23rd International Congress on Acoustics

The Acoustic Group
CONSULTING ACOUSTICAL AND VIBRATION ENGINEERS

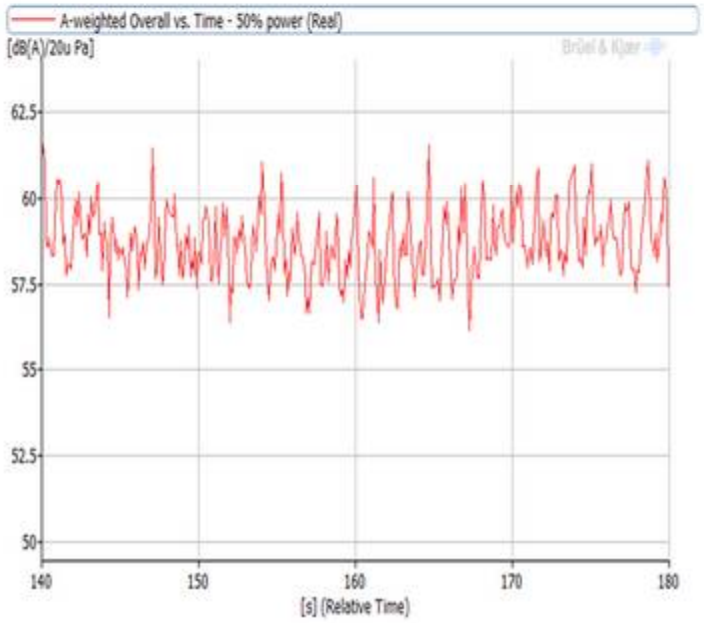
A simplified method for determination of “amplitude modulation” of audible and inaudible wind turbine noise

Steven Cooper

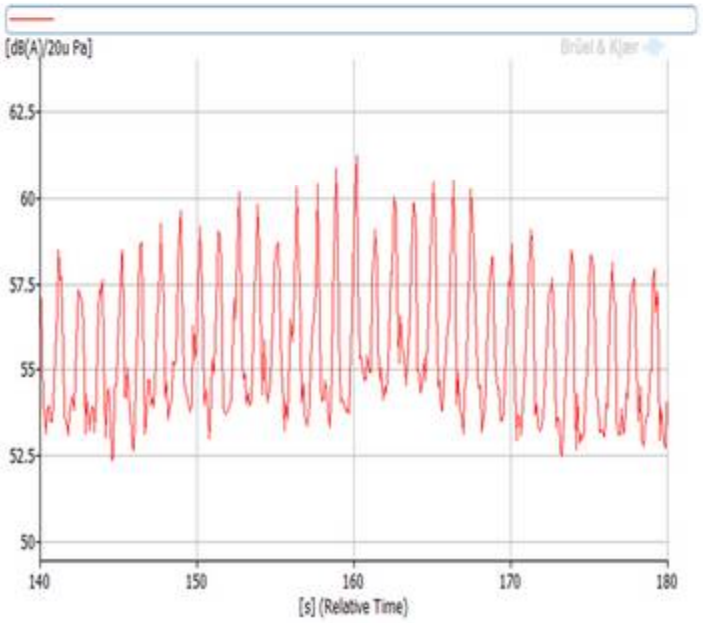
Cape Bridgewater Windfarm Study – Modulation of A-weighted level for different power settings

