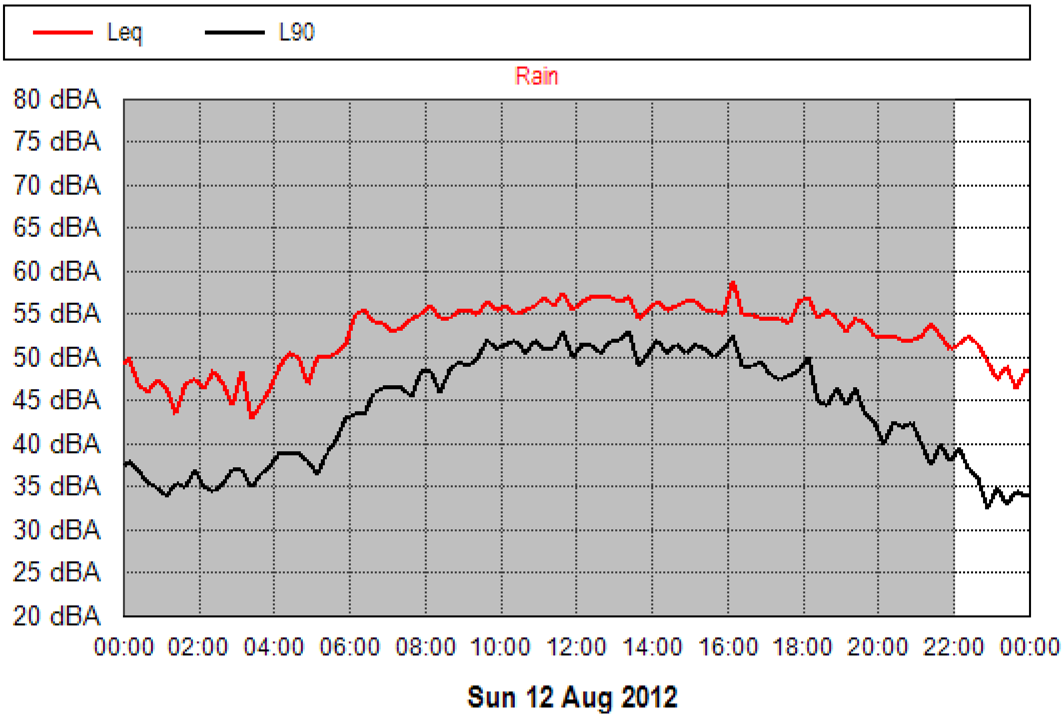

Thu 09 Aug 2012




Fri 10 Aug 2012

**Project: Oxley to Kempsey, Pacific Highway**
**Location: U2 - 106 Ravenswood Road**



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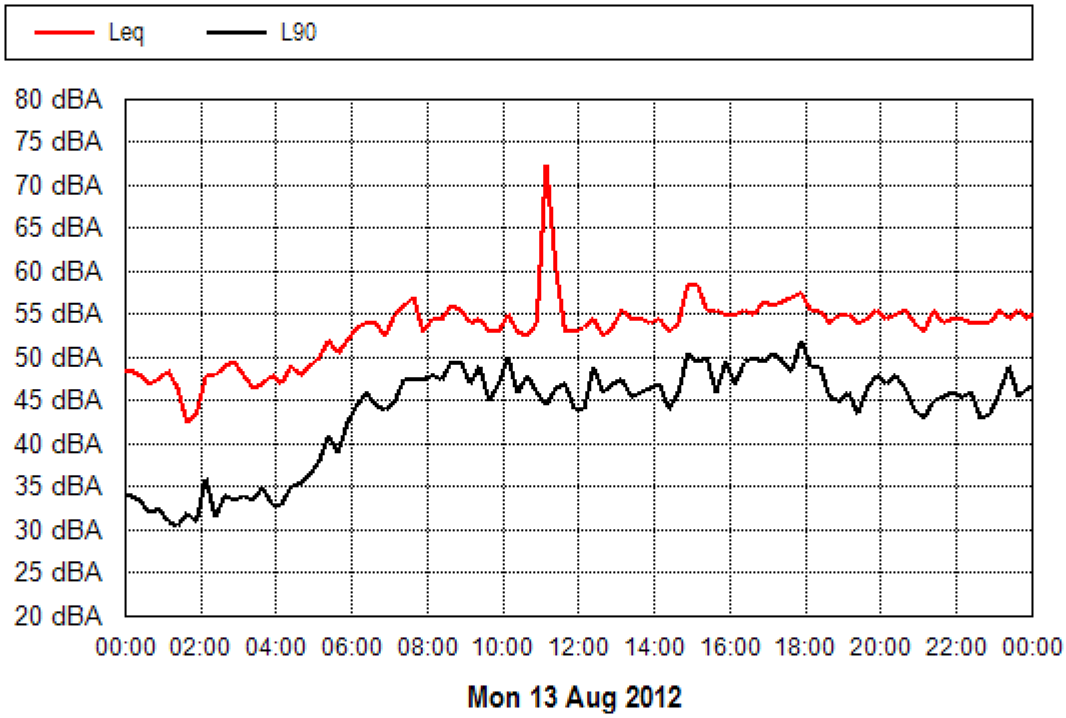
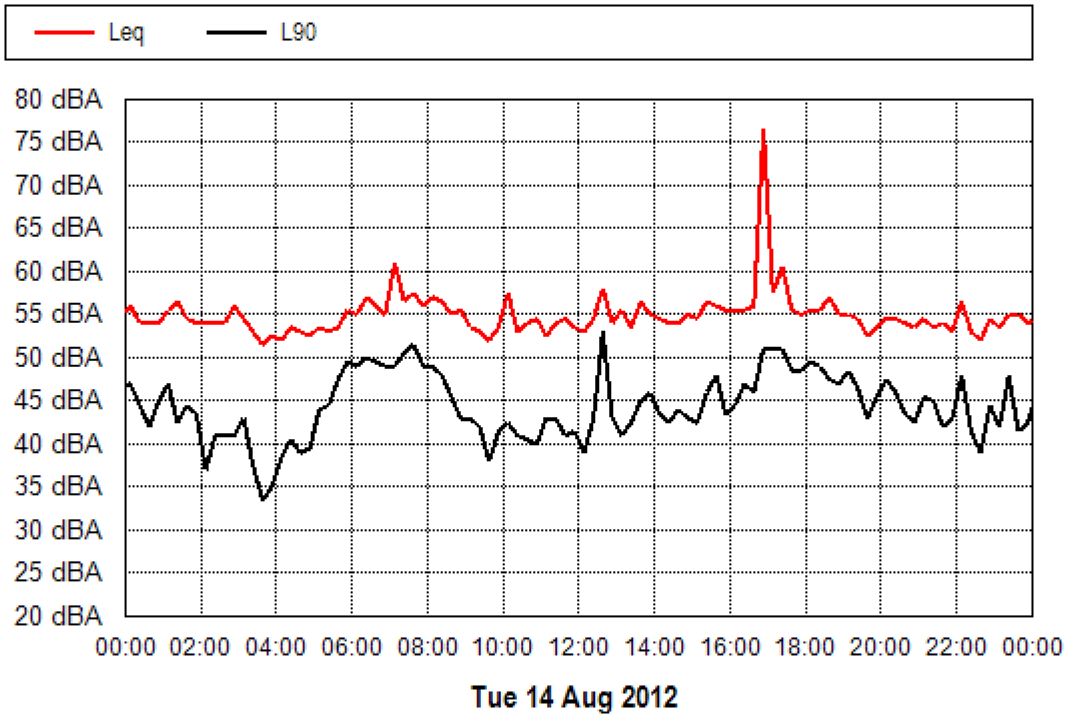
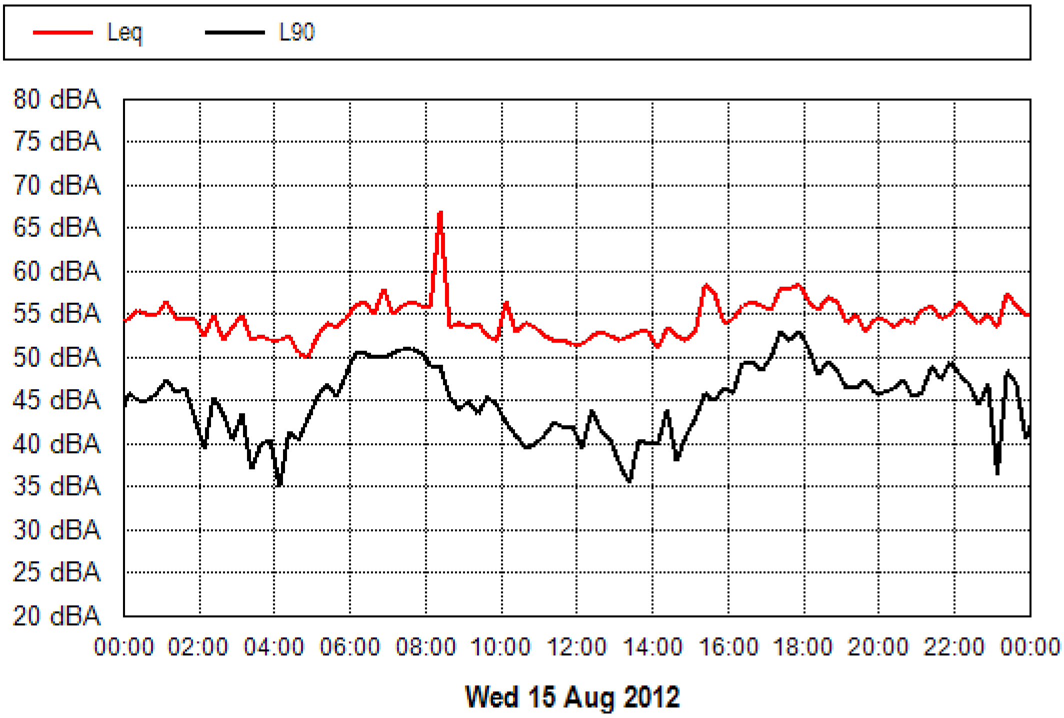
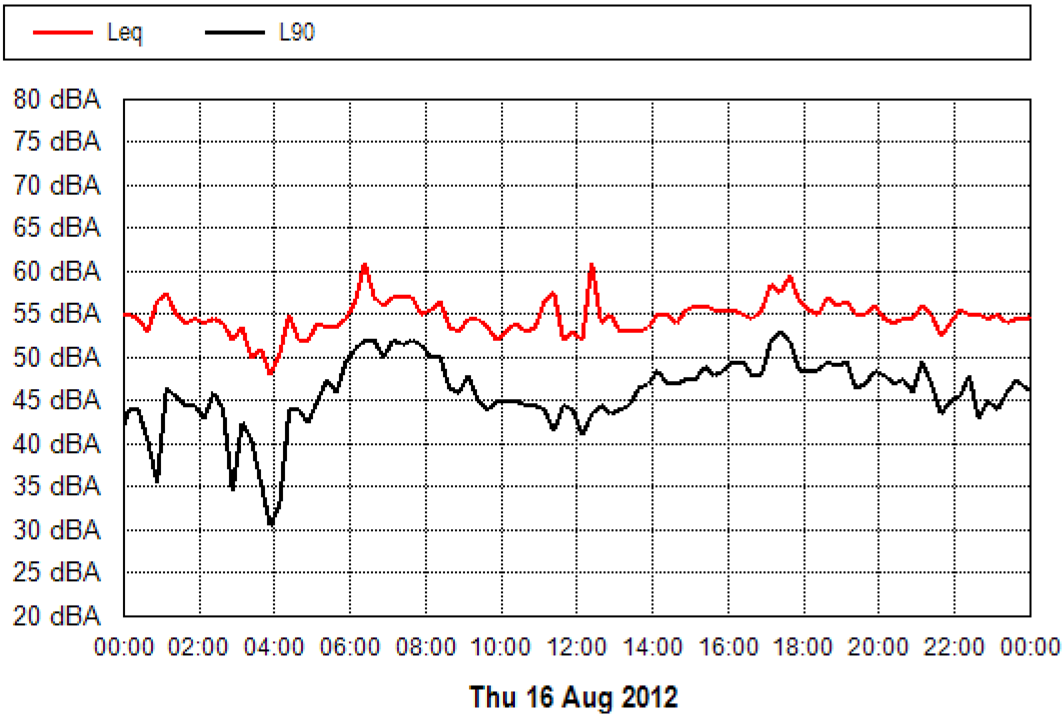
**Location: U2 - 106 Ravenswood Road**



