intake/outfall quantities and the outfall temperature and salinity are presented in the **Table 80.**

Table 80 - Details of Intake Sea Water and Outfall Discharge water

S. No.	Description	Details			
DETAILS OF INTAKE SEA WATER					
1	Maximum intake seawater quantity (m^3/hr)	**Existing**		**Proposed**	**After Expansion**
		125,500 (Several Intakes)		78,050	203,550
2	Intake sea water quality	**Parameter**		**Value**	
		Salinity		40 – 43 ppt	
		Temperature (Max.)		35 °C	
Details of Intake System (Proposed)					
3	Details of intake pipeline (HDPE)	No. of duty pipelines		2	
		Diameter of pipe (inner dia)		2.4 m	
	Intake velocity for HDPE	Minimum		0.8 m/s	
		Maximum		2.5 m/s	
4	Location of Intake Center Line of intake tower (UTM – 40R Coordinates in meters)	Easting (m)		334878.90	
		Northing (m)		2805237.46	
5	Depth of intake	-10m below low water level			
DETAILS OF OUTFALL DISCHARGE WASTEWATER					
1	Maximum outfall discharge quantity (m^3/hr)	**Existing**		**Proposed**	**After Expansion**
		125,500		78,050	203,550
2	Quality of outfall discharge quantity	**Parameter**		**Value**	
		Salinity – (Max.)		ΔS – 7ppt Max Temp – 50 ppt	
		Temperature (Max.)		ΔT - 7°C	
				Max Temp - 42°C	
Details of Outfall System (Proposed)					
3	Details of outfall pipeline (HDPE)	No. of duty pipelines		2	
		Diameter of pipe (inner dia)		2.4 m	
	Outfall velocity (HDPE)	Minimum		0.8 m/s	
		Maximum		2.5 m/s	
4	Details of outfall system & diffuser		**Existing outfall channel**	**Outfall pipeline option 1**	**Outfall pipeline option 2**
		Easting (m)	335701.00	334917.06	334428.81
		Northing (m)	2805915.00	2805805.71	2804877.96

7.5.3.2.2.1.1. Modeling Scenarios

Totally eight (8) modeling scenarios are considered for the two conceptual outfall locations for a maximum outfall discharge load of 78,050 m^3/hour alongside the existing intake and outfall facilities to assess the combinative effect and finalize the best outfall location from a modeling standpoint.

- Scenario 1: - Intake location with outfall at location-1 for maximum design flow velocity for normal Tidal flow
- Scenario 2: Intake location with outfall at location-1 for minimum design flow velocity for normal Tidal flow
- Scenario 3: Intake location with outfall at location-2 for maximum design flow velocity for normal Tidal flow
- Scenario 4: Intake location with outfall at location-2 for minimum design flow velocity for normal Tidal flow
- Scenario 5: - Intake location with outfall at location-1 for maximum design flow velocity for Tidal flow and annual extreme wind condition
- Scenario 6: Intake location with outfall at location-1 for minimum design flow for Tidal flow and annual extreme wind condition
- Scenario 7: Intake location with outfall at location-2 for maximum design flow velocity for Tidal flow and annual extreme wind condition
- Scenario 8: Intake location with outfall at location-2 for minimum design flow velocity for Tidal flow and annual extreme wind condition

7.5.3.2.2.1.2. Model Domain

A 7 km × 7 Km grid was selected for the modeling study. The maximum depth in the model domain is 13.6m. All bathymetric points were referred to local CD and were used for the study. The model domain is divided into 10 m X 10 m square grids for high resolution simulation of currents and water levels. The validated hydrodynamic model was used for the analyses of the plume dynamics for given criteria and locations.

7.5.3.2.2.1.3. Water Levels

Water levels at the coastal area vary reasonably due to the large tides. Given the large scale of the intertidal zone both horizontally and vertically, the actual water level acts as a significant control on the volume, duration and direction of transport of materials in this region, including the water and materials in marine discharges.

7.5.3.2.2.1.4. Tidal Currents

It is possible to examine current meter records to identify key oceanographic processes that occur at that site. Accordingly, analysis of the records from a current meter deployed from 24th July 2018 onwards off shore from the discharge location in 10 m water depth was utilized to provide a temporal view of the mechanisms generating the near-shore flow field at a single point. The analysis shows that the tides the coastal area is semi-diurnal, with tidal sea-surface height variability in excess of 2.4 m.

7.5.3.2.2.1.5. Model Calibration and validation

The hydrodynamic model was established using the available local data and is calibrated by performing a comparison of site specific measurements and modeled data. The result of this hydrodynamic modeling was used to drive the thermal and salinity profile assessments. Comparison between model simulated and measured tides is shown in **Figure 47.** Average water level during spring tide is about 2.2 m.

The maximum current observed is 0.5 m/s during the model period with an average flood current direction reverses with flood and ebb (**Figure 48** and **Figure 49**). The u-component of the current represents the along shore component and the v-component the onshore component. Both the u-component and v-component showed very good comparison with the respective model simulated current components. Red colour represents modeling results and blue colour represents measurements. Though the season is characterized with weak currents, the variations associated with the tidal oscillations and wind driven currents are well captured in the model results. As the model successfully simulated the prevailing currents, the results and the model setup are further used for simulation of thermal and salinity plumes associated with various outfall quantities and qualities.

It is to be noted that there exist an along shore current movement during the peak flood and ebb tidal conditions (Figure 48 and Figure 49) indicates the chance of recirculating and redistributing the outfall contaminants injected in a lower velocity. This can be easily mitigated by ensuring an outfall design velocity higher that of maximum current speed. The AD modeling results are presented as images. Each image shows the maximum spreading extent of the waste water plume over the two days simulation period for the different scenarios and outfall locations (see Table 81 through to Table 83). It is important to note that the results represent a composition of the minimum dilution for the period under consideration and does not represent a snapshot in time. The winds during this period originate from a south westerly direction with a mean wind speed of 10 m/s.

Figure 50 represents the depth averaged velocity plot versus in situ model. It is observed that the velocity magnitude matches reasonably well with the modeled velocity. In situ values are observed to have high disturbance which may be attributed to the day to operations and navigational activities at the port area. As expected the current follows diurnal pattern with reversal during ebb and flood (**Figure 48** and **Figure 49**).

