Application of Software MIKE 21

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Major Disciplines

- River Engineering
- River & Reservoir System Modelling
- Coastal and Offshore Engineering
- Foundation and Structures
- Applied Earth Sciences
- Instrumentation Calibration and Testing Services

Solutions are provided through PHYSICAL and MATHEMATICAL MODEL studies

MIKE 21 is a computer program that simulates flows, waves, sediments and ecology in rivers, lakes, estuaries, bays, coastal areas and seas in two dimensions. It was developed by DHI .

MIKE 21 HD
MIKE 21 SW
MIKE 21 BW

MKIE 21 Flow Model FM :- (Flexible Mesh)

1. Hydrodynamic Model (HD)
2. Mud Transport Module (MT)
3. Sand Transport Module (ST)
4. ECO Lab /Oil Spill Module (ELOS)
5. Particle Tracking Module (PT)

The Particle Tracking module calculates the transport and determine the fate of dissolved, suspended and sedimented substances discharged or accidently spilled in lakes, estuaries and coastal areas or at the open sea.

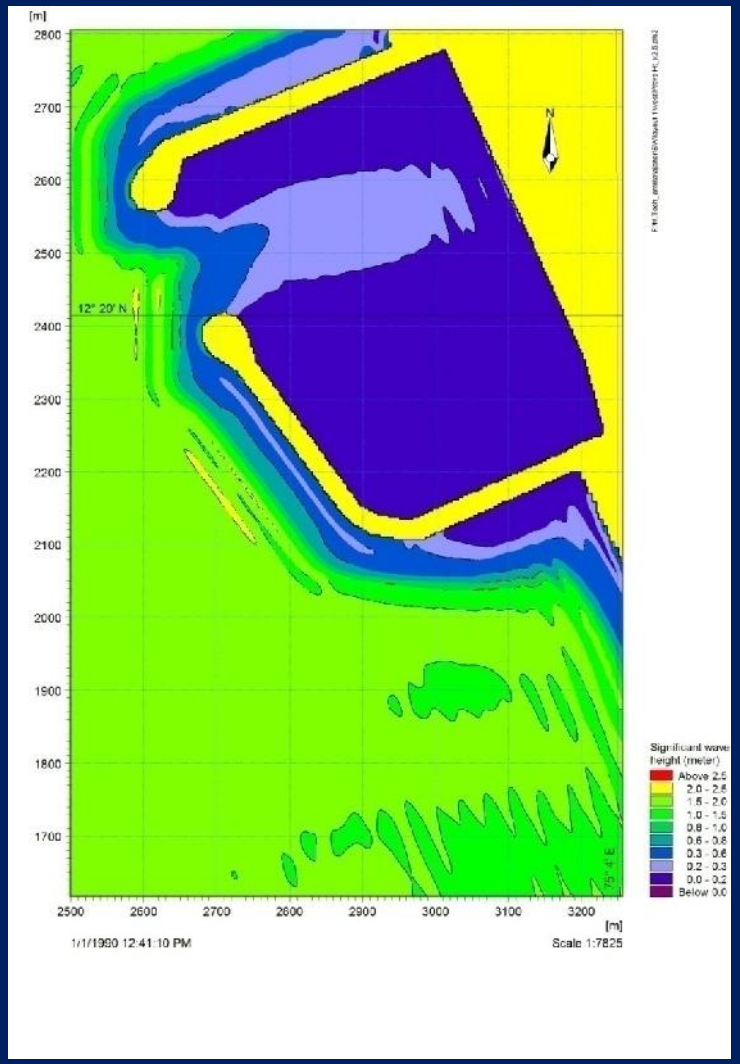
MIKE 21 SW

MIKE 21 SW is a state-of-the-art numerical tool for prediction and analysis of wave climates in offshore and coastal areas

MIKE 21 SW includes the following physical phenomena:

- Wave growth by action of wind
- Non-linear wave-wave interaction
- Dissipation due to white-capping
- Dissipation due to bottom friction
- Dissipation due to depth-induced wave breaking
- Refraction and shoaling due to depth variations
- Wave-current interaction
- Effect of time-varying water depth and flooding and drying

A major application area is the design of offshore, coastal and port structures where accurate assessment of wave loads is of utmost importance to the safe and economic design of these structures


[m]
2800
2700
2600
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12° 20' N
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3100
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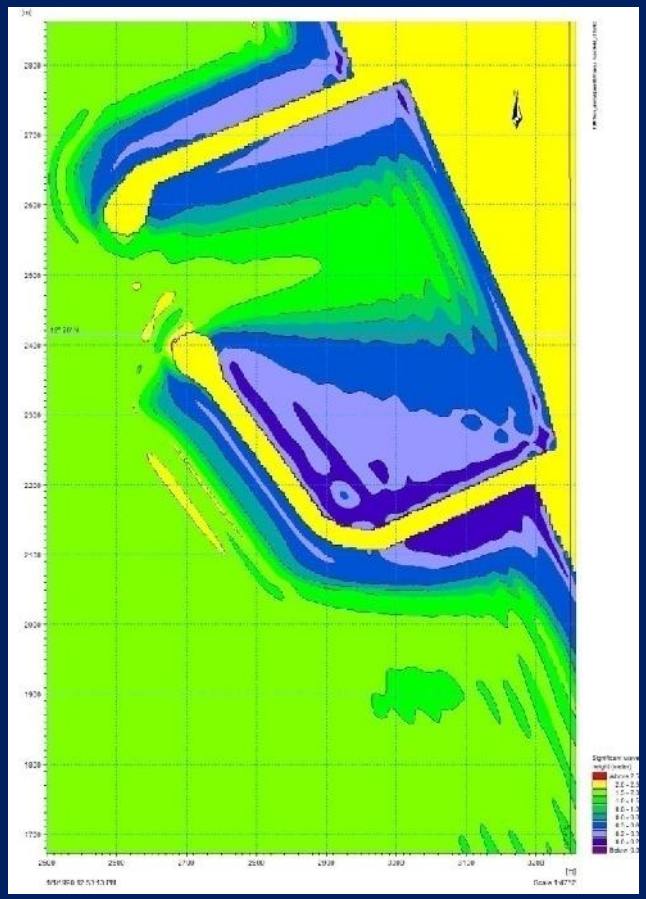
Scale 1:7825
N
Significant wave height (meter)
Above 2.5
2.0 - 2.5
1.6 - 2.0
1.0 - 1.6
0.8 - 1.0
0.6 - 0.8
0.3 - 0.6
0.2 - 0.3
0.0 - 0.2
Below 0.0