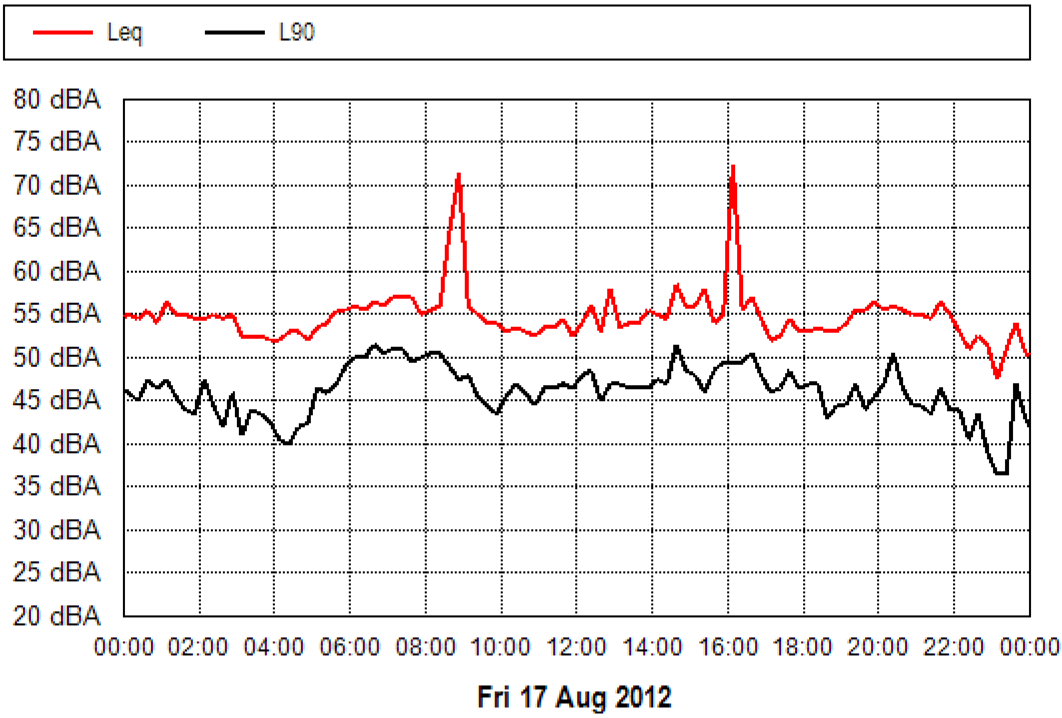



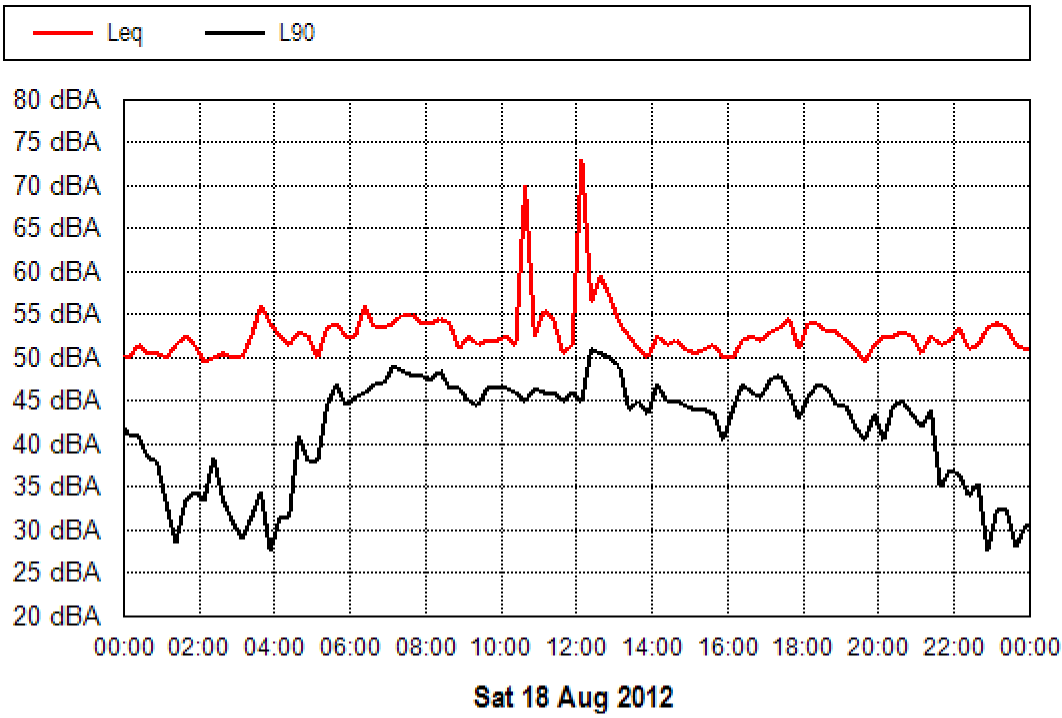
**Project: Oxley to Kempsey, Pacific Highway**
**Location: U2 - 106 Ravenswood Road**



