

| Location                              | Noise Criterion, $L_{Aeq(1hr)}$ (dBA) | Future Existing Noise Level, $L_{Aeq(1hr)}$ (dBA) | Future Noise Level, $L_{Aeq(1hr)}$ (dBA) | Future Noise Level Exceeds Target? | Increase in Noise Level, (dBA) |
|---------------------------------------|---------------------------------------|---|--|------------------------------------|--------------------------------|
| School, East                          |                                       |   |  |                                    |                                |
| Prestons Public School                | 45                                    | 47  | 48                                       | Yes                                | 1                              |
| Prestons Child Care Centre            | 40                                    | 44  | 46                                       | Yes                                | 2                              |
| Lurnea High School                    | 45                                    | 44  | 46                                       | Marginal                           | 2                              |
| University of Western Sydney Building | 45                                    | 45  | 47                                       | Yes                                | 2                              |
| Casula High School                    | 45                                    | 38  | 40                                       | No                                 | 2                              |
| Fellowship Baptist Church             | 40                                    | 49  | 50                                       | Yes                                | 1                              |
| Milperra Public School                | 45                                    | 45  | 47                                       | Yes                                | 2                              |
| Hannans Road Public School            | 45                                    | 45  | 47                                       | Yes                                | 1                              |
| Broderick Gillawarna School           | 45                                    | 45  | 47                                       | Yes                                | 2                              |

Note: Increase in noise level calculated to one decimal place and then rounded to the nearest whole number.

Table 8-10 shows that where the internal noise levels in the Future Design scenario are above the *ECRTN* "base" criterion, the increase in noise level from the Future Existing scenario is generally within the 2dBA *ECRTN* allowance goal. Therefore no additional noise mitigation is considered reasonable given the marginal increase in noise level.

At Hammondville Public School, at the first school building fronting the motorway in the southern block of buildings, both the target noise level and the 2dBA allowance goal are exceeded. Architectural treatment by way of provision of mechanical ventilation is therefore recommended for consideration at the affected building, to enable windows to be shut whilst still providing for ventilation.

## 9 MAXIMUM NOISE LEVEL EVENTS

### 9.1 Assessment Procedure

For road redevelopments, the *ECRTN* and *ENMMM* provide guidance as to the likelihood of sleep disturbance. According to the *ECRTN*, there are no universally accepted criteria governing the likelihood of sleep disturbance. In other words, at the current level of understanding, it is not possible to establish absolute noise level goals that would correlate to levels of sleep disturbance (for all or even a majority of people).

The *ECRTN* suggests that:

- maximum internal noise levels below 50dBA to 55dBA are unlikely to cause awakening reactions;
- one or two events per night, with maximum internal noise levels of 65dBA to 70dBA, are not likely to affect health and wellbeing significantly;
- at locations where road traffic is continuous rather than intermittent, the  $L_{Aeq,9hour}$  target noise level should sufficiently account for sleep disturbance impacts;
- however, where the emergence of  $L_{Amax}$  noise levels over the  $L_{Aeq}$  noise level is greater than 15dBA, the  $L_{Aeq,9hour}$  criterion may not sufficiently account for sleep disturbance impacts.

Thus the *ECRTN* recommends that the assessment of sleep disturbance should include a consideration of the maximum noise levels occurring during the night time period and the emergence of these levels above the ambient noise level.

The issue of sleep disturbance is addressed within the RTA's *ENMMM* in a similar manner. It is suggested that the assessment of sleep disturbance should include an examination of "maximum noise events": A "maximum noise event" is defined as any single event where the  $L_{Amax}$  noise level exceeds 65dBA and the  $L_{Amax}$  noise level exceeds the  $L_{Aeq,1hour}$  noise level by more than 15dBA.

"Maximum noise event" characteristics to be assessed at nearest residential receivers include their occurrence throughout the 10.00pm to 7.00am night time period and their magnitudes.

Due to the absence of a definitive qualitative correlation between sleep disturbance and noise level, the *ENMMM* suggests that the above nominated noise levels and guidelines should not be taken to as stringent criteria, but should be taken into consideration when determining noise mitigation measures to address general road traffic noise.

### 9.2 Maximum Noise Level Assessment

Two MadMax maximum noise level loggers were installed at representative locations at Hammondville and Narwee to quantify typical prevailing maximum noise levels. The device near Hammondville malfunctioned, however the device located at 54A Grove Avenue, Narwee recorded data considered to be representative.

Table 9-1 presents a summary of the measured noise levels during the night of 17 March 2010 between the hours of 10.00pm to 7.00am.

**Table 9-1 Maximum Noise Level Events, Existing Road Alignment**

| Time         | $L_{Aeq,1hour}$<br>Noise<br>Level<br>(dBA) | Maximum<br>Measured<br>$L_{Amax}$ Noise<br>Levels (dBA) | Number of<br>Times $L_{Amax}$ is<br>equal to or<br>greater than<br>$L_{Aeq,1hour}$ | Number of<br>Occurrences<br>above 65dBA |
|--------------|--|---|--|---|
| 10pm to 11pm | 56   | 69  | Nil  | 2                                       |
| 11pm to 12am | 55   | 63  | Nil  | 0                                       |
| 12am to 1am  | 53   | 67  | Nil  | 1                                       |
| 1am to 2am   | 51   | 63  | Nil  | 0                                       |
| 2am to 3am   | 51   | 64  | Nil  | 0                                       |
| 3am to 4am   | 52   | 69  | 1  | 1                                       |
| 4am to 5am   | 55   | 66  | Nil  | 1                                       |
| 5am to 6am   | 58   | 68  | Nil  | 4                                       |
| 6am to 7am   | 59   | 67  | Nil  | 7                                       |

There was only one occasion where the  $L_{Aeq,1hour}$  noise level was exceeded by 15dBA or more. This was recorded in the time period between 3.00-4.00am. In addition, the number of times the maximum noise level exceeded 65dBA were relatively few. This is considered to be due to the set back to the residences from the motorway, coupled with the existence of noise barriers.

Although the redevelopment will increase the volume of vehicles on the motorway, generally the net effect of the additional median lanes is to move the traffic stream further from the dwellings, towards the median, although they may be less shielded by the roadside barriers. Overall there would be no change in the number of instances when higher noise levels occur.

Most importantly only one maximum noise level event as defined in the *ENMM* was measured where the  $L_{Amax}$  noise level exceeded the  $L_{Aeq,1hour}$  noise level by 15dBA or more. This indicates for this project that the  $L_{Aeq,9hr}$  descriptor is sufficient to address sleep disturbance

## 10 CONSTRUCTION NOISE

This section deals with the majority of construction activity which will occur during standard daytime construction hours. It is recognised that a small proportion of the overall construction will need to occur outside of standard hours during the generally more sensitive evening and night time and also on Saturday afternoons and Sundays. These works are required to maintain daytime traffic flow and manage safe construction sites and are generally limited to a few nights at any one location.

Prior to construction approval, these “out of hours” works will require strong justification for the need and much more detailed noise and vibration assessment and consideration of specific mitigation measures, based on the chosen methodology. As a minimum, the mitigation measures discussed in this section for daytime construction would be adopted “out of hours”. This report doesn’t address these works in detail, although further management measures are discussed in Section 10.8.1.

### 10.1 Noise Management Levels

Using the noise criteria presented in Section 6, the noise management levels for residential receivers for each noise catchment, based on the background noise levels measured, are presented in Table 10-1.

**Table 10-1 Site Specific Construction Noise Management Levels – (dBA)**

| NCA      | Monitoring Location with Lowest Daytime & Evening RBL | Suburb       | Construction Noise Management Level, $L_{Aeq,15min}$ |         |            | Sleep Disturbance Criteria, $L_{Amax,1min}$ |
|----------|---|--------------|--|---------|------------|---|
|          |   |              | Daytime  | Evening | Night Time |   |
| CVW_HH_S | 45 Incense Place                                      | Casula       | 62   | 54      | 43         | 53  |
| M7_HH_N  | 43 Acacia Avenue                                      | Prestons     | 64   | 55      | 43         | 53  |
| MA_HLD_S | 17 Fitzgerald Avenue                                  | Hammondville | 65   | 58      | 44         | 54  |
| HR_HLD_N | 80 Renton Avenue                                      | Moorebank    | 62   | 54      | 46         | 56  |
| HLD_HR_N | 4 Flanders Avenue                                     | Milperra     | 59   | 54      | 43*        | 53*   |
| HLD_S    | 4 Meteren Close                                       | Milperra     | 64   | 55      | 43         | 53  |
| HR_FR_S  | 46 Louie Street                                       | Padstow      | 62   | 56      | 44         | 54  |
| QS_GA_N  | 32 Ely Street   | Revesby      | 64   | 57      | 44         | 54  |
| FR_BR_N  | 24 Iris Avenue  | Riverwood    | 60   | 56      | 49         | 59  |
| BR_KGR_N | 4 Arilla Avenue                                       | Riverwood    | 67   | 61      | 50         | 60  |
| BR_KGR_S | 41 Earls Avenue                                       | Riverwood    | 60   | 55      | 44*        | 54*   |

Note: Daytime (7.00am-6.00pm), Evening (6.00pm-10.00pm) and Night time (10.00pm-7.00am).

\* Lowest night-time RBL values occur at a different location to that shown

The *ICNG* presents the following noise management levels for non-residential premises:

- Active recreation areas (such as parks) external  $L_{Aeq (15 min)}$  65dBA
- Industrial premises: external  $L_{Aeq (15 min)}$  75dBA

- Offices, retail outlets external  $L_{Aeq (15 \text{ min})}$  70dBA

For the childcare centre, although they are classified as noise sensitive commercial receivers it is recommended that criteria are considered on a project specific basis. In this case we consider the residential noise criteria should be adopted.

## 10.2 Construction Activities, Equipment Noise Levels & Predictions

Typical construction activities and sound levels of typical construction equipment are listed in Table 10-2, based on information provided by the operator, Interlink Roads, as design input to the project. The Table gives the sound power level based on the  $L_{Aeq}$  ( $L_{weq}$ ) and  $L_{Amax}$  ( $L_{wmax}$ ) sound power levels emitted by the equipment.

