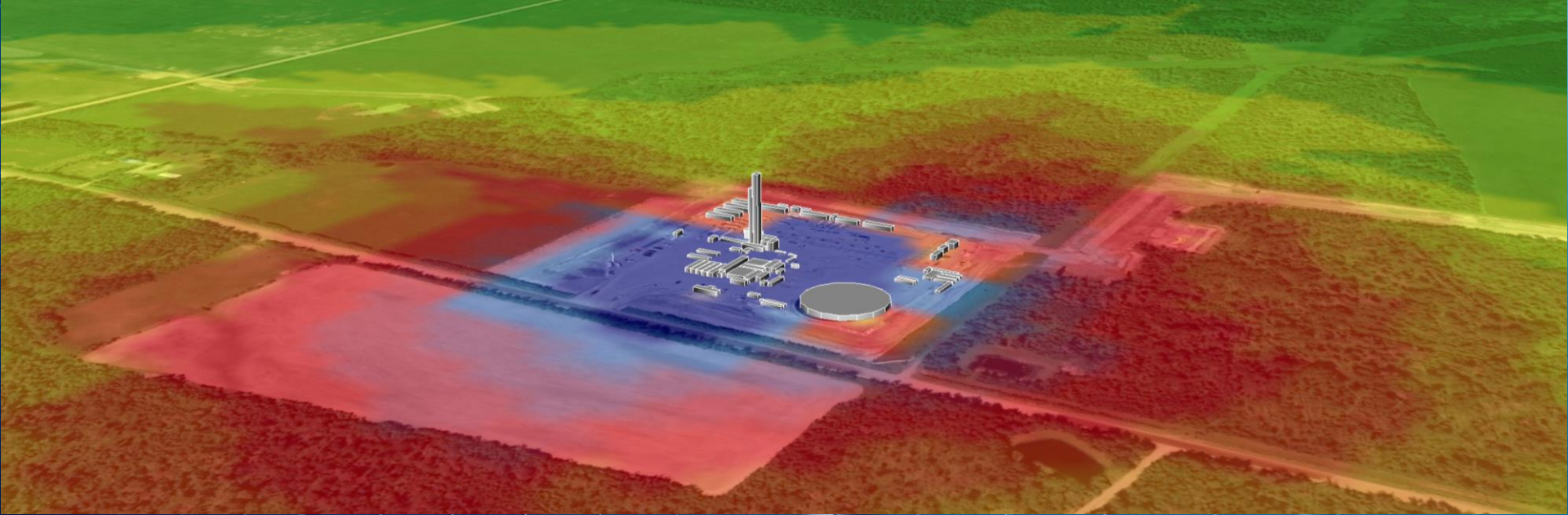




Noise Emissions in Unconventional Energy Development

Leveraging Data for Mitigation Innovation



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Agenda

Noise/Sound Fundamentals

Noise Emissions-Sources

Mitigation





Noise and Sound Fundamentals



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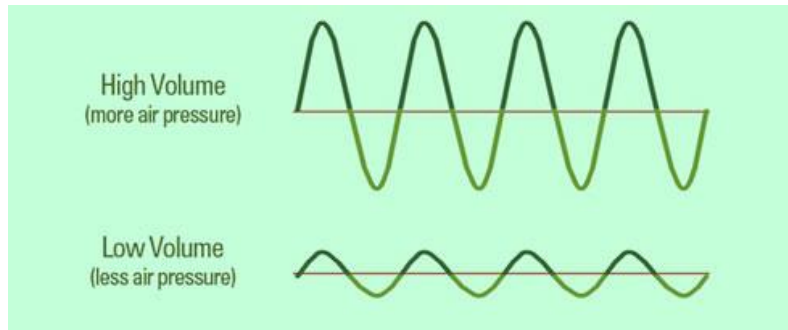
What is Sound?



Sound Measurement

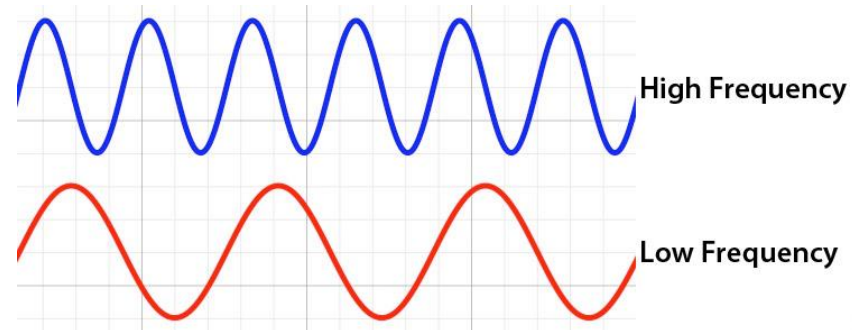
How Loud (level)

- Decibels (dB)
- How big the vibrations are



Character (Pitch)

