



MINING NOISE ENGINEERING CONTROL PRACTICE

Ben van Zyl, Acoustical Engineer, Acusolv

13 June 2025 Emperors Palace

Noise Control Domains

Workplace

HEARING
SAFETY

Occupational Health & Safety ACT

- o Aim: Conserve Hearing Safety
- o Control noise in the workplace
- o Noise not to exceed 85 dBA
- o Reduce if more than 85 dBA
- o Wear hearing protection
- o Audiometric testing

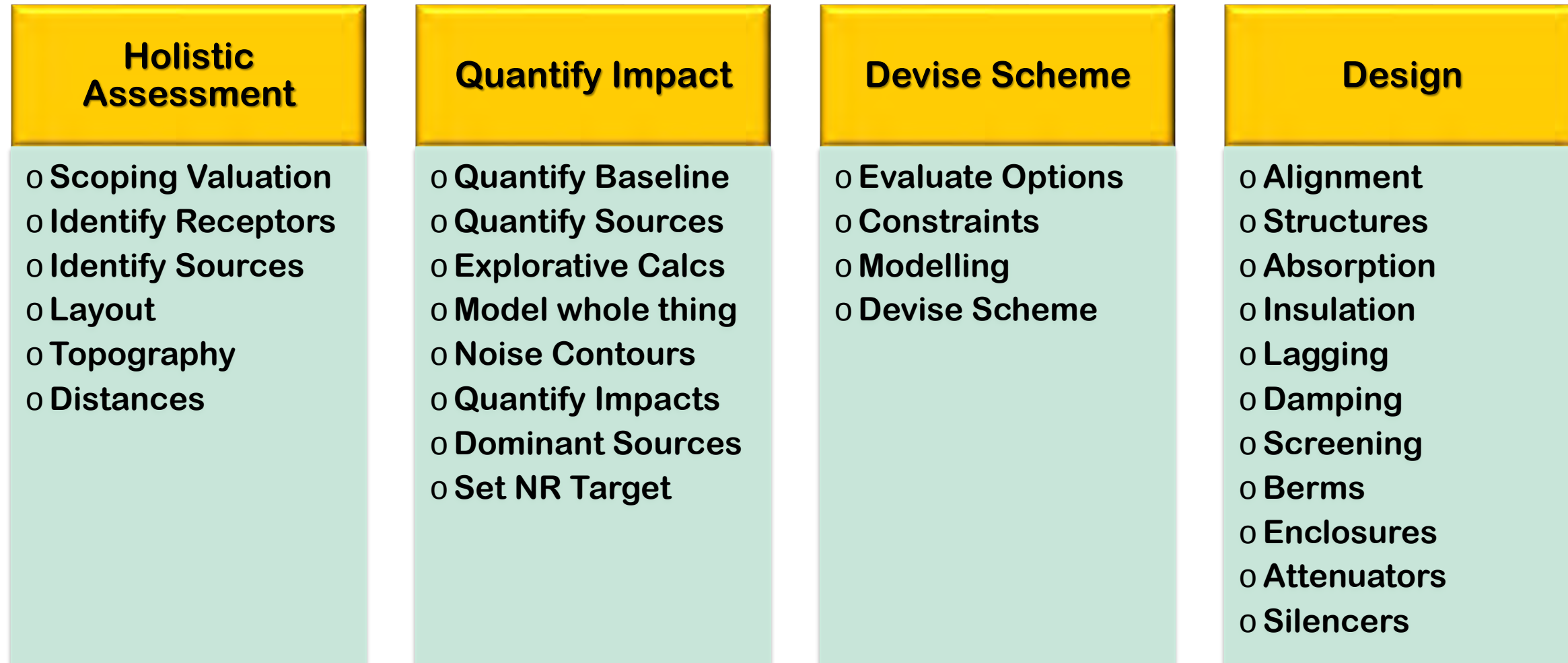
Environmental

QUALITY
OF
LIFE

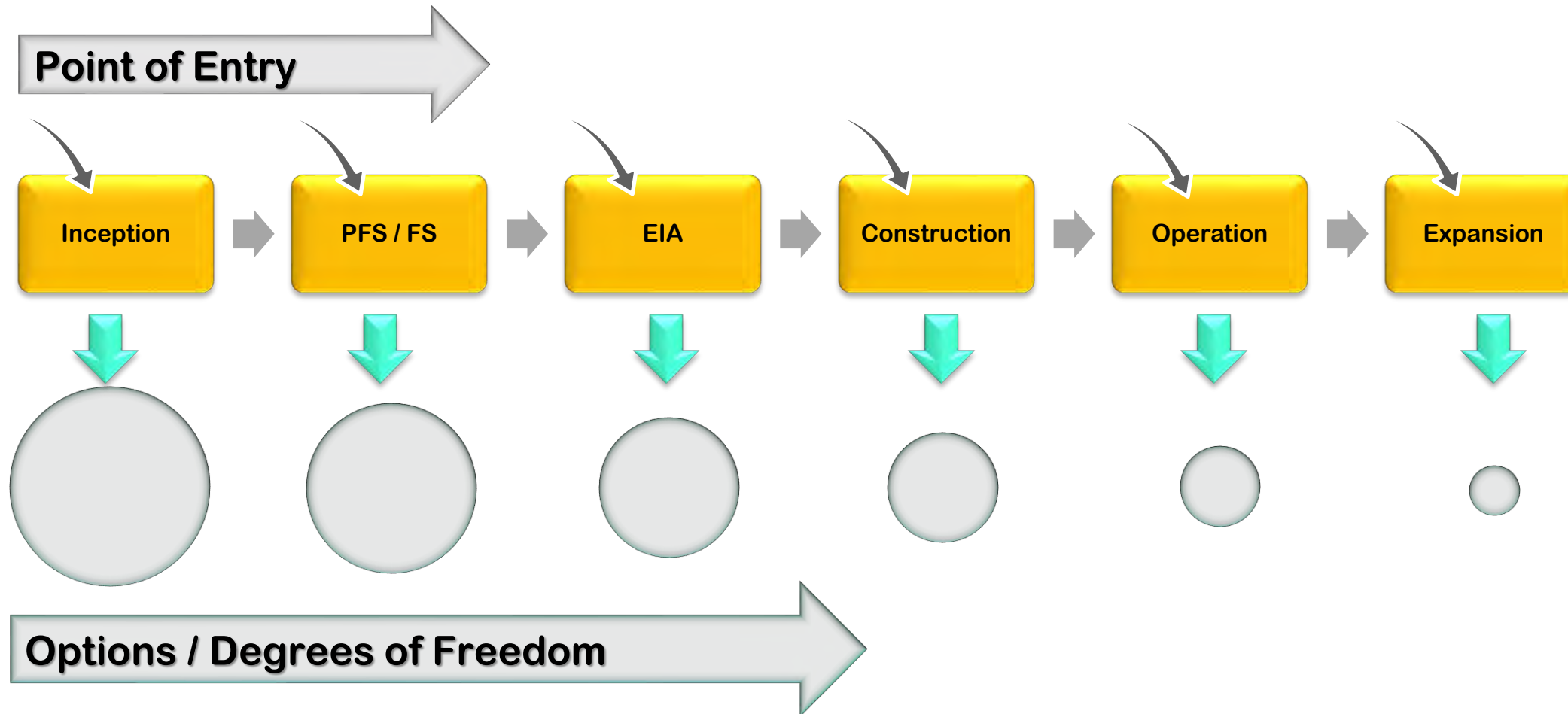
Environment Conservation ACT

- o Aim: Conserve quality of life
- o Living and work comfort
- o EIA Noise study required for new developments, expansions or changes which may affect people in external environment

Development of Noise Control Solutions



Noise Control Options



Measures & Materials

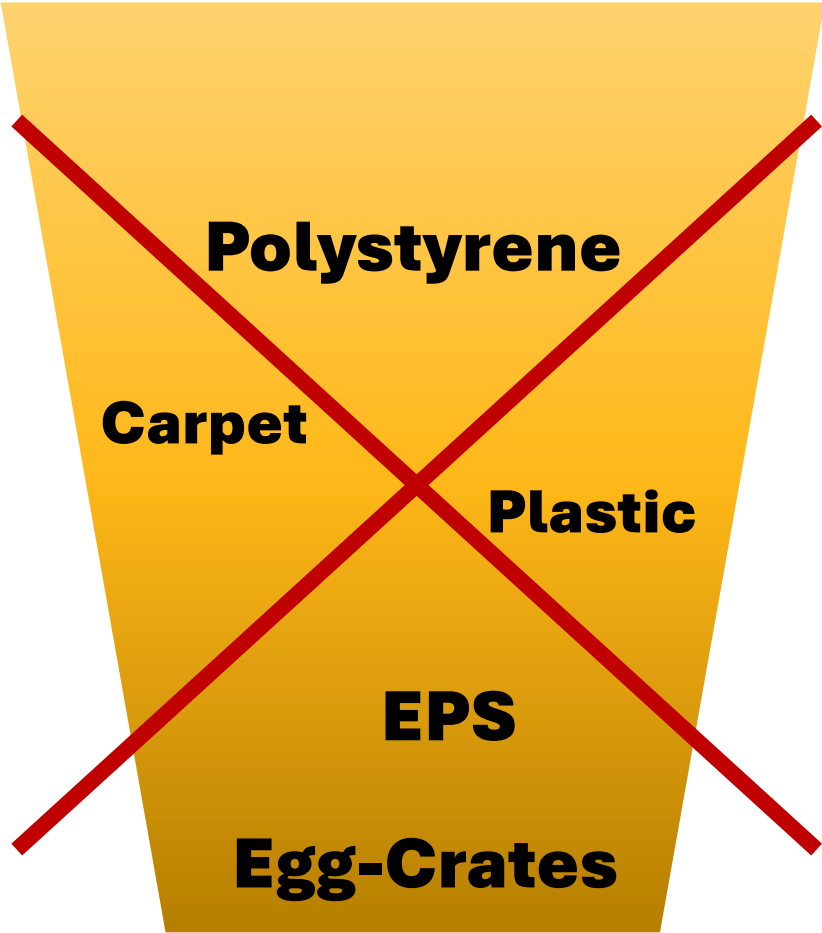
Tools



Materials



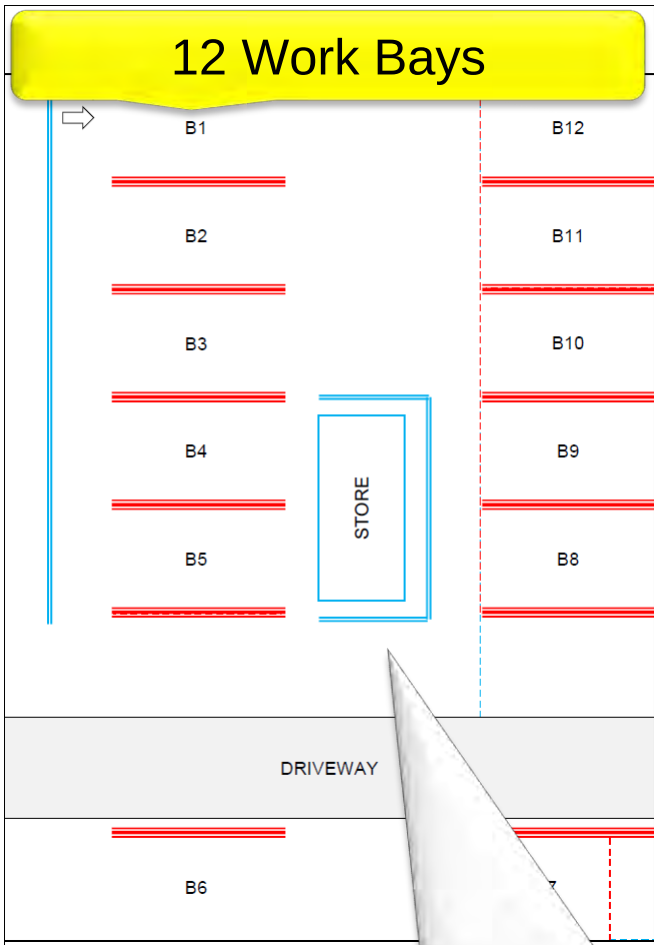
Bin



Metal Workshop

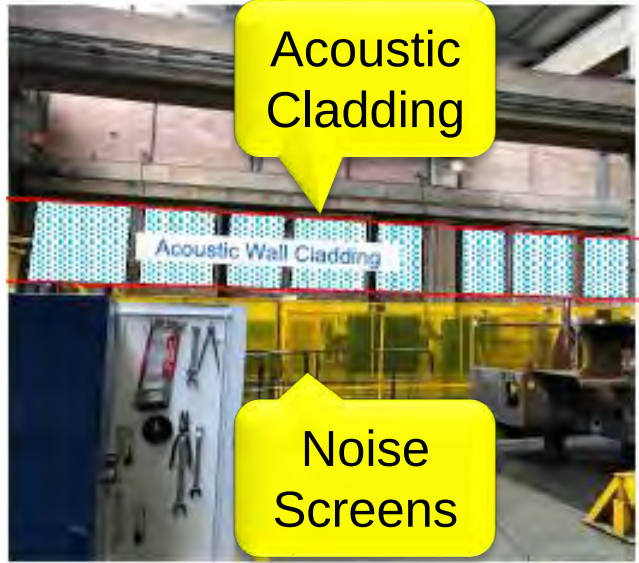
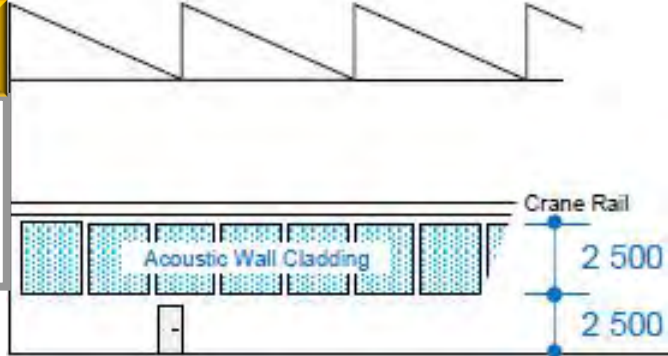
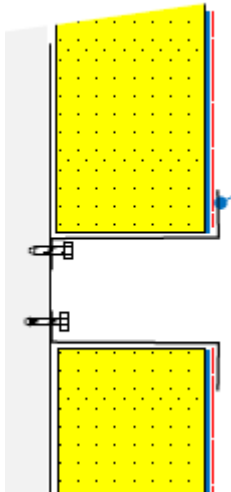
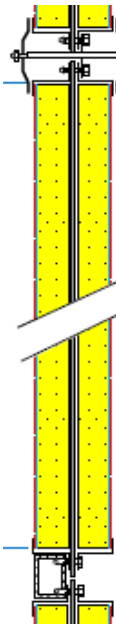
Aim: $L_{Aeq-8h} < 85$ dBA

Workplace



Intermittent Impulsive Noise
85 - 90 dBA

- ### Design Measures
- o Noise Screens – LP-Direct
 - o Acoustic Cladding – LP-Reverb