TURBINE 13 LOCATION 7
A-WEIGHTED OVERALL VS. TIME

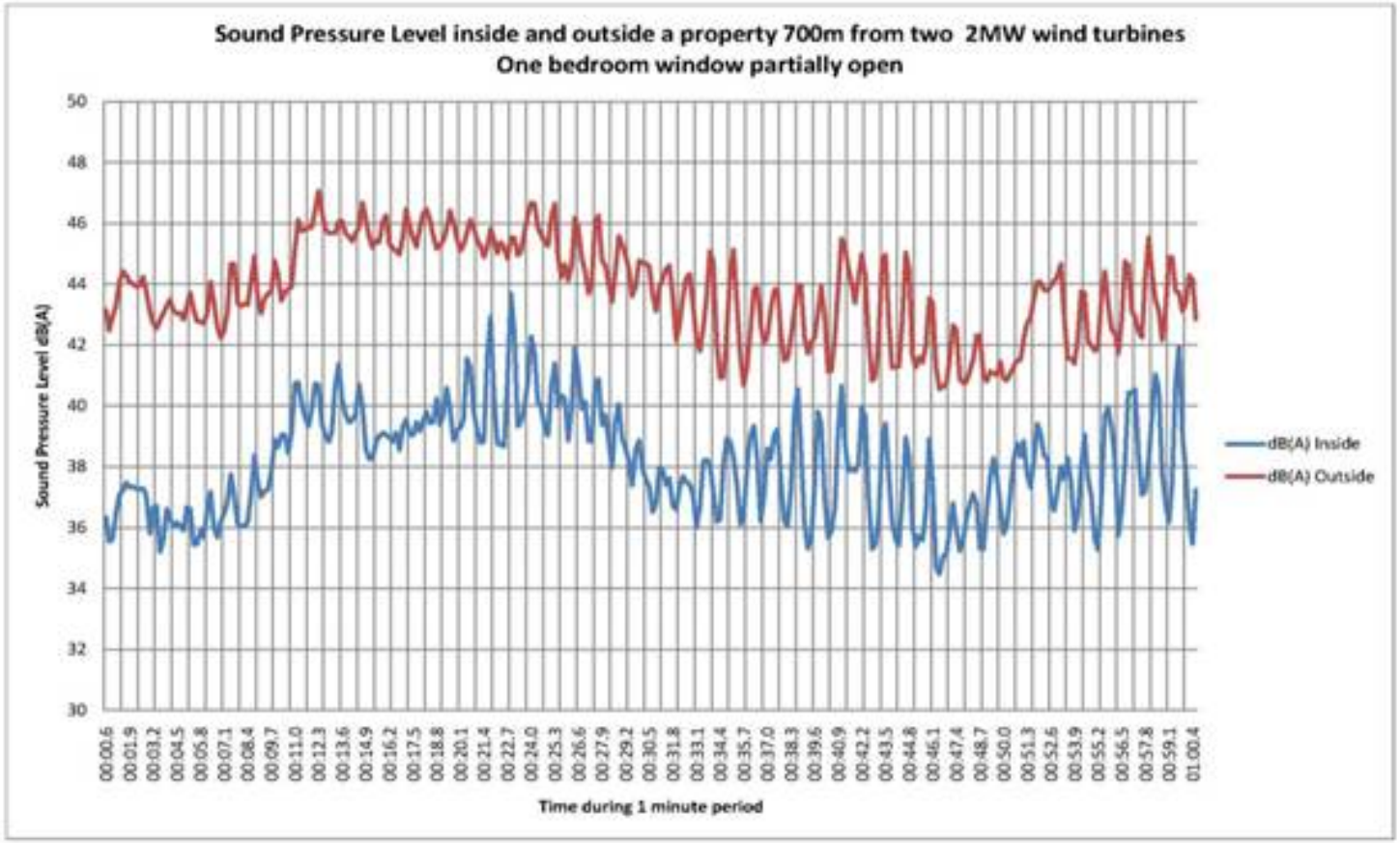
50% power



14% power

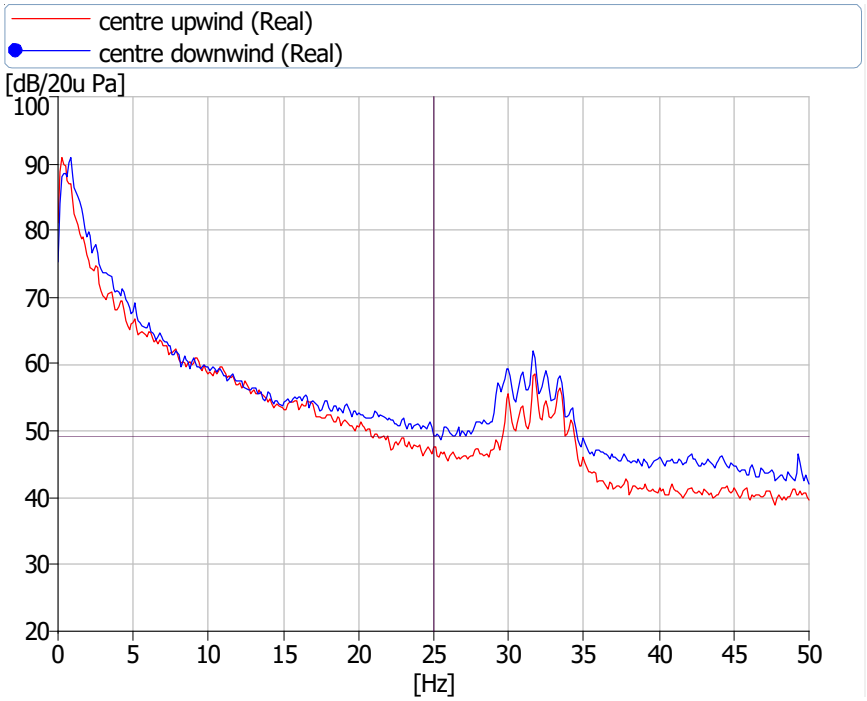