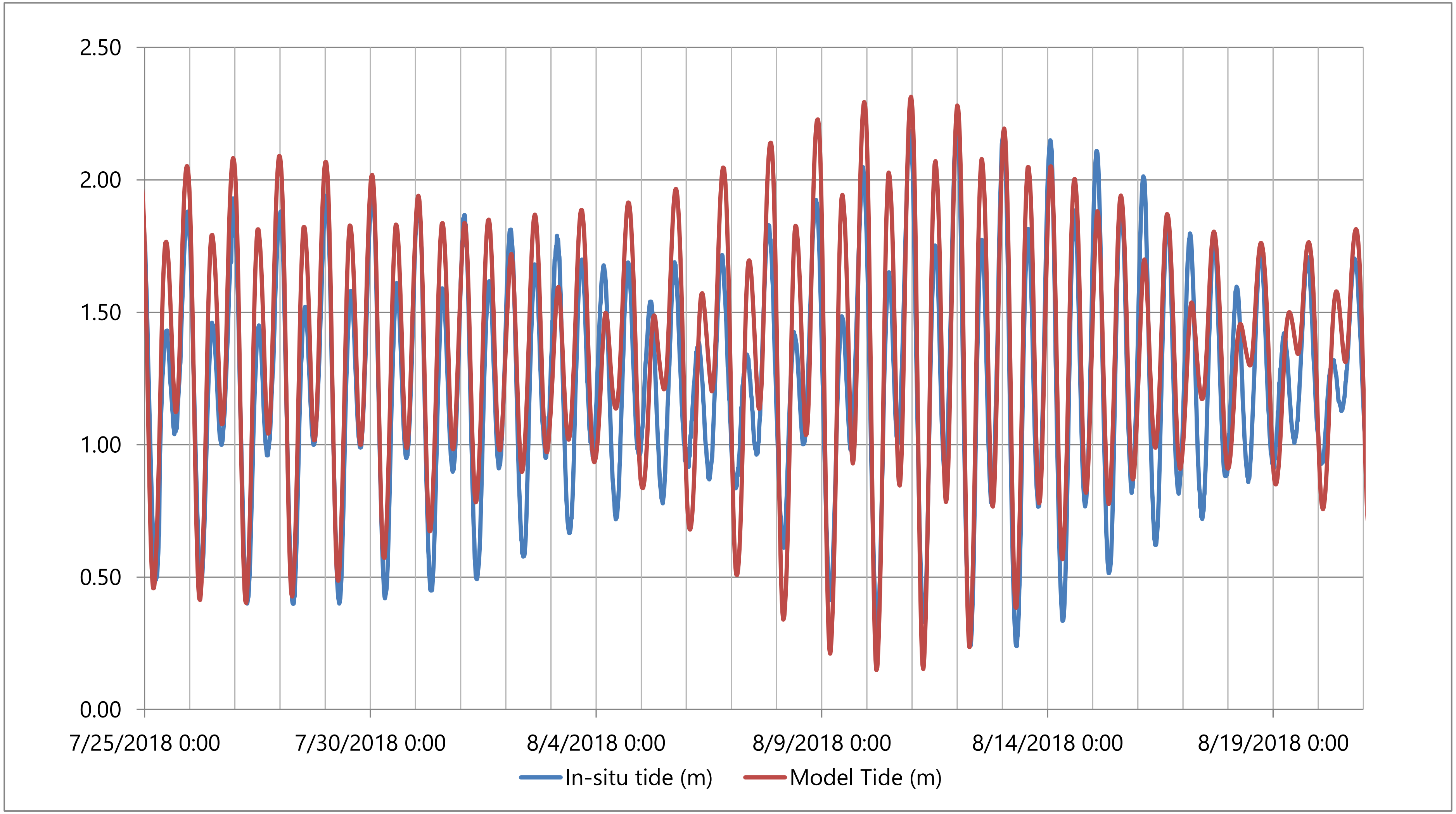


Figure 47 - Time Series Plot of modeled tide vs. measured tide

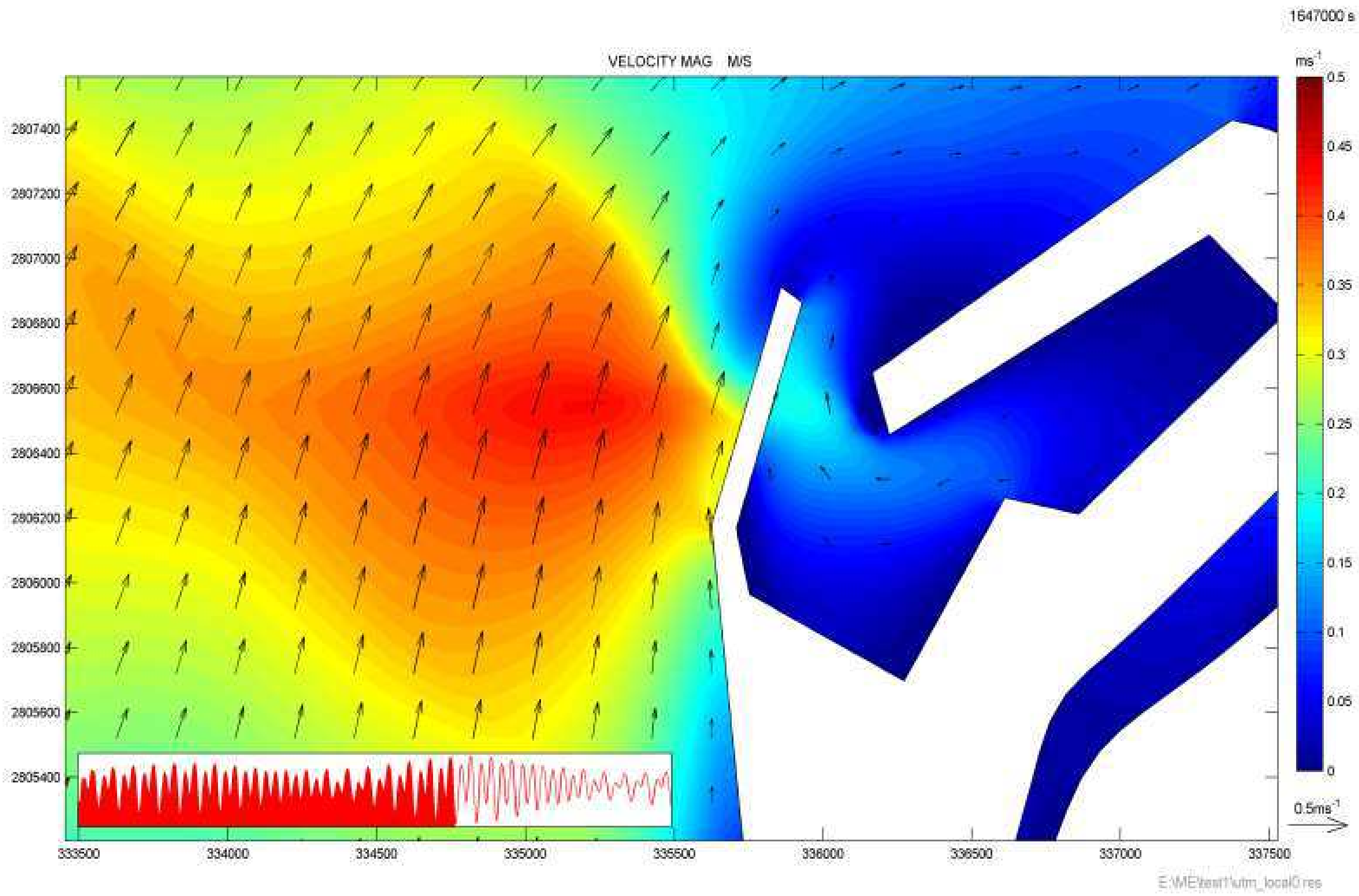


Figure 48 - Modeled flow scenario during peak flood

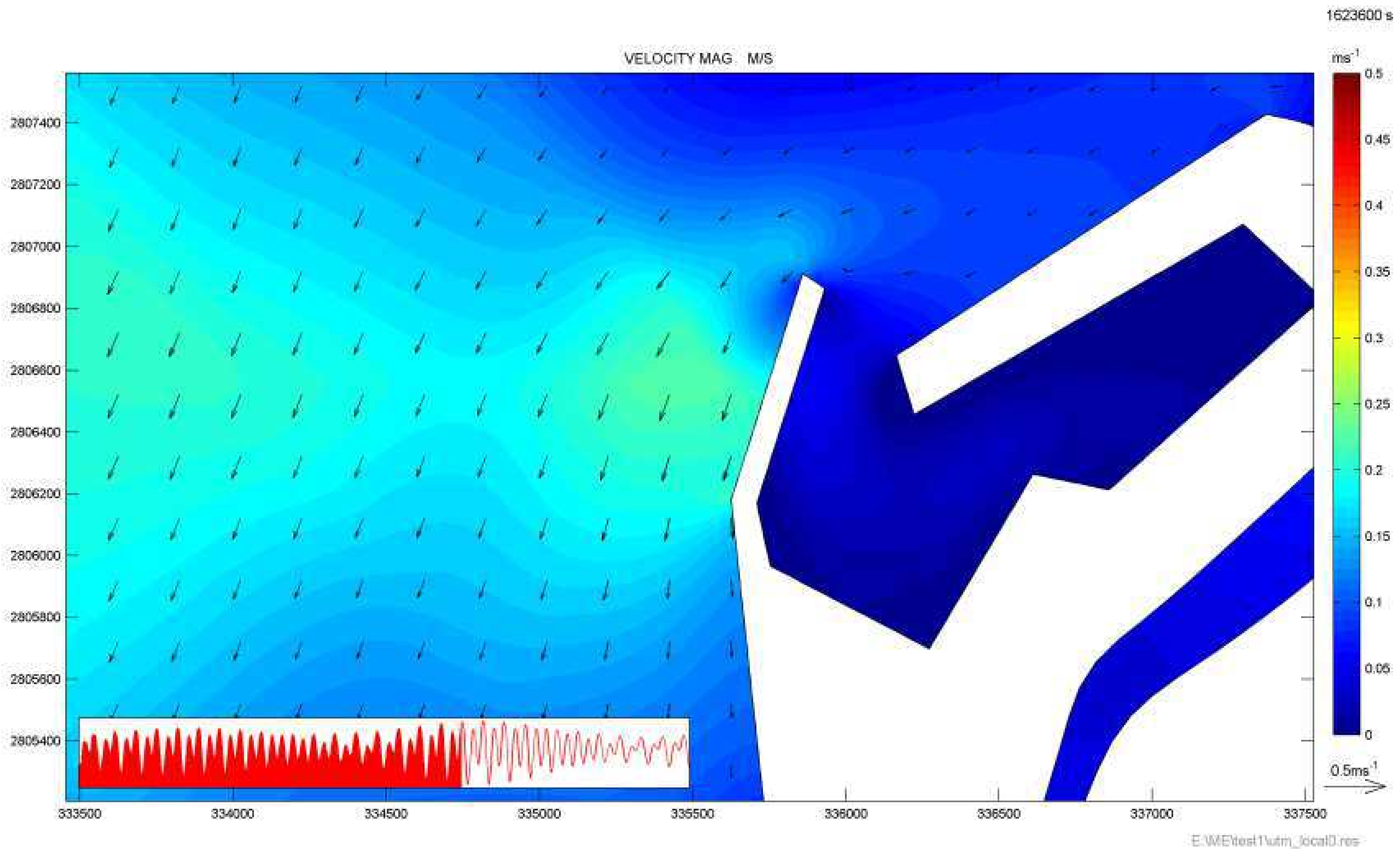


Figure 49 - Modeled flow scenario ebb

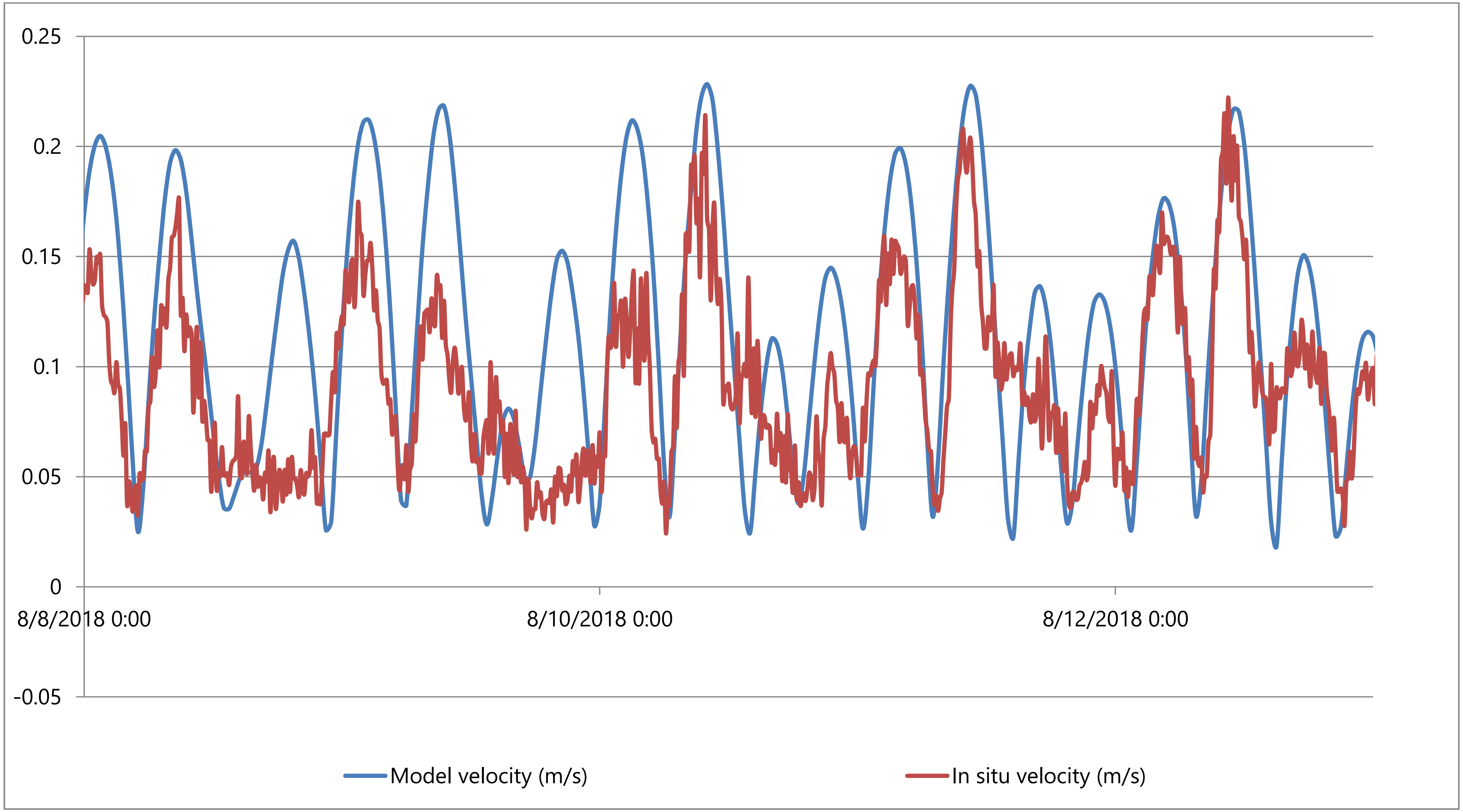


Figure 50 - Depth averaged model vs in situ velocity magnitude

7.5.3.2.2.1.6. Simulation and Dispersion Modeling Results

As explained earlier, MIKE21 AD module is used to simulate temperature and salinity dispersion of the outfall discharge. The outfall water temperatures and salinities are given below. The reference temperature and salinity are taken as 35°C and 43ppt respectively.

Parameter	Outfall location 1	Outfall location 2	Existing Outfall
Temperature	+7°C	+7°C	+7°C
Salinity	+7 ppt	+7 ppt	+7 ppt
Velocity min	0.8 m/s	0.8 m/s	-
Velocity max	2.5 m/s	2.5 m/s	-

The outfall pipeline and diffuser configurations and dimensions are based on information sourced from relevant drawings. AD model was run to simulate the plume advection-dispersion pattern for a period of 28 days. The modeling results are presented in **Table 81**, **Table 82** and **Table 83.**

Table 81 - Maximum Excess Temperature and Salinity for Outfall 1

Scenario Cases	Maximum Excess Temperature (°C)		Maximum Excess Salinity (ppt)	
	At 300 m	At 500 m	At 300 m	At 500 m
Spring Tide - Calm conditions with 2.5m/s velocity	0.25	<0.25	~0.25	<0.2
Spring Tide - With Wind and with 2.5m/s velocity	0.25	<0.25	~0.25	<0.2

Table 82 - Maximum Excess Temperature and Salinity for Outfall 2

Scenario Cases	Maximum Excess Temperature (°C)		Maximum Excess Salinity (ppt)	
	At 300 m	At 500 m	At 300 m	At 500 m
Spring Tide - Calm conditions with 2.5m/s velocity	0.25	<0.25	~0.25	<0.1
Spring Tide - With Wind and with 2.5m/s velocity	0.25	<0.25	~0.25	<0.1

Table 83 - Maximum Average Salinity for Outfalls

Scenario	Wind (knots)	Discharge location	Flow rate (m^3/hr)	Current speed	Distance to achieve 1:10 dilution level	Distance to achieve 1:100 dilution level
1	0	1	78,050	2.5m/s	<300m	<1km
2	0	1	78,050	0.8 m/s	<300m	<1km
3	0	2	78,050	2.5m/s	<300m	<1km
4	0	2	78,050	0.8m/s	<300m	<1km
5	14	1	78,050	2.5m/s	<300m	<1km
6	14	1	78,050	0.8m/s	<300m	<1km
7	14	2	78,050	2.5m/s	<300m	<1km
8	14	2	78,050	0.8m/s	<300m	<1km

The temperature and salinity plume dispersion obtained around the outfall points after during peak tidal conditions were used for the analysis and is used to analyze the dispersion pattern for different scenarios as discussed in the following sections.

7.5.3.2.2.1.6.1. Plume dispersion (Temperature and Salinity) due to tide only at Outfall at location-1

Validated tidal model was rerun with given outfall velocity condition for two locations to analyze the distribution of salt and heat with peak high water tide and peak low water tide. **Figure 51** through **Figure 54** presents the extents of heat and salt dispersion without the influence of wind from outfall 1 along with the plume dispersion from the existing outfall. Every model case was simulated for a period of 28 days. It is noticed that extents of plume is more or less similar with tidal currents but it is influenced by other parameters like velocity of diffusion and wind speed and direction.

7.5.3.2.2.1.6.2. Plume dispersion (Temperature and salinity) due to tide and wind at Outfall at location-1

The process was repeated with 1 in 1 wind derived from the global wind model by ECMWF to study the plume dispersion during a tidal cycle. This enabled to track the plume under the influence of continuous wind blow. The model runs were undertaken considering the outfall and intake points. **Figure 55 through Figure 58** presents the dispersion of plume from outfall option 1 with the influence of annual extreme wind and varying velocity considerations. As can be seen through the modeling results better dilutions are achieved with increased velocities with the plume moving in the direction of diffusion. The concentration plume reaches <0.25 within 300m from the outfall for all scenarios considered. However the lower velocity diffusion results in the sinking of dense water and while faster dilution is assured with increased velocity.