Mine Expansion Project

Enviro

Existing Operations

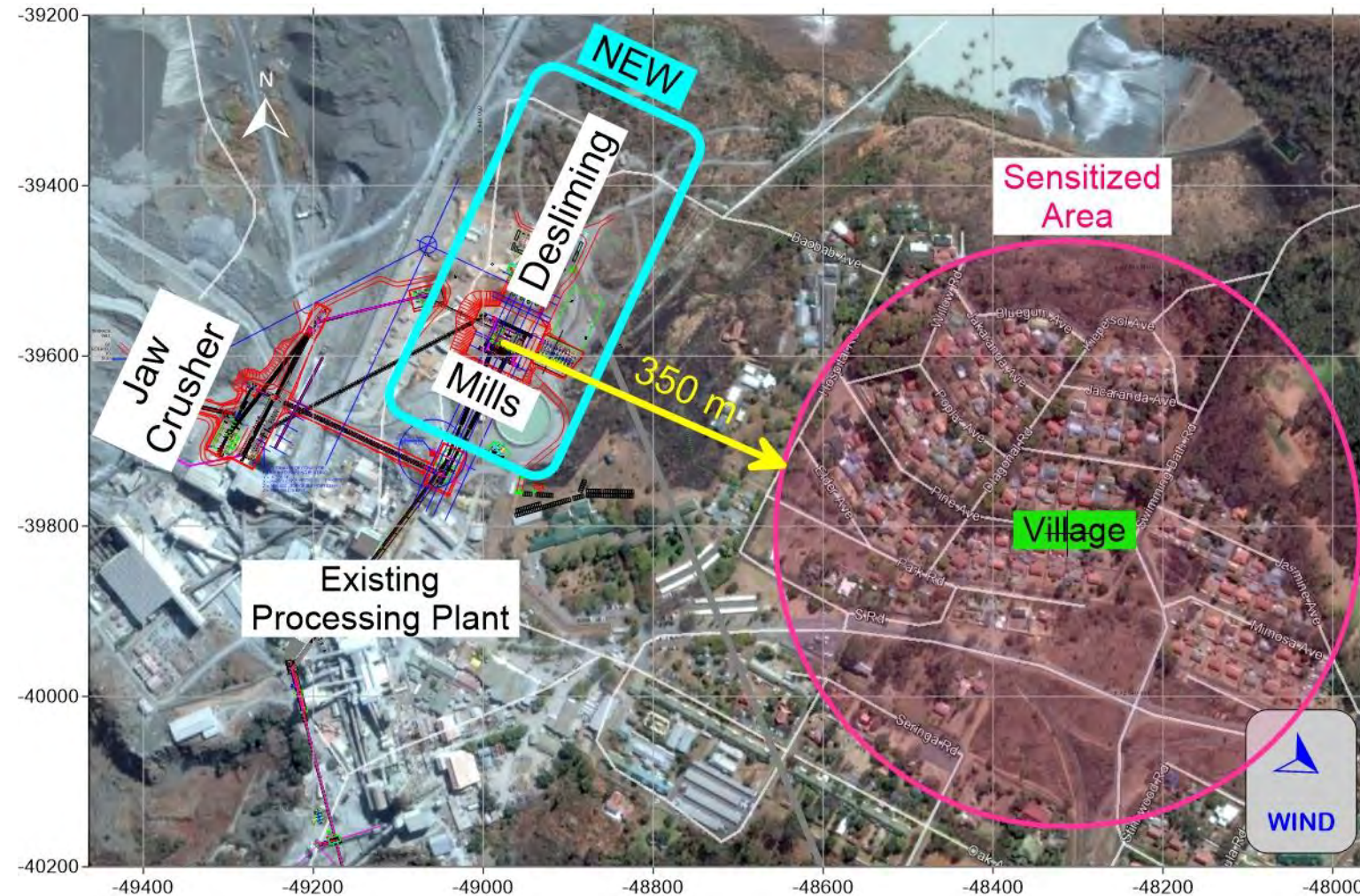
- o Processing Plant
- o Mills & Screens
- o Crusher

Expansion Project

- o New Mills
- o Desliming Plant
- o Vibrating Screens

Village Sensitized

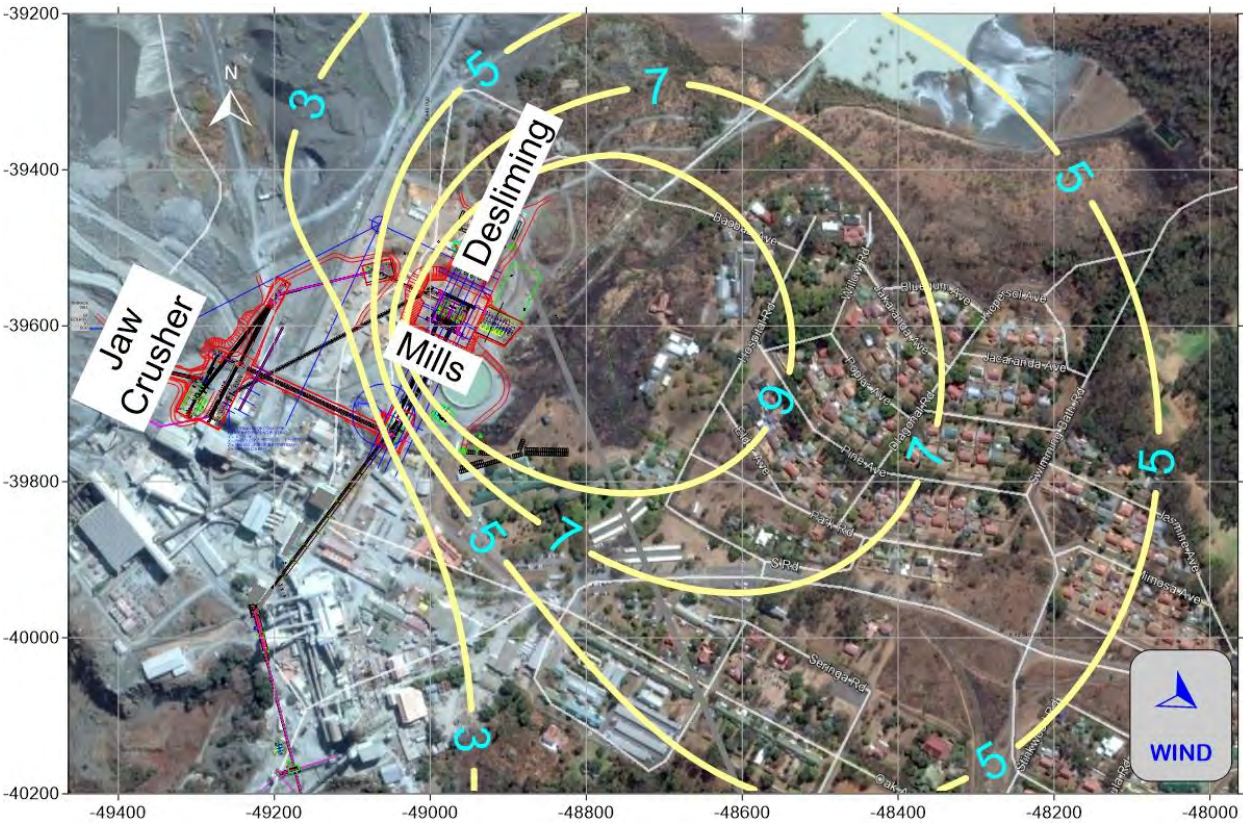
Sensitivity Map



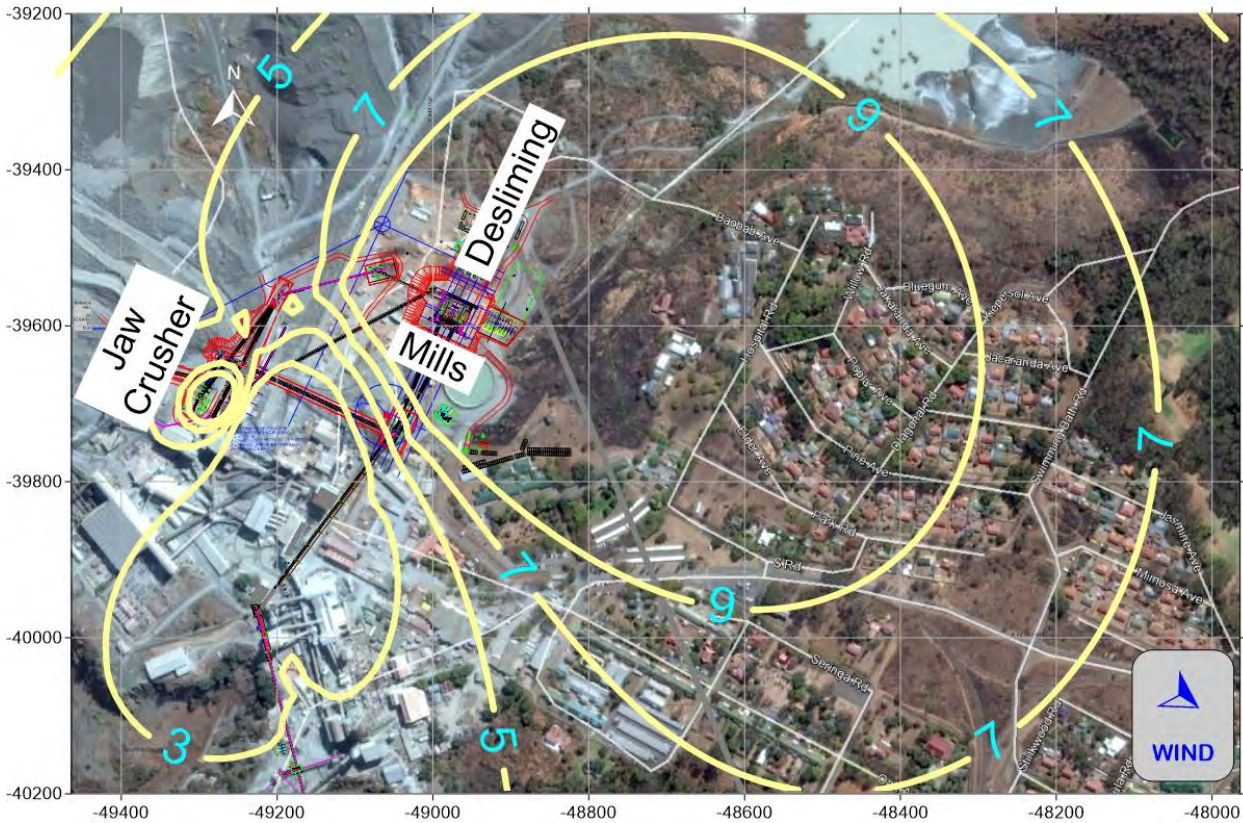
Noise Impact Modelled - Unmitigated



New Plant Solo



New + Existing Operations



Ambient Level = 45 dBA at Night

Mill and Desliming Plant

Enviro

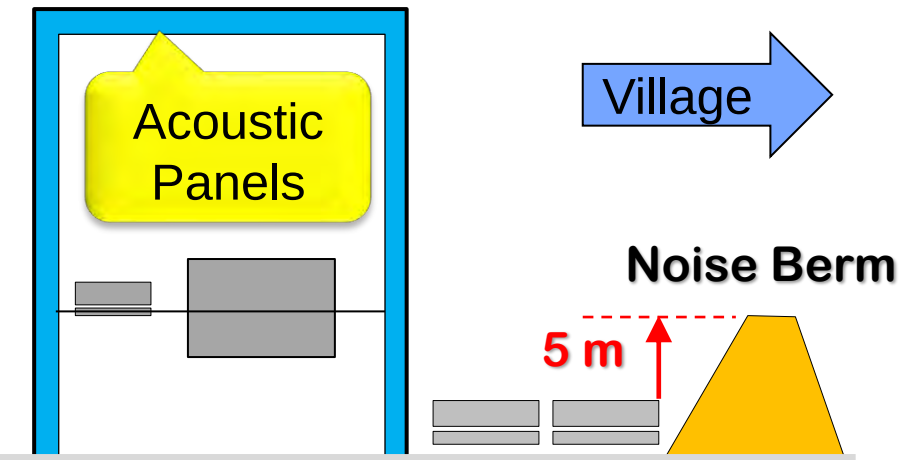
Noise Control Scheme



Design Measures

- Mills: Plant Enclosure
- Deslime Screens: Noise Berm

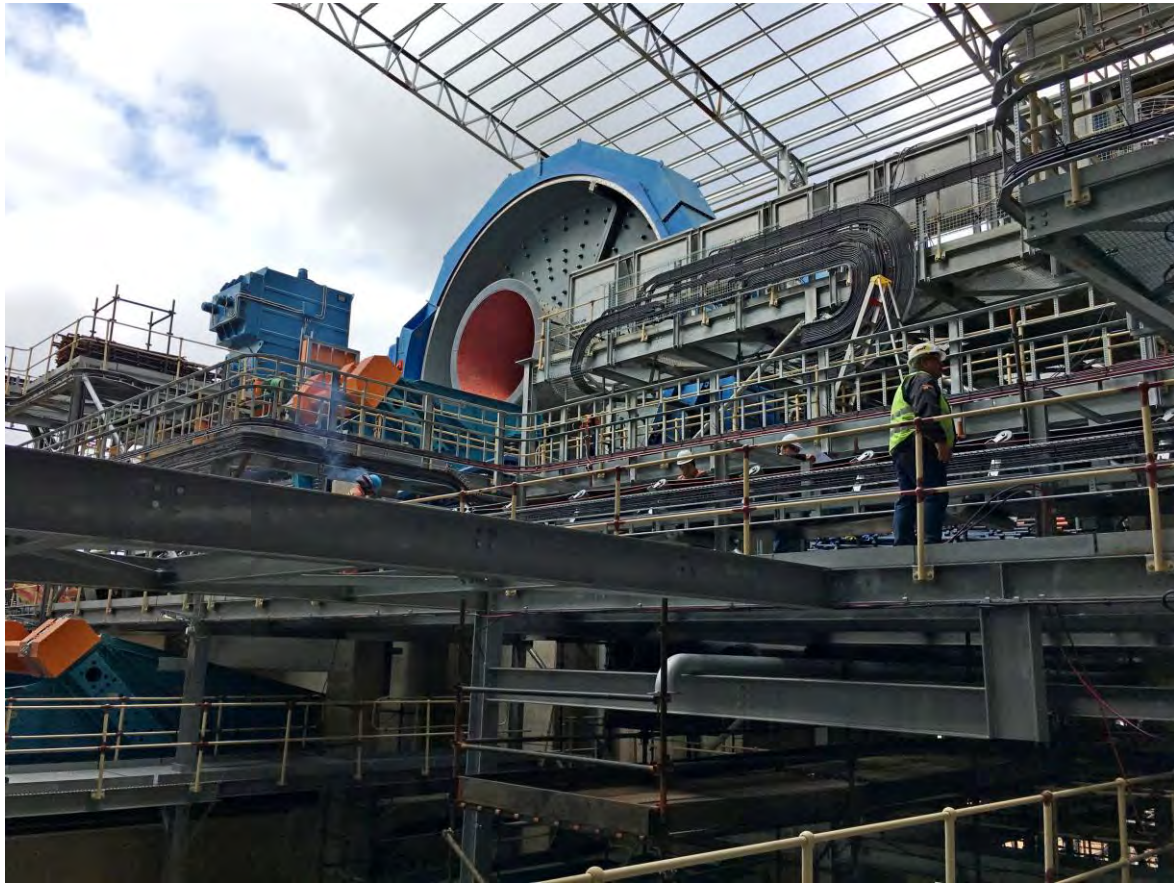
Mills
Screens
Enclosed



Implementation of Control Scheme

Enviro

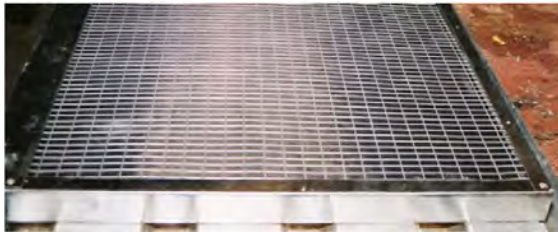
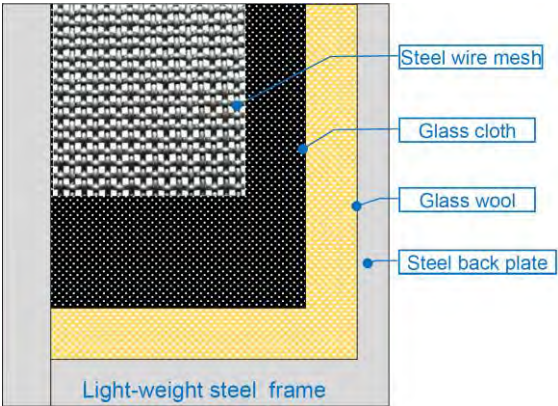
Enclosure Construction - Commencement