Simultaneous Inside and Outside Measurements – Leonards Hill Wind Farm (Victoria, Australia)

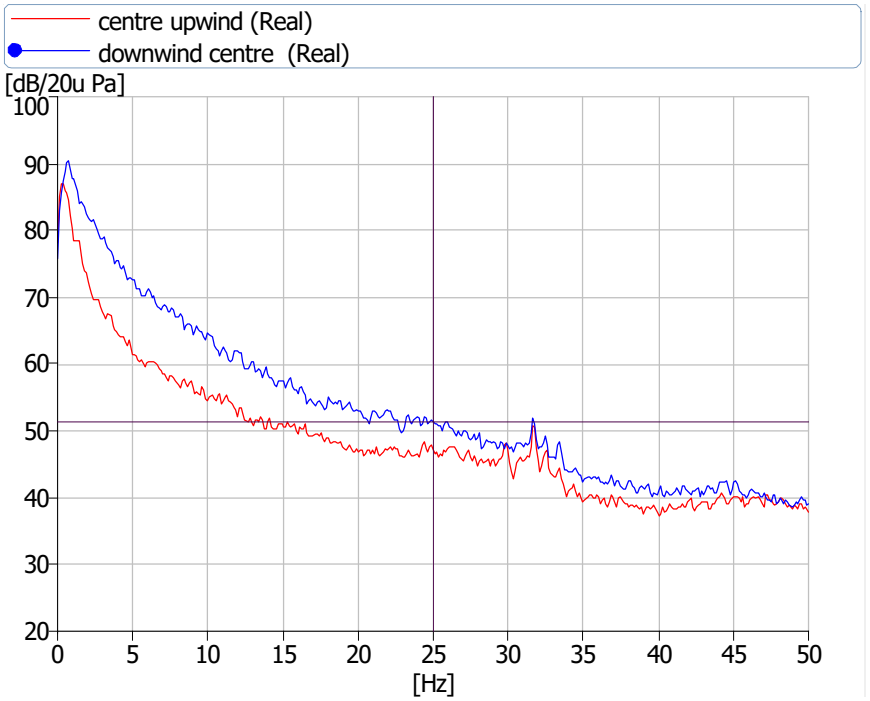


Courtesy of L Huson & Associates

FFT (0-50 Hz, 400 lines)

