

Figure 7.2.32: Phase 2: Exceedance of 5 mg/L excess TSS in % of time for NE (top), SW (middle) and Inter (bottom) monsoons.

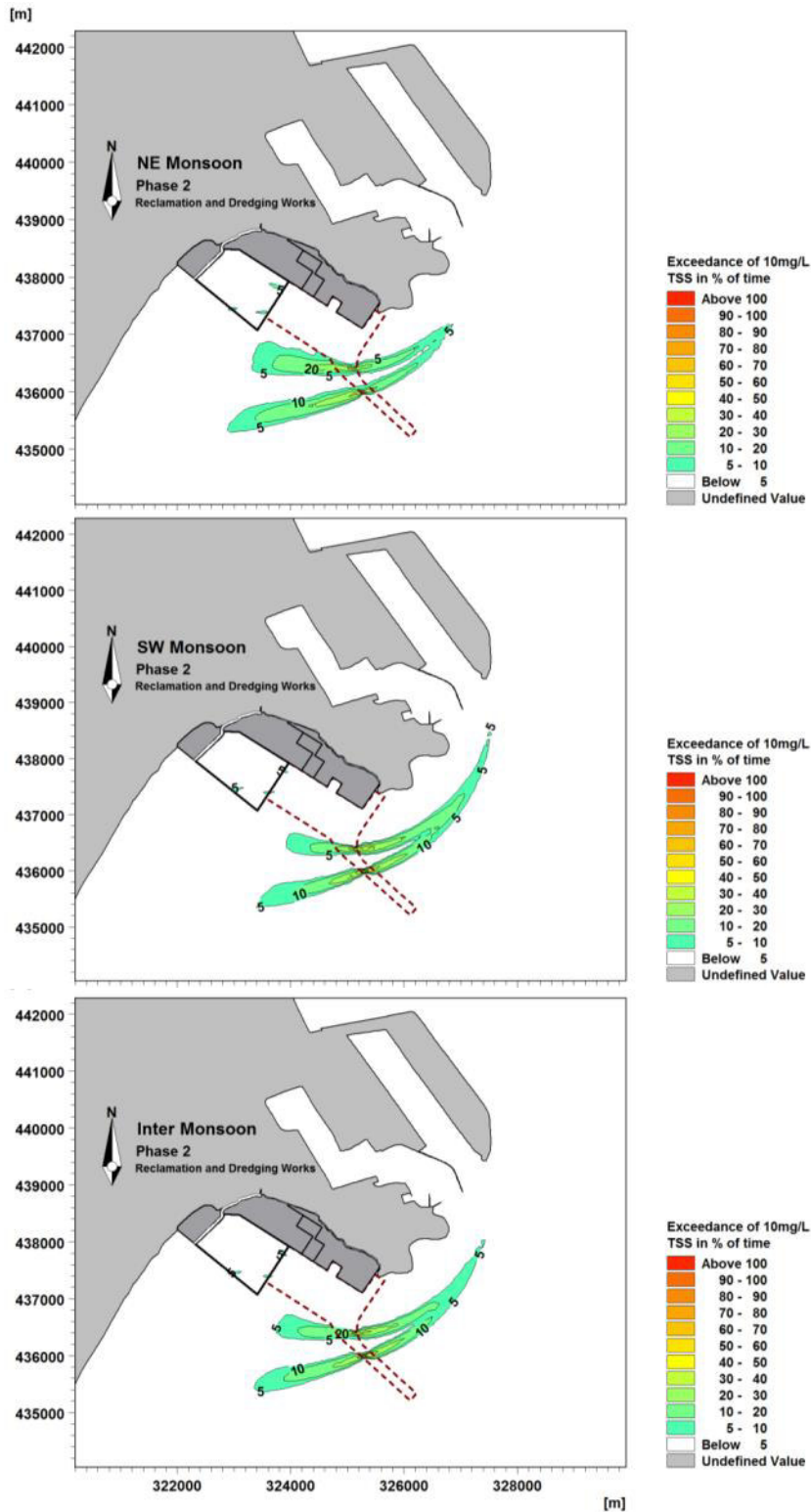


Figure 7.2.33: Phase 2: Exceedance of 10 mg/L excess TSS in % of time for NE (top), SW (middle) and Inter (bottom) monsoons.

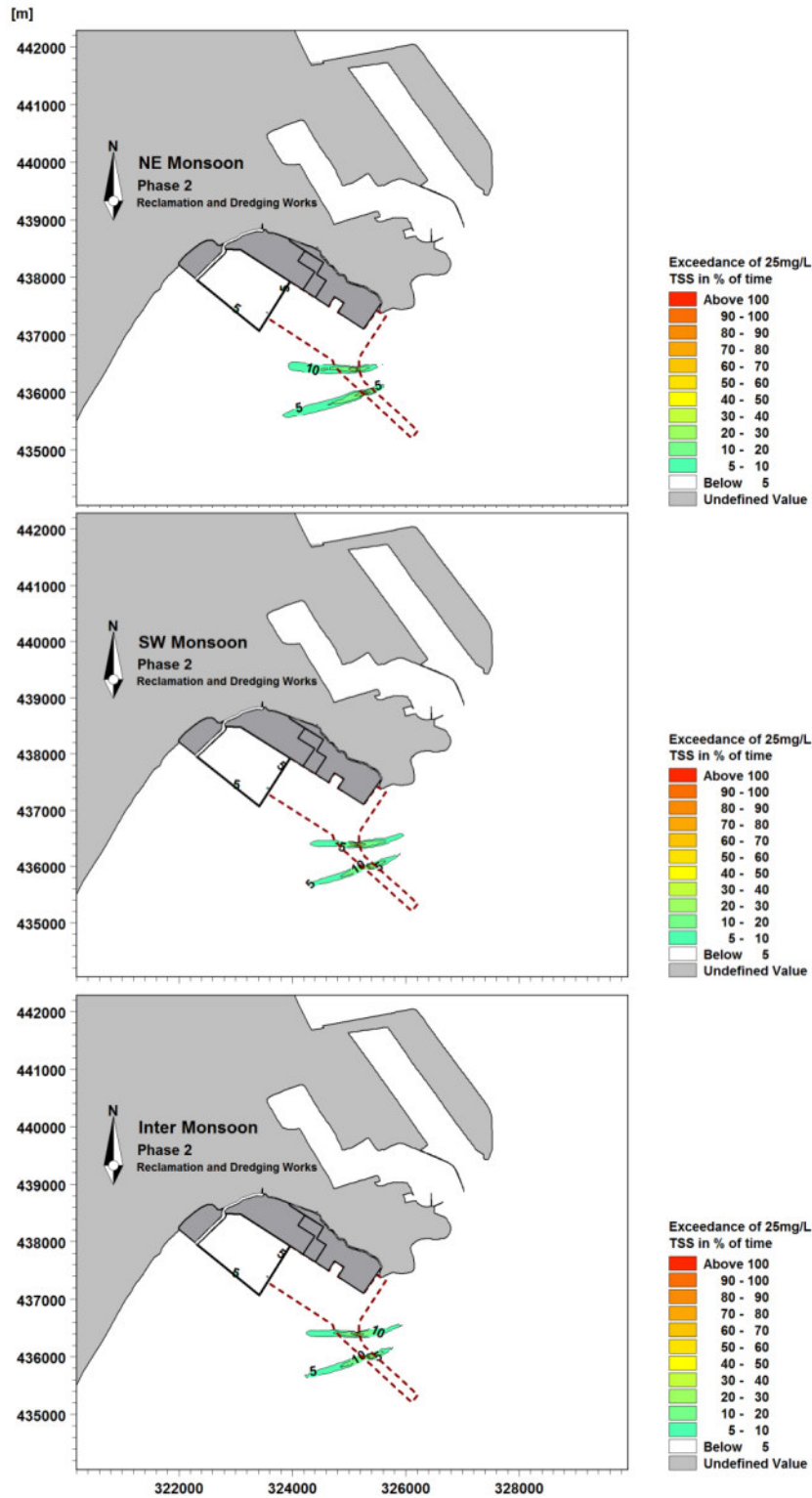


Figure 7.2.34: Phase 2: Exceedance of 25 mg/L excess TSS in % of time for NE (top), SW (middle) and Inter (bottom) monsoons.

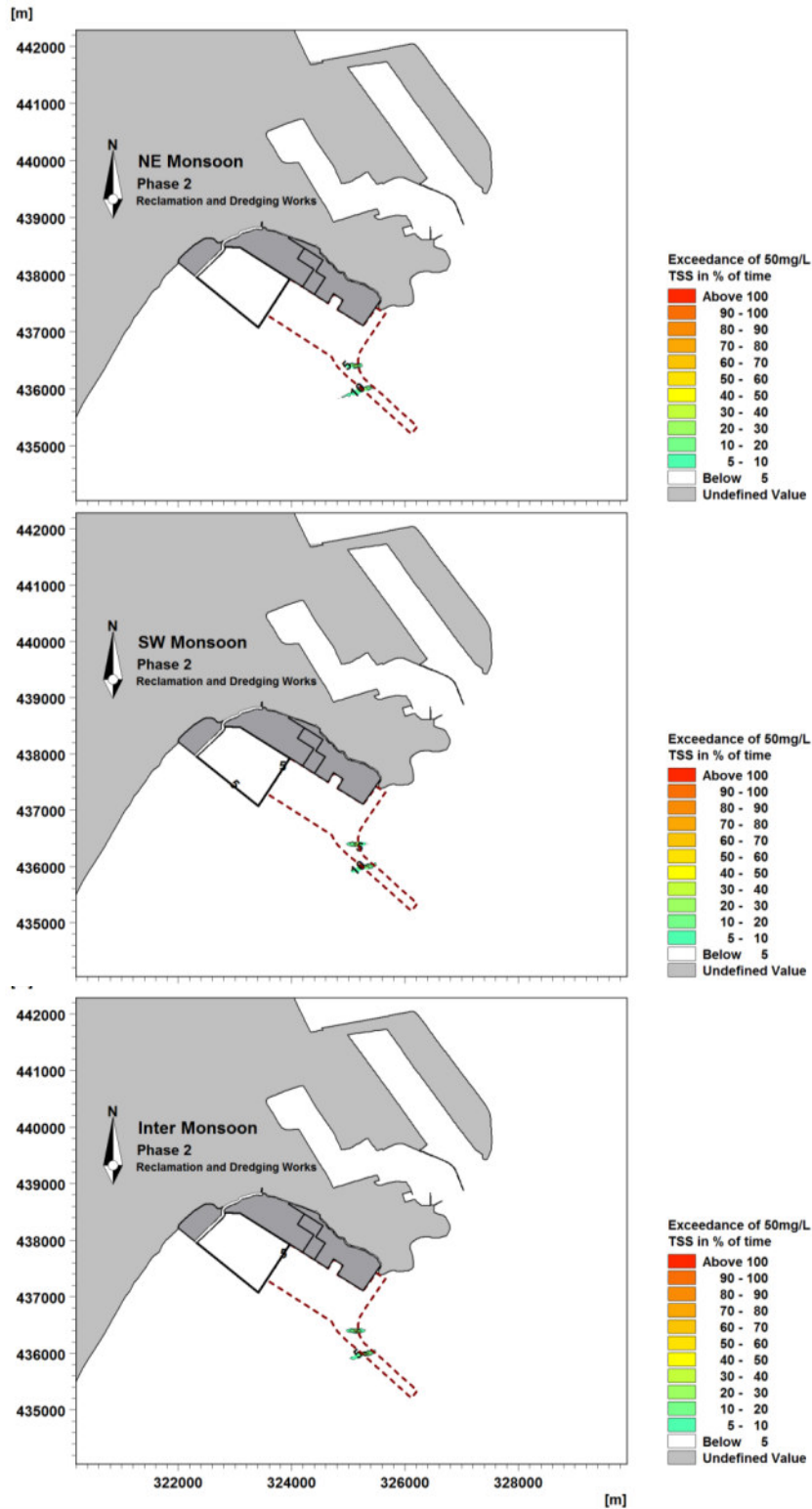


Figure 7.2.35: Phase 2: Exceedance of 50 mg/L excess TSS in % of time for NE (top), SW (middle) and Inter (bottom) monsoons.

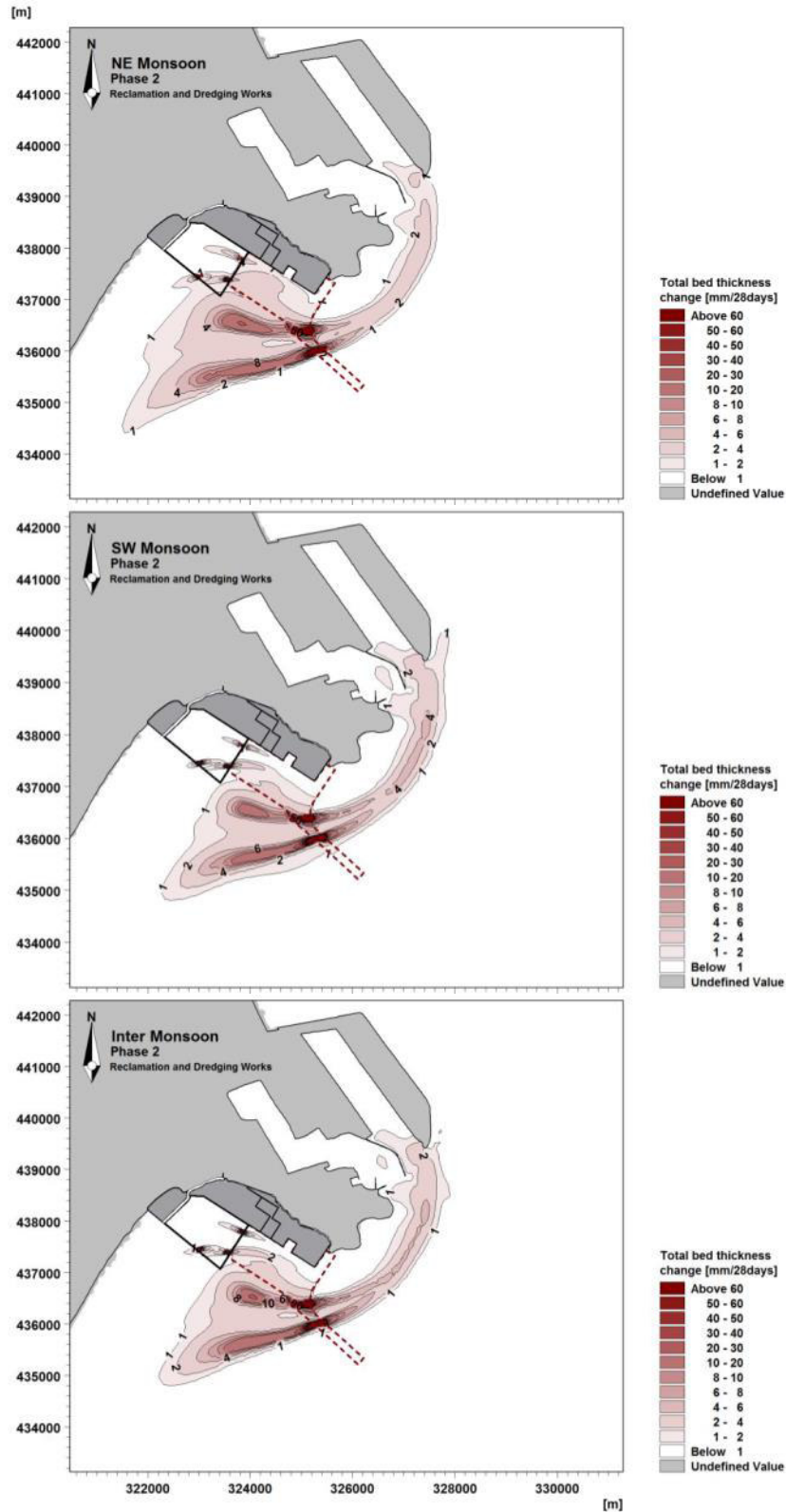


Figure 7.2.36: Phase 2: Total bed thickness change within 28days for NE (top), SW (middle) and Inter (bottom) monsoons.

7.2.2.1.6 Phase 3

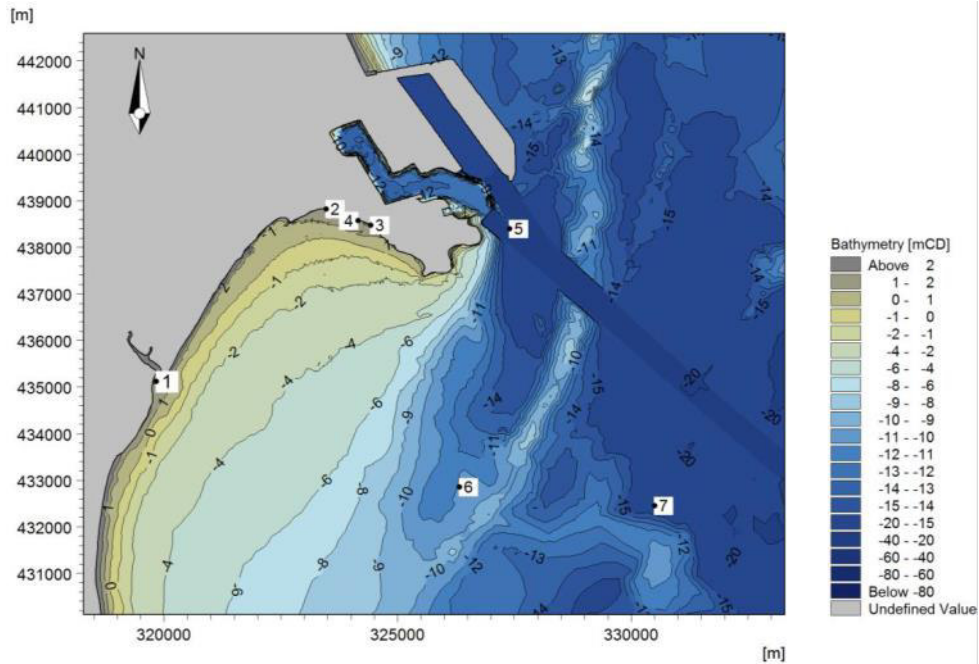
The predicted sediment plume results for Phase 3 are presented as follows:

Figure	Descriptions
Figure 7.2.36	Phase 3: Simulated mean excess TSS levels during NE (top), SW (middle) and inter (bottom) monsoons.
Figure 7.2.37	Phase 3: Simulated maximum excess TSS levels
Figure 7.2.38	Phase 3: Exceedance of 5 mg/L excess TSS in % of time for NE (top), SW (middle) and Inter (bottom) monsoons.
Figure 7.2.39	Phase 3: Exceedance of 10 mg/L excess TSS in % of time for NE (top), SW (middle) and Inter (bottom) monsoons.
Figure 7.2.40	Phase 3: Exceedance of 25 mg/L excess TSS in % of time for NE (top), SW (middle) and Inter (bottom) monsoons.
Figure 7.2.41	Phase 3: Exceedance of 50 mg/L excess TSS in % of time for NE (top), SW (middle) and Inter (bottom) monsoons.
Figure 7.2.42	Phase 3: Total bed thickness change within 28days for NE (top), SW (middle) and Inter (bottom) monsoons. Phase 1a (Case A): Exceedance of 50 mg/L excess TSS in % of time for NE (top), SW (middle) and Inter (bottom) monsoons.