**Table 10-2 Typical Construction Events and Plant Sound Levels – (dBA)**

| Activity   | Plant and Equipment        | Sound Power Level (SWL) |            |
|--|----------------------------|-------------------------|------------|
|  |                            | $L_{Aeq}$               | $L_{Amax}$ |
| Compound establishment                               | • Light vehicles           | 93                      | 97         |
|  | • Trucks                   | 93                      | 97         |
|  | • Crane                    | 105                     | 113        |
| Traffic control                                      | • Traffic control vehicles | 93                      | 97         |
| Removal of existing linemarking                      | • Linemarking trucks       | 93                      | 97         |
|  | • Grinding machine         | 100                     | 103        |
| Linemarking  | • Linemarking trucks       | 93                      | 97         |
|  | • Traffic control vehicles | 93                      | 97         |
| Installation or removal of temporary safety barriers | • Traffic control vehicles | 93                      | 97         |
|  | • Trucks                   | 93                      | 97         |
|  | • Crane                    | 105                     | 113        |
| Removal of wire rope barrier                         | • Trucks                   | 93                      | 97         |
|  | • Crane                    | 105                     | 113        |
|  | • Generator                | 100                     | 103        |
|  | • Compressor               | 106                     | 107        |
| Saw cutting  | • Saw cutter               | 114                     | 118        |
|  | • Light vehicles           | 93                      | 97         |
|  | • Water cart               | 109                     | 113        |
| Clearing and grubbing                                | • Excavator (30t)          | 109                     | 115        |
|  | • Chainsaw                 | 114                     | 118        |
|  | • Mulcher                  | 114                     | 118        |
|  | • Dump truck               | 93                      | 97         |
|  | • Water cart               | 109                     | 113        |
| Earthworks   | • Excavator                | 109                     | 115        |
|  | • Dump truck               | 93                      | 97         |
|  | • Compactor                | 109                     | 115        |
|  | • Water cart               | 109                     | 113        |

| Activity  | Plant and Equipment       | Sound Power Level (SWL) |                   |
|---|---------------------------|-------------------------|-------------------|
|   |                           | L <sub>Aeq</sub>        | L <sub>Amax</sub> |
|   | • Grader                  | 109                     | 115               |
|   | • Profiler                | 114                     | 118               |
|   | • Dozer                   | 114                     | 118               |
|   | Roller                    | 106                     | 114               |
| Pavement construction<br>(rip and re-compact sub-grade, place<br>select material and compact) | • Grader                  | 109                     | 115               |
|   | • Excavator               | 109                     | 115               |
|   | • Roller                  | 106                     | 114               |
|   | • Dump truck              | 93                      | 97                |
|   | • Water cart              | 109                     | 113               |
|   | • Wacker Packer           | 106                     | 107               |
| Concrete works<br>(construction of concrete pavement,<br>kerbs and barriers)                  | • Spray sealing equipment | 109                     | 113               |
|   | • Agitator truck          | 109                     | 113               |
|   | • Concrete pump           | 108                     | 112               |
|   | • Vibrators               | 106                     | 107               |
|   | • Compaction equipment    | 106                     | 107               |
|   | • Concrete saw            | 114                     | 118               |
| Paving<br>(delivery of raw materials, placement of<br>surface material, saw cutting)          | • Compressor              | 106                     | 107               |
|   | • Generator               | 100                     | 103               |
|   | • Profiler                | 114                     | 118               |
|   | • Paver                   | 114                     | 118               |
|   | • Asphalt truck           | 93                      | 97                |
| Drainage works  | • Sprayer                 | 93                      | 97                |
|   | • Roller                  | 106                     | 114               |
|   | • Agitator truck          | 109                     | 113               |
|   | • Concrete pump           | 108                     | 112               |
|   | • Vibrators               | 106                     | 107               |
| Mill and re-sheet   | • Jackhammer              | 115                     | 117               |
|   | • Welding machine         | 106                     | 107               |
|   | • Under boring equipment  | 107                     | 110               |
|   | • Milling machine         | 114                     | 118               |
|   | • Trucks                  | 93                      | 97                |
| Signs installation  | • Paving machine          | 114                     | 118               |
|   | • Asphalt trucks          | 93                      | 97                |
|   | • Rollers                 | 106                     | 114               |
|   | • Piling machine          | 107                     | 110               |
|   | • Agitator truck          | 109                     | 113               |
|   | • Concrete pump           | 108                     | 112               |
|   | • Vibrators               | 106                     | 107               |
|   | • Crane                   | 105                     | 113               |
|   | • Trucks                  | 93                      | 97                |

| Activity                    | Plant and Equipment    | Sound Power Level (SWL) |                   |
|-----------------------------|------------------------|-------------------------|-------------------|
|                             |                        | L <sub>Aeq</sub>        | L <sub>Amax</sub> |
| Landscaping and vegetation  | • Generators           | 100                     | 103               |
|                             | • Light vehicles       | 93                      | 97                |
|                             | • Trucks               | 93                      | 97                |
| Noise barriers construction | • Piling machine       | 107                     | 110               |
|                             | • Concrete trucks      | 109                     | 113               |
|                             | • Vibrators            | 106                     | 107               |
|                             | • Crane                | 105                     | 113               |
|                             | • Trucks               | 93                      | 97                |
|                             | • Generators           | 100                     | 103               |
|                             | • Welding equipment    | 106                     | 107               |
| Bridge works – Daytime      | • Oxy gear             | 100                     | 103               |
|                             | • Jackhammer           | 115                     | 117               |
|                             | • Piling               | 107                     | 110               |
|                             | • Agitator truck       | 109                     | 113               |
|                             | • Concrete pump        | 108                     | 112               |
|                             | • Vibrators            | 106                     | 107               |
|                             | • Crane                | 105                     | 113               |
|                             | • Trucks               | 93                      | 97                |
| Bridge works – Night Time   | • Generators           | 100                     | 103               |
|                             | • Piling               | 107                     | 110               |
|                             | • Crane                | 105                     | 113               |
|                             | • Trucks               | 93                      | 97                |
|                             | • Cherry picker        | 102                     | 108               |
|                             | • Welding gear         | 106                     | 107               |
| Sedimentation basins works  | • Excavator            | 109                     | 115               |
|                             | • Concrete pump        | 108                     | 112               |
|                             | • Concrete trucks      | 109                     | 113               |
|                             | • Vibrators            | 106                     | 107               |
|                             | • Trucks               | 93                      | 97                |
| OMCS works                  | • Excavator            | 109                     | 115               |
|                             | • Under boring machine | 107                     | 110               |
|                             | • Piling               | 107                     | 110               |
|                             | • Cranes               | 105                     | 113               |
|                             | • Concrete saw cutter  | 114                     | 118               |
|                             | • Concrete pump        | 108                     | 112               |
|                             | • Concrete trucks      | 109                     | 113               |
|                             | • Vibrators            | 106                     | 107               |
| • Trucks                    | 93                     | 97                      |                   |

Using the assumed plant items and their associated sound power levels (with consideration given to the operational changes, intermittent processes and changes in distance of mobile plant), Table 10-3 presents a combined  $L_{Aeq}$  sound power level for each scenario and ranks the construction events with potential noise impacts in descending order. A more detailed table is presented in Appendix I.

**Table 10-3 Ranking of Construction Events**

| Ranking  | Activity  | Equivalent $L_{weq}$<br>(dBA) |
|--|---|-------------------------------|
| 1  | Earthworks  | 119                           |
| 2  | Clearing and grubbing   | 118                           |
| 3  | Paving (delivery of raw materials, placement of surface material, saw cutting)          | 117                           |
|  | Bridge works – Daytime  |                               |
|  | OMCS works  |                               |
|  | Mill and re-sheet   |                               |
|  | Drainage works  |                               |
| Concrete works (construction of concrete pavement, kerbs and barriers) |   |                               |
| 4  | Pavement construction (rip and re-compact sub-grade, place select material and compact) | 116                           |
| 5  | Signs installation  | 114                           |
|  | Saw cutting   |                               |
| 6  | Sedimentation basins works  | 113                           |
|  | Noise barriers construction   |                               |
| 7  | Bridge works – Night Time   | 110                           |
| 8  | Removal of wire rope barrier  | 109                           |
| 9  | Compound Establishment  | 105                           |
| 10   | Installation or removal of temporary safety barriers                                    | 104                           |
| 11   | Landscaping and vegetation  | 98                            |
| 12   | Removal of existing linemarking   | 97                            |
| 13   | Linemarking   | 94                            |
| 14   | Traffic control   | 89                            |

### 10.3 Predicted $L_{Aeq}$ Noise Levels

Predicted noise levels at each catchment are given for daytime, evening and night time operations based on construction details prepared by Interlink Roads and forwarded by the RTA for this assessment. For earthworks and road works, the construction is dynamic and noise levels will vary as the equipment moves along the proposed development site. Between King Georges Road and Fairford Road, the existing motorway carriageway is wide enough to accommodate the additional lanes. Construction works here would therefore be expected to be less intensive, with the most significant works being milling and re-sheeting of the existing carriageways, construction of a concrete slip form central barrier, line-marking and OCMS works.

Table 10-4 presents a summary of the typical range of maximum  $L_{Aeq}$  noise levels that may be expected in each catchment (without the implementation of any special noise mitigation). The noise levels include the noise reduction benefit of the existing noise barriers and mounds along the route. Appendix J presents noise emissions for individual plant items and activities and forms the basis of the summary presented in Table 10-4.

**Table 10-4 Predicted Construction Noise Levels**

| NCA  | Day                        |   | Evening                    |   |                            | Night   |  |  |
|--|----------------------------|---|----------------------------|---|----------------------------|---|--|--|
|  | $L_{Aeq,(15min)}$<br>(dBA) | Exceedance<br>of Noise<br>Management<br>Level | $L_{Aeq,(15min)}$<br>(dBA) | Exceedance<br>of Noise<br>Management<br>Level | $L_{Aeq,(15min)}$<br>(dBA) | Exceedance<br>of Noise<br>Management<br>Level | Maximum<br>Noise<br>Level,<br>$L_{max}$<br>(dBA) | Exceedance<br>of<br>Maximum<br>Noise<br>Level Goal |
| <b>Residential King Georges Road to Belmore Road (Chainage 8880 to 10650)</b>              |                            |   |                            |   |                            | <b>Duration: 6 months</b>                     |  |  |
| BR_KGR_N   | 36-69                      | Up to 2dBA                                    | 27-67                      | Up to 6dBA                                    | 27-67                      | Up to 17dBA                                   | 35-71  | Up to 11dBA  |
| BR_KGR_S   | 34-70                      | Up to 10dBA                                   | 25-68                      | Up to 13dBA                                   | 25-68                      | Up to 24dBA                                   | 33-72  | Up to 18dBA  |
| <b>Residential Belmore Road to Fairford Road (Chainage 10650 to 12380)</b>                 |                            |   |                            |   |                            | <b>Duration: 7 months</b>                     |  |  |
| FR_BR_N  | 37-66                      | Up to 6dBA                                    | 28-64                      | Up to 8dBA                                    | 28-64                      | Up to 15dBA                                   | 36-68  | Up to 9dBA   |
| <b>Residential Fairford Road to The River Road (Chainage 12380 to 13980)</b>               |                            |   |                            |   |                            | <b>Duration: 11 months</b>                    |  |  |
| OS_GA_N  | 48-68                      | Up to 4dBA                                    | 24-66                      | Up to 9dBA                                    | 24-66                      | Up to 22dBA                                   | 32-70  | Up to 16dBA  |
| HR_FR_S  | 38-74                      | Up to 12dBA                                   | 44-72                      | Up to 16dBA                                   | 29-72                      | Up to 28dBA                                   | 37-76  | Up to 22dBA  |
| <b>Residential The River Road to Henry Lawson Drive (Chainage 13980 to 17430)</b>          |                            |   |                            |   |                            | <b>Duration: 27 months</b>                    |  |  |
| HR_FR_S  | 38-74                      | Up to 12dBA                                   | 29-72                      | Up to 16dBA                                   | 29-72                      | Up to 28dBA                                   | 37-76  | Up to 22dBA  |
| <b>Residential Henry Lawson Drive to East of Toll Plaza Area (Chainage 17430 to 18600)</b> |                            |   |                            |   |                            | <b>Duration: 7 months</b>                     |  |  |
| HLD_HR_N   | 33-66                      | Up to 7dBA                                    | 24-64                      | Up to 10dBA                                   | 24-64                      | Up to 21dBA                                   | 32-68  | Up to 15dBA  |
| HLD_S  | 36-59                      | Nil   | 27-57                      | Up to 2dBA                                    | 27-57                      | Up to 14dBA                                   | 35-61  | Up to 8dBA   |
| <b>Residential Toll Plaza Area (Chainage 18600 to 19860)</b>                               |                            |   |                            |   |                            | <b>Duration: 3 months</b>                     |  |  |
| MA_HLD_S   | 46-67                      | Up to 2dBA                                    | 22-67                      | Up to 9dBA                                    | 22-67                      | Up to 23dBA                                   | 30-71  | Up to 17dBA  |
| <b>Residential West of Toll Plaza Area to Heathcote Road (Chainage 19860 to 21300)</b>     |                            |   |                            |   |                            | <b>Duration: 9 months</b>                     |  |  |
| HR_HLD_N   | 30-62                      | Nil   | 21-60                      | Up to 6dBA                                    | 21-60                      | Up to 14dBA                                   | 29-64  | Up to 8dBA   |
| MA_HLD_S   | 31-69                      | Up to 4dBA                                    | 22-67                      | Up to 9dBA                                    | 22-67                      | Up to 23dBA                                   | 30-71  | Up to 17dBA  |
| <b>Residential Heathcote Road to East of Moorebank Avenue (Chainage 21300 to 22585)</b>    |                            |   |                            |   |                            | <b>Duration: 10 months</b>                    |  |  |
| HR_HLD_N   | 30-62                      | Nil   | 21-60                      | Up to 6dBA                                    | 21-60                      | Up to 14dBA                                   | 29-64  | Up to 8dBA   |
| MA_HLD_S   | 31-69                      | Up to 4dBA                                    | 22-67                      | Up to 9dBA                                    | 22-67                      | Up to 23dBA                                   | 30-73  | Up to 19dBA  |
| <b>Residential East of Moorebank Avenue to East of Hume Hwy (Chainage 22585 to 23585)</b>  |                            |   |                            |   |                            | <b>Duration: 4 months</b>                     |  |  |
| M7_HH_N  | 31-69                      | Up to 5dBA                                    | 22-67                      | Up to   | 22-67                      | Up to   | 30-71  | Up to  |