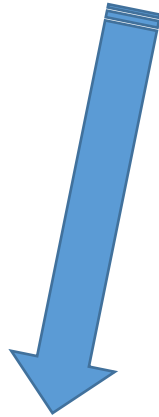
- Frequency
- How many vibrations



Sound Vs. Noise

noise: sound/s that are unwanted

noun



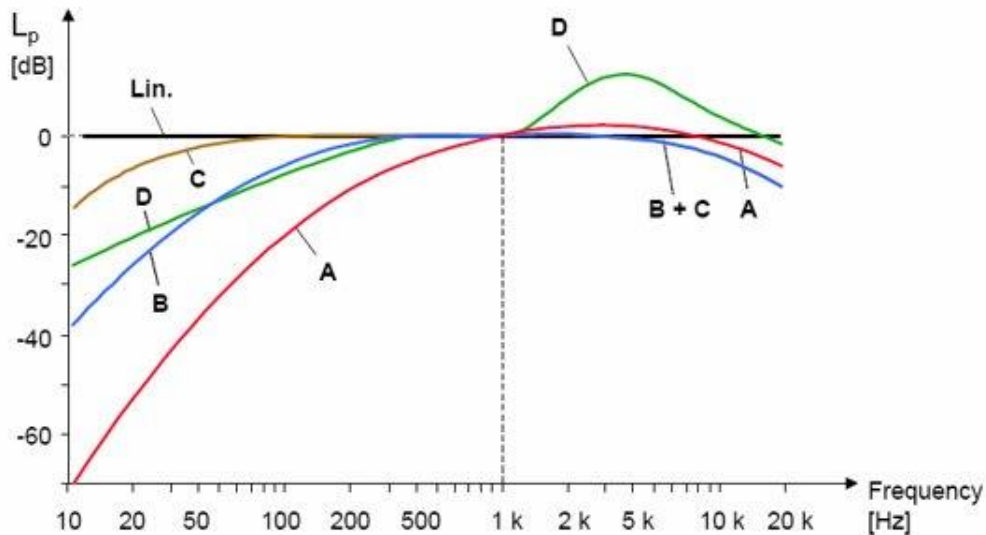
Physics/Engineering



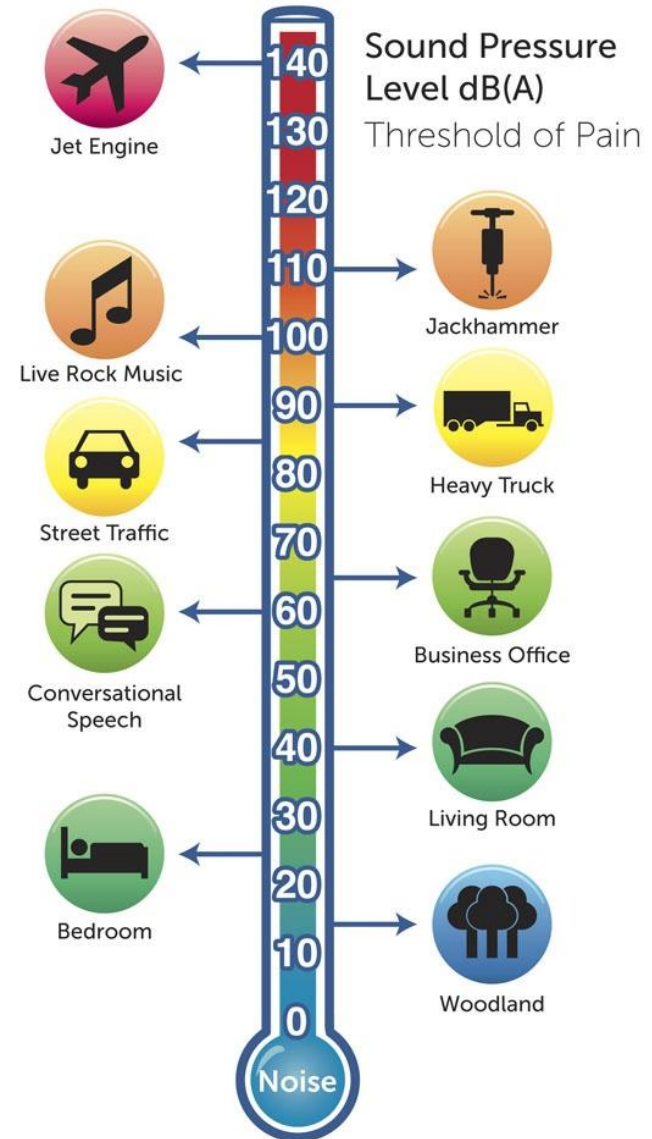