Implementation of Control Scheme

Enviro

Milling & Screening Plant Enclosure



Implementation of Control Scheme

Enviro

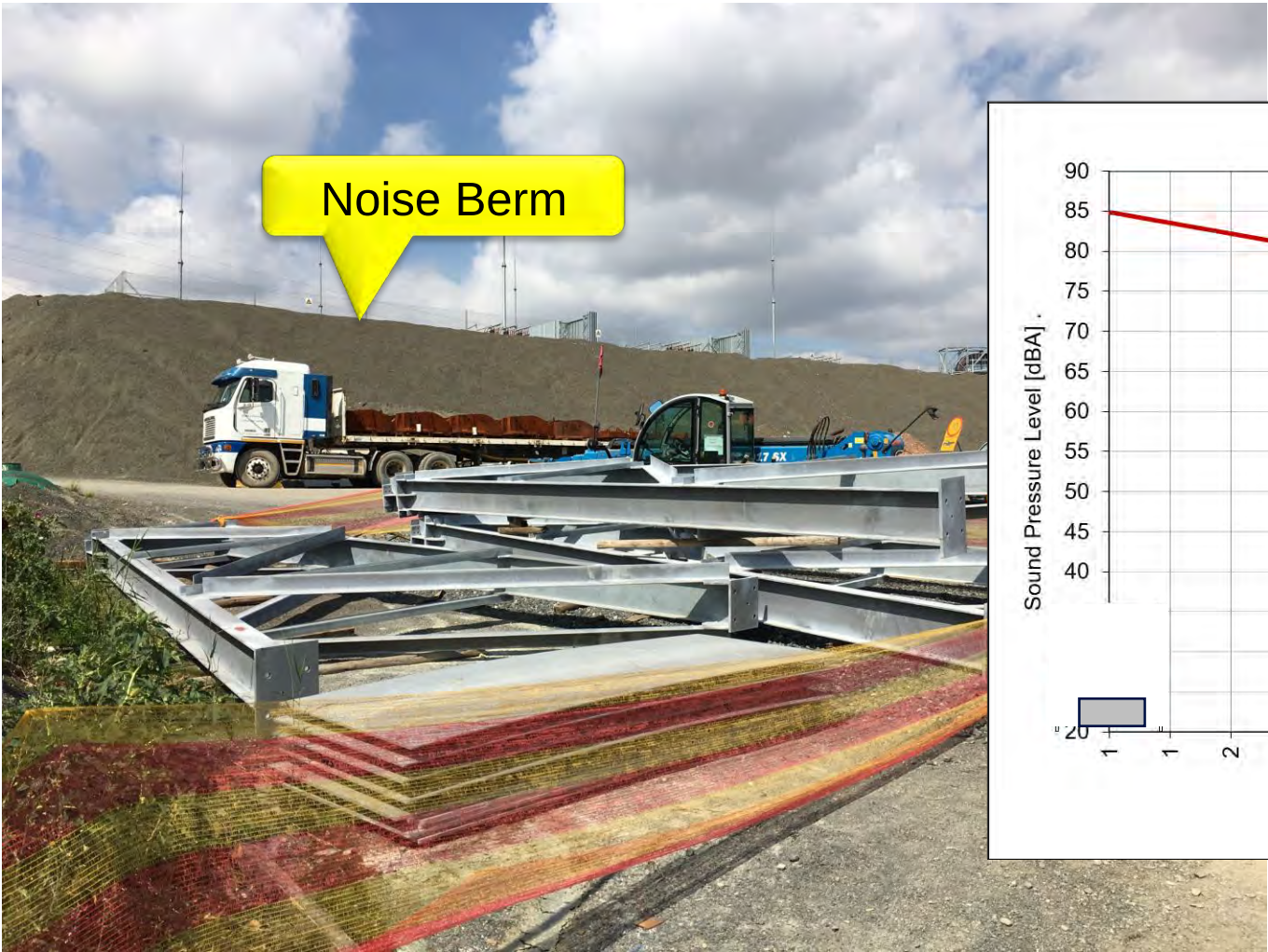
Milling & Screening Plant Enclosure



Implementation of Control Scheme

Enviro

Desliming Plant – Noise Berm



New LHD - NR Design

Aim: Cab Noise < 80 dBA

Workplace

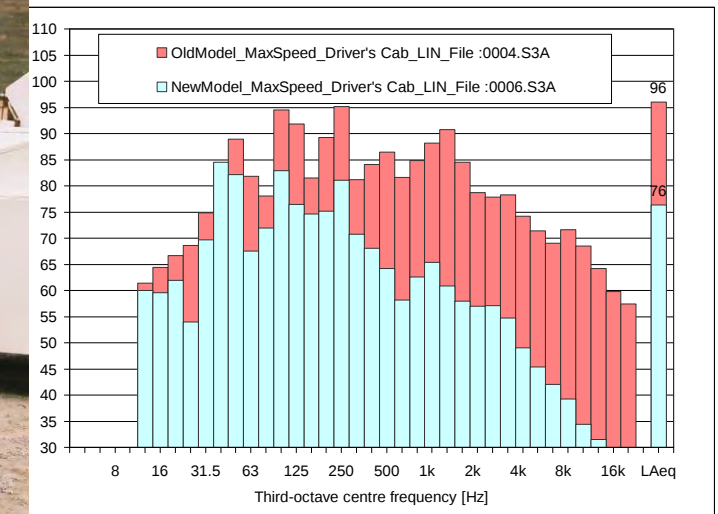
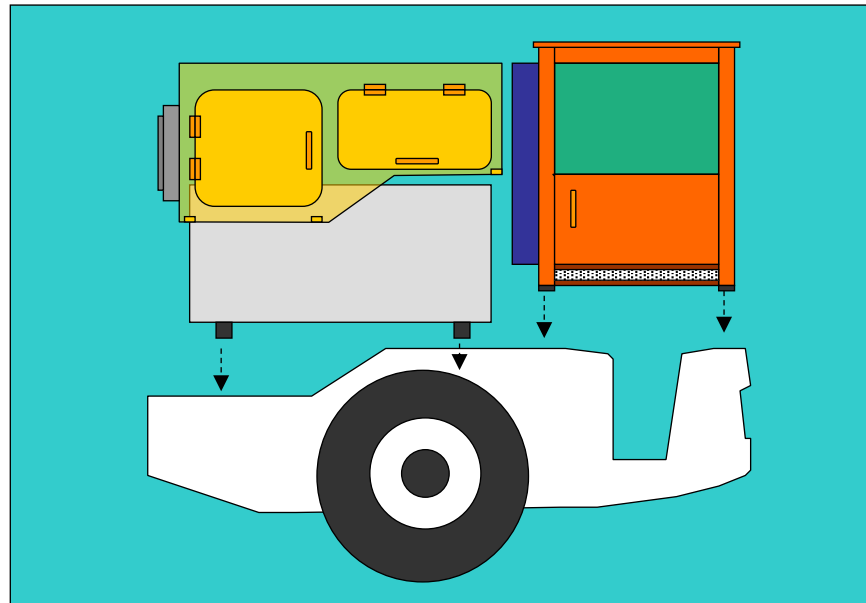
Stone Duster LHD

NR Scheme & Specifications

- o Vibration isolation drivetrain & cab
- o Soundproof engine & cab

Implementation

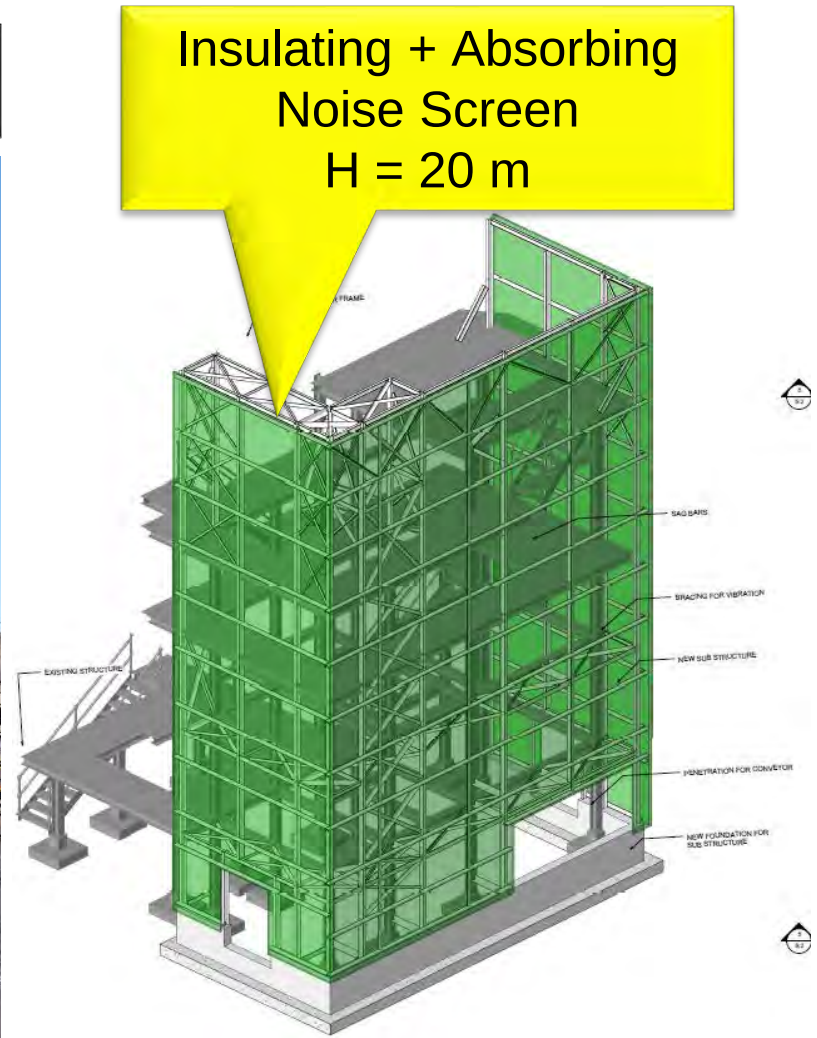
- o [Engine + Drivetrain + Cab] suspended on anti-vibration mounts
- o Only cab soundproofed



Crusher – Noise Screen

Enviro

Crusher noise reduction

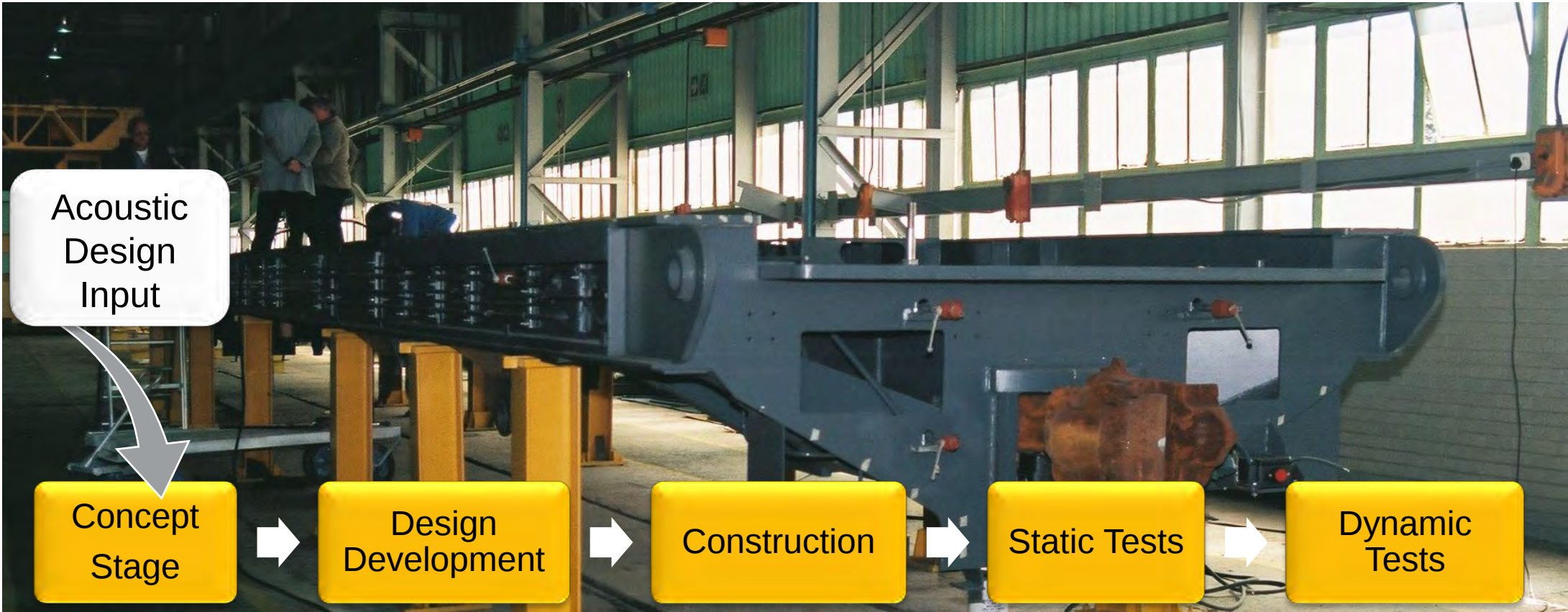


E15 Locomotive – New Design

Aim: LP inside Drivers Cab < 75 dBA

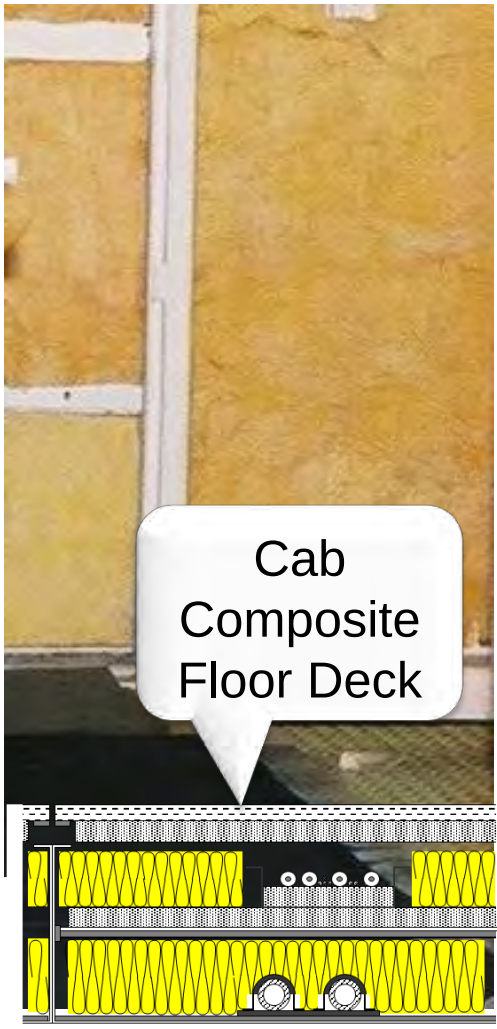
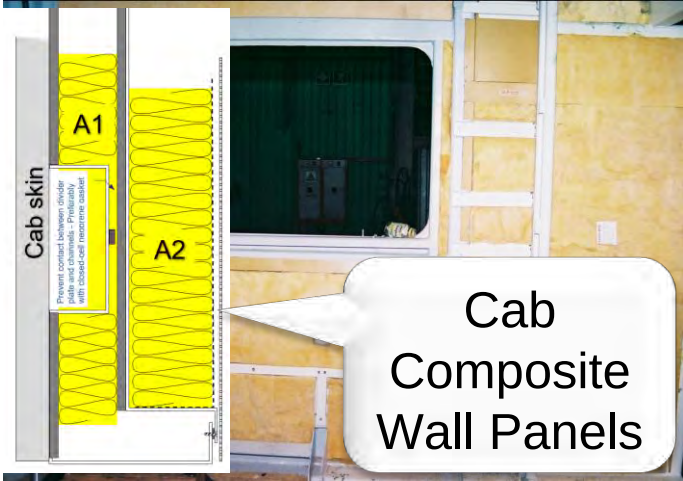
Workplace

