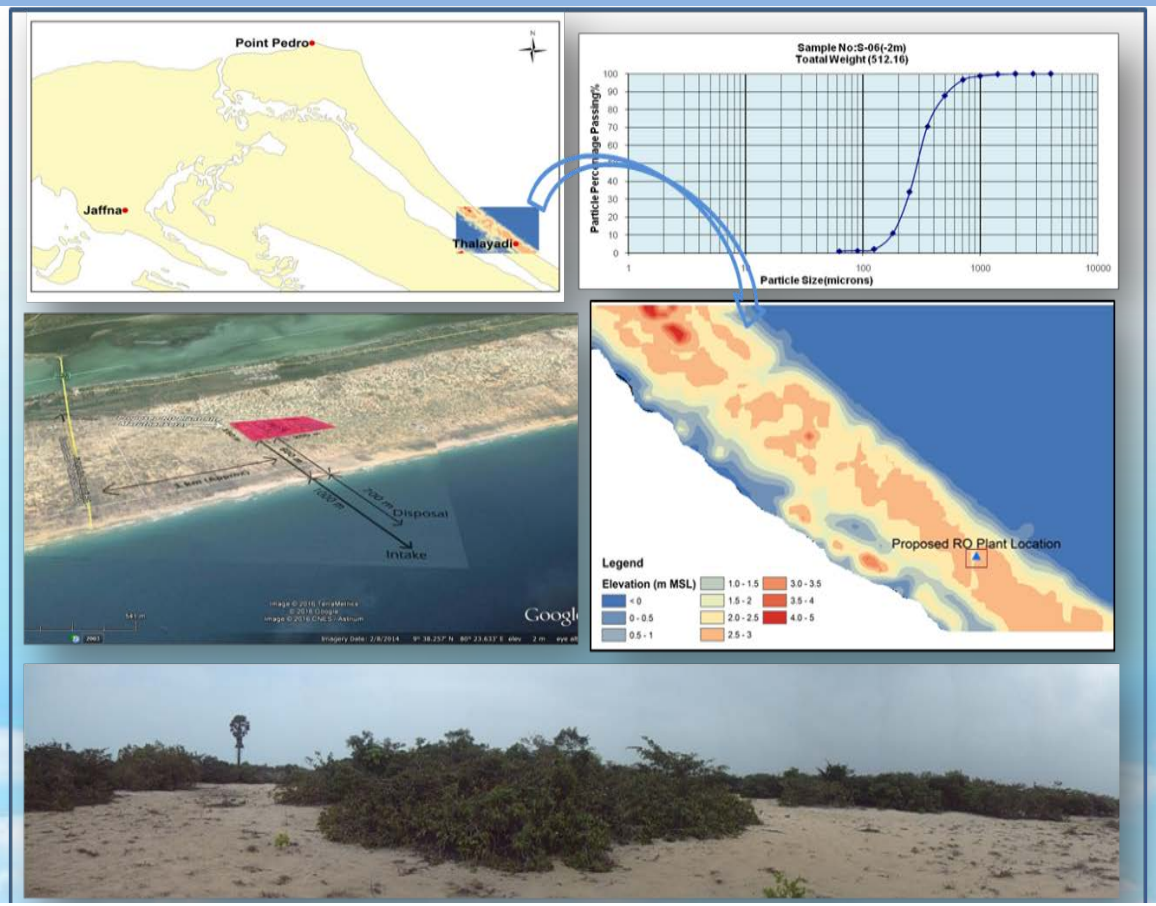
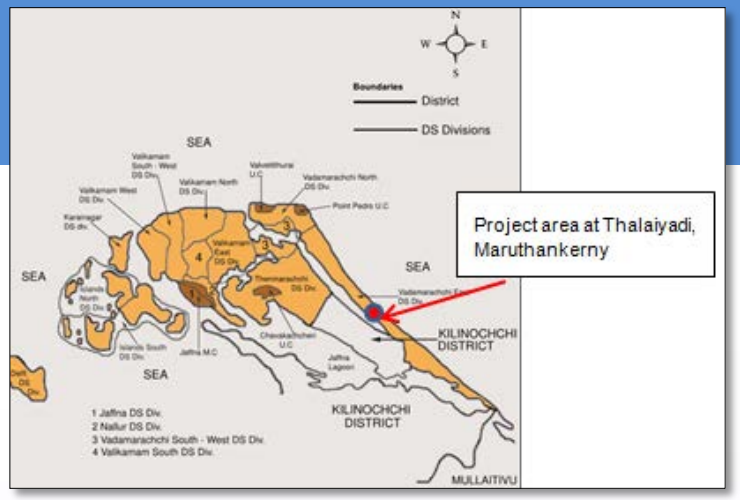
Environmental Impacts

