Surf Wave Parks – Assessing the Sound of Fun

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SUMMARY

Surf wave parks are an emerging commercial development that are increasingly being proposed to be built around Australia. When considering noise control they present large areas of water where substantial inertial masses are displaced in order to create surfable waves of heights, currently up to 2 m, that continuously break in sections of the water body area with a high frequency and long duration. Patron, traffic, plant and machinery noise are often misperceived by the public to be the main contributing noise sources, where long durational noise from resonance of air in the tube of the wave or cavitation of the bubbles created in the spilling or breaking process are dominant. Airborne generation of noise from breaking waves has been shown to be complex, containing tonal, modulating and broadband components, which are all additive when assessing noise dose. A case study is presented of a wave park proposal in Tompkins Park, Alfred Cove, Western Australia alongside the Swan River. This proposal has been controversial due to its placement next to a protected migratory water bird sanctuary, and the large number of noise sensitive receivers in the surrounding residential neighbourhood. Characteristics of wave noise are examined indicating placement and assessment problems relative to the location.

1 OUTLINE

The observation of underwater noise generated from breaking waves has been extensively studied, but when considering airborne noise, the literature is sparse. A few studies exist indicating spectra of plunging and spilling waves and physical modelling (Bolin and Åbom 2010; Tollefsen and Byrne 2011; Dallas and Tollefsen 2016). The tonal components have been shown to be approximated by a horizontal flu like open/closed ended tube that has tonal and harmonic frequencies directly related to the width and length of the tube where the acoustic mechanism is the resonance of the entrained air in the wave's barrel. This observation implies that the noise would also have directional low frequency components apart from the omnidirectional broadband noise created by bubble cavitation in the spill or breaking processes. These processes result in a pink noise spectrum dominated by low frequencies with harmonic content. The main determinants of magnitude of noise has also been shown to be wave height and speed. Modulation has also been observed in the 50 Hz third octave band. Any assessment of the airborne noise from breaking waves needs to account for such complex noise characteristics, the operational nature of the wave park (such as frequency of wave creation, height and speed), the area of the noise source and placement of the park relative to noise sensitive receivers. This assessment must also account for the surrounding atmospheric environment when considering acoustic propagation behaviour. Usually such parks are planned or placed in remote areas where noise control tends to not be an issue, but due to commercial reasons developers would ideally like to place them in residential areas to increase patronage. The placement of this particular proposal in a southerly location adjacent to Alfred Cove with the most sensitive area of a nature reserve directly north, separated by a cove of water with an ever present south-westerly/easterly wind means that assessment must take into account the strong positive sound speed gradient and downward refracting conditions that would likely be present in the evenings, which is the control criterion. This could potentially have a severe negative impact on the migratory bird habitat. The effect of anthropogenic noise on birds is well documented where levels above 45-50 dBA have been demonstrated to have significant negative impacts resulting in a large observed reduction in numbers of affected species (Ware et al. 2015). This has mainly been attributed to increased vigilance due to noise, resulting in lower body mass, changes in demography, communication masking and general area avoidance.

Analysis of a similar wave park proposal in Sydney reveals floors in the noise assessment process due to the non-consideration of the above-mentioned characteristics of wave noise and noise generation area. Additionally, the application of tonal and modulation penalties (+10 dBA) are likely to be applied in such a proposal (Figure 1 & 2). Furthermore, application of refraction in propagation modelling indicates that Tompkins Park is not an ideal location. Noise emissions would likely exceed the prescribed regulations

for Western Australia in the absence of objective evidence. Until further evidence of noise generated from such parks is available, control of such noise will be difficult to evaluate, and authorities should demonstrate caution when assessing such proposals placed in noise sensitive areas.