Perception/Expectation



dBA vs. dBC Theory



NOISE THERMOMETER

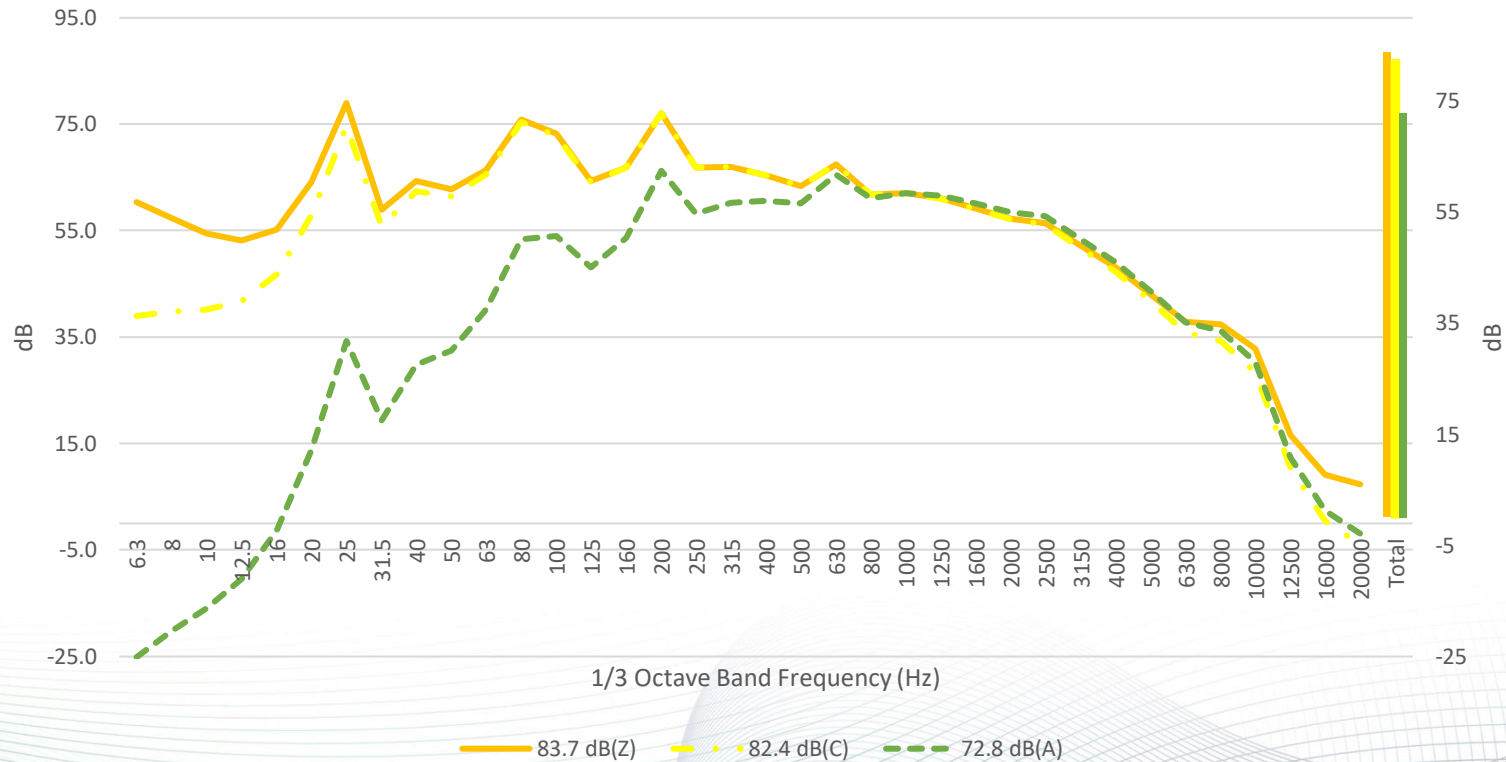


dBA vs. dBC

Example



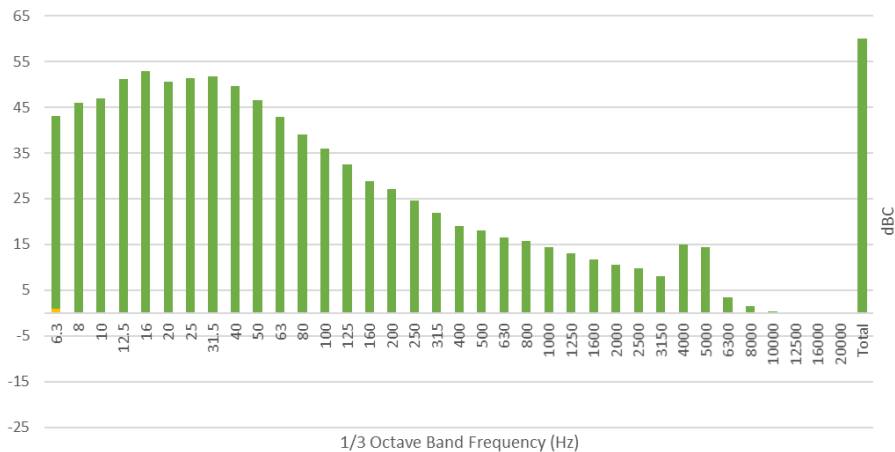
Work Over Rig (AU) - Fenceline Boundary - 20m