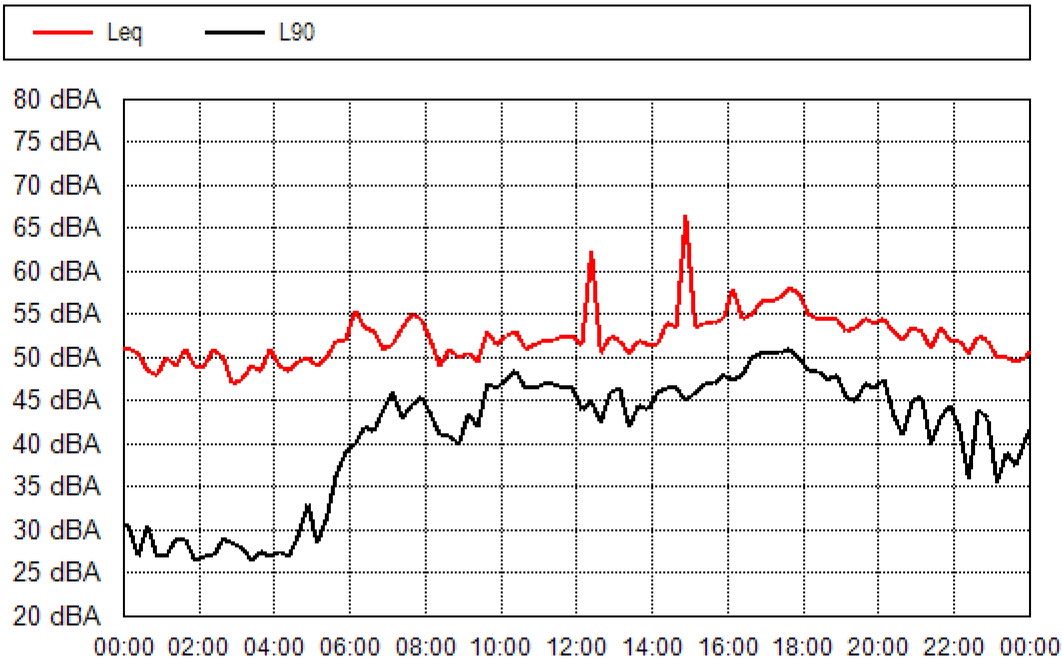



**Project: Oxley to Kempsey, Pacific Highway**
**Location: U2 - 106 Ravenswood Road**



**Project: Oxley to Kempsey, Pacific Highway**
**Location: U2 - 106 Ravenswood Road**

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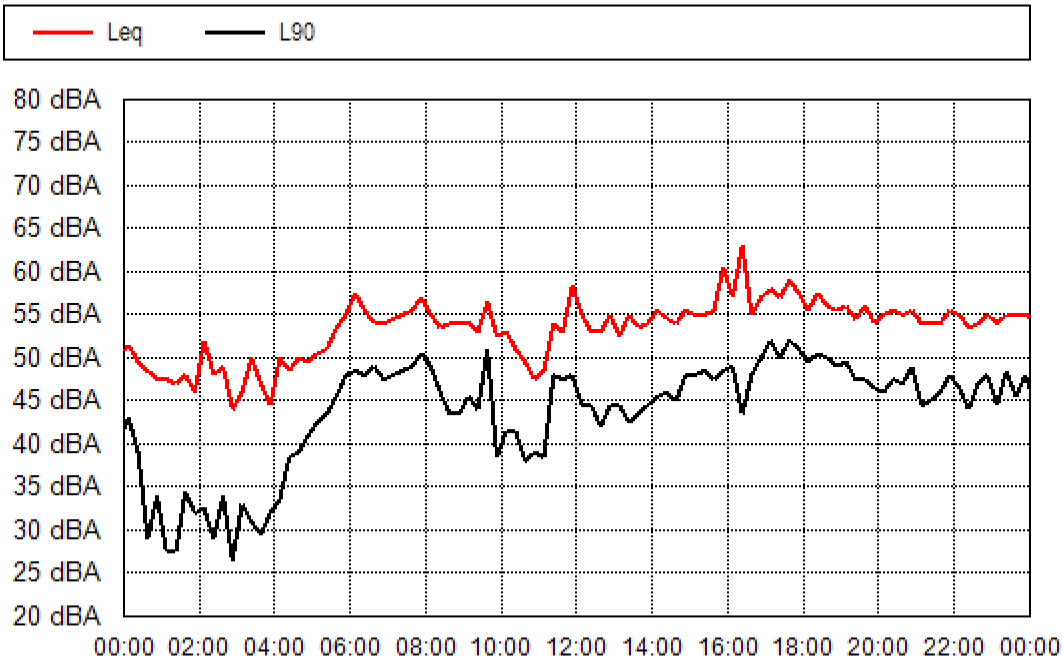
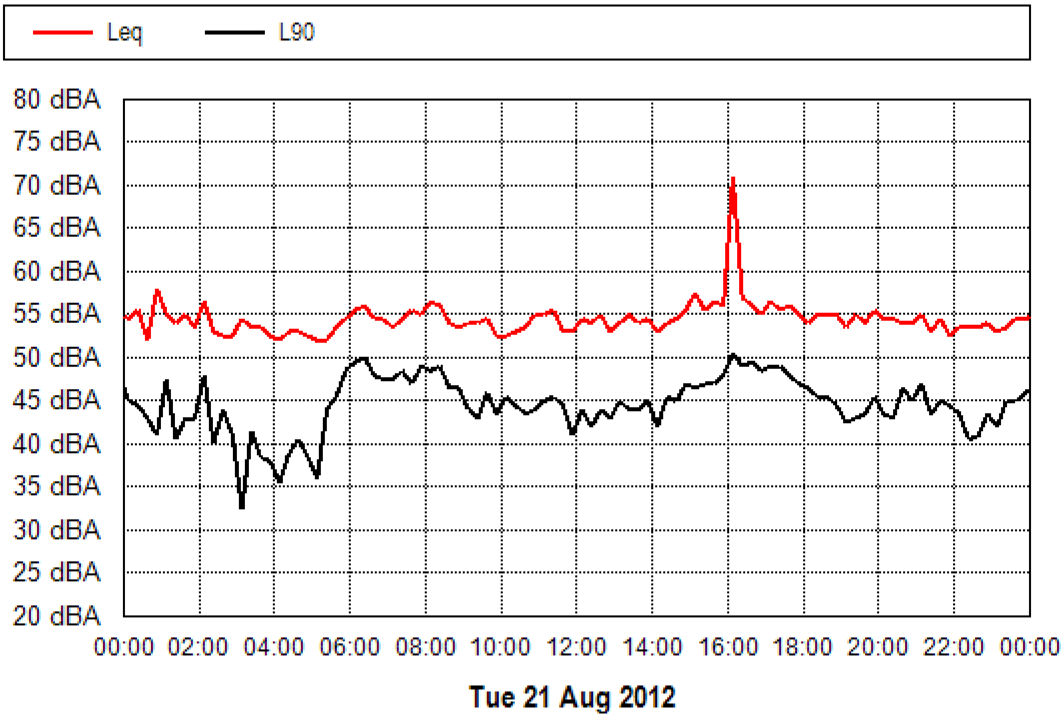
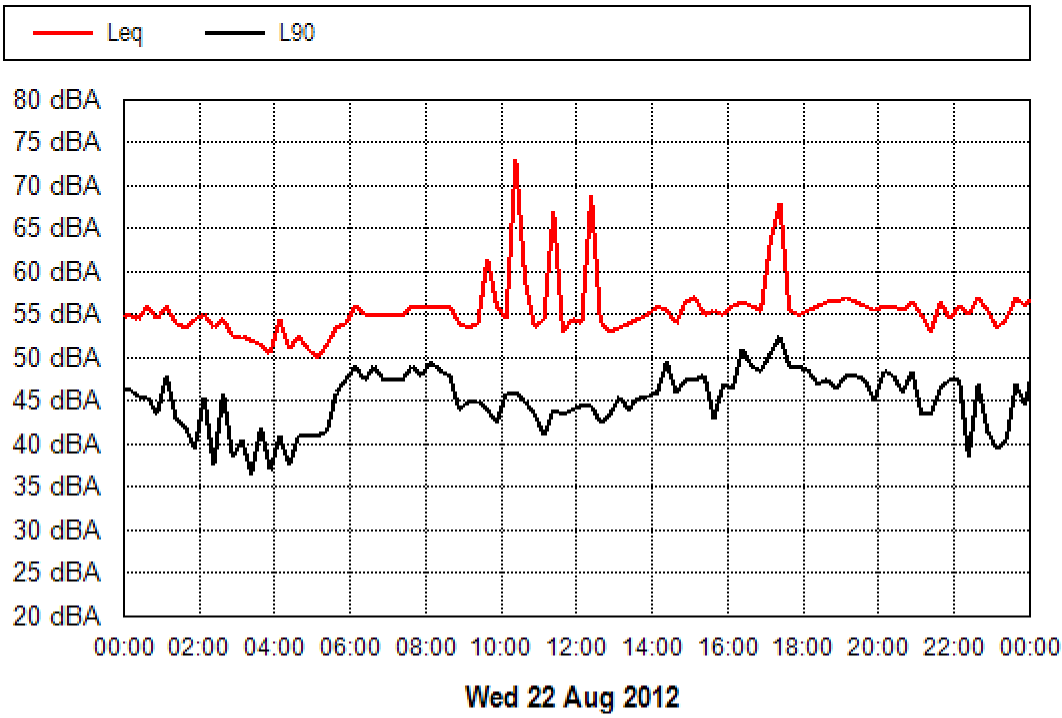


