Noise from the wheel rail interface: a systems approach

Wheels and rolling stock

↑ ↓

Wheel / rail interface

↑ ↓

Rails & track system

CRC for rail innovation

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CRC Research Program

CRC for rail innovation

Researching the wheel rail interface as a noise generating system

QR NATIONAL

ARTC

QueenslandRail

NSW Government Transport Construction Authority

Southern Cross University *A new way to think*

University of Wollongong

The University of Queensland Australia

NSW Government Transport RailCorp

Outline

- The need for research
- The wheel / rail interface as a noise generating system
- Case studies

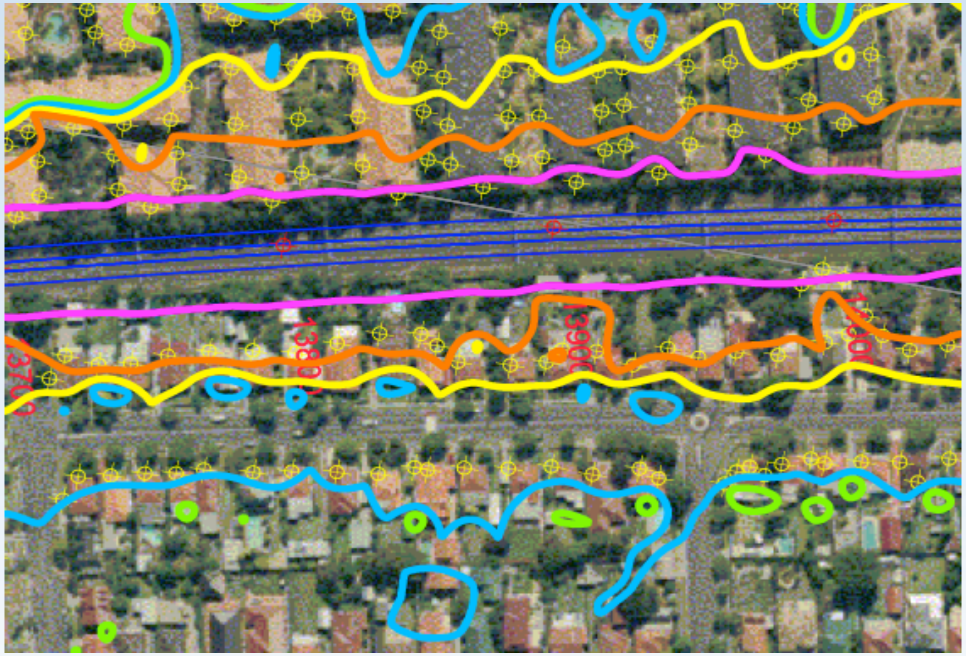
The case for managing noise

Objection to proposed rail projects

Long standing complaints about existing rail operations

Objection to completed rail projects and noise barriers

Rolling Noise



- Rolling noise is normal; it is the dominant noise source for most rail corridors / systems
- But the "tool box" of mitigation options can be limited

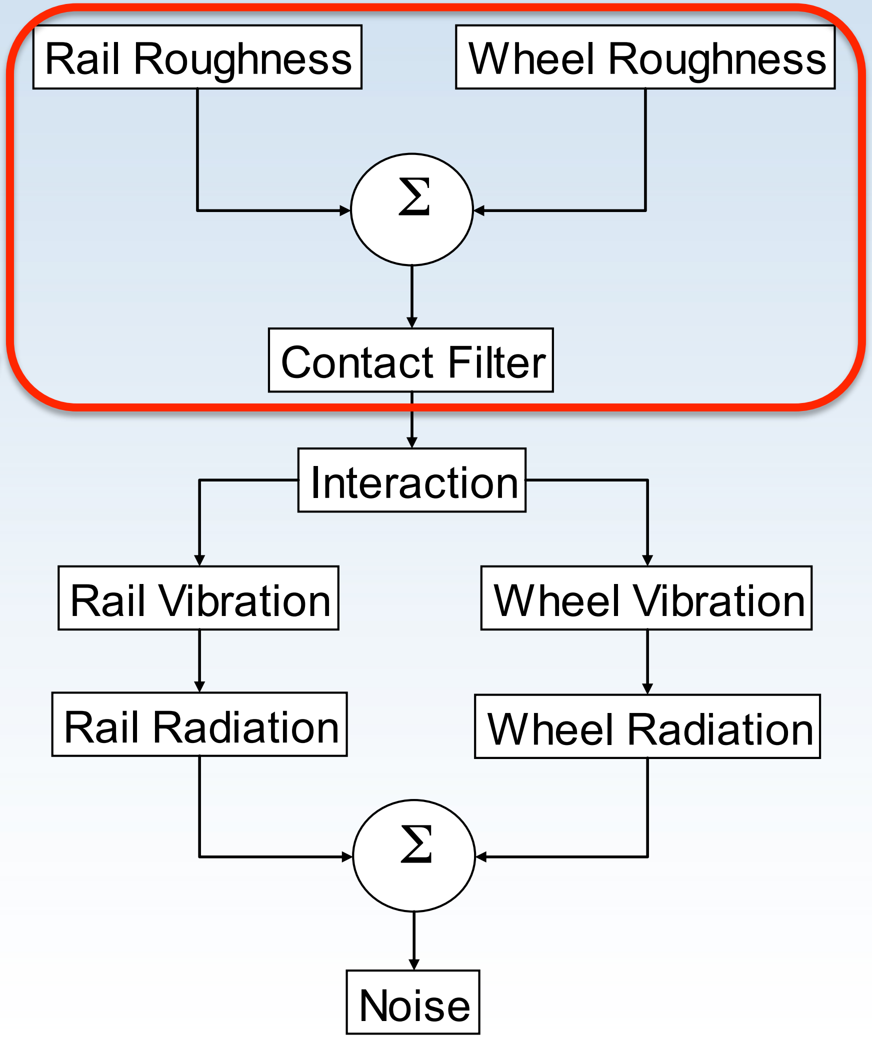
  A) Slower / less traffic, or B) build noise walls

Curve noise

- Long standing issue, acute noise, some impressive progress
- Improvement in some areas, but getting worse in others
- Mechanism(s) not fully understood

