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| **TO** | Karen Hillman | **FAX NO** | EMAIL |
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| **FROM** | Murray Burling | **FILE LOC** | .1C |
| **SUBJECT** | Albany Waterfront Flushing<br>Results of Revised Layout Flushing Modelling | **PRIORITY** | Regular |

Karen,

**INTRODUCTION**

As requested, we have completed modelling for two scenarios for a revised Albany Boat Harbour. These layouts were as provided by Martin Baird of DPI (Fixed Breakwater Option) and as noted by the project team (Floating Breakwater Option).

The modelling work entailed amending the previous model layouts and then re-running all the flushing scenarios for the new layouts. A total of 18 simulations were run: 2 layouts x 3 seasons x 3 time-periods.

The modelling methodology was identical to that adopted for the previous body of work. Flushing of the various harbour components was assessed using a conservative dye tracer, which was then tracked through the simulation. The e-folding concentration of approximately 37% was used to define the flushing time-scale. All times reported here refer to this e-folding level.

**RESULTS**

The table below shows all flushing times determined from the modelling. The first two result columns present the predicted flushing times for the boat harbour for the fixed and floating breakwater options respectively. The second two result columns show the same for the tug harbour.

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**Table 1 - Predicted e-folding Flushing Times (Days)**

| **Simulation - month and description of wind and tidal conditions** | **Post Development e-folding time (days) Marina/Harbour** | | **Post Development e-folding time (days) Tug Harbour** | |
|---|---|---|---|---|
| **January** | Fixed Breakwater | Floating Breakwater | Fixed Breakwater | Floating Breakwater |
| 1. Typical summer conditions with predominantly south-easterly winds with speed generally of 4 to 7 m/s. Tidal range varies between 0.5 m to 1.0 m. | 5.2 | 3.9 | 3.2 | 3.1 |
| 2. Southerly winds for first two days (speed of 2 to 5 m/s) and then changing to stronger easterly winds (up to 10 m/s). Low tidal range of 0.4 m to 0.7 m. | 5.4 | 3.3 | 2.5 | 2.3 |
| 3. Easterly winds for first two days (speed 3 to 9 m/s) and then after varying direction between east and southwest. Tidal range of approximately 1.0 m. | 6.0 | 3.3 | 1.3 | 0.8 |
| **April** | Main harbour | Main harbour | Tug Harbour | Tug Harbour |
| 1. Winds varying between north and west (speed up to 7 m/s) for first three days, and then winds between south and east with speed up to 9 m/s. Tidal range of 0.4 m to 0.6 m. | 5.1 | 5.1 | 3.3 | 2.5 |
| 2. Dye simulation was started at the middle of simulation 1. Wind direction varying between south and east for first three days. Wind is constantly from the south day 4 to day 6, and then after constantly from the east. Wind strength is typically between 3 to 8 m/s. Tidal range of approximately 0.5 m. | 3.6 | 1.9 | 1.2 | 1.1 |
| 3. For first five days constant easterly winds (3 to 8 m/s), ending with a half day storm with wind speed up to 13 m/s. After storm, wind direction is southeast. Tidal range varies from 0.3 to 0.6 m. | 5.3 | 4.2 | 2.0 | 1.6 |

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**Table 1 (Continued)**

| Simulation - month and description of wind and tidal conditions | Post Development e-folding time (days) Marina/Harbour | | Post Development e-folding time (days) Tug Harbour | |
|---|---|---|---|---|
| **July** | Main harbour | Main harbour | Tug Harbour | Tug Harbour |
| 1. North-westerly winds (typical for winter) with speed of 5 to 7 m/s, and tidal range of approximately 0.8 m. | 3.7 | 3.6 | 2.0 | 1.4 |
| 2. Predominantly north-westerly winds with speed of 4 to 6 m/s. Simulation starts with wind speed up to 10 m/s. Tidal range of 0.7 m. | 3.8 | 3.3 | 1.7 | 1.2 |
| 3. First three days North-westerly winds (3 to 9 m/s) and low tidal variation of 0.4 m. Then, winds are lighter (2 to 3 m/s) and vary between southeast and northeast, and tidal variation increases to 1.0 m. | 3.4 | 3.4 | 1.7 | 1.2 |

## SUMMARY

The main conclusions from this work are as follows:

1. Flushing times are predicted to be lower for the revised layouts when compared to the previously modelled cases. In some cases significant reductions have resulted from the modification to the layout. This is in part due to the reduced enclosure of the boat harbour entrance and the increased disconnection between the boat harbour and the tug harbour basins.
2. Flushing times for the boat harbour are predicted to be 3.5 to 6 days in the case of the fixed breakwater option.
3. The floating breakwater option is predicted to reduce flushing rates by an average of 1-2 days, with the resulting range of flushing times predicted to be 2 to 5 days.
4. The floating breakwater is less effective (in terms of flushing) in July, and most effective in January.
5. The tug harbour is predicted to flush in 1 to 3 days. An improvement of up to 0.5 days was observed when compared to the original layout, which had a more enclosed entrance.

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We trust this provides the necessary information to assist in the selection of an appropriate option to move forward with. Please feel free to contact me if you need to discuss the results in greater detail.

Best Regards,

Murray Burling
Discipline Lead: Coastal & Ocean
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