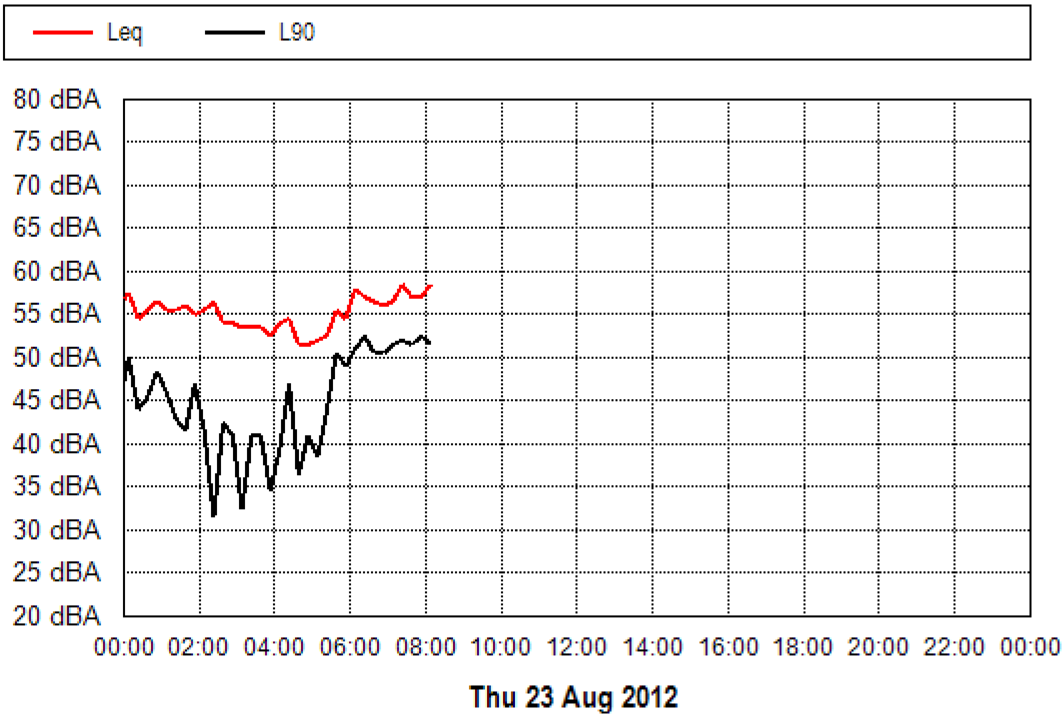

Mon 20 Aug 2012

**Project: Oxley to Kempsey, Pacific Highway**
**Location: U2 - 106 Ravenswood Road**

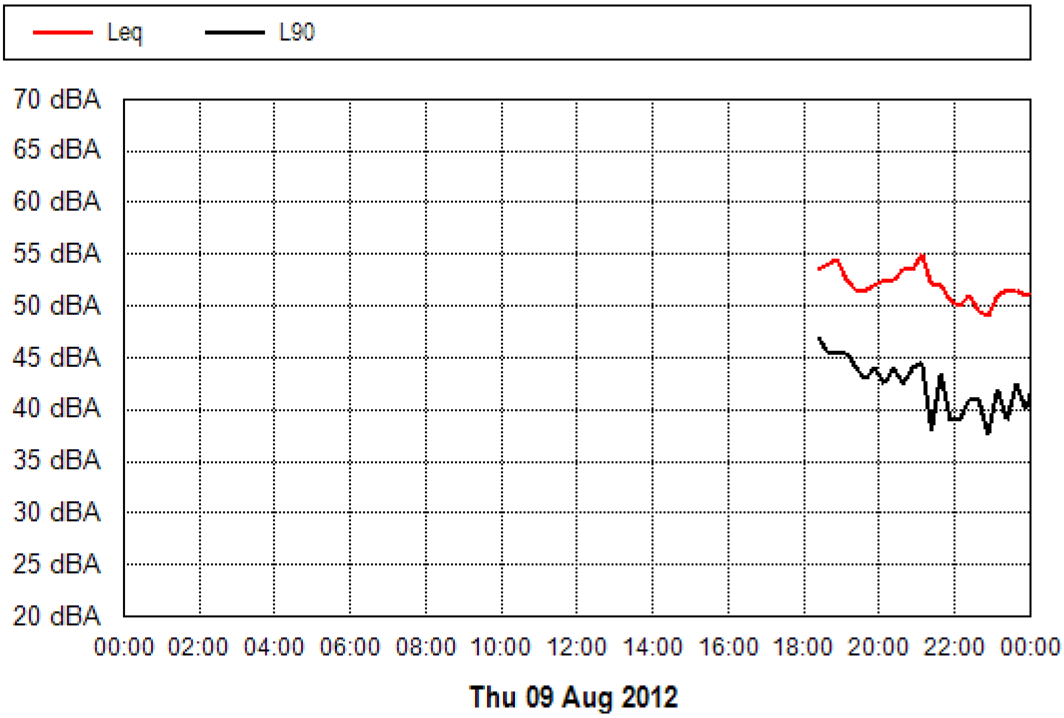


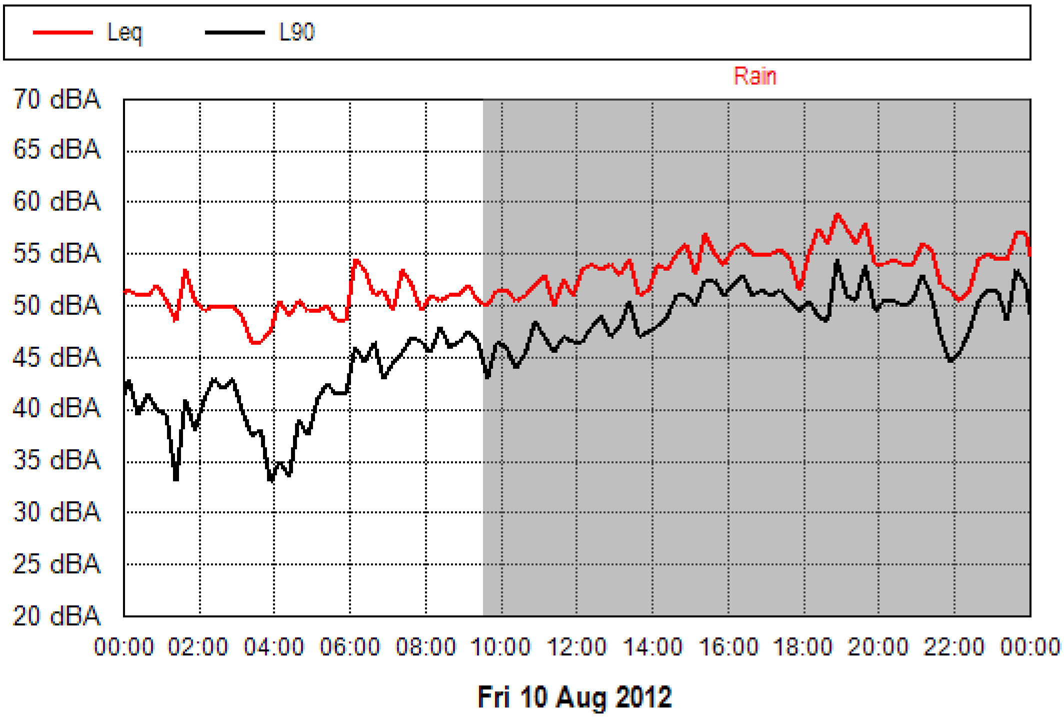



**Project: Oxley to Kempsey, Pacific Highway**
**Location: U2 - 106 Ravenswood Road**

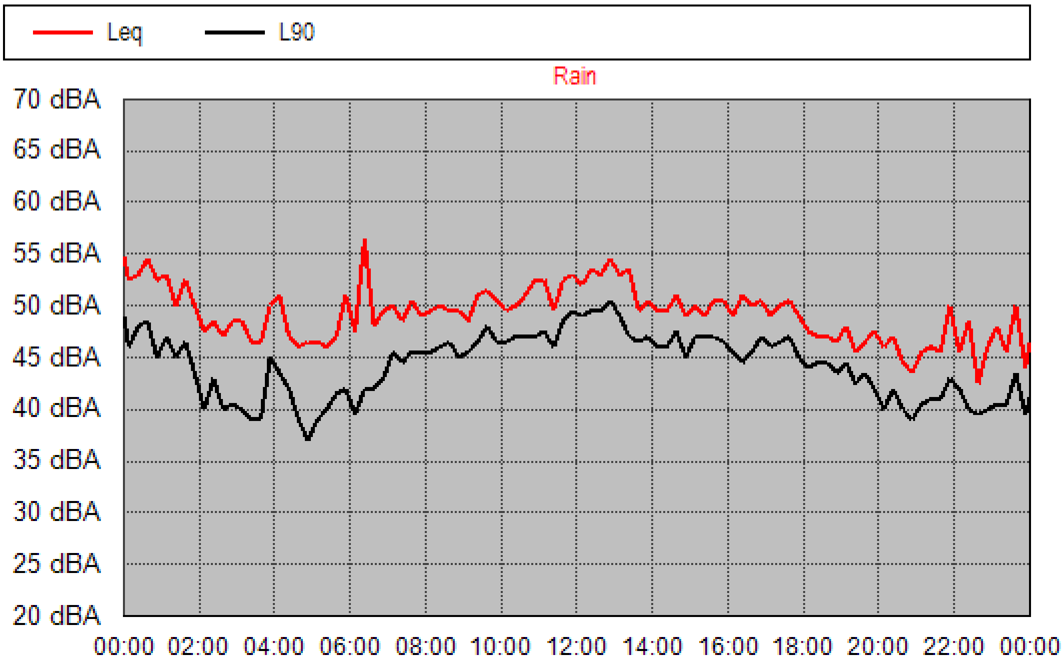