| NCA  | Day                            |                                      | Evening                        |                                      |                                | Night                                |   | Exceedance of Maximum Noise Level, L <sub>max</sub> (dBA) | Exceedance of Maximum Noise Level Goal |
|--|--------------------------------|--------------------------------------|--------------------------------|--------------------------------------|--------------------------------|--------------------------------------|---|---|--|
|  | L <sub>Aeq,(15min)</sub> (dBA) | Exceedance of Noise Management Level | L <sub>Aeq,(15min)</sub> (dBA) | Exceedance of Noise Management Level | L <sub>Aeq,(15min)</sub> (dBA) | Exceedance of Noise Management Level | Maximum Noise Level, L <sub>max</sub> (dBA) |   |  |
|  |                                |                                      |                                | 12dBA                                |                                | 24dBA                                |   | 18dBA   |  |
| CVW_HH_S   | 30-68                          | Up to 6dBA                           | 21-66                          | Up to 12dBA                          | 21-66                          | Up to 23dBA                          | 29-70                                       | Up to 17dBA   |  |
| <b>Residential East of Hume Hwy to Camden Valley Way (Chainage 23585 to 28290)</b>                   |                                |                                      |                                |                                      |                                |                                      | <b>Duration: 16 months</b>                  |   |  |
| M7_HH_N  | 31-69                          | Up to 5dBA                           | 22-67                          | Up to 12dBA                          | 22-67                          | Up to 24dBA                          | 30-71                                       | Up to 18dBA   |  |
| CVW_HH_S   | 30-68                          | Up to 6dBA                           | 21-66                          | Up to 12dBA                          | 21-66                          | Up to 23dBA                          | 29-70                                       | Up to 17dBA   |  |
| CVW_M7_W   | 28-52                          | Nil                                  | 19-50                          | Nil                                  | 19-50                          | Up to 7dBA                           | 27-54                                       | Up to 1dBA  |  |
| <b>Commercial/Industrial King Georges Road to Belmore Road (Chainage 8880 to 10650)</b>              |                                |                                      |                                |                                      |                                |                                      | <b>Duration: 6 months</b>                   |   |  |
| Commercial BR_BR_N   | 36-69                          | Nil                                  |                                |                                      |                                |                                      |   |   |  |
| <b>Commercial/Industrial Fairford Road to The River Road (Chainage 12380 to 13980)</b>               |                                |                                      |                                |                                      |                                |                                      | <b>Duration: 11 months</b>                  |   |  |
| Commercial GA_FR_N   | 48-68                          | Nil                                  |                                |                                      |                                |                                      |   |   |  |
| Commercial HR_FR_S   | 38-74                          | Up to 4dBA                           |                                |                                      |                                |                                      |   |   |  |
| <b>Commercial/Industrial Henry Lawson Drive to East of Toll Plaza Area (Chainage 17430 to 18600)</b> |                                |                                      |                                |                                      |                                |                                      | <b>Duration: 7 months</b>                   |   |  |
| Commercial SC_QS_N   | 33-66                          | Nil                                  |                                |                                      |                                |                                      |   |   |  |
| <b>Commercial/Industrial Heathcote Road to East of Moorebank Avenue Chainage (21300 to 22585)</b>    |                                |                                      |                                |                                      |                                |                                      | <b>Duration: 10 months</b>                  |   |  |
| Commercial HR_HLD_N  | 30-62                          | Nil                                  |                                |                                      |                                |                                      |   |   |  |
| Commercial MA_HLD_S  | 31-69                          | Nil                                  |                                |                                      |                                |                                      |   |   |  |

Note: Specified durations cover the active construction duration. Works may be undertaken intermittently during the entire construction period.

As can be seen from predicted noise levels presented in Table 10-4 (and the detailed analysis in Appendix J), in many residential locations the noise management levels are expected to be exceeded at least during some stage during project construction. Noise management and mitigation would therefore need to be considered and implemented where reasonable and feasible, to minimise the acoustic impacts. This should be assessed in detail in the Construction Noise Management Plan to be prepared by the contractor prior to commencement of works on site. At that stage, full details of the construction methodology, type and number of equipment on site will be better known.

#### **10.4 Construction of New Control Building, Hammondville**

The construction of the new control building (which is to be located to the south east of the existing building, immediately adjacent to and on the southern side of the Hammondville toll plaza) would involve laying concrete foundations with a frame and cladding building construction. Services such as power, water and communications would also be installed. The most significant works are related to the earthworks and concreting. Noise levels during these phases are expected to be in the order of 70dBA at the nearest residences, which is 5dBA higher than the relevant 65dBA noise management level. These relatively noise intensive external works are expected to be of short duration (i.e within a few weeks at most) and will be limited to daytime hours. Nevertheless, management of construction noise will be required to minimise the impact at the nearest and most affected dwellings. This should include consideration of limiting works to daytime hours only and advising the residents about the timing and duration of works.

#### **10.5 Installation of VMS's**

A number of VMS's will be installed outside the M5 Motorway corridor, generally on major roads leading to or from the Motorway. This work comprises earthworks for footings (an excavator, backhoe or similar), concreting associated with the footings (a concrete truck) and use of a crane to lift the VMS into position. Work is likely to occur during the night in order to minimise interruption to road traffic. The construction is however of short duration and is expected to be completed in approximately two nights at any site.

For the purpose of assessment, the most conservative noise management levels have been used. These are considered to be reasonably representative.

Indicative noise levels at residences adjacent to the cross roads leading to and from the motorway are show in

Table 10-5. Night-time noise management levels and sleep disturbance criteria would depend on the area in which the installation is taking place, but would vary from 43-50dBA for the management level ( $L_{Aeq,15min}$ ) and 53-60dBA for sleep disturbance ( $L_{Amax}$ ).

At residences adjacent to the cross roads, distances to the works are typically in the 15m to 35m range. Adjacent to the motorway, distances are greater than 35m. The above noise levels indicate that noise levels are likely to be over the relevant noise management levels and management of the noise levels to minimise impacts is therefore recommended to minimise impacts, including advising nearby residents of the works. This will be addressed in the contractor's Construction Noise Management Plan prior to undertaking works on site. Potential measures for consideration include minimising the duration of works, carrying out as much of the works as feasible during daytime or evening hours, and advising nearby residents about the timing and duration of works.

**Table 10-5 Typical Noise Levels Related to VMS Installation on Cross Roads**

| Distance from works, metres | L <sub>Aeq,15min</sub> Noise Level, dBA |            |          | Maximum Noise Level, dBA |            |          |
|-----------------------------|---|------------|----------|--------------------------|------------|----------|
|                             | Earthworks                              | Concreting | Hoisting | Earthworks               | Concreting | Hoisting |
| 15                          | 77                                      | 77         | 73       | 83                       | 77         | 73       |
| 25                          | 73                                      | 73         | 69       | 79                       | 73         | 69       |
| 35                          | 70                                      | 70         | 66       | 76                       | 70         | 66       |
| 45                          | 68                                      | 68         | 64       | 74                       | 68         | 64       |
| 55                          | 66                                      | 66         | 62       | 72                       | 66         | 62       |
| 65                          | 65                                      | 65         | 61       | 71                       | 65         | 61       |
| 75                          | 64                                      | 64         | 60       | 70                       | 64         | 60       |
| 85                          | 62                                      | 62         | 58       | 68                       | 62         | 58       |

**10.6 Construction Site Compounds**

10.6.1 Location and Use of Compounds

Construction compounds need to be located close to the M5 Motorway due to complex nature of the works in normal traffic flow condition. As the widening works need to be undertaken under traffic flow conditions, there would be very limited opportunities to locate required construction site compounds. It would therefore be necessary to establish compounds at locations as close as possible to the motorway corridor.

Compounds would include:

- offices and meeting rooms;
- reception and general administration area;
- amenity and first aid facilities;
- parking areas;
- storage of plant, equipment and tools; and
- material storage areas including stockpiling.

Construction site compounds would be fenced and covered in hardstand. Offices would generally be prefabricated and material storage areas would include purpose built temporary structures as required. Access to construction compounds would be via the motorway or the arterial road network where possible to minimise impacts on local roads.

The locations of these compounds, together with details of their size, proposed uses and access points in provided in Table 10-6.