The modelling results show:

- The geometry of the sediment plume aligns with the current direction (i.e. north-east and south-west). The pattern of sediment plume does not change significantly across the difference monsoon periods.
- Localised plume of 5 mg/L mean excess suspended sediment concentrations are predicted around the sediment spill source.
- The maximum excess suspended sediment concentration of 10 mg/L are predicted around the study area
- Localised 5, 10, 25 and 50 mg/L excess concentration is exceeded 5% of the time at around the sediment spill source.
- The excess TSS levels have been extracted at 7 defined spots and summarised in **Table 7.2.7**
- The predicted sedimentation rate and impacted areas in Kuantan Port channel induced by construction works of proposed development Phase 3 is shown in **Figure 7.2.42**. However, it should be highlighted that this temporary sedimentation impact will not exist after the project completion.



Table 7.2.7: Phase 3: Summary of predicted excess TSS levels at specific spots.

Phase 3 Points	Excess Mean TSS (mg/L)			Excess Maximum TSS (mg/L)			Exceedance of 5 mg/L in % of time		
	NE	SW	Inter	NE	SW	Inter	NE	SW	Inter
P1	<2	<2	<2	<5	<5	<5	<5	<5	<5
P2	<2	<2	<2	<5	<5	<5	<5	<5	<5
P3	<2	<2	<2	<5	<5	<5	<5	<5	<5
P4	<2	<2	<2	<5	<5	<5	<5	<5	<5
P5	<2	<2	<2	<5	<5	<5	<5	<5	<5
P6	<2	<2	<2	<5	<5	<5	<5	<5	<5
P7	<2	<2	<2	<5	<5	<5	<5	<5	<5

Phase 3 Points	Exceedance of 10 mg/L in % of time			Exceedance of 25 mg/L in % of time)			Exceedance of 50 mg/L in % of time		
	NE	SW	Inter	NE	SW	Inter	NE	SW	Inter
P1	<5	<5	<5	<5	<5	<5	<5	<5	<5
P2	<5	<5	<5	<5	<5	<5	<5	<5	<5
P3	<5	<5	<5	<5	<5	<5	<5	<5	<5
P4	<5	<5	<5	<5	<5	<5	<5	<5	<5
P5	<5	<5	<5	<5	<5	<5	<5	<5	<5
P6	<5	<5	<5	<5	<5	<5	<5	<5	<5
P7	<5	<5	<5	<5	<5	<5	<5	<5	<5

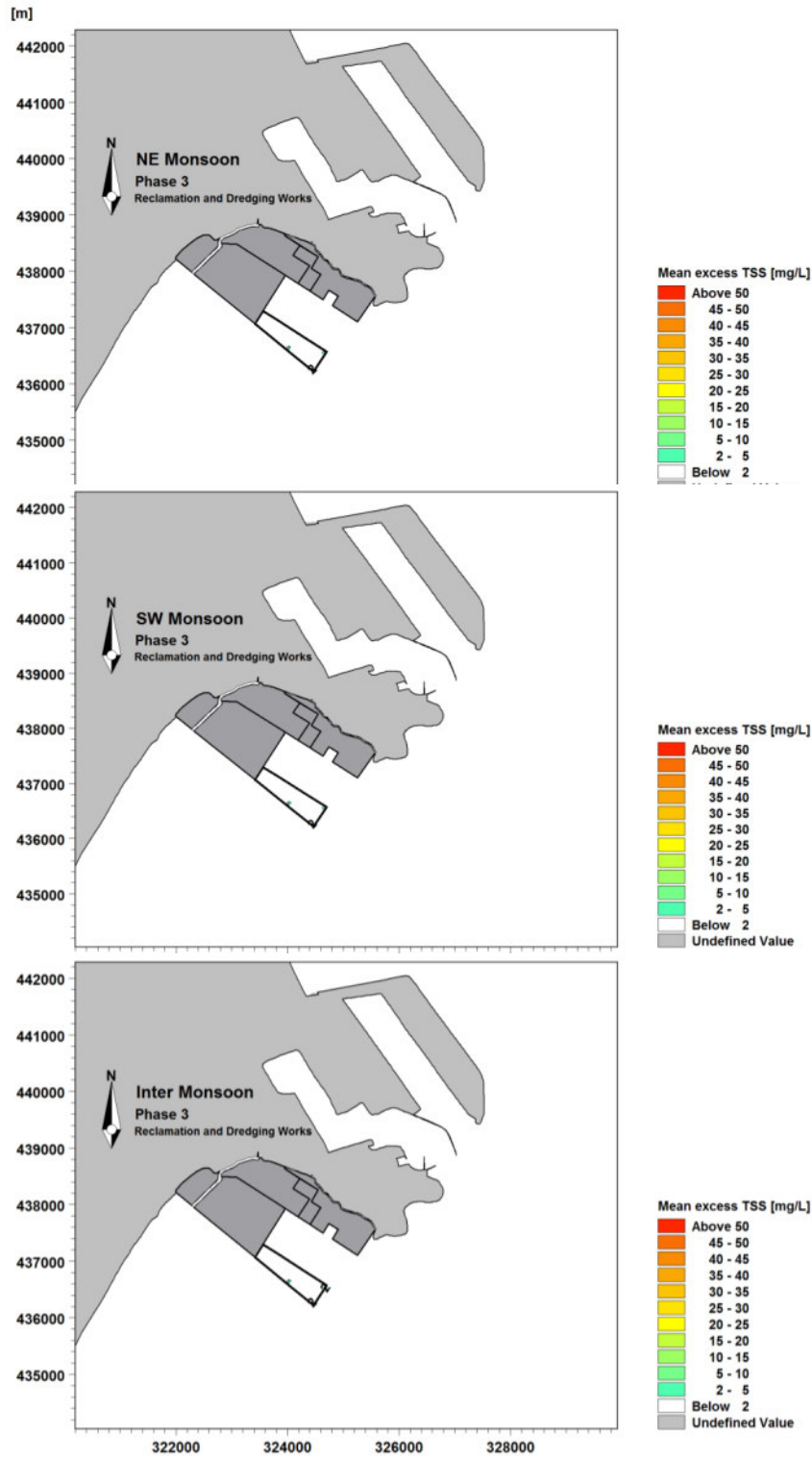


Figure 7.2.37: Phase 3: Simulated mean excess TSS levels during NE (top), SW (middle) and inter (bottom) monsoons.

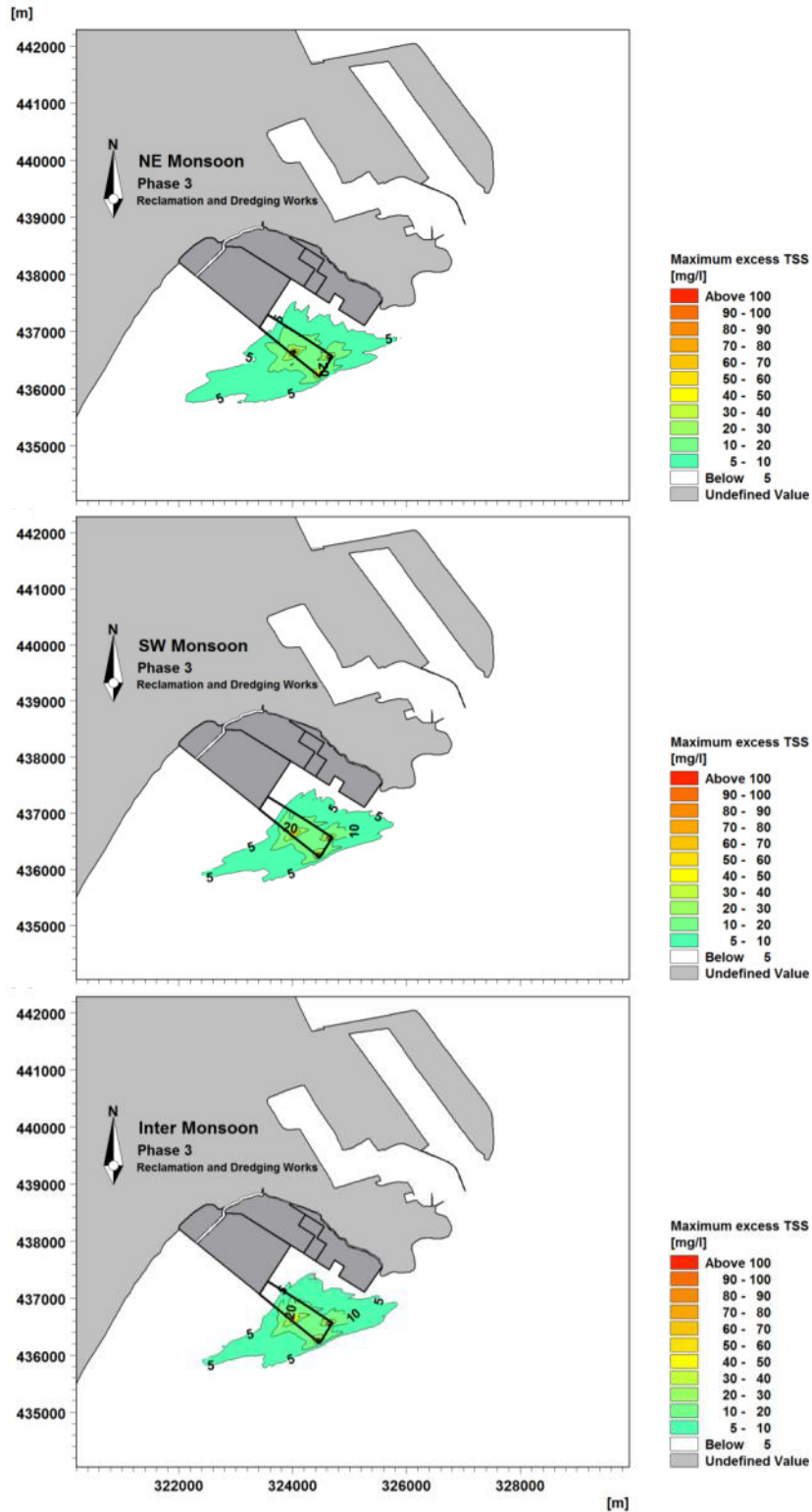


Figure 7.2.38: Phase 3: Simulated maximum excess TSS levels during NE (top), SW (middle) and inter (bottom) monsoons.

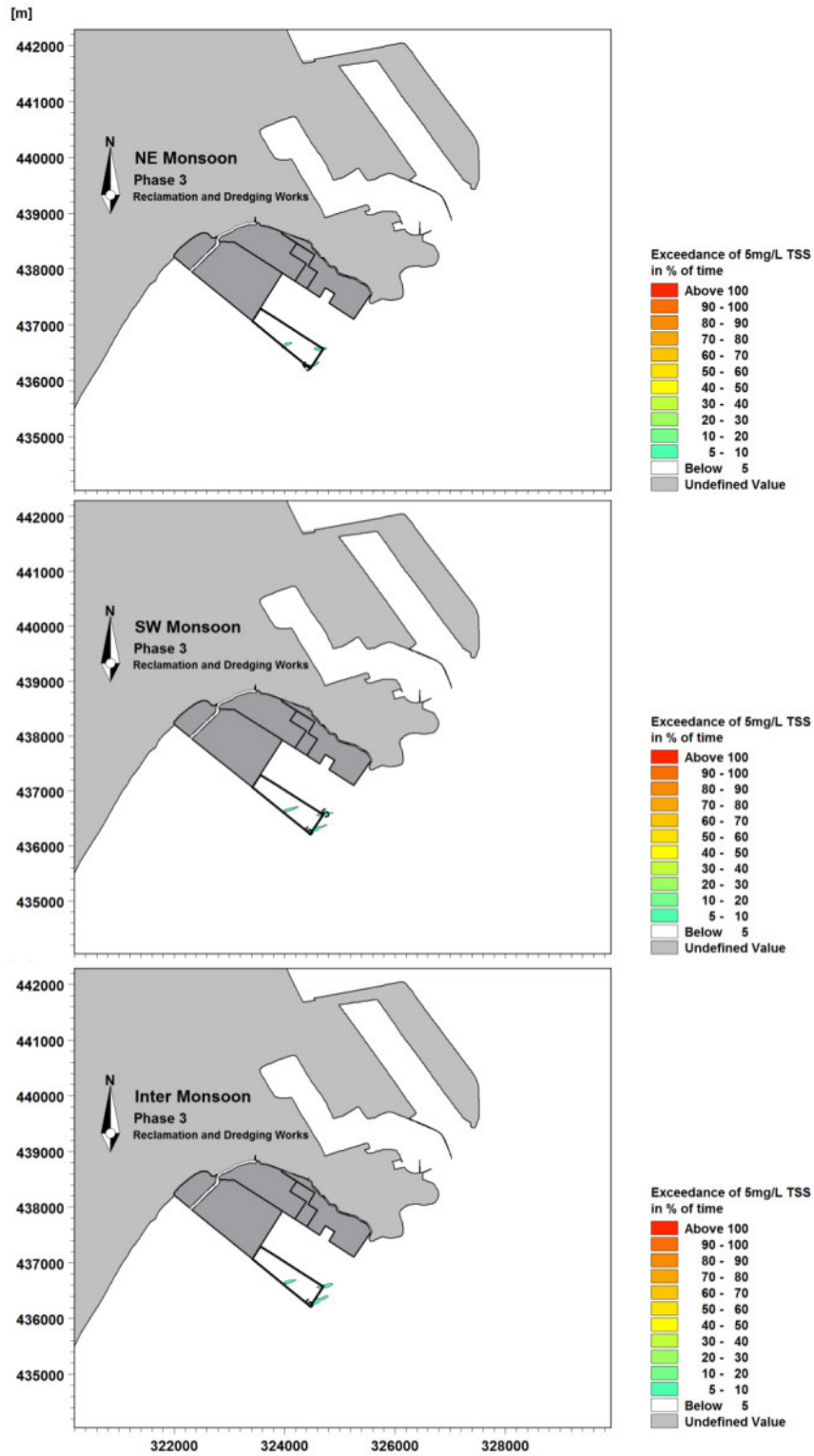


Figure 7.2.39: Phase 3: Exceedance of 5 mg/L excess TSS in % of time for NE (top), SW (middle) and Inter (bottom) monsoons.

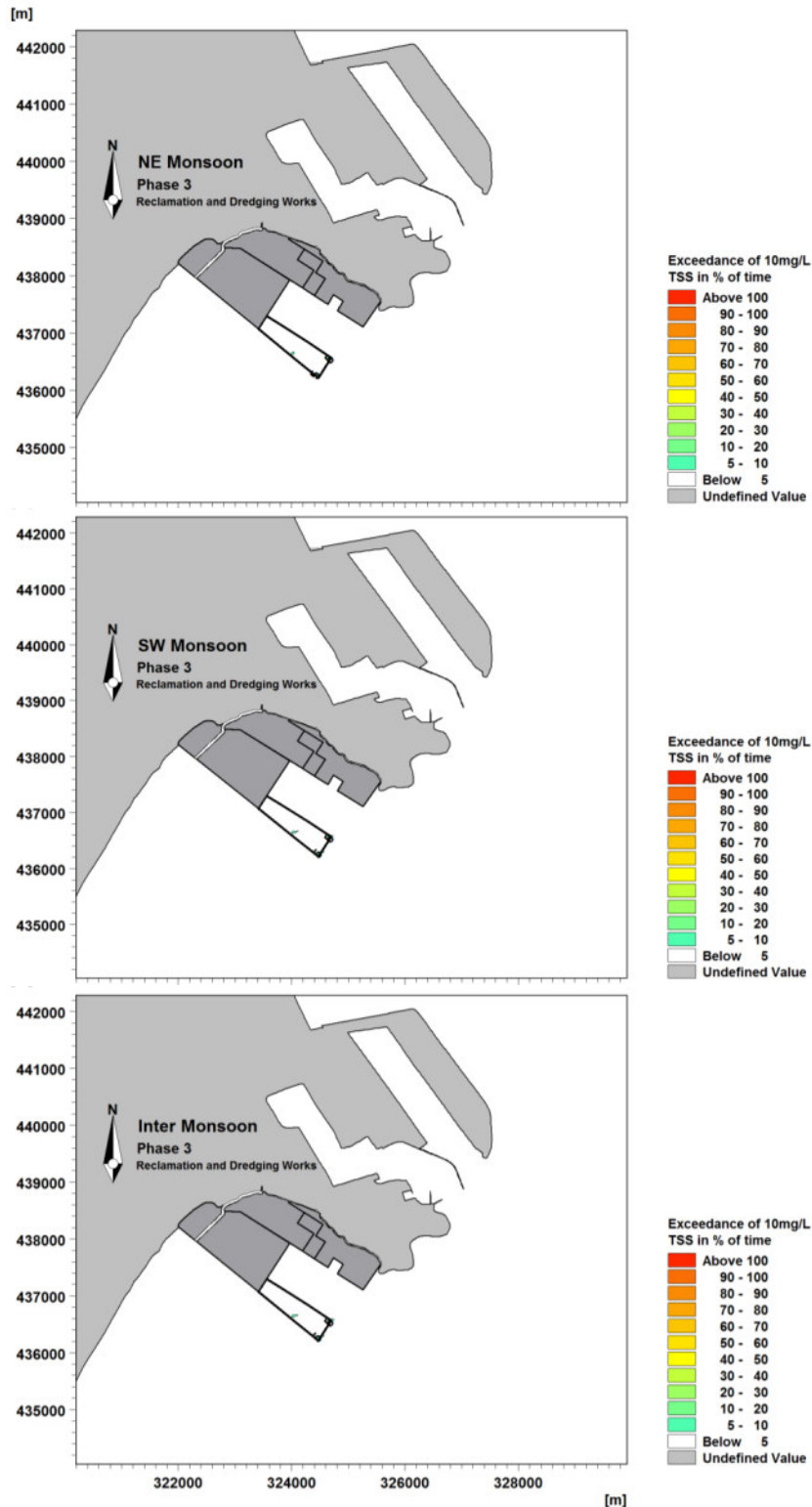


Figure 7.2.40: Phase 3: Exceedance of 10 mg/L excess TSS in % of time for NE (top), SW (middle) and Inter (bottom) monsoons.

