

# Road Traffic Noise

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# Basic Stuff

- Noise is measured in decibels (dB)
- Logarithmic measuring scale:
  - 1 truck running – say 70dB
  - 2 trucks running – 73dB
  - 10 trucks running – 80dB

BUT

- Human hearing very non-linear, so truck revving at say 80dB sounds about twice as loud as truck running at 70dB, or something at 50dB sounds about twice as loud as 40dB(A).

# More Basic Stuff

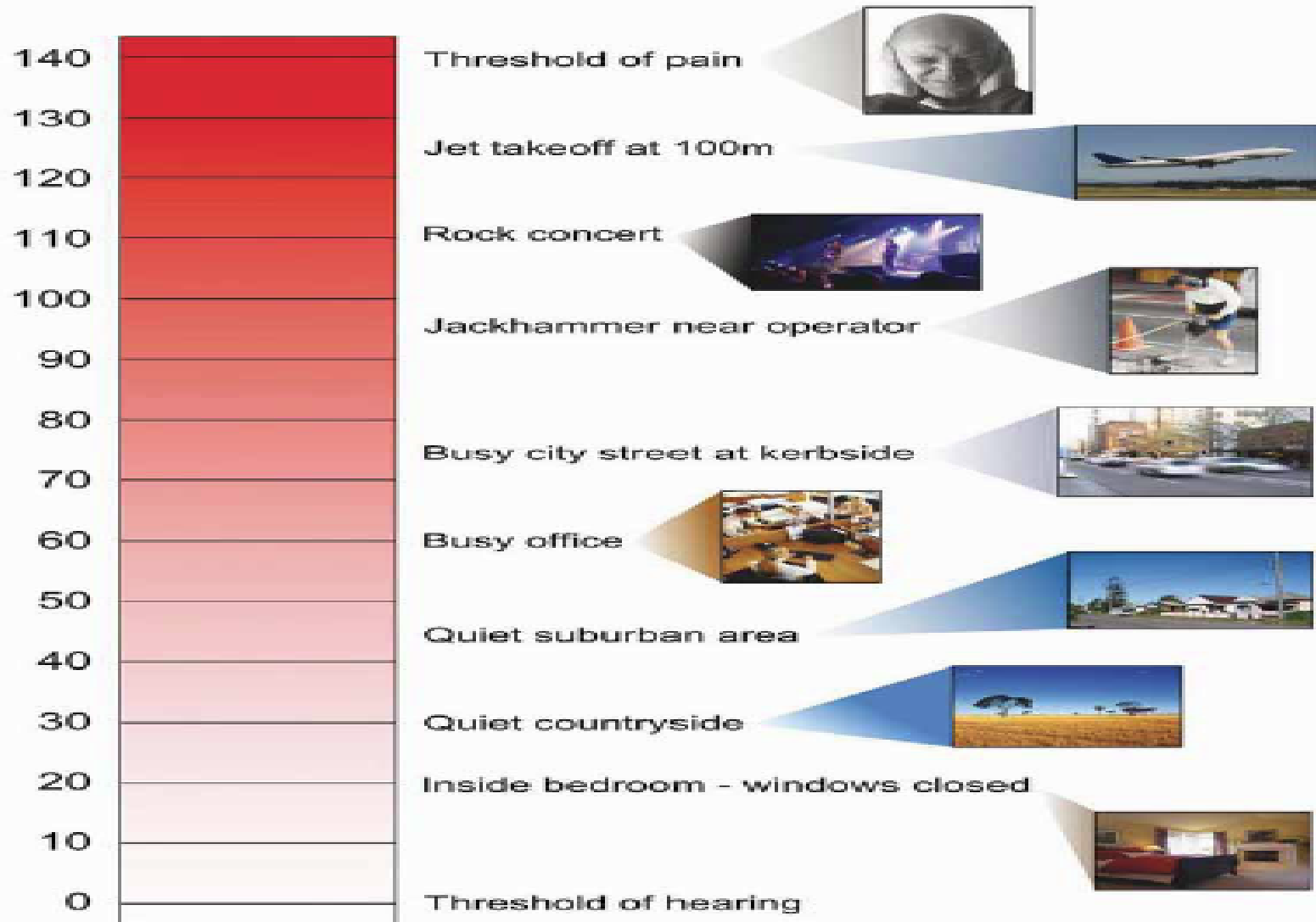
- Noise propagates spherically – like a big expanding balloon.