Systems Approach

- TWINS [1]
- RRNPS [2]
- Wheel / rail interface system



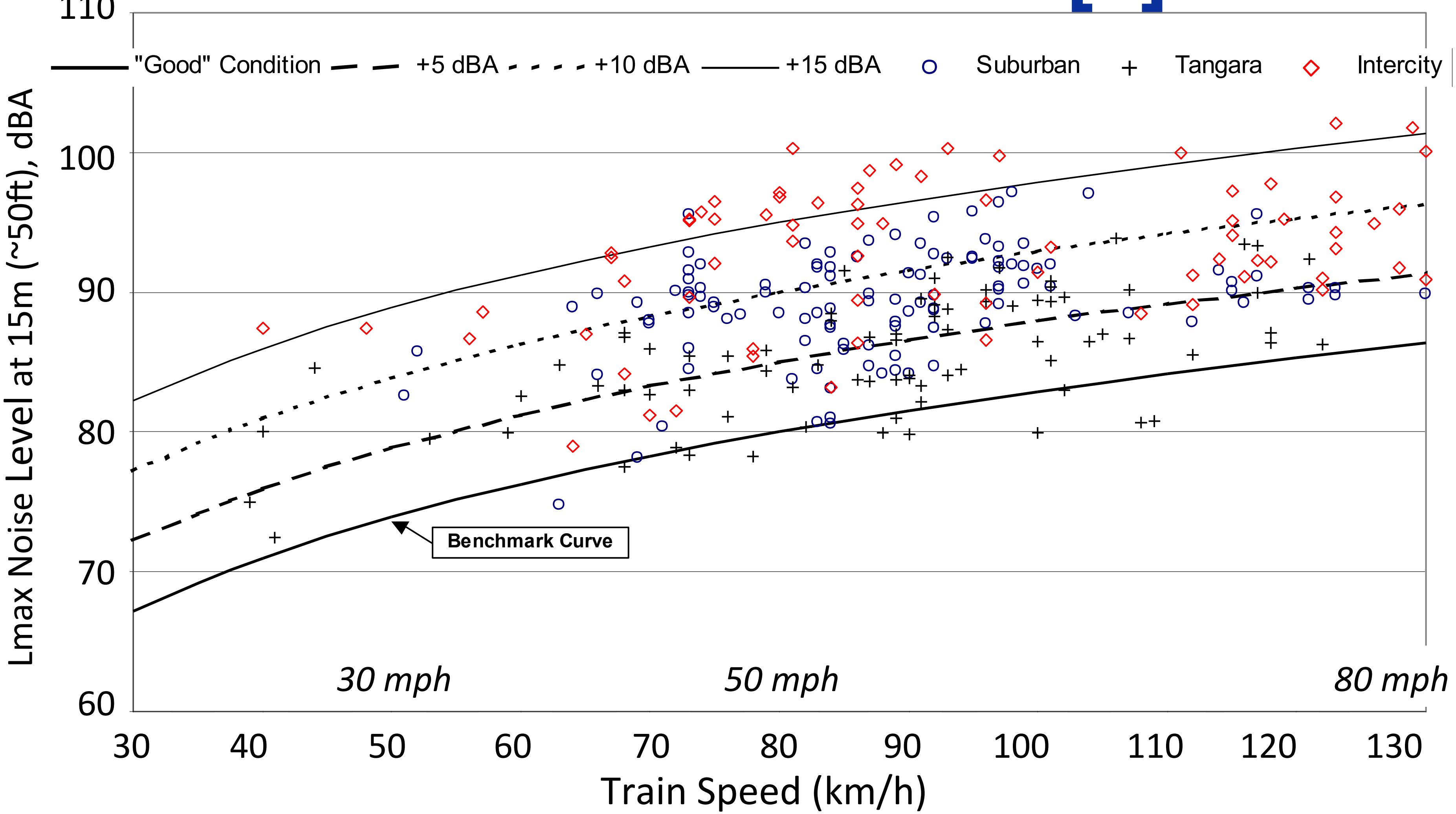
Systems Approach

- Addressing the noise source system
  - Can be far more cost effective
  - Opens up more treatment options
- Success relies on understanding the system
  - Each situation (and system) is different
  - What works in one case may not in another
  - Trial and error approach => hit and miss results
  - Failures can be damaging