**Project: Pacific Highway, Oxley to Kempsey**
**Location: U3 - 61 Mingaletta Road**



**Project: Pacific Highway, Oxley to Kempsey**
**Location: U3 - 61 Mingaletta Road**

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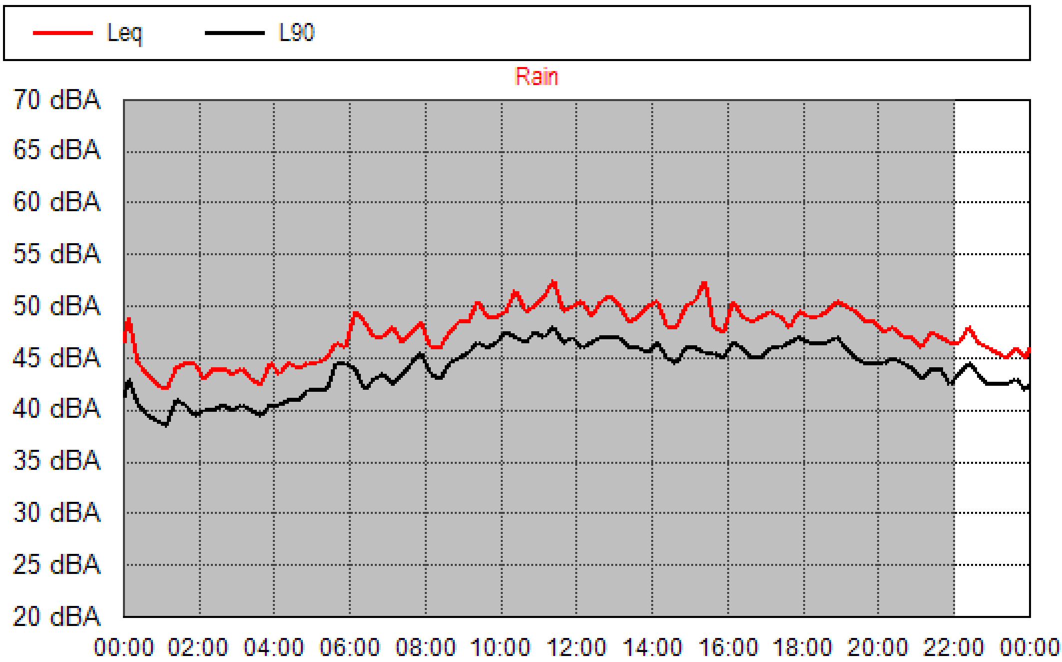
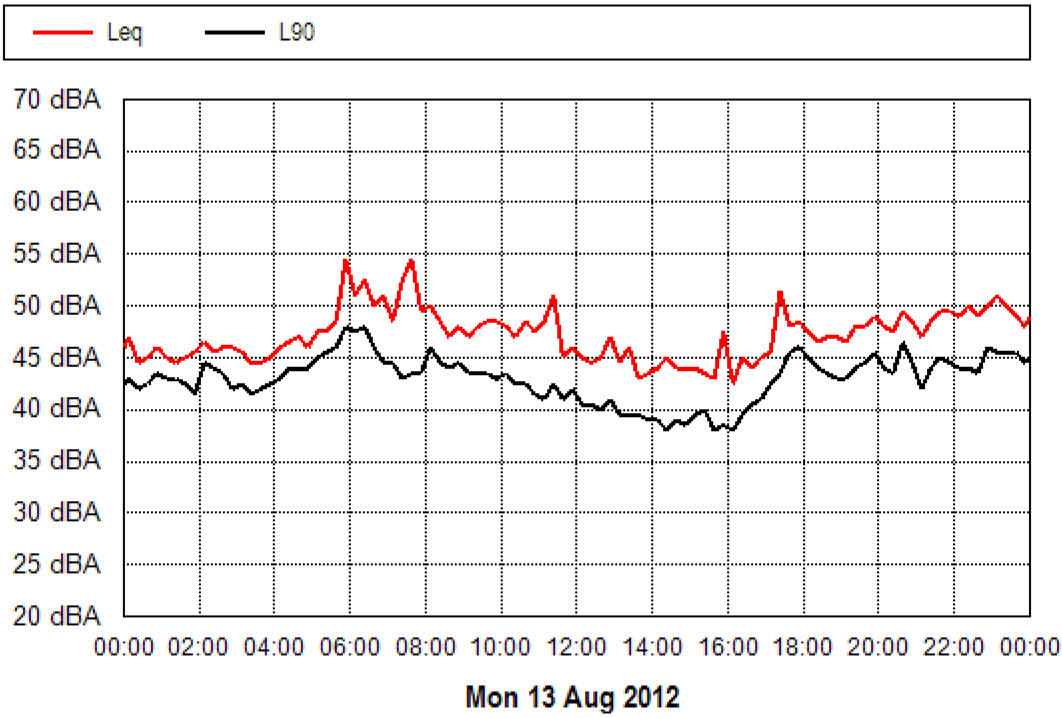
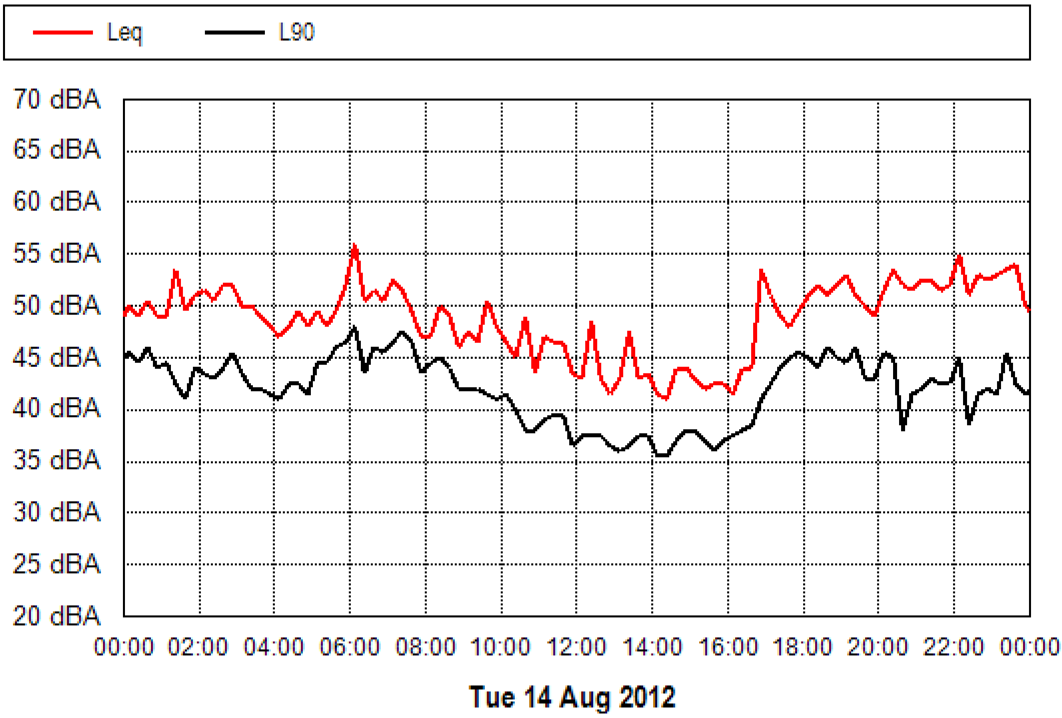