**Table 10-6 Construction Site Compound Details**

| Compound                              | Location                                 | Approx. Size (m <sup>2</sup> ) | Proposed Use                        | Proposed Access  | Day Traffic Movements* |       | Night Traffic Movements* |       |
|---------------------------------------|--|--------------------------------|-------------------------------------|--|------------------------|-------|--------------------------|-------|
|                                       |  |                                |                                     |  | Light                  | Heavy | Light                    | Heavy |
| Moorebank Avenue<br>(24 hour use)     | Near 175-209 Moorebank Avenue, Moorebank | 46,750                         | Main office                         | Access directly from Moorebank Avenue  | 180                    | 40    | 50                       | 10    |
| M5/Graham Avenue – 1<br>(24 hour use) | Near 59-79 Graham Avenue, Casula         | 17,930                         | Satellite office, materials laydown | Access from M5 Motorway  | 30                     | 10    | 10                       | 15    |
| M5/Graham Avenue – 2                  | Near 81 Graham Avenue, Casula            | 6,170                          | Satellite office materials laydown  | Access from either Graham Avenue, Liverpool Street or possibly M5 Motorway       | 10                     | 10    | N/A                      | N/A   |
| M5/Graham Avenue – 3                  | Near 85A Graham Avenue, Lurnea           | 10,900                         | Satellite office, materials laydown | Access from Graham Avenue  | 10                     | 10    | N/A                      | N/A   |
| Heathcote Road<br>(24 hour use)       | Near 152 Heathcote Road, Hammondville    | 12,080                         | Satellite office, materials laydown | Access from Heathcote Road direct into compound, possible access from Anzac Road | 20                     | 10    | 10                       | 10    |
| Bransgrove Road<br>(24 hour use)      | Bransgrove Road, Panania                 | 29,940                         | Satellite office, materials laydown | Access from Henry Lawson Drive into Bransgrove Road                              | 20                     | 20    | 10                       | 10    |
| Henry Lawson Drive                    | Near 450 Henry Lawson Drive, Milperra    | 12,000                         | Satellite office, materials laydown | Access from Henry Lawson Drive and possibly from M5 motorway on ramp             | 10                     | 10    | N/A                      | N/A   |
| Cedar Road                            | Near 2-80 Cedar Road, Casula             | 42,990                         | Satellite office, materials laydown | Not required 24hr use, access from M5 Motorway and M7 on ramp.                   | 20                     | 10    | N/A                      | N/A   |

| Compound                           | Location                                     | Approx. Size (m <sup>2</sup> ) | Proposed Use                        | Proposed Access   | Day Traffic Movements* |       | Night Traffic Movements* |       |
|------------------------------------|--|--------------------------------|-------------------------------------|---|------------------------|-------|--------------------------|-------|
|                                    |  |                                |                                     |   | Light                  | Heavy | Light                    | Heavy |
| Beaconsfield Road<br>(24 hour use) | Near 68 Marigold Street, Milperra            | 3,000                          | Main office materials laydown       | Access via either Milperra Road or Beaconsfield Road into Marigold Street       | 90                     | 40    | 10                       | 10    |
| Gibson Avenue<br>(24 hour use)     | Near 80-84 Gibson Avenue, Padstow            | 6,000                          | Satellite office, materials laydown | Access from Gibson Avenue, via Canterbury Road or Fairford Road and Watson Road | 90                     | 40    | 20                       | 5     |
| North side of Heathcote Road       | Cnr M5 on ramp and Heathcote Road, Moorebank | 3,000                          | Materials laydown                   | Access/egress from South bound Heathcote Road. Possible egress on to M5 on ramp | 20                     | 10    | N/A                      | N/A   |

Note: \* Vehicle movements relates to round trips (i.e. one movement relates to a particular vehicle arriving at and departing from a particular site compound).

Some of these compounds are required to be operational 24 hours per day as they would be used to support night works.

Although these compounds are intended to be used during the more sensitive night time periods, it is noted that during these periods no major noise intensive activities would be likely to be carried out on a regular basis.

The night time uses would typically be related to:

- traffic management launch areas;
- storage and laydown areas; and
- office and amenities.

Note that the projected traffic volumes shown in Table 10-6 are based on an average daytime and night-time hour. Further detail on variation in movements would be required during the detailed design stage of the assessment.

#### 10.6.2 Predicted Noise Levels from 24-Hour Construction Compounds

Noise contours associated with each of the 24-hour construction site compounds have been calculated to establish the potential noise impact associated with night time uses to the surrounding noise-sensitive receiver locations.

The noise contours due to night-time operations are shown in Figure 10-1 to Figure 10-6. These are based on 3 trucks and 1 crane operating simultaneously within a 15 minute period and are considered to be representative of peak activity, which would typically not be expected to occur frequently during the night time period. In each case the contour representing the site-specific night time criterion is shown in red.

**Figure 10-1 Moorebank Avenue 24 Hour Construction Compound**



Figure 10-2 M5/Graham Avenue 24 Hour Construction Compound



Figure 10-3 Heathcote Road 24 Hour Construction Compound



Figure 10-4 Bransgrove Road 24 Hour Construction Compound

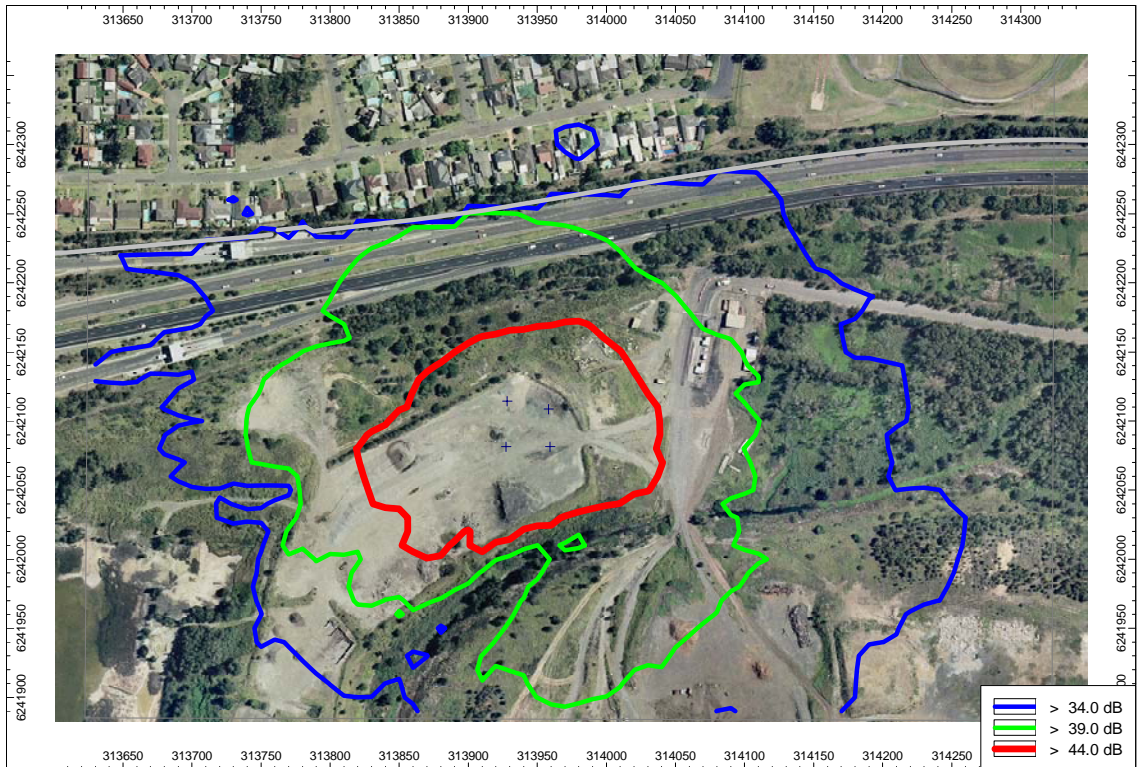


Figure 10-5 Beaconsfield Road 24 Hour Construction Compound



Figure 10-6 Gibson Road 24 Hour Construction Compound



As can be seen from predicted noise contours presented in Figure 10-1 to Figure 10-6, it is possible that the noise management levels would be exceeded at three of the 24 hour construction site compounds during night time use. The identified construction site compounds with potential noise impacts to surrounding noise sensitive residential receivers are:

- M5/Graham Avenue site compound with up to 3dBA above night time criterion predicted to dwellings located on the eastern and southern boundaries of site compound;
- Heathcote Road site compound with up to 10dBA above night time criterion predicted to dwellings surrounding the site compound; and
- Gibson Road site compound with up to 14dBA above night time criterion predicted to the dwellings located on the western boundary of site compound.

Therefore, noise management and mitigation would need to be considered and implemented to minimise the noise impacts during peak activity periods. These should be examined in further detail during preparation of the Construction Noise Management Plan, prior to commencement of works on site. Measures to be considered might include avoiding significant stockpiling activity during the night time period, limiting the duration of this or similar noise intensive activity, and use of the quietest available equipment to undertake the task.

A possible control measure may be to establish at least a 2.4m high hoarding made of ply wood around the perimeter boundary at the identified construction compounds with potential noise impacts to the surrounding areas. The feasibility of this measure would be investigated during the preparation of the Construction Noise Management Plan for the project (see Section 10.8). This measure in itself may typically provide in the order of 10dBA to 15dBA noise reduction.

During the evening period, assuming activities similar to the night time period, some exceedances would be expected during the Heathcote Road and Gibson Road site compounds during peak activity, but to a lesser extent to that during the night time. Noise management measures similar to those for the night time period would provide benefit during the less critical evening period.

Daytime construction noise criterion is predicted to achieve compliance at all construction compounds with daytime noise levels in the range 30dBA to 60dBA during peak activity.

## 10.7 Construction Traffic Noise Assessment

This section presents the appropriate *DECCW* noise level goals for “new developments which generate additional traffic on public roads”, and assesses the potential impact. The potential impact of additional traffic would be at the residences surrounding the construction compounds listed in Section 8.

### 10.7.1 Road Traffic Noise Goals

The *Environmental Criteria for Road Traffic Noise (ECRTN)* sets out criteria for assessment of noise from vehicles on public roads.

The document sets out noise criteria for “arterial”, “sub-arterial”, “collector roads” and “local roads”. Most of the roads surrounding the construction compounds would either be “collector” roads or considered as a “local” road. Criteria for “land use developments with potential to create additional traffic” on collector and local roads are as follows:

- Daytime (7.00am-10.00pm)  $L_{Aeq,1hr}$  60dBA Collector,  $L_{Aeq,1hr}$  55dBA Local
- Night Time (10.00pm-7.00am)  $L_{Aeq,1hr}$  55dBA Collector,  $L_{Aeq,1hr}$  50dBA Local

Where existing traffic noise levels exceed the above noise levels, the development should not increase existing levels by more than 2dBA.

### 10.7.2 Site Compound Related Traffic Noise on Public Roads

Based on traffic flows provided by Halcrow, and comparing to the anticipated increase in traffic movements provided in Table 10-6, the increase in road traffic noise surrounding each construction compound is summarised in Table 10-7.