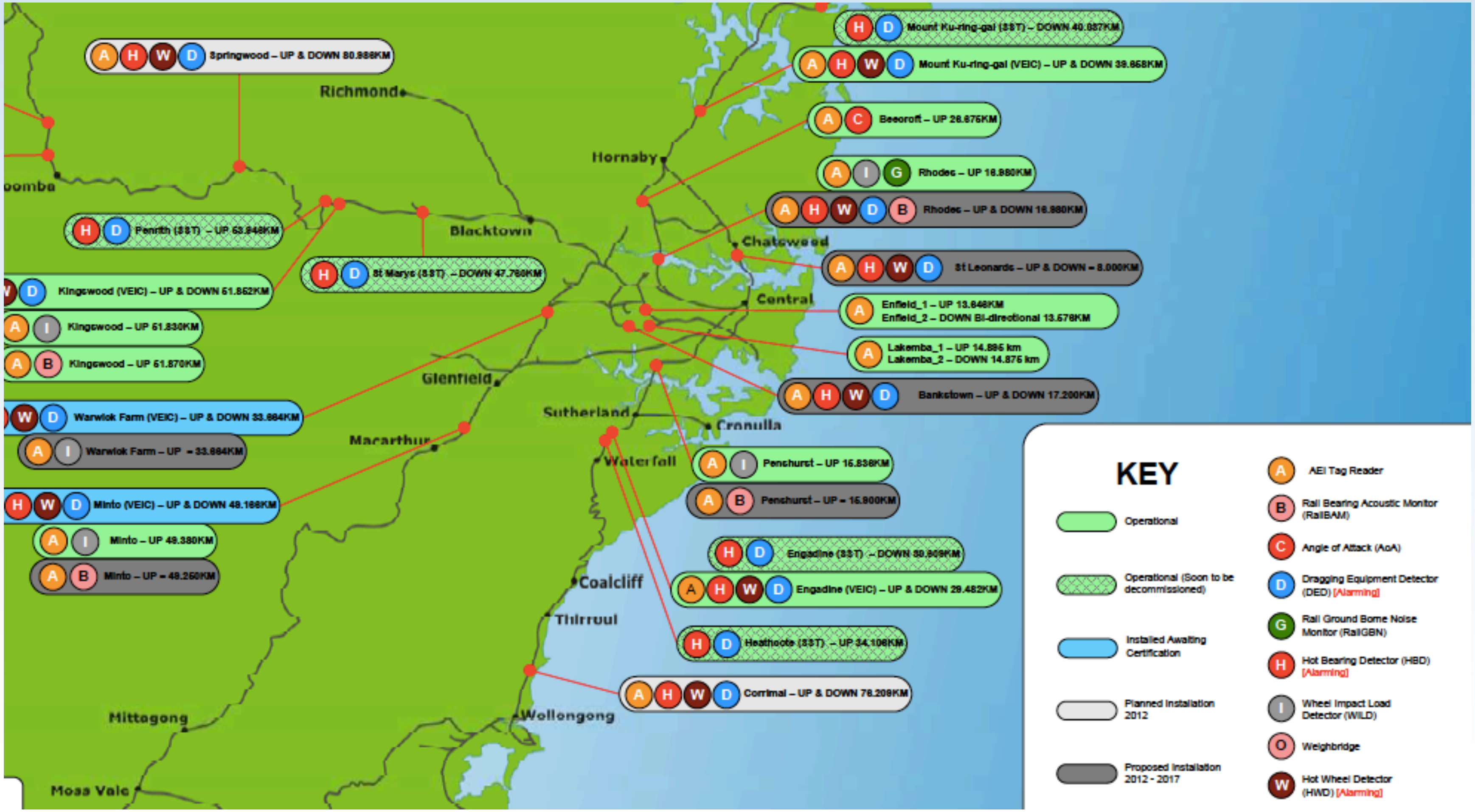
Case Studies

- Rolling noise
  - Wheel and rail defects
  - Wheel and rail surface “micro-roughness”
  - Track system and rail damping
- Curve noise
  - Wheel rail interface friction
  - On-train and wayside detection
  - Track system and wheel / rail profile

Wheel tread defects [3]



Wayside monitoring network [4]



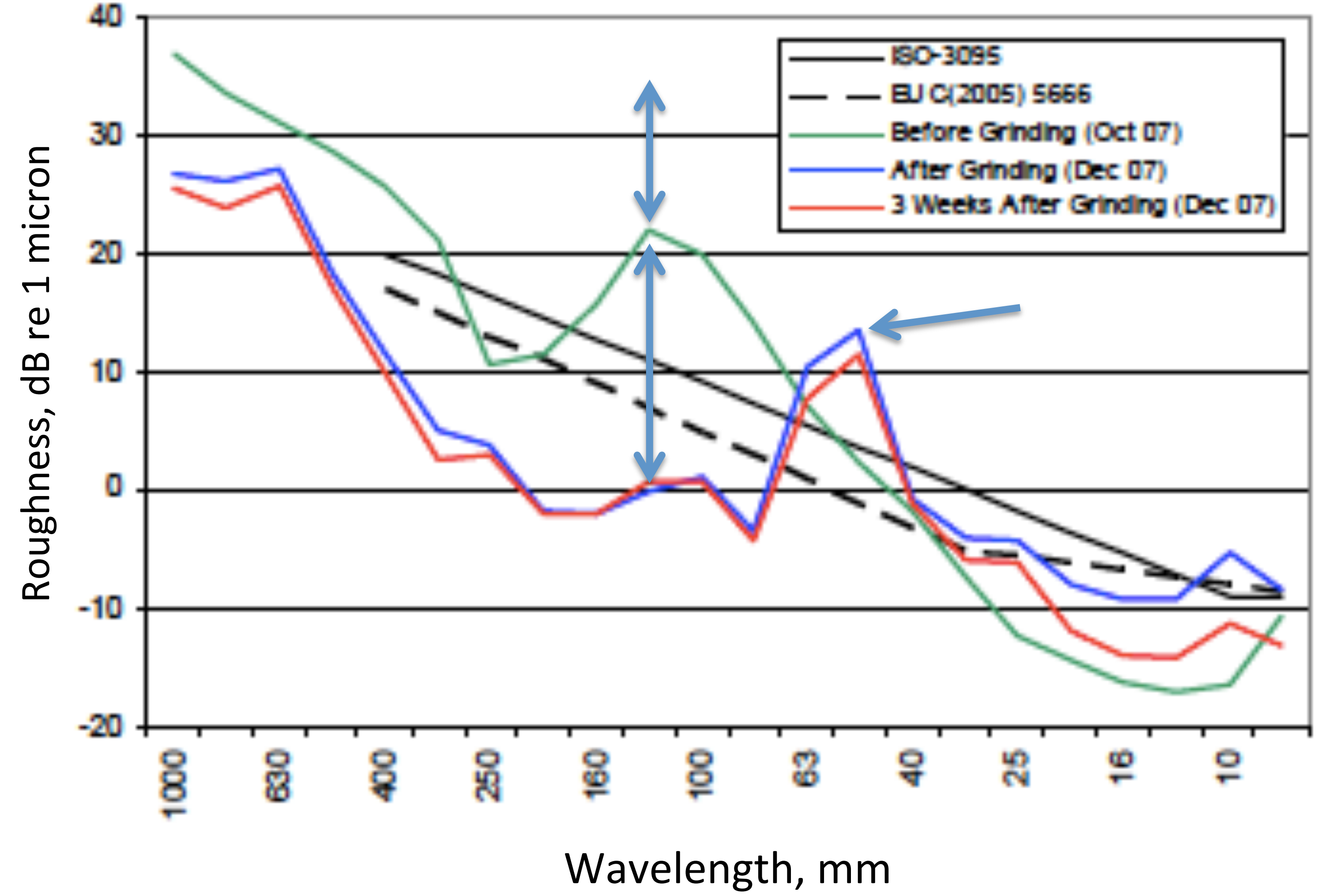
Rail surface defects: Squats

- >20dBA increase in rolling noise
- Aggressive grinding gave temporary improvement:
  - Approx 10dBA
  - Degraded approx 1dBA per week