Installation of Seawater Desalination Plant at Thalayadi

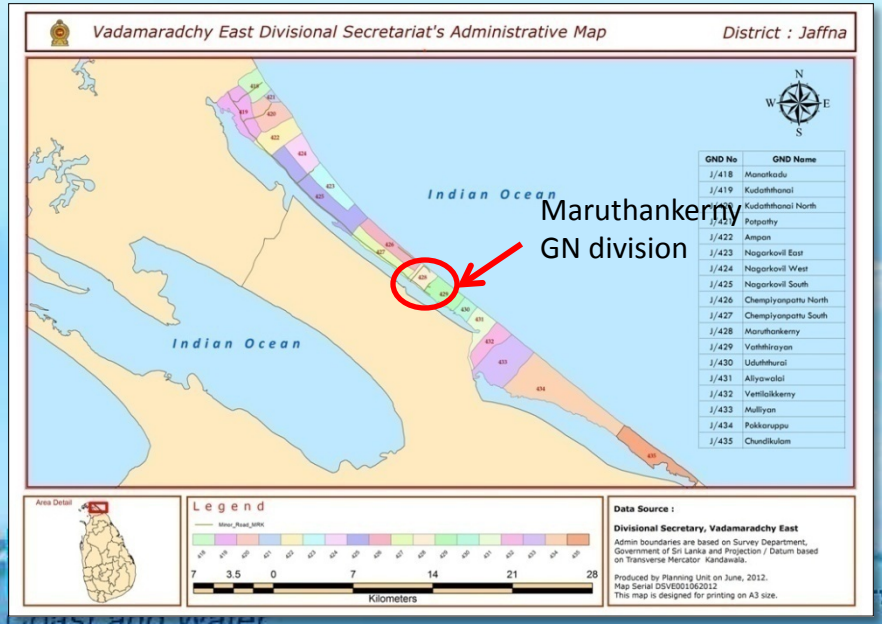


SWRO Plant Location



The proposed land identified to establish SWRO plant is located in:

- Vadamarachchi East Divisional Secretariat (DS) (consists of 18 GN divisions)
- Maruthankerny GN Division (consists of 3 villages)
- Thalaiyadi village