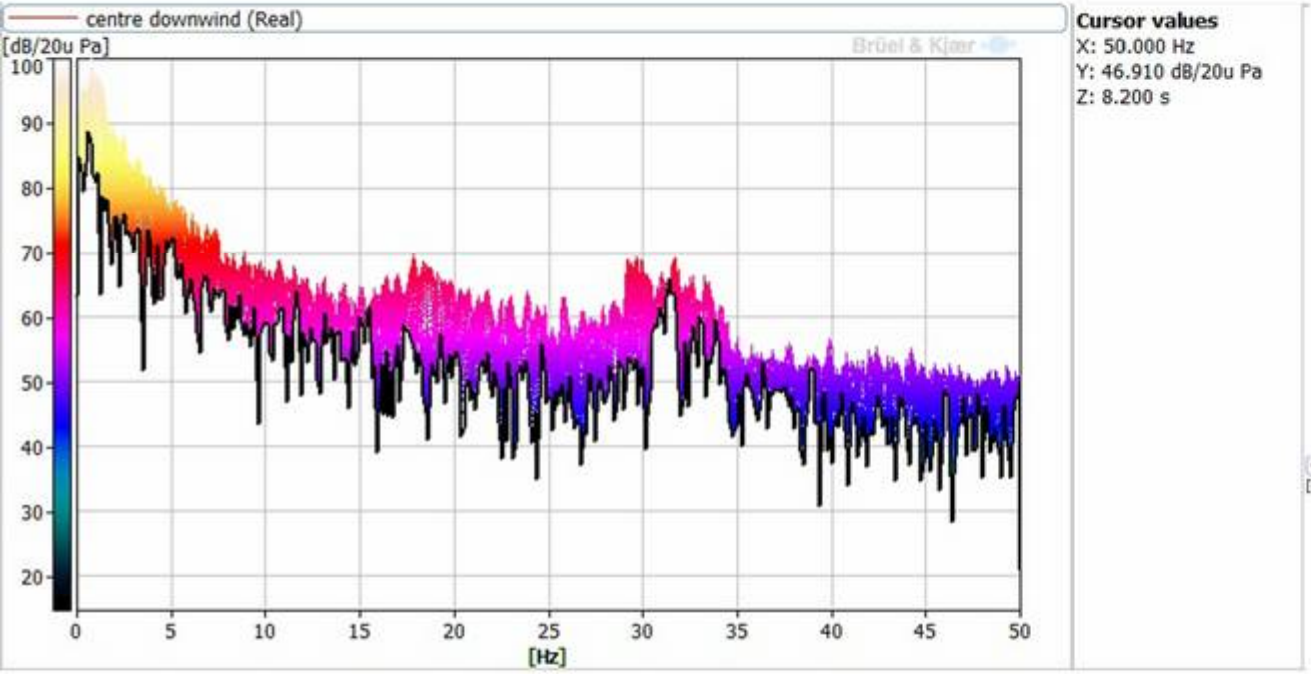


50% power

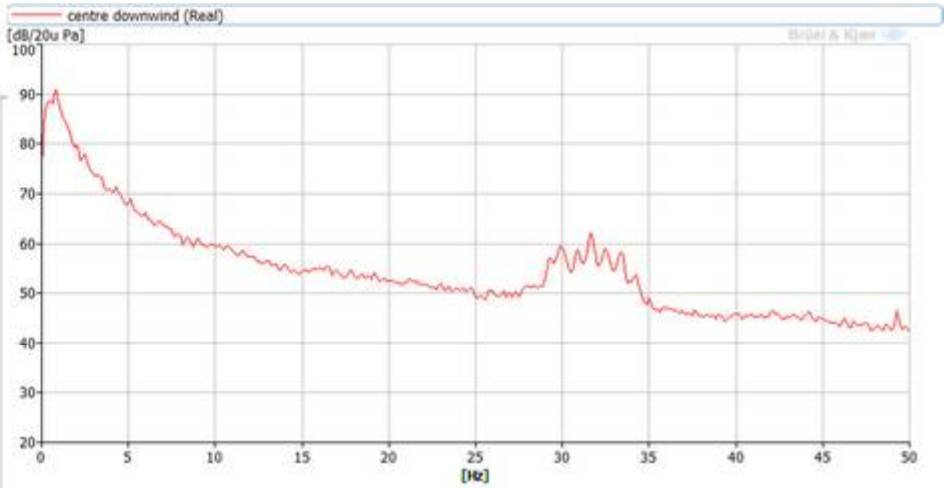


14% power

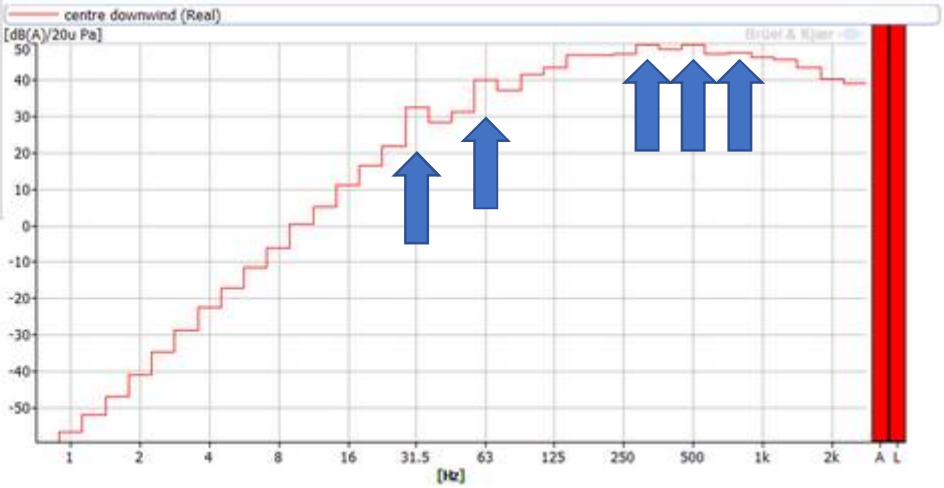