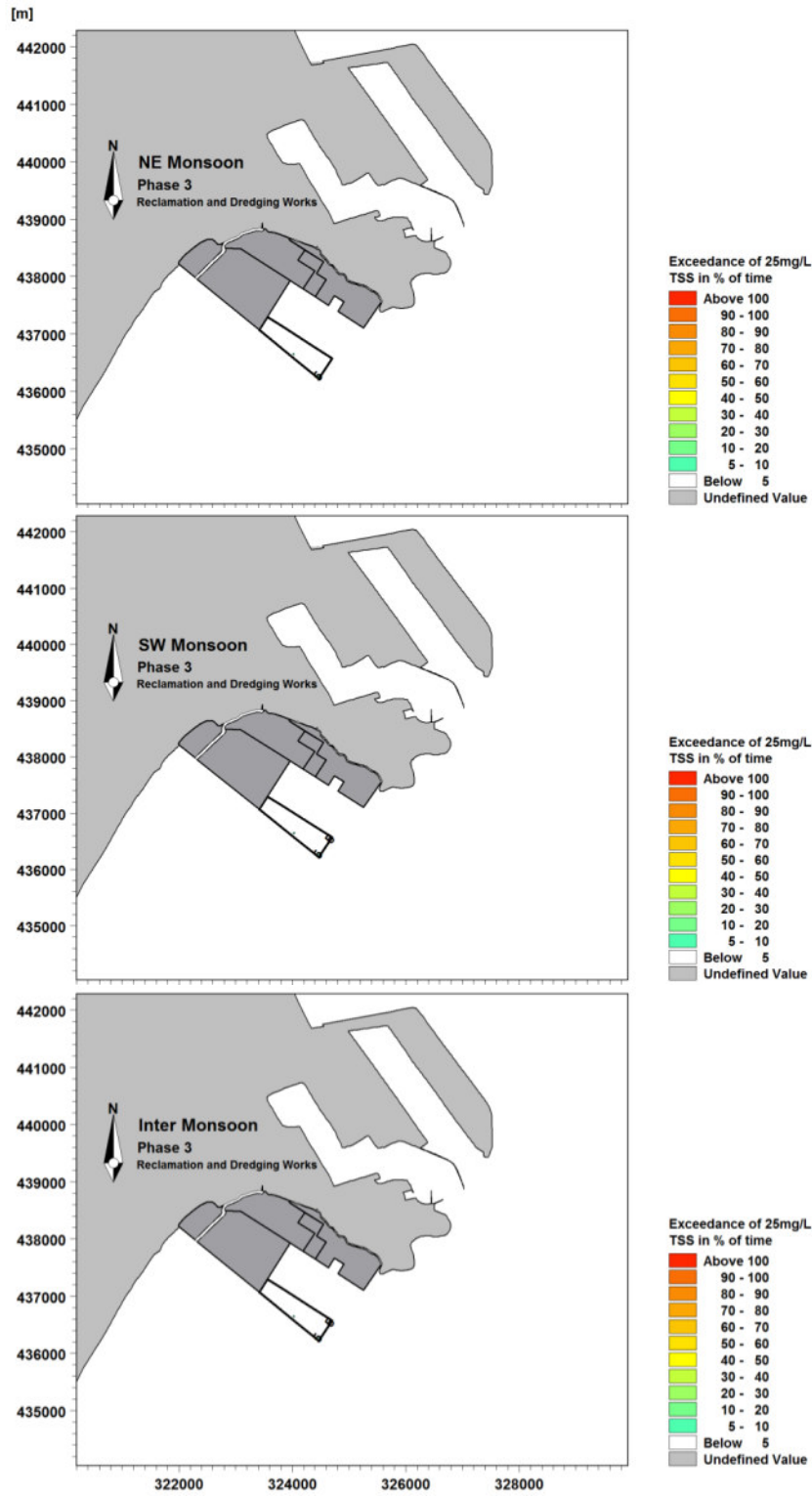


Figure 7.2.41: Phase 3: Exceedance of 25 mg/L excess TSS in % of time for NE (top), SW (middle) and Inter (bottom) monsoons.

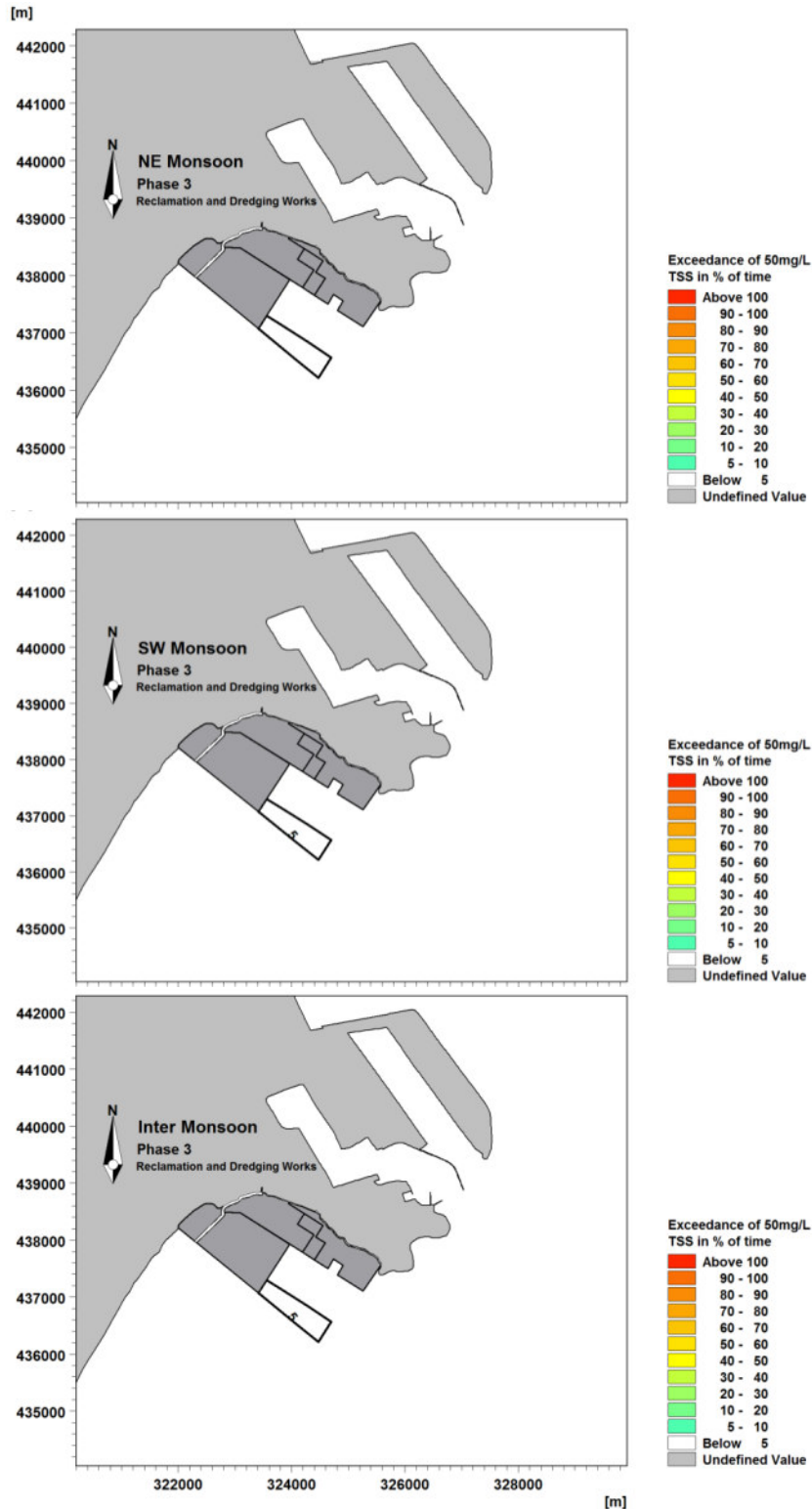


Figure 7.2.42: Phase 3: Exceedance of 50 mg/L excess TSS in % of time for NE (top), SW (middle) and Inter (bottom) monsoons.

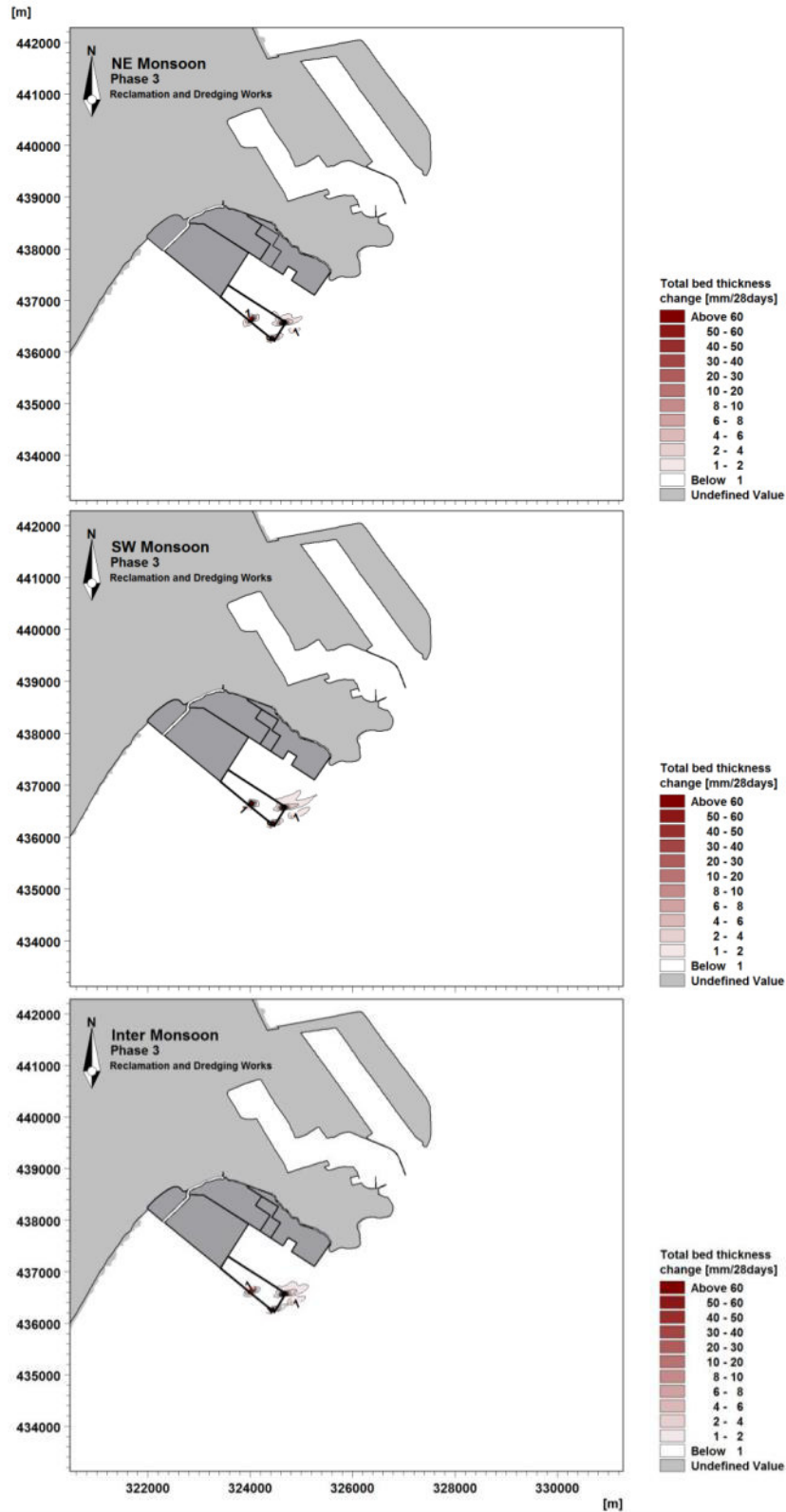


Figure 7.2.43: Phase 3: Total bed thickness change within 28days for NE (top), SW (middle) and Inter (bottom) monsoons.

7.2.2.2 Hydraulic Study – Permanent Effect

In this section, the permanent hydraulic impacts for this development as quantified by the calibrated numerical modelling system are presented. The impacts are presented as changes to the existing (pre-development) conditions induced by the development. The impacts are considered as permanent since the changes will remain after the proposed development is implemented. As the project is planned to be carried out by phases, the evaluation of permanent impacts have been assessed for each of the three (3) development phases (including sub-phases 1a, 1b, and 1c) for different seasonal conditions. The potential permanently impacted parameters have been identified as follows:

- Water levels
- Current flows
- Waves
- Adjacent coastline / Sediment transport
- STP flushing assessment
- River channel assessment – Impacts on water levels in artificial river channel

The basis of the simulation is illustrated in the full hydraulic report in Appendix 7.1.

Differences = Proposed developments (Phase 1a, 1b, 1c, 2, and 3) – Baseline

In addition to the 2D maps, eight (8) locations have been selected as “extraction point” to further detail permanent hydraulic impacts. **Figure 7.2.14** presents an overview of the key extraction points

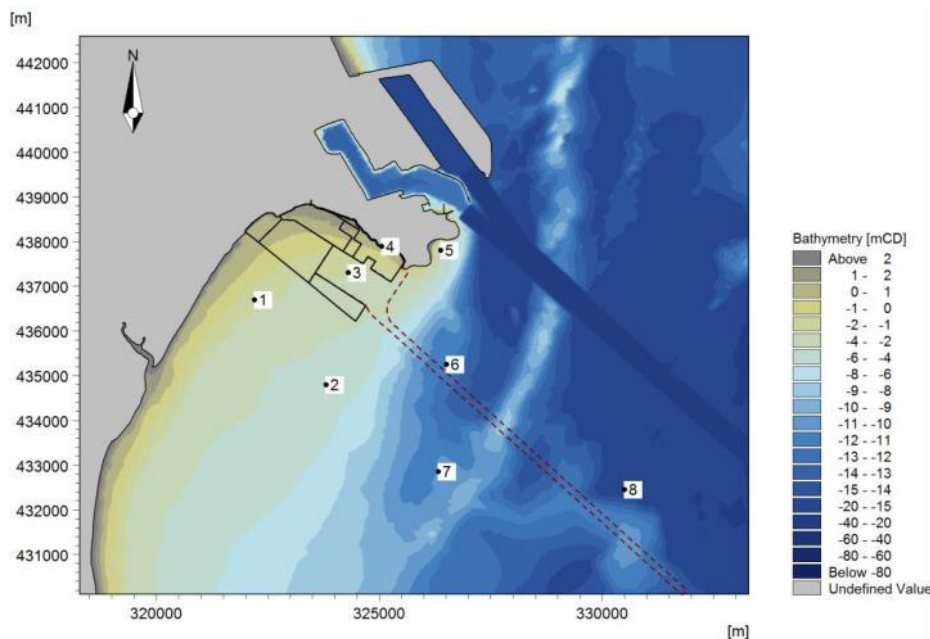


Figure 7.2.44: Extraction points for the present assessment

7.2.2.2.1 Open Sea Water Level

Water level changes have been analysed for the different phases of the project. Examples of predicted maximum water levels for the existing conditions and conditions with the developments implemented are presented in **Figure 7.2.45** based on a 28-days simulation using normal discharge of 1 m³/s from the Sg Pengorak and the storm water drain during NE monsoon conditions. The predicted changes in maximum water levels as compared to existing have been extracted at 8 locations (see **Figure 7.2.44** and summarized in **Table 7.2.8**).

The results show the reduction of maximum water level of 1 cm occurs in the proposed channel between main land and reclaimed area during Phase 1c, 2 and 3. Other locations indicate that changes in water level are not significant. Predicted changes are similar for the three different seasonal conditions.

The predicted changes in maximum water levels are generally induced by a modification of the flow pattern in the study area due to the proposed channel design. However the predicted impacts are localized and considered minor during the normal conditions. Further analysis on the upstream flooding impacts (extreme discharge event during heavy rain) associated with the proposed project have been considered and discussed in **Section 7.2.2.2.6**.

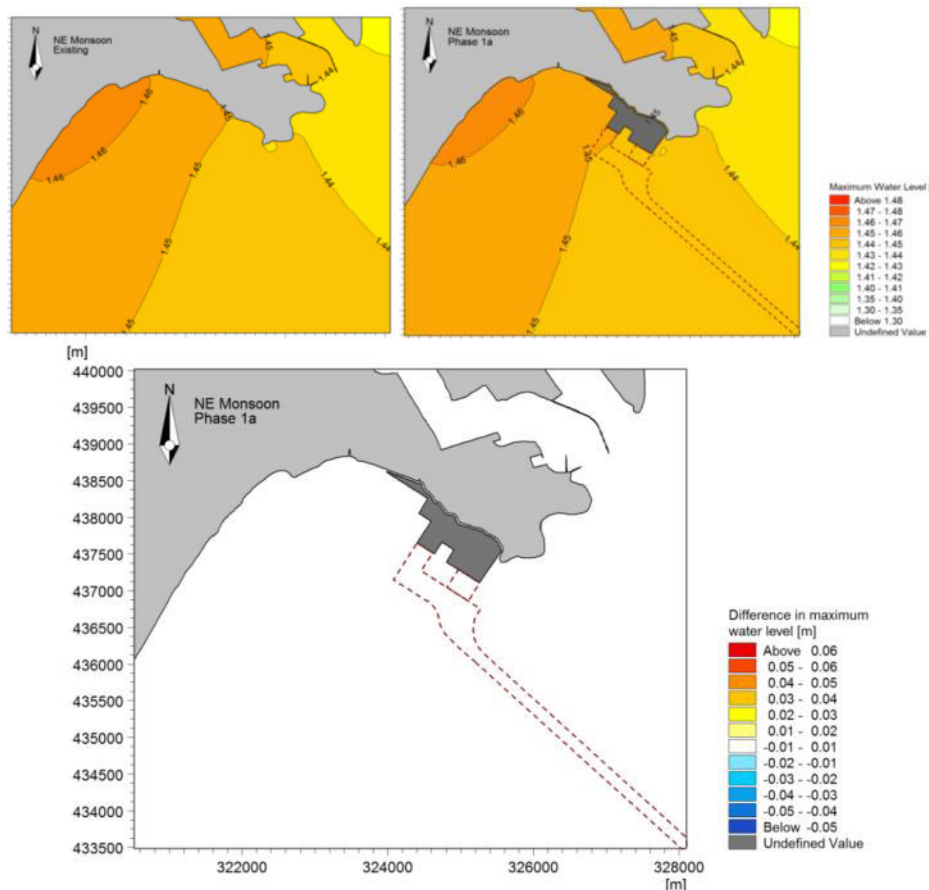


Figure 7.2.45: Maximum water levels over a 28 day simulation for existing (top - left) and Phase 1a development (top -right) and the changes in water levels (bottom) during NE Monsoon.

Table 7.2.8: Summary of predicted changes in maximum water level in meter for different season monsoons

Predicted Changes in Maximum Water Level as Compared to Existing Conditions															
Point	NE Monsoon					SW Monsoon					Inter Monsoon				
	Phase 1a	Phase 1b	Phase 1c	Phase 2	Phase 3	Phase 1a	Phase 1b	Phase 1c	Phase 2	Phase 3	Phase 1a	Phase 1b	Phase 1c	Phase 2	Phase 3
1	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
2	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
3	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
4	*	*	-0.01	-0.01	-0.01	*	*	-0.01	-0.01	-0.01	*	*	-0.01	-0.01	-0.01
5	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
6	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
7	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
8	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*

*changes range between -0.01m (exclusive) to +0.01m (exclusive)



7.2.2.2 Current

The potential current flows impact of the development is presented in this section. Current flow simulations have been carried out for pre- and post-development phases, 1a, 1b, 1c, 2 and 3. The analysis have been carried out based on simulations covering 28 days of tide for each of the three seasons (NE, SW, and inter monsoons) with normal discharge of 1 m³/s from the Sg Pengorak and the storm water drain

Long term current impacts are taken as changes in current conditions arising from the presence of the proposed development. Changes to currents as a result of the proposed project were assessed through specific analysis of the current characteristics, mean and maximum current speeds. Both have been calculated from the 28-day modelling results and the differences of mean and maximum between the baseline and proposed development phases are calculated.

Figure 7.2.46 shows an example of predicted mean currents over 28 days for existing and Phase 1a, as well as the current flow changes. The current flow impacts for each phase are presented as change plots and discussed in details in subsequent sections.

Besides that, the predicted changes in mean and maximum current speed as compared to existing have been extracted at the defined location (see **Figure 7.2.44**) for each phases and summarized in the **Table 7.2.9**.