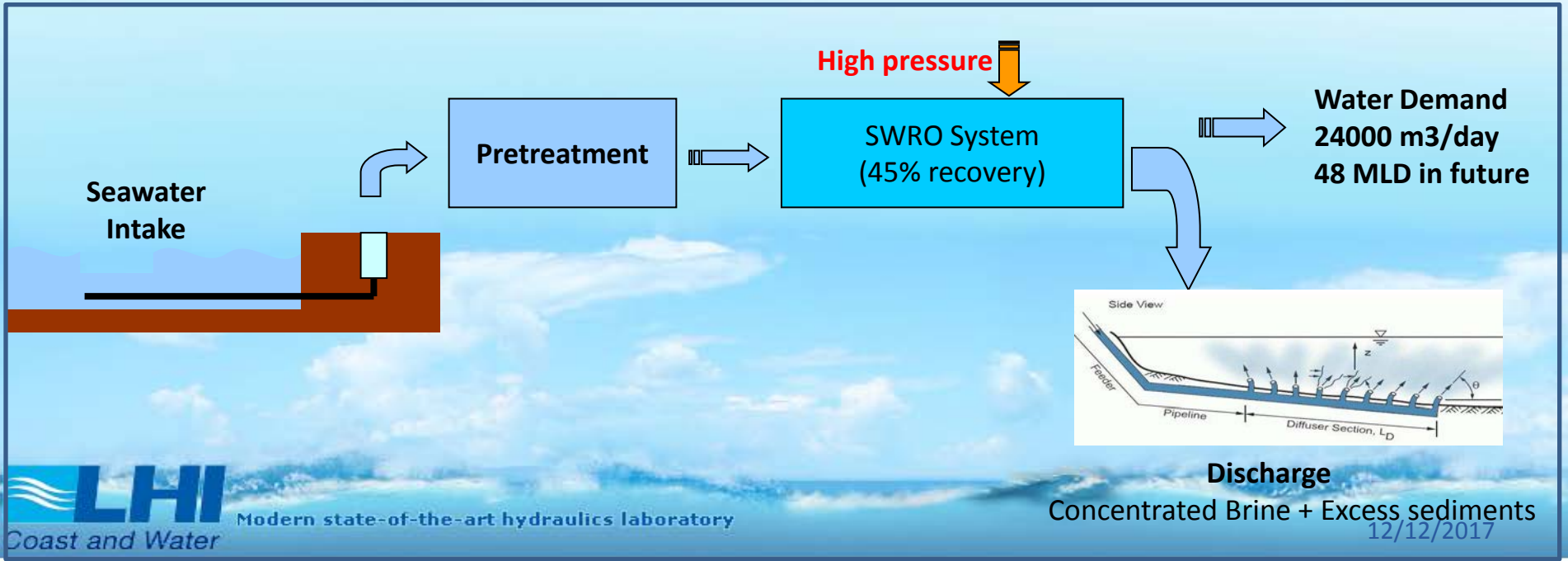


RODP Components

- Intake structure (ultimate capacity of 48MLD)
- SWRO Treatment Unit
- Outfall structure (24MLD & 48MLD)
- Potable Water Conveyance facilities
  - Storage tank (10,000 m3)
  - Pumping station
  - 8 km long 800mm dia. main from RODP to delivery point

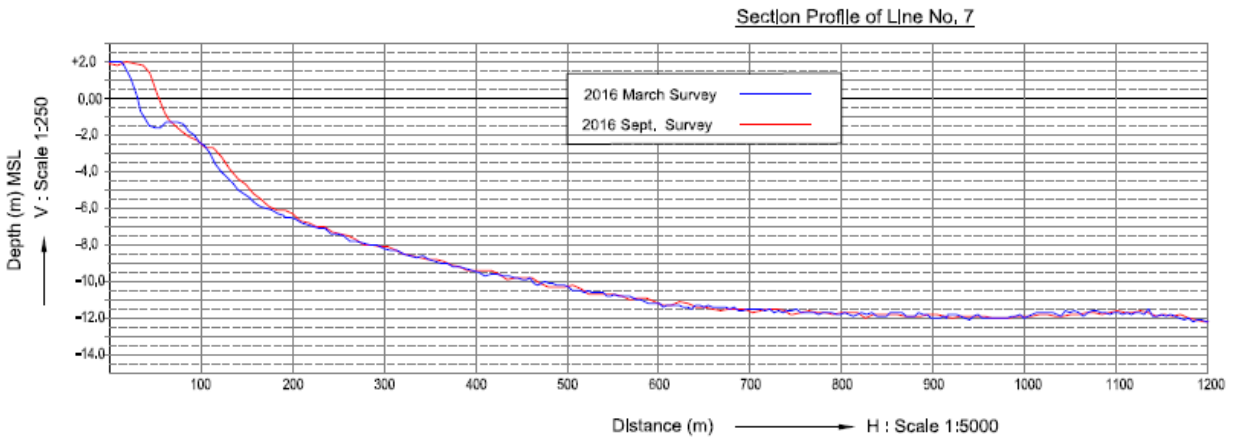
Key Possible Environmental Issues

- Impacts due to Extraction of Sea water (Impingement & Entrainment)
- Impacts due to Concentrated Brine Discharge
- Impact on Terrestrial flora/fauna
- Impact on marine life