Mathematically, this means noise from a source reduces by 6dB every time distance is doubled.

- A noise source that is, say, 20 metres away, sounds half as loud when it is moved to 60 metres away – i.e. distance needs to be multiplied by 3 for a sound to be about half as loud.

# Typical Sound Levels

Indicative A-weighted decibel (dBA) noise levels in typical situations



# Basic Road Stuff

- Acoustically, noise from a road is a combination of individual loud noises (e.g. trucks) and a somewhat continuous line of less discernible individual sources (e.g. a line of steadily moving cars)
- Mathematically, noise from the individual sources attenuates at 6dB every doubled distance

BUT

noise from the line sources attenuates at 3dB every double distance

# More Basic Road Stuff

- So moving a road alignment from one distance to an alignment 3 times that distance away reduces loud noise events by  $\sim 10\text{dB}$  and therefore to about half as loud,

**BUT**

- You have to move a road alignment 10 times that distance before the steady background traffic noise reduces to about half

# Important Road Stuff

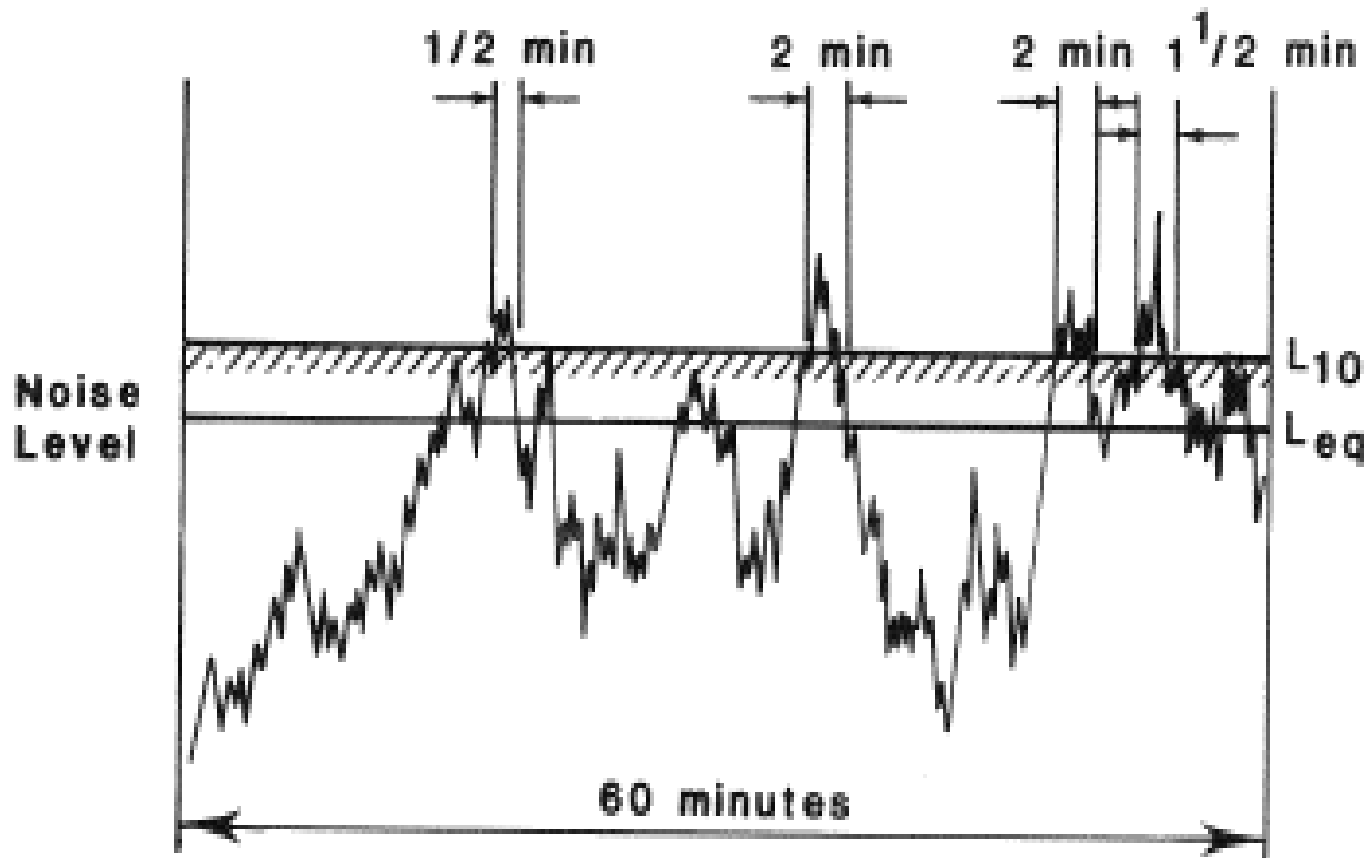
- At close distances from a road, loud noise events are the aspect that is most intrusive
- At larger distances, the steady roar of vehicle noise tends to become the aspect that is most intrusive.
- Loud events tend to relate to engine noise, particularly from trucks and motor bikes
- A 'quiet' road surface reduces the steady roar noise, but not the loud events
- Truck exhaust pipes are 3.2 to 3.6 metres high, so a barrier has to be higher still to be effective