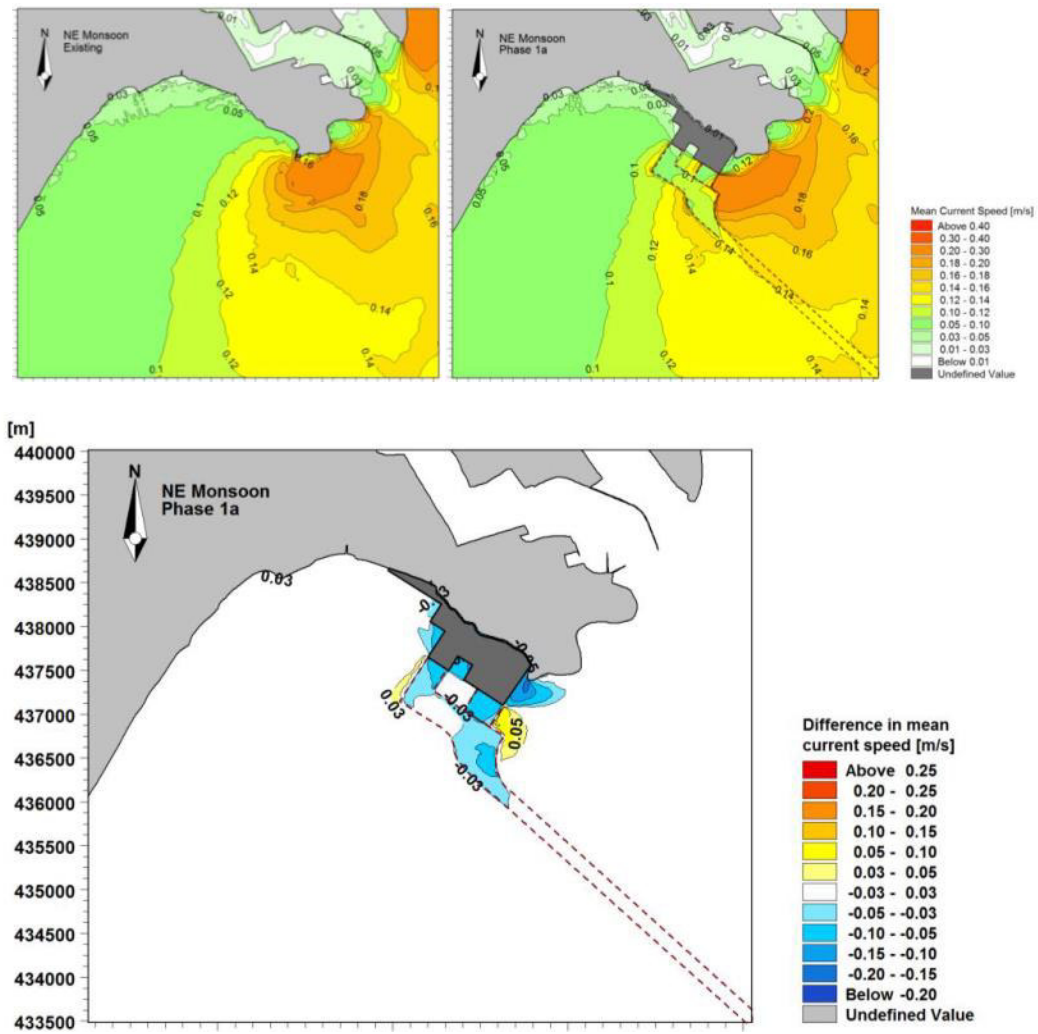


Figure 7.2.46: Mean current speed for existing (top - left) and Phase 1a development (top –right) and changes in current speed (bottom) – NE Monsoon.

Table 7.2.9: Summary of predicted changes in mean and maximum current speed for different season monsoons.

Point	Predicted changes in mean current speed					Predicted changes in max current speed				
	Phase 1a	Phase 1b	Phase 1c	Phase 2	Phase 3	Phase 1a	Phase 1b	Phase 1c	Phase 2	Phase 3
NE Monsoon										
1	*	*	*	*	*	**	**	**	**	-0.06
2	*	*	*	*	*	**	**	**	**	0.05
3	-0.03	-0.03	-0.03	-0.04	-0.09	-0.10	-0.08	-0.08	-0.09	-0.22
4	-0.07	-0.07	-0.06	-0.06	-0.06	-0.09	-0.09	**	**	**
5	*	*	*	*	*	**	**	**	**	**
6	*	*	*	*	*	**	**	**	**	**
7	*	*	*	*	*	**	**	**	**	**
8	*	*	*	*	*	**	**	**	**	**
SW Monsoon										
1	*	*	*	*	*	**	**	**	**	**
2	*	*	*	*	*	**	**	**	**	**
3	-0.04	-0.03	-0.04	-0.05	-0.09	-0.08	-0.07	-0.05	-0.05	-0.19
4	-0.07	-0.07	-0.06	-0.06	-0.06	-0.09	-0.09	**	**	**
5	*	*	*	*	*	**	**	**	**	**
6	*	*	*	*	*	**	**	**	**	**
7	*	*	*	*	*	**	**	**	**	**
8	*	*	*	*	*	**	**	**	**	**
Inter Monsoon										
1	*	*	*	*	*	**	**	**	**	**
2	*	*	*	*	*	**	**	**	**	**
3	-0.04	-0.03	-0.04	-0.04	-0.08	-0.08	-0.06	-0.07	-0.06	-0.16
4	-0.07	-0.03	-0.06	-0.06	-0.06	-0.09	0.19	**	**	**
5	*	*	*	*	*	**	**	**	**	**
6	*	*	*	*	*	**	**	**	**	**
7	*	*	*	*	*	**	**	**	**	**
8	*	*	*	*	*	**	**	**	**	**

*changes range between -0.03m/s (exclusive) to +0.03m/s (exclusive)

**changes range between -0.01m (exclusive) to +0.01m (exclusive)



7.2.2.2.1 Phase 1a

The statistical results are presented in 2D map plot through **Figure 7.2.47** and **Figure 7.2.48**. A summary of differences in mean and maximum current speed at the extraction point is tabulated in the **Table 7.2.10**. Based on the simulated results, it can be observed that:

- The reduction in mean and maximum current speed of 0.1 m/s and 0.2 m/s localised around the project development area are predicted;
- The predicted reduction in the mean current speed of 0.2 m/s is observed at the east of reclamation area, just south of the headland.
- An increase of current speed around east of dredged basin area can be observed. This is due to the deepening of the basin which have allow good water exchange;
- The most noticeable changes are found in the dredging area (point 3) and reserved channel (point 4) with magnitude below 0.1 m/s;
- The changes in current speed almost similar for all different seasonal conditions;
- Overall, the current flow impacts are localized around the project area and minor.

Table 7.2.10: Phase 1a: Changes in mean and maximum current speed for different season monsoons

Point	Changes: Existing vs Phase 1a					
	NE Monsoon		SW Monsoon		IM Monsoon	
	Changes in mean current speed (m/s)	Changes in max current speed (m/s)	Changes in mean current speed (m/s)	Changes in max current speed (m/s)	Changes in mean current speed (m/s)	Changes in max current speed (m/s)
1	*	**	*	**	*	**
2	*	**	*	**	*	**
3	-0.03	-0.10	-0.04	-0.08	-0.04	-0.08
4	-0.07	-0.09	-0.07	-0.09	-0.07	-0.09
5	*	**	*	**	*	**
6	*	**	*	**	*	**
7	*	**	*	**	*	**
8	*	**	*	**	*	**

*changes range between -0.03m/s (exclusive) to +0.03m/s (exclusive)

**changes range between -0.05m/s (exclusive) to +0.05m/s (exclusive)



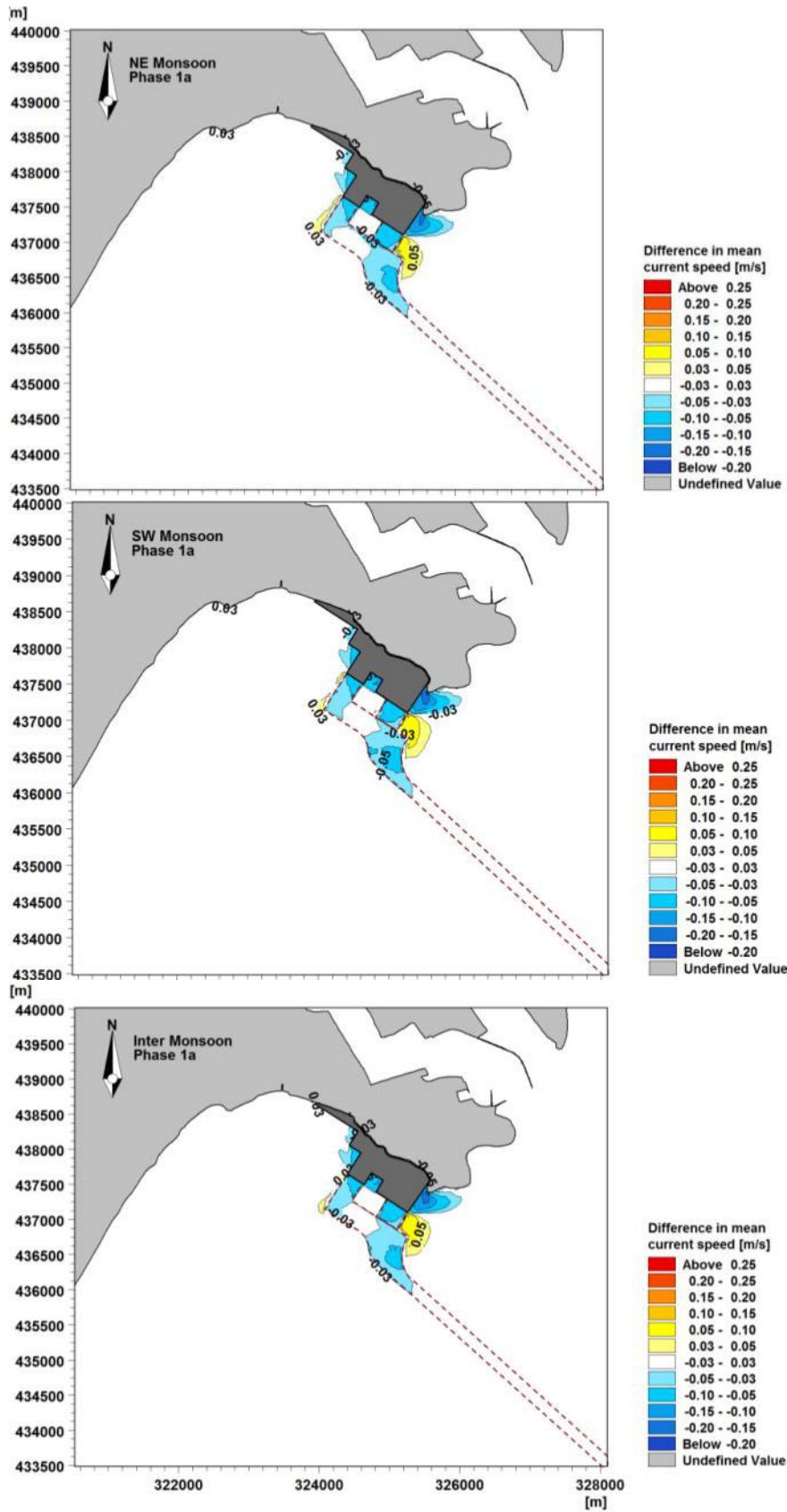


Figure 7.2.47: Phase 1a. Predicted changes in mean current speeds between existing during NE (top), SW (middle) and Inter (bottom) monsoons.

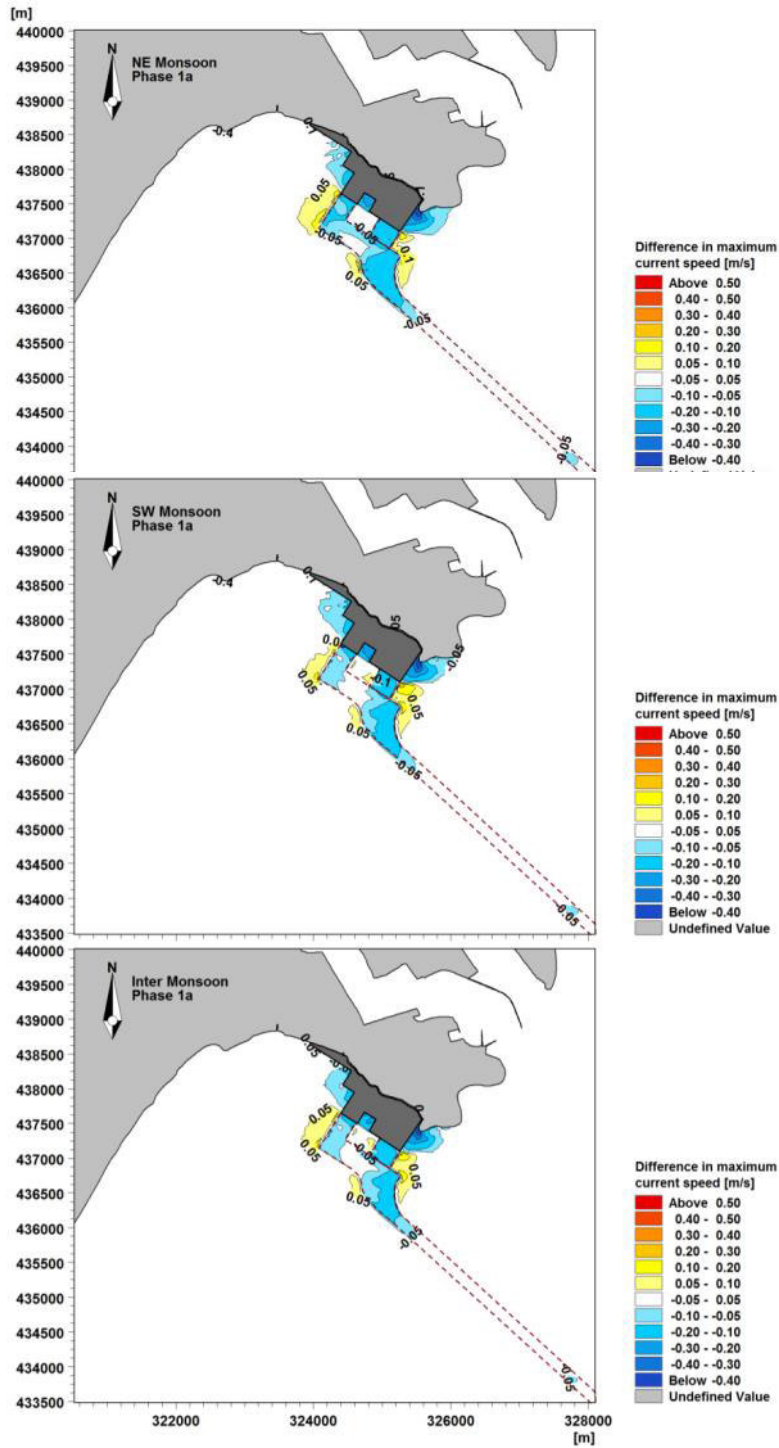


Figure 7.2.48: Phase 1a. Predicted changes in max current speeds between existing during NE (top), SW (middle) and Inter (bottom) monsoons.

7.2.2.2.2 Phase 1b

The statistical results are presented in 2D map plot through **Figure 7.2.49** and **Figure 7.2.50**. A summary of differences in mean and maximum current speed at the extraction point is tabulated in the **Table 7.2.11**. Based on the simulated results, it can be observed that:

- Similar changes in current speeds as Phase 1a development are predicted. The additional reclaimed area near to shore during Phase 1b does not give a significant impacts. It is because the proposed reclamation is built on existing shallow waters that already impose a significant resistance to the flow, therefore, changes have been minimized.
- The reduction in mean and maximum current speed of 0.1 m/s and 0.2 m/s localised around the project development area are predicted;
- The predicted reduction in the mean current speed of 0.2 m/s is observed at the east of reclamation area, just south of the headland.
- An increase of current speed around east of dredged basin area can be observed. This is due to the deepening of the basin which have allow good water exchange;
- The most noticeable changes are found in the dredging area (point 3) and reserved channel (point 4) with magnitude below 0.2 m/s;
- The changes in current speed almost similar for all different seasonal conditions;
- Overall, the current flow impacts are localized around the project area and minor.

Table 7.2.11: Phase 1b: Changes in mean and maximum current speed for different season monsoons

Point	Changes: Existing vs Phase 1b					
	NE Monsoon		SW Monsoon		IM Monsoon	
	Changes in mean current speed (m/s)	Changes in max current speed (m/s)	Changes in mean current speed (m/s)	Changes in max current speed (m/s)	Changes in mean current speed (m/s)	Changes in max current speed (m/s)
1	*	**	*	**	*	**
2	*	**	*	**	*	**
3	-0.03	-0.10	-0.04	-0.08	-0.04	-0.08
4	-0.07	-0.09	-0.07	-0.09	-0.07	-0.09
5	*	**	*	**	*	**
6	*	**	*	**	*	**
7	*	**	*	**	*	**
8	*	**	*	**	*	**

*changes range between -0.03m/s (exclusive) to +0.03m/s (exclusive)

**changes range between -0.05m/s (exclusive) to +0.05m/s (exclusive)



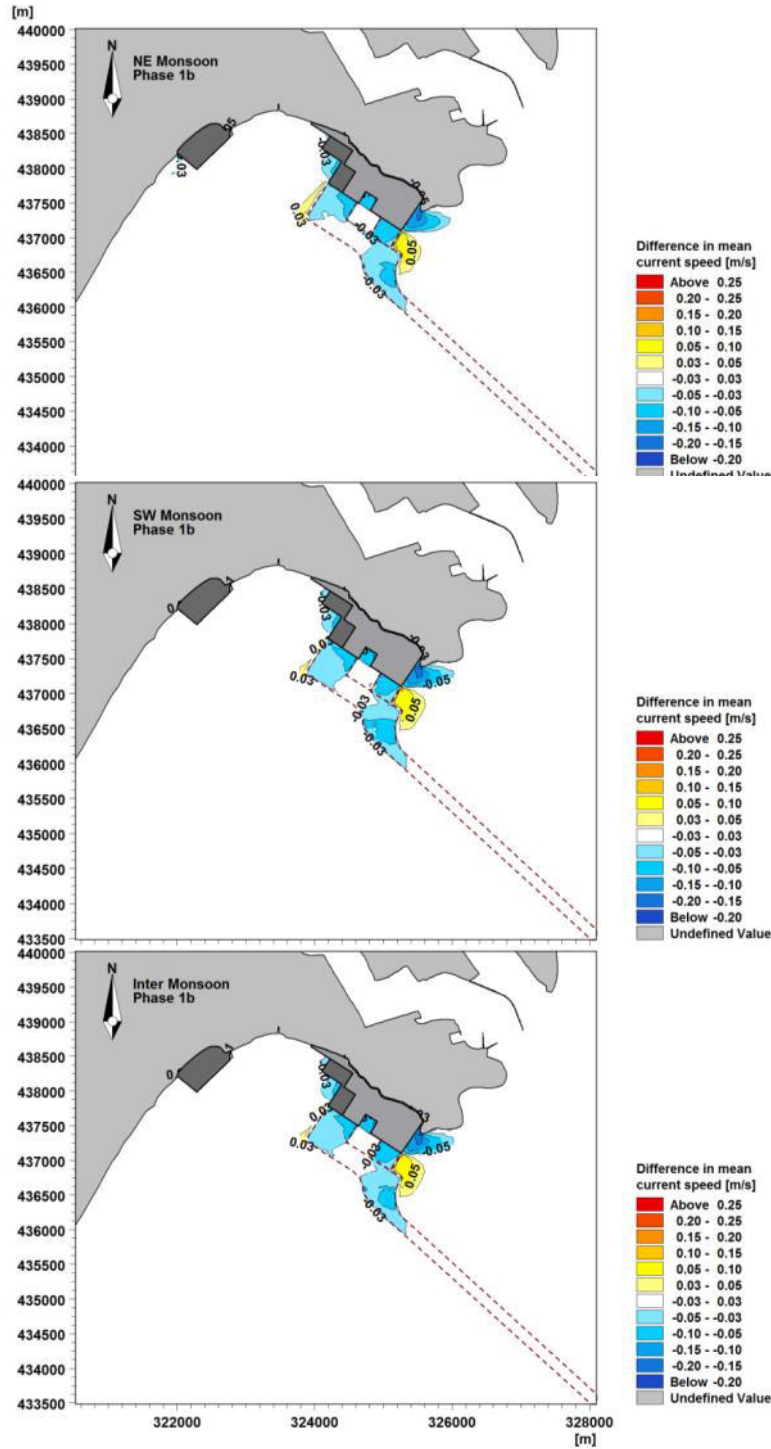


Figure 7.2.49: Phase 1b. Predicted changes in mean current speeds between existing during NE (top), SW (middle) and Inter (bottom) monsoons.