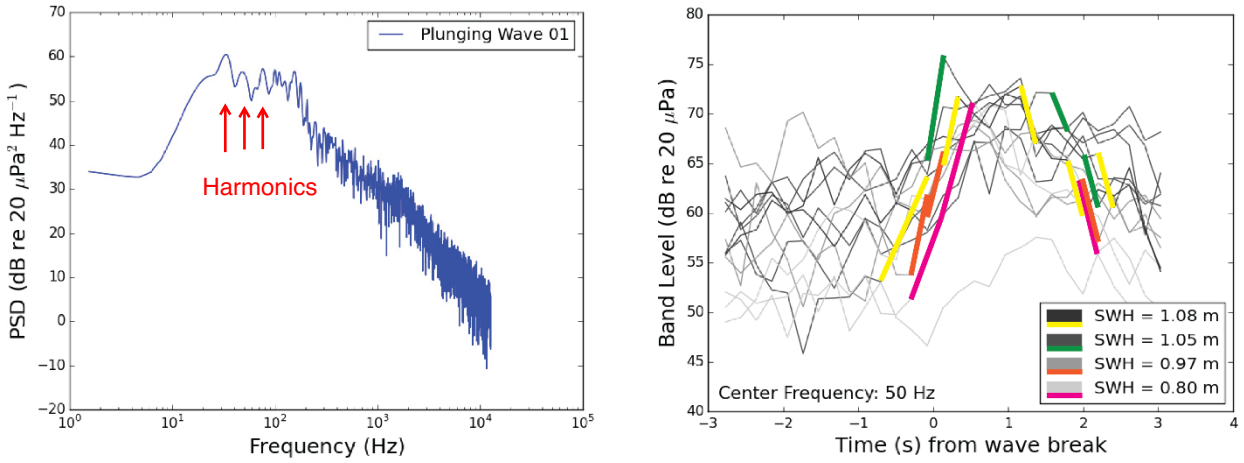

Figure 1: Analysis of Dallas and Tollefsen indicating a $L_{A\ Fast}$ 3dB modulation is present.

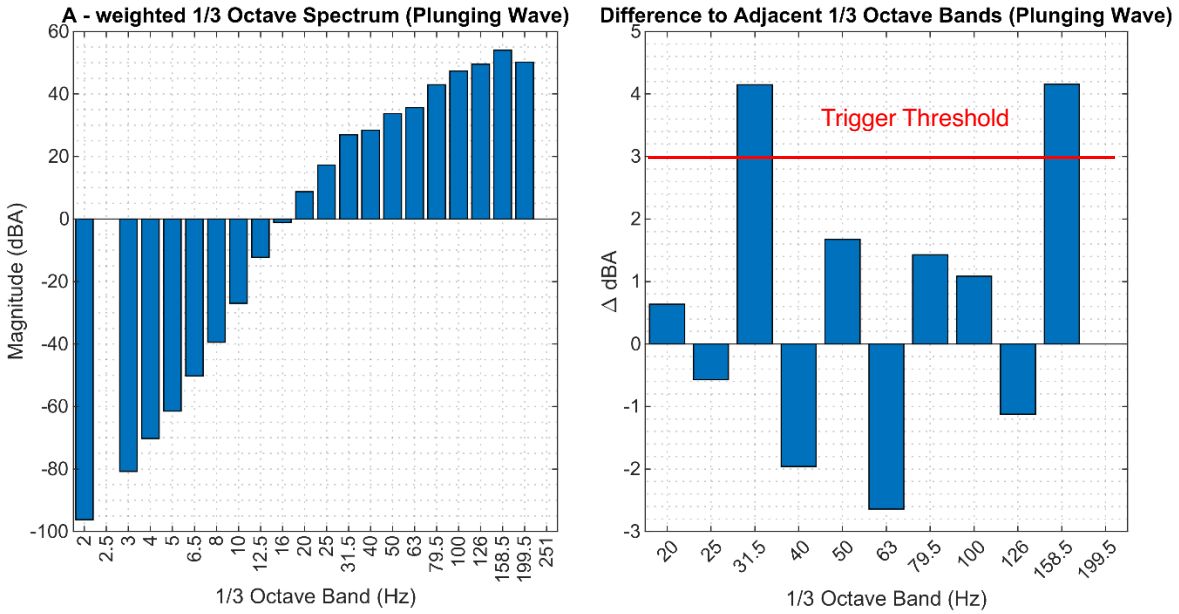

Figure 2: Transformation of the spectrum in Figure 1 to 1/3 Octave band analysis indicates tonality is present.

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