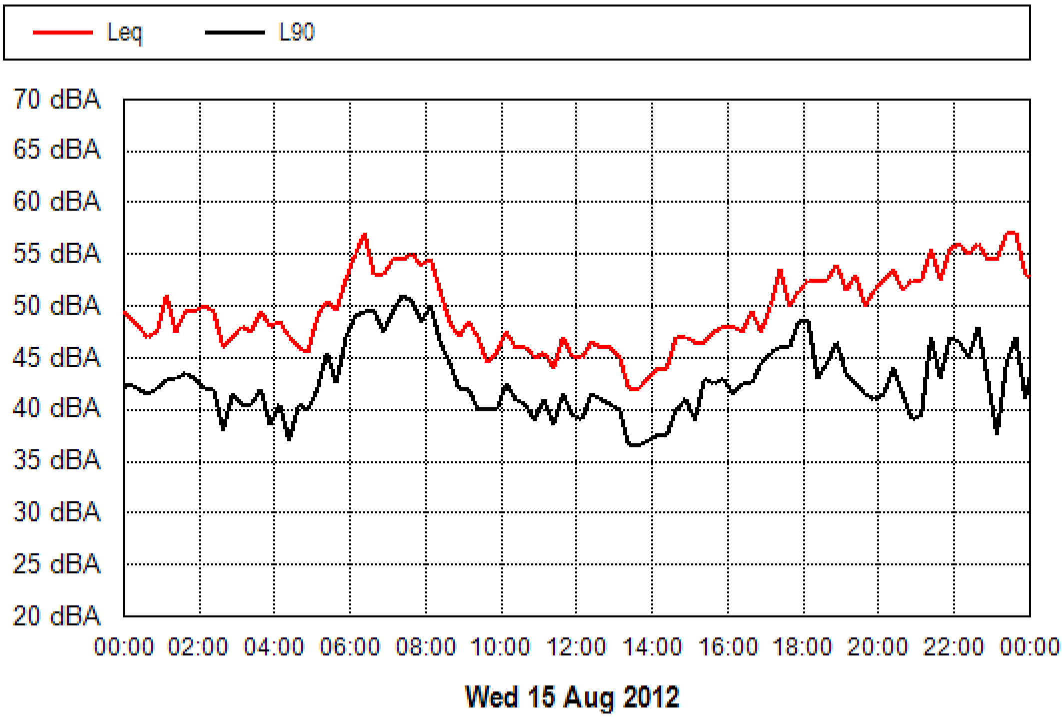

**Sun 12 Aug 2012**

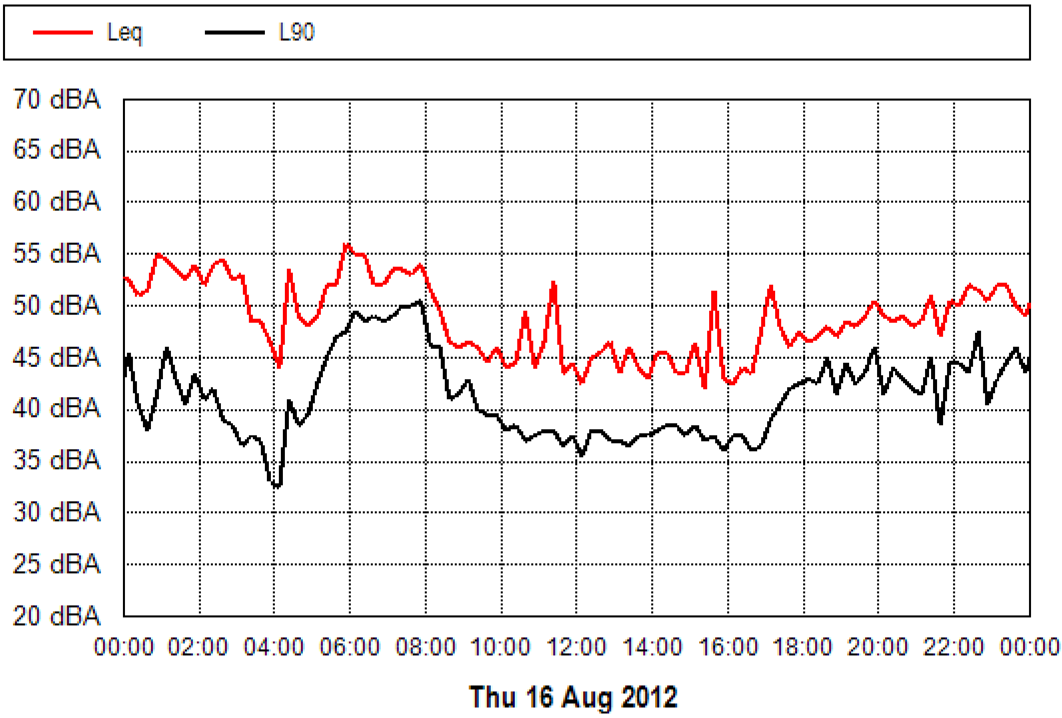
**Project: Pacific Highway, Oxley to Kempsey**
**Location: U3 - 61 Mingaletta Road**