CBW Turbine 13 at 50% power



FFT vs Time (0-50 Hz, 400 lines)



FFT (0-50 Hz, 400 lines)

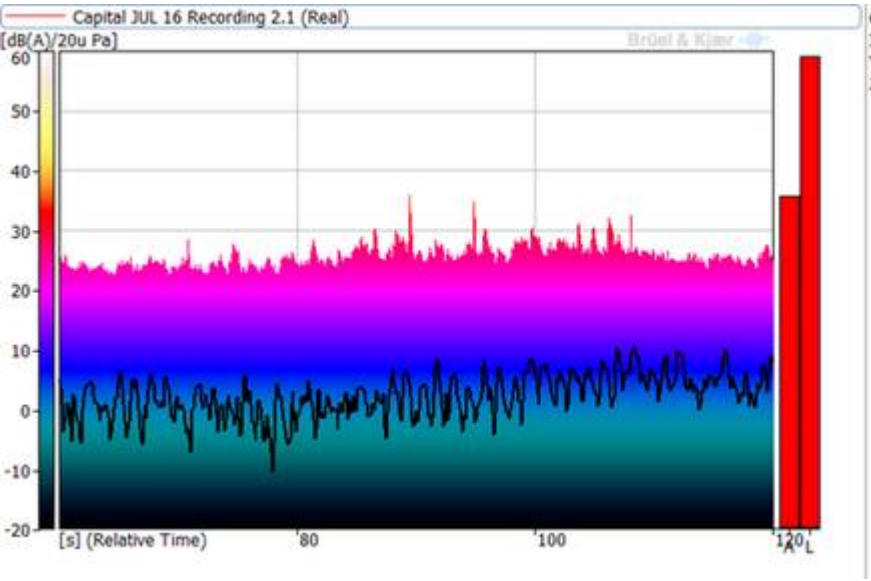


1/3 Octave Bands (A-weighted)