WAVE TRANQUILLITY STUDIES FOR THE DEVELOPMENT OF FISHERY HARBOUR AT AJANUR, KERALA

These Studies have been done in two parts

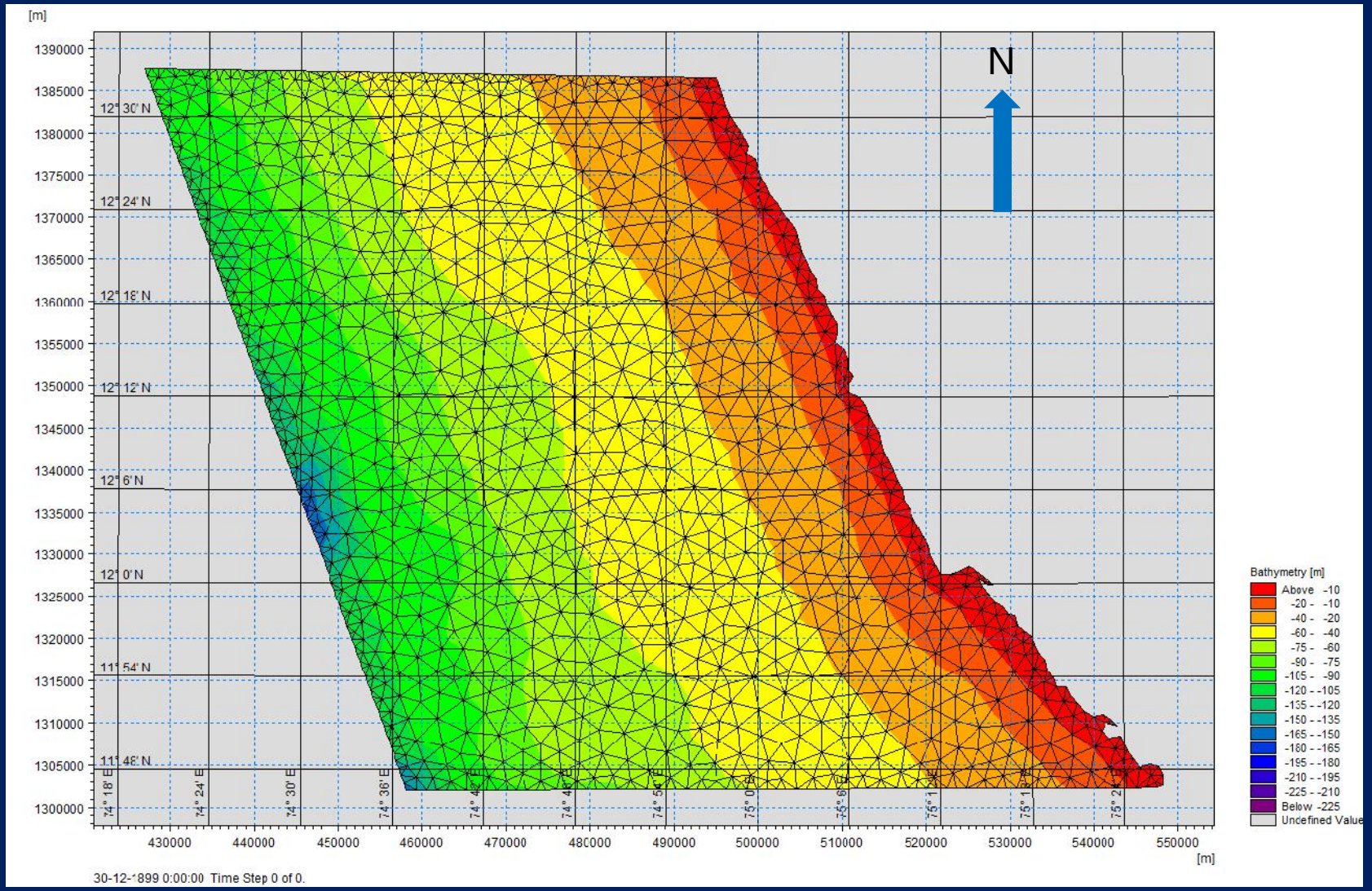
- **WAVE TRANSFORMATION STUDY –**

  Wave Transformation from Deep water to shallow water

- **WAVE TRANQUILLITY STUDIES –**

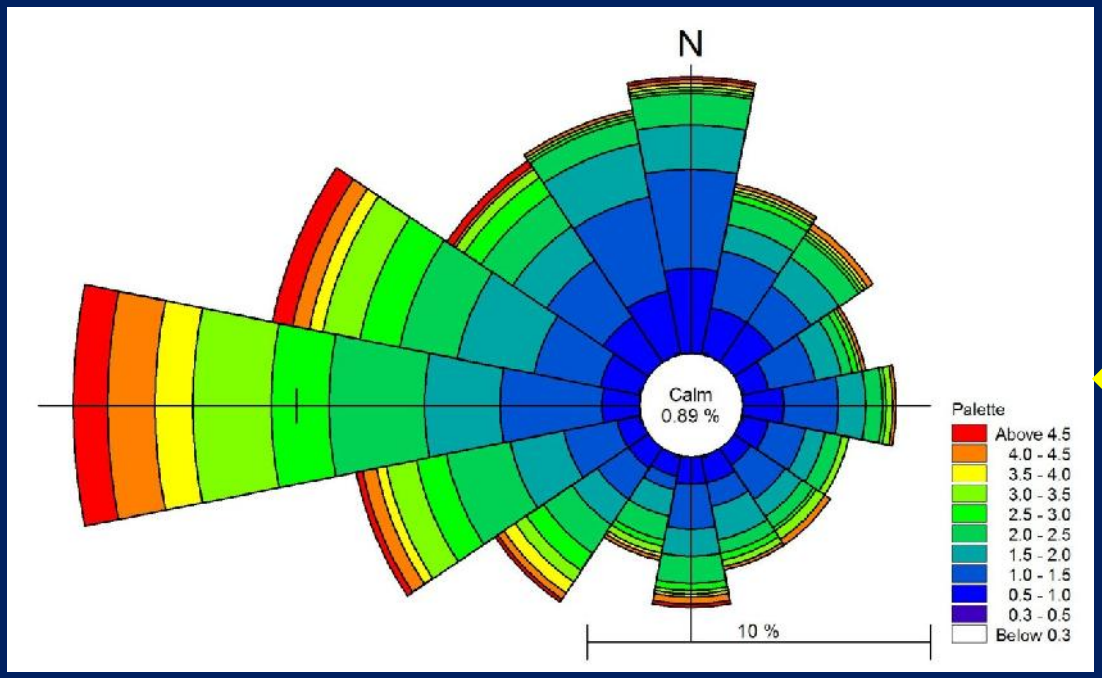
  Wave Propagation inside the Harbour

WAVE TRANSFORMATION STUDIES USING MIKE 21 SW



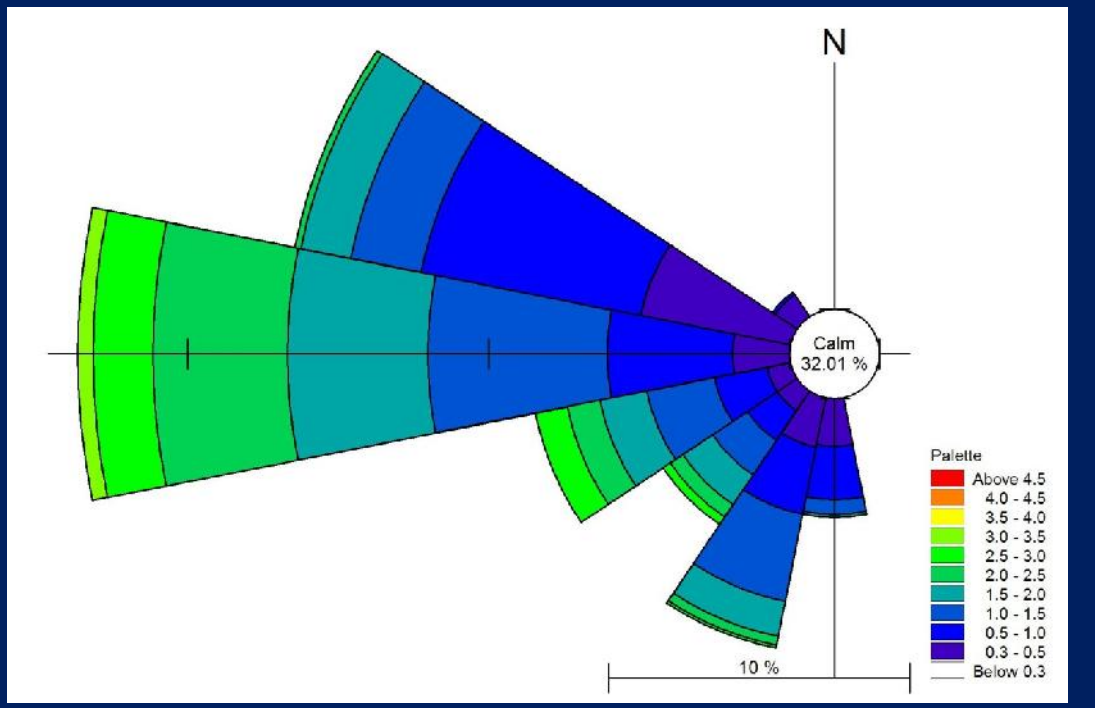
Bathymetry used in the MIKE-21 SW Studies