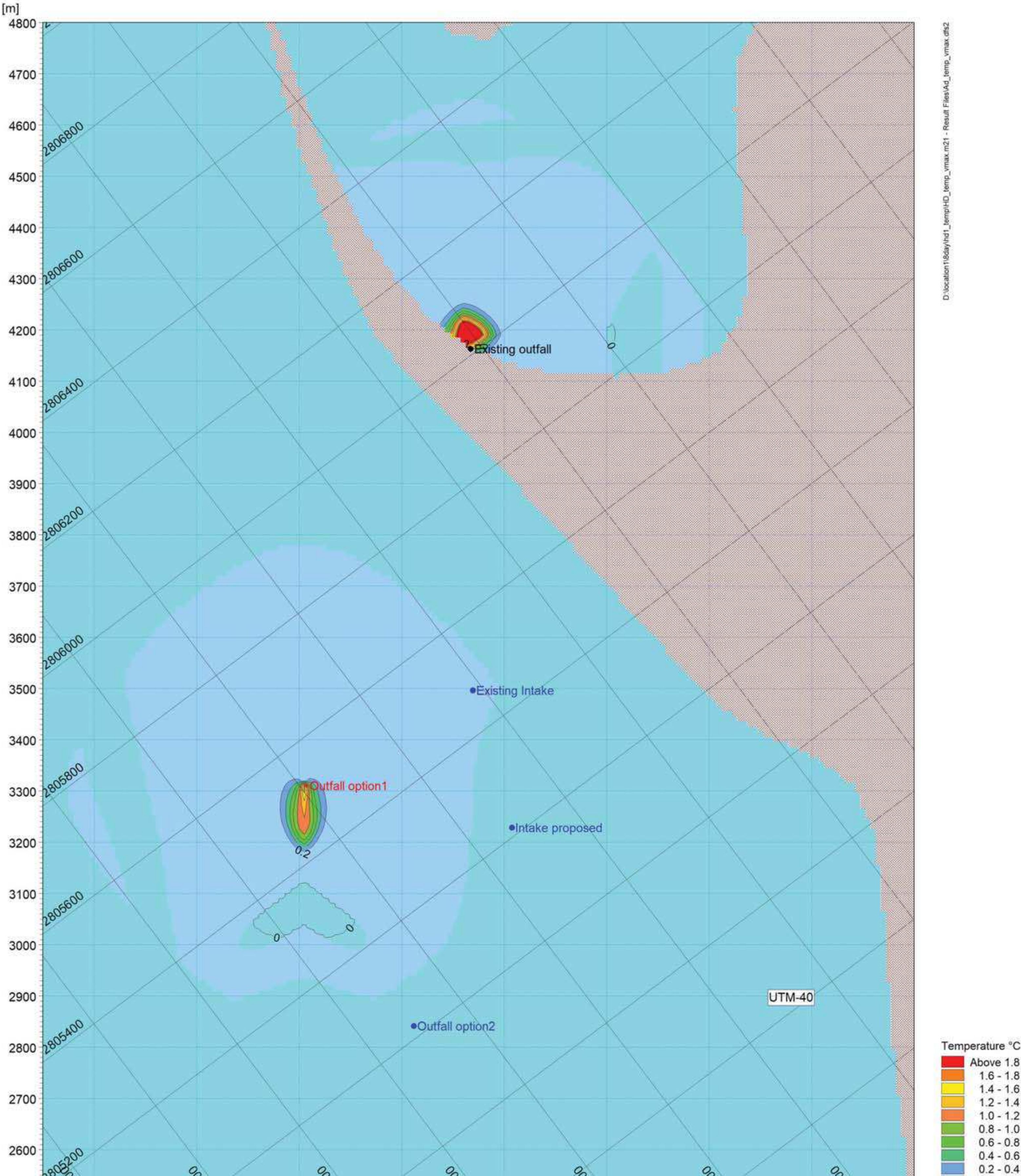
7.5.3.2.2.1.6.3. Plume dispersion (Temperature and salinity) due to tide only at Outfall at location-2

The plume patterns obtained are presented from **Figure 59** through **Figure 62.** The present test condition of maximum design flow (2.5 m/s) shows a faster dissipation mixing very well within 1km of the outfall throughout the tide. As the tidal current is relatively less compared to diffuser velocity, the plume velocity dominates the plume pattern compared to tide. Effect of wind on the plume dispersion is negligible. Salinity pattern also shows similar pattern of temperature for a distance then the pattern moves differently and vanishes faster than the temperature plume. It is noticed that the direction of diffusion plays a significant role in the dissipation and mixing.

7.5.3.2.2.1.6.4. Plume dispersion (Temperature and salinity) due to tide and wind at Outfall at location-2

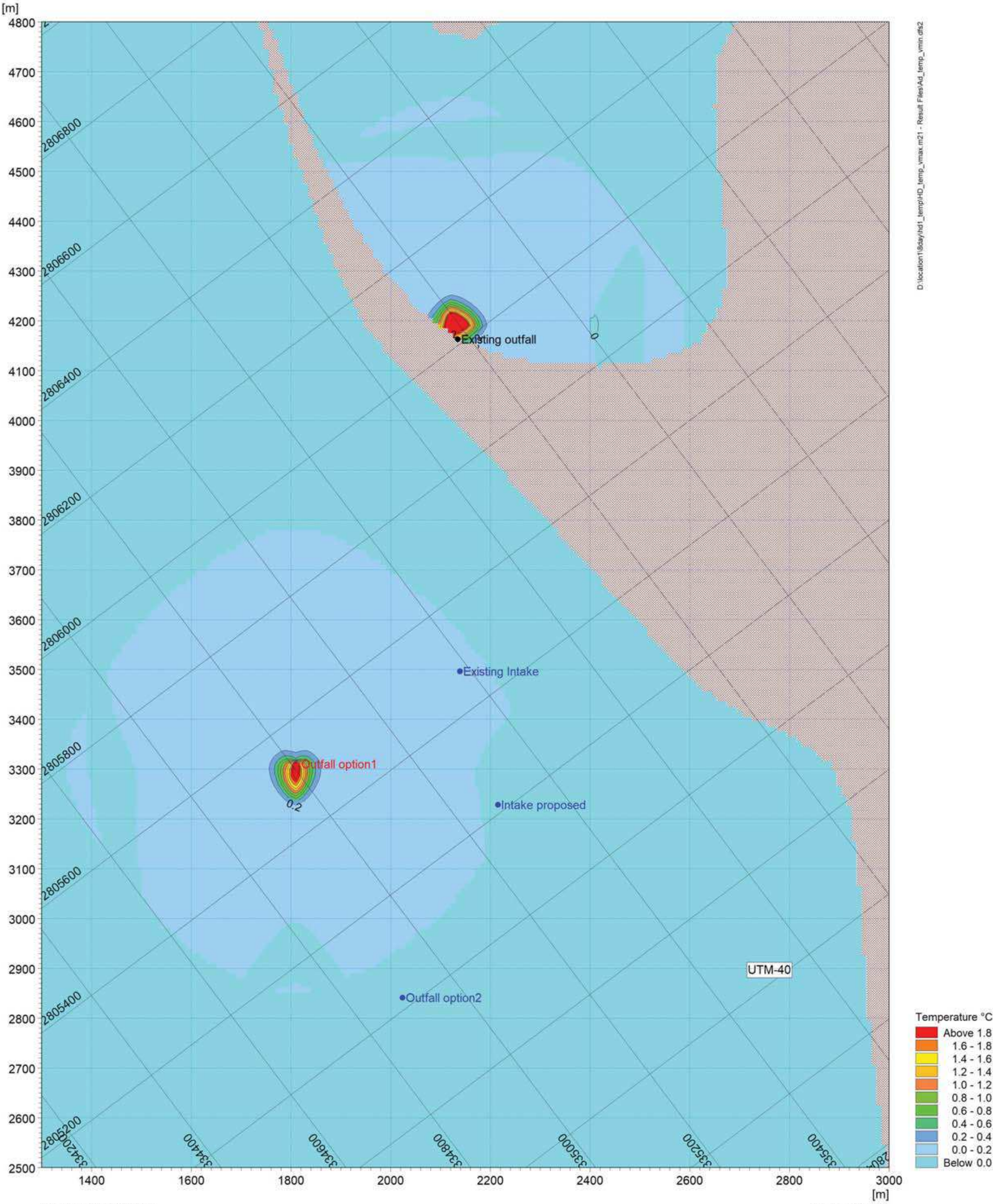
As in outfall option 1, simulations of 28 days were conducted with and without the influence of wind to study the dispersion of temperature and salinity plumes. **Figure 63** to **Figure 66** shows the respective simulation results during the peak high water spring with two diffusion velocity conditions 2.5 m/s and 0/8 m/s.

Figure 51 - Dissipation of temperature plume from outfall option-1 with no wind and diffusion at a velocity of 2.5 m/s during peak high water spring (Scenario-1)



[m]
Existing outfall
Existing Intake
Outfall option1
Intake proposed
Outfall option2
UTM-40
Temperature °C
Above 1.8
1.6 - 1.8
1.4 - 1.6
1.2 - 1.4
1.0 - 1.2
0.8 - 1.0
0.6 - 0.8
0.4 - 0.6
0.2 - 0.4
0.0 - 0.2
Below 0.0
12-08-2018 00:00:00
Scale 1:10170

Figure 52 - Dissipation of temperature plume from outfall option1 with no wind and diffusion at a velocity of 0.8m/s during peak high water spring (Scenario-2)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3100
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2900
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2700
2600
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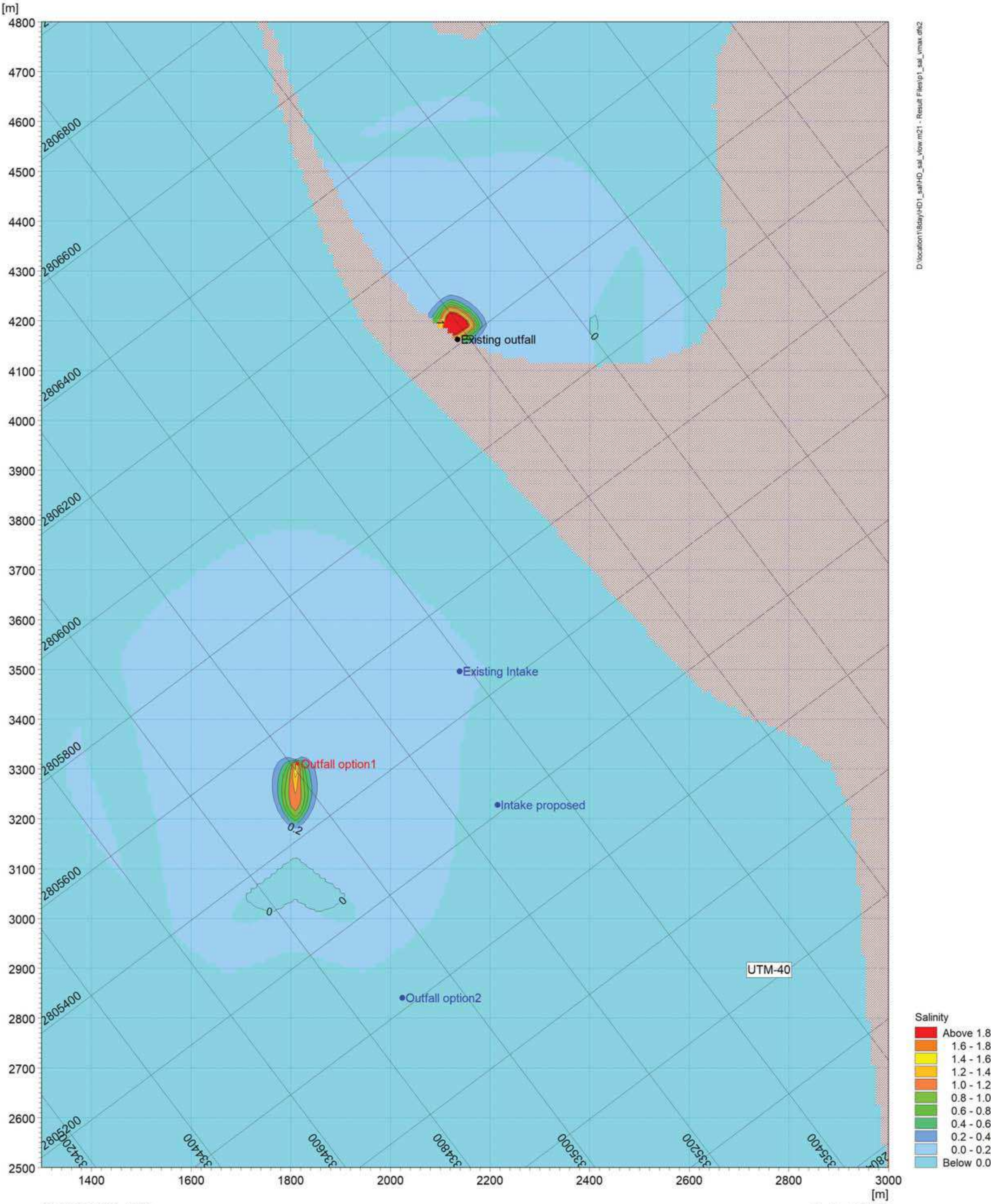
2806200
2806000
2805800
2805600
2805400
2805200
334400
334600
334800
335000
335200
335400
Existing outfall
Existing Intake
Outfall option1
Intake proposed
Outfall option2
0.2
0
UTM-40
12-08-2018 00:00:00
Scale 1:10170
D:\location1\8day\hd1_temp\HD_temp_vmax.m21 - Result Files\Ad_temp_vmin.dfs2
Temperature °C
Above 1.8
1.6 - 1.8
1.4 - 1.6
1.2 - 1.4
1.0 - 1.2
0.8 - 1.0
0.6 - 0.8
0.4 - 0.6
0.2 - 0.4
0.0 - 0.2
Below 0.0

Figure 53 – Dispersion of salinity plume from outfall option-1 with no wind and diffusion at a velocity of 2.5 m/s during peak high water spring (Scenario-1)