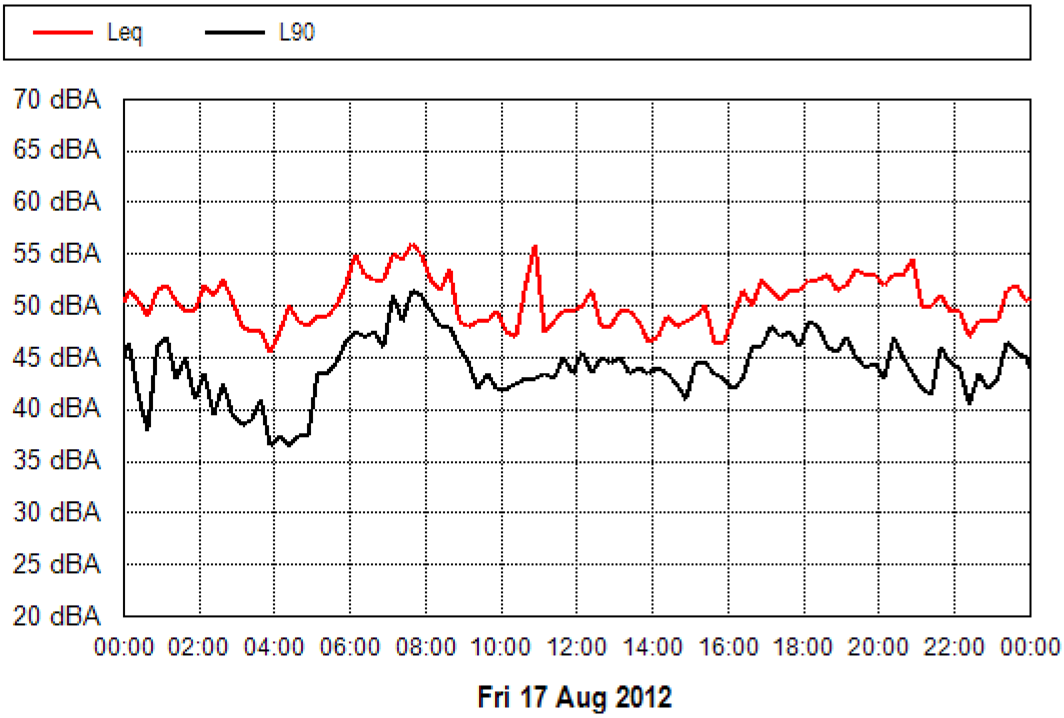



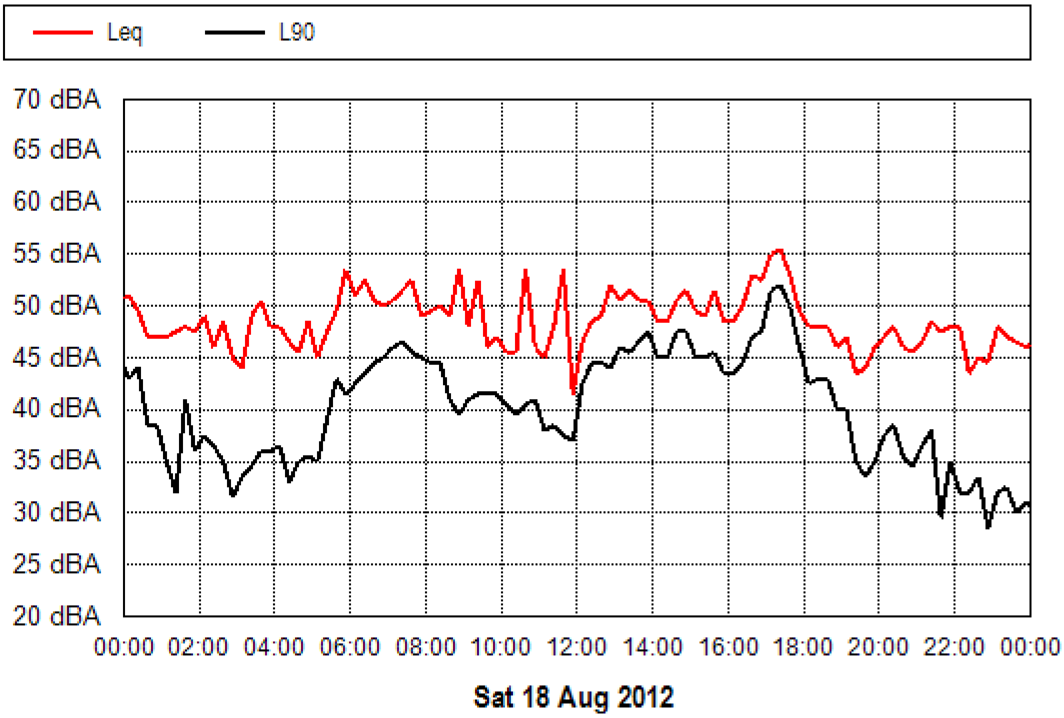
**Project: Pacific Highway, Oxley to Kempsey**
**Location: U3 - 61 Mingaletta Road**



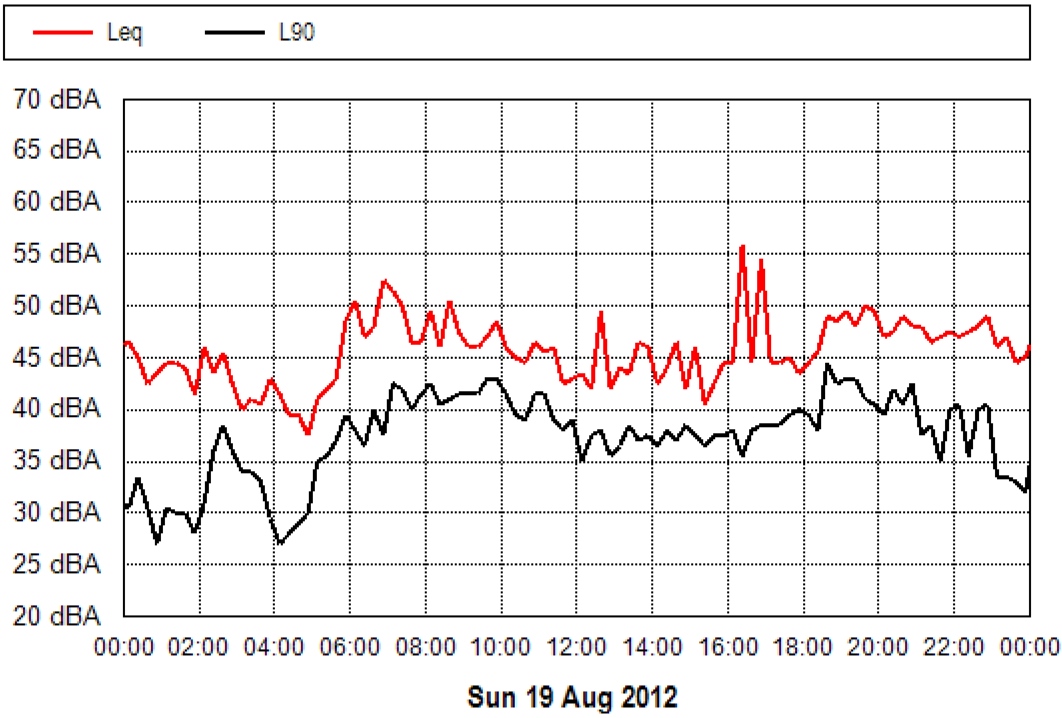



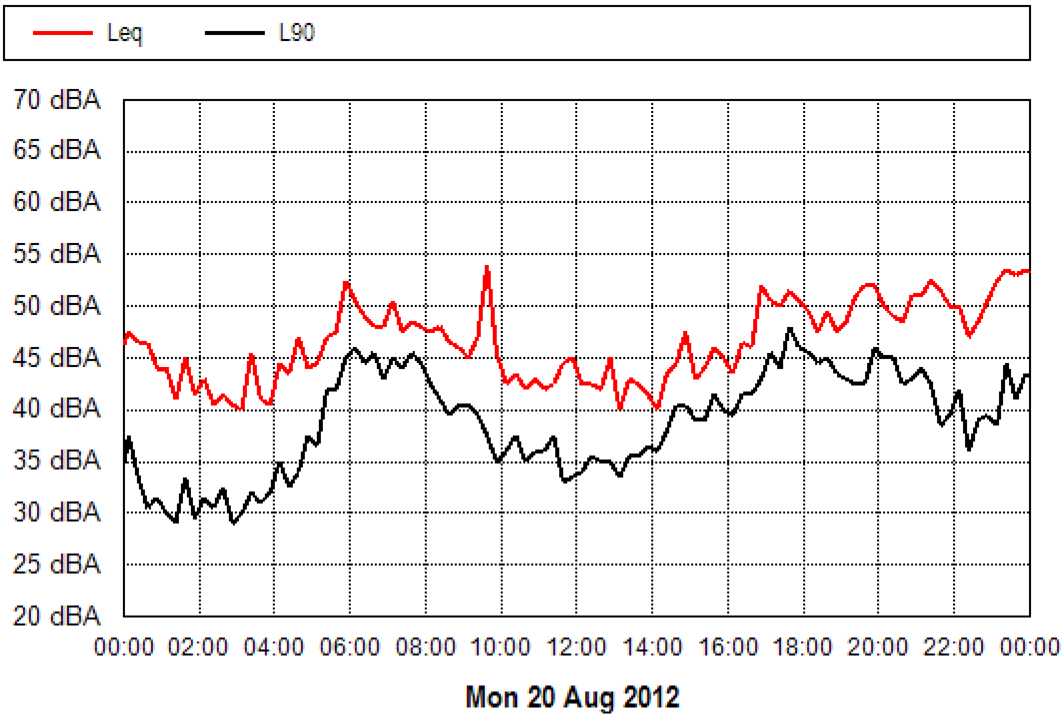
**Project: Pacific Highway, Oxley to Kempsey**
**Location: U3 - 61 Mingaletta Road**