WAVE ROSE DIAGRAMS FOR ANNUAL PERIOD



Offshore

Inshore



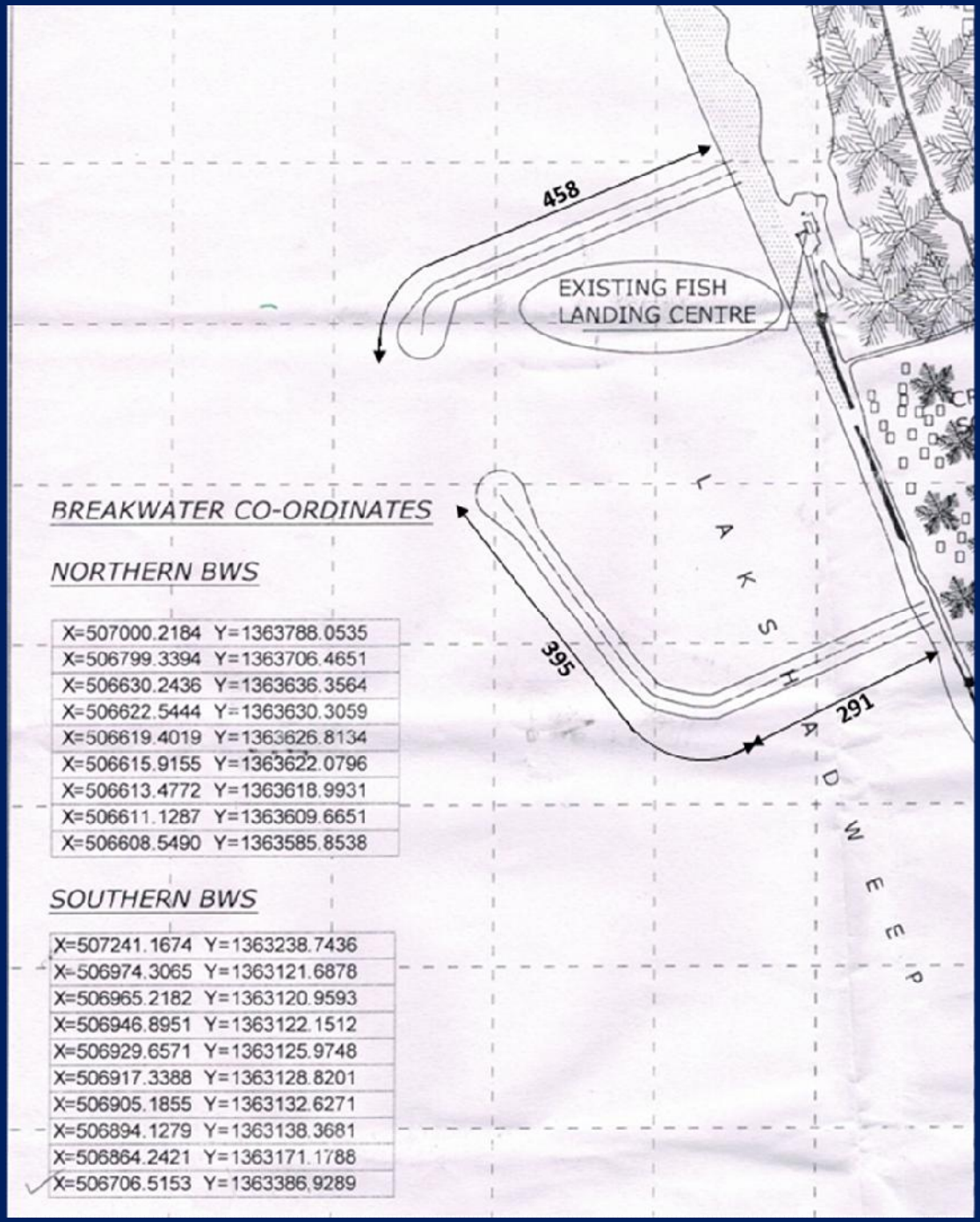
WAVE CONDITIONS FROM WAVE TRANSFORMATION STUDIES

INCIDENT WAVE DIRECTION	INCIDENT WAVE HEIGHT (m)
SSW	1.5
SW	2.5
WSW	2.5
WEST	2.5
WNW	1.5

Input to MIKE 21 BW model

MIKE 21 BW MODEL

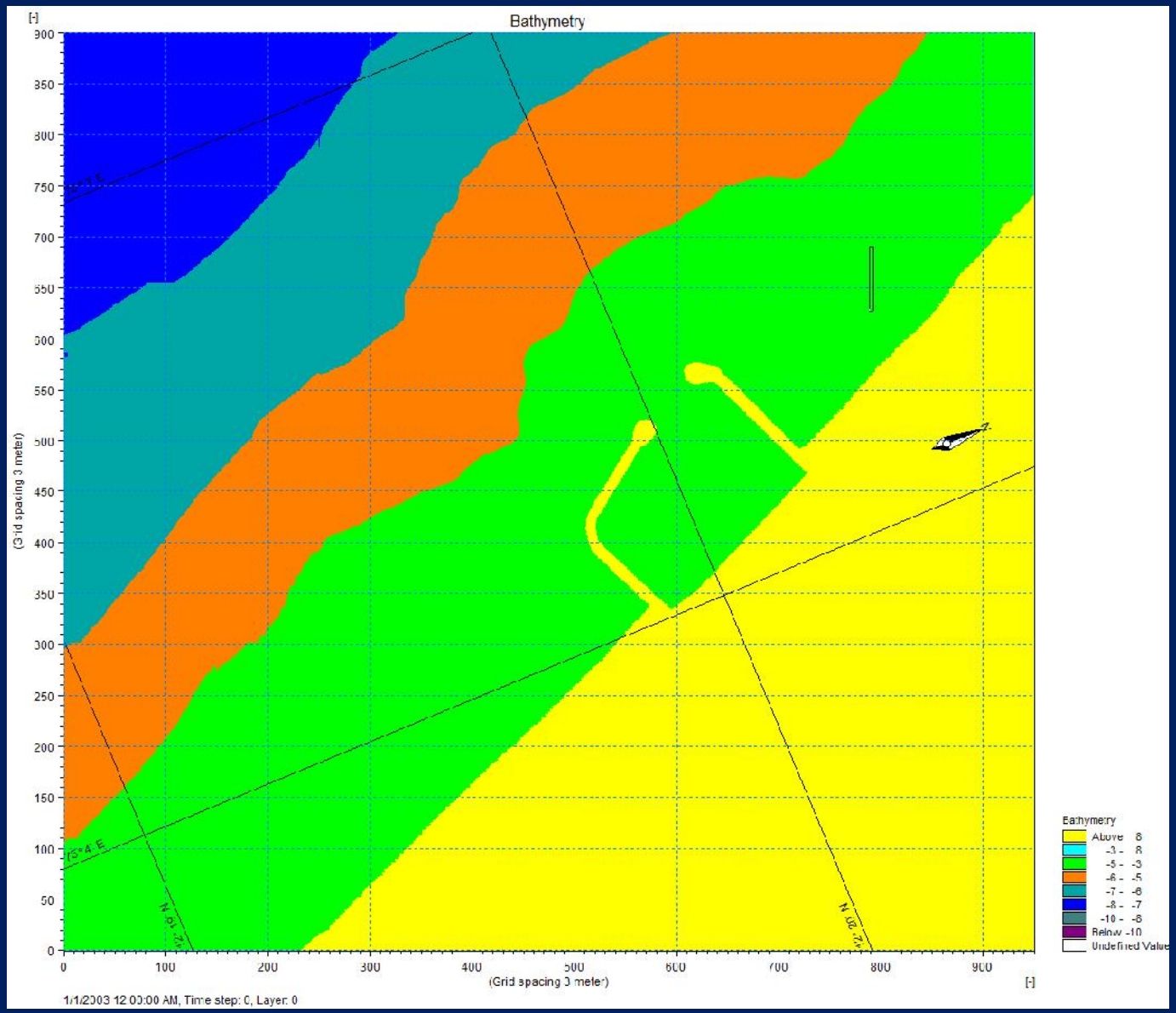
This model solves the enhanced Boussinesq equations by an implicit finite difference techniques with variable defined on a space-staggered rectangular grid. This module is typically selected for calculation of short and long period wave disturbance in ports and harbours