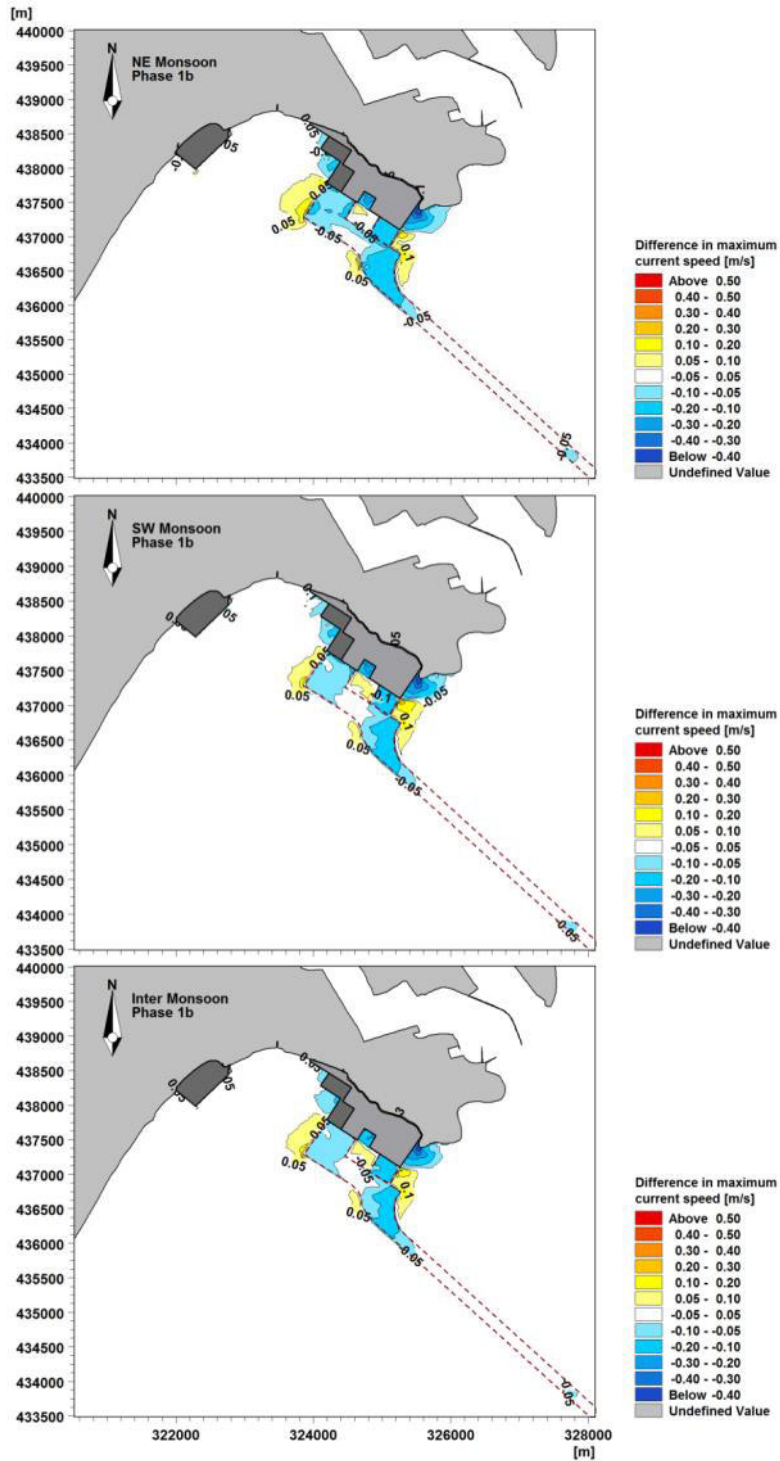


Figure 7.2.50: Phase 1b. Predicted changes in max current speeds between existing during NE (top), SW (middle) and Inter (bottom) monsoons.

7.2.2.2.3 Phase 1c

The statistical results are presented in 2D map plot through **Figure 7.2.51** and **Figure 7.2.52**. A summary of differences in mean and maximum current speed at the extraction point is tabulated in the **Table 7.2.12**. Based on the simulated results, it can be observed that:

- Similar changes in current speeds as Phase 1b development are predicted. The additional reclaimed area near to shore during Phase 1c does not give a significant impacts. It is because the proposed reclamation is built on existing shallow waters that already impose a significant resistance to the flow, therefore, changes have been minimized.
- The reduction in mean and maximum current speed of 0.1 m/s and 0.2 m/s localised around the project development area are predicted;
- The predicted reduction in the mean current speed of 0.2 m/s is observed at the east of reclamation area, just south of the headland.
- An increase of current speed around west of dredged basin area can be observed. This is due to the deepening of the basin which have allow good water exchange;
- The most noticeable changes are found in the dredging area (point 3) and reserved channel (point 4) with magnitude below 0.1 m/s;
- The changes in current speed almost similar for all different seasonal conditions;
- Overall, the current flow impacts are localized around the project area and minor.

Table 7.2.12: Phase 1c: Changes in mean and maximum current speed for different season monsoons

Point	Changes: Existing vs Phase 1c					
	NE Monsoon		SW Monsoon		IM Monsoon	
	Changes in mean current speed (m/s)	Changes in max current speed (m/s)	Changes in mean current speed (m/s)	Changes in max current speed (m/s)	Changes in mean current speed (m/s)	Changes in max current speed (m/s)
1	*	**	*	**	*	**
2	*	**	*	**	*	**
3	-0.03	-0.08	-0.04	-0.05	-0.04	-0.07
4	-0.06	**	-0.06	**	-0.06	**
5	*	**	*	**	*	**
6	*	**	*	**	*	**
7	*	**	*	**	*	**
8	*	**	*	**	*	**

*changes range between -0.03m/s (exclusive) to +0.03m/s (exclusive)

**changes range between -0.05m/s (exclusive) to +0.05m/s (exclusive)



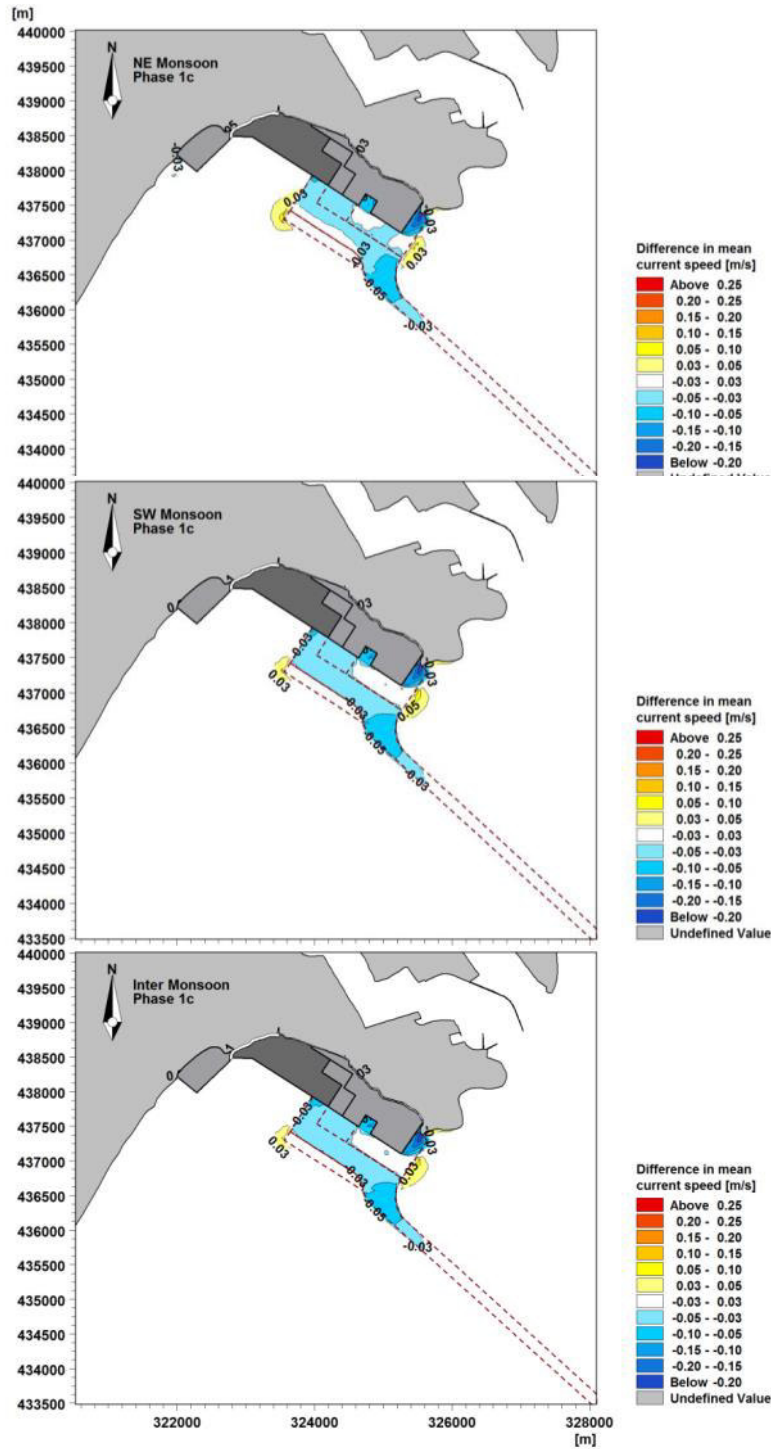


Figure 7.2.51: Phase 1c. Predicted changes in mean current speeds between existing during NE (top), SW (middle) and Inter (bottom) monsoons.

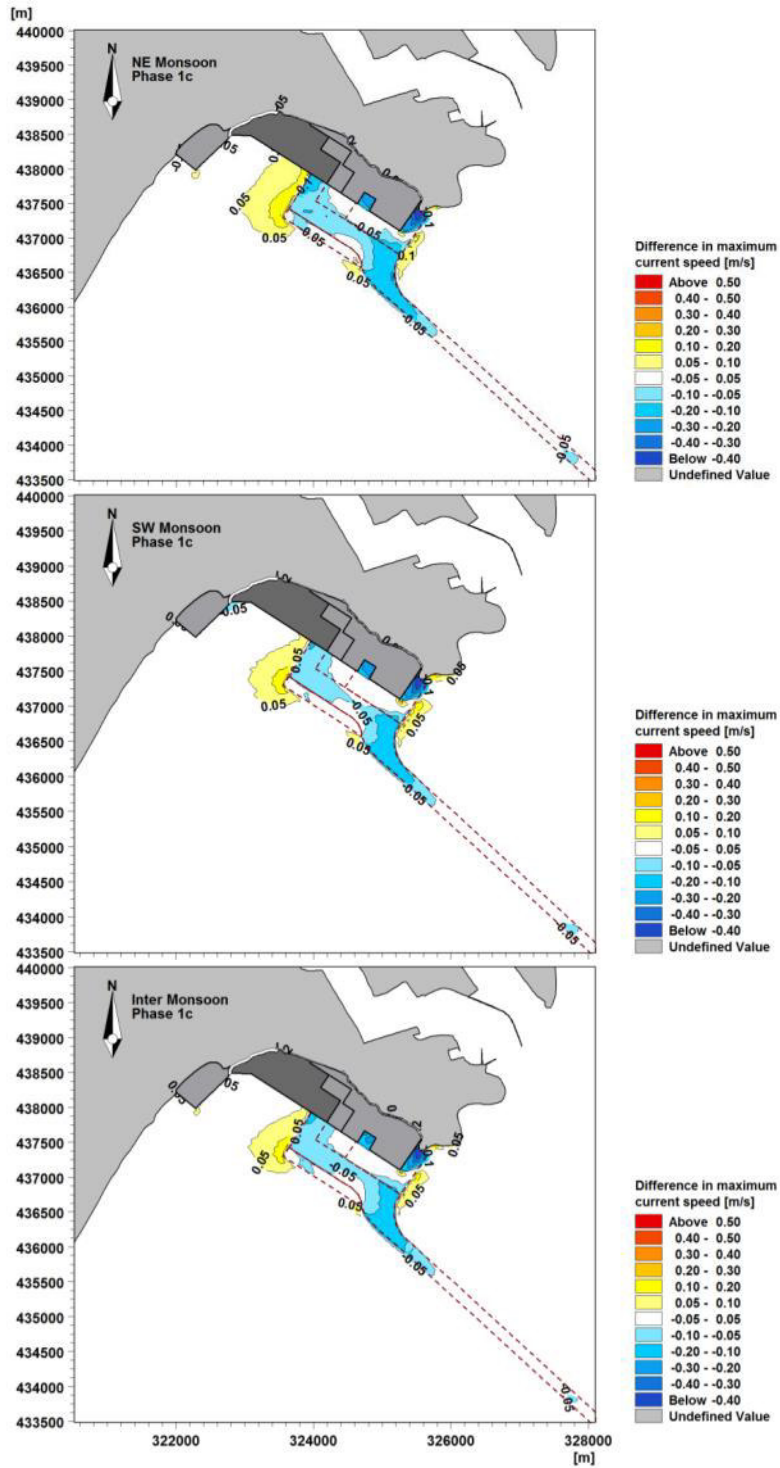


Figure 7.2.52: Phase 1c. Predicted changes in max current speeds between existing during NE (top), SW (middle) and Inter (bottom) monsoons.

7.2.2.2.4 Phase 2

The statistical results are presented in 2D map plot through **Figure 7.2.53** and **Figure 7.2.54**. A summary of differences in mean and maximum current speed at the extraction point is tabulated in the **Table 7.2.13**. Based on the simulated results, it can be observed that:

- Similar changes in current speeds as Phase 1c development are predicted. The additional reclaimed area during Phase 2 gives a slightly increase in mean current speed at the edge of the reclamation up to 0.1 m/s. The maximum current speed changes at the Phase 2 reclamation area is predicted around 0.3 m/s;
- The reduction in mean and maximum current speed of 0.1 m/s and 0.2 m/s in the dredging area are predicted;
- The predicted reduction in the mean current speed of 0.2 m/s is observed at the east of reclamation area, just south of the headland.
- The most noticeable changes are found in the dredging area (point 3) and reserved channel (point 4) with magnitude below 0.1 m/s;
- The changes in current speed almost similar for all different seasonal conditions;
- Overall, the current flow impacts are localized around the project area and minor.

Table 7.2.13: Phase 2: Changes in mean and maximum current speed for different season monsoons

Point	Changes: Existing vs Phase 2					
	NE Monsoon		SW Monsoon		IM Monsoon	
	Changes in mean current speed (m/s)	Changes in max current speed (m/s)	Changes in mean current speed (m/s)	Changes in max current speed (m/s)	Changes in mean current speed (m/s)	Changes in max current speed (m/s)
1	*	**	*	**	*	**
2	*	**	*	**	*	**
3	-0.04	-0.09	-0.05	-0.05	-0.04	-0.06
4	-0.06	**	-0.06	**	-0.06	**
5	*	**	*	**	*	**
6	*	**	*	**	*	**
7	*	**	*	**	*	**
8	*	**	*	**	*	**

*changes range between -0.03m/s (exclusive) to +0.03m/s (exclusive)

**changes range between -0.05m/s (exclusive) to +0.05m/s (exclusive)



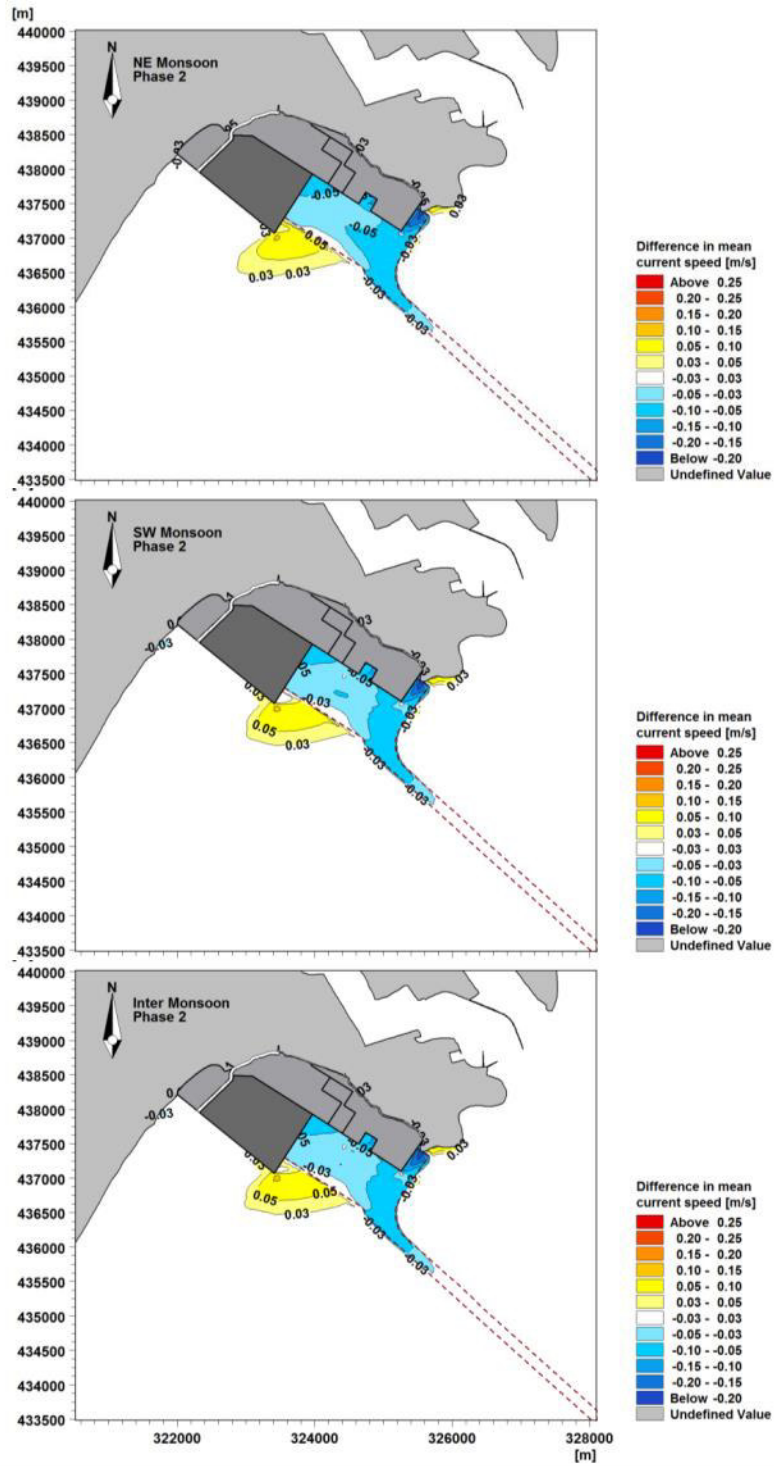


Figure 7.2.53: Phase 2. Predicted changes in mean current speeds between existing during NE (top), SW (middle) and Inter (bottom) monsoons.