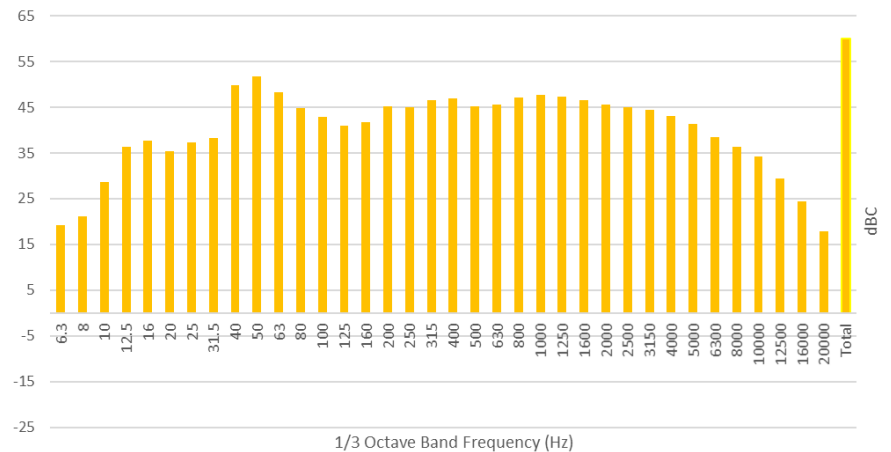
dBA vs. dBC

Example

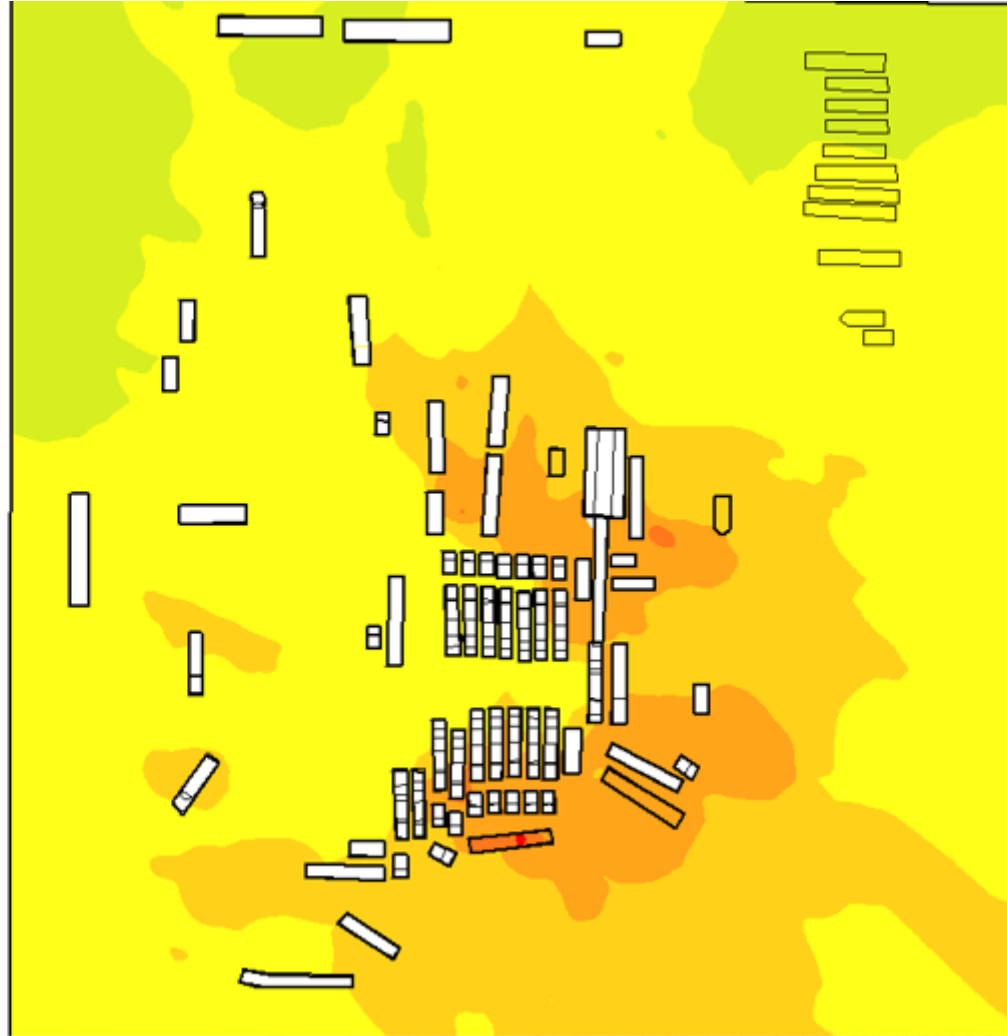
Wind Driven ("Apple")