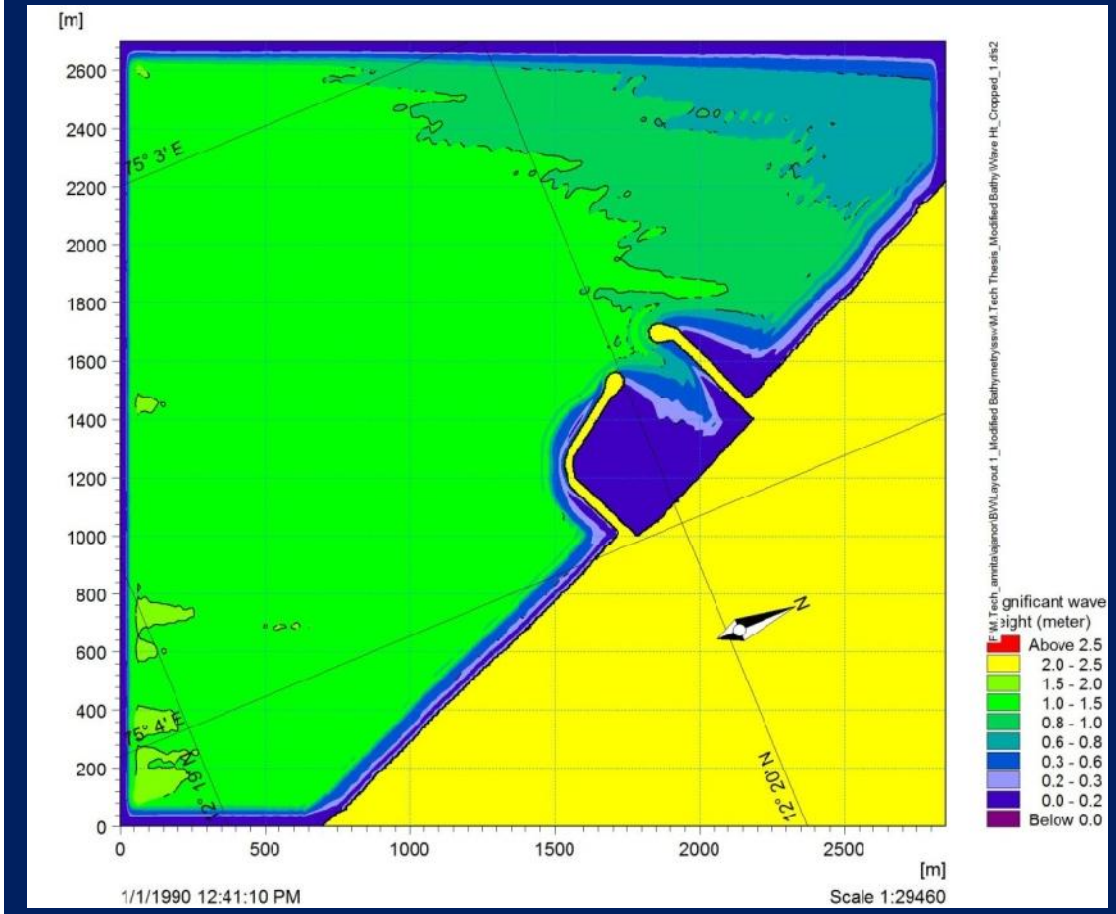


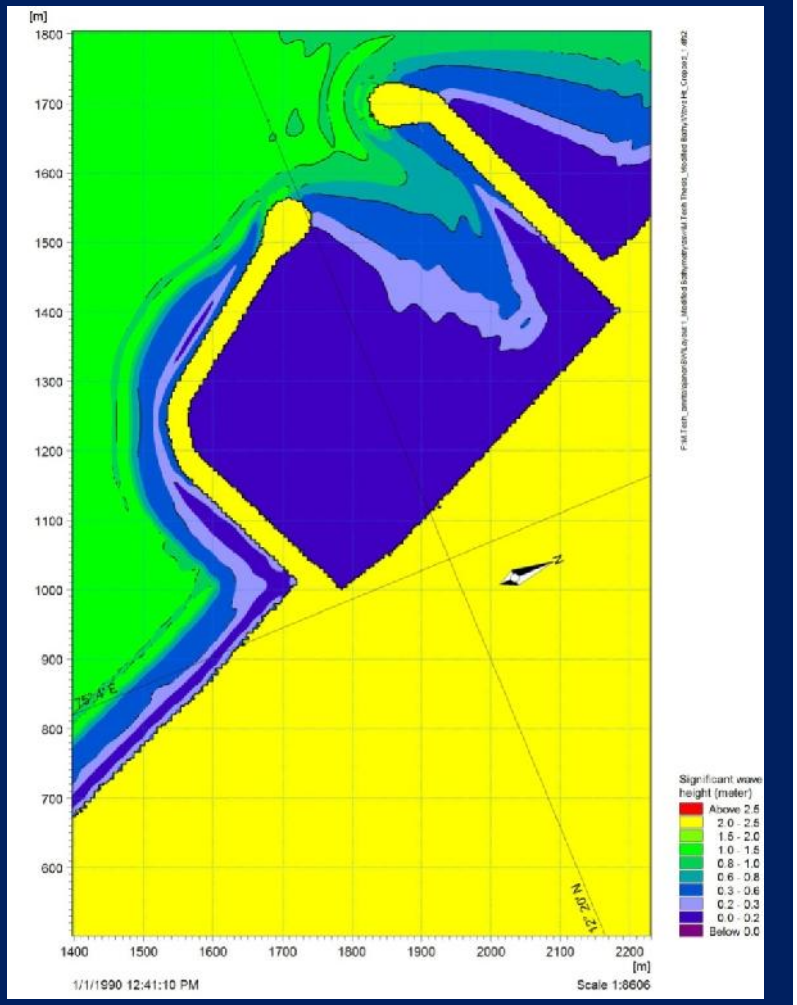
PROPOSED

LAYOUT 1

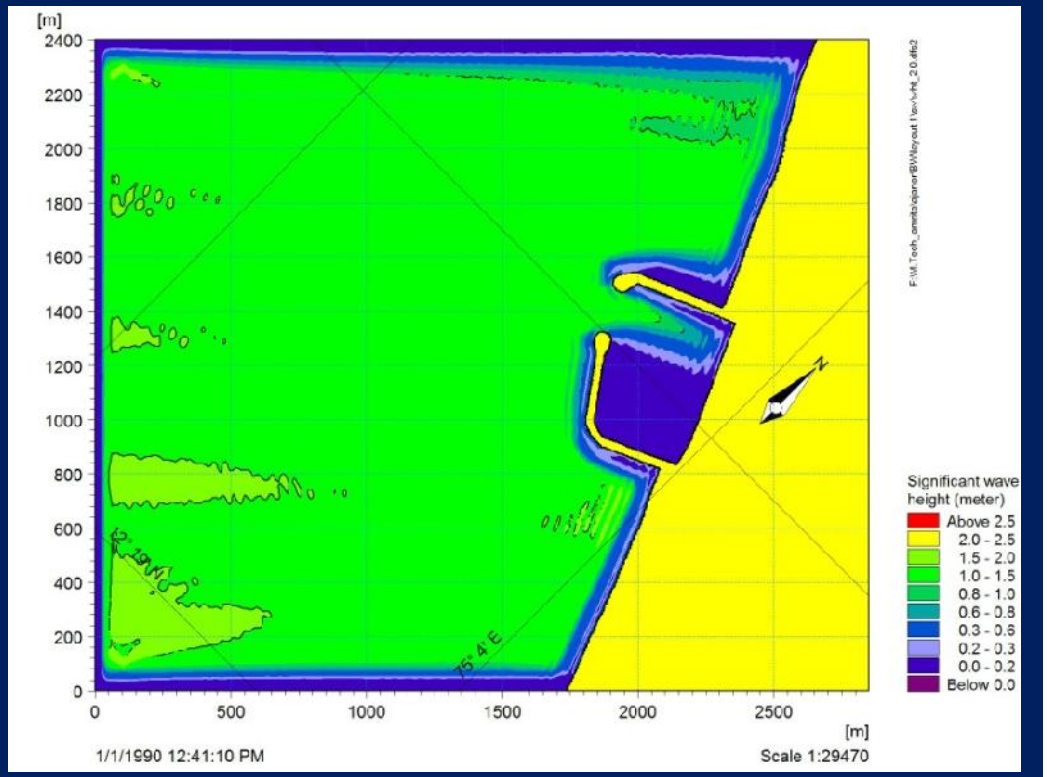
SAMPLE BATHYMETRY - LAYOUT 1

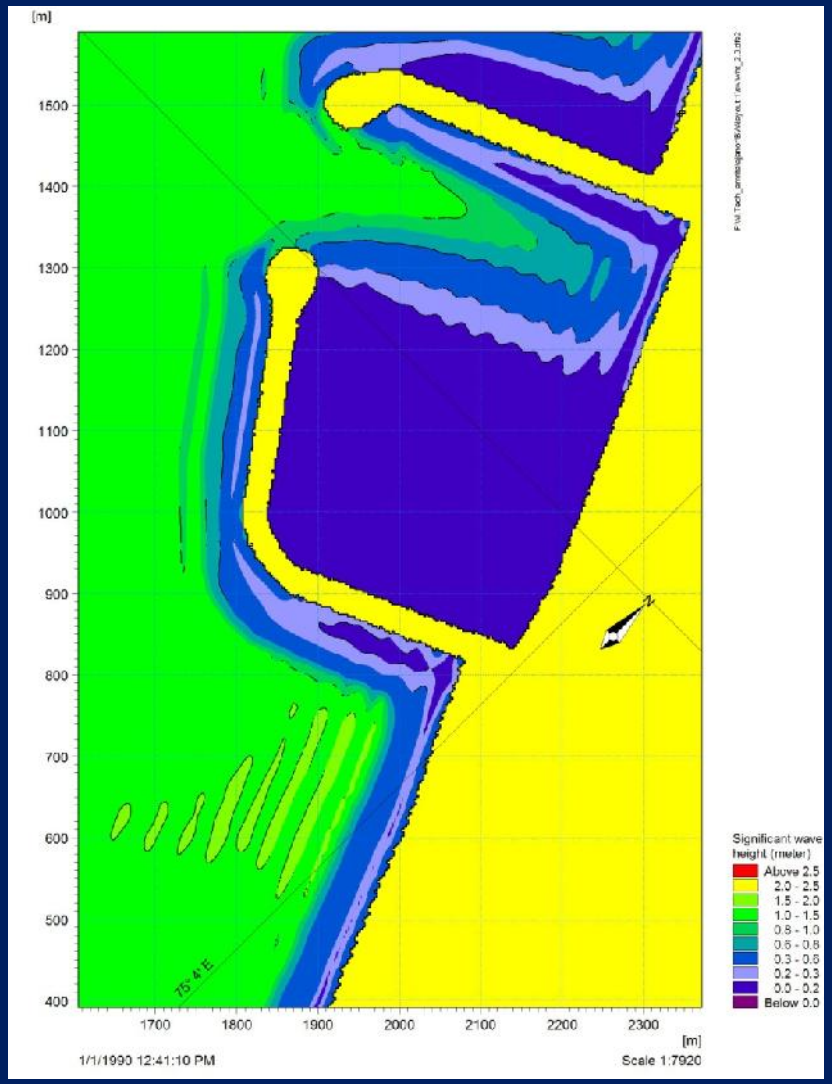