# Laborious Basic Stuff

- dB(A) – attempt to approximate human sensitivity to frequency
- Statistical measurements:
  - L1
  - L10
  - Leq
  - LA,eq,T



# Laborious Basic Stuff



# Vehicle Noise

- Primarily, assessment criteria are based on LAeq
- $LA_{eq,1hr} = 37.3 + 10 \log(M(1 + 0.082p))$ 
  - M is the number of vehicles per hour
  - p is the % heavy vehicles
  - Level is predicted for 25 metres
- Trucks are roughly 10dB louder than cars
- If night traffic is mostly trucks, traffic noise remains as loud even if passing vehicles drop to only 9% of daytime flow

# Effects on Vehicle Noise

- Reducing speed from 100kph:
  - 90kph: -1.5dB(A)
  - 80kph: -3dB(A)
  - 60kph: -7dB(A)
- Trucks are as noisy at 20kph as at 80kph  
Quietest at about 40kph
- Gradient of 3% increases Leq noise about 1dB(A). Higher gradients greatly increase risk of engine brake noise from heavy vehicles
- Any sudden change of speed causes loud noise events, so exit and entry arrangements need care

# DECCW Criteria

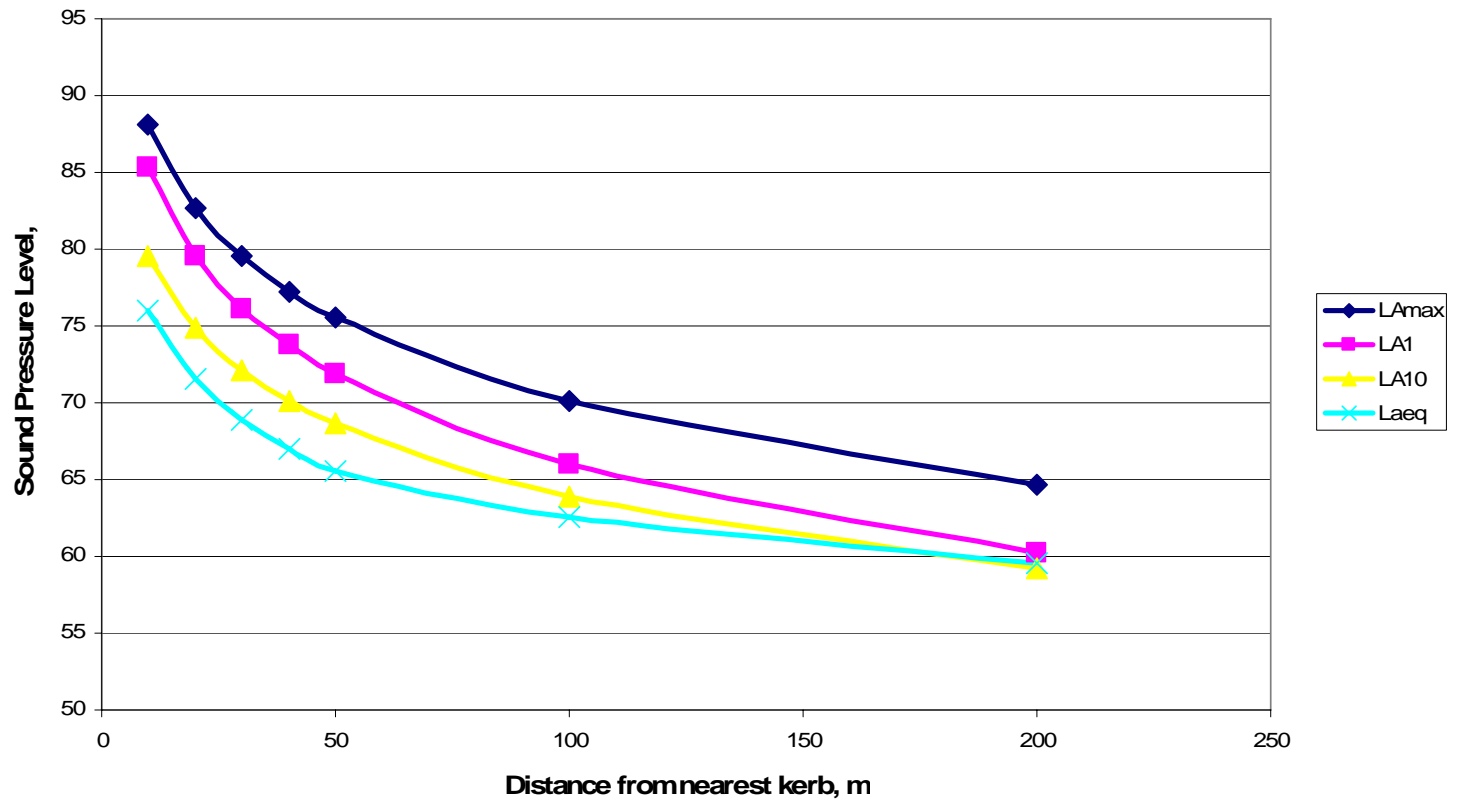
- These are the criteria that RTA is required to adopt to assess mitigation treatments:

L<sub>Aeq</sub> noise level complying with the table below  
 Plus consideration of sleep disturbance

<b>Type of Project</b>	<b>Day (7am to 10pm)</b>	<b>Night (10pm to 7am)</b>
Dwelling near New Freeway	L <sub>Aeq</sub> (15hr) 55	L <sub>Aeq</sub> (9hr) 50
Dwelling near Redevelopment of Existing Freeway/arterial	L <sub>Aeq</sub> (15hr) 60	L <sub>Aeq</sub> (9hr) 55
School Classroom (internal)	L <sub>Aeq</sub> (1hr) 40	-
Hospital (internal)	L <sub>Aeq</sub> (1hr) 35	L <sub>Aeq</sub> (1hr) 35
Places of Worship (internal)	L <sub>Aeq</sub> (1hr) 40	L <sub>Aeq</sub> (1hr) 40
Open space (active use)	L <sub>Aeq</sub> (1hr) 60	-
Open space (passive use)	L <sub>Aeq</sub> (1hr) 55	-
Childcare Facilities	Sleeping Rooms	35
	Indoor play	40
	Outdoor play	55