**Table 10-7 Daytime Site Compound Traffic - (Vehicles per hour)**

| Compound                              | Assessed Road                          | Existing |       |      | Additional |       | Total |       |      | Increase (dBA) |
|---------------------------------------|--|----------|-------|------|------------|-------|-------|-------|------|----------------|
|                                       |  | Light    | Heavy | %    | Light      | Heavy | Light | Heavy | %    |                |
| Moorebank Avenue<br>(24 hour use)     | Moorebank Avenue                       | 1427     | 95    | 6.2  | 33         | 7     | 1460  | 102   | 6.5  | 0.2            |
| M5/Graham Avenue – 1<br>(24 hour use) | M5 Motorway                            | 2646     | 480   | 15.4 | 5          | 2     | 2651  | 482   | 15.4 | 0.0            |
| M5/Graham Avenue – 2                  | Graham Avenue                          | 196      | 2     | 1.0  | 2          | 2     | 198   | 4     | 1.9  | 0.3            |
| M5/Graham Avenue – 3                  | Graham Avenue                          | 196      | 2     | 1.0  | 2          | 2     | 198   | 4     | 1.9  | 0.3            |
| Heathcote Road<br>(24 hour use)       | Heathcote Road                         | 2145     | 169   | 7.3  | 4          | 2     | 2148  | 170   | 7.4  | 0.0            |
| Bransgrove Road<br>(24 hour use)      | Bransgrove Road                        | 383      | 11    | 2.7  | 4          | 4     | 386   | 14    | 3.6  | 0.3            |
| Henry Lawson Drive                    | Henry Lawson                           | 1279     | 90    | 6.6  | 2          | 2     | 1281  | 92    | 6.7  | 0.1            |
| Cedar Road                            | Cedar Road                             | 141      | 19    | 11.7 | 4          | 2     | 144   | 21    | 12.4 | 0.3            |
| Beaconsfield Road<br>(24 hour use)    | Beaconsfield Road<br>(Industrial Area) | 659      | 52    | 7.3  | 16         | 7     | 675   | 59    | 8.0  | 0.3            |
| Gibson Road<br>(24 hour use)          | Gibson Avenue                          | 979      | 154   | 13.6 | 16         | 7     | 995   | 161   | 14.0 | 0.1            |
| North side of Heathcote Road          | Heathcote Road                         | 220      | 205   | 48.2 | 4          | 2     | 223   | 206   | 48.1 | 0.1            |

Note: Site compound related traffic on Liverpool Street (M5/Graham Avenue Compound 2), Anzac Road (Heathcote Road compound) and Watson Road (Gibson Road Compound) is also expected to increase noise levels by substantially less than 2dBA.

**Table 10-8 Night Time Site Compound Traffic - (Vehicles per hour)**

| Compound                              | Assessed Road                          | Existing |       |      | Additional |       | Total |       |      | Increase (dBA) |
|---------------------------------------|--|----------|-------|------|------------|-------|-------|-------|------|----------------|
|                                       |  | Light    | Heavy | %    | Light      | Heavy | Light | Heavy | %    |                |
| Moorebank Avenue<br>(24 hour use)     | Moorebank Avenue                       | 456      | 24    | 5.0  | 11         | 2     | 467   | 26    | 5.3  | 0.2            |
| M5/Graham Avenue – 1<br>(24 hour use) | M5 Motorway                            | 617      | 100   | 13.9 | 2          | 3     | 619   | 103   | 14   | 0.1            |
| M5/Graham Avenue – 2                  | Graham Avenue                          |          |       |      |            |       |       |       |      |                |
| M5/Graham Avenue – 3                  | Graham Avenue                          |          |       |      |            |       |       |       |      |                |
| Heathcote Road<br>(24 hour use)       | Heathcote Road                         | 711      | 44    | 5.9  | 2          | 2     | 714   | 47    | 6.1  | 0.0            |
| Bransgrove Road<br>(24 hour use)      | Bransgrove Road                        | 125      | 2     | 1.9  | 2          | 2     | 127   | 5     | 3.6  | 0.7            |
| Henry Lawson Drive                    | Henry Lawson                           |          |       |      |            |       |       |       |      |                |
| Cedar Road                            | Cedar Road                             |          |       |      |            |       |       |       |      |                |
| Beaconsfield Road<br>(24 hour use)    | Beaconsfield Road<br>(Industrial Area) | 217      | 12    | 5.2  | 2          | 2     | 219   | 14    | 6.1  | 0.3            |
| Gibson Road<br>(24 hour use)          | Gibson Avenue                          | 339      | 40    | 10.6 | 4          | 1     | 343   | 41    | 10.8 | 0.1            |
| North side of Heathcote Road          | Heathcote Road                         |          |       |      |            |       |       |       |      |                |

Note: Site compound related traffic on Anzac Road (Heathcote Road compound) and Watson Road (Gibson Road Compound) is also expected to increase noise levels less than 2dBA.

Table 10-7 and Table 10-8 indicate that the increased traffic flow due to the site compounds would result increases in noise levels that are below 2dBA. The increases are therefore within the *ECRTV* allowance criteria.

## 10.8 Mitigation of Construction Noise

Best practice mitigation and management measures will be used to minimise construction noise and vibration at noise sensitive receivers, thereby reducing the potential impacts. This will be described in a Construction Noise Management Plan (CNMP), to be prepared by the contractor for the project.

The CNMP will consider the following issues as a minimum:

- a) identify nearby residences and other sensitive land uses;
- b) develop noise management levels consistent with the *ICNG*;
- c) assess the potential impact from the proposed construction methods;
- d) where management levels are exceeded examine of feasible and reasonable noise mitigation;
- e) develop reactive and proactive strategies for dealing with any noise complaints;
- f) identify a site contact person to follow up complaints; and
- g) noise monitoring.

In general, management of noise and vibration requires attention to the following:

- Construction hours.
- Noise and vibration monitoring on site and at sensitive receivers.
- Training and awareness.
- Communication.
- Incident and emergency response.
- Non-conformance, preventative and corrective action.

Where appropriate the specific noise mitigation measures could include:

- Mitigation of specific noise sources may be possible by using portable temporary screens.
- For extended periods of driven piling and use of rock breakers, respite periods might be considered.
- Maximising the offset distance between noisy plant items and sensitive receivers.
- Avoiding using noisy plant simultaneously and/or close together, adjacent to sensitive receivers.
- Orienting equipment away from sensitive receivers.
- Carrying out loading and unloading away from sensitive receivers.
- Using dampened tips on rock breakers.
- Using noise source controls, such as the use of residential class mufflers, to reduce noise from all plant and equipment including bulldozers, cranes, graders, excavators and trucks.

- Selecting plant and equipment based on noise emission levels.
- Using alternative construction methods to minimise noise levels.
- Providing alternative arrangements with affected residents such as temporary relocation.
- Selecting site access points and roads as far as possible away from sensitive receivers.
- Using spotters, closed circuit television monitors, “smart” reversing alarms, or “squawker” type reversing alarms in place of traditional reversing alarms.
- Design site compounds and site work methods to minimise the need for reversing, therefore minimising reversing alarm noise.

Education and training of site staff is necessary for satisfactory implementation of noise mitigation measures. Education and training strategies should focus on:

- Site awareness training / environmental inductions that include a section on noise mitigation techniques / measures to be implemented throughout the project.
- Ensuring work occurs within approved hours.
- Locating noisy equipment away from sensitive receivers.
- Using noise screens for mobile plant and equipment.
- Ensuring plant and equipment is well maintained and not making excessive noise.
- Turning off machinery when not in use.

For noise mitigation measures that result in a direct reduction in noise level, indicative noise reductions that can potentially be achieved by these measures, subject to the type and number of equipment and intensity of construction activities, are shown in Table 10-9. Other measures that also provide significant benefits are listed in Table 10-10. It is recommended that these be considered in preparation of a construction noise management plan prior to commencing works on site.

**Table 10-9 Measures to Reduce Construction Noise Levels**

| Management Measure  | Potential Noise Reduction, dBA |
|---|--------------------------------|
| <b>Administrative Controls</b>  |                                |
| Turning off machinery when not in use   | 0-5                            |
| <b>Engineering Controls</b>   |                                |
| Portable temporary screens  | 5-10                           |
| Screen or enclosure for stationary equipment  | 10-15                          |
| Maximising the offset distance between noisy plant items and sensitive receivers.   | 3-6                            |
| Avoiding using noisy plant simultaneously and/or close together, adjacent to sensitive receivers.   | 2-3                            |
| Orienting equipment away from sensitive receivers.  | 3-5                            |
| Carrying out loading and unloading away from sensitive receivers.   | 3-5                            |
| Using dampened tips on rock breakers.   | 3-6                            |
| Using noise source controls, such as the use of residential class mufflers, to reduce noise from all plant and equipment including bulldozers, cranes, graders, excavators and trucks | 5-10                           |
| Selecting site access points and roads as far as possible away from sensitive receivers   | 3-6                            |
| Employ non noise-generating structures such as site offices, storage sheds, stockpiles and tanks as noise barriers  | 5-10                           |

**Table 10-10 Other Measures to Mitigate Construction Noise Impacts**

| Management Measure   |
|--|
| <b>Administrative Controls</b>   |
| Operate during approved hours  |
| Undertake regular noise monitoring to determine the impact of operating plant on sensitive receivers   |
| Appropriate training of onsite staff   |
| Undertake community consultation and respond to complaints in accordance with established project procedures   |
| Respite periods for pile drivers and rock breakers   |
| <b>Engineering Controls</b>  |
| Using spotters, closed circuit television monitors, "smart" reversing alarms, or "squawker" type reversing alarms in place of traditional reversing alarms to minimise the intrusiveness of reversing alarms |

### 10.8.1 Out of Hours Noise Management

In addition to the noise control measures identified above, a range of noise management approaches would be adopted to mitigate potential impacts. For example, the scheduling of noise-intensive activities could be an effective noise management strategy in the present instance. Specifically, time restrictions should be placed on the most noise-intensive activities, especially concrete sawing, rockbreaking and the use of jackhammers in the vicinity of sensitive receivers. For example, where there is a definite requirement for such activities to be completed out of the normal construction hours, they would be restricted to 9:00 pm to 11:00 pm where reasonable and feasible. Similarly, with respect to the activities located at any one section of the Motorway in the vicinity of sensitive receivers, advanced notice of high noise activities would be provided and respite periods employed, such as avoiding, where practicable, two consecutive evenings in the same area where concrete saws are being used.

An important component therefore of the noise management of the proposed works is to undertake effective community consultation through all major stages of the construction programme. The community would be kept informed as to the nature, timing and duration of impending works, the nearest sensitive receivers likely to be affected and the monitoring programme associated with the impending works.

### 10.9 Removal/Replacement of Existing Barriers

During the barrier upgrade process, there may be a need to remove sections of existing barrier, before the upgraded barrier is replaced. At these times there is the potential for increased traffic noise to propagate to residences previously shielded by the barrier. Whilst from a construction perspective it would be more efficient to remove large sections of barrier, it is recognised that this may increase traffic noise levels at sensitive receivers by typically 10 dBA in some locations. For this reason, construction methods would be adopted that seek to minimise these impacts. This may include, where practicable, the provision of new higher posts directly in front of or behind the existing wall, over the full length and then progressively swap panels and add additional panels. In this case the increase in noise levels would be 2-3dBA and are only likely to last a few hours. Alternatively, short sections of barriers could be removed (typically 10-20m at a time), new posts installed and panels replaced within a shift. Increases in noise levels of less than 5dBA would be typical and these gaps would only exist during daytime periods.

## 10.10 Assessment of Construction Vibration

Impacts from vibration can be considered both in terms of effects on building occupants (human comfort) and the effects on the building structure (building damage). Of these considerations, the human comfort limits are the most stringent. Therefore, for occupied buildings, if compliance with human comfort limits is achieved, it will follow that compliance will be achieved with the building damage objectives.