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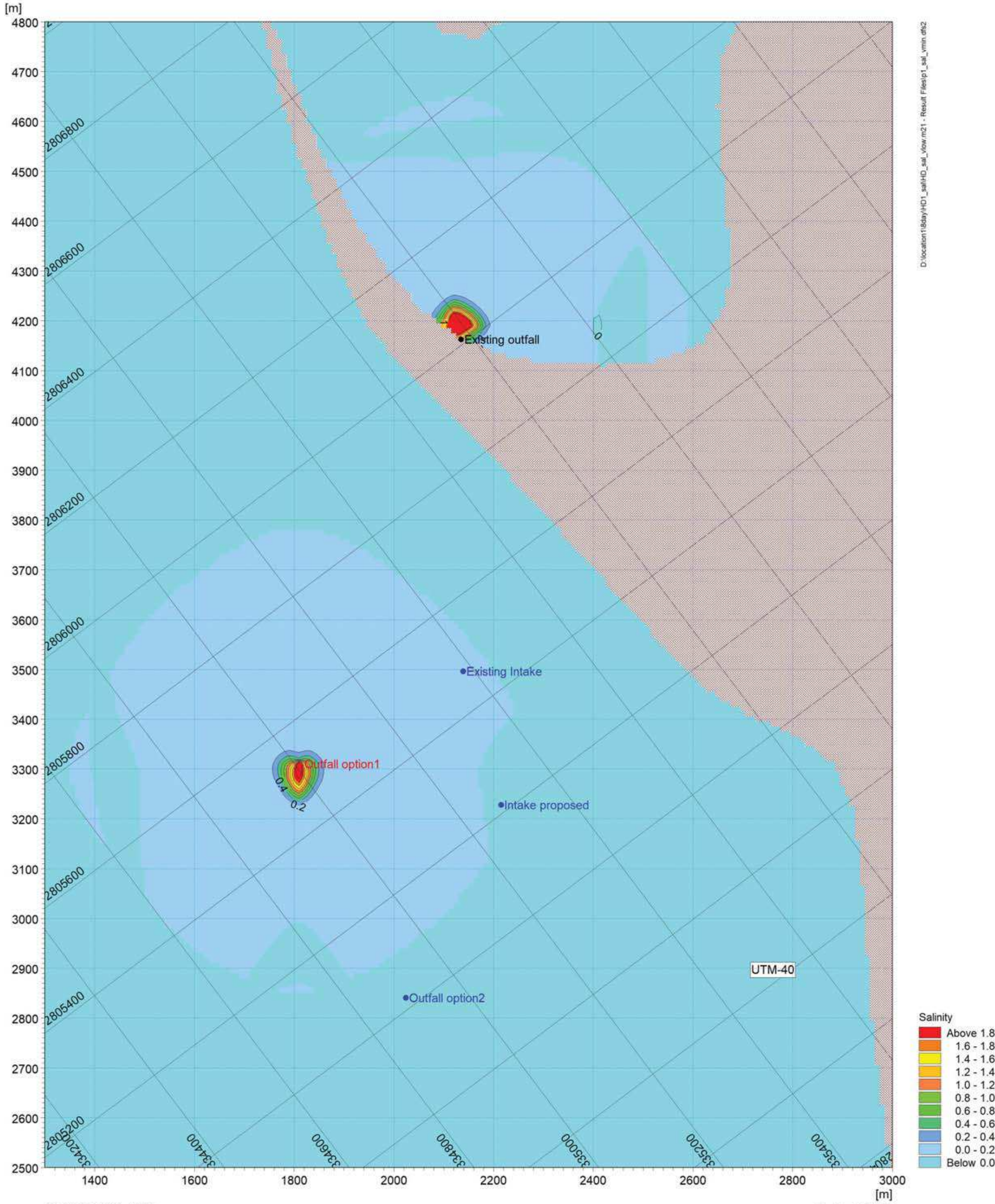
2806200
2806000
2805800
2805600
2805400
2805200
334200
334400
334600
334800
335000
335200
335400
Existing outfall
Existing Intake
Outfall option1
Intake proposed
Outfall option2
0.2
0
UTM-40
D:\location1\8day\HD1_sal\HD_sal_vlow.m21 - Result Files\p1_sal_vmax.dfs2
Salinity
Above 1.8
1.6 - 1.8
1.4 - 1.6
1.2 - 1.4
1.0 - 1.2
0.8 - 1.0
0.6 - 0.8
0.4 - 0.6
0.2 - 0.4
0.0 - 0.2
Below 0.0
08-08-2018 00:16:00
Scale 1:10160

Figure 54 – Dispersion of salinity plume from outfall option1 with no wind and diffusion at a velocity of 0.8m/s during peak high water spring (Scenario-2)



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3100
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2800
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[m]
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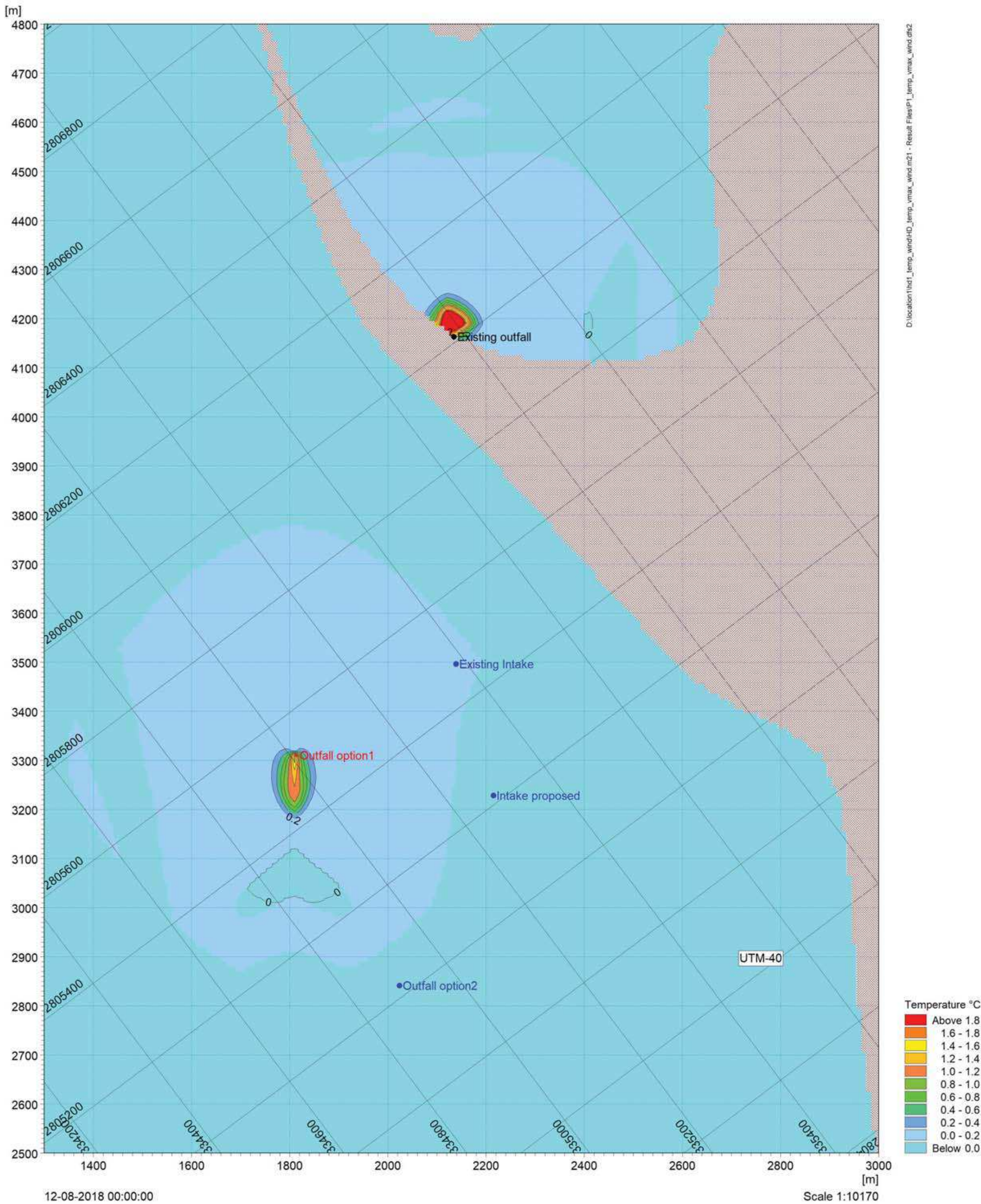
2806000
2805800
2805600
2805400
2805200
334200
334400
334600
334800
335000
335200
335400
Existing outfall
Existing Intake
Outfall option1
Intake proposed
Outfall option2
UTM-40
0.4
0.2
0
D:\location1\8day\HD1_sal\HD_sal_vlow.m21 - Result Files\p1_sal_vmin.dfs2
Salinity
Above 1.8
1.6 - 1.8
1.4 - 1.6
1.2 - 1.4
1.0 - 1.2
0.8 - 1.0
0.6 - 0.8
0.4 - 0.6
0.2 - 0.4
0.0 - 0.2
Below 0.0
08-08-2018 00:16:00
Scale 1:10160

Figure 55 - Dispersion of temperature plume from outfall option-1 during high-water spring in presence of annual extreme wind and diffusion velocity at 2.5m/s (Scenario-5)



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[m]
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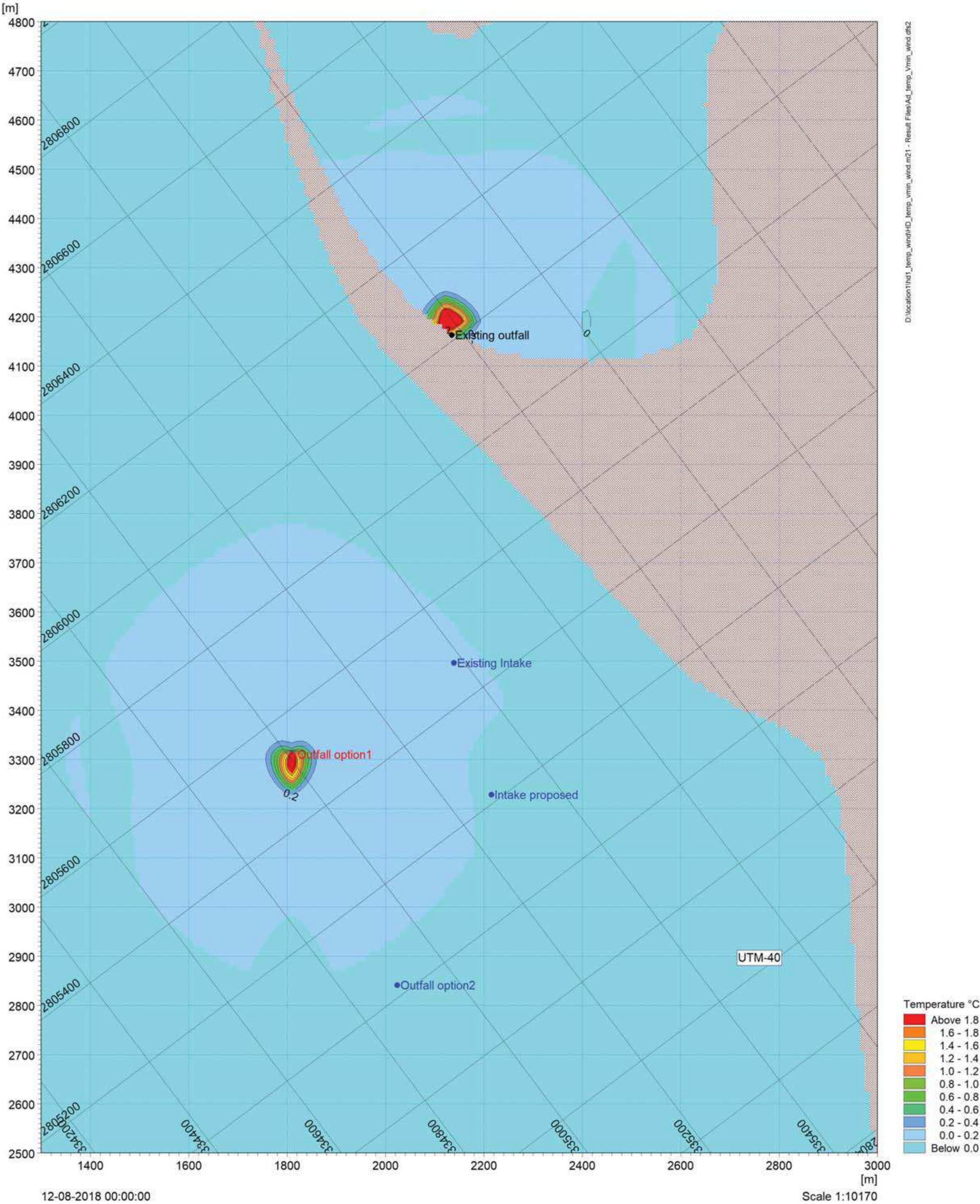
2806200
2806000
2805800
2805600
2805400
2805200
334400
334600
334800
335000
335200
335400
Existing outfall
Existing Intake
Outfall option1
Intake proposed
Outfall option2
0.2
0
UTM-40
D:\location1\hd1_temp_wind\HD_temp_vmax_wind.m21 - Result Files\P1_temp_vmax_wind.dfs2
Temperature °C
Above 1.8
1.6 - 1.8
1.4 - 1.6
1.2 - 1.4
1.0 - 1.2
0.8 - 1.0
0.6 - 0.8
0.4 - 0.6
0.2 - 0.4
0.0 - 0.2
Below 0.0
12-08-2018 00:00:00
Scale 1:10170

Figure 57 - Dispersion salinity plume from diffuser outfall option 1 with max velocity diffusion (2.5m/s) in presence of wind during high water spring (Scenario 5)