Rail surface defects: corrugation

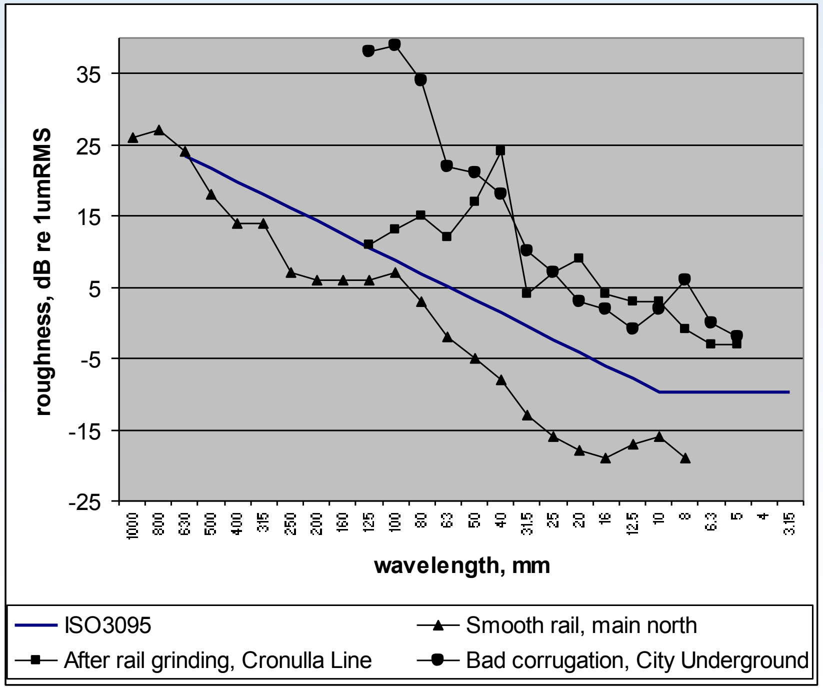
- Growth rate approx 3dB/month
- Friction modifier trialed
- Similar system fitted with resilient fasteners [5]

Rail surface defects: corrugation



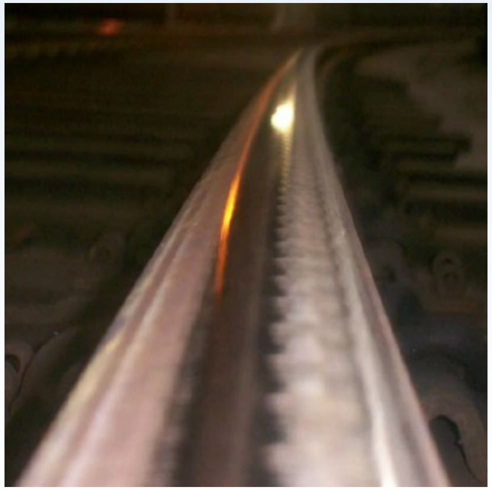
Wheel and rail roughness

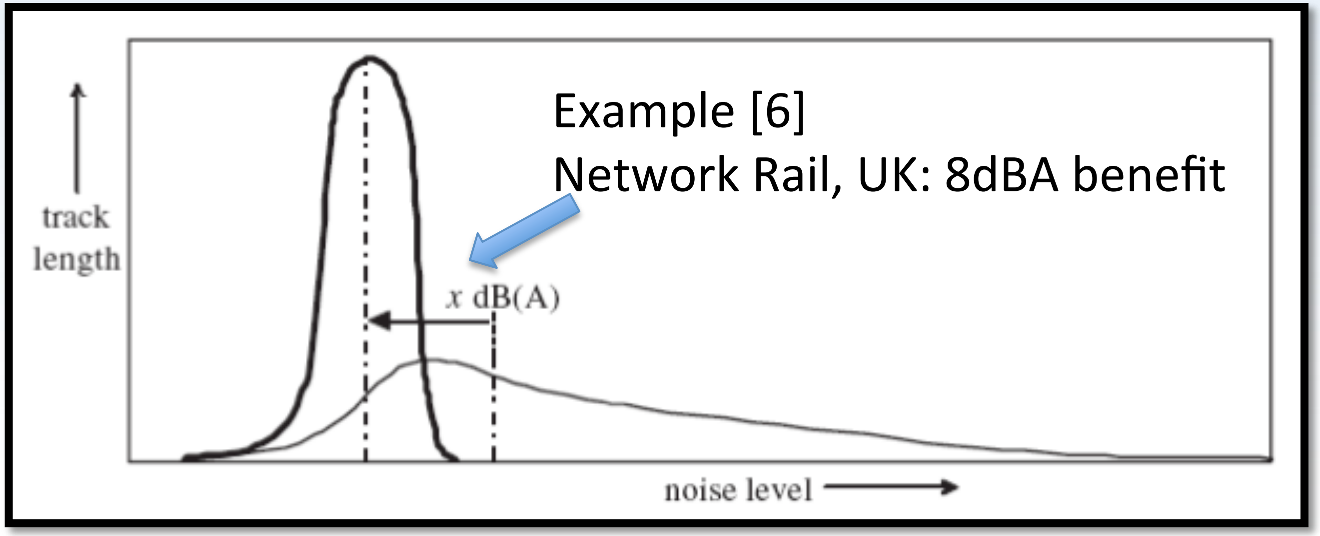
- If wheels free of defects, rail roughness generally dominates rolling noise