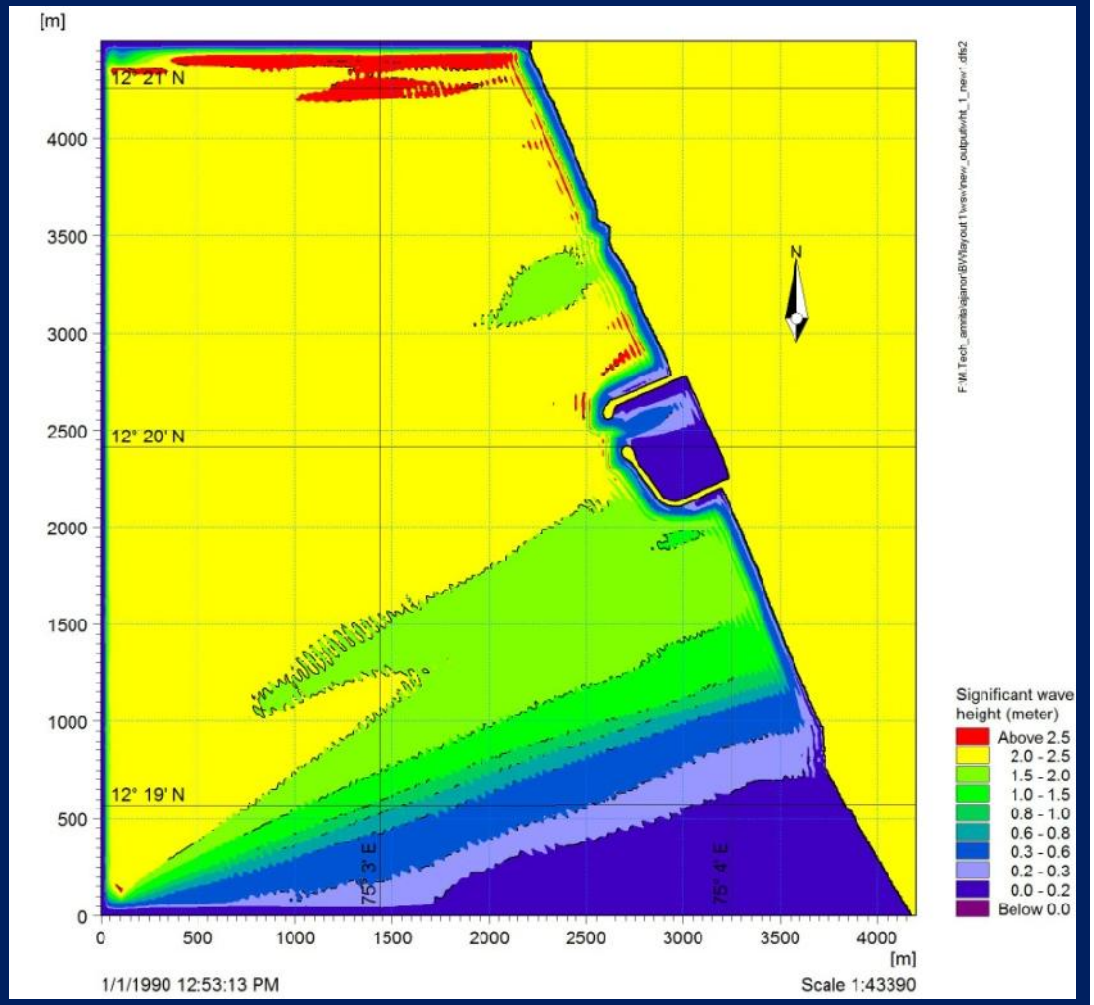


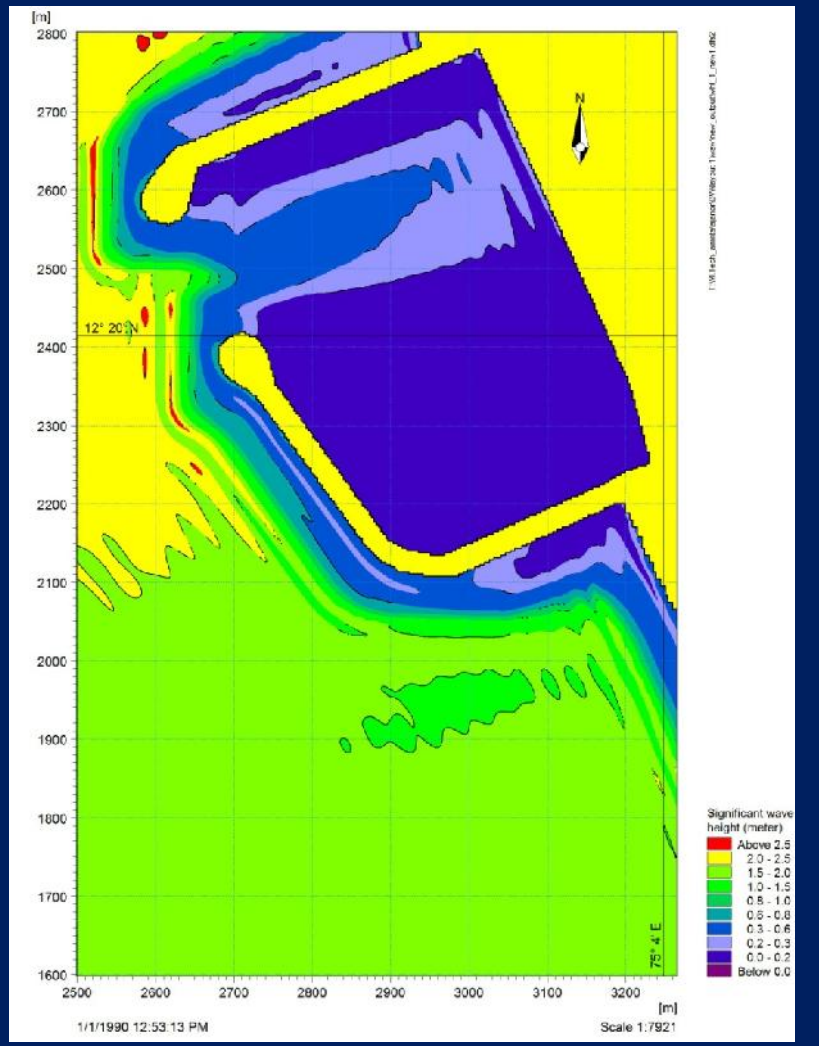
WAVE DISTRIBUTION PLOTS FOR PROPOSED LAYOUT 1
INCIDENT WAVE HEIGHT =1. m AND DIRECTION = SSW