### 10.10.1 Vibration Impacts

Ground vibration may potentially be caused by piling, rock hammering, drilling and ground compaction operations associated with construction of the road. Most of the proposed works will be in soft ground and rock hammering and drilling is not likely to be carried out. Vibration levels generated during piling and ground compaction operations (including vibratory rolling) will depend on the exact equipment to be used and the type of ground. Table 10-11 provides estimated vibration levels at a range of distances from piling, rock hammering, drilling and ground compaction operations. These vibration levels have been taken from Wilkinson Murray's database and are based on previous measurements on similar projects. The vibratory roller, impact piling and bored piling were measured in soft ground whilst the other equipment listed operates in rock.

**Table 10-11 Typical Vibration Levels from Construction Plant for Typical Worst Case Ground Conditions**

| Source                         | Peak Particle Vibration Levels, mm/s |      |      |      |      |       |
|--------------------------------|--------------------------------------|------|------|------|------|-------|
|                                | 5m                                   | 10m  | 20m  | 30m  | 40m  | 50m   |
| Vibratory roller               | -                                    | 4.1  | 2.6  | 2.4  | 2.2  | 1.9   |
| Heavy Rock Breaker             | 4.5                                  | 1.3  | 0.4  | 0.2  | 0.12 | 0.085 |
| Rock drill (estimate)          | -                                    | 0.5  | 0.2  | 0.1  | 0.05 | 0.04  |
| Light Rock Hammer (e.g. 600kg) | 0.2                                  | 0.06 | 0.02 | 0.01 | -    | -     |
| Impact Piling                  | 11                                   | 3.5  | 1.0  | 0.5  | 0.2  | 0.05  |
| Bored Piling                   | -                                    | 0.2  | <0.1 | -    | -    | -     |

Note: Theoretically, there can be an increase in vibration levels from two pieces of plant operating at the same location and in phase for energy average levels, however this is unlikely to affect the peak particle velocity as they are random incoherent vibration sources. Given this, vibration assessments are conducted based on individual sources.

The vibration criterion associated with building damage to residences (15mm/s) is easily complied with, considering the typical distances that any construction activities will be occurring from residential buildings. Compliance with the criterion indicates that there is a low risk of building damage from the proposed construction works.

In respect of human comfort, the only activities with potential for affecting nearby residents are vibratory roller and impact piling. In relation to impact piling, this is not expected to be carried out near residences, so this section addresses primarily vibratory rolling. A vibratory roller generates continuous vibration and it has been assumed that one may operate almost continuously for a full day during daytime hours. On this basis, depending upon the response of the particular ground type at the location, the daytime human comfort criterion would only be met at distances significantly greater than 50m. This means that there is potential that the human comfort criterion may be exceeded in some areas, mainly in those limited areas where a vibratory roller is used in the construction of pavement outside the existing lanes and possibly also in some cases where the vibratory roller is used on the median strip.

#### 10.10.2 Vibration Mitigation Measures

When vibratory rollers or impact piling rigs are brought to the site, ground-borne vibration levels will be measured to establish the minimum working separation between the equipment and nearby vibration sensitive receivers.

Continuous vibration monitoring will be carried out when a vibratory roller is operated within 30m of a building, or as required. Where the measured vibration levels exceed the appropriate limit applying to the measurement, construction activities or equipment will be modified (eg using a lighter or smaller vibratory roller) to ensure ongoing compliance with the limits. Otherwise, arrangements will be made with the affected residents to allow the operations to continue without affecting the residents' comfort.

Vibration monitoring will be carried out in response to a complaint about construction vibration in a residence. The monitoring will be carried out within the residence on the floor either at the location where the complaint originated or mid-floor span in a typical room.

The above mitigation measures, and any other measures deemed feasible and reasonable, should be addressed by the contractor in the Construction Noise Management Plan for the project.

## 11 CONCLUSIONS

Noise from the proposed M5 West Upgrade Project has been assessed. The following aspects have been considered:

- operational noise; and
- construction noise and vibration.

### 11.1 Noise Monitoring

Noise monitoring was undertaken by others at twenty locations, for use on the project. The noise monitoring was used to establish background noise levels for setting construction noise objectives, and to provide existing traffic noise levels for the purpose of verification/ calibration of the noise model.

### 11.2 Noise Modelling and Validation

The noise predictions for various modelling scenarios are presented in Appendices D and E. The scenarios modelled are:

- Year 2013 immediately before opening (Future Existing); and
- Year 2023 10 years after opening (Future Design)

The noise model was calibrated based on the measured existing noise levels provided for the project.

### 11.3 Recommendations for Operational Noise

The noise predictions indicated existing noise levels along the M5 West Upgrade generally exceed the target noise criteria. The allowance goal of an increase of more than 2 dBA, and/or "acute" noise levels, are exceeded at 285 locations.

Noise mitigation would be considered for all residential receivers which exceed the allowance goal and/or the acute noise levels. The following new road-side barriers are proposed with indicative heights and extents to be reviewed in the detailed design process:

- Northside – PB1 – 4.5m – East of Kurrajong Road – 275m;
- Southside – PB2 – 6.0m – West of Box Road – 400m;
- Northside – PB3 – 4.5m – Infill barrier between Hume Highway and railway – 240m;
- Southside – PB7 – 4.0m – Between Horsley Road and Panania North Public School – 510m; and
- Southside – PB8 – 4.0m – Infill barrier behind Parry Avenue – 155m.

It is also proposed to replacing an existing barrier with one of increased height:

Southside – PB7a – 5.0m – Barrier between Beaconsfield Street and Queens Street - 950m.

After installation of the proposed noise barriers, noise mitigation by architectural treatment of individual residences may be considered for a total of 182 residences. These are listed in Table 8-8 of the main text.

At most passive recreation areas, and most non-residential noise-sensitive receivers, the predicted increase in noise level due to the project is less than 2dBA, and hence the provision of additional mitigation is not considered reasonable. At the New Brighton Golf Course a higher increase is predicted, but the area over which the base criterion is exceeded is small, and provision of a long noise barrier to protect this area is not considered reasonable. Consideration of architectural treatment is recommended for one building in Hammondville Public School.

#### 11.4 Construction Noise and Vibration Assessment

Noise from construction is expected to result in impact at some residences, for at least some of the time. It is likely that the noise management levels would be exceeded during project construction, particularly at residential receivers. Vibration will generally be within comfort levels, and well within damage thresholds, although perceptible at times. The most significant vibration is expected to occur during the use of vibratory rollers, particularly in limited areas where some widening outside the existing lanes is carried out. In order to minimise the impacts, it is recommended that a Construction Noise Management Plan be prepared by the contractor prior to undertaking works on site. This will be based on the proposed construction methodology, activities and details of plant and equipment available at the time, to review the impacts and identify management and mitigation measures that can be implemented where feasible and reasonable.

##### Note

All materials specified by Wilkinson Murray (Sydney) Pty Limited have been selected solely on the basis of acoustic performance. Any other properties of these materials, such as fire rating, chemical properties etc. should be checked with the suppliers or other specialised bodies for fitness for a given purpose.

##### Quality Assurance

We are committed to and have implemented AS/NZS ISO 9001:2008 "Quality Management Systems – Requirements". This management system has been externally certified and Licence No. QEC 13457 has been issued.

##### AAAC

This firm is a member firm of the Association of Australian Acoustical Consultants and the work here reported has been carried out in accordance with the terms of that membership.

| Version | Status | Date              | Prepared by                                | Checked by  |
|---------|--------|-------------------|--|-------------|
| A       | Draft  | 22 June 2010      | John Wassermann                            | Glenn Homes |
| B       | Draft  | 20 August 2010    | Jimi Ang<br>John Wassermann<br>Glenn Homes | Rob Bullen  |
| C       | Draft  | 25 August 2010    | Jimi Ang<br>Glenn Homes                    | Rob Bullen  |
| D       | Final  | 13 September 2010 | Jimi Ang                                   | Neil Gross  |

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# APPENDIX A

## GLOSSARY OF TERMS



## GLOSSARY

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 overleaf, 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.

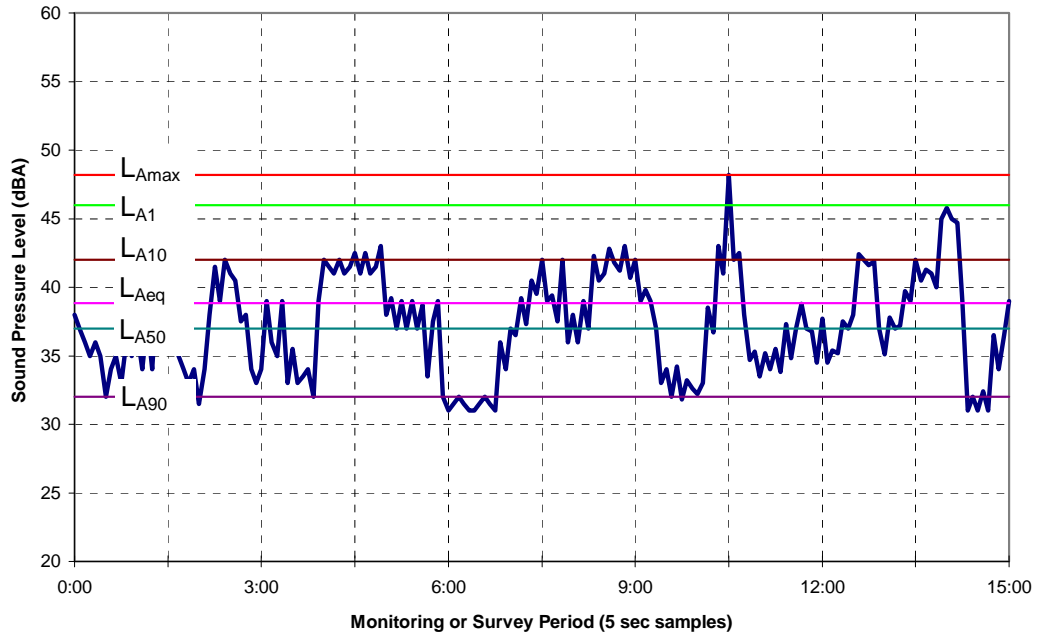
**$L_{Aeq}$**  – The equivalent continuous sound level ( $L_{Aeq}$ ) is the energy average of the varying noise over the sample period and is equivalent to the level of a constant noise which contains the same energy as the varying noise environment. This measure is also a common measure of environmental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

**$L_{A50}$**  – The  $L_{A50}$  level is the noise level which is exceeded for 50% of the sample period. During the sample period, the noise level is below the  $L_{A50}$  level for 50% of the time.

**$L_{A90}$**  – 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.

**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 10<sup>th</sup> percentile (lowest 10<sup>th</sup> 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.



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## APPENDIX B

### HEGGIES REPORT - NOISE MEASUREMENT RESULTS





**HEGGIES**

REPORT 10-8495

Revision 0

**M5 Motorway  
Operational Noise Monitoring  
November-December 2009**

PREPARED FOR  
RTA Environment Branch  
101 Miller Street  
NORTH SYDNEY NSW 2060

JANUARY 2010

**HEGGIES PTY LTD**  
ABN 29 001 584 612



# M5 Motorway

## Operational Noise Monitoring

### November-December 2009

**PREPARED BY:**

**Heggies Pty Ltd**  
 2 Lincoln Street Lane Cove NSW 2066 Australia  
 (PO Box 176 Lane Cove NSW 1595 Australia)  
 Telephone 61 2 9427 8100 Facsimile 61 2 9427 8200  
 Email sydney@heggies.com Web www.heggies.com

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Heggies Pty Ltd is a Member Firm of the Association of Australian Acoustical Consultants.