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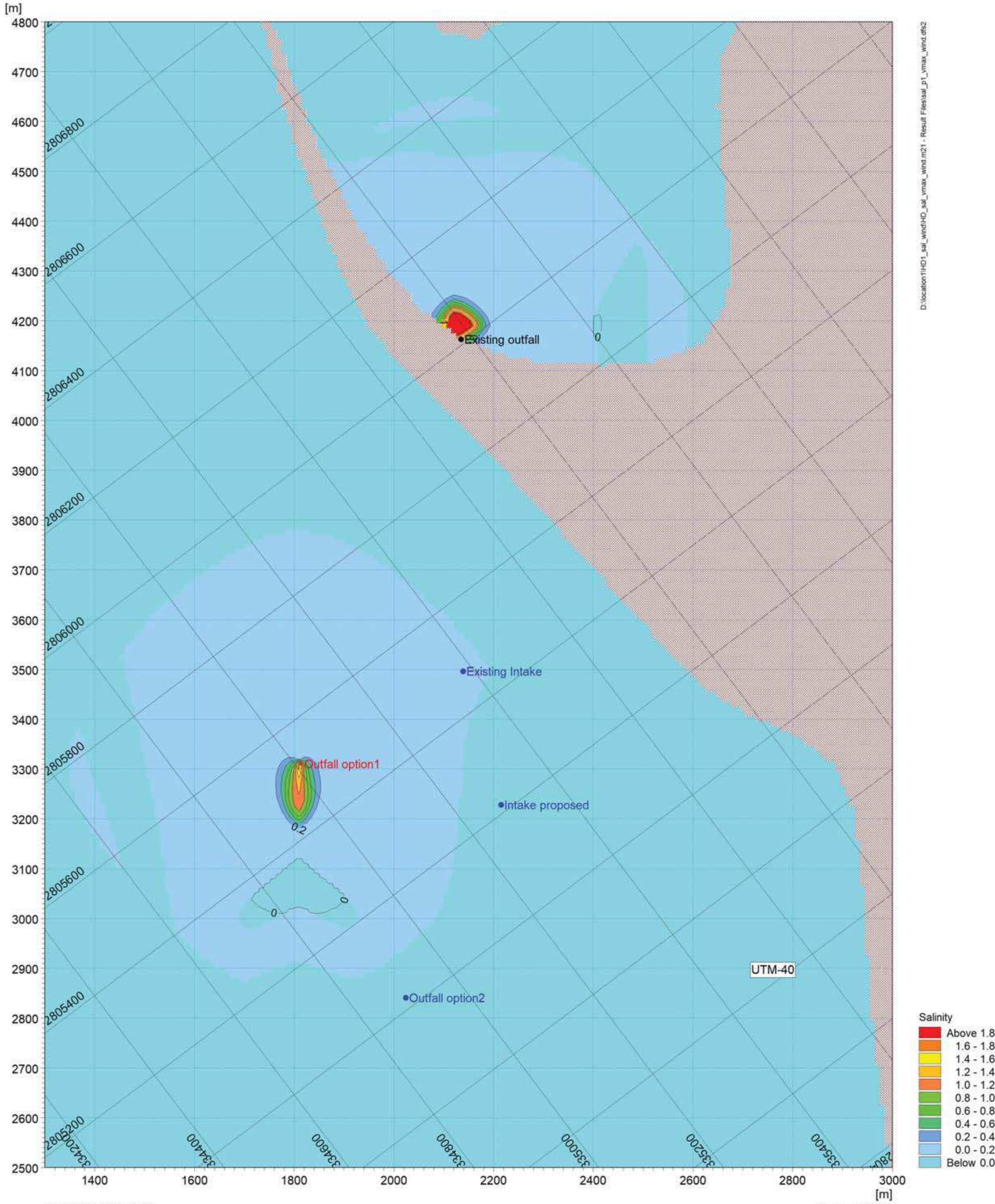
2806200
2806000
2805800
2805600
2805400
2805200
334400
334600
334800
335000
335200
335400
Existing outfall
Existing Intake
Outfall option1
Intake proposed
Outfall option2
0.2
0
UTM-40
Temperature °C
Above 1.8
1.6 - 1.8
1.4 - 1.6
1.2 - 1.4
1.0 - 1.2
0.8 - 1.0
0.6 - 0.8
0.4 - 0.6
0.2 - 0.4
0.0 - 0.2
Below 0.0
12-08-2018 00:00:00
Scale 1:10170
D:\location1\hd1_temp_wind\HD_temp_vmin_wind.m21 - Result Files\Ad_temp_Vmin_wind.dfs2

Figure 58 - Dispersion salinity plume from diffuser outfall option 1 with velocity diffusion of 0.8m/s (minimum) in presence of wind during high water spring (Scenario 6)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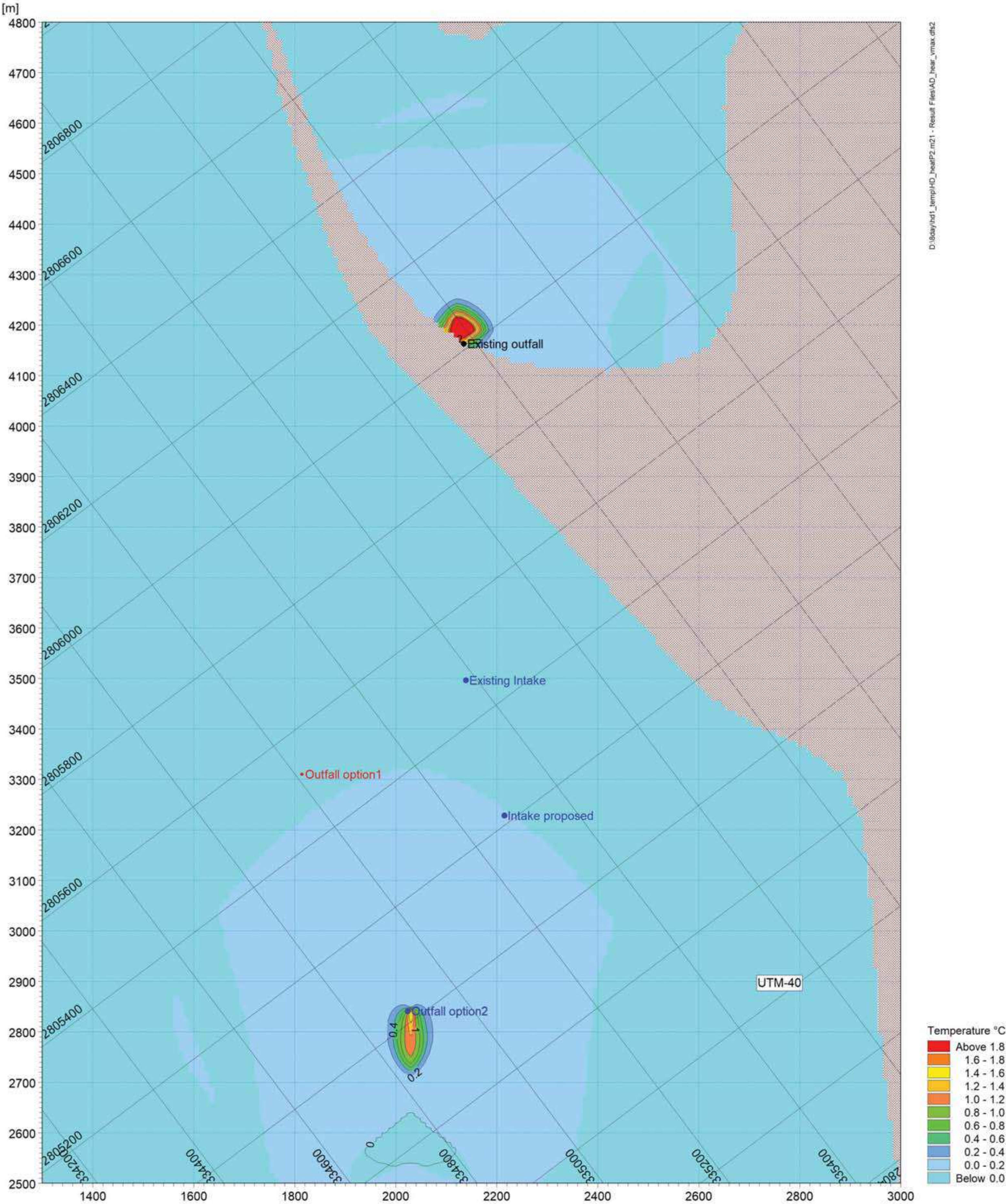
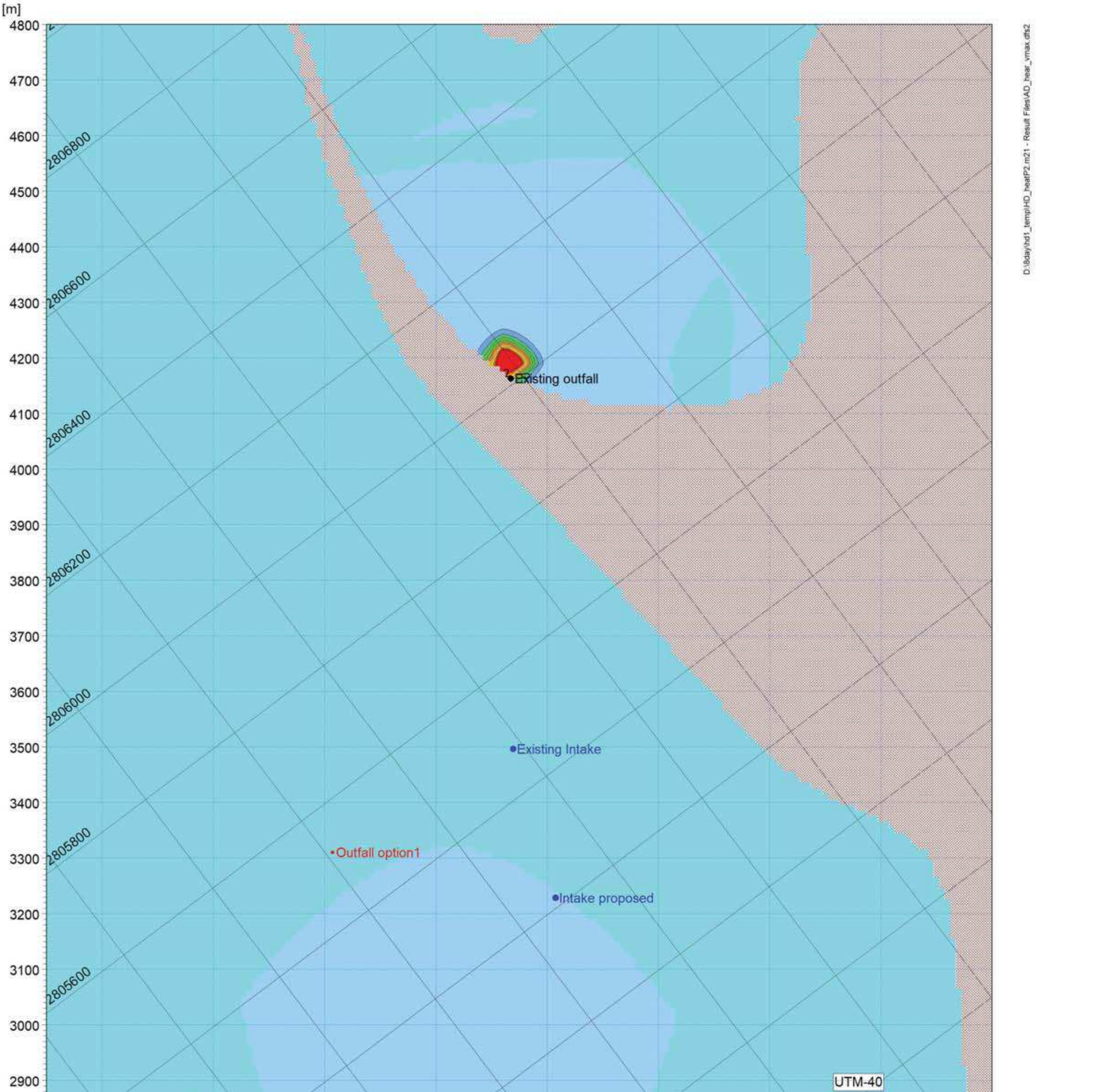
2805600
2805400
2805200
334200
334400
334600
334800
335000
335200
335400
Existing outfall
Existing Intake
Outfall option1
Intake proposed
Outfall option2
UTM-40
0
0.2
D:\location1\HD1_sal_wind\HD_sal_vmax_wind.m21 - Result Files\sal_p1_vmax_wind.dfs2
Salinity
Above 1.8
1.6 - 1.8
1.4 - 1.6
1.2 - 1.4
1.0 - 1.2
0.8 - 1.0
0.6 - 0.8
0.4 - 0.6
0.2 - 0.4
0.0 - 0.2
Below 0.0
12-08-2018 00:00:00
Scale 1:10160

Figure 59 – Dissipation of excess temperature plume for the outfall option-2 with high velocity diffusion (2.5m/s) and without wind (Scenario 3)



[m]
Existing outfall
Existing Intake
Outfall option1
Intake proposed
Outfall option2
UTM-40
Temperature °C
Above 1.8
1.6 - 1.8
1.4 - 1.6
1.2 - 1.4
1.0 - 1.2
0.8 - 1.0
0.6 - 0.8
0.4 - 0.6
0.2 - 0.4
0.0 - 0.2
Below 0.0
D:\8day\hd1_temp\HD_heatP2.m21 - Result Files\AD_hear_vmax.dfs2
12-08-2018 00:00:00
Scale 1:10170