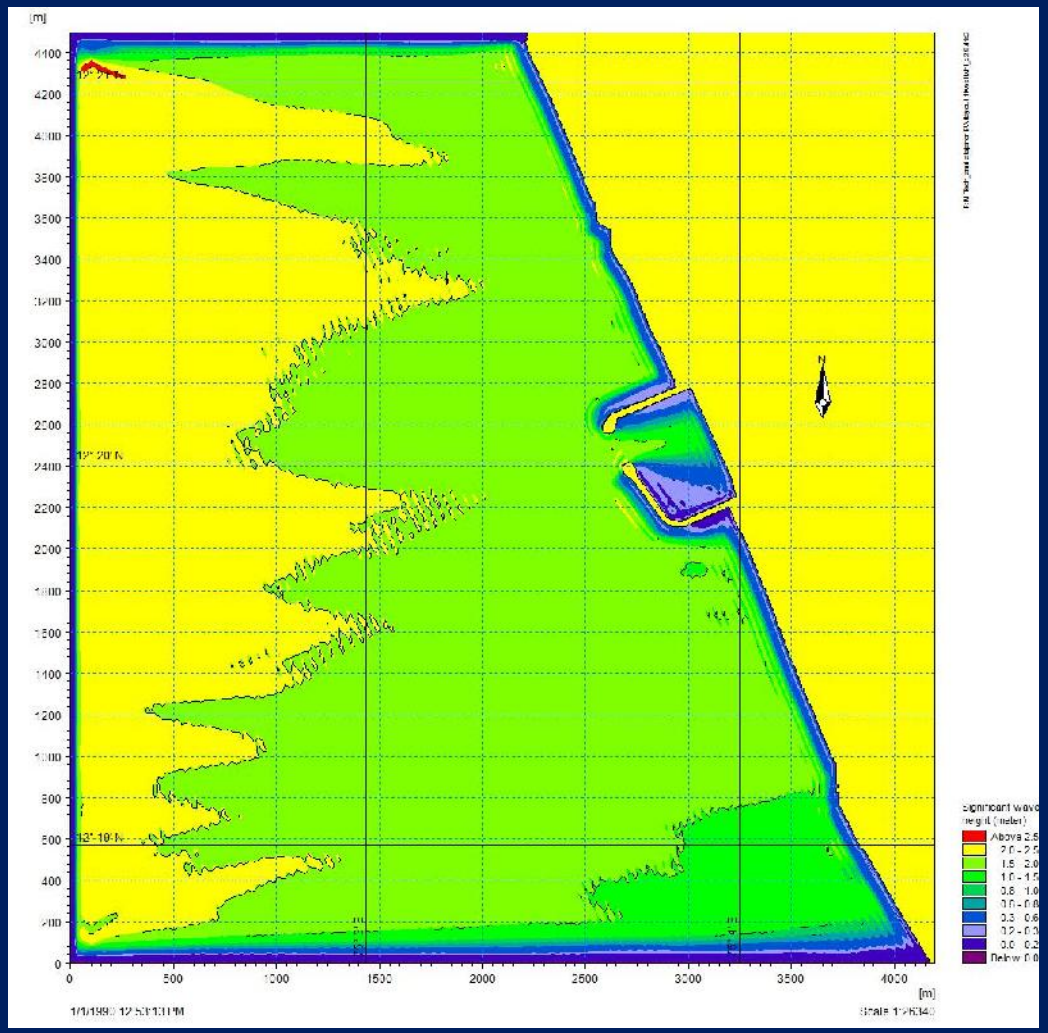


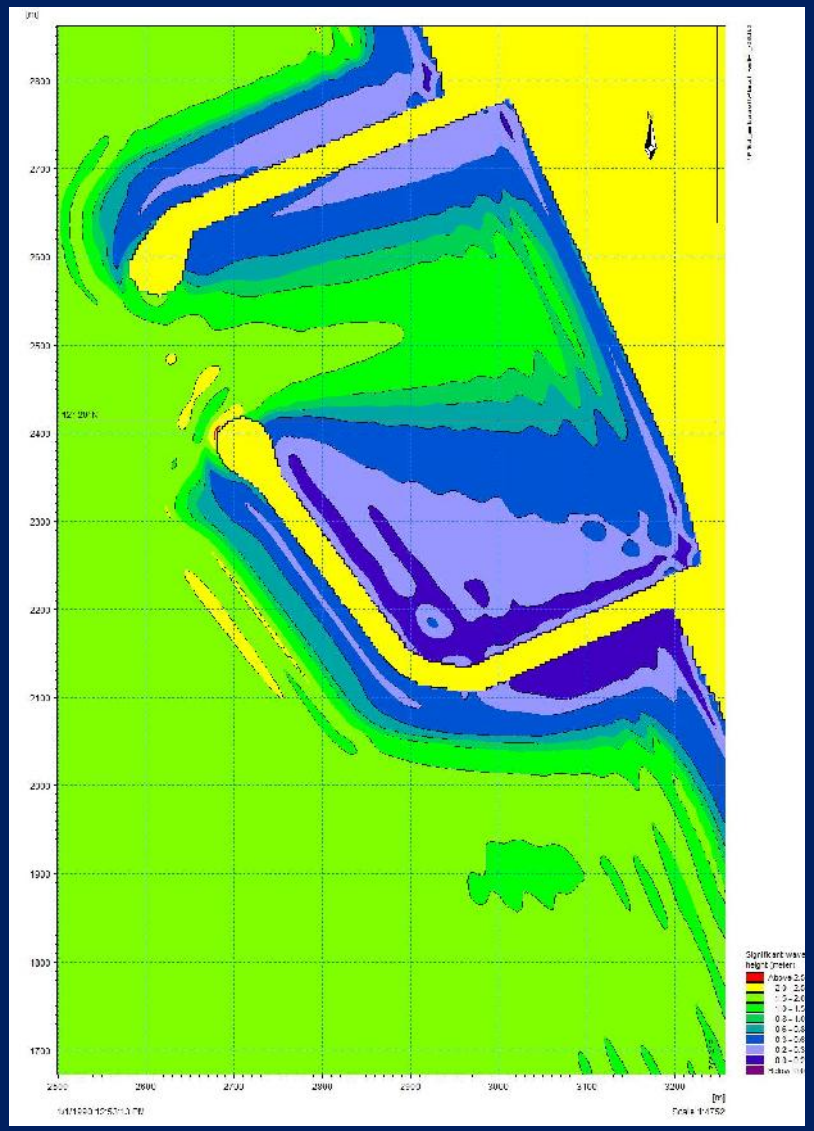
WAVE DISTRIBUTION PLOTS FOR PROPOSED LAYOUT 1
INCIDENT WAVE HEIGHT = 2.0 m AND DIRECTION = SW