Sishen – Saldanha Iron Ore



E15 Locomotive – New Design

Workplace

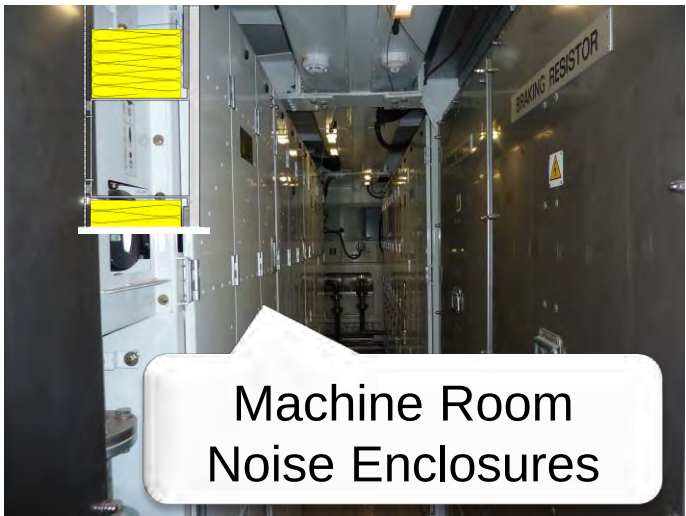


E15 Locomotive – New Design

Workplace



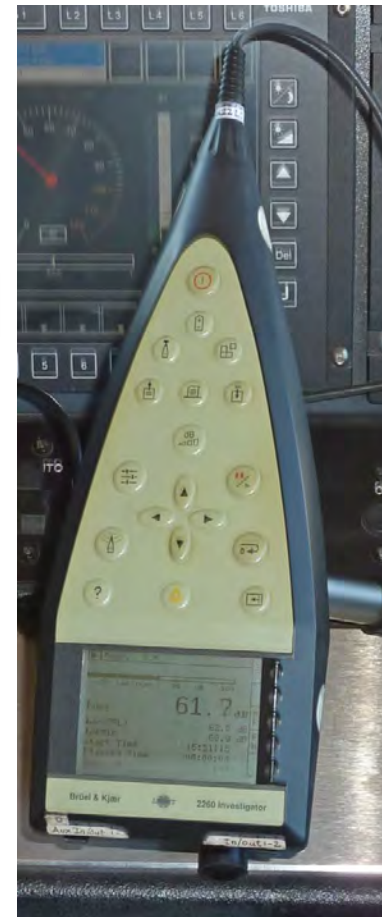
Sound Lock between
Cab & Machine Room



E15 Locomotive – Commissioning Tests

Workplace

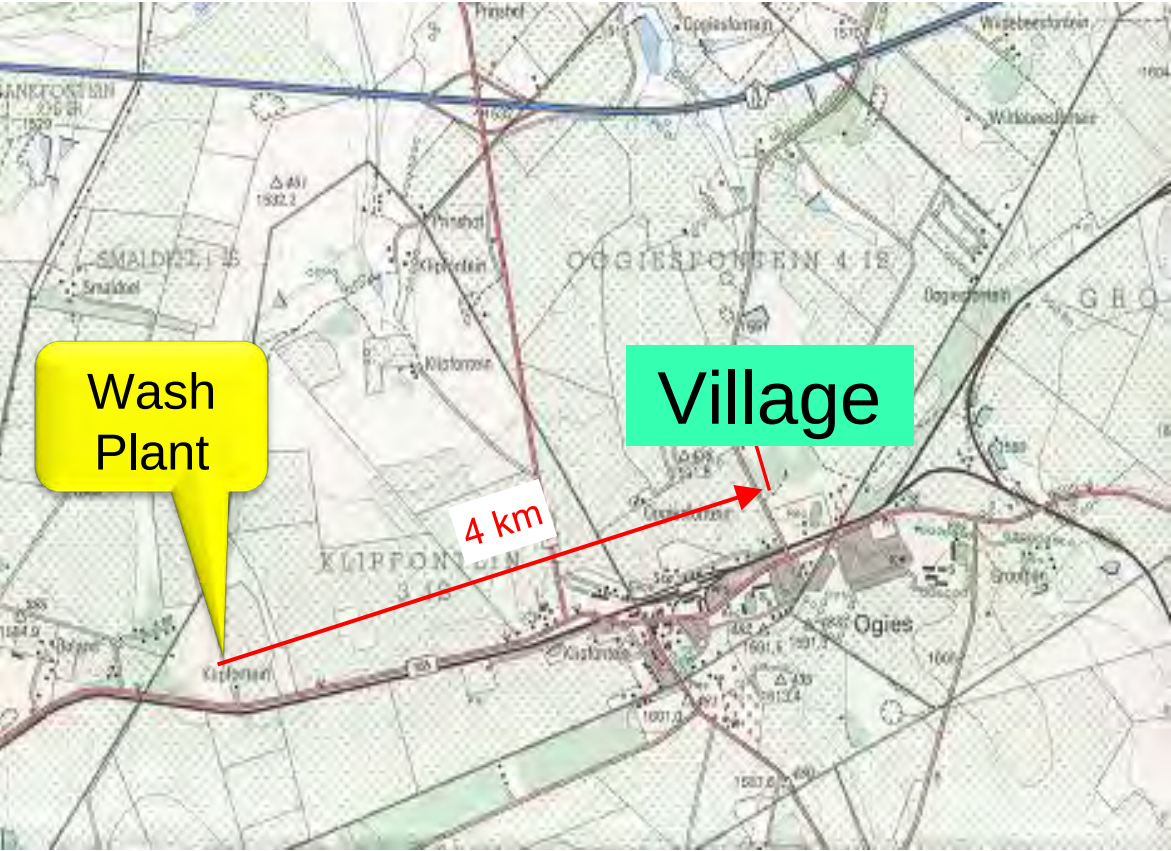
Sishen – Saldanha Iron Ore



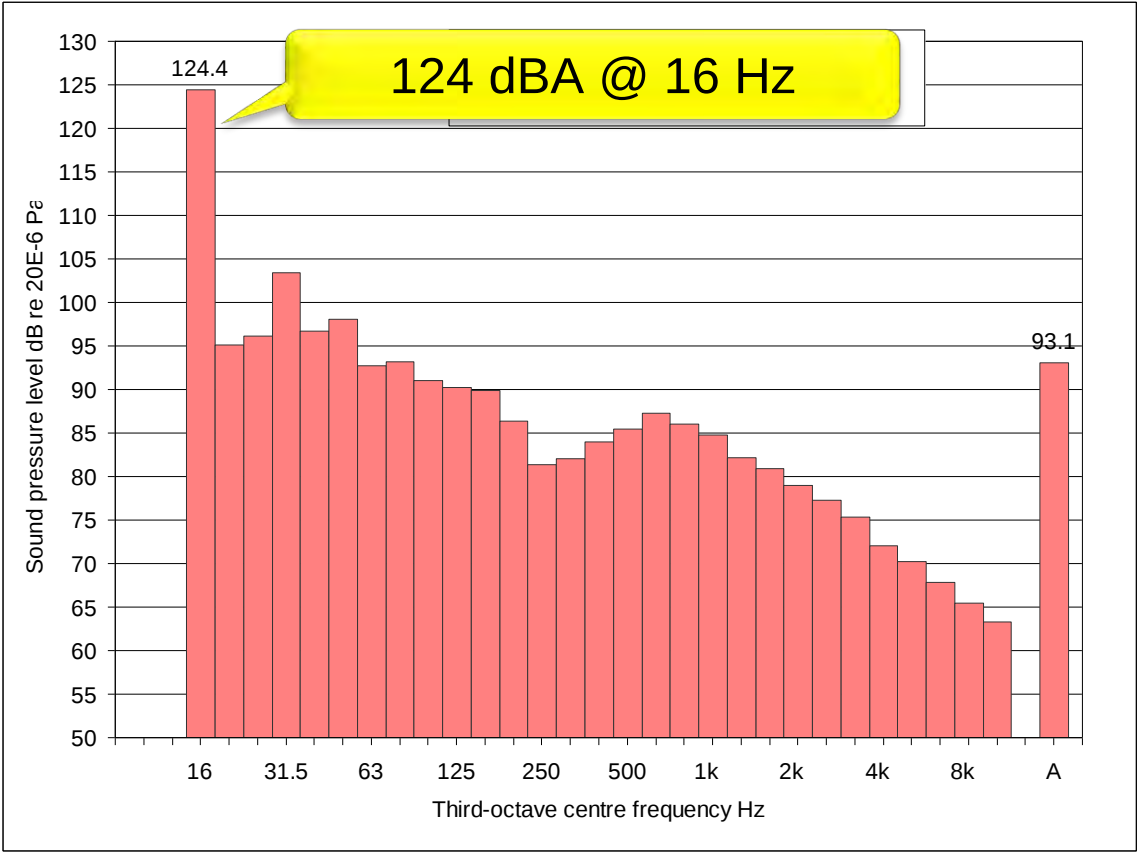
Wash Plant - Infra-Sound



Long Distance Infra-Sound Propagation



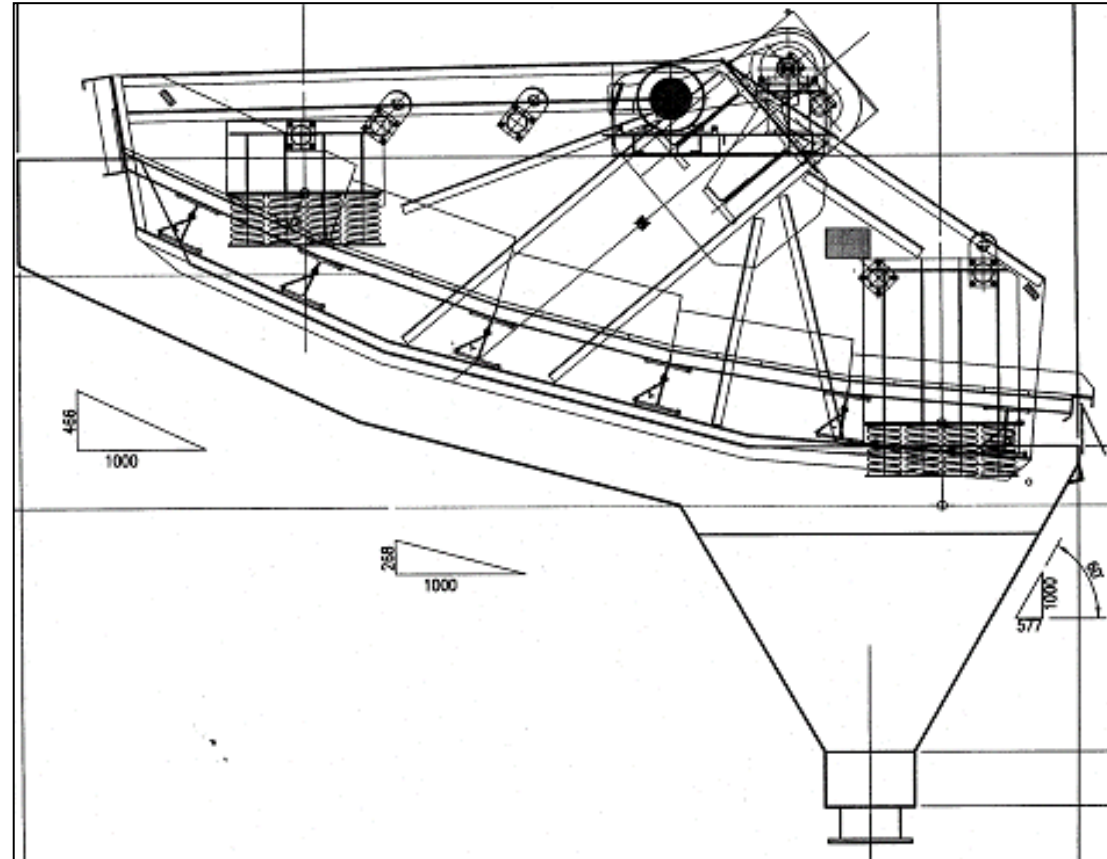
Vibrating Screen Noise Spectrum



Vibrating Screens – Infra-Sound

Enviro

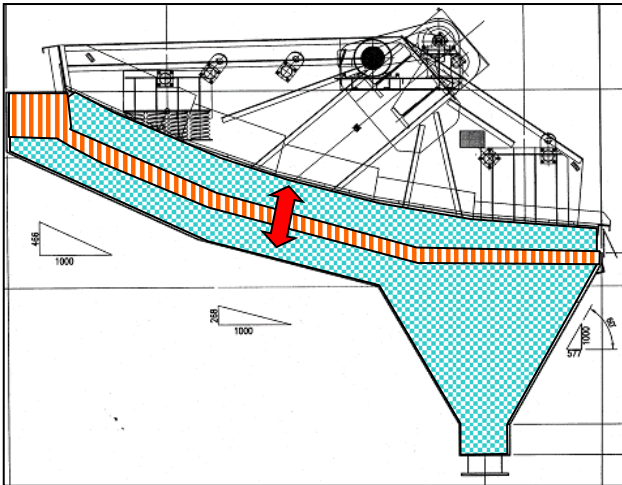
Banana Screen

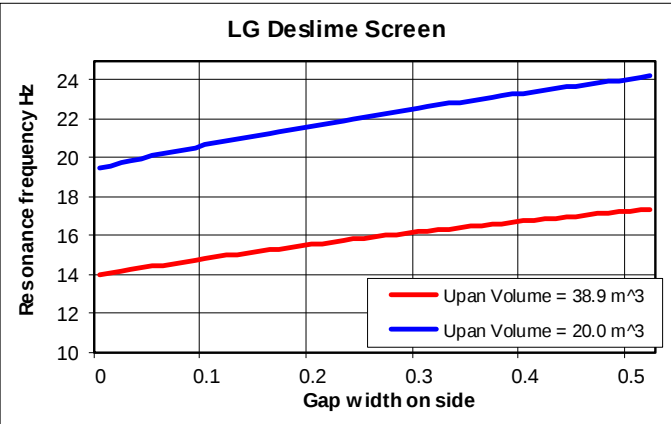


Vibrating Screen



Modelling



Vibrating screen Helmholtz Resonance																								
Klipspruit		L G Desliming screen																						
NearField plane source	$P_0 = \rho c v_0 \ e^{(2\pi f t - kr)}$																							
FarField piston source	$P(r) = \frac{1}{2} \rho c v_0 \frac{a}{r} k a \ e^{(2\pi f t - kr)}$																							
Screen perforation resonance	$f_0 = \frac{c}{2\pi} \sqrt{\frac{\kappa_p S_{deck}}{L' V}} \quad \text{Hz}$																							
Screen gap resonance	$f_0 = \frac{c}{2\pi} \sqrt{\frac{S_{Gap}}{L' V}} \quad \text{Hz}$																							
LG Deslime Screen <table border="1"><caption>Approximate data points from the LG Deslime Screen graph</caption><thead><tr><th>Gap width on side</th><th>Resonance frequency (Hz) - Upan Volume = 38.9 m³</th><th>Resonance frequency (Hz) - Upan Volume = 20.0 m³</th></tr></thead><tbody><tr><td>0.0</td><td>14.0</td><td>19.5</td></tr><tr><td>0.1</td><td>15.0</td><td>20.5</td></tr><tr><td>0.2</td><td>16.0</td><td>21.5</td></tr><tr><td>0.3</td><td>16.5</td><td>22.5</td></tr><tr><td>0.4</td><td>17.0</td><td>23.5</td></tr><tr><td>0.5</td><td>17.5</td><td>24.5</td></tr></tbody></table>				Gap width on side	Resonance frequency (Hz) - Upan Volume = 38.9 m³	Resonance frequency (Hz) - Upan Volume = 20.0 m³	0.0	14.0	19.5	0.1	15.0	20.5	0.2	16.0	21.5	0.3	16.5	22.5	0.4	17.0	23.5	0.5	17.5	24.5
Gap width on side	Resonance frequency (Hz) - Upan Volume = 38.9 m³	Resonance frequency (Hz) - Upan Volume = 20.0 m³																						
0.0	14.0	19.5																						
0.1	15.0	20.5																						
0.2	16.0	21.5																						
0.3	16.5	22.5																						
0.4	17.0	23.5																						
0.5	17.5	24.5																						
LP	Sound pressure level at 16 Hz at 3.0 m without resonance LP		128 dB																					
	Sound pressure level in the gap		145 dB																					
fo	Helmholtz fo	Slot Resonance	309 Hz																					
		Mode 1 Gap Resonance	17.6 Hz																					
	To reduce fo to 13 Hz Reduce gap long side to 0.1 m																							
	Air speed in Gap		1.8 m/s																					
	ShortNeck																							