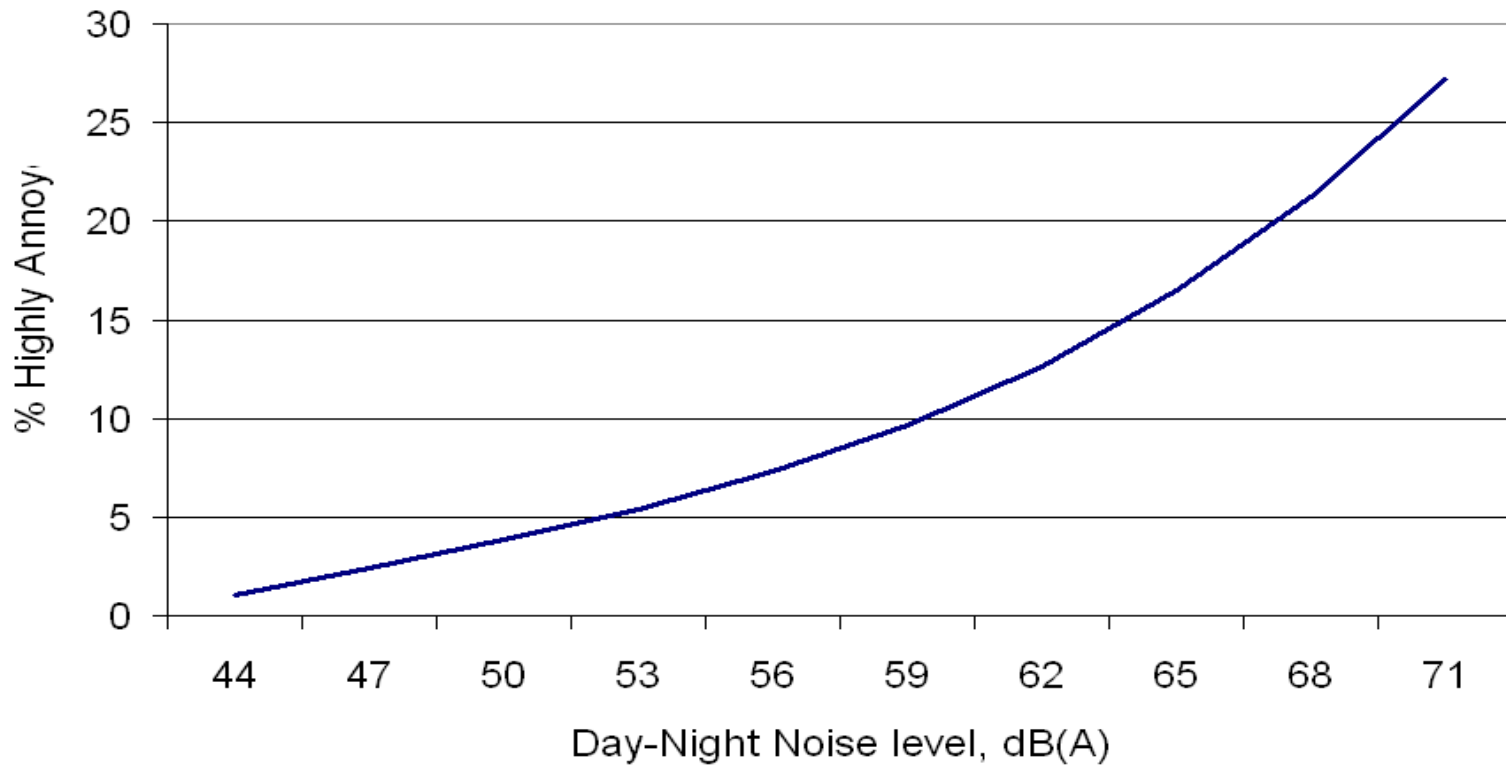
# M2 Data

**Analysis of M2 Measurements by Bob in 2004 (110kph, maybe 3000v/hr)**