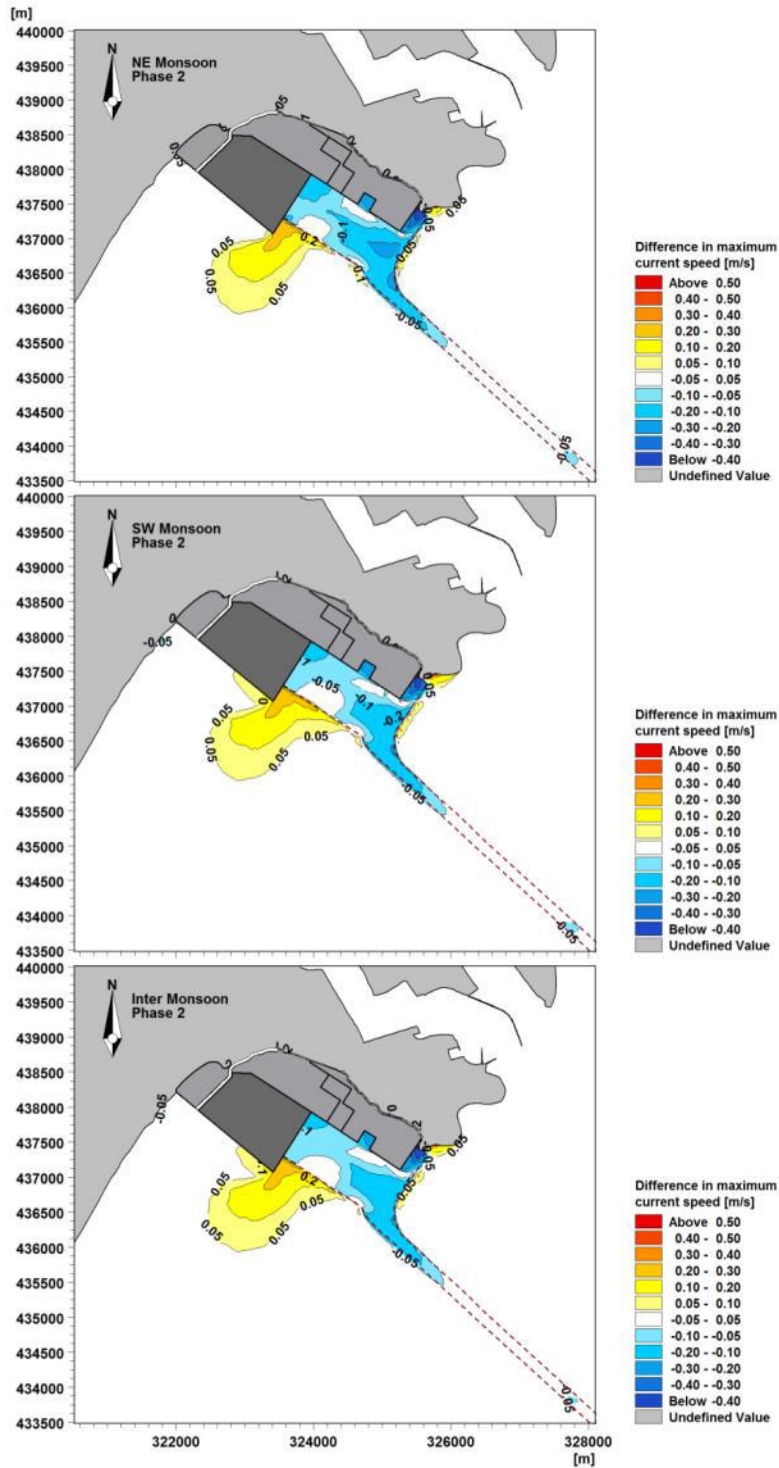


Figure 7.2.54: Phase 2. Predicted changes in max current speeds between existing during NE (top), SW (middle) and Inter (bottom) monsoons.

7.2.2.2.5 Phase 3

The statistical results are presented in 2D map plot through **Figure 7.2.55** and **Figure 7.2.56**. A summary of differences in mean and maximum current speed at the extraction point is tabulated in the **Table 7.2.14**. Based on the simulated results, it can be observed that:

- Similar changes in current speeds as Phase 2 development are predicted. The additional reclaimed area during Phase 3 gives a slightly increase in mean current speed at the edge of the reclamation up to 0.15 m/s. The maximum current speed changes at the Phase 2 reclamation area is predicted around 0.1 m/s;
- The reduction in mean and maximum current speed of 0.1 m/s and 0.2 m/s in the dredging area are predicted;
- The predicted reduction in the mean current speed of 0.2 m/s is observed at the east of reclamation area, just south of the headland.
- The most noticeable changes are found in the dredging area (point 3) and reserved channel (point 4) with magnitude below 0.1 m/s;
- The changes in current speed almost similar for all different seasonal conditions;
- Overall, the current flow impacts are localized around the project area and minor.

Table 7.2.14: Phase 3: Changes in mean and maximum current speed for different season monsoons

Point	Changes: Existing vs Phase 3					
	NE Monsoon		SW Monsoon		IM Monsoon	
	Changes in mean current speed (m/s)	Changes in max current speed (m/s)	Changes in mean current speed (m/s)	Changes in max current speed (m/s)	Changes in mean current speed (m/s)	Changes in max current speed (m/s)
1	*	**	*	**	*	**
2	*	**	*	**	*	**
3	-0.04	-0.09	-0.05	-0.05	-0.04	-0.06
4	-0.06	**	-0.06	**	-0.06	**
5	*	**	*	**	*	**
6	*	**	*	**	*	**
7	*	**	*	**	*	**
8	*	**	*	**	*	**

*changes range between -0.03m/s (exclusive) to +0.03m/s (exclusive)

**changes range between -0.05m/s (exclusive) to +0.05m/s (exclusive)



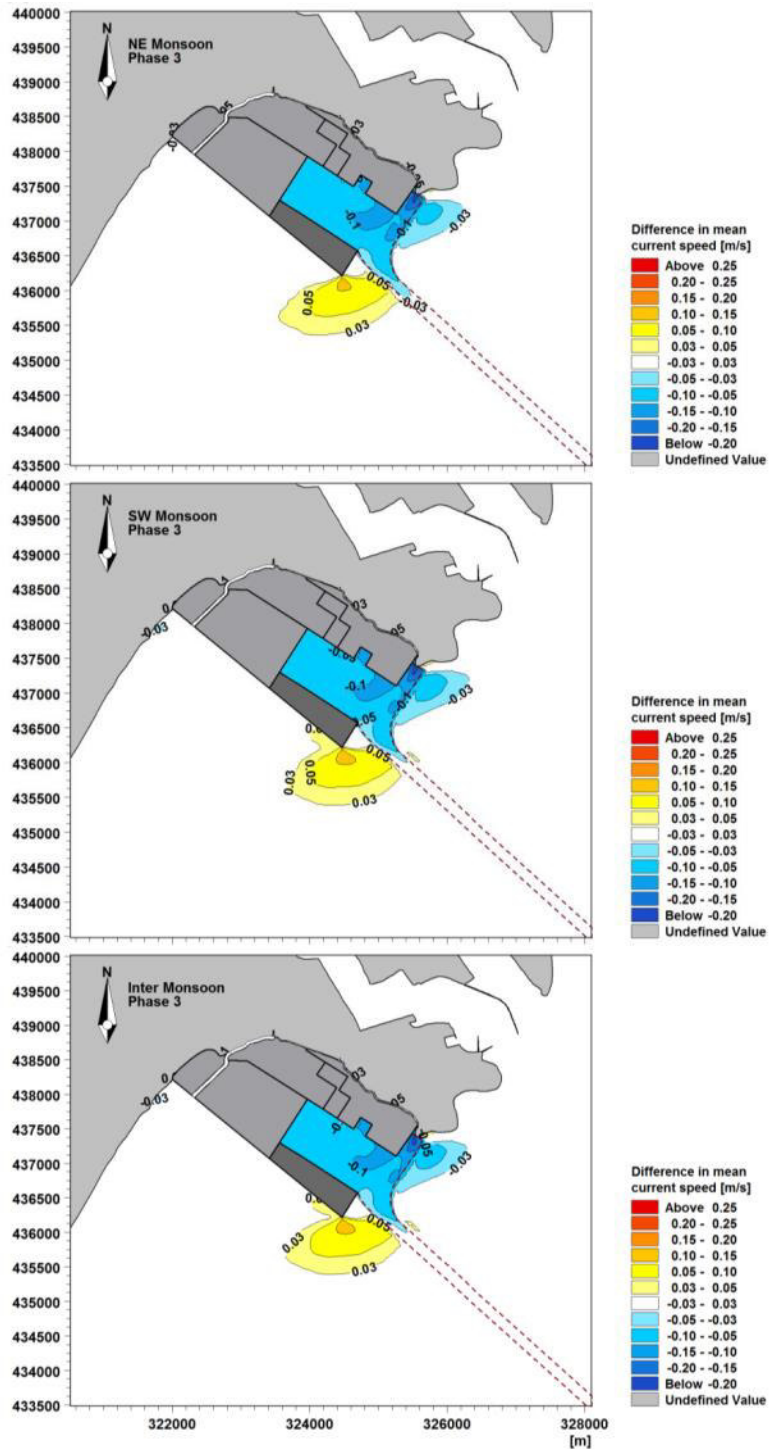


Figure 7.2.55: Phase 3. Predicted changes in mean current speeds between existing during NE (top), SW (middle) and Inter (bottom) monsoons.

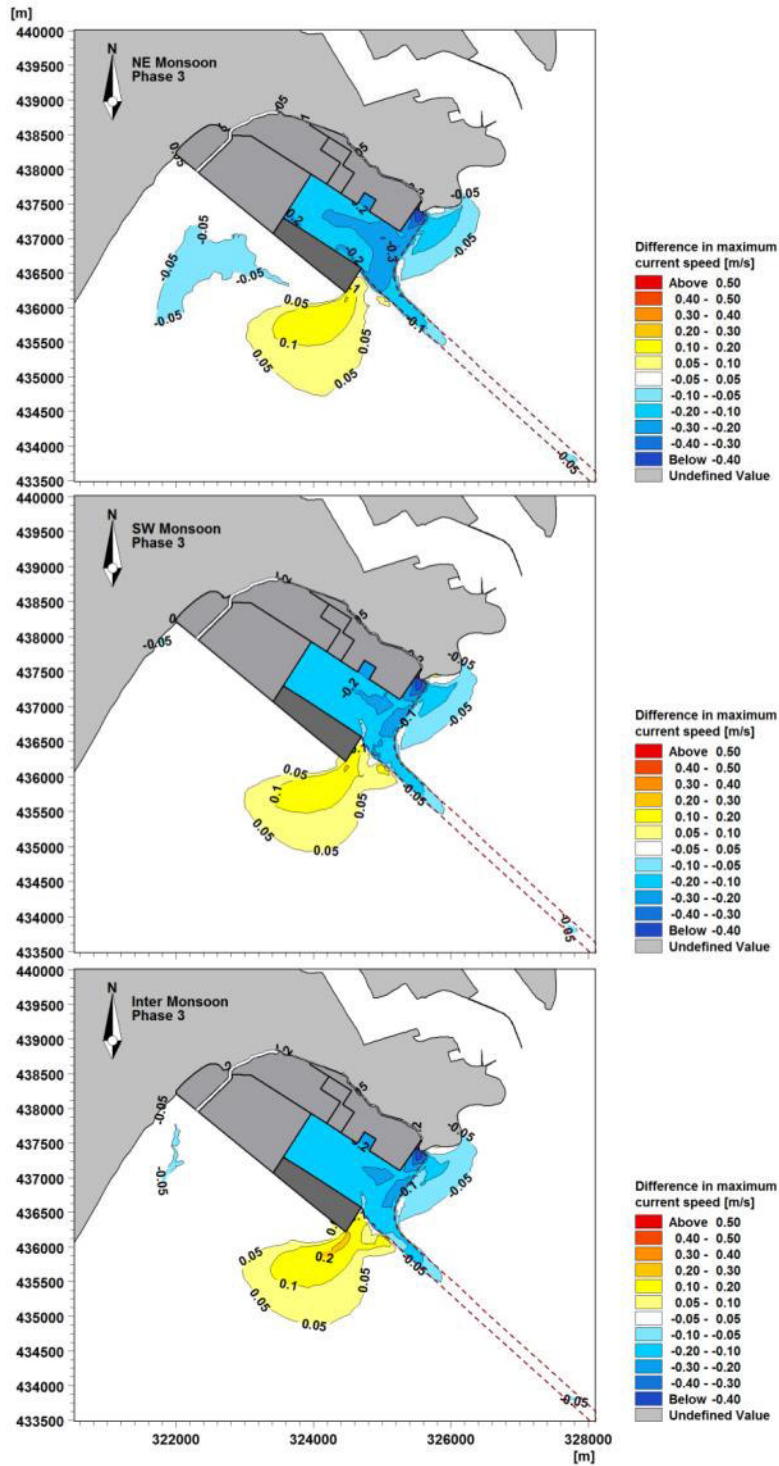


Figure 7.2.56: Phase 3. Predicted changes in max current speeds between existing during NE (top), SW (middle) and Inter (bottom) monsoons.

7.2.2.2.3 Wave

Wave simulations have been carried out for pre-development (existing) conditions and post development phases 1a, 1b, 1c, 2 and 3. The potential impact of the proposed development in significant wave height has been analysed based on the computed statistical analysis for a full tidal cycle of 28 days. **Figure 7.2.57** shows an example of predicted mean significant wave height for existing and phases 1a as well as the differences between them. The wave impacts are presented in “difference” plot only and discussed in details for all three seasonal conditions in the next sections.

Besides that, the predicted changes in mean and maximum significant wave height as compared to existing conditions have been extracted at the defined location (see **Figure 7.2.44**) for each phases and summarized in the **Table 7.2.15**.

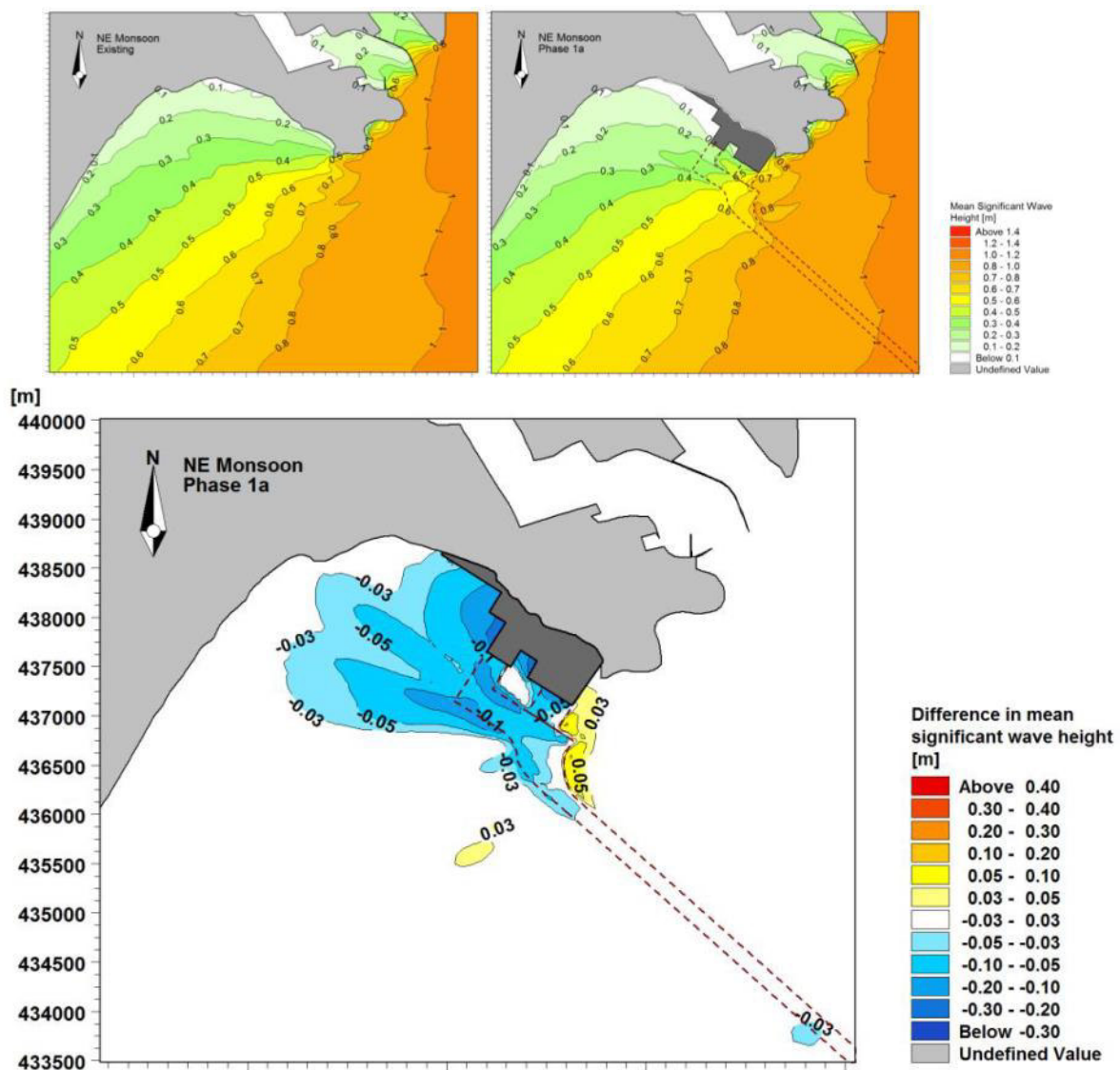


Figure 7.2.57: Example plot for mean significant wave height for existing (top - left) and Phase 1ab development (top -right) and changes in current speed (bottom) – NE Monsoon.

Table 7.2.15: Summary of predicted changes in mean and maximum significant wave height for different season monsoons.

Point	Predicted changes in mean significant wave height as compared to existing condition					Predicted changes in max significant wave height as compared to existing condition				
NE Monsoon										
	Phase 1a	Phase 1b	Phase 1c	Phase 2	Phase 3	Phase 1a	Phase 1b	Phase 1c	Phase 2	Phase 3
1	*	*	*	*	-0.07	**	**	**	**	-0.14
2	*	*	*	*	*	**	**	**	**	**
3	-0.09	-0.09	-0.06	*	*	-0.15	-0.15	-0.10	-0.07	-0.08
4	*	*	*	*	*	**	**	**	**	**
5	*	*	*	*	*	**	**	**	**	**
6	*	*	*	*	*	**	**	**	**	**
7	*	*	*	*	*	**	**	**	**	**
8	*	*	*	*	*	**	**	**	**	**
SW Monsoon										
	Phase 1a	Phase 1b	Phase 1c	Phase 2	Phase 3	Phase 1a	Phase 1b	Phase 1c	Phase 2	Phase 3
1	*	*	*	*	*	**	**	**	**	**
2	*	*	*	*	*	**	**	**	**	**
3	*	*	*	*	*	-0.08	-0.08	-0.05	-0.03	-0.06
4	*	*	*	*	*	**	**	**	**	**
5	*	*	*	*	*	**	**	**	**	**
6	*	*	*	*	*	**	**	**	**	**
7	*	*	*	*	*	**	**	**	**	**
8	*	*	*	*	*	**	**	**	**	**
Inter Monsoon										
	Phase 1a	Phase 1b	Phase 1c	Phase 2	Phase 3	Phase 1a	Phase 1b	Phase 1c	Phase 2	Phase 3
1	*	*	*	*	-0.03	**	**	**	**	-0.06
2	*	*	*	*	*	**	**	**	**	**
3	-0.03	-0.03	*	*	*	-0.06	-0.06	**	**	-0.06
4	*	*	*	*	*	**	**	**	**	**
5	*	*	*	*	*	**	**	**	**	**
6	*	*	*	*	*	**	**	**	**	**
7	*	*	*	*	*	**	**	**	**	**
8	*	*	*	*	*	**	**	**	**	**

*changes range between -0.03m (exclusive) to +0.03m (exclusive)

**changes range between -0.05m (exclusive) to +0.05m (exclusive)



7.2.2.2.3.1 Phase 1a

The statistical results are presented in 2D map plot through **Figure 7.2.58** and **Figure 7.2.59**. A summary of differences in mean and maximum significant wave height at the extraction point is tabulated in the **Table 7.2.16**. Based on the simulated results, it can be observed that:

- For all different seasonal conditions, difference in mean significant wave height is less than 0.15m and localised around the project area;
- For northeast monsoon, the impacts are bigger in extent compared with other monsoons;
- As expected, the future reclamation will induce a wave-sheltering effect to the south of the project area. This sheltering effect may benefit the local fishermen as slightly lower waves are expected at the area;
- It may also benefit the coastline at the south of project site as the rate of erosion caused by NE waves will be reduced. However, this effect is not a permanent benefit from the structure, as erosion will likely be shifted further away from the proposed development along coast;
- The predicted changes are localised around the proposed development. No significant changes to the area beyond the immediate vicinity of the project site are predicted.