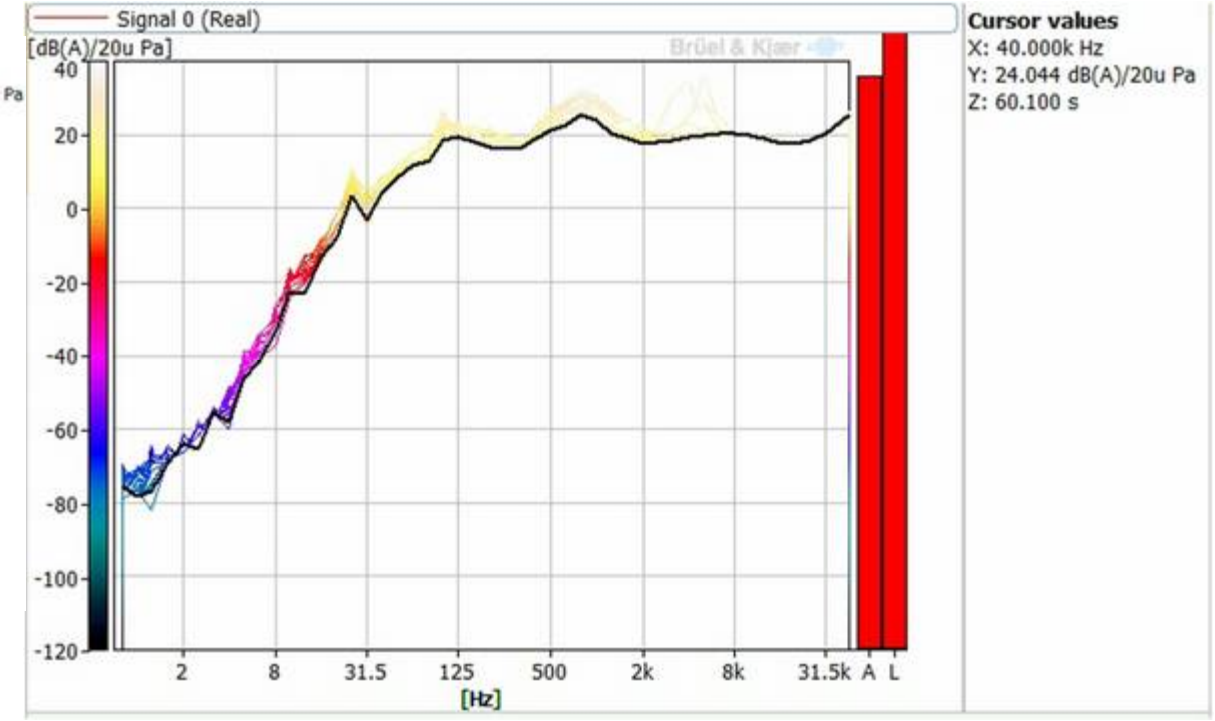
Manual Detection of AM

- Some methods have used A-weighted levels or peaks in the A-weighted 1/3 octave band spectra to then be subject to assessment in 10 second blocks of time for which the median of the maximum and minimum over a 10 minute sample is used to determine the AM
- Other proposals have nominated the use of an FFT analysis of the blade pass frequency but without due consideration of the BT = 1 issue
- Based upon a modified Den Brook Methodology the use of 1/3 octave as described above have been used for comparison purposes
- On the basis of an A-weighted spectrum, then the criticism of non-compliance with BT = 1 is reduced because of the attenuation of the A-weighting filter