Heggies Pty Ltd operates under a Quality System which has been certified by SAI Global Pty Limited to comply with all the requirements of ISO 9001:2008 "Quality management systems - Requirements" (Licence No 3236).

This document has been prepared in accordance with the requirements of that System.

**DOCUMENT CONTROL**

| Reference | Status     | Date            | Prepared       | Checked      | Authorised   |
|-----------|------------|-----------------|----------------|--------------|--------------|
| 10-8495   | Revision 0 | 29 January 2010 | Mitchell Allen | Ian Wallbank | Ian Wallbank |
|           |            |                 |                |              |              |
|           |            |                 |                |              |              |
|           |            |                 |                |              |              |
|           |            |                 |                |              |              |



## TABLE OF CONTENTS

|          |  |   |
|----------|--|---|
| 1        | INTRODUCTION                               | 4 |
| 2        | UNATTENDED NOISE MONITORING                | 4 |
| 2.1      | Instrumentation                            | 4 |
| 2.2      | Methodology                                | 4 |
| 2.3      | Locations                                  | 5 |
| 3        | NOISE MONITORING RESULTS                   | 6 |
| 4        | SUMMARY AND CONCLUSION                     | 7 |
| Table 1  | Monitoring Locations and Reference Numbers | 5 |
| Table 2  | Current (2009) Noise Monitoring Results    | 6 |
| Figure 1 | Noise Monitoring Locations – Section 1     | 1 |
| Figure 2 | Noise Monitoring Locations – Section 2     | 2 |
| Figure 3 | Noise Monitoring Locations – Section 3     | 3 |

Appendix A Unattended Noise Monitoring Locations



## 1 INTRODUCTION

Heggies Pty Ltd (Heggies) was engaged by the Roads and Traffic Authority (RTA) to undertake environmental noise monitoring during the months of November and December 2009 at 20 locations along the boundaries of the M5 South West Motorway. The assessment area for this study was defined by the RTA as encompassing the 22 km of roadway spanning Camden Valley Way, Prestons and King Georges Road, Beverley Hills.

Background noise monitoring has been carried out at a total of 20 locations in order to characterise the existing noise environment at dwellings along the alignment of the Motorway. The selected locations were chosen based on various criteria including the following:

- an even spread of locations along the length of the motorway,
- the proximity of the location to the motorway and façade most exposed to road traffic noise

Monitoring results have been used to quantify a baseline scenario of current (2009) operational noise emissions and to determine their compliance with relevant noise design goals as defined by the Department of Environment, Climate Change and Water's (DECCW) "*Environmental Criteria for Road Traffic Noise*" (1999, ECRTN), the current NSW Government regulatory document for noise criteria relevant to road traffic.

## 2 UNATTENDED NOISE MONITORING

### 2.1 Instrumentation

Equipment for the continuous unattended noise monitoring comprised Acoustic Research Laboratories Environmental Noise Loggers Type EL-215 and EL-316 fitted with microphone windshields.

All equipment used for the surveys carries current manufacturer's calibration certification. Calibration was recorded when the noise loggers were set-up and before downloading of the data. Calibration drift did not exceed 0.5 dBA.

All items of acoustic instrumentation employed during the noise monitoring surveys were designed to comply with the requirements of AS 1259.2-1990 "*Acoustics - Sound Level Meters Part 2: Integrating - Averaging*" and carried appropriate and current NATA (or manufacturer) calibration certificates.

### 2.2 Methodology

The M5 South West Motorway ambient noise monitoring was carried out as follows:

- All noise loggers were programmed to store a variety of noise indices including LA90, LAeq, LA10 and LA1 noise levels on a continuous basis at 15-minute period intervals;
- Loggers were left onsite for a minimum period of one week. In some instances, the loggers remained on site for longer periods;
- The unattended noise loggers were positioned 1 m from the most noise affected facade of the dwelling and at a height of 1.5 m above local ground level.

Prevailing weather conditions were reviewed using weather information recorded by the Bureau of Meteorology (BOM) and available data resources. Weather details obtained for the entire period of noise monitoring include wind speed, wind direction and rainfall occurrence and amount. The effects due to weather events which generated extraneous noise data were analysed and excluded where appropriate.



## 2.3 Locations

Each noise monitoring location identified for the assessment was chosen based on various criteria including the following:

- Even spread of locations along the length of the motorway
- Proximity of the specific location to the motorway and façade most exposed to road traffic noise
- Location where extraneous noise was absent

Whilst on site, consideration was given to the immediate surrounding acoustic environment in the selection of the final placement of each noise logger. The objective was to ensure that the exposure of each microphone to extraneous noise was minimised, eg final logger positions were chosen to avoid proximity to mechanical noise such as pool pumps, air-conditioning units, etc.

**Table 1** lists the 20 locations where monitoring was undertaken for the present assessment - refer to **Appendix A** for location maps.

Table 1 Monitoring Locations and Reference Numbers

| Reference Number | Address              | Suburb       |
|------------------|----------------------|--------------|
| 1                | 45 Incense Place     | Casula       |
| 2                | 43 Acacia Avenue     | Prestons     |
| 3                | 40A Ironbark Avenue  | Casula       |
| 4                | 15 Foveaux Avenue    | Lurnea       |
| 5                | 33 Mary Crescent     | Liverpool    |
| 6                | 55 Grove Street      | Casula       |
| 7                | 15 Barwon Court      | Wattle Grove |
| 8                | 80 Renton Avenue     | Moorebank    |
| 9                | 17 Fitzgerald Avenue | Hammondville |
| 10               | 4 Meteren Close      | Milperra     |
| 11 <sup>1</sup>  | 4 Flanders Avenue    | Milperra     |
| 12               | 64 Tracey Street     | Revesby      |
| 13               | 32 Ely Street        | Revesby      |
| 14               | 23 Carrington Street | Revesby      |
| 15               | 46 Louie Street      | Padstow      |
| 16               | 24 Iris Avenue       | Riverwood    |
| 17               | 2/62 Kentucky Road   | Riverwood    |
| 18               | 41 Earls Avenue      | Riverwood    |
| 19 <sup>1</sup>  | 4 Arilla Avenue      | Riverwood    |
| 20               | 60 Parry Avenue      | Narwee       |

<sup>1</sup> Noise monitoring at these locations was conducted over both monitoring periods in order to serve as a point of comparison.



### 3 NOISE MONITORING RESULTS

Data obtained at each noise logger location has been processed in accordance with ECRTN principles to derive relevant descriptors. Extraneous noise data identified as being unrepresentative of road traffic noise levels was excluded from the measured data prior to processing.

LAeq and LA90 results from noise monitoring at the chosen 20 locations are given below in **Table 2** for both daytime (15hr) and night-time (9hr) periods. The single number presented is an average<sup>1</sup> of the combined weekly monitoring results.

Table 2 Current (2009) Noise Monitoring Results<sup>2</sup>

| Address                       | Measured Noise Levels (dBA) |           |            |           |
|-------------------------------|-----------------------------|-----------|------------|-----------|
|                               | LAeq(15hr)                  | LAeq(9hr) | LA90(15hr) | LA90(9hr) |
| 45 Incense Place              | 56.5                        | 51.8      | 49.3       | 39.3      |
| 43 Acacia Avenue              | 58.5                        | 54.1      | 50.5       | 38.0      |
| 40A Ironbark Avenue           | 60.0                        | 56.0      | 54.1       | 41.7      |
| 15 Foveaux Avenue             | 60.5                        | 55.6      | 53.0       | 43.7      |
| 33 Mary Crescent              | 57.3                        | 53.3      | 50.1       | 41.2      |
| 55 Grove Street               | 60.2                        | 57.0      | 53.4       | 39.8      |
| 15 Barwon Court               | 62.4                        | 58.2      | 56.1       | 41.8      |
| 80 Renton Avenue <sup>1</sup> | 56.7                        | 54.0      | 50.2       | 41.9      |
| 17 Fitzgerald Avenue          | 58.5                        | 54.7      | 53.1       | 39.5      |
| 4 Meteren Close               | 58.2                        | 54.5      | 51.3       | 39.0      |
| 4 Flanders Avenue             | 56.7                        | 54.1      | 49.8       | 45.7      |
| 64 Tracey Street              | 59.6                        | 56.3      | 53.8       | 46.5      |
| 32 Ely Street                 | 60.3                        | 57.1      | 52.8       | 39.5      |
| 23 Carrington Street          | 59.9                        | 57.1      | 53.7       | 40.7      |
| 46 Louie Street               | 57.6                        | 54.5      | 51.2       | 38.5      |
| 24 Iris Avenue                | 56.6                        | 53.9      | 50.6       | 44.1      |
| 2/62 Kentucky Road            | 57.6                        | 54.9      | 51.5       | 38.4      |
| 41 Earls Avenue               | 54.9                        | 51.6      | 49.5       | 40.3      |
| 4 Arilla Avenue               | 62.8                        | 59.6      | 57.7       | 46.7      |
| 60 Parry Avenue               | 57.4                        | 55.1      | 51.0       | 43.0      |

<sup>1</sup> Noise logger failed after five and a half days of logging. Recorded data includes full 24 hour periods across both weekend days.

Noise loggers were deployed at 4 Flanders Avenue and 4 Arilla Avenue across both monitoring periods due to equipment failure and to serve as a point of comparison. Whilst noise data obtained does not comprise 7 days consecutive logging, analysis and comparison with other noise logging locations yields confidence that the overall data presented is representative of a typical week long data collection period.

<sup>1</sup> LAeq results have been log averaged, whilst the LA90 results presented are a linear average of the lowest 10<sup>th</sup> percentile.

<sup>2</sup> Refer to Heggies data set provided (*10-8495 Noise Logging Summary.xls*) for comprehensive break down of noise monitoring results.