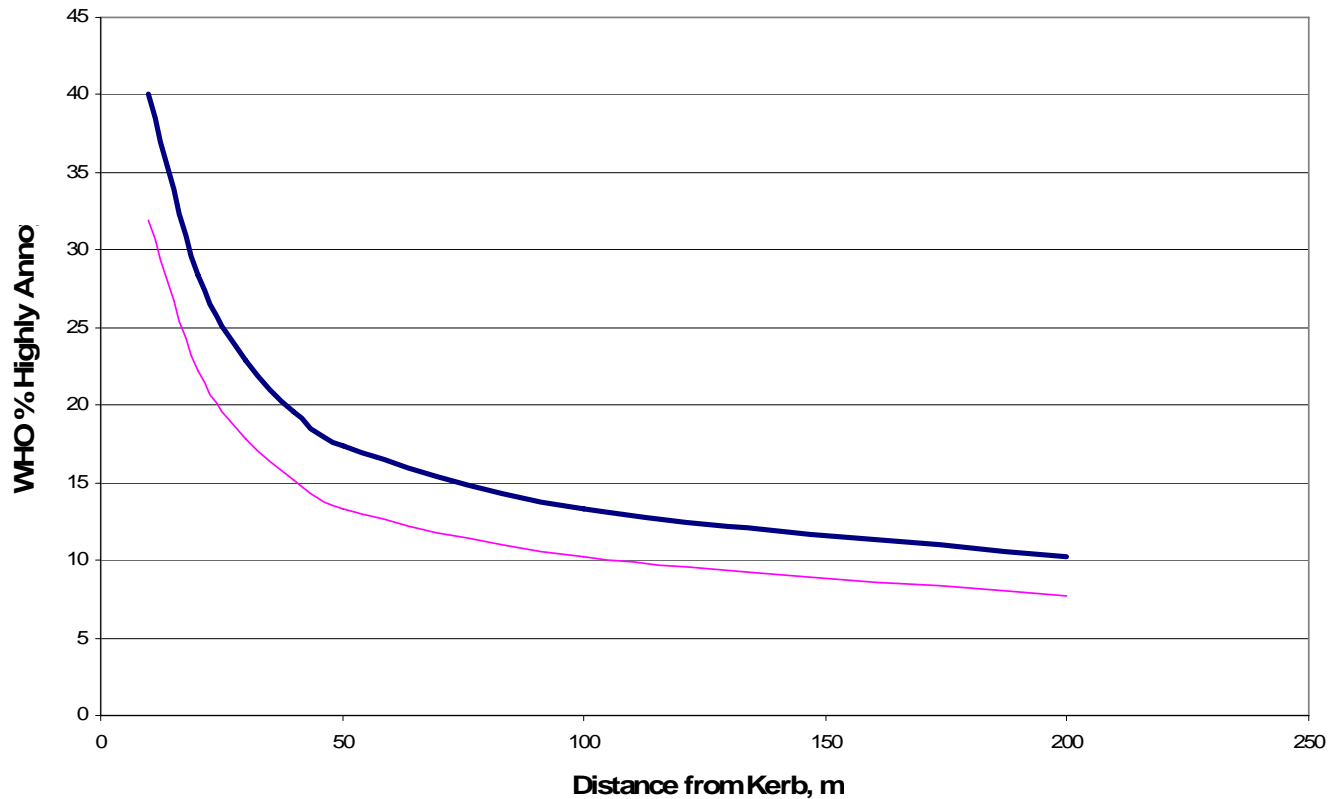
# WHO Research, 2011

WHO % Highly Annoyed by Traffic Noise



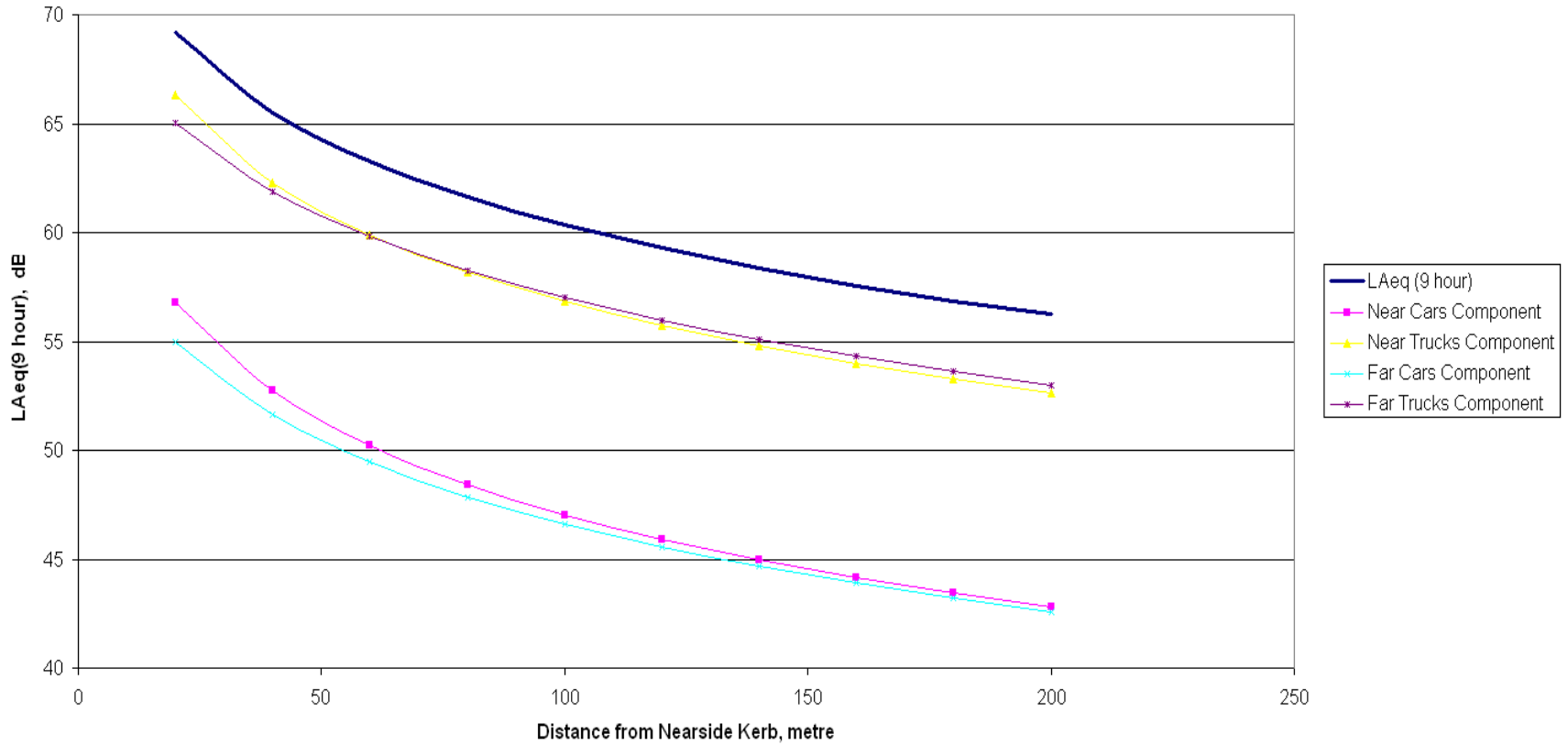