Table 7.2.16: Phase 1a: Changes in mean and maximum significant wave height for different season monsoons

Point	Changes: Existing vs Phase 1a					
	NE Monsoon		SW Monsoon		IM Monsoon	
	Changes in mean significant wave height (m)	Changes in max significant wave height (m)	Changes in mean significant wave height (m)	Changes in max significant wave height (m)	Changes in mean significant wave height (m)	Changes in max significant wave height (m)
1	*	**	*	**	*	**
2	*	**	*	**	*	**
3	-0.09	-0.15	*	-0.08	-0.03	-0.06
4	*	**	*	**	*	**
5	*	**	*	**	*	**
6	*	**	*	**	*	**
7	*	**	*	**	*	**
8	*	**	*	**	*	**

*changes range between -0.03m (exclusive) to +0.03m (exclusive)

**changes range between -0.05m (exclusive) to +0.05m (exclusive)



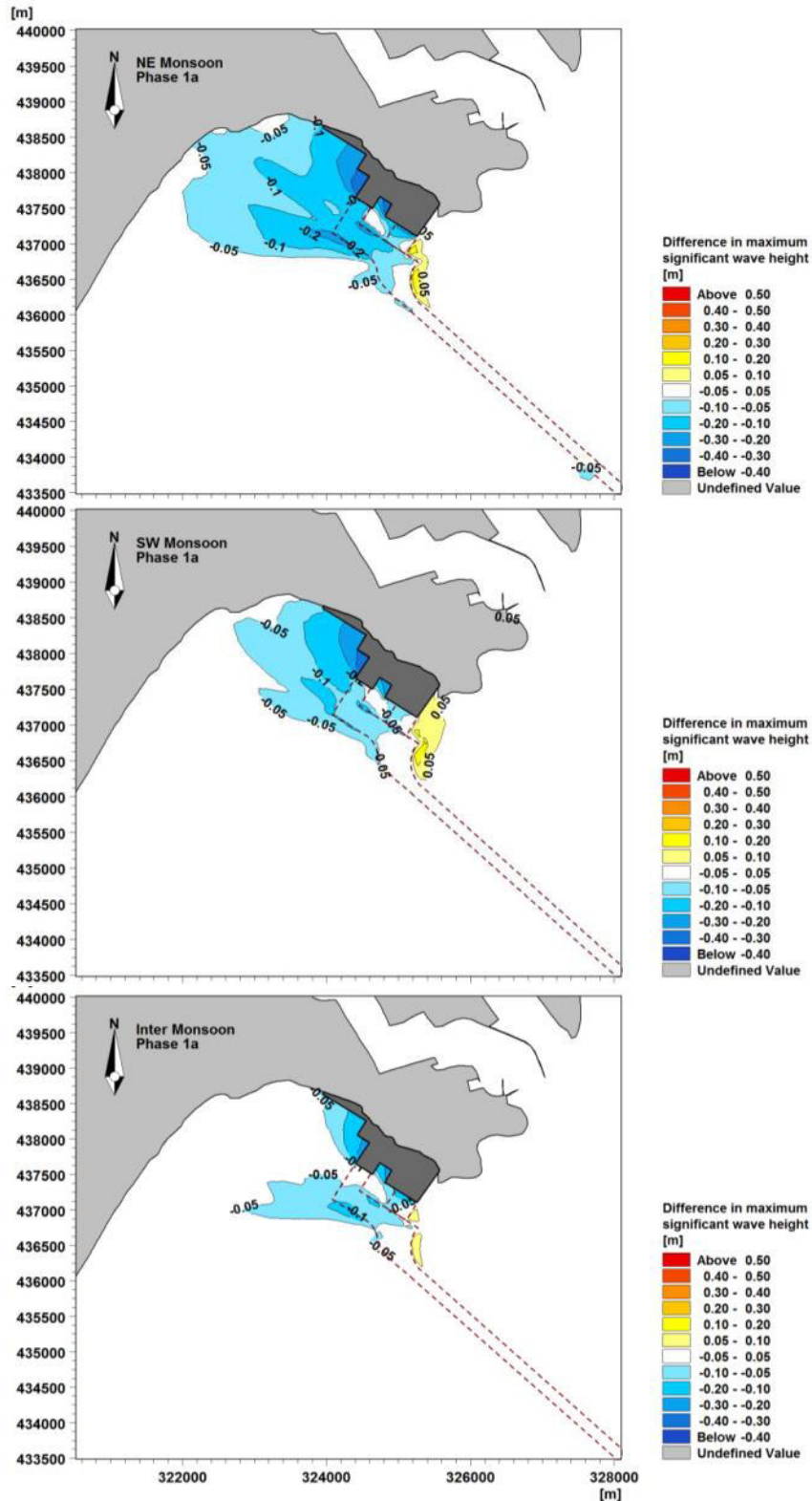


Figure 7.2.59: Phase 1a. Predicted changes in max significant wave height between existing during NE (top), SW (middle) and Inter (bottom) monsoons.

7.2.2.3.2 Phase 1b

The statistical results are presented in 2D map plot through **Figure 7.2.60** and **Figure 7.2.61**. A summary of differences in mean and maximum significant wave height at the extraction point is tabulated in the **Table 7.2.17**. Based on the simulated results, it can be observed that:

- Similar changes in significant wave height as Phase 1a development are predicted. The additional reclaimed area near to shore during Phase 1b does not give a significant impacts.
- For all different seasonal conditions, difference in mean significant wave height is less than 0.15m and localised around the project area;
- For northeast monsoon, the impacts are bigger in extent compared with other monsoons;
- An increase of mean significant wave height about 0.05m at east of dredged basin area can be observed.
- The predicted changes are localised around the proposed development. No significant changes to the area beyond the immediate vicinity of the project site are predicted.

Table 7.2.17: Phase 1b: Changes in mean and maximum significant wave height for different season monsoons

Point	Changes: Existing vs Phase 1b					
	NE Monsoon		SW Monsoon		IM Monsoon	
	Changes in mean significant wave height (m)	Changes in max significant wave height (m)	Changes in mean significant wave height (m)	Changes in max significant wave height (m)	Changes in mean significant wave height (m)	Changes in max significant wave height (m)
1	*	**	*	**	*	**
2	*	**	*	**	*	**
3	-0.09	-0.15	*	-0.08	-0.03	-0.06
4	*	**	*	**	*	**
5	*	**	*	**	*	**
6	*	**	*	**	*	**
7	*	**	*	**	*	**
8	*	**	*	**	*	**

*changes range between -0.03m (exclusive) to +0.03m (exclusive)

**changes range between -0.05m (exclusive) to +0.05m (exclusive)



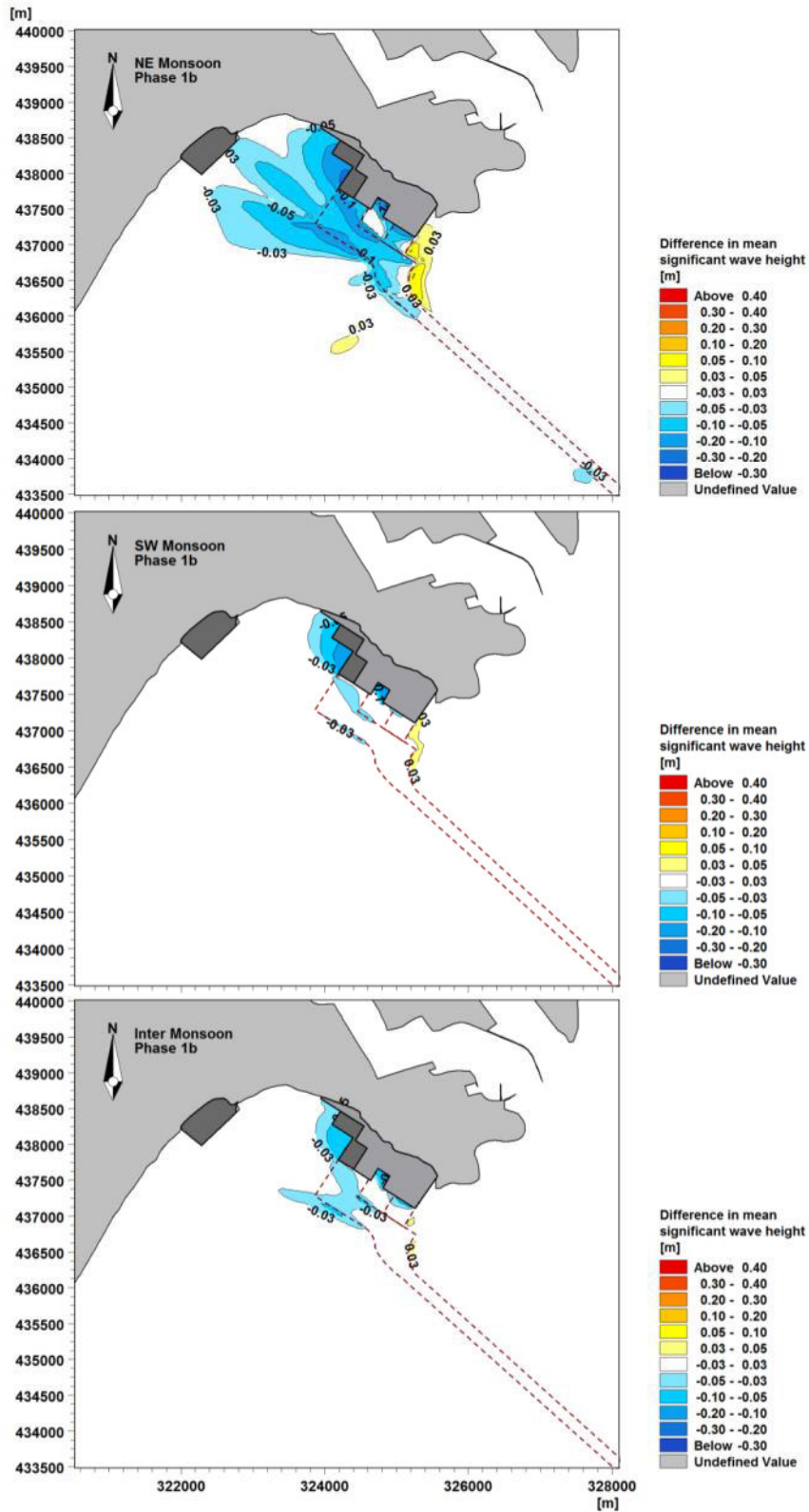


Figure 7.2.60: Phase 1b. Predicted changes in mean significant wave height between existing during NE (top), SW (middle) and Inter (bottom) monsoons.

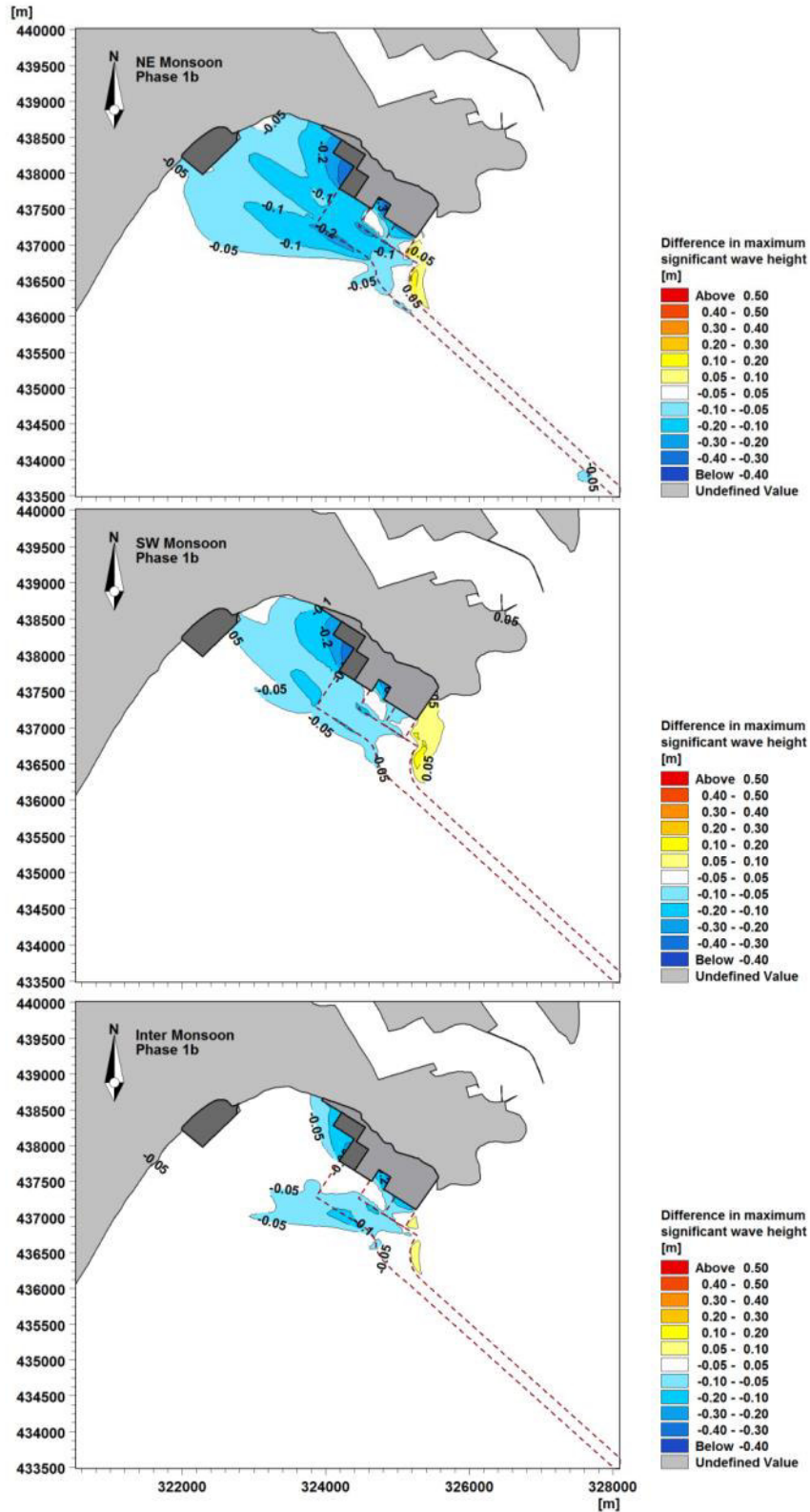


Figure 7.2.61: Phase 1b. Predicted changes in max significant wave height between existing during NE (top), SW (middle) and Inter (bottom) monsoons.

7.2.2.2.3.3 Phase 1c

The statistical results are presented in 2D map plot through **Figure 7.2.62** and **Figure 7.2.63**. A summary of differences in mean and maximum significant wave height at the extraction point is tabulated in the **Table 7.2.18**. Based on the simulated results, it can be observed that:

- Similar changes in significant wave height as Phase 1b development are predicted. The additional reclaimed area near to shore during Phase 1c does not give a significant impacts.
- For all different seasonal conditions, difference in mean significant wave height is less than 0.10m and localised around the project area;
- For northeast monsoon, the impacts are bigger in extent compared with other monsoons;
- The predicted changes are localised around the proposed development. No significant changes to the area beyond the immediate vicinity of the project site are predicted.

Table 7.2.18: Phase 1c: Changes in mean and maximum significant wave height for different season monsoons

Point	Changes: Existing vs Phase 1c					
	NE Monsoon		SW Monsoon		IM Monsoon	
	Changes in mean significant wave height (m)	Changes in max significant wave height (m)	Changes in mean significant wave height (m)	Changes in max significant wave height (m)	Changes in mean significant wave height (m)	Changes in max significant wave height (m)
1	*	**	*	**	*	**
2	*	**	*	**	*	**
3	-0.06	-0.10	*	-0.05	*	**
4	*	**	*	**	*	**
5	*	**	*	**	*	**
6	*	**	*	**	*	**
7	*	**	*	**	*	**
8	*	**	*	**	*	**

*changes range between -0.03m (exclusive) to +0.03m (exclusive)

**changes range between -0.05m (exclusive) to +0.05m (exclusive)



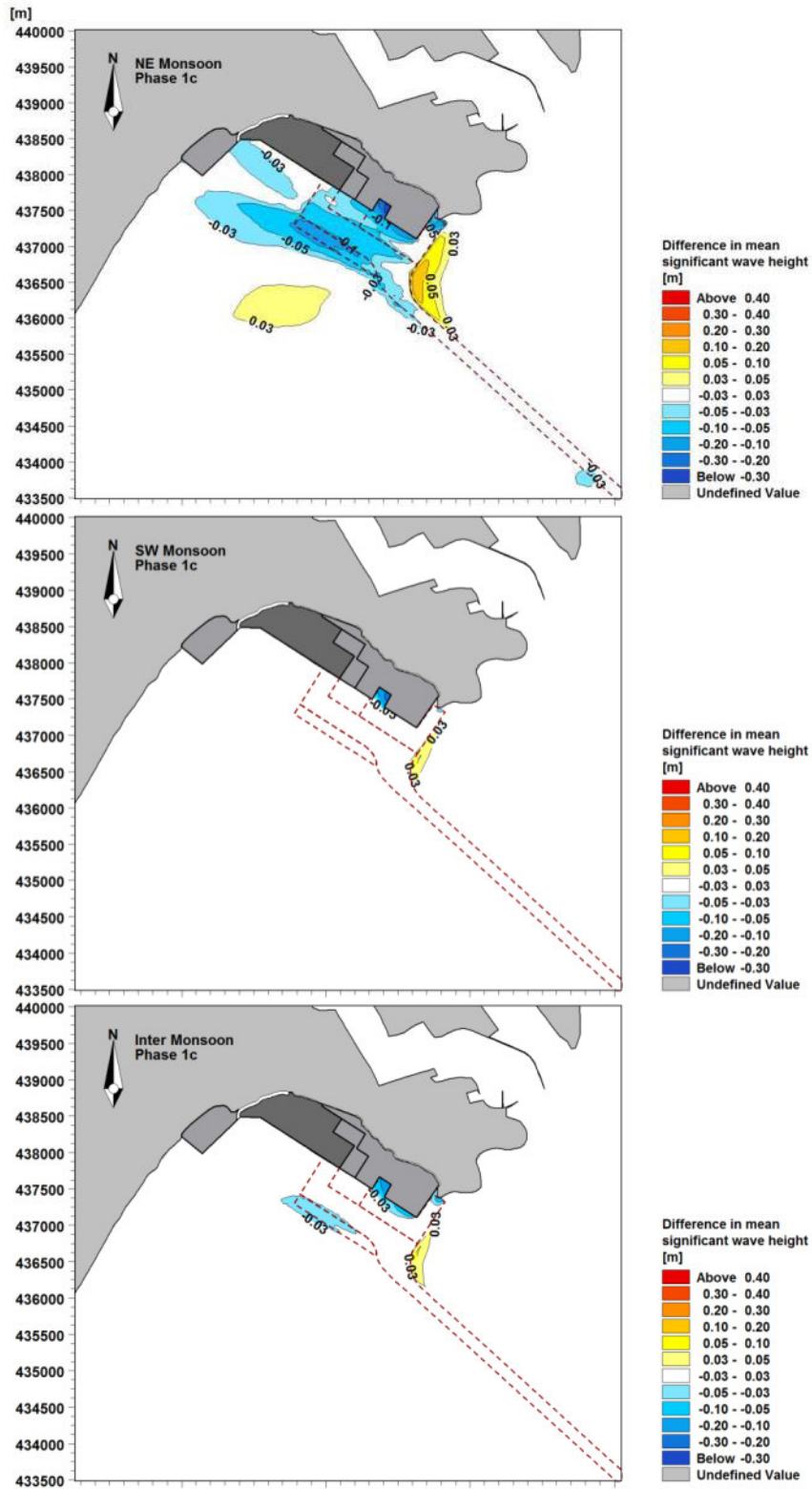


Figure 7.2.62: Phase 1c. Predicted changes in mean significant wave height between existing during NE (top), SW (middle) and Inter (bottom) monsoons.