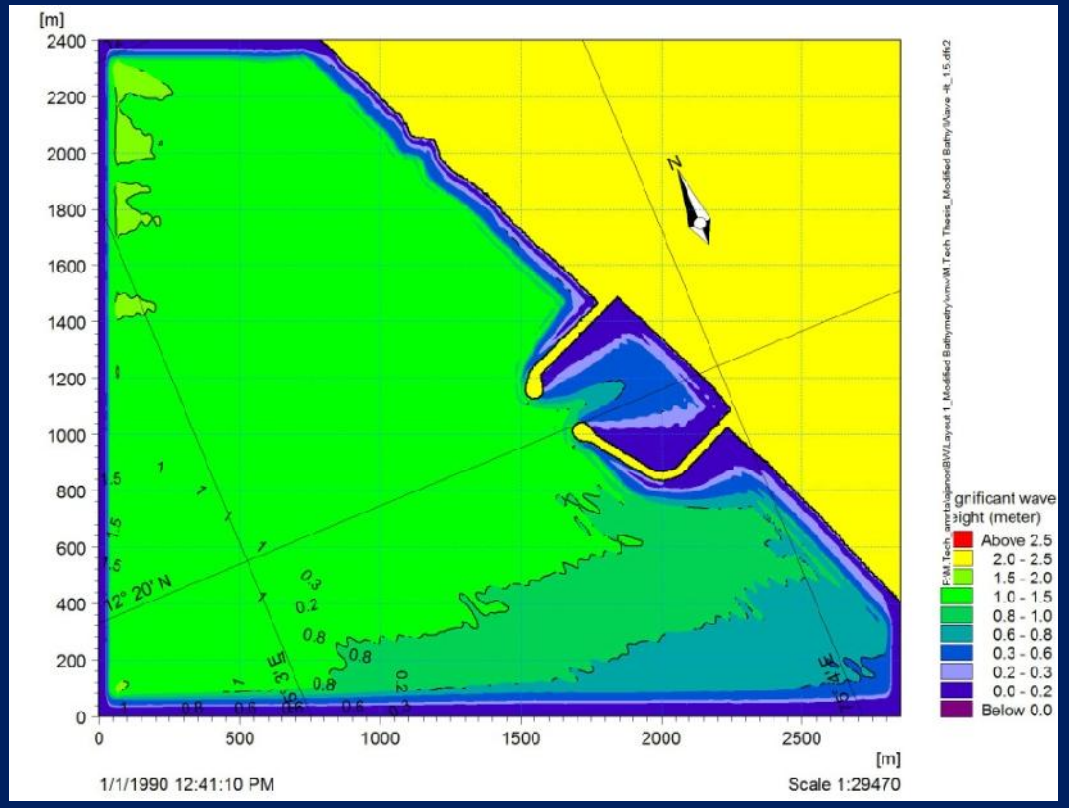


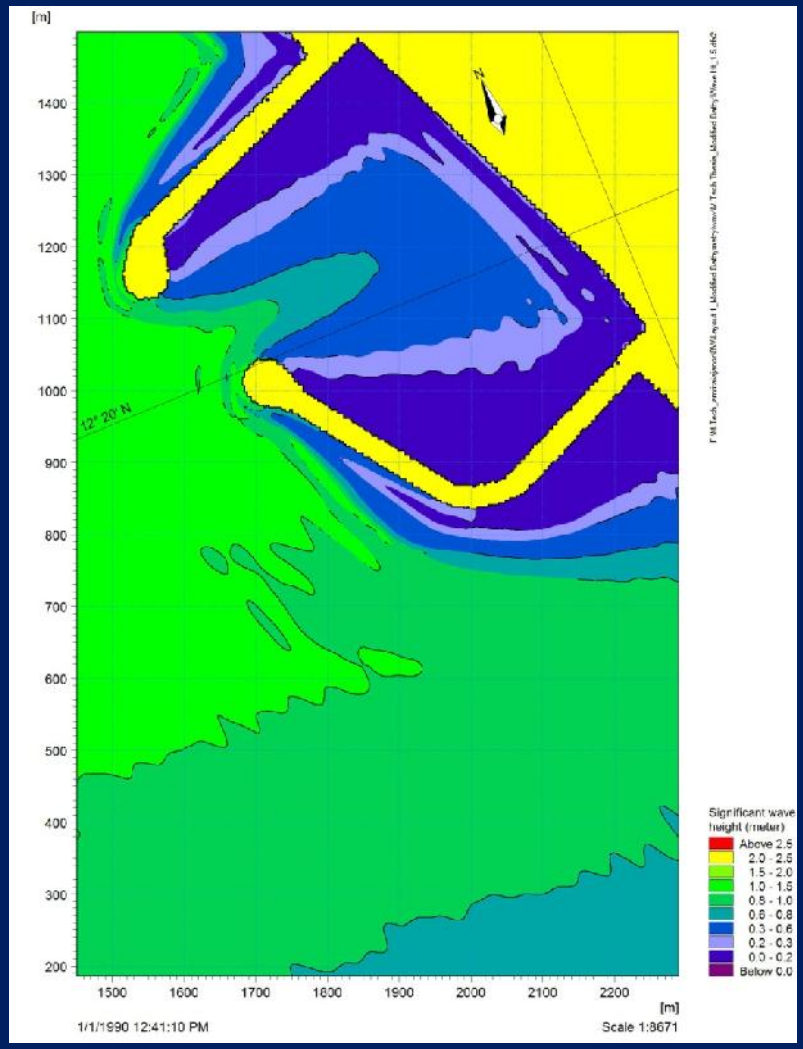
WAVE DISTRIBUTION PLOTS FOR PROPOSED LAYOUT 1
INCIDENT WAVE HEIGHT = 2.5 m AND DIRECTION = WSW