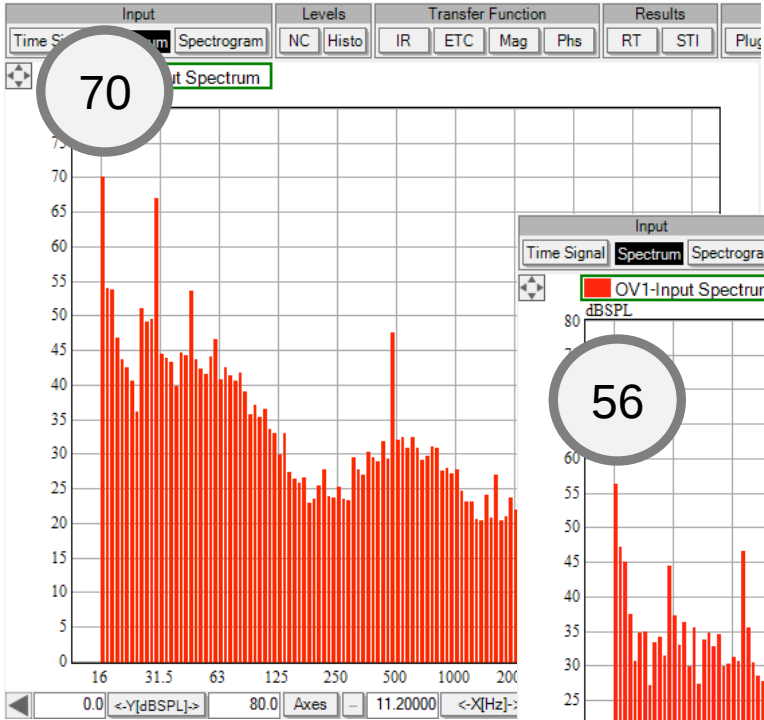
Vibrating Screen



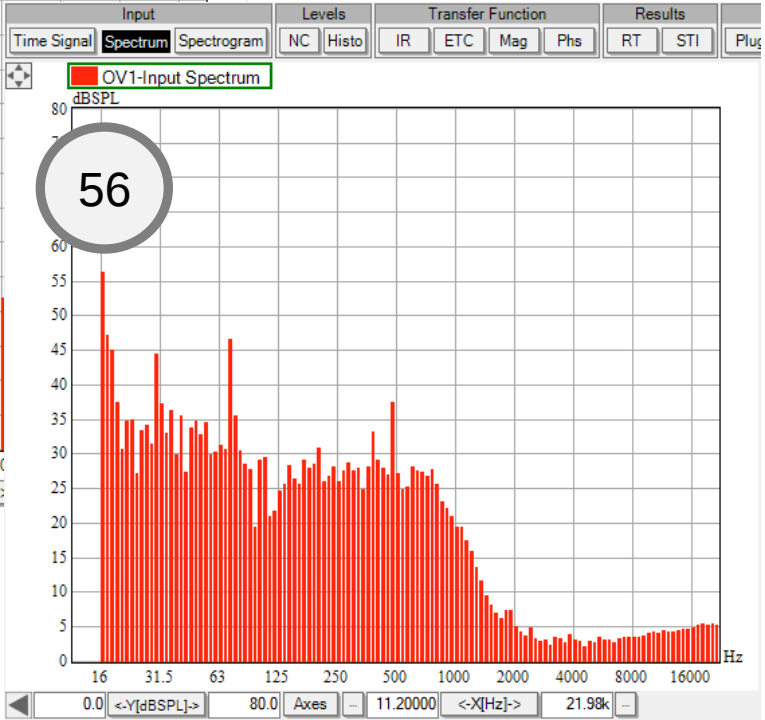
Resonance Detuning



Before



After

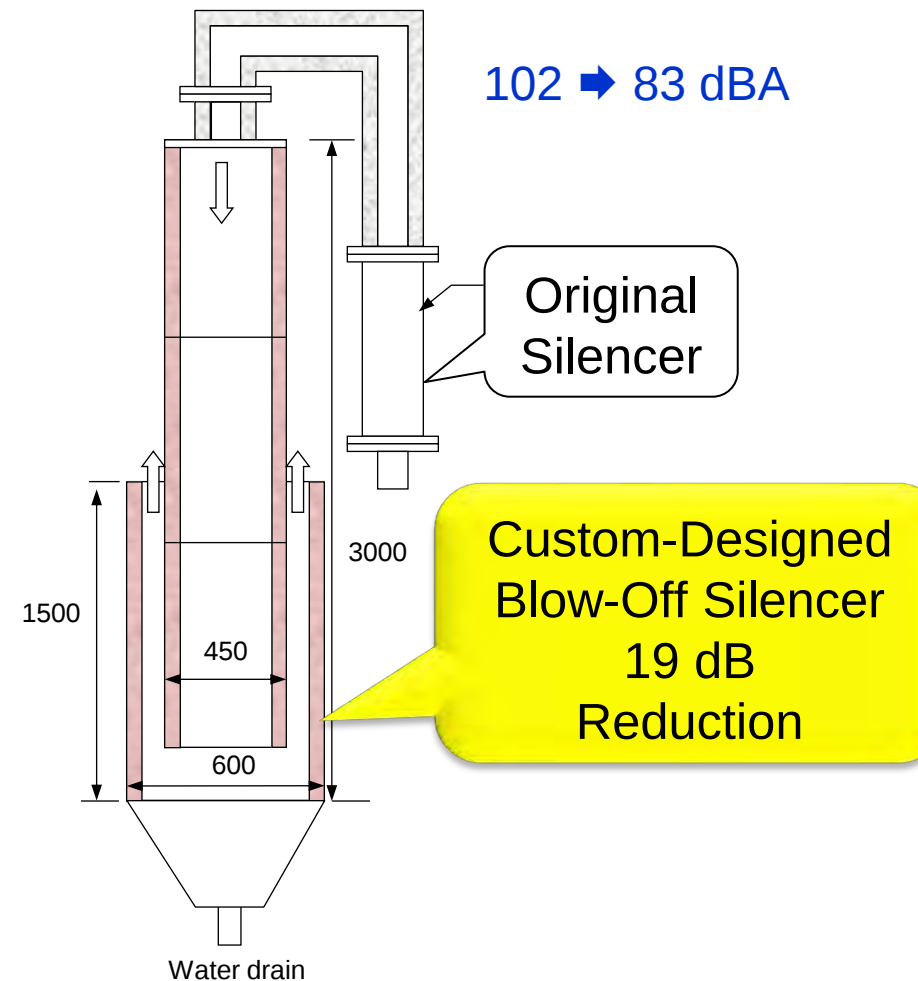


Steam Blow-Off at 102 dBA

Aim: LP at 3 m < 85 dBA

Workplace

Custom-Designed Blow-off Silencer

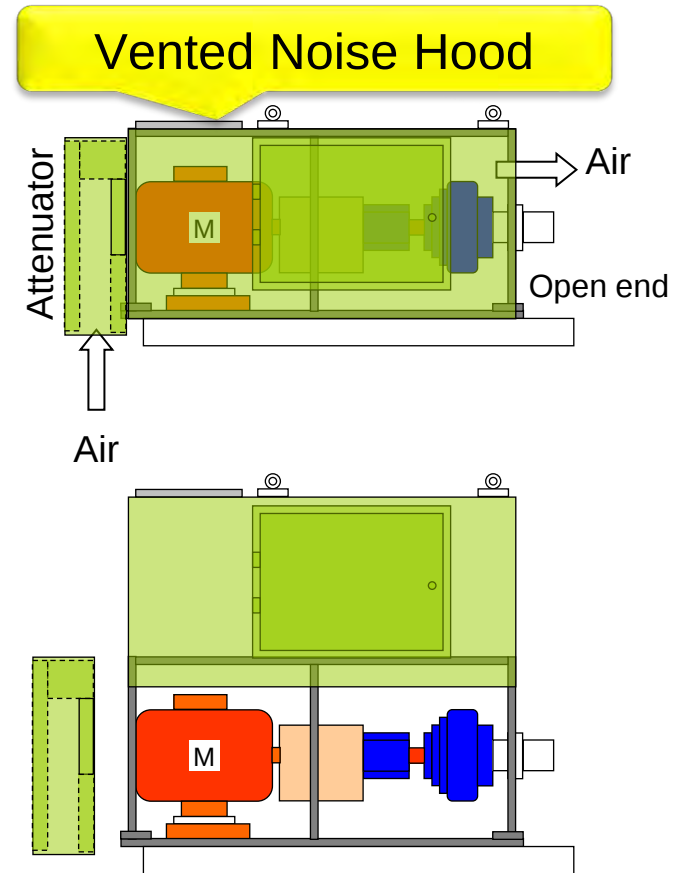
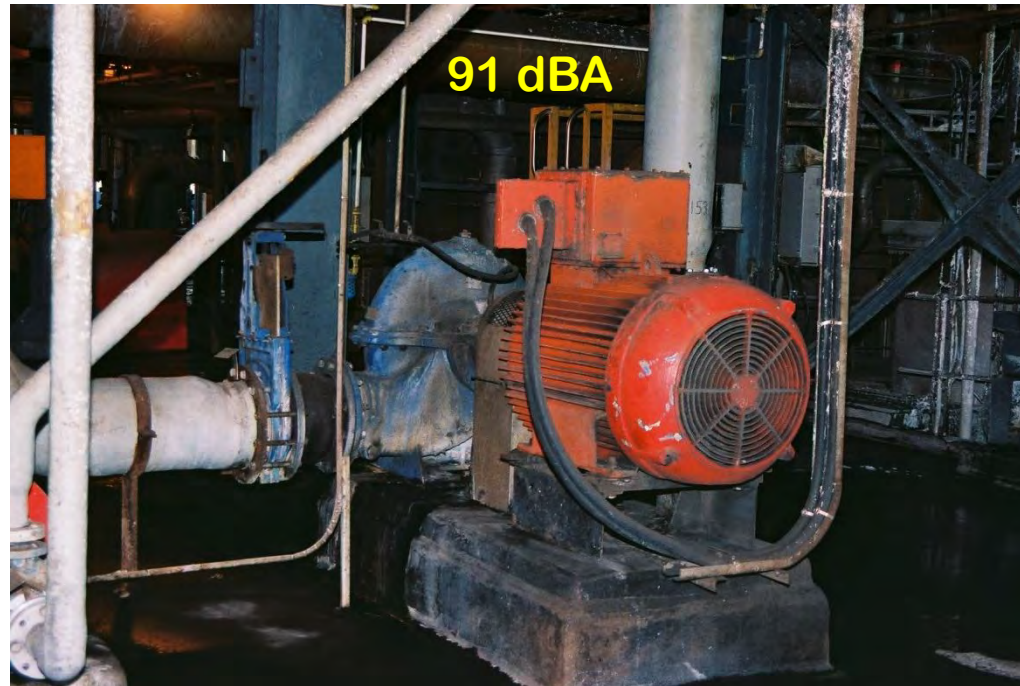


Motor-Pump Unit – Vented Noise Hood

Aim: LP at 1 m < 85 dBA

Workplace

Example: Motor and Pump



Noise reduction 92 ➔ 80 dBA



Thank you

T +27 11 498 7100

E info@mineralscouncil.org.za

W www.mineralscouncil.org.za

Rosebank Towers, 19 Bierman Ave, Rosebank, Johannesburg, 2196

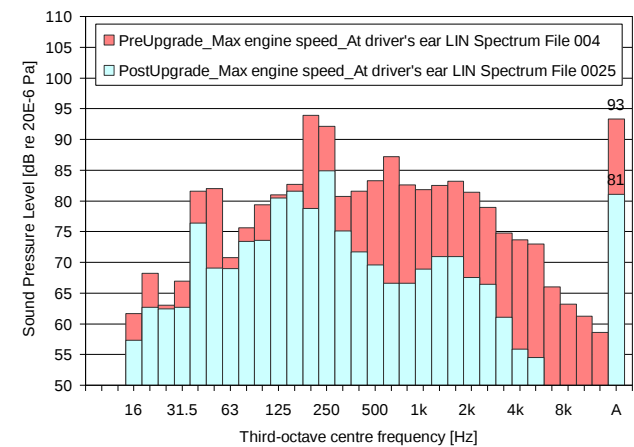
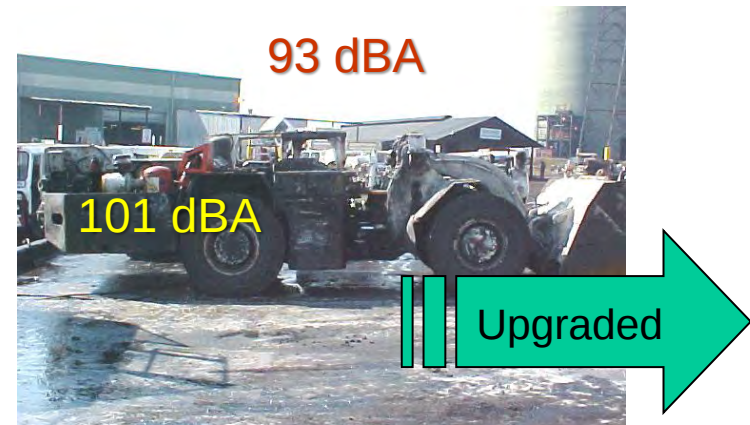


Existing LHD – Modifications

Aim: Cab Noise < 85 dBA

Workplace

Wright 356 LHD Vehicle



Engine Noise 101 ➔ 89 dBA

9E Locomotive Upgrade Project

Aim: LP inside Drivers Cab < 80 dBA

Workplace

Sishen – Saldanha Iron Ore



Before Upgrade

Engine room
102 dBA



Driver's cab
88 dBA

Upgraded 9E – Commissioning Tests

Workplace

Sishen – Saldanha Iron Ore

No space in engine room – Soundproof Cab only

After Upgrade



Engine
room
102 dBA

Driver's
Cab
88 ➔ 73
dBA

New Upcast Ventilation Shaft

Enviro



Baseline Assessment

- o Rural Farming
- o Very quiet - 33 dBA at Night
- o Shaft operates 24/7
- o Fan + Motor (Tonal)

Ambient Level = 33 dBA at Night

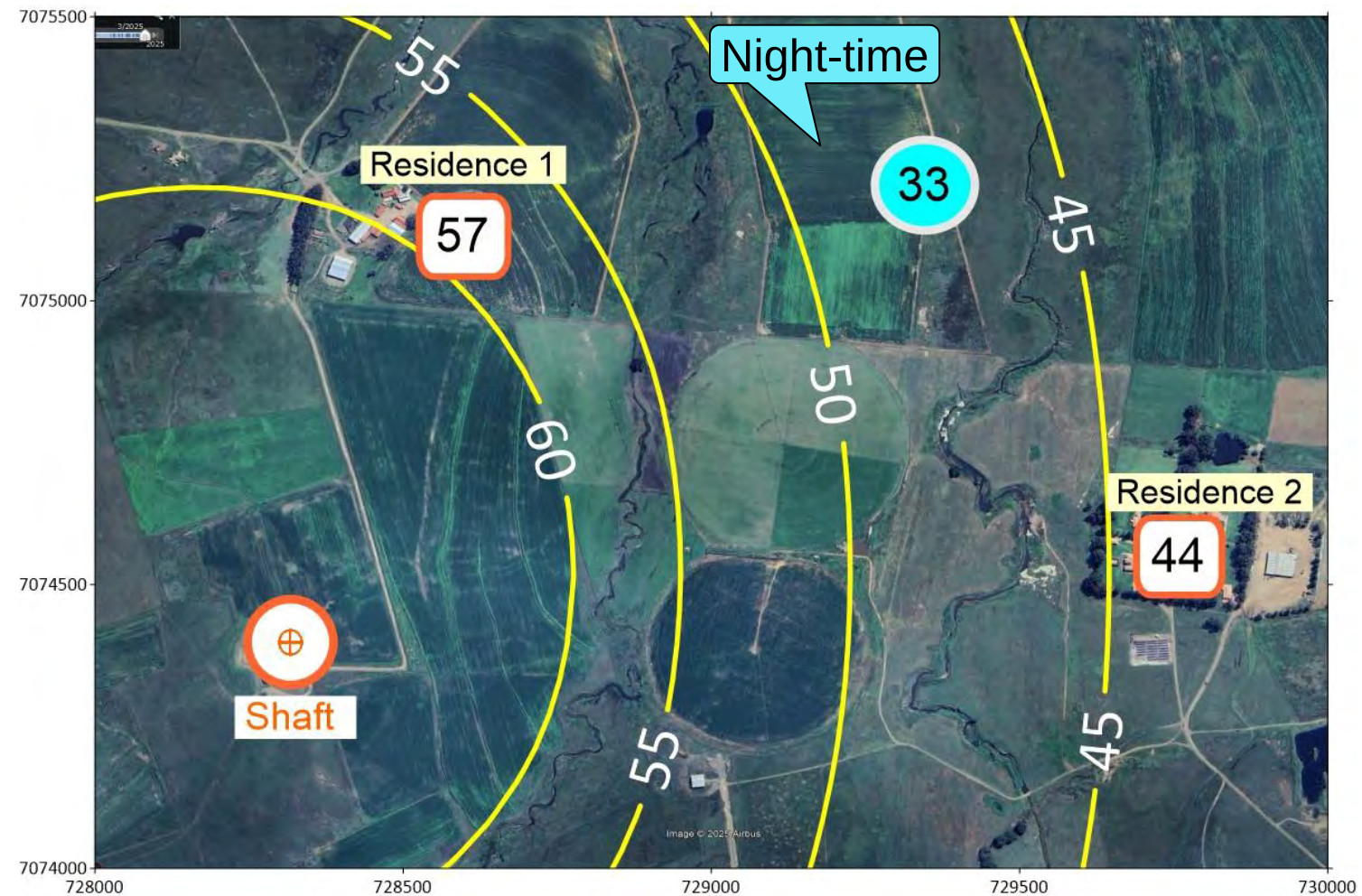
Shaft Noise Footprint

Enviro

Fan Noise

- o 57 dBA at Residence 1
(Impact dL = + 24 dB)
- o 44 dBA at Residence 2
(Impact dL = + 11 dB)

