7 Sensitivity Modelling

The sensitivity of the model was analysed to determine the range of uncertainty in the model results for changes in key parameters. The following variables were tested for the 1% AEP 120 minute catchment derived flood event (or PMF 90 minute for open-ocean elevated water level Case 3):

- Catchment roughness – increased and decreased by 20%
- Catchment rainfall – increased and decreased by 20%
- Tailwater level – increased by 0.4m and 0.9m, which also represents an analysis of sea level rise
- Open-ocean elevated water level

7.1 Catchment Roughness

Values of the hydraulic roughness parameter applied to the model in the 2D grid were increased and decreased by 20% for the sensitivity analysis. For this assessment, the roughness was not adjusted in the 1D channels, pipes and culvert elements.

Differences of the peak water level were compared to the base model with the roughness values increased by 20% and decreased by 20%. **Figures 73 to 78** in **Appendix C** show the differences throughout the study area.

The impact of 2D roughness values on the results of the modelling are generally relatively low with a negligible average and median level difference. Larger differences occur at isolated locations. Increases and decreases are observed in both scenarios, due to the either additional or less resistance of the roughness changes.

Event peak water levels changes generally within the range of -0.1m to +0.1m are noted:

- For channels draining to Jilling Cove (from Woodland Street South, Balgowlah and Ernest Street, Balgowlah Heights)
- Near Holmes Avenue, Allenby Street, and Monash Crescent, Seaforth
- In streets near Manly Beach generally bounded by Ashburner Street, Gilbert Street, and Ceramic Lane as shown on **Figures 75 and 78**.

7.2 Catchment Rainfall

The average rainfall intensity for the 1% AEP 120 minute duration storm was increased and decreased by 20% for the sensitivity analysis.

Differences of the peak water level were compared to the base model for the rainfall increases and decrease. **Figures 79 to 84** in **Appendix C** show the differences throughout the study area.

Impacts due to variations in rainfall intensity are widespread across the study area, although there are certain areas that are more significantly affected than others.

The average change is generally low within the flood extent. Larger differences occur at isolated locations, which generally coincide with larger flow paths and storage areas.

7.3 Tailwater Level

Tailwater levels were increased by 0.4m and 0.9m. **Figures 85 to 87** in **Appendix C** show the area of affectation as a result of these changes. This analysis also represents an analysis of sea level rise scenarios, being +0.4m representing the year 2050 and +0.9m representing the year 2100. Isolated locations in foreshore areas show increase of flood extent as a result of the change in tailwater level. There are very limited areas where the tailwater level increase influences the flood depths that are not directly linked to the foreshore.

7.4 Open-Ocean Elevated Water Level

Elevated ocean levels may occur during storm events at ocean fronting areas (eg Manly Beach and Shelley Beach) due to the effects of wave runup and wind setup in an oceanic storm event.. Three sensitivity cases are modelled for elevated ocean levels based on OEH (2015) which lists combinations of catchment flooding and oceanic inundation scenarios as listed in **Table 7-1**. The peak of the elevated ocean condition may not specifically coincide with the peak of the catchment rainfall thus this condition has been run as a sensitivity.

Table 7-1 Open-Ocean Elevated Water Level Sensitivity Scenarios

Case	Catchment Rainfall	Ocean Boundary Tailwater (m AHD)	Harbour Boundary Tailwater (m AHD)	Figure
1	1% AEP 120 minute duration	2.30	1.40	88
2	2% AEP 120 minute duration (noting 5% AEP was not a modelled design event)	2.60	1.45	89
3	PMF 90 minute duration	2.60	1.45	90

Case 1 (1% AEP 120 minute duration rainfall with 5% AEP elevated tailwater levels in Table 7-1) was compared to the 1% AEP peak water level results with a tailwater level of 1.40m AHD. The sensitivity assessment is focussed to identify whether the elevated tailwater level results in increased peak water levels on properties. Peak water level increases of up to 0.01m are estimated in scattered locations across Manly as shown on **Figure 88**. An increase of up to 0.03m is estimated in Smith Street and Pine Street for the elevated tailwater condition due to reduced conveyance in the drainage pipe network. Properties in this area are estimated to have an inundation depth of 0.2m to 0.7m for the design tailwater boundary condition (discussed in **Section 4.5**).

Case 2 (2% AEP 120 minute duration rainfall with 1% AEP elevated tailwater levels in Table 7-1) was compared to the 1% AEP peak water level results with a tailwater level of 1.40m AHD. In Case 2, no increase is estimated to peak flood levels compared the design tailwater boundary condition. A reduction in the peak flood level for the elevated ocean level model is shown in many areas where shorter duration catchment rainfall durations dominate.

Case 1 (PMF 90 minute duration rainfall with 1% AEP elevated tailwater levels in Table 7-1) was compared to the 1% AEP peak water level results with a tailwater level of 1.40m AHD. A reduction in the peak flood level for the elevated ocean level model is shown in many areas where shorter duration catchment rainfall durations dominate. Peak flood levels are estimated to increase by up to 0.01m at Collingwood Street/Pacific Street, Smith Street / Pine Street, Carlton Street, The Corso / South Steyne, in Manly.

In conclusion, the ocean water level sensitivity analysis results indicate that the adopted design tailwater boundary conditions are suitable for the purposes of this study.