Williamstown Maritime Precinct Wave, Wash and Surge Study - Stage 3 Mitigation Options Assessment

Report

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Synopsis	This BMT report documents Stage 3 of the study conducted for Parks Victoria, Victoria State Government, on monitoring, data analysis, modelling, and assessment of high-level options to mitigate damaging wave, wash and surge intermittently experienced at the Williamstown Maritime Precinct. Stage 3 focuses on advanced analysis of collected data, comparative assessment of potential mitigation measures, and recommendations.
Author	Dr. Daniel Machado, Lindsey Gilbert, and Marzieh Derkani
Reviewed By	Dr Daniel Machado
Project Manager	Dr Daniel Machado

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Executive Summary

The Williamstown Maritime Precinct – Wave, Wash and Surge Study (this study) is concerned with 'wave, wash and surge' events intermittently experienced and reported by stakeholders at the Williamstown Maritime Precinct, southwest of Melbourne, Victoria. The study, commissioned by Parks Victoria (PV) and the Department of Transport (DoT), Victoria State Government, involves monitoring, data analysis, and identification of high-level options to mitigate the 'wave, wash and surge', which are regarded as both inconvenient and damaging by local stakeholders. The study comprises three stages, namely: Stage 1 – Data Collection; Stage 2 – Data Analysis; and Stage 3 – Potential Mitigation Options.

This report documents the findings of Stage 3 – Potential Mitigation Options, it covers further advanced analysis of the data collected during previous stages, general characterisation of the wave climate in the study area, development of a comparative assessment framework for evaluation of mitigation measures to the 'wave, wash and surge' events, which was informed by engagement with key stakeholders from PV, DoT and local marinas and yacht clubs. The outcome of this assessment process is a set of recommendations ranked by their overall score, considering effectiveness (likelihood) and consequence criteria, for mitigating the risk posed by the vessel generated wake and surge on berthed vessels.

Building on the previous stages of the study, key findings of the additional data analysis completed in Stage 3 include:

- The wave climate that is naturally occurring in the Williamstown Maritime Precinct results in conditions that do not conform with the Australian Standards for Marina Design. The results of a calibrated and validated spectral wave model of wind sea waves for the broader Port Phillip Bay and Hobsons Bay propagating to Williamstown, indicate significant wave height extremes of 0.78m and 0.55m for the 50year and 1year average return interval (ARI), exceeding the criteria recommended in the Standard. Further, annual probabilities of occurrence of 1.4%, 3.0% and 4.35% for significant wave heights greater than 0.3m for short period waves (<2s), 0.3m for longer period waves (>2s) and 0.15m for longer period waves (>2s), respectively, all exceed the recommendations from the Standard for good wave climate in marinas.
- The naturally occurring wind and wave conditions in the study area result in moored boat motions of variable amplitude. For typical/ambient conditions these motions are generally of lesser amplitude than those caused by marine traffic, as observed in this study. More severe or extreme weather conditions, however, can result in extreme boat motions and impact to infrastructure, which have not been the focus of this study.
- The wave climate of the Williamstown Maritime Precinct is further degraded by the frequent occurrence of wake and surge generated by vessel transits through and around the study area, with wave heights that at times exceed those recommended in the Standard (i.e., 0.15m for "beam" seas and 0.3m for "head" and "oblique" seas).
- Wake and surge generated by vessels transiting through and around the study area were analysed, using the measured data to characterise the wave properties close to the source vessels (where the wake is generated) and the affected area (i.e., marinas, yacht clubs and public piers). It was found that different vessels produce a distinctive wake pattern or "signature" at the source, with four types of vessels characterised: 1. Fast ferries (i.e., catamaran design), 2. Large (commercial) ships with deep draught (e.g., cargo, tanker, cruise ship, etc), 3. Tugs, and 4. Small to medium motorboats (not included in other categories). However, despite distinctive wake signatures of the various vessel types at the source, the properties of the propagated wake waves observed in the affected areas are not too dissimilar, which is attributed to the physics of the wave propagation process. In

practical terms, this means that wake and surge from different vessel types affect the study area in a similar way.

- Expanding on the detection of 'wave, wash and surge' events, the acceleration data collected from the boat motion sensors was further analysed using a dynamic threshold algorithm. This confirmed the frequent occurrence of 'surge' boat motions that have been reported by the local stakeholders prior and during this study. Peak accelerations recorded during the surge motions were between 1.5 and 2.0m/s^2. The data analysis indicated that these surge motions occurred in the vast majority of the detected events, in conjunction with the roll angular motions, and hence these surge events had already been accounted for in the catalogue of events previously developed during Stage 2.
- Looking at the timeseries of properties of propagated wake wave package and the response motions of moored boats measured, it is inferred that the surge motions are initiated by the leading waves of the propagated package, which are characterised by having smaller wave height but larger wavelength and period (i.e., a relatively longer wave that travels faster in the water). In contrast the subsequent waves in the propagated package have larger wave height but smaller wavelength and period (i.e., relatively shorter, and steeper waves), which in turn are associated with initiation and prolongation of the angular (e.g., roll and pitch) motions.