Predicted Levels - Unmitigated



Shaft Noise Control

Enviro

Design Target

LP < 27 dBA at Nearest Residence

Design Measures

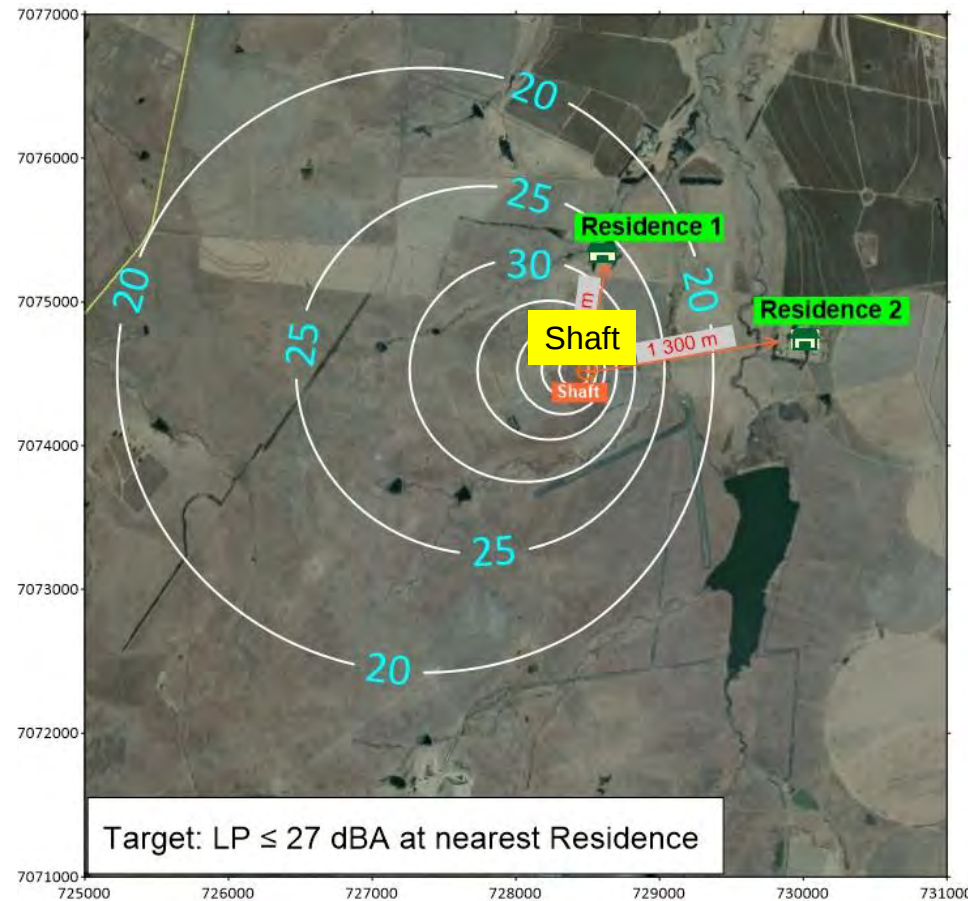
Fan Noise

- o Attenuators
- o Duct lining
- o Breakout control
- o Directed Discharge

Motor Noise

- o Motor House soundproof

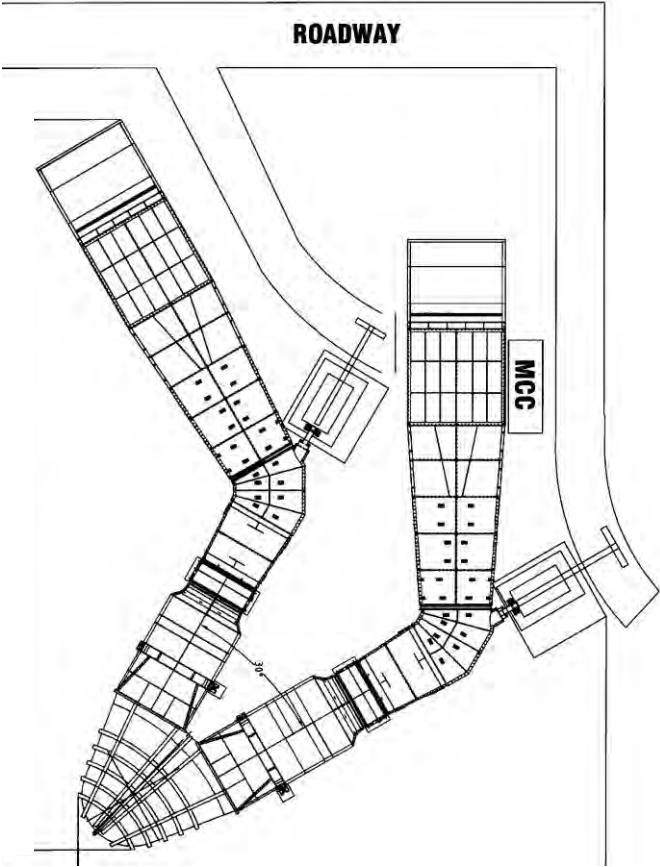
Horizontal Configuration



Shaft Noise Control

Enviro

Horizontal Configuration



Vertical Discharge



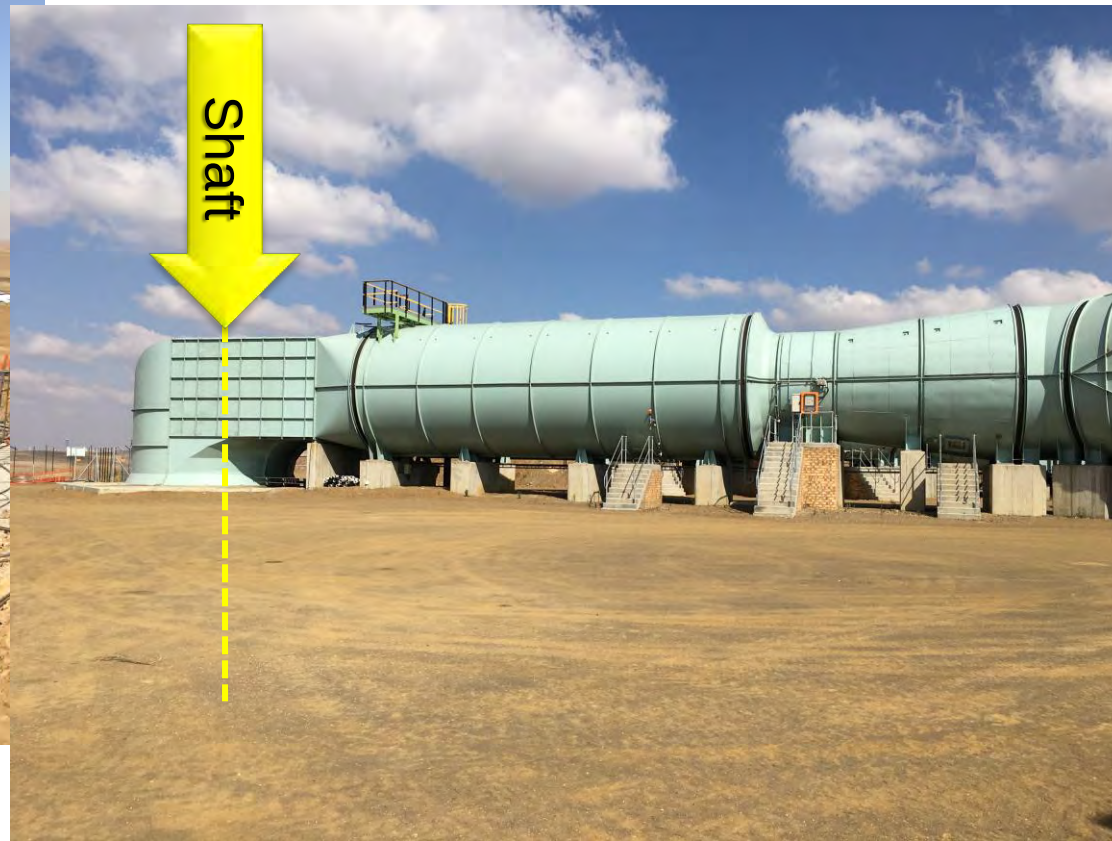
Ventilation Shaft

Enviro

Upcast Shaft Construction



Operational



Ventilation Shaft

Enviro

Motor House



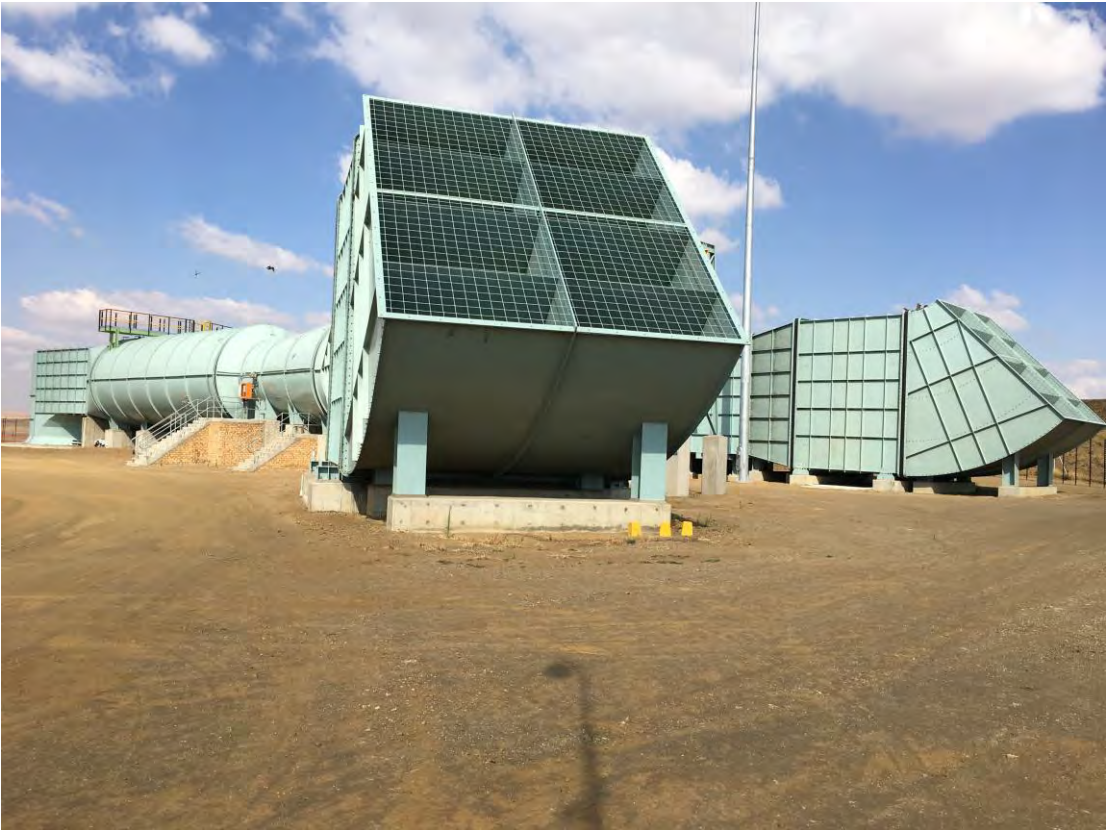
Sound-proofed
Motor House

Structure-borne noise

Structure-borne
Noise
Isolation



Controlled Atmospheric Discharge



Overland Conveyor Noise

Enviro



Conveyor Noise – Extent and Duration

Enviro

Physical Length

- o Extended Noise Footprint:
- o Noise generated over entire length of Conveyor
- o Routing: Proximity to residential unavoidable