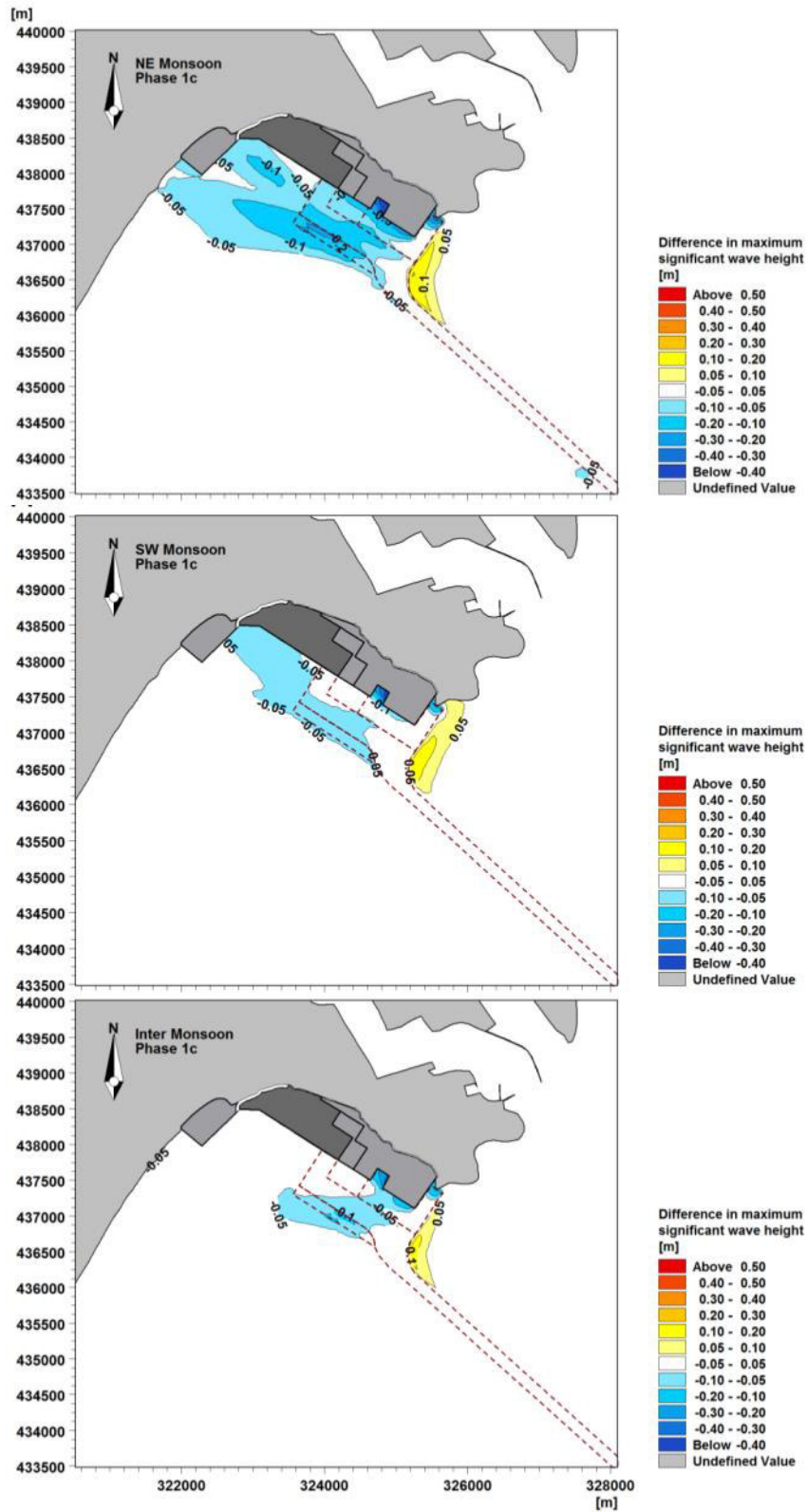


Figure 7.2.63: Phase 1c. Predicted changes in max significant wave height between existing during NE (top), SW (middle) and Inter (bottom) monsoons.

7.2.2.2.3.4 Phase 2

The statistical results are presented in 2D map plot through **Figure 7.2.64** and **Figure 7.2.65**. A summary of differences in mean and maximum significant wave height at the extraction point is tabulated in the **Table 7.2.19**. Based on the simulated results, it can be observed that:

- As expected, the future Phase 2 reclamation will induce a wave sheltering effect immediately to the south of project reclaimed area up to 0.1 m (reduce) in mean significant wave height;
- For northeast monsoon, the impacts are bigger in extent compared with other monsoons;
- The predicted changes are localised around the proposed development. No significant changes to the area beyond the immediate vicinity of the project site are predicted.

Table 7.2.19: Phase 2: Changes in mean and maximum significant wave height for different season monsoons

Point	Changes: Existing vs Phase 2					
	NE Monsoon		SW Monsoon		IM Monsoon	
	Changes in mean significant wave height (m)	Changes in max significant wave height (m)	Changes in mean significant wave height (m)	Changes in max significant wave height (m)	Changes in mean significant wave height (m)	Changes in max significant wave height (m)
1	*	**	*	**	*	**
2	*	**	*	**	*	**
3	*	-0.07	*	-0.03	*	**
4	*	**	*	**	*	**
5	*	**	*	**	*	**
6	*	**	*	**	*	**
7	*	**	*	**	*	**
8	*	**	*	**	*	**

*changes range between -0.03m (exclusive) to +0.03m (exclusive)

**changes range between -0.05m (exclusive) to +0.05m (exclusive)



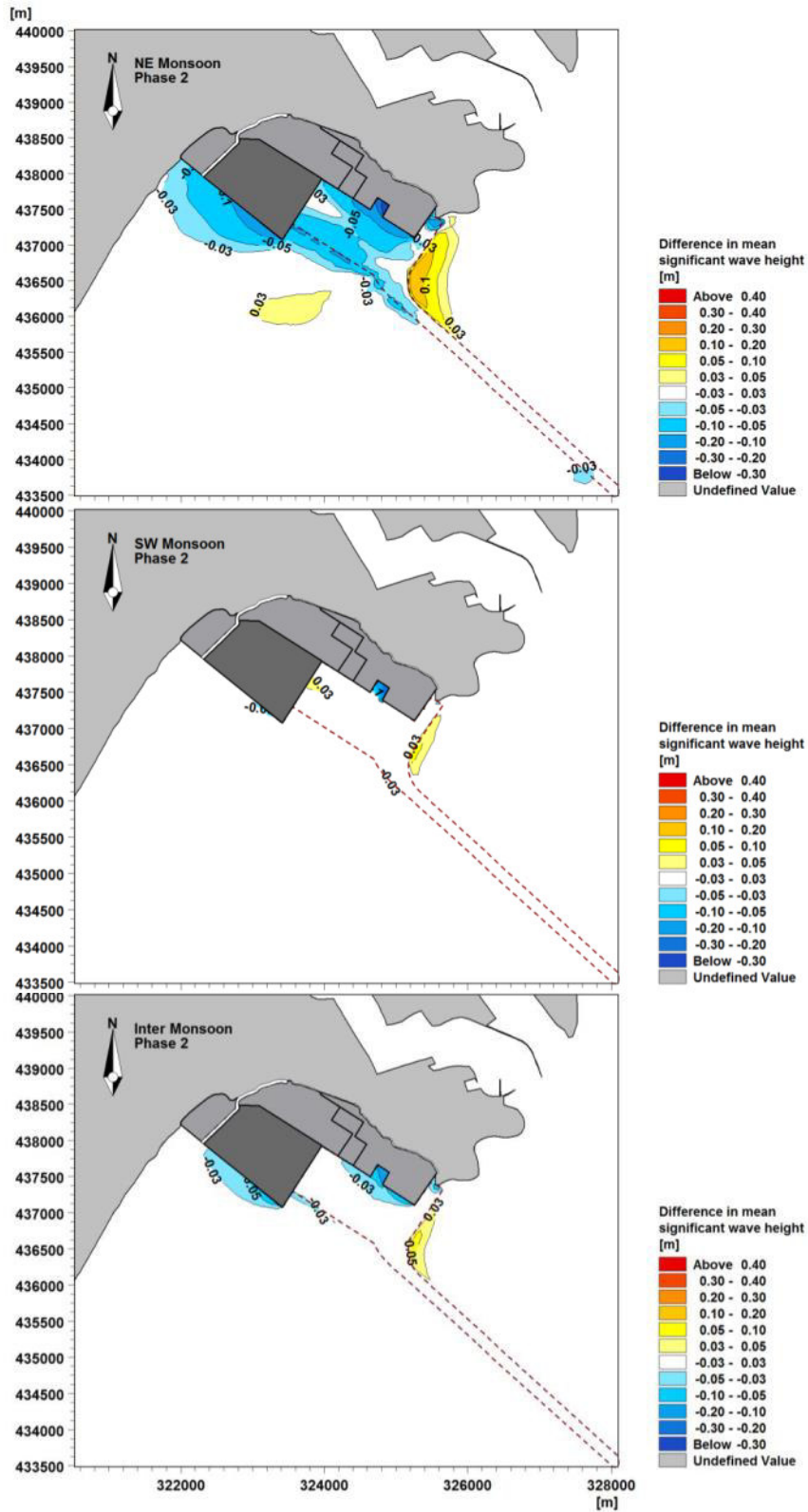


Figure 7.2.64: Phase 2. Predicted changes in mean significant wave height between existing during NE (top), SW (middle) and Inter (bottom) monsoons.

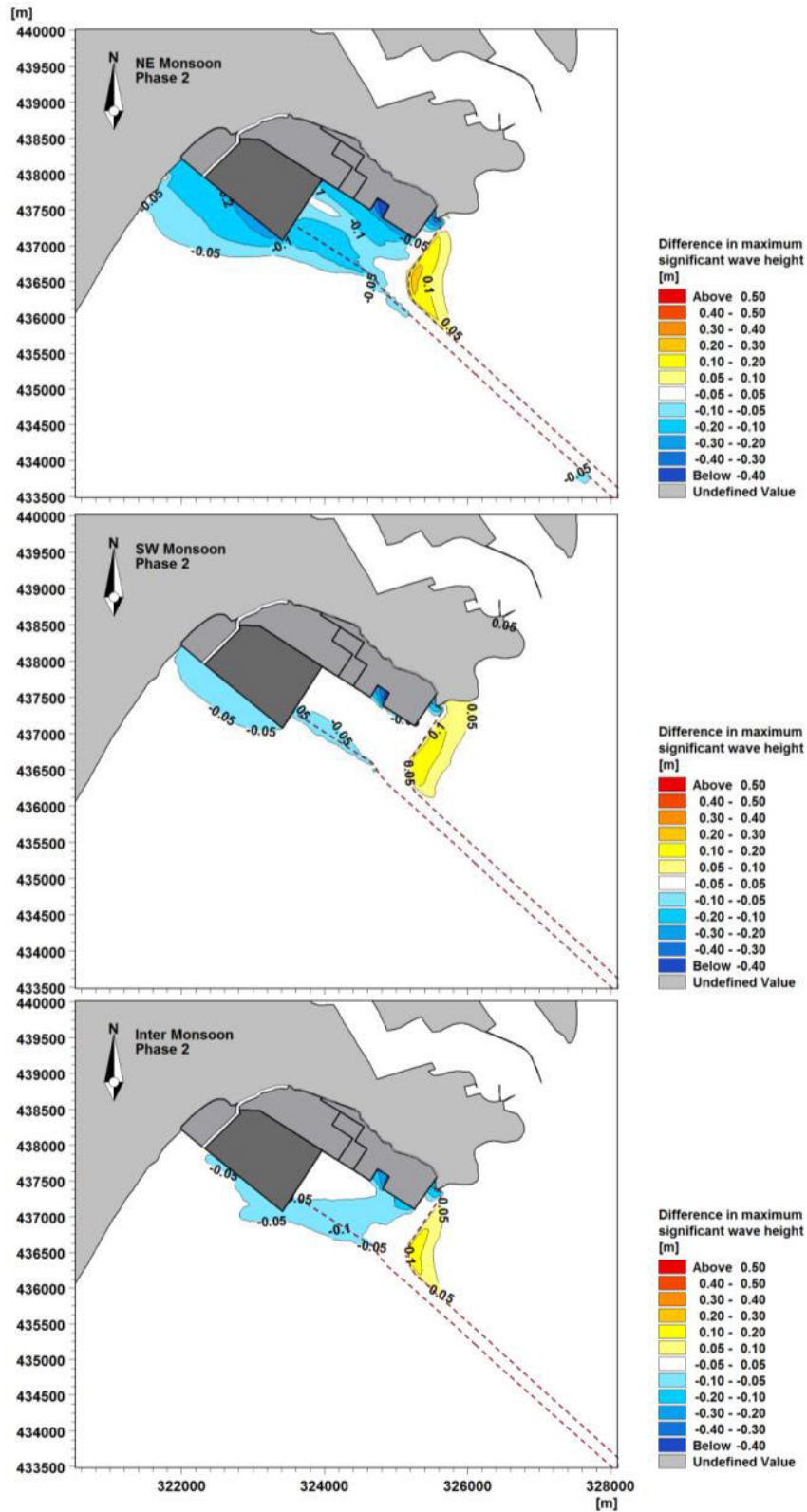


Figure 7.2.65: Phase 2. Predicted changes in max significant wave height between existing during NE (top), SW (middle) and Inter (bottom) monsoons.

7.2.2.2.3.5 Phase 3

The statistical results are presented in 2D map plot through **Figure 7.2.66** and **Figure 7.2.67**. A summary of differences in mean and maximum significant wave height at the extraction point is tabulated in the **Table 7.2.20**. Based on the simulated results, it can be observed that:

- As expected, the future Phase 3 reclamation will induce more wave sheltering effect immediately to the south of project reclaimed area up to 0.3 m (reduce) in mean significant wave height. This sheltering effect may benefit the local fishermen as slightly lower waves are expected at the area;
- For northeast monsoon, the impacts are bigger in extent compared with other monsoons;
- The predicted changes are localised around the proposed development. No significant changes to the area beyond the immediate vicinity of the project site are predicted.

Table 7.2.20: Phase 3: Changes in mean and maximum significant wave height for different season monsoons

Point	Changes: Existing vs Phase 3					
	NE Monsoon		SW Monsoon		IM Monsoon	
	Changes in mean significant wave height (m)	Changes in max significant wave height (m)	Changes in mean significant wave height (m)	Changes in max significant wave height (m)	Changes in mean significant wave height (m)	Changes in max significant wave height (m)
1	-0.07	-0.14	*	**	-0.03	-0.06
2	*	**	*	**	*	**
3	*	**	*	-0.06	*	**
4	*	**	*	**	*	**
5	*	**	*	**	*	**
6	*	**	*	**	*	**
7	*	**	*	**	*	**
8	*	**	*	**	*	**

*changes range between -0.03m (exclusive) to +0.03m (exclusive)

**changes range between -0.05m (exclusive) to +0.05m (exclusive)



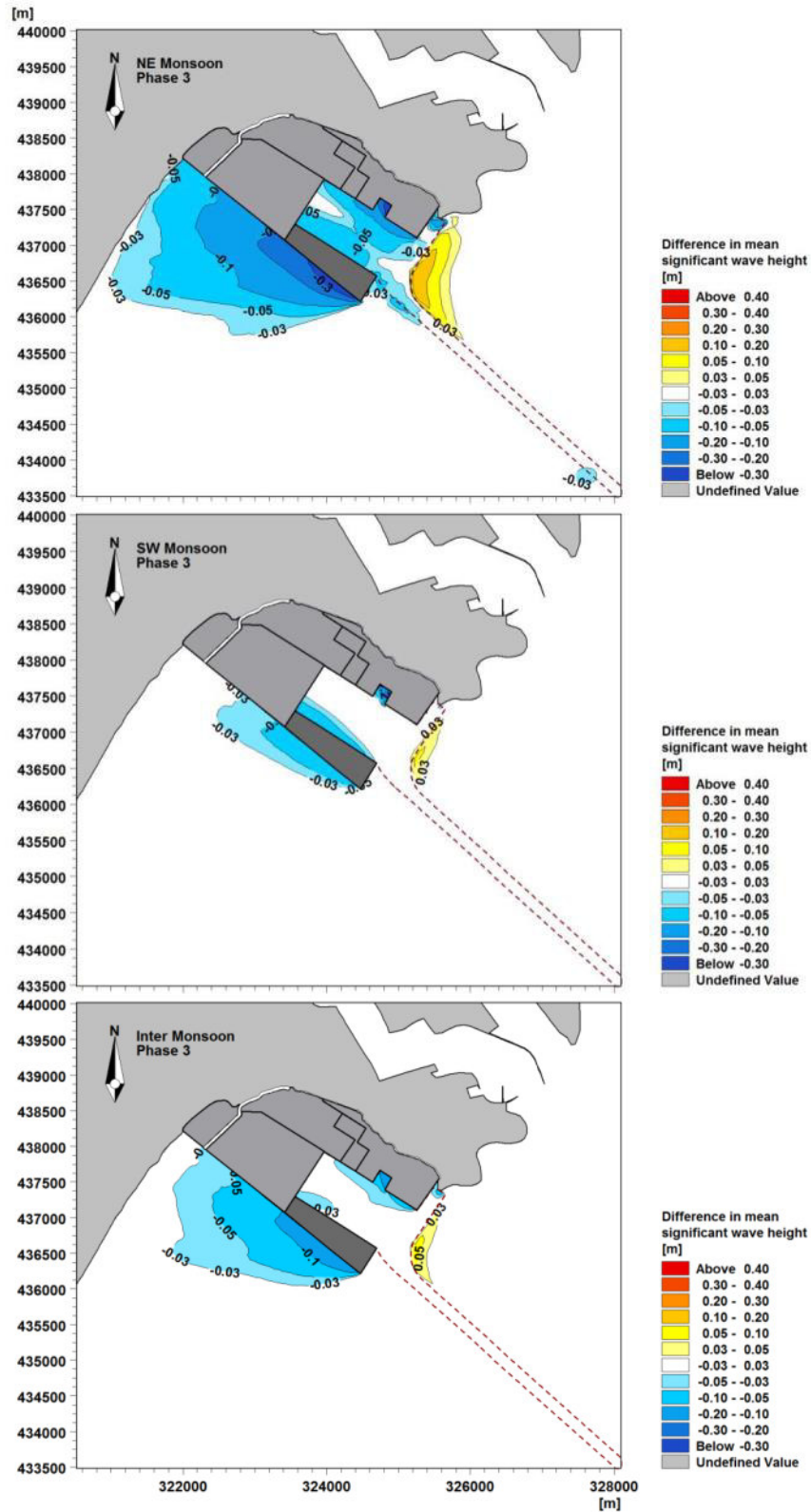


Figure 7.2.66. Predicted changes in mean significant wave height between existing during NE (top), SW (middle) and Inter (bottom) monsoons.