## 4 SUMMARY AND CONCLUSION

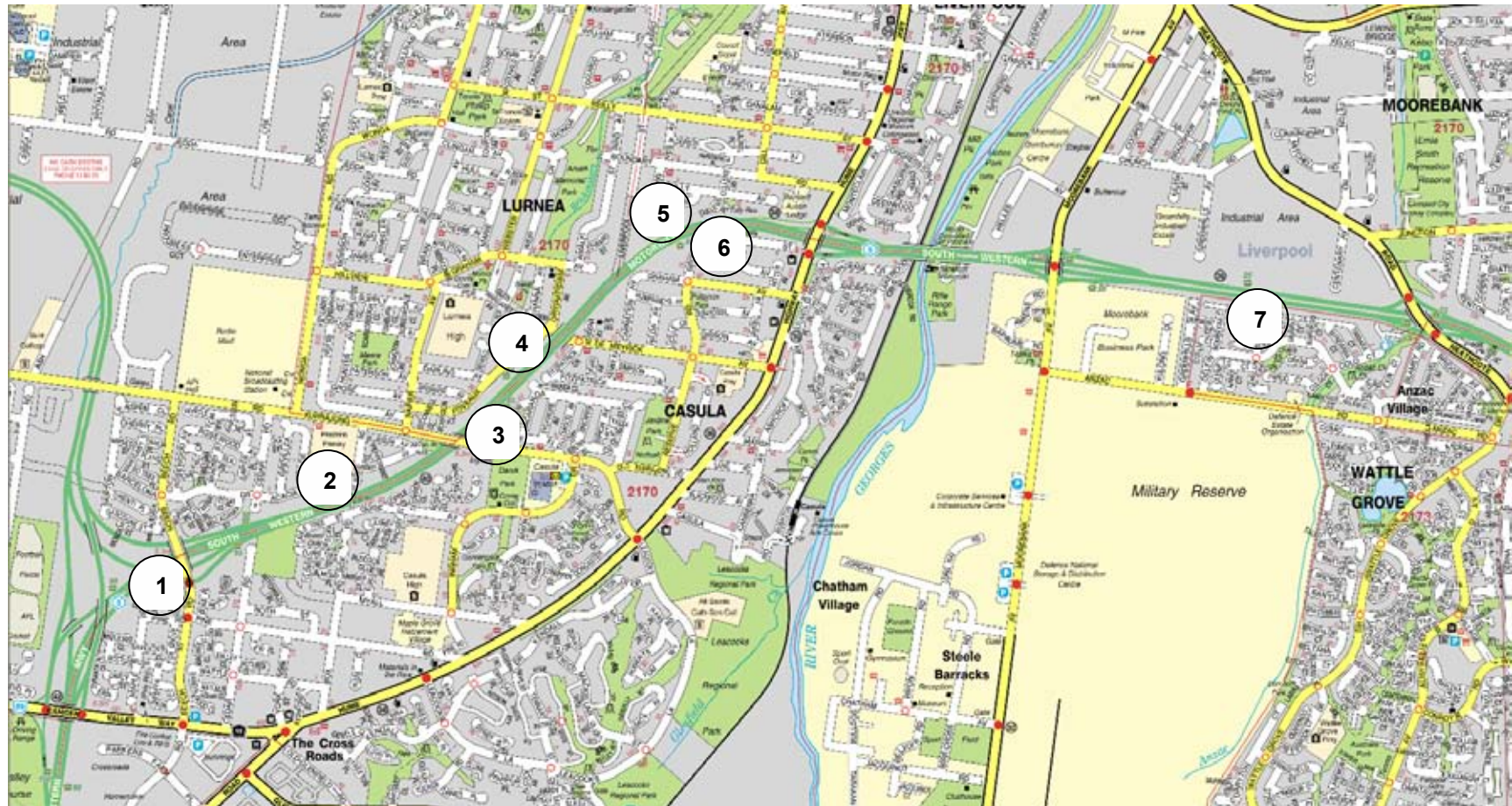
This report presents a synopsis of the results of operational noise surveys conducted along the M5 Motorway during November and December 2009. 15hr and 9hr time periods have been presented to enable the potential for comparison with the DECCW's "*Environmental Criteria for Road Traffic Noise*" (ECRTN).

Noise monitoring was conducted at a total of 20 locations aligning the Motorway. Monitoring locations were chosen based on their geographical spread, proximity to the motorway, and consideration of practical restrictions.

Data identified as extraneous to road traffic noise levels was omitted prior to processing measured noise results.

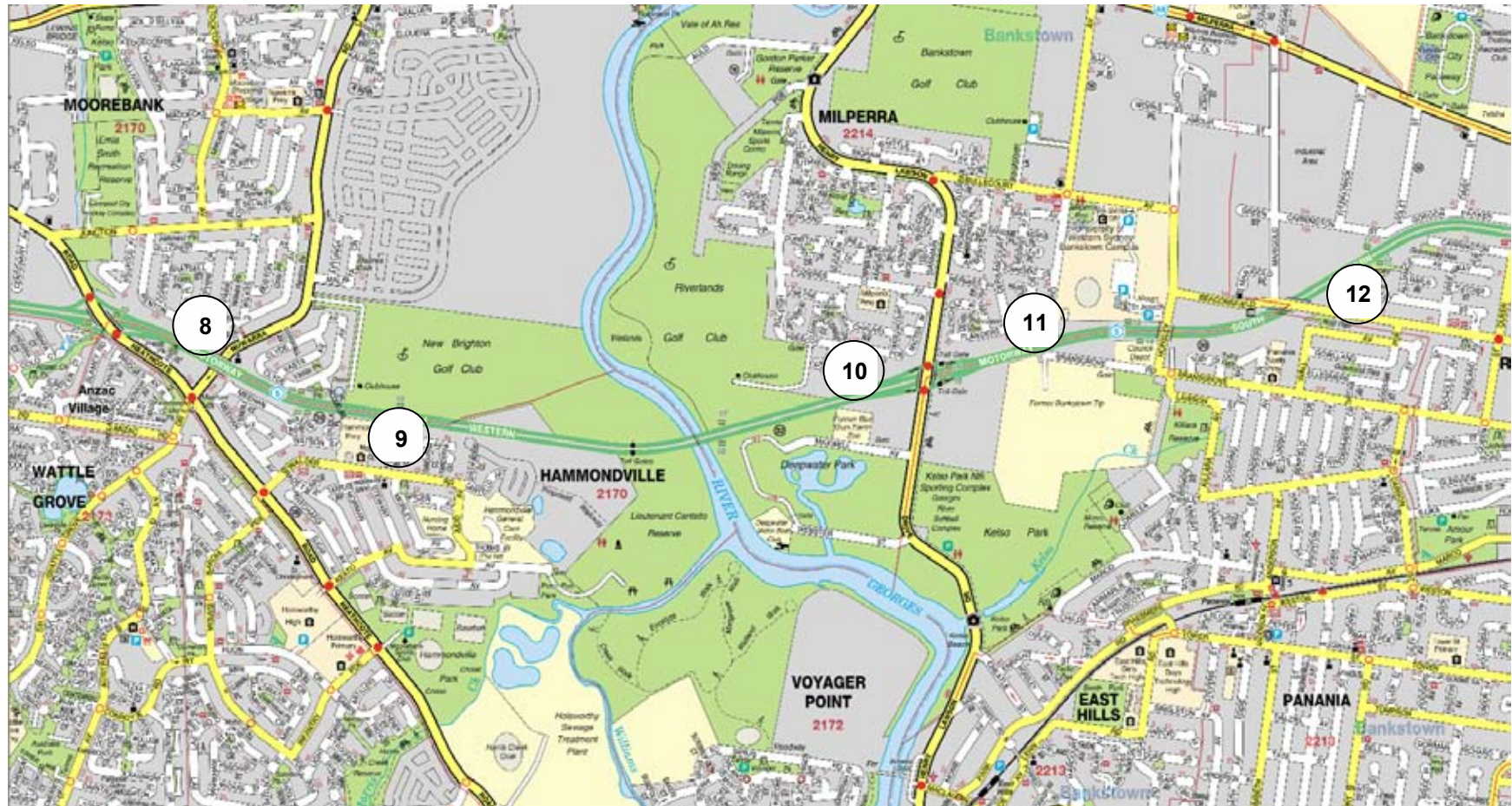
UNATTENDED NOISE MONITORING LOCATIONS

Figure 1 Noise Monitoring Locations – Section 1



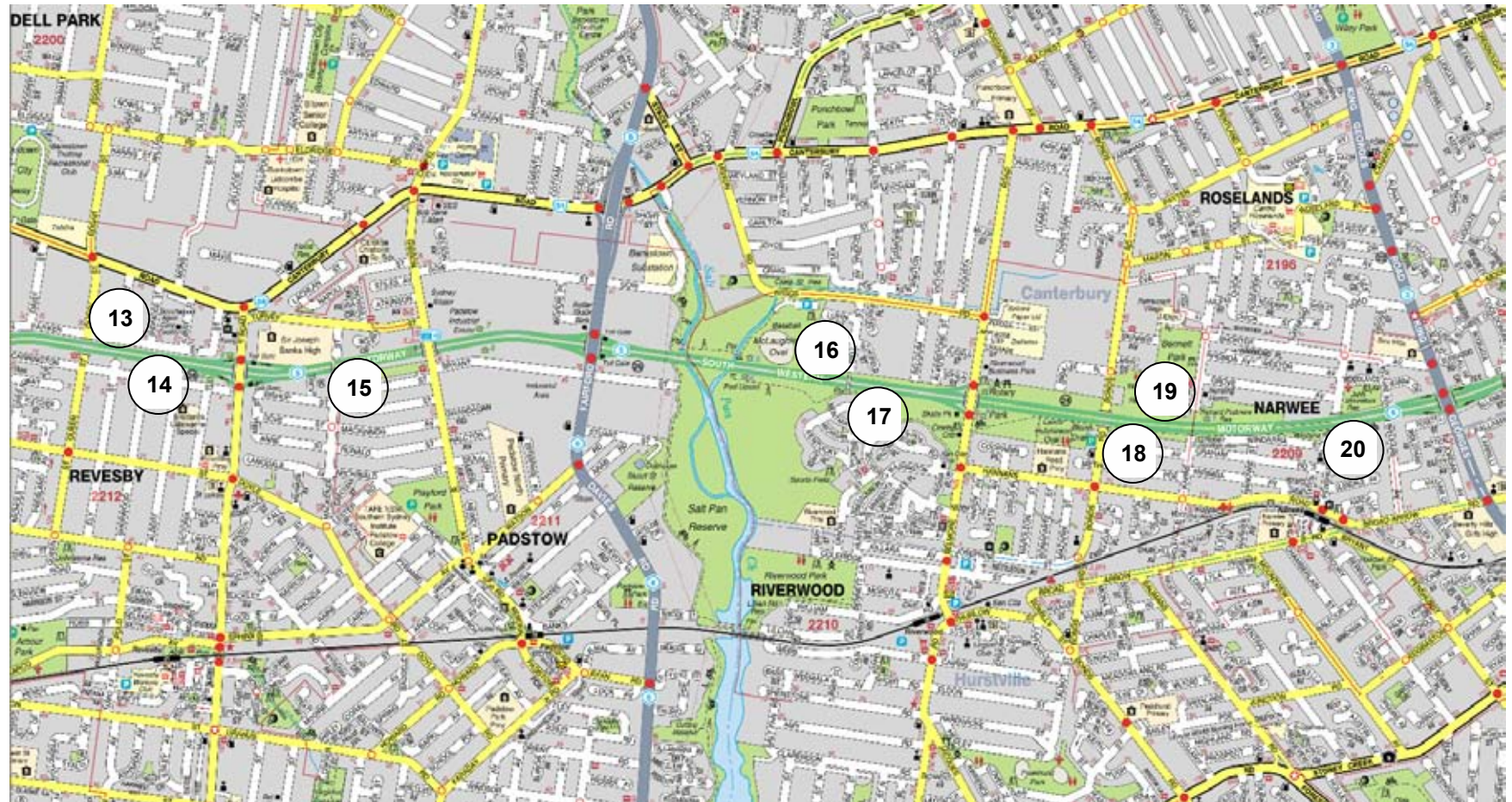
UNATTENDED NOISE MONITORING LOCATIONS

Figure 2 Noise Monitoring Locations – Section 2



UNATTENDED NOISE MONITORING LOCATIONS

Figure 3 Noise Monitoring Locations – Section 3



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APPENDIX C  
LOCATIONS OF EXISTING BARRIERS

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