Operation

- o Continuous Operation 24/7
- o Runs at Night



Conveyor Noise – Annoying Characteristics

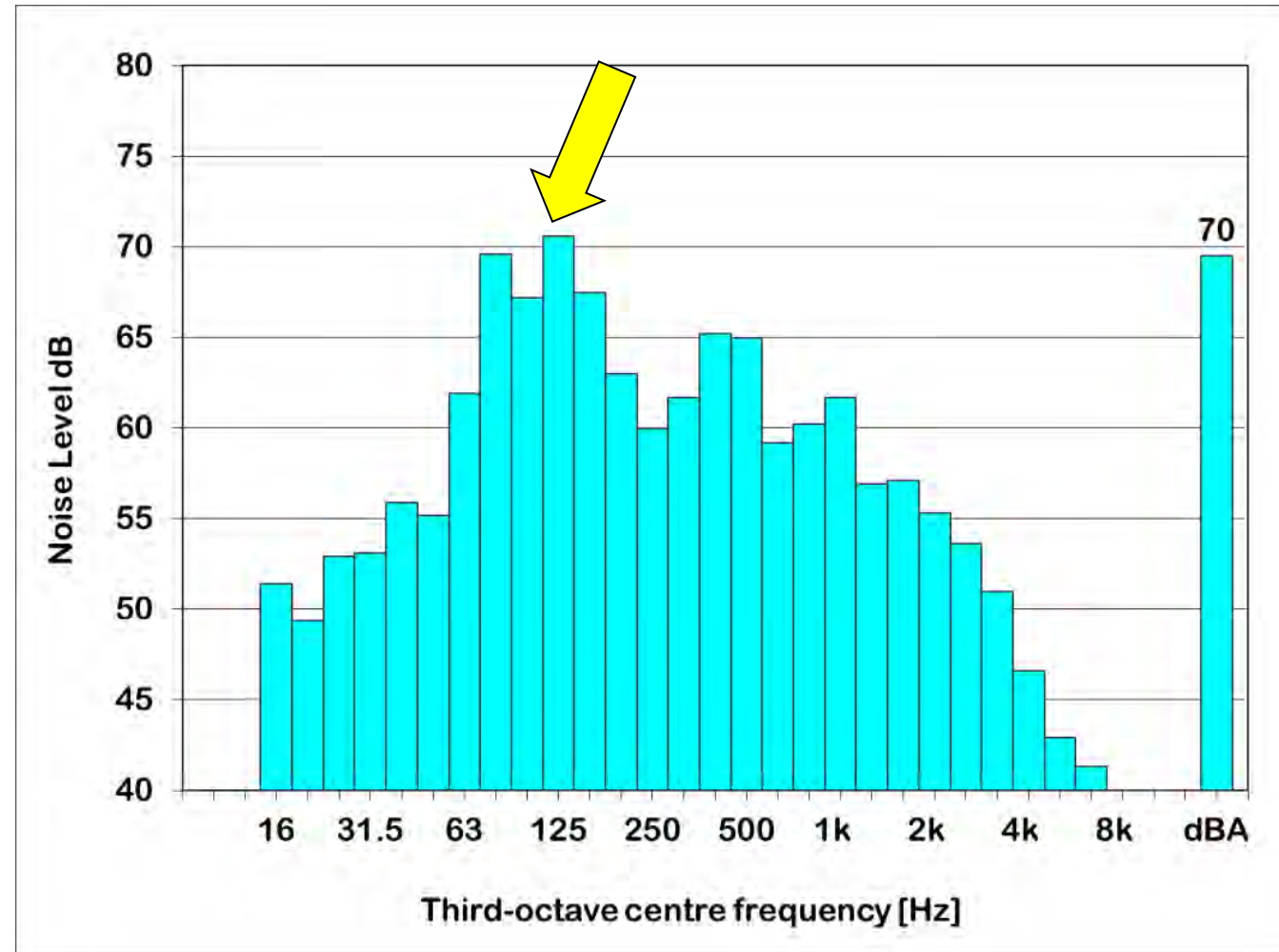
Enviro

Low Frequency Noise

- o Rich in Low-frequencies
- o Low-f prevails over longer distances

Other Features

- o Pulsating Noise
- o Bearing Failure
- o Start-up Alarm

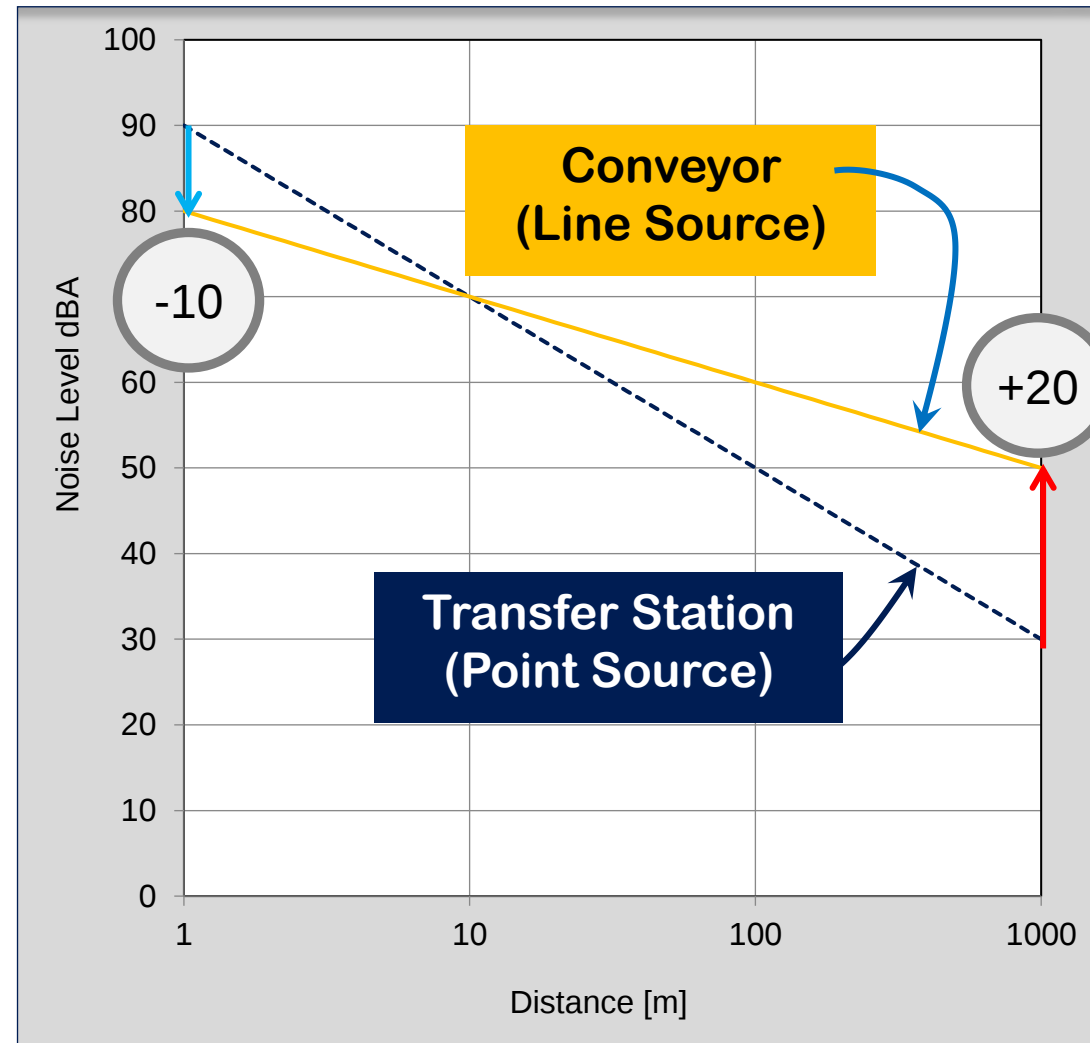


Conveyor Noise

Enviro

Conveyor = Line Source

- o Line Source: Noise falls off at slow rate
- o Point Source: - 6 dB/2x
Line Source: - 3 dB/2x

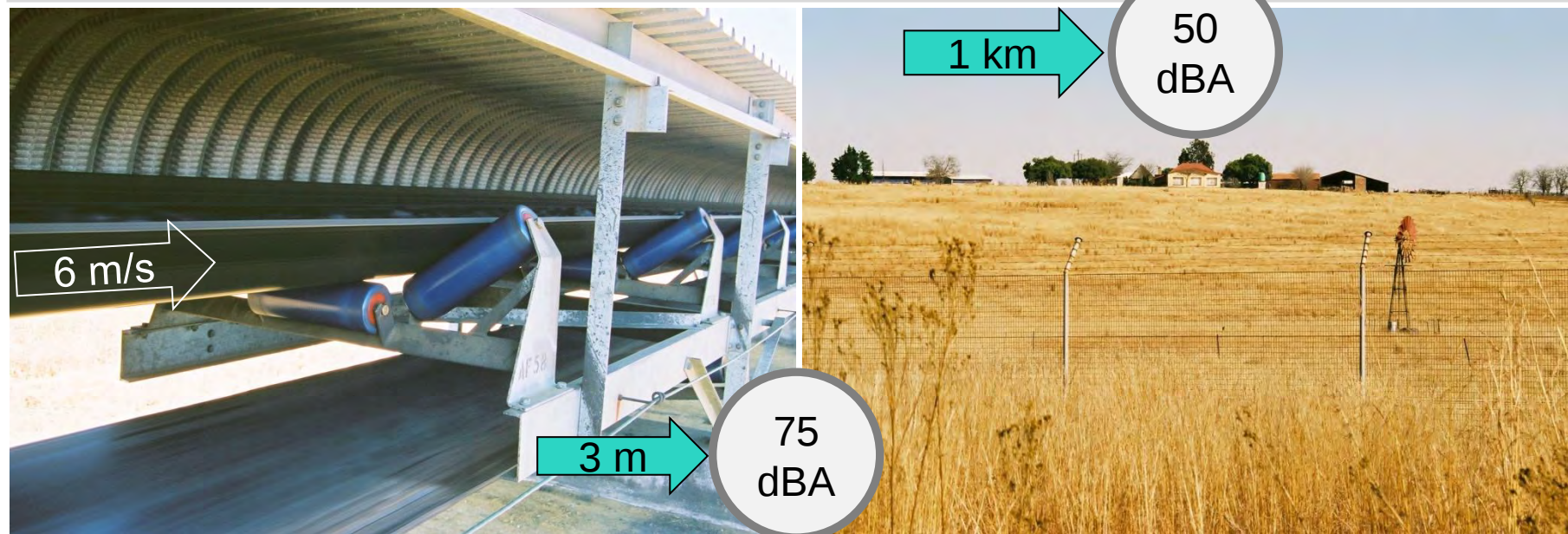


Conveyor – Levels at Source Deceiving

Enviro

Consequence

- o Aural impression at conveyor – Misleading
- o High noise levels at distance



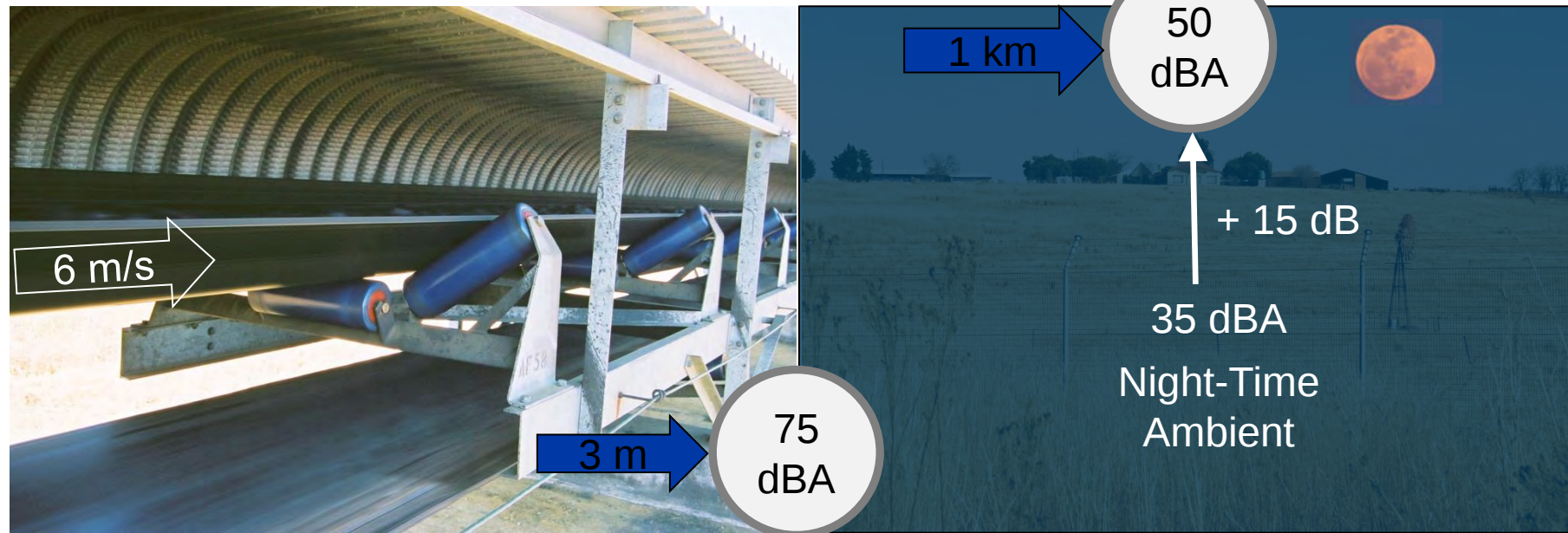
- o Large Footprint

Conveyor Noise – Night-time Impact

Enviro

Night-Time Impact

- o Rural night-time ambient level 35 dBA
- o Conveyor noise at 1 km 45 - 50 dBA



- Noise Impact at 1 km distance ~ 10 - 15 dB

Conveyor Noise-Generating Mechanisms

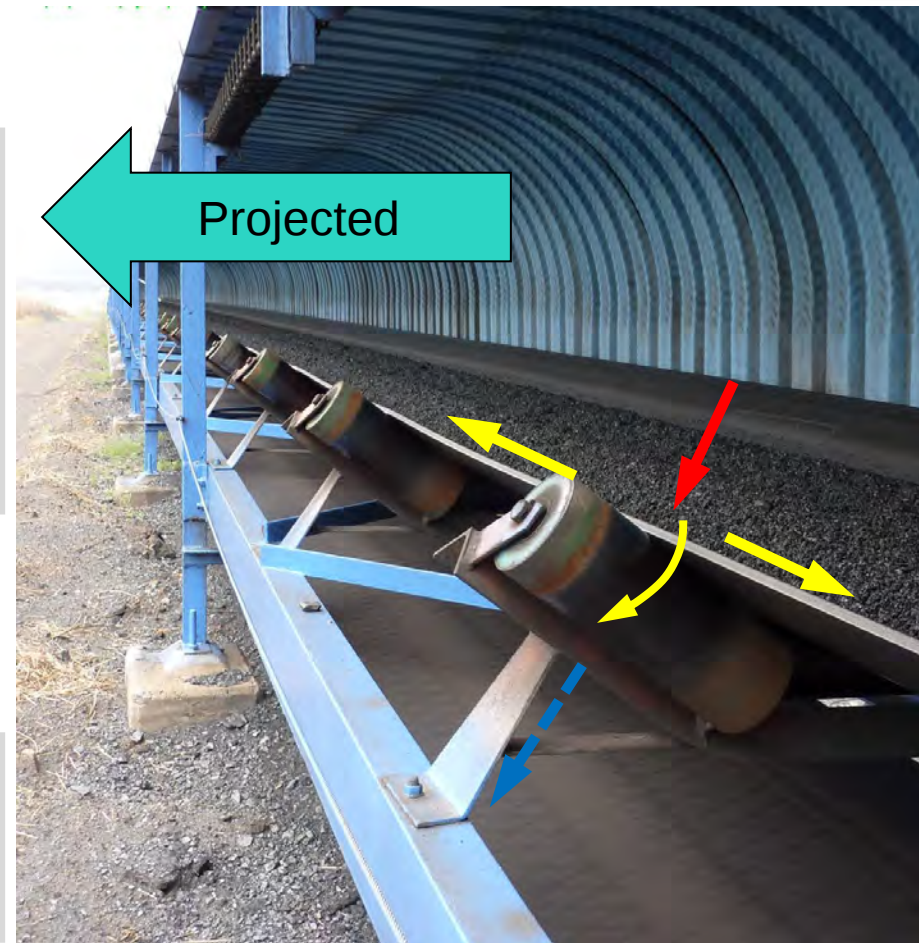
Enviro

Primary Mechanisms

- o Belt ↓ Roll Impact
- o Impact, friction, movement at Belt-Roll interface
- o Roll Response
- o Belt Response

Secondary Mechanisms

- o Support structure & Canopy excitation
- o Projection of airborne noise by canopy

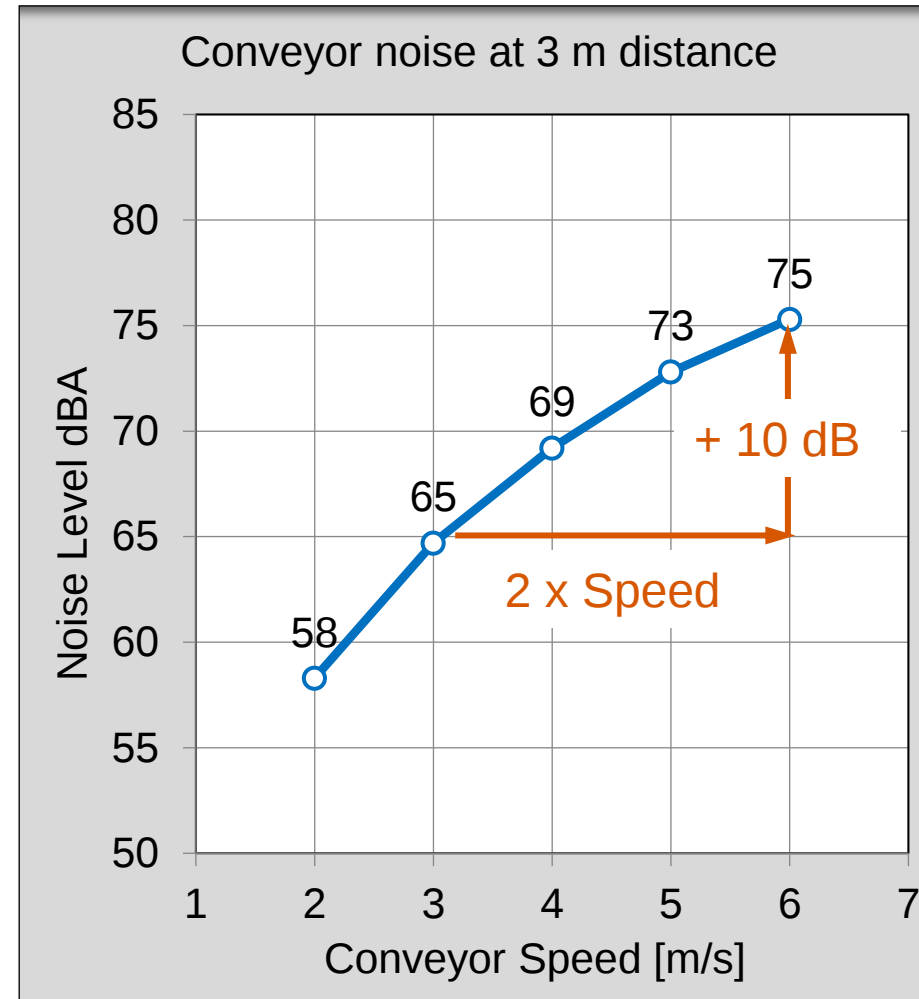


Conveyor Noise: + 10 dB / 2 x Speed

Enviro

Conveyor Speed

- o Doubling in speed $\Rightarrow$ + 10 dB



Conveyor Noise – Roll Type



Roll Type		
Idler	Noise level At 1 m [dBA]	Advantage Noise relative to Standard Steel Roll [dB]
Steel Standard	91	0 dB (Reference)
Steel Rounded	82	- 9 dB
HPDE Type A	75	- 15 dB
HPDE Type B	70	- 21 dB

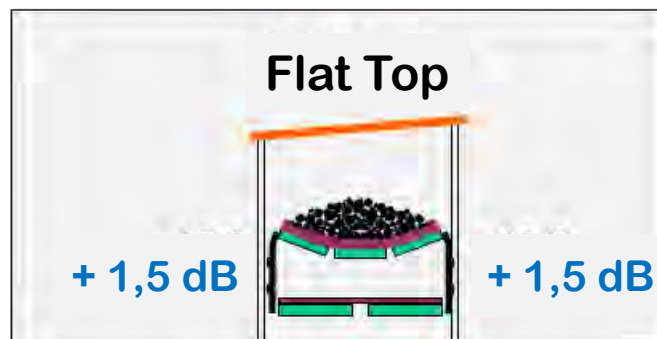
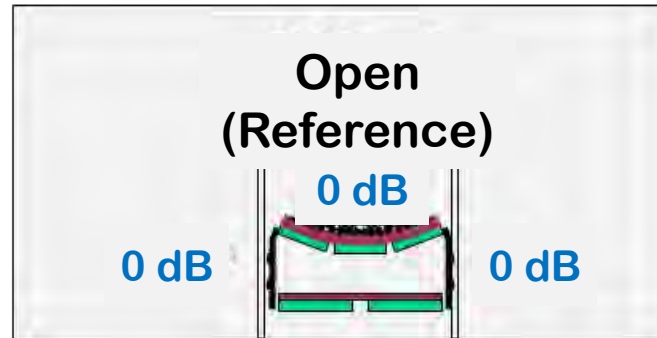