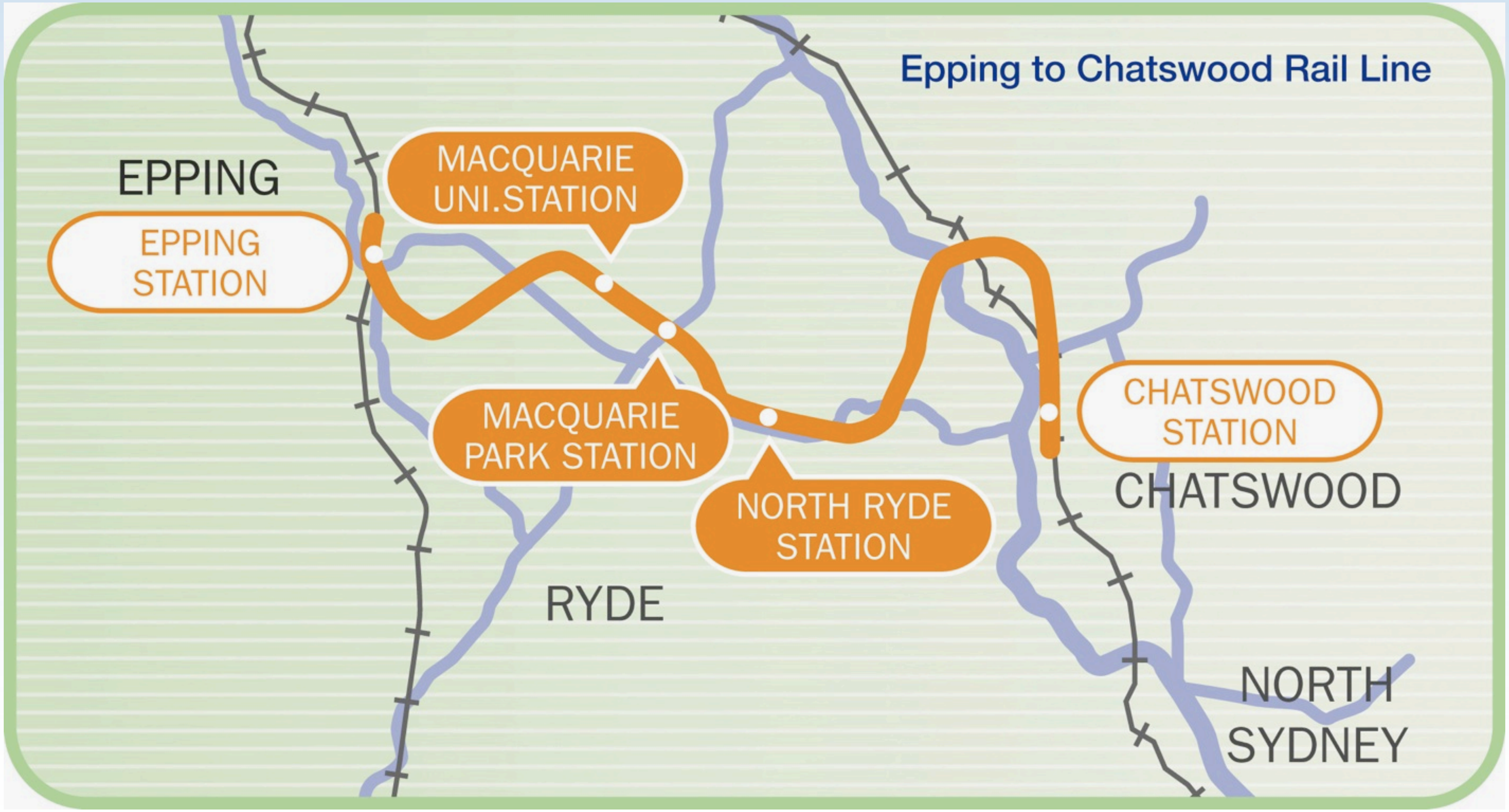
Rail roughness

- Network-wide noise benefits can be significant
- But grinding can also cause rail surface undulation, which increases noise [7]