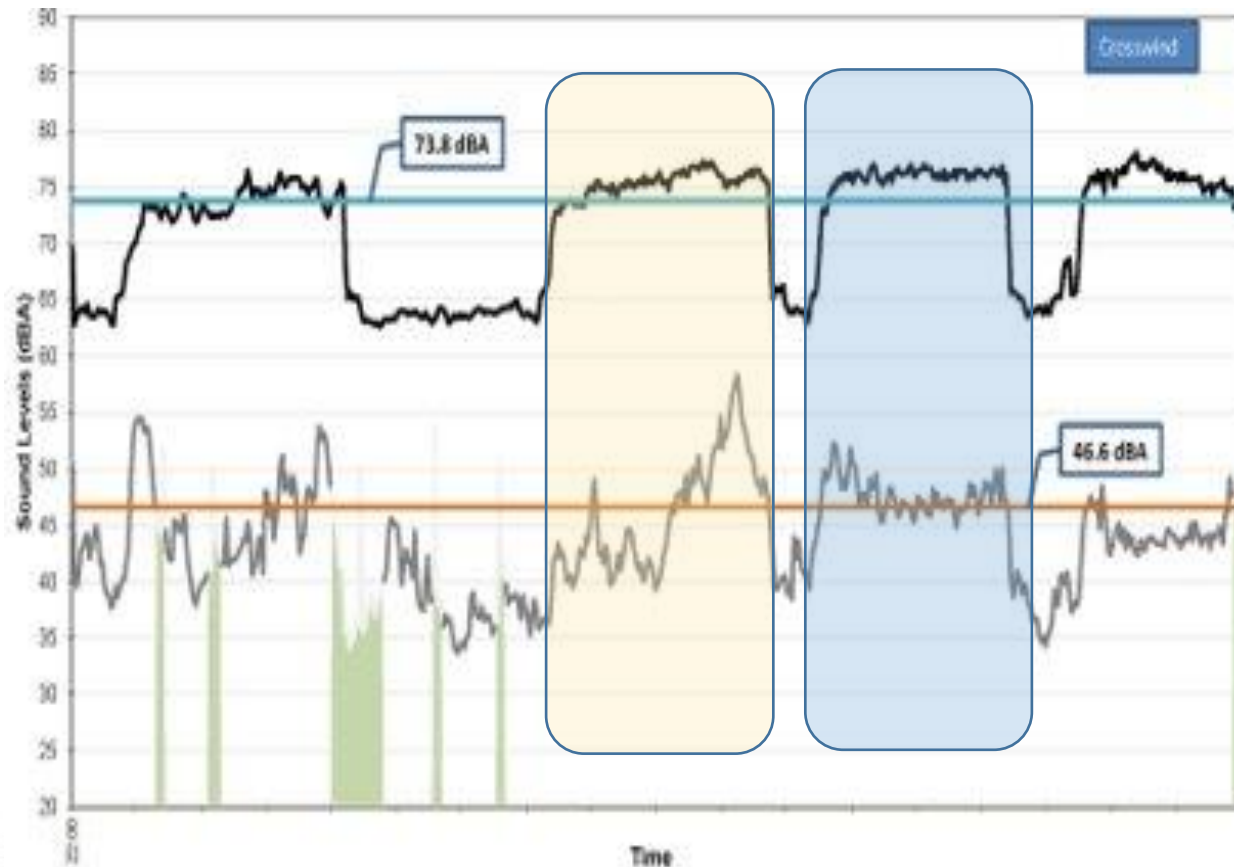
Facility Driven ("Orange")