Conveyor Noise - Housing

Enviro

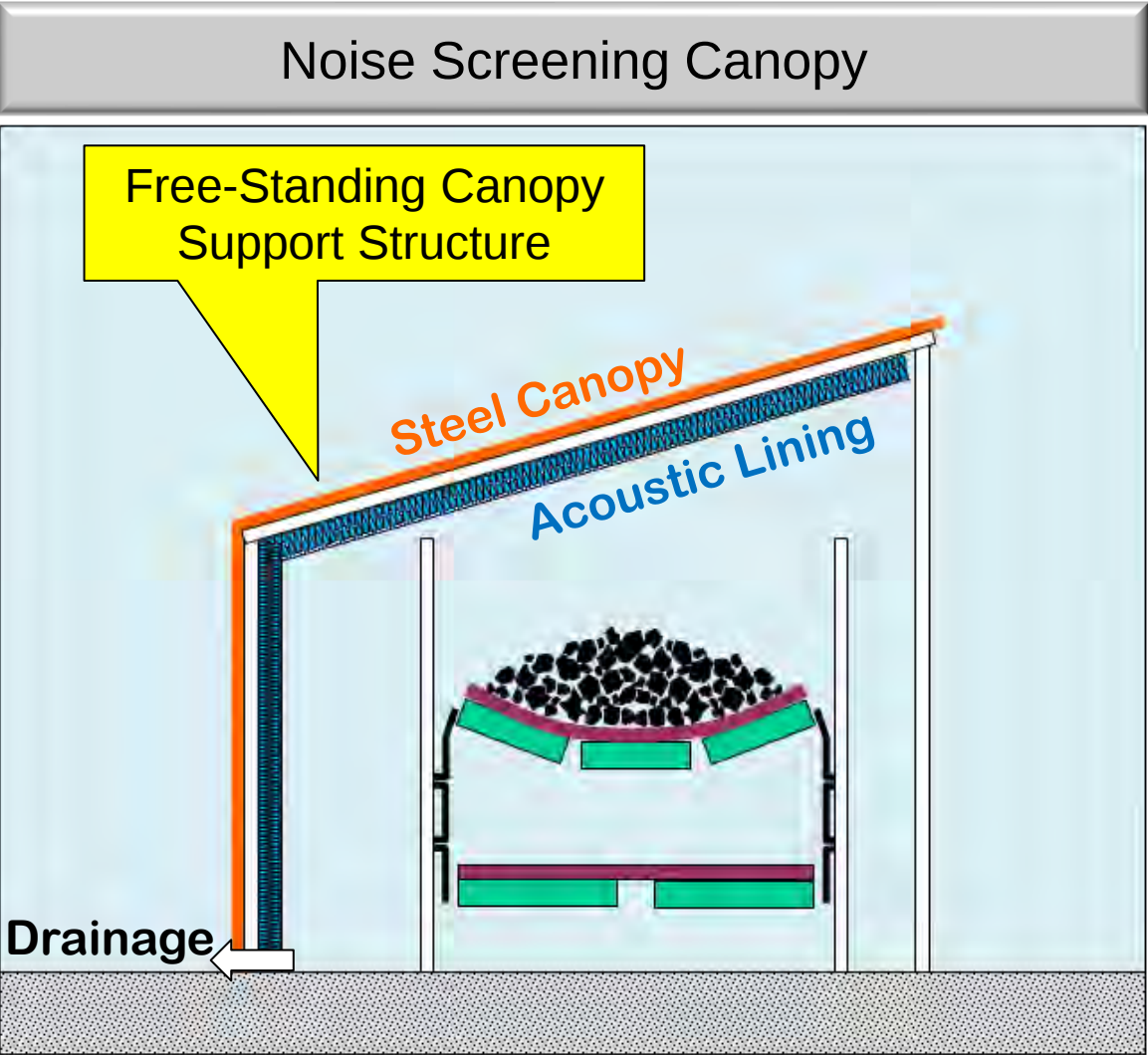
Conveyor Housing

- o Changes Directivity



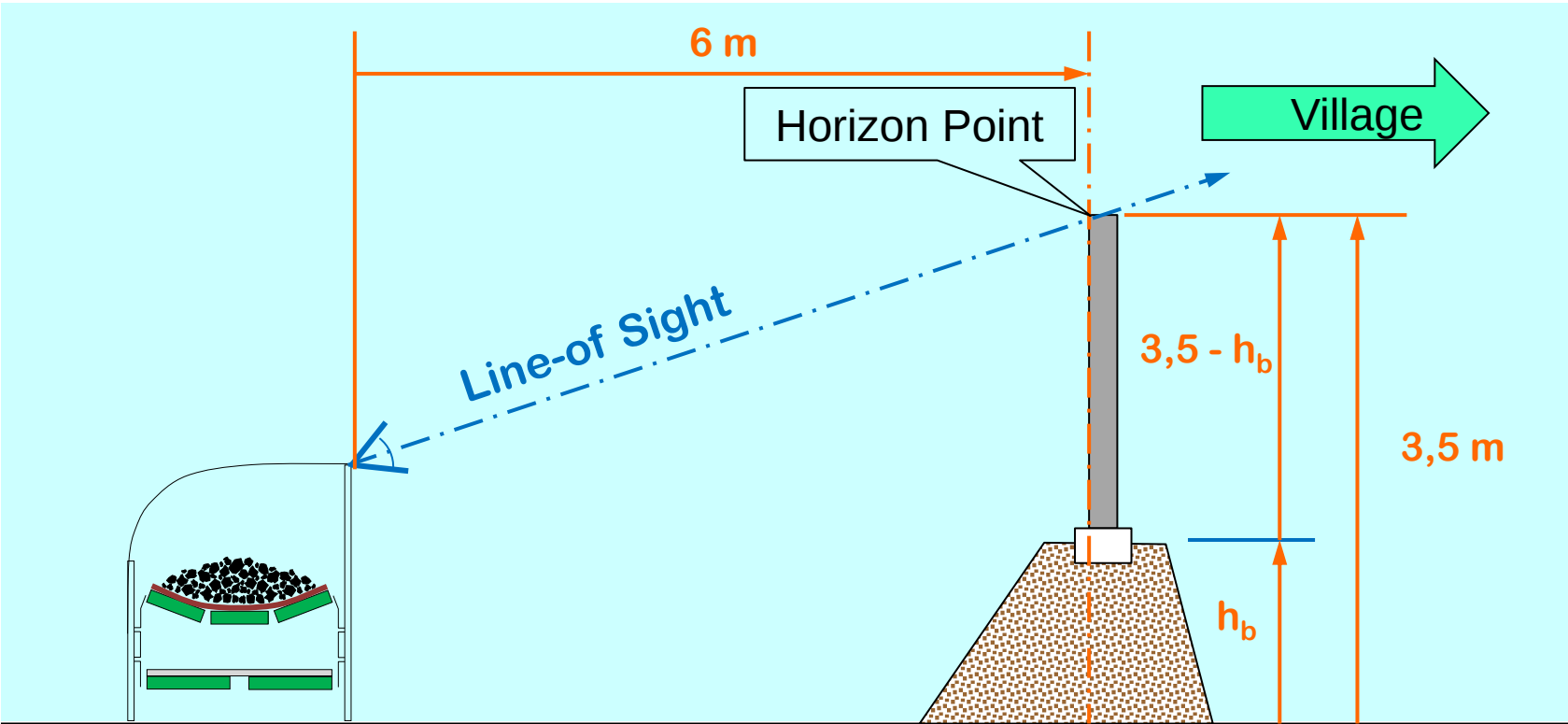
Conveyor Noise - Barriers

Enviro



Conveyor Noise - Barriers

Noise Barrier - Example

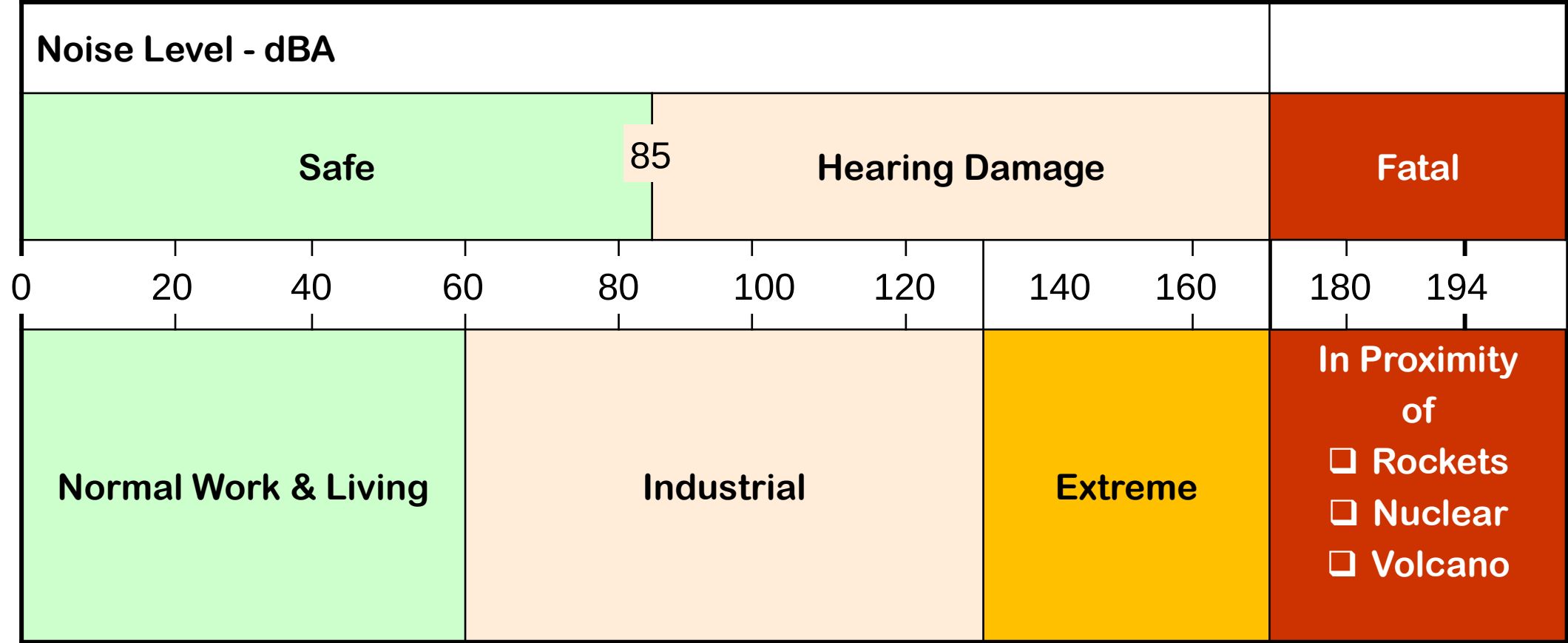


Conveyor Noise - Barriers

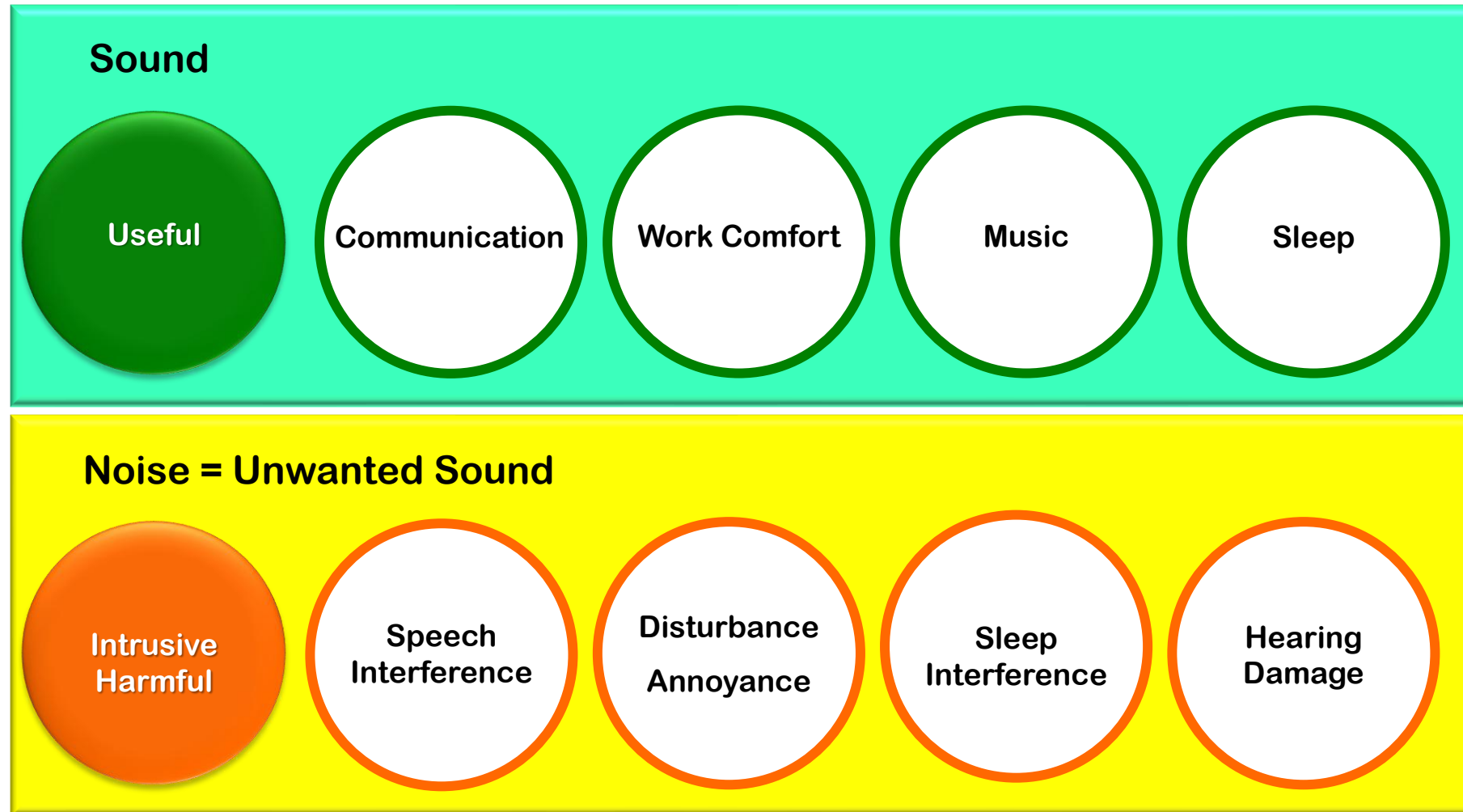
Effect of Screen on Conveyor Noise Level



Decibel Scale - Context



Sound versus Noise



Environmental Noise

Community Reaction to Noise

Guideline	Increase in Noise Level	Reaction
SANS 10103	0 – 10 dB	Sporadic complaints
	5 – 15 dB	Widespread complaints
	10 – 20 dB	Threats of action
	> 15 dB	Vigorous action
Noise Regulations	3 dB	Disturbing noise

Mining Sources of Noise

Main Operations

- o **Underground (Occupational Noise - Hearing Safety)**
- o **Opencast (Drilling, Excavation, Dozing, Loading, Trucks)**
- o **Plant (Crushing, Milling, Screening)**
- o **Dumps & Tailings (Trucks, Dumping, Dozing)**

Infrastructure

- o **Ventilation Shafts**
- o **Overland Conveyors**
- o **Haul Roads**
- o **Railway Lines**

Mining – Sources of Noise

Primary Operations

- o Underground (Occupational Noise - Hearing S...)
- o Opencast (Drilling, Excavation, Dozing, L...ks)
- o Plant (Crushing, Milling, Screening)
- o Dumps (Trucks, Dumping, Do...

Infrastructure

- o **Ventilation Shafts**
- o **Overland Conveyors**
- o Haul Roads
- o Railway Lines

Often Underestimated