# So annoyance expectations?

Analysis of M2 data by Bob (2004, 110kph, maybe 3000v/hr)



# Prediction if AADT 20000 and no barriers

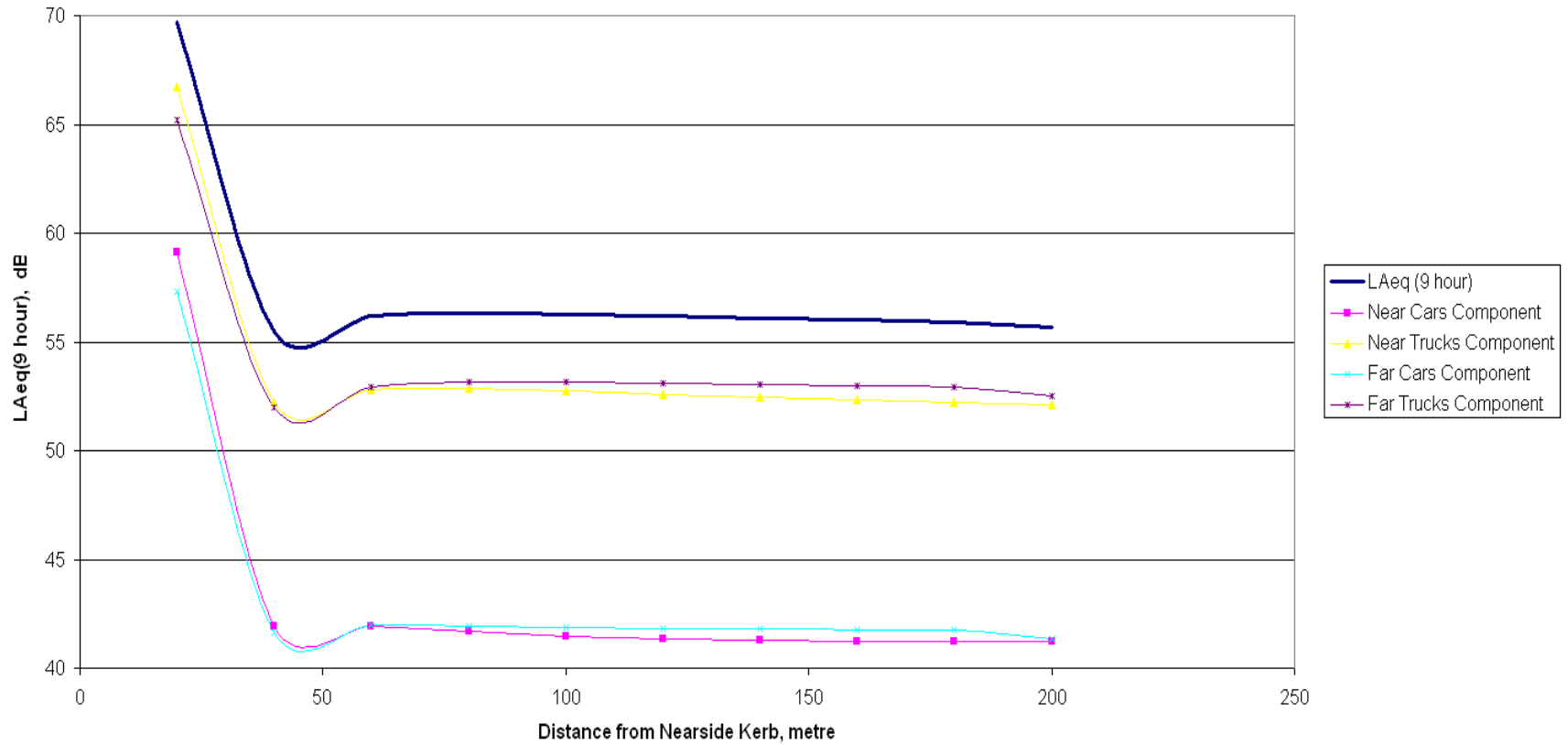
Night Period LAeq(9 hour) Traffic Noise vs Distance from Nearside Kerb