Complex Emissions-Frequency



Complex Emissions-Time



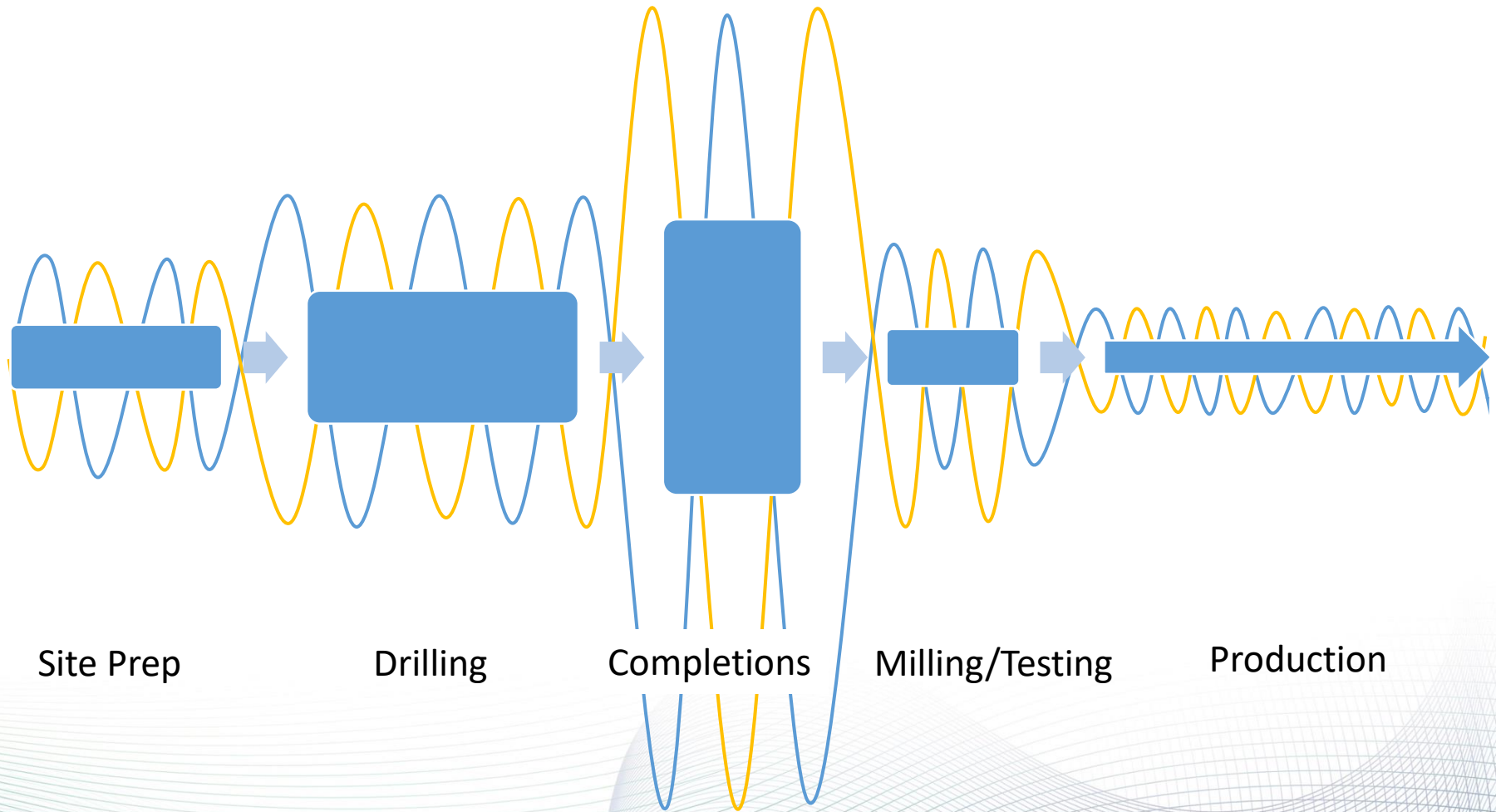


Noise Emissions - Sources

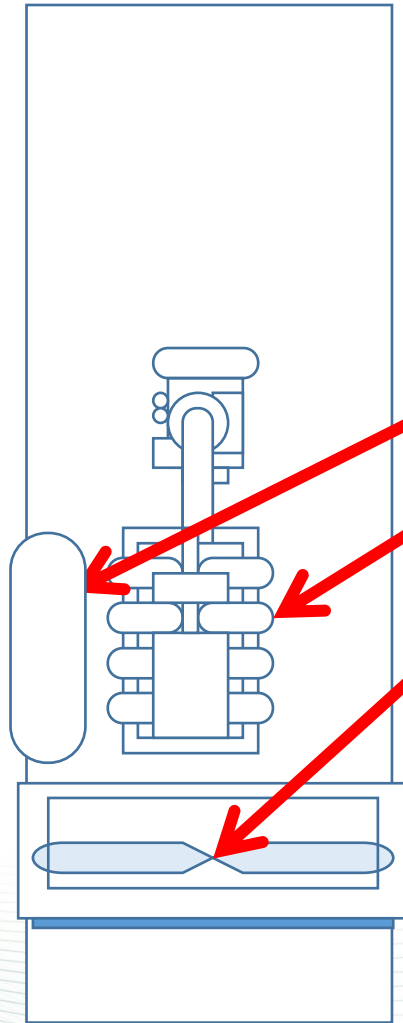


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Emissions – Wellpad Timeline



Noise Emissions - Sources



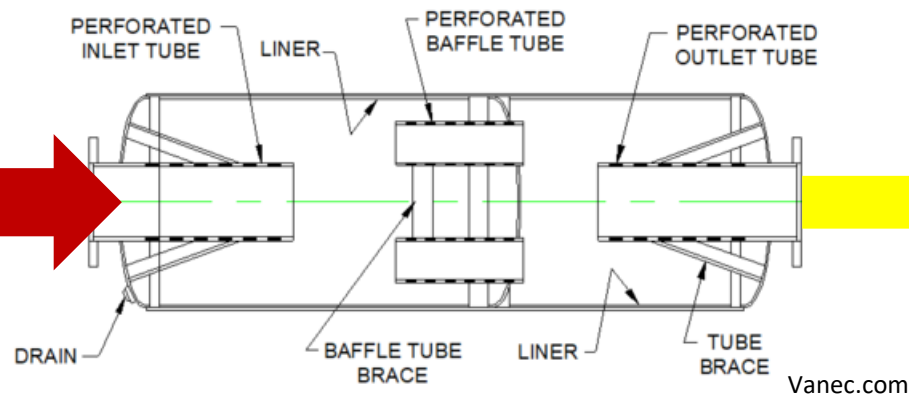
Common major noise sources:

- Engine exhausts
- Engine casings
- Cooler fans

Other noise sources:

- Mobile equipment
- Valves, piping
- Electric motors, pumps
- Sand systems

Noise Emissions – Engine Exhaust

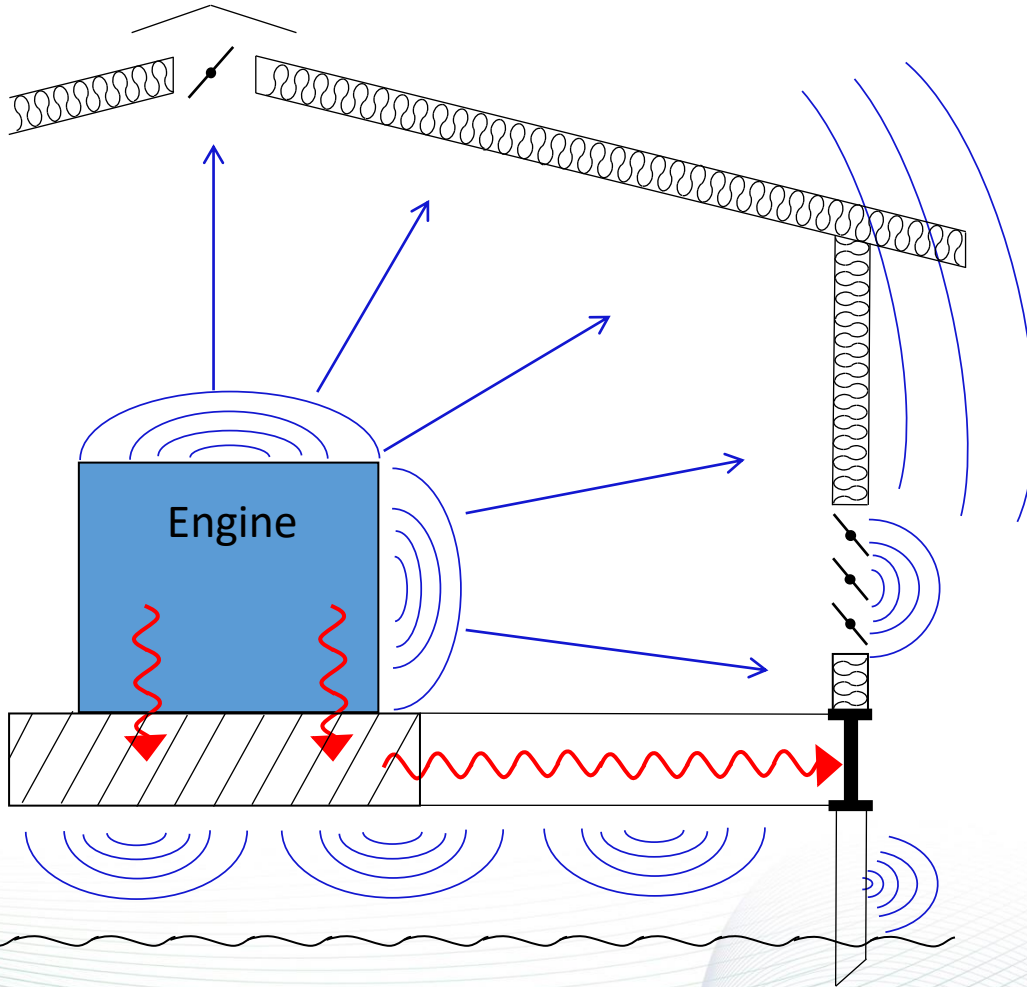


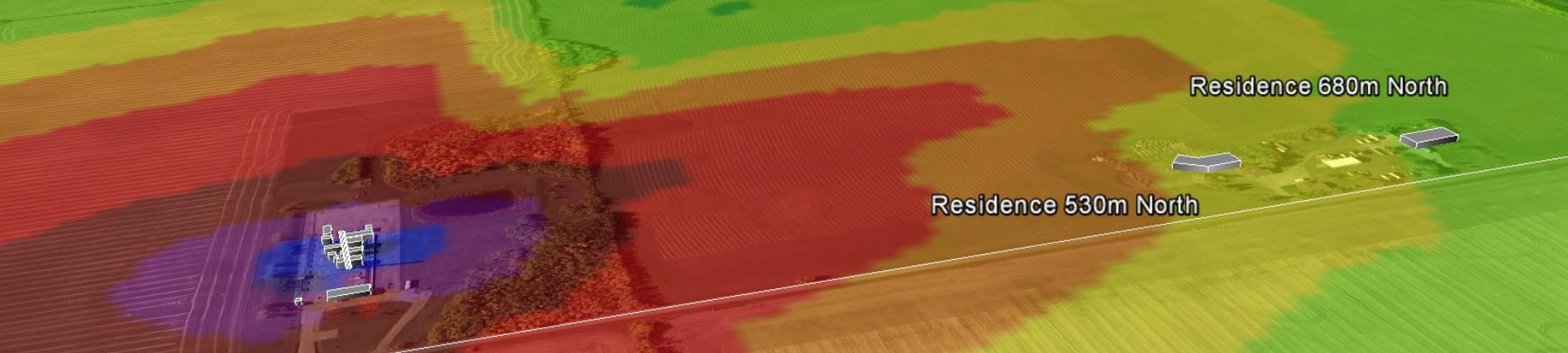
Noise Emissions – Fans

Cooler Side Near Field Sound Map



Noise Emissions – Engine Casing





Residence 680m North

Residence 530m North

Mitigation Opportunities



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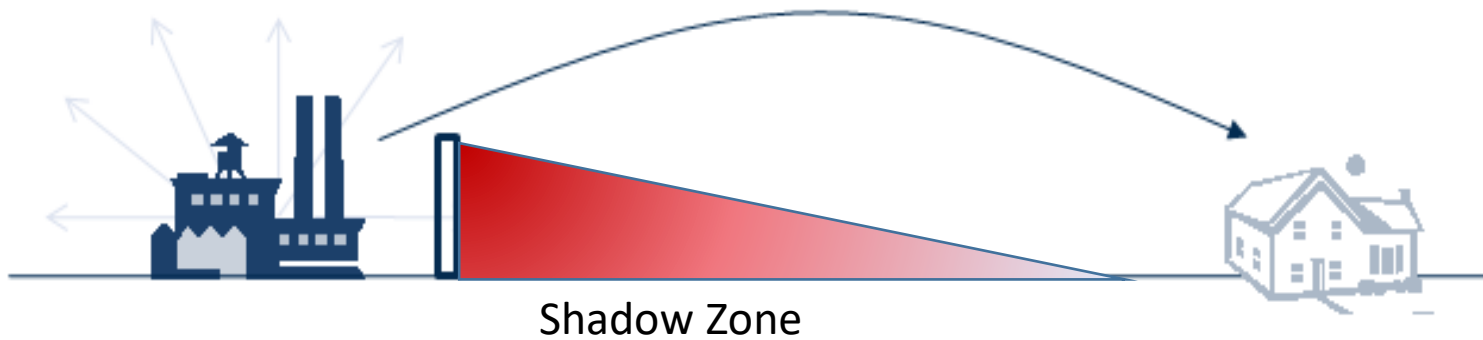
Noise Mitigation – Philosophy