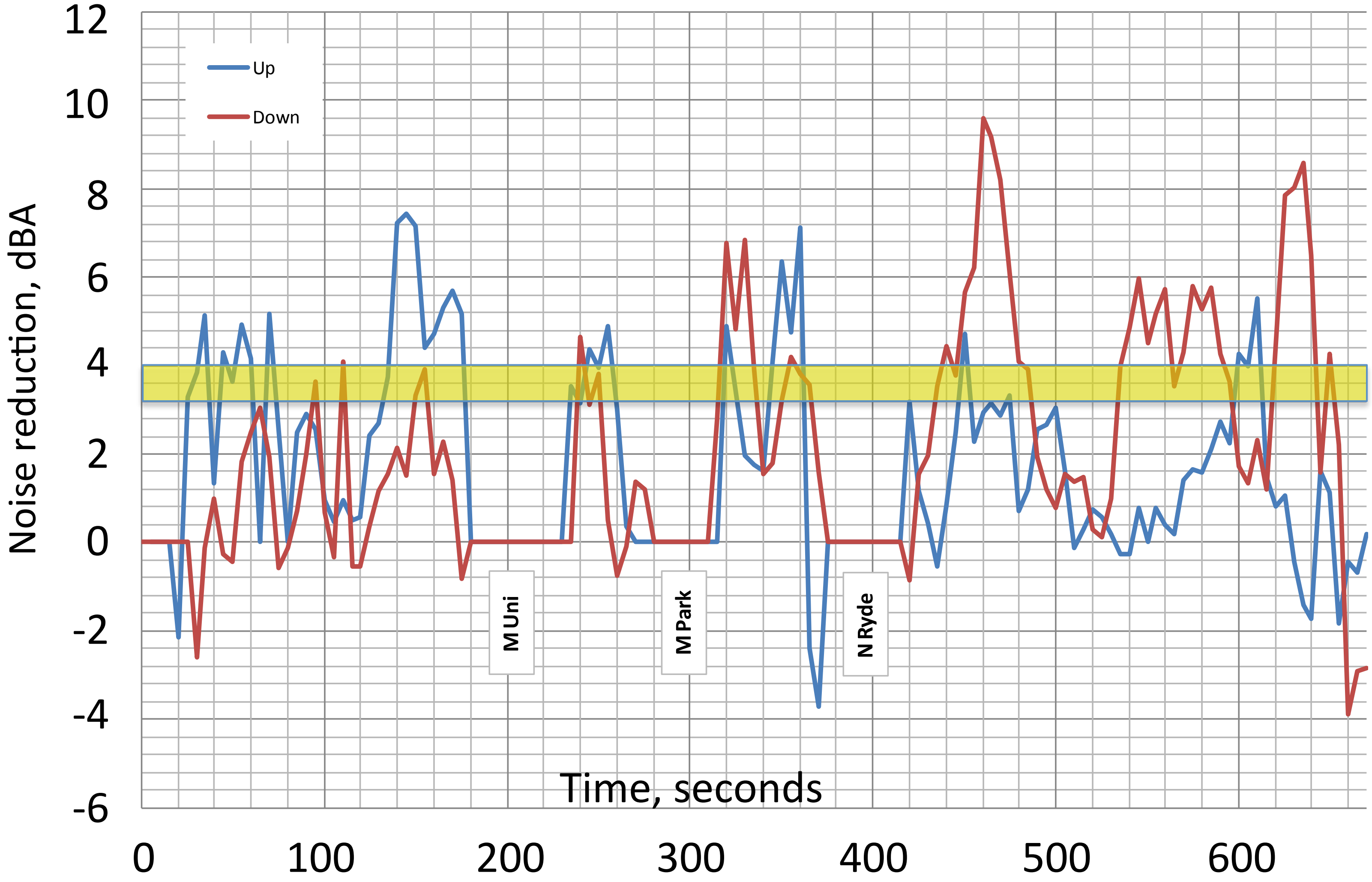




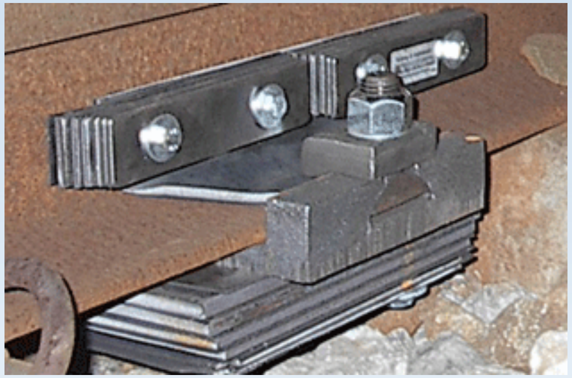
Epping Chatswood Rail Line [8]