A comparative assessment framework was developed for the evaluation of potential mitigation measures to the events. The framework integrates data outcomes and insights from the monitoring and analysis program, and incorporated input from engagement with stakeholders. The framework was developed following the principles of multi-criteria analysis and risk management, and as such it considers the likelihood (of effectiveness) and the consequences (either positive benefit or negative detriment) along with a comprehensive set of social, economic, environmental, and other criteria. Based on the two mitigation strategies identified as viable in the previous stage of the study, namely: "Reducing the generation of wake as the main cause of the events, i.e., operational control measures, such as managing vessel transit and speed limits" and "Local reduction of effects of the incident waves (including wake waves) on the boats and infrastructure", a list of 14 potential mitigation measures was prepared with consideration of input from the stakeholders:

- Operational control measures
  - Education and enforcement of speed control / limit of Recreational Boats
  - Education and enforcement of speed control / limit of Fast Ferries
  - Education and enforcement of speed control / limit of Tugs and Pilot boats and Port Tenders
  - Education and enforcement of speed control / limit of large commercial (e.g., Cargo, Tanker, and Cruise Ship) vessels
  - Education and enforcement of speed control / limit of Small – Medium Commercial Vessels (excluding Tug and Pilot vessels)
  - Creation and/or modification of 5 knot zone
  - Restriction of vessels
- Reduce local effect measures
  - Redistribution of moored boats
  - Damping devices
  - Improvement of fendering systems
  - Repair and replacement of joints in marinas and yacht clubs' infrastructure
  - Spacing boats within local marinas and yacht clubs
  - Re-alignment of berths within marinas and yacht clubs
  - Wave attenuation at the marina scale

The potential mitigation measures were then evaluated and scored using the comparative assessment framework, and then ranked based on the overall scores obtained as a product of the effectiveness (likelihood) and consequence scores. The evaluation and scoring process was further informed and "calibrated" by direct engagement with key stakeholders including government agencies (PV and DoT), local yacht clubs and marinas (Royal Yacht Club of Victoria, Hobsons Bay Yacht Club, The Anchorage Marina, Royal Victorian Motor Yacht Club, Savages Wharf Marina, and Blunt's Boatbuilders), as well as Port Phillip Ferries. There is an element of overlap in some of the mitigation measures, (e.g., the speed control / limit of either recreation boats and small to medium commercial boats and the modification of the 5-knot zone), however, it is noted that each measure was assessed and ranked individually. In general, the comparative assessment results indicate that the "operational control measures" rank higher than the "local reduction of effects" measures. In more detail, the results show:

- The five best ranked measured are: 1. Creation or modification of 5 knot zone, i.e., extend the 5kt speed limit from the foreshore to the channel boundary of the Williamstown channel; followed by 2. Education and enforcement of speed control / limit of recreational boats; 3. Education and enforcement of speed control / limit of Fast Ferries; 4. Wave attenuation at the local marina scale; and 5. Education and enforcement of speed control / limit of large commercial vessels.
- The four worst ranked measures are: 13. Spacing boat berths within the local marinas (this measure is considered not viable by the local marinas and yacht clubs, based on their direct feedback); 12. Repair, replacement and maintenance of joints / piles in marinas' infrastructure, e.g., pontoons, jetties (this measure is already part of the maintenance program of the local marinas and yacht clubs, based on their direct feedback); and 11. Education and enforcement of speed control / limit of small to medium commercial vessels (this measure becomes somewhat redundant if the measure ranked 1st is applied). Further, the measure of restriction of vessels was discarded as it was rendered as non-feasible at this point in time (and thus automatically ranked 14th).
- A set of three other measures ranked 8th in a tied ranking, these are: Redistribution of boats within marinas, i.e., large boats moored next to smaller ones; Damping devices, e.g., "rider poles"; mooring springs, etc., aimed to avoid contact; and Improvement of fendering systems, i.e., aimed to minimise impact when contact occurs. These measures have, to some extent, already been trialled / implemented by the local marinas and yacht clubs and found to be of limited effectiveness, based on their direct feedback.

The comparative assessment provides direction regarding the relative effectiveness of each mitigation. The following is a list of recommendations in priority order, with consideration of the overall scores, which account for effectiveness (likelihood) and consequence criteria.

1. Modification, i.e., extension, of a 5kt zone speed limit from the Williamstown foreshore to the channel boundary of the Williamstown channel, including navigational aids and signage, and an education campaign targeting the main users of this area, namely recreational boats and small to medium sized commercial vessels.
2. Undertake speed controlled trials and route changes on Fast Ferries to test avoiding the critical speeds (e.g., 17-20kt) to determine the best low wash and wake operating conditions for these ferries. Consideration in the trials should be given to rapid versus slow accelerating and decelerating, in line with the vessel design and capacity.
3. Explore implementation of education and enforcement of speed control / limit of large commercial vessels e.g., cargo, tankers, cruise ships) as well as port support vessels (e.g., tugs, pilot boats and port tenders), in collaboration and engagement with VPCM / Ports Victoria, the Harbour Master, and their teams.
4. The marinas, yacht clubs and foreshore businesses plan for future wave attenuation at a local scale to provide wave protection suitable for each of their facilities.

5. Re-alignment of berths within the marinas (likely to only be feasible if/when marinas are refurbished / upgraded and may not be feasible nor viable for all marinas).