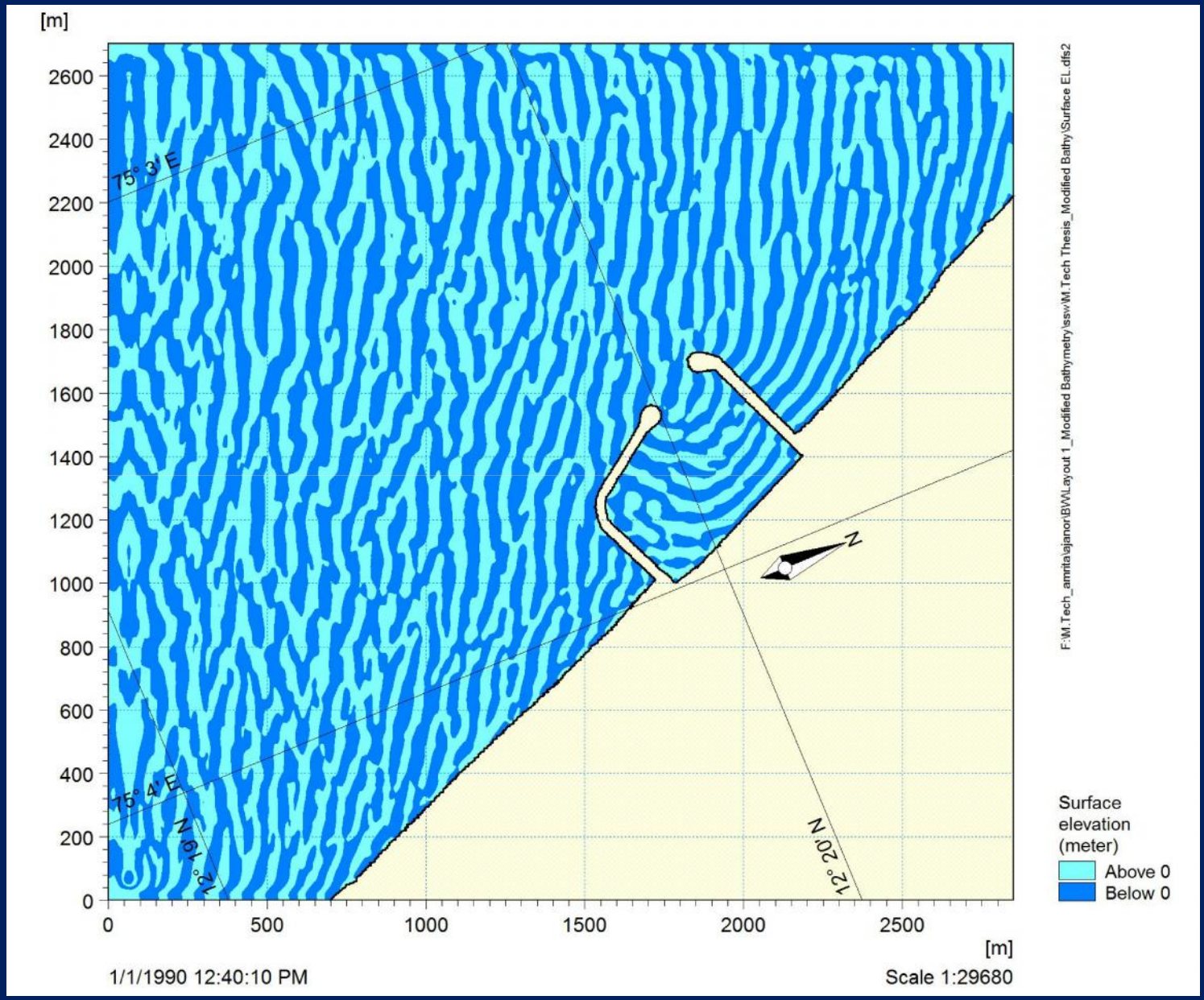
WAVE DISTRIBUTION PLOTS FOR PROPOSED LAYOUT 1
INCIDENT WAVE HEIGHT = 2.5 m AND DIRECTION = WEST





WAVE DISTRIBUTION PLOTS FOR PROPOSED LAYOUT 1
INCIDENT WAVE HEIGHT = 1.5 m AND DIRECTION = WNW

SAMPLE WATER SURFACE ELEVATION PLOT - LAYOUT 1



WAVE HEIGHTS IN THE HARBOUR FOR THE INPUT WAVE CONDITIONS
LAYOUT 1

Wave Direction	Wave Height (m)	Area (%) having more than 0.3 m wave height	Average wave height in the area given in col. 3 (m)	Highest wave height in the harbour (m)
SSW	1.5	19.95	0.58	1.41
SW	2.0	28.68	0.69	1.57
WSW	2.5	48.04	1.02	2.52
West	2.5	62.21	0.84	2.51
WNW	1.5	41.28	0.50	1.13

WAVE HEIGHT, AVERAGE WAVE HEIGHT AND MAXIMUM WAVE HEIGHTS OF ALL THE THREE LAYOUTS

Layout	Wave Direction	Wave Height (m)	Area (%) having more than 0.3 m wave height	Average wave height in the area given in col. 4 (m)	Highest wave height in the harbour (m)	Remarks
Column No1	2	3	4	5	6	7
Layout 1	SSW	1.5	19.95	0.58	1.41	
	SW	2.0	28.68	0.69	1.57	
	WSW	2.5	48.04	1.02	2.52	
	West	2.5	62.21	0.84	2.51	
	WNW	1.5	41.28	0.50	1.13	
Layout 2	SSW	1.50	38.01	0.52	1.20	
	SW	2.0	55.31	0.68	1.52	
	WSW	2.5	51.64	0.98	2.28	
	West	2.5	92.69	0.93	3.99	
	WNW	1.5	23.41	0.58	1.13	
Layout 3	SSW	1.5	1.09	0.35	0.55	
	SW	2.0	0.10	0.31	0.38	
	WSW	2.5	0.08	0.37	0.61	
	West	2.5	0.08	0.32	0.39	
	WNW	-	-	-	-	*

NUMBER OF SAFE OPERATIONAL DAYS IN A YEAR

Layout	Layout -1	Layout - 2	Layout - 3
Number of operational days	201 days	208 days	365 days in the harbour

CONCLUSIONS

- The percentage occurrence of wave distribution (Table 2.1) at 10m depth near Ajanur for January to December shows that , the predominant wave directions are SSW, SW , WSW , West , and WNW with the percentage occurrence of 8.55, 5.35, 8.56, 23.72 and 16.78 respectively. The maximum wave height of 3.0 m from West direction is observed.

- The input wave conditions for the wave tranquility studies are derived as follows for input to the MIKE21BW model for study of with Layout-1, Layout-2 and Layout-3.

Incident Wave Direction	Incident Wave Height
SSW	1.5
SW	2.5
WSW	2.5
WEST	2.5
WNW	1.5

Cont…

CONCLUSIONS

- The wave tranquility studies with Layout-1 indicated that the berthing operations have to be planned in the southern area. The wave heights from WSW, West and WNW are creating more disturbances in the entrance area. Safe berthing operation is possible for about 201 days in a year.

- The wave tranquility studies with Layout-2 indicated that the berthing operations have to be planned in the northern area. Safe berthing operation is possible for about 208 days in a year

- With Layout 3 there is a considerable improvement in the wave heights in side the harbour basin. The wave heights are always less than the wave tranquility limit of 0.3m. With Layout-3 the harbour will be operational from wave tranquility point of view throughout the year. However vessels may face some difficulty while entering to the harbour as they have to sail for a short distance along the waves i.e broadside waves. Littoral drift studies done at CWPRS (T.R. No. 5357 of February 2016) has also indicated that southward drift is predominant, Thus layout -3 appears to be good from tranquility point of view.

- The above statistics is based on the ship observed visual wave data. These data are observed through ships. During stormy conditions ship try to avoid storm track, therefore these data do not contains storm data. Therefore non operational days shall be taken without storm and storms shall add to the non operational days.

Thank you