Figure 60 - Dissipation of temperature plume from outfall option-2 without wind and diffusion velocity 0.8m/s (Scenario 4)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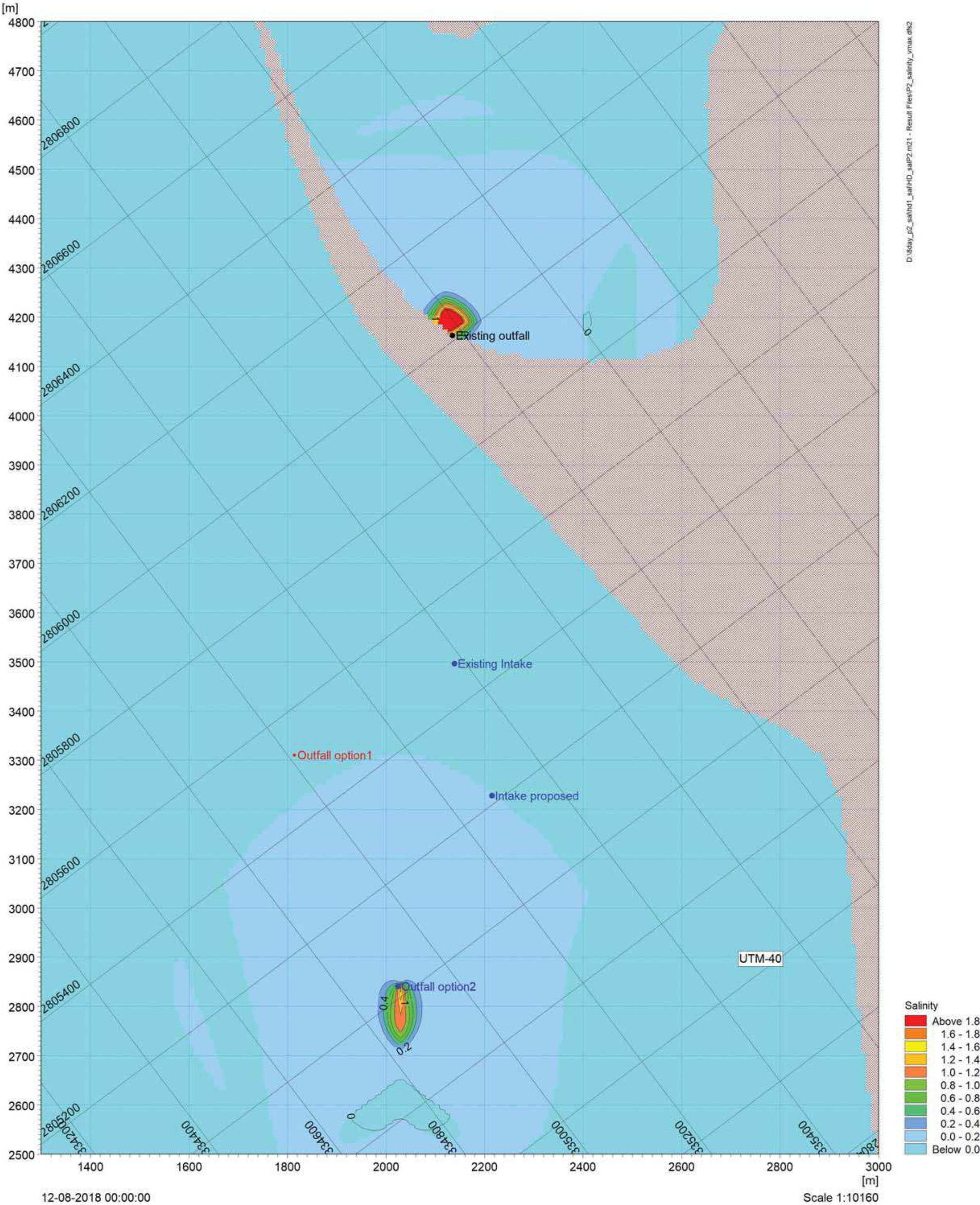
2806000
2805800
2805600
2805400
2805200
334200
334400
334600
334800
335000
335200
335400
Existing outfall
Existing Intake
Outfall option1
Intake proposed
Outfall option2
UTM-40
Temperature °C
Above 1.8
1.6 - 1.8
1.4 - 1.6
1.2 - 1.4
1.0 - 1.2
0.8 - 1.0
0.6 - 0.8
0.4 - 0.6
0.2 - 0.4
0.0 - 0.2
Below 0.0
12-08-2018 00:00:00
Scale 1:10170
D:\8day\hd1_temp\HD_heatP2.m21 - Result Files\AD_hear_vmax.dfs2

Figure 61 - Dispersion of excess salinity plume for outfall option-2 with high velocity diffusion (2.5 m/s) and without wind (Scenario 3)



12-08-2018 00:00:00

Scale 1:10160

Figure 62 - Dispersion of salinity plume from outfall option-2 without wind and diffusion velocity 0.8 m/s (Scenario 4)

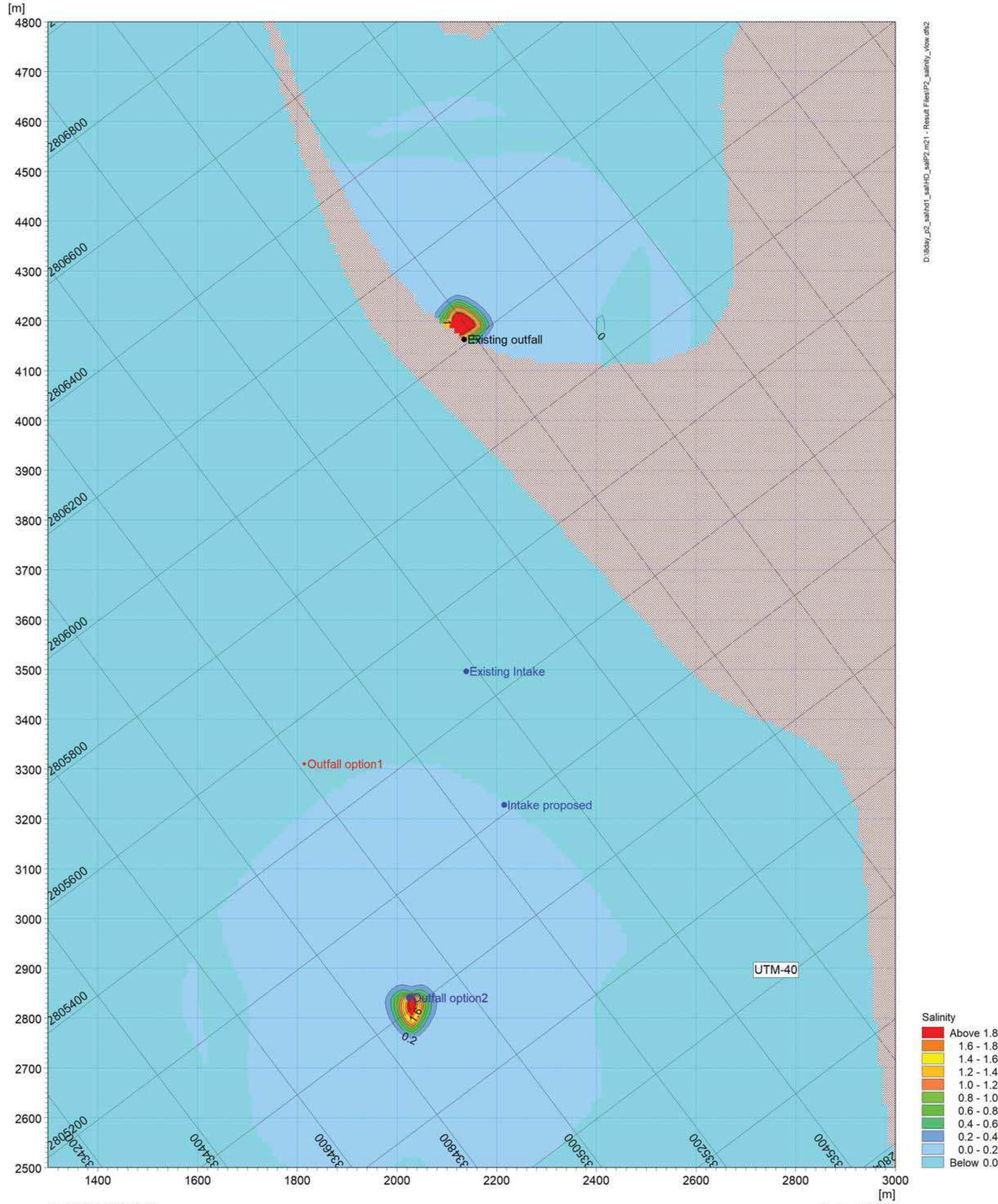
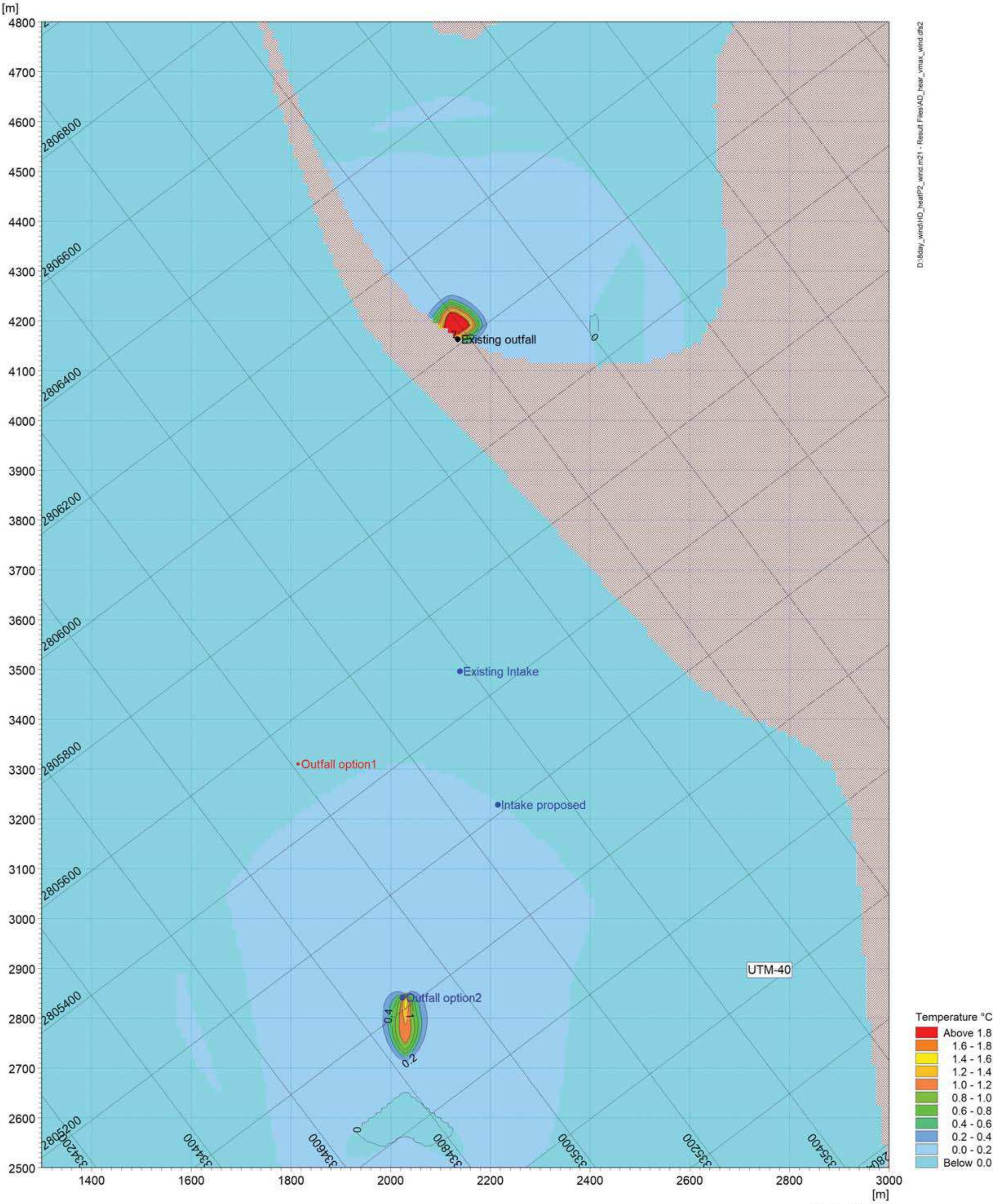

[m]
4800
4700
4600
4500
4400
4300
4200
4100
4000
3900
3800
3700
3600
3500
3400
3300
3200
3100
3000
2900
2800
2700
2600
2500
2806800
2806600
2806400
2806200
2806000
2805800
2805600
2805400
2805200
Existing outfall
Existing Intake
Outfall option1
Intake proposed
Outfall option2
UTM-40
334200
334400
334600
334800
335000
335200
335400
1400
1600
1800
2000
2200
2400
2600
2800
3000
[m]
12-08-2018 00:00:00
Scale 1:10160
D:\8day_p2_sal\hd1_sal\HD_salP2.m21 - Result Files\P2_salinity_vlow.dfs2
Salinity
Above 1.8
1.6 - 1.8
1.4 - 1.6
1.2 - 1.4
1.0 - 1.2
0.8 - 1.0
0.6 - 0.8
0.4 - 0.6
0.2 - 0.4
0.0 - 0.2
Below 0.0

Figure 63 - Dissipation of excess temperature plume with high velocity diffusion (2.5m/s) and annual extreme wind during High water spring - outfall option2 (Scenario 7)



[m]
D:\8day_wind\HD_heatP2_wind.m21 - Result Files\AD_hear_vmax_wind.dfs2
Existing outfall
Existing Intake
Outfall option1
Intake proposed
Outfall option2
UTM-40
Temperature °C
Above 1.8
1.6 - 1.8
1.4 - 1.6
1.2 - 1.4
1.0 - 1.2
0.8 - 1.0
0.6 - 0.8
0.4 - 0.6
0.2 - 0.4
0.0 - 0.2
Below 0.0
Scale 1:10170

Figure 64 - Dissipation of excess temperature plume with low velocity diffusion (0.8m/s) and annual extreme wind during High water spring- outfall option2 (Scenario 8)