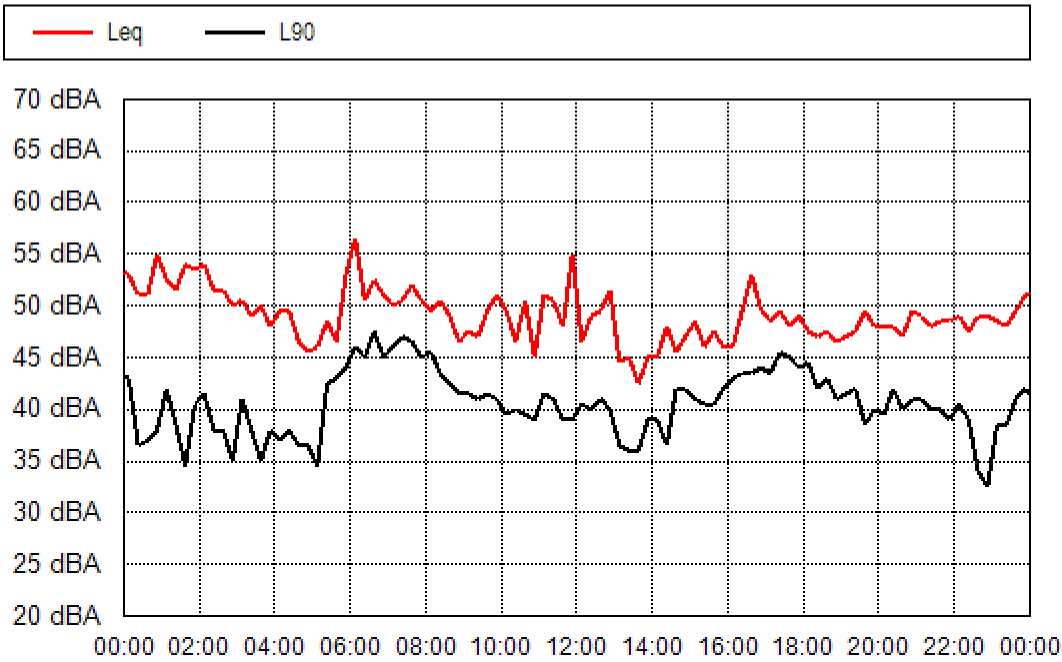



**Project: Pacific Highway, Oxley to Kempsey**
**Location: U3 - 61 Mingaletta Road**

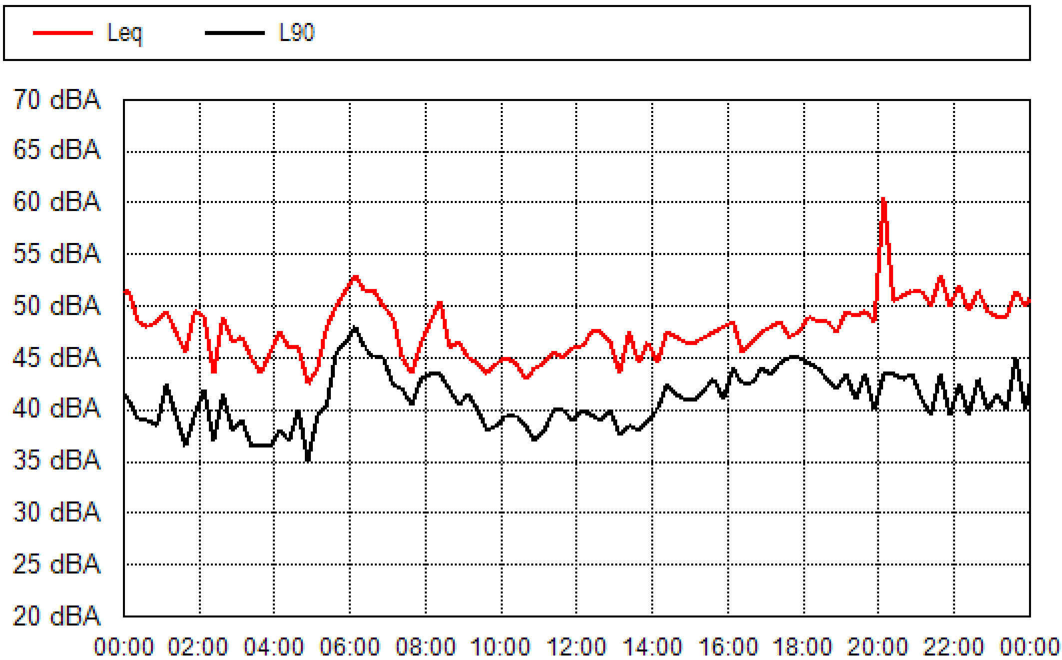


**Project: Pacific Highway, Oxley to Kempsey**
**Location: U3 - 61 Mingaletta Road**

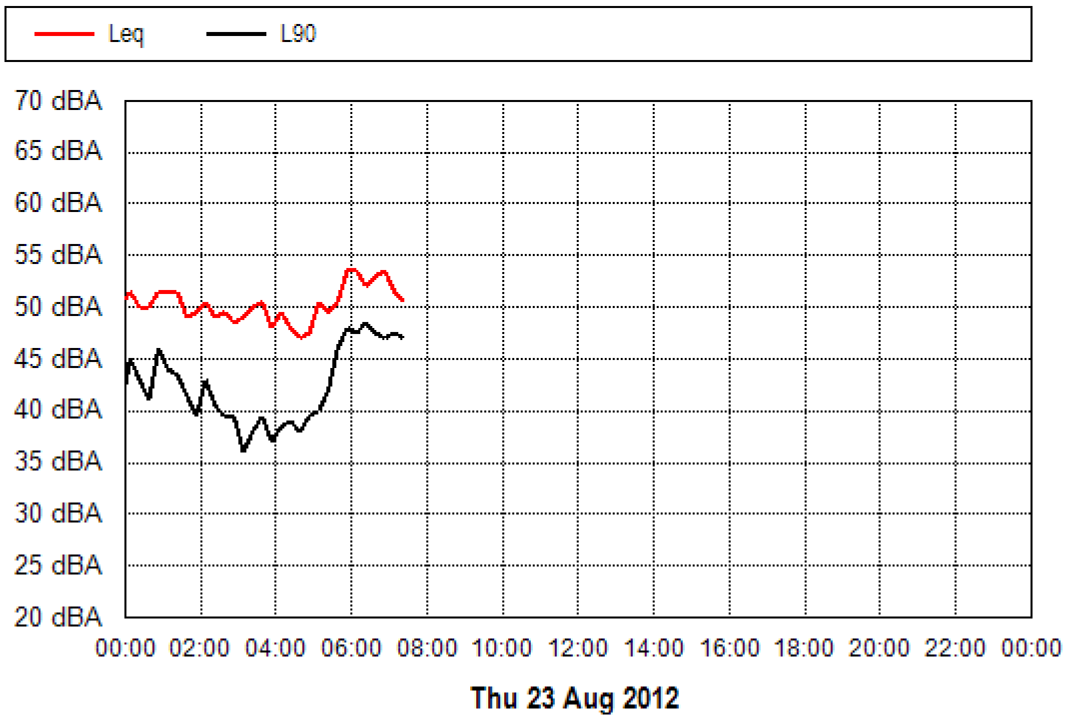



**Tue 21 Aug 2012**




**Wed 22 Aug 2012**

**Project: Pacific Highway, Oxley to Kempsey**
**Location: U3 - 61 Mingaletta Road**



# APPENDIX D

## AGENCY CONSULTATION

**Table D-1 EPA Document Review 24/09/2013**

| Report Reference | EPA Comments | Response |
|---|---|---|
| Page 10 - Section 3.2 Operational Traffic Noise Criteria | Last paragraph, source code error in document | Amended with correct table reference |
| General comment | Any references to Office of Environment and Heritage (OEH), DECCW or DECC should be amended to refer to the Environment Protection Authority (EPA) | Reference to Office of Environment and Heritage (OEH and DECC on page 10 replaced with reference to Environment Protection Authority (EPA) |
| Page 30 – 4th paragraph | Source code error in document | Amended with correct table reference |
| Page 32 - 33 | Figure 7 -1 text orphaned onto page 33 | Adjusted formatting to avoid orphaning of text |
| General comment | Other than the above minor editorial corrections the EPA is satisfied with the K2K ONMR and has no further comments | - |