25 Hz 1/3 octave band time trace and movie plot of turbine

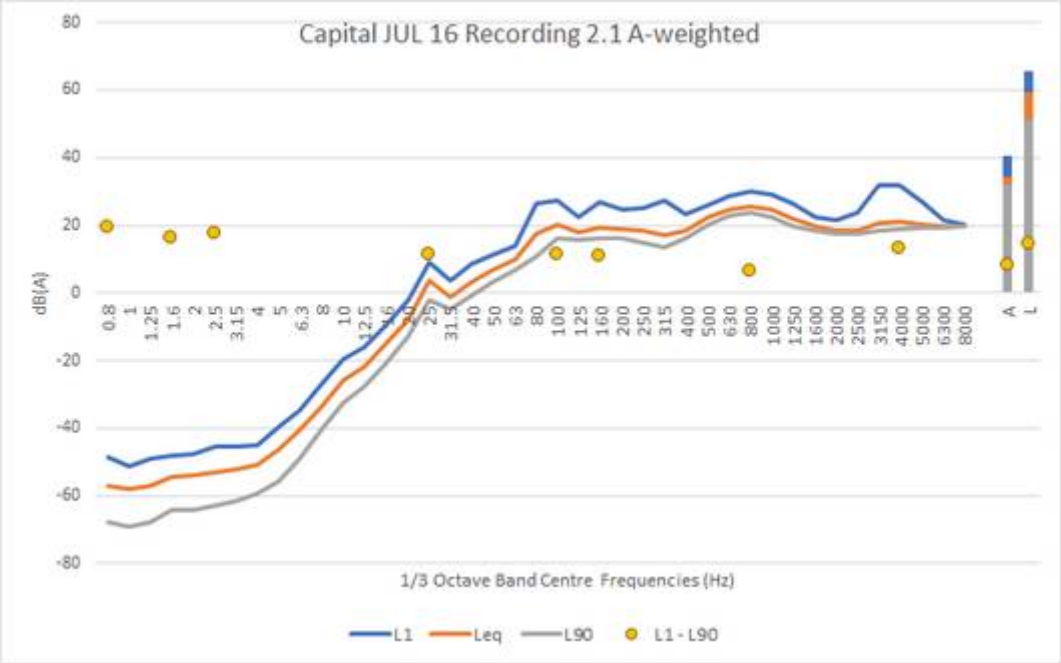


25 Hz 1/3 Octave Band Time Splice

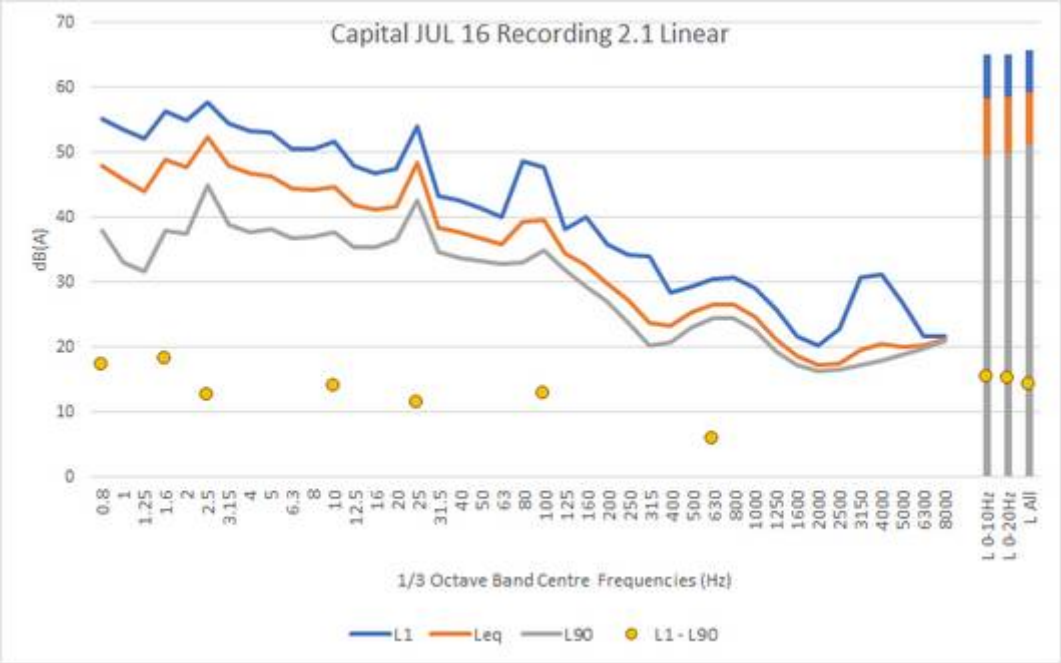


CPB vs. Time (1/3 octave bands)

Modulation Indices derived from alternative method (A-weighted spectra)



Modulation Indices derived from alternative method (linear spectra)



Comparison of Modified Den Brook Method and Simplified Statistical Method