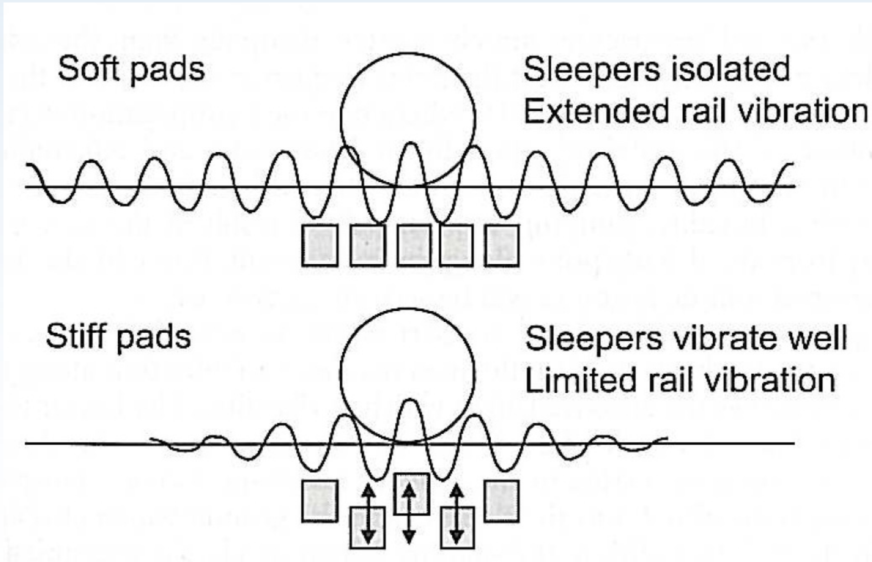
Rail grinding



Rail damping

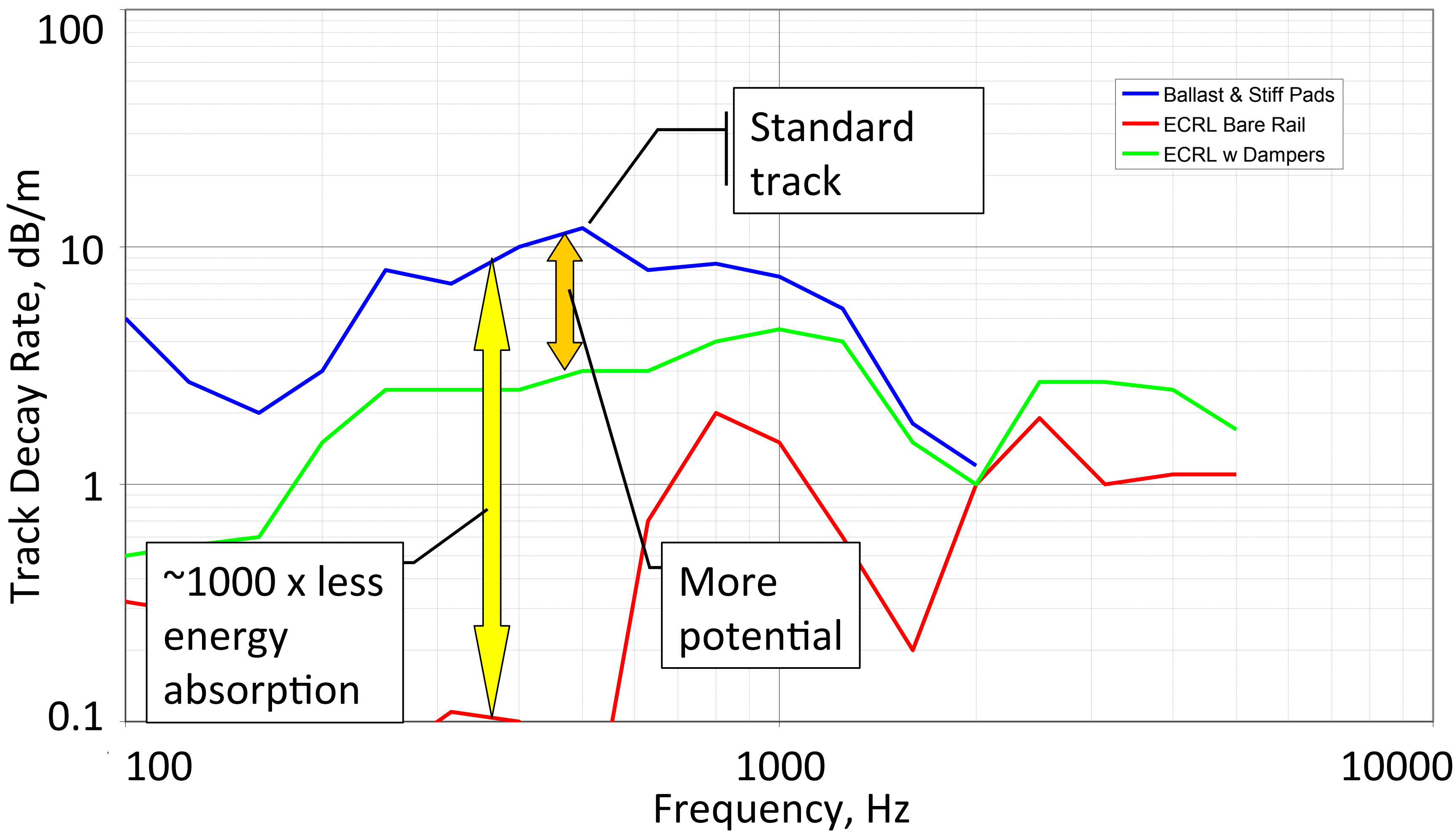


- Rail fastener stiffness plays a role



- Case studies

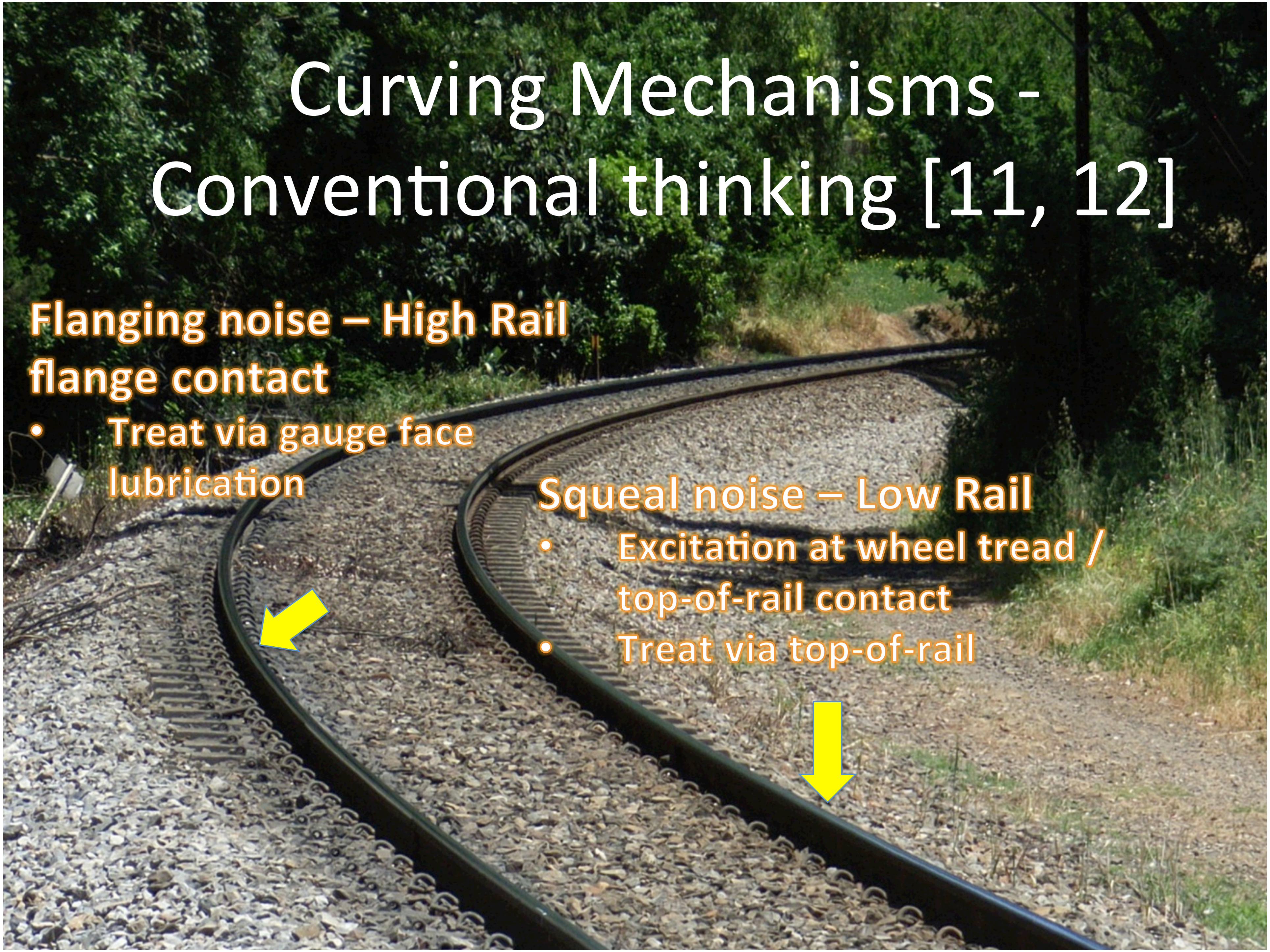
Epping Chatswood Rail Line: Rail damping