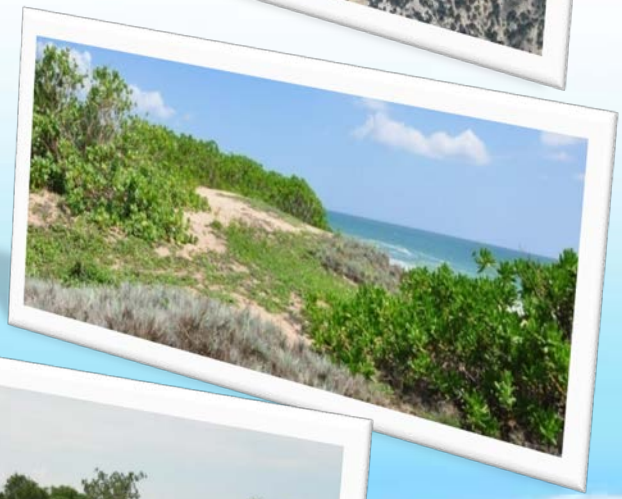
Investigations carried out

- Bathymetric survey (before & after monsoon – 2 times)
- Water level / current measurements (all 4 seasons)
- Water quality measurements (all 4 seasons)
- Numerical modelling of brine discharge
  (simulate all 4 seasons with average & extreme conditions)
- Marine biological Survey
- Terrestrial
  Ecological Survey



Existing Environment _ Plant Area

- 200m x 200m land area
- Scrubs and bushes common to coastal lands
- Entire plant area consists of a sandy surface
- **No economic or social activities**

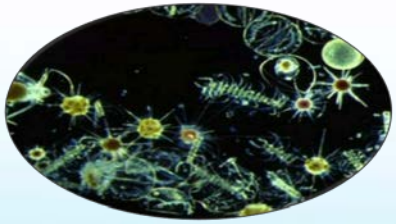


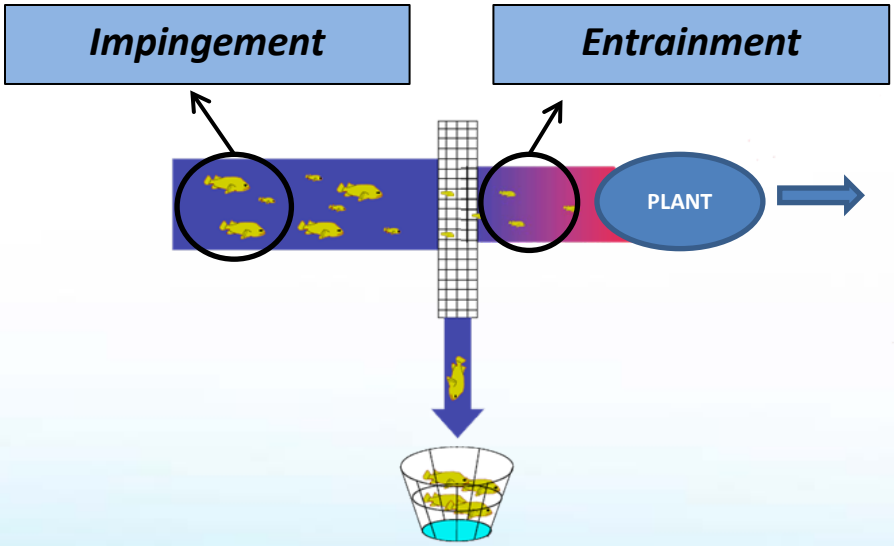
- No private land acquisition
- No evacuation of people or their livelihood related infrastructure buildings

Possible Impacts due to Intake

- Seawater

  a habitat which contains an entire ecosystem





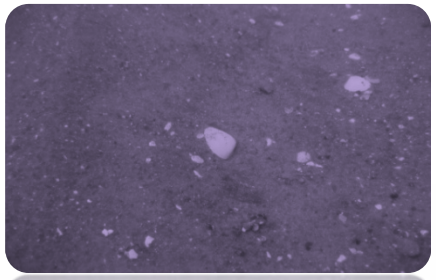
- loss of Aquatic life and biodiversity

  Animals > mesh – injury or death due to **impinging effect**

  Animals < mesh – **Entrained** into the plant and killed by thermal and chemical alterations.