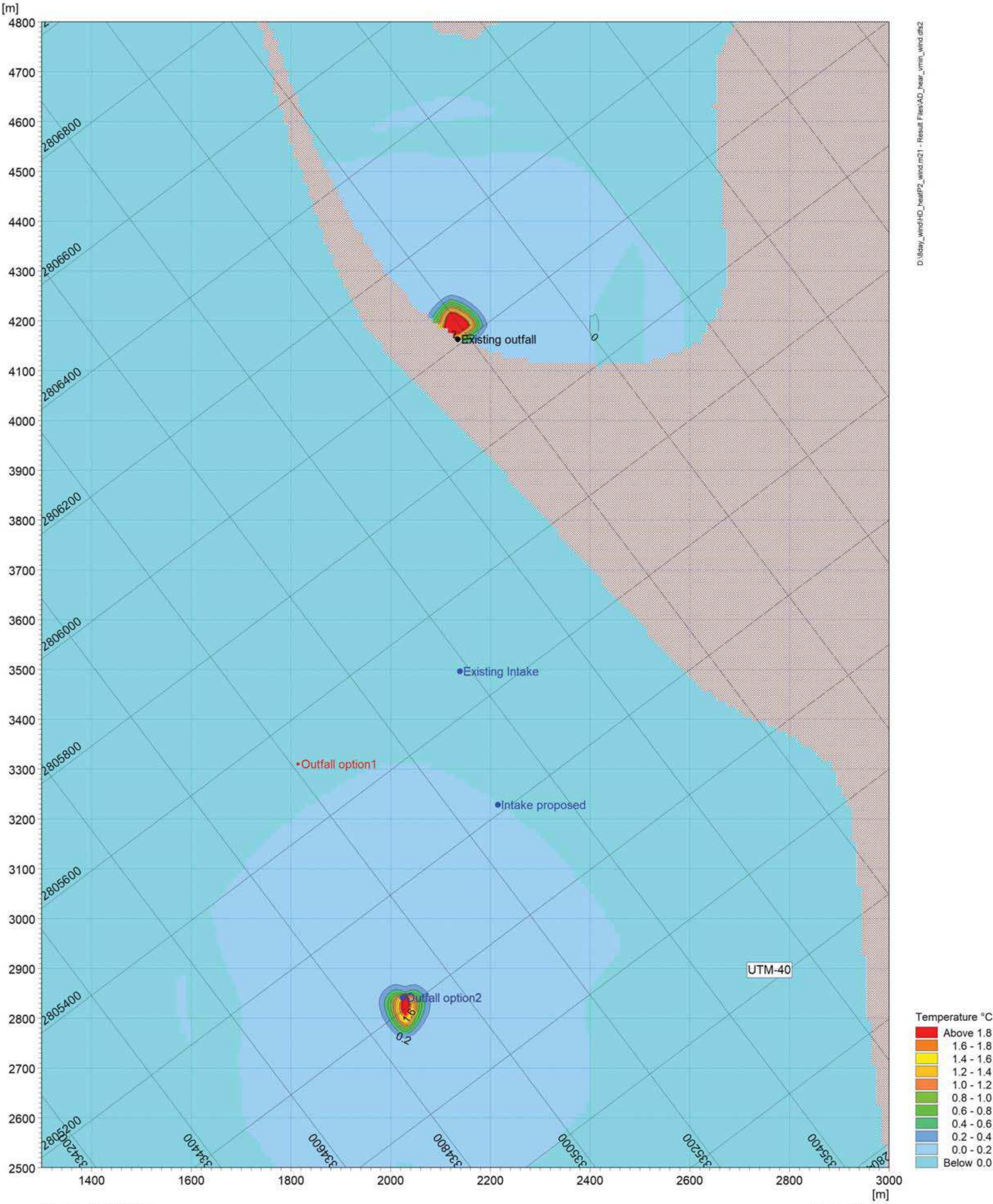
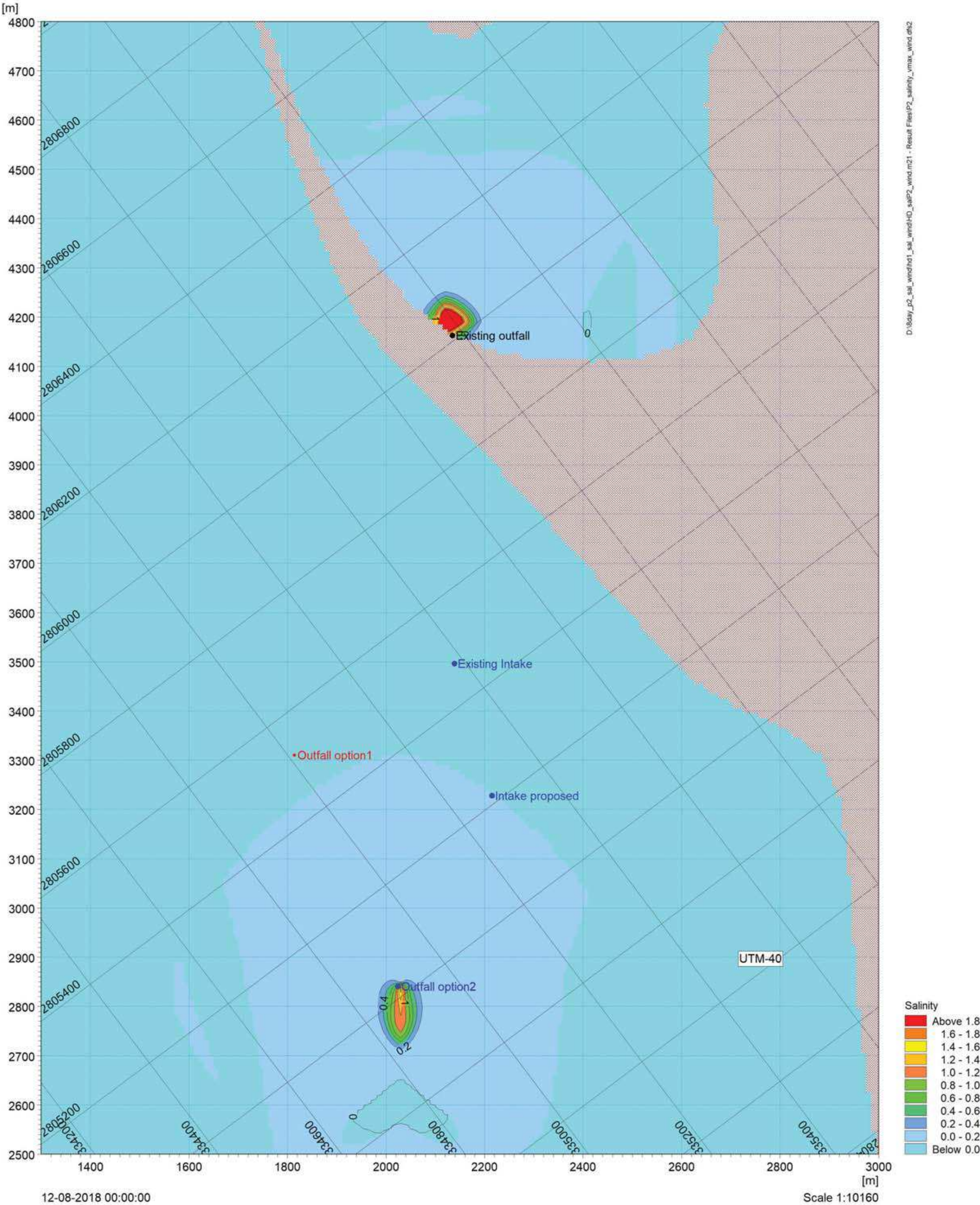

[m]
Existing outfall
Existing Intake
Outfall option1
Intake proposed
Outfall option2
UTM-40
Temperature °C
Above 1.8
1.6 - 1.8
1.4 - 1.6
1.2 - 1.4
1.0 - 1.2
0.8 - 1.0
0.6 - 0.8
0.4 - 0.6
0.2 - 0.4
0.0 - 0.2
Below 0.0
12-08-2018 00:00:00
Scale 1:10170
D:\8day_wind\HD_heatP2_wind.m21 - Result Files\AD_hear_vmin_wind.dfs2

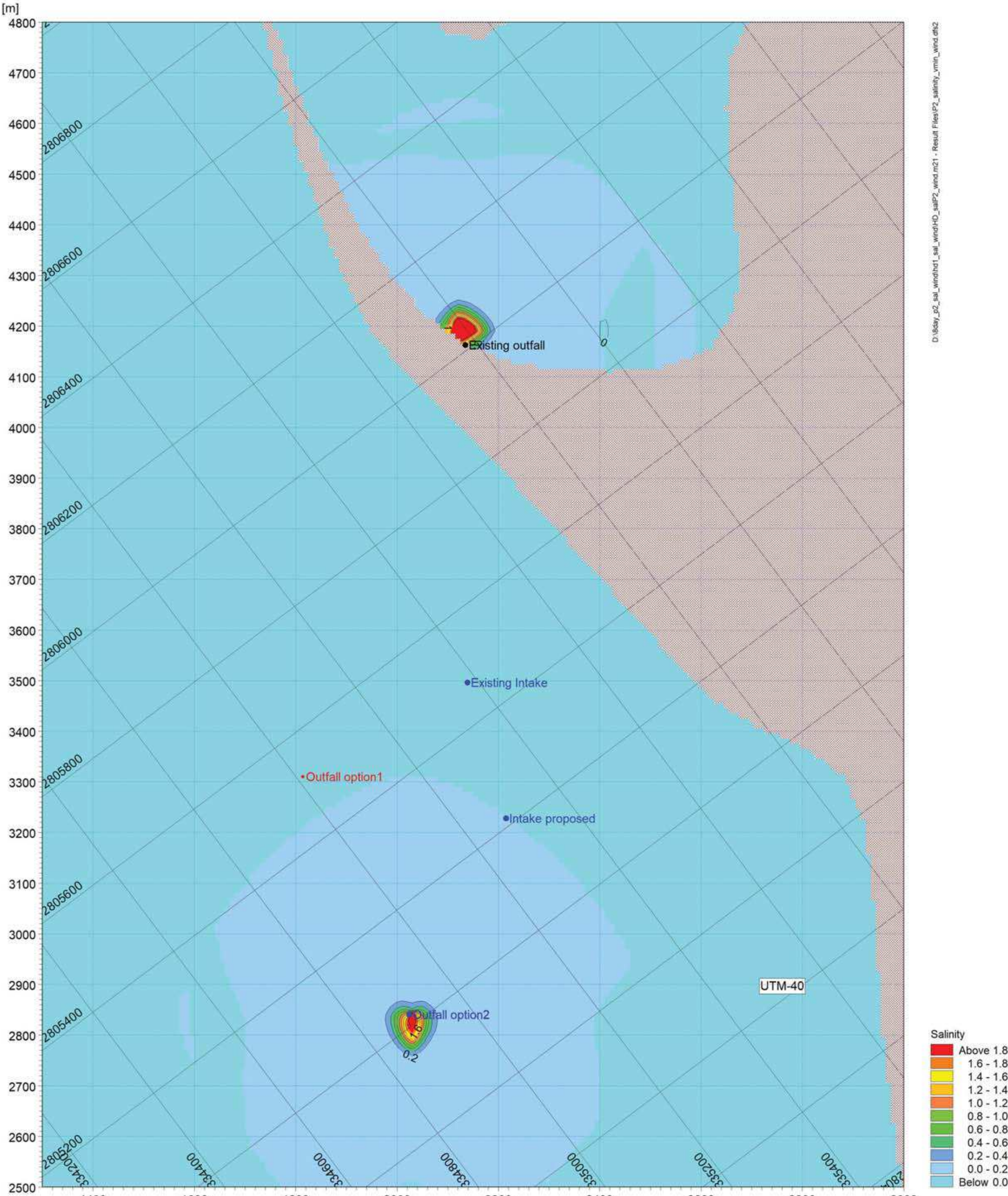
Figure 65 - Dispersion of excess salinity plume with low velocity diffusion (2.5m/s) with tide and annual extreme wind during High water spring- outfall option-2 (Scenario 7)



12-08-2018 00:00:00

Scale 1:10160

Figure 66 - Dispersion of excess salinity plume with low velocity diffusion (0.8 m/s) and annual extreme wind during High water spring - outfall option-2 (Scenario 8)



12-08-2018 00:00:00

Scale 1:10160

7.5.3.2.2.1.7. Discussion on Thermal Plume Dispersion

The perusal on thermal plume dispersion results that the temperature excess (above ambient) does not exceed 0.25 °C from ambient temperature level beyond initial zone of dilution (300 m radius). The recommended norm for excess temperature as per marine water quality objectives of DM-EPSS (Environmental Standards and Allowable Limits of Pollutants on Land, Water and Air Environment, 2003) is 2°C from background (ambient) level. The modeled results clearly indicate that excess temperature outside mixing zone comply with recommended norms, and impact due to the increase in temperature in the sea water quality will be negligible.

7.5.3.2.2.1.8. Discussion on Salinity Plume Dispersion

The perusal of the salinity plume dispersion results, the salinity concentration excess (above ambient) do not exceed 0.25 ppt (less than 0.6% of the ambient salinity) beyond initial zone of dilution (300 m radius). The recommended norm for excess salinity as per article 22 of DM Local order 61 of 1991 is increased or decreased salinity of receiving water greater than 2ppt from ambient values. The modeled results clearly indicate that salinity change outside mixing zone comply with recommended norms, and impact due to the salinity increase in the sea water quality will be negligible.

7.5.4. IMPACT ON TERRESTRIAL WATER RESOURCES DURING OPERATION PHASE

The source of groundwater and soil contamination will be due to the improper management of wastewater generated by personnel and solid waste generation, spill, leaks of chemicals/hazardous materials. Since client is committed to implement effective waste management and spill prevention measures, impacts on ground water quality in the project site are expected to be minor magnitude.