# Adding a 5m high noise barrier

Night Period LAeq(9 hour) Traffic Noise vs Distance from Nearside Kerb



# The RTA Approach

- Beaver away on road design
- Assess noise vs DECCW criteria
- Attempt to minimise the constraints:
  - buy properties, and/or
  - improve design alignment, and/or
  - adjust road height/depth
  - consider tunnels?
- Calculate treatment requirements
- Assess what is “feasible and reasonable” to implement
- Adopt mitigation treatments:
  - road pavement treatments, and/or
  - roadside noise barriers, and/or
  - earth berms, and/or
  - architectural treatments to buildings

# Key Problems to Address

- Background noise monitoring was 2007, summer, probably insects, not reflective of most adversely affected locations. Still appears to be used for Gerringong. Must do more.
- “Feasible and Reasonable” Treatments:
  - Feasible: technically possible
  - Reasonable: DECCW discusses aspects to be considered, however there are no criteria used to decide “reasonable”.
- Reasonable means different things to different stakeholders - RTA, residents, etc
- Architectural treatments are inappropriate in an area such as Berry – why move here to live in a closed air-conditioned house (mitigation for 48 of the 83 dwellings identified in the Gerringong upgrade have been decided as architectural treatments)
- Outdoor amenity is a key asset to the Berry area. There is no objective measurement basis for “amenity”.

# UK Design Manual for Roads and Bridges, 1994

## 7. POSSIBLE MITIGATION MEASURES

7.1 The assessment of noise and vibration should be based on the scheme with mitigation as agreed by the Overseeing Department.

7.2 Examples of possible mitigation techniques are described below. They generally apply to both noise and vibration attenuation.

- realigning a route away from residential areas or other sensitive locations;
- keeping a route low within the natural topography to exploit any natural screening and enhance this by the use of cuttings and, in exceptional circumstances, tunnels;
- providing environmental barriers, such as earth mounding or acoustic fencing. Conventional environmental barriers are not effective in reducing ground borne vibration and may be only partially effective against airborne vibration. They should therefore be ignored in assessing vibration nuisance unless more detailed tests show appreciable benefits from the design proposed;
- the use of alternative road surfaces.

7.3 Reducing the noise/vibration impact of a road is just one of the factors to be considered in route choice and design, and conflicts can exist. For example, an acoustic barrier may introduce unacceptable visual intrusion. In addition, any mitigation measure must perform to an acceptable level in traffic, road safety and economic terms.