- ❑ **Path based** : Add control between the source and receiver.
 - Silencers, enclosures, barriers, etc.
 - Add mass and dampening to vibrating components.
- ❑ **Source based** : Reduce the sound emitted by the source.
 - Quieter or slower engines, slow fans, electrification.
 - Reduce waste, generally

Noise Mitigation – Portability



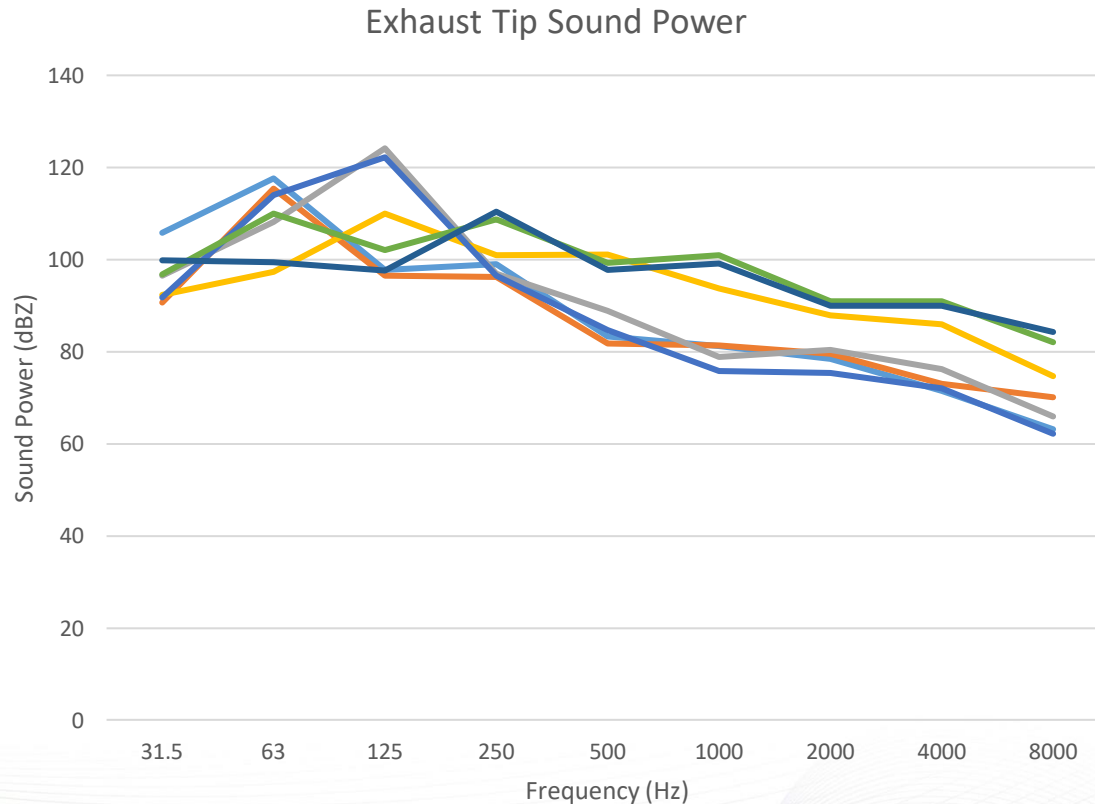


Noise Mitigation – Evolution



Noise Source	SPL (dBA)
Truck 8 Exhaust Muffler Tip	44.0
Truck 8 Exhaust Muffler Shell	43.5
Truck 7 Cooler Exhaust	42.3
Blender West Engine Exhaust Tip	42.1
Truck 8 Cooler Inlet	39.7
Truck 11 Engine Casing	38.5
Sand Conveyor	36.6

Noise Mitigation – Leveraging Data



A photograph of a large industrial facility, possibly a refinery or chemical plant, with numerous tall distillation columns and complex piping. The sky is filled with dramatic, white and grey clouds. The foreground of the image is a blue grid pattern that curves and flows into a series of overlapping, wavy bands of color (blue, green, yellow, and orange) at the bottom.

Research Wishlist



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Research – Wishlist

- ❑ **Sound and Annoyance:** Experience indicates that not all sounds result in uniform annoyance.
 - What other factors are related to annoyance?
 - How do cumulative effects change perception or stakeholder engagement?
 - Leverage new technology to extend past “single values” dBC/dBA into full datasets.
- ❑ **Environmental Propagation:** Variations in the environment cause large sound fluctuations in sound.
 - Existing modeling technology based on dated studies and limited data sets in low frequencies.
 - Large scale control studies using modern technology and full data set (frequency and temporal).
 - Benefit to mitigation planning and policy development.