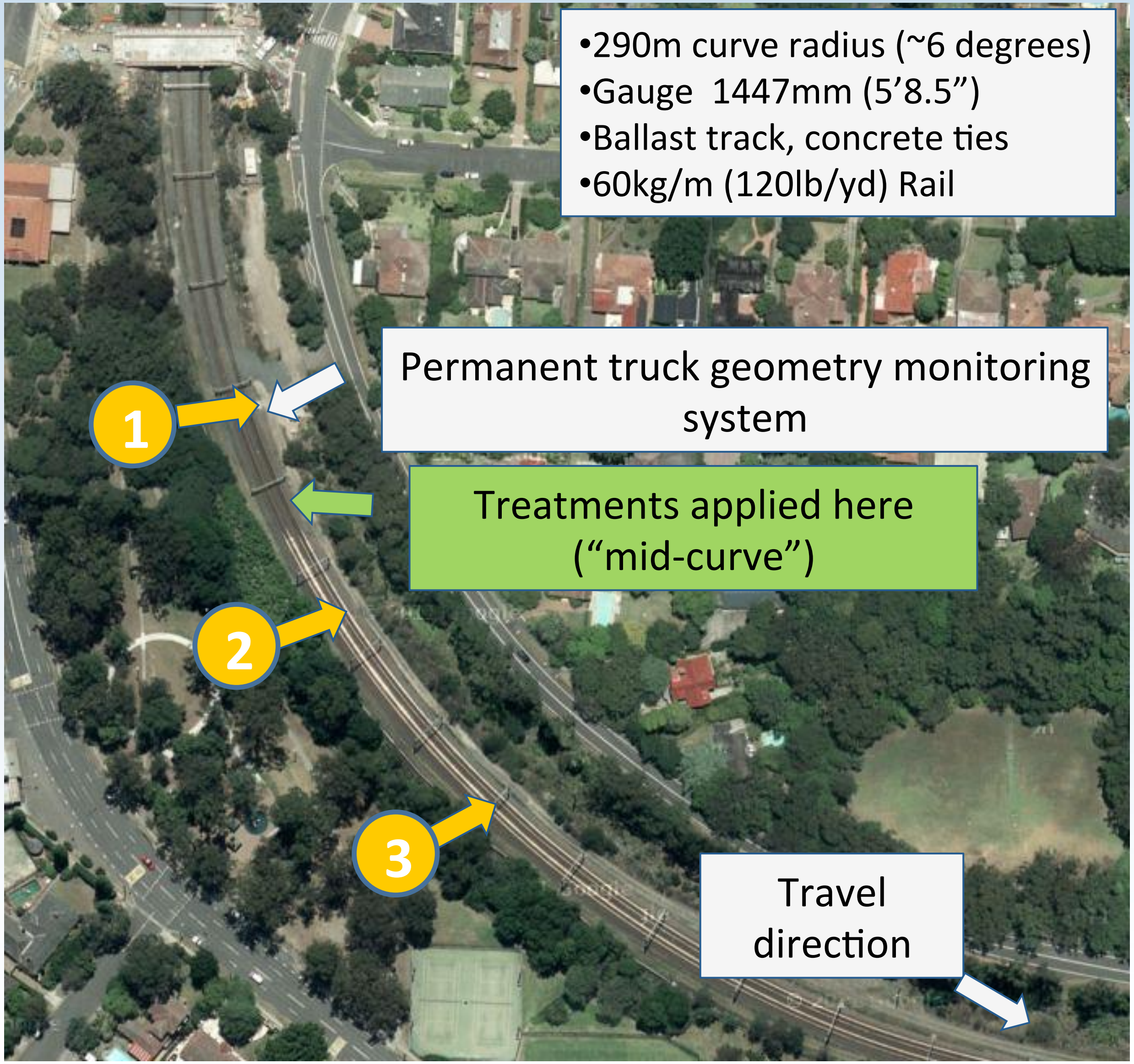
Rail damper installation

Curve noise

- Complaints in late 1980's and early 1990's
- Initial investigations inconclusive
- Detailed investigations:
  - Kalousek et al, NSW [9]
  - Powell et al, Queensland [10]


Curving Mechanisms - Conventional thinking [11, 12]
Flanging noise – High Rail flange contact
• Treat via gauge face lubrication
Squeal noise – Low Rail
• Excitation at wheel tread / top-of-rail contact
• Treat via top-of-rail

Detailed track tests

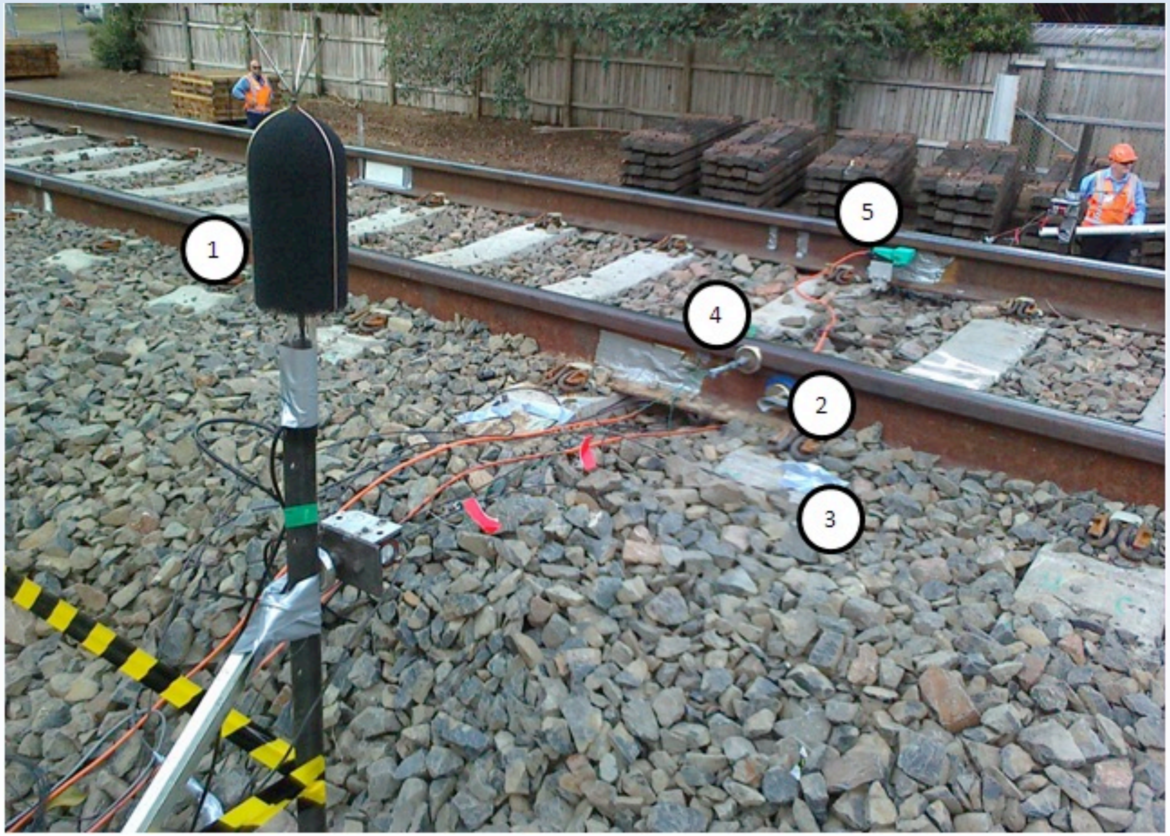


Findings

- Identified other wheel / rail mechanisms [13]
- Highlighted different track responses [14]
- (Also led to insights into freight cars and trucks – heavy haul presentation deals with this)

Track System Dynamics

- Dynamic testing carried out before and after track upgrade



Summary

- Rolling noise
  - Wheel and rail defects
  - Wheel and rail surface “micro-roughness”
  - Track system and rail damping
- Curve noise
  - Wheel rail interface friction
  - Track system
  - Rail profile
  - (Rolling stock performance)

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