7.6. LAND ENVIRONMENT

The impacts of the proposed project during the construction and operation phases have been identified using Impact Assessment Methods. The identified significant impacts which may get affected and require mitigation measures due to the proposed activities of the project has been addressed below.

7.6.1. IMPACT ON LAND USE

The project will be facilitated in the existing Layyah Power Station of SEWA which is surrounded by industrial units of Port. It is consistent with surroundings. Hence, there is no change in land use of the project area.

7.6.2. IMPACT ON LAND ENVIRONMENT DURING CONSTRUCTION PHASE

The topography of the project site is flat barren land. During construction of foundation, excavated earth will be reused for construction & re-pairing of roads and refilling of foundation. Thus the impact during the construction is low magnitude and insignificant.

The dredged materials to be generated from dredging activity will have impact on land quality. Since it is proposed to dispose the dredged wastes to the Sharjah Municipality (SM) authorized service providers in compliance with SM regulations, the impact on land quality will be minor effect.

In general, one or more of the following activities impart adverse impacts on the land environment:

- Handling of solid construction materials, where from fugitive solids may deteriorate the soil characteristics;
- Handling and disposal of construction solid wastes, which may deteriorate soil characteristics and change the physical features, drainage, etc;
- Disposal of liquid wastes on land, thereby deteriorating soil quality;
- Disposal of miscellaneous used/damaged materials and solid wastes thereby imparting negative impact on aesthetic value.

As it is committed to provide effective construction waste management for the entire construction period, expected impact on land quality will be minor effect.

7.6.3. IMPACT ON LAND ENVIRONMENT DURING OPERATION PHASE

The generated solid wastes from domestic and industrial activity will be properly collected and stored in the area specified for solid waste storage. The domestic waste generated will be collected and stored in the respective garbage bin. The general waste generated from the industrial activity will be collected and stored in the waste bin. The collected domestic and mixed waste will be properly disposed to Sharjah Municipality authorized service providers for further treatment and safe disposal.

Since the facility is committed that solid wastes will be properly stored in bin and disposed to agencies for further treatment and safe disposal, impact is not envisaged on land quality (ground water and soil) due to disposal of solid wastes.

7.7. ECOLOGY

The impacts of the proposed project during the construction and operation phases have been identified using Impact Assessment Methods. The identified significant impacts which may get affected and require mitigation measures due to the proposed activities of the project has been addressed below.

The impacts on biodiversity during the construction and operation phases have been identified and evaluated using impact assessment methods. The process of ecological impact assessment hereunder described.

7.7.1. ECOLOGICAL IMPACT ASSESSMENT METHODS

The following components are considered to determine the significance of ecological impacts:

- Compliance to legal requirement;
- The baseline conditions of the area – The baseline of ecology is characterised based on marine and the terrestrial ecological survey conducted in the project region;
- The sensitivity of receptors – sensitive receptors are identified and described in **Table 85**; and
- Evaluation criteria

7.7.1.1. Legal requirements

Ecological impacts assessment comply the UAE Federal requirement and IFC. The assessment is in line with IFC PS-6 and its corresponding guidance note 6. The specific requirements are hereunder briefly discussed.

7.7.1.1.1. UAE Federal requirements

In accordance with Federal environmental law, reserve areas shall be protected from work, activities and acts which may lead to damage or deterioration of the natural environment and Setting up establishments, buildings or construct roads, drive vehicles or practice any agricultural, industrial or commercial activities in reserve areas without the permission of the Competent Authorities are also prohibited under this law. Resting, hatching or habitation shall be protected in in accordance with the provision of this Law.

7.7.1.1.2. International Requirement - International Financial Corporation

The IFC PS6 objectives are:

- To protect and conserve biodiversity
- To maintain the benefits from ecosystem services

- To promote the sustainable management of living natural resources through the adoption of practices that integrates conservation needs and development priorities.

IFC PS6 requires that a conservation value is allocated to the ecological features (protected areas, habitats and species) which are likely to be directly or indirectly impacted in the project study area. Under the IFC guidance, the requirements of PS6 apply to projects in all habitats, whether or not those habitats have been previously disturbed and whether or not they are legally protected. Specifically a project is required to:

- Assess significance of project impacts on all levels of biodiversity as an integral part of the social and environmental assessment process
- Take into account differing values attached to biodiversity by specific stakeholders
- Assess major threats to biodiversity, especially habitat destruction and invasive alien species.

In accordance with IFC PS6, habitats are divided into modified, natural and critical habitats. Critical habitats can be either modified or natural habitats supporting high biodiversity value, including:

- Habitat of significant importance to critically endangered and/or endangered species
- Habitat of significant importance to endemic and/or restricted-range species
- Habitat supporting globally significant concentrations of migratory species and/or congregatory species
- Highly threatened and/or unique ecosystems
- Areas associated with key evolutionary processes.

Since habitat destruction is recognized as a major threat to the maintenance of biodiversity and to assess likely significance of impacts, IFC PS6 requires the following depending on habitat status:

- Modified Habitat: exercise care to minimize any conversion or degradation of such habitat, depending on scale of project, identify opportunities to enhance habitat and protect and conserve biodiversity as part of operations.
- Natural Habitat: developer will not significantly convert or degrade such habitat unless no financial/technical feasible alternatives exist, or overall benefits

outweigh cost (including those to biodiversity), and conversion or degradation is suitably mitigated. Mitigation must achieve no net loss of biodiversity where feasible; offset losses through creation of ecologically comparable area that is managed for biodiversity, compensation of direct users of biodiversity.

- Critical Habitat: in areas of critical habitat the Project Proponent will not implement Project activities unless there are no measurable adverse impacts on the ability of the critical habitat to support established populations of species described or on the functions of the critical habitat; no reduction in population of a recognized critically endangered or endangered species and lesser impacts mitigated as per natural habitats.

7.7.1.2. Summary of ecological conditions in the project area

7.7.1.2.1. Terrestrial ecological conditions

The proposed project will be established in the existing site of Layyah Power Station of SEWA. The study area of project site is already developed and the project site does not have significant flora and fauna.

7.7.1.2.2. Terrestrial Protected Areas

The nearest national protected area is Wasit natural reserve (0.86 km^2) which is located 8.5 km east from the project site. It is an essential site for bird ecology within the emirate of Sharjah and it is a unique landscape with a natural lake maintained by the upwelling of underground water. The most distinguished feature of the reserve is the diverse ecosystem since it has different habitats and types of vegetation compromising coastal sand dunes, along with salt flat (Sabkhas) linking ponds and a large open lake *(Source: http://www.epaashj.ae/protected-areas/wasit-nature-reserve/)*.

There are no other protected areas for nature conservation designated at national or international levels within the project study region.

7.7.1.2.3. Marine ecological conditions

Ten stations were selected to be representative within the study area. The epibenthic communities were dominated by oyster bed, corals, sandy and silty sand areas. Moderate diverse condition with potential importance of corals and oyster beds was found especially on station ME-05 and ME-08. Phytoplankton density in terms of cell counts varied from 22-83 $\times10^3$ No./L with an overall average population density of 40.6×10^3 No./L. The dominant class of the phytoplankton was Dinophyceae (dinoflagellates) (45.8%) followed by Bacillariophyceae (Diatoms) (36%) and Cyanophyceae (Cyanobacteria) (18.2%). Harmful Algal blooms were absent in the phytoplankton samples. The zooplankton population had an average population of 172 individuals in no./m^3. A total of 12 taxa were recorded. Acartia fossae (22.3%), Copepods (19.7%), Oikupleura sp (14.8%), Sagitta (12.9%) and Lucifer sp. (10.12%) were the major group and species of the zooplankton. Fish eggs and fish larvae were not found in the samples collected. The perusal of the present levels of planktonic communities indicates that it was found moderate population density along the project area. The macro-benthic infauna along the project area had population values ranging from 1200-3880 No./m^2 (average 2772 No./m^2). Moderately high diversity index of Margalef (d) and Shannon-Wiener (H') at stations ME-01, ME-02, ME-04, ME-05, ME-06, ME-07, ME-08 & ME-09 shows moderate healthy statues of macro-benthic in-fauna in this project area.

7.7.1.2.4. Marine Protected Areas

There is no marine protected area for nature conservation designated at national or international levels within the project study region.

7.7.1.3. Sensitivity of the receptors

The sensitivity of the ecological receptor has been determined using the criteria presented in **Table 84.**

Table 84 – Criteria for determining sensitivity of the receptor for ecology

Sensitivity Ranking	Detail	Habitat or Site Criteria	Species criteria
Very high	Very high importance and rarity. International scale with limited potential for substitution.	Internationally designated sites (or equal status). Habitats of significant international ecological importance.	IUCN Critically Endangered and Endangered species (IUCN red list)
High	High importance and rarity, national scale, or regional scale with limited potential for substitution, species of international status but not within designated areas.	Nationally designated sites (or equal status). Areas of habitats of national ecological importance, and natural habitats of significant ecological importance and/or high biodiversity with limited potential for substitution.	IUCN Vulnerable species. Nationally protected species of significant population size and importance.
Moderate	High or medium importance and rarity, local or	Regionally important natural habitats. Natural habitats. Modified	IUCN Near Threatened species. Nationally protected

Sensitivity Ranking	Detail	Habitat or Site Criteria	Species criteria
	regional scale, and limited potential or substitution, species of national status but not within designated areas.	habitats with high biodiversity or under significant threat of loss within the region.	species or rare species, but not a significant population size and not of national importance.
Light	Very low or low importance and rarity, and local scale.	Undesignated sites and habitats of natural habitats of some local biodiversity and cultural heritage interest. Modified habitats with limited ecological value. Other sites with little or no local biodiversity and cultural interest. Modified habitats with limited biodiversity value.	IUCN Least Concern. Species of local national importance.
Marginal	Very limited ecological importance.	Highly modified habitats of no biodiversity value.	IUCN Least Concern species. Species of no national importance.

The identified receptors are assessed based on the criteria mentioned above for the sensitivity. The details of sensitive receptors concerning ecological features are presented in **Table 85**.

Table 85 – Details of sensitive receptors in relation to ecological features

Receptor Type	Name of the receptor	Distance – km (Direction)	General Sensitivity	Sensitivity to ecological features	
				Habitat or Site Criteria	Species criteria
Industrial premises	Project site	--	Marginal	Marginal	Marginal
Natural Habitat	Sharjah Creek	0.40 (E)	Moderate	Moderate	Moderate

Receptor Type	Name of the receptor	Distance – km (Direction)	General Sensitivity	Sensitivity to ecological features	
				Habitat or Site Criteria	Species criteria
Natural Habitat	Arabian Gulf (Sea)	Adjacent	Moderate	Moderate	Moderate
Natural Habitat	Khalid Lagoon	1.50 (SSE)	Moderate	Moderate	Moderate
Natural Habitat	Al Khan Lagoon	2.60 (S)	Moderate	Moderate	Moderate
Ecologically Protected Area	Wasit Natural Reserve	8.5 (E)	High	High	High

7.7.1.4. Criteria of ecological impact assessment

The magnitude of the potential impacts upon each ecological feature has been assessed for the construction and operation of the Project, using the criteria presented in **Table 86**.

Table 86 – Criteria for determining impact significance for ecology

Degree of Significance (Adverse/ beneficial)	Criteria
Major	Environmental effects are clearly noticeable and are sufficient to destabilize the resource. Change to the specific conditions assessed resulting in long term/permanent change, typically widespread in nature and requiring significant intervention to return to baseline.
Moderate	Detectable change to the specific conditions assessed resulting in non-fundamental temporary or permanent change.
Minor	Detectable but minor change to the specific condition assessed
Negligible	No perceptible change to the specific condition assessed.

7.7.2. ECOLOGICAL IMPACT DURING CONSTRUCTION PHASE

7.7.2.1. Terrestrial ecology – Construction phase impact identification and evaluation

The extent of habitat to be affected by the project is approximately 25,000m^2. The project site is flat without any significant flora and fauna and currently left barren. Since there is no significant flora and fauna in the project affected area, the expected impact on terrestial ecology will be minor effect.

7.7.2.2. Marine ecology – Construction phase impact identification and evaluation

The construction of intake and outfall structures and the laying of pipelines in the seabed may cause the following environmental impacts on marine ecological environment:

- The construction of intake and outfall structures and the laying of pipelines in the seabed may lead to a destruction of benthic habitats. The mechanical impact is usually lethal for benthic organisms in the immediate construction site.
- Disturbance of sediments may have short-term indirect effects on marine life.

7.7.2.2.1. Impact of installation of offshore structures

Installation of the intake structure and pipeline would effectively eliminate any (sandy or rocky) biota in the structural footprint, and reduce the area of seabed available for colonization by marine benthic communities. The loss of substratum as a result of the offshore intake and outfall effluent pipelines would, however, is temporary, as the structures themselves would provide an alternative substratum for colonizing communities.

The physical removal of sediments or bedrock for the intake and outfall structures, and disposal of the excavated materials will destroy benthic biota within the marine construction zone.

Active rehabilitation of intertidal communities is not possible, but rapid natural recovery of disturbed habitats in the turbulent intertidal and surf-zone areas can be expected. Furthermore, the intake and marine structures will serve as a new 'hard-bottom' substrate for colonization by marine benthic communities. Recolonisation will start rapidly after cessation of trenching, and species numbers may recover within short periods (weeks) whereas biomass often remains reduced for several years.

The impact of disturbance of the intertidal and sub tidal rocky shore during installation of the intake and discharge pipelines is assessed to be of moderate effect and with the implementation of mitigation can be reduced to minor.