Mitigation by Selecting a Suitable Location

- no hard substrates such as coral reefs, sandstone reefs & rock reefs
- Sea grasses were not present
- the entire study area is consists of pure sand



Sand Bed

Species groups observed are not unique to the study area

Seagrasses

→ Not a sensitive Marine Environment

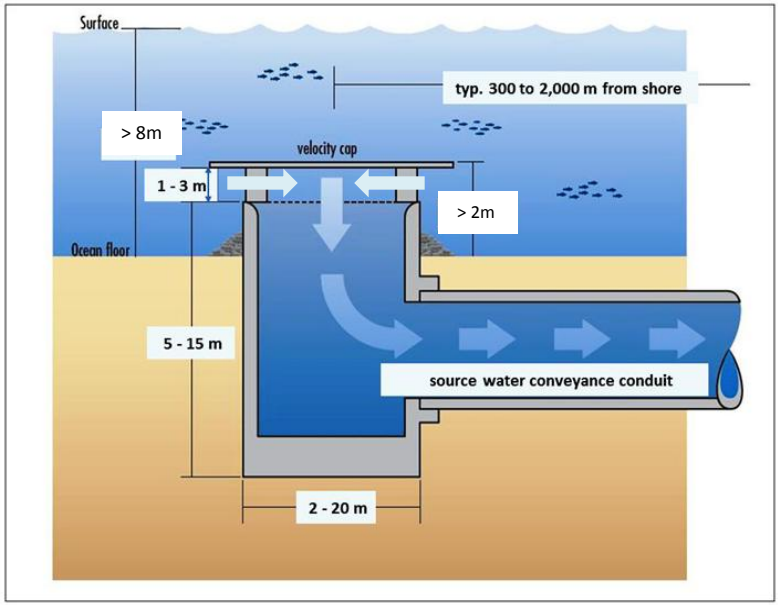
Impact to the marine environment is minimal & suitable to locate effluent discharge.

Coral reefs

Mitigation Measures..

Impact to the Marine life

Selecting a location with low marine sensitivity



Entrainment

Providing screens with small mesh

Impingement

Reducing the intake velocity as much as possible

Velocity below 0.15 m/s is recommended

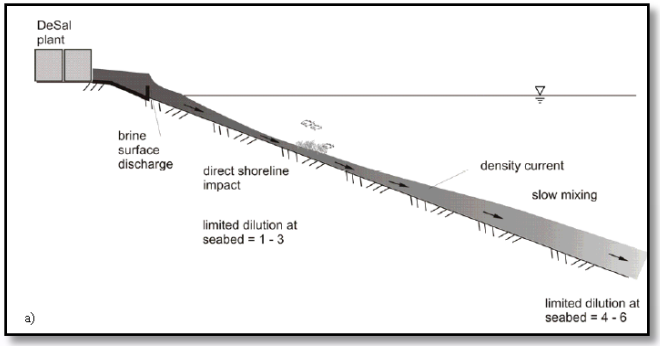
No significant impacts ➡ no mitigation is needed

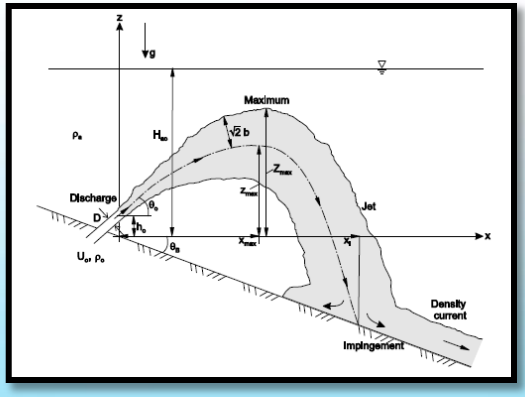
Contactor to follow Best Technology Available

Flat bed is preferred to install the intake structure

Possible Impacts due to Discharge

Negative Buoyant Surface Discharge





Negative Buoyant Jet discharge

- **Salinity increase (Excess Brine)**
- **Increase sediments in water**

Can minimize by achieving proper dilution

Searching for better Dispersion through Numerical Modelling

Dispersion characteristics depends on sea state

- Wave Climate Modelling

  to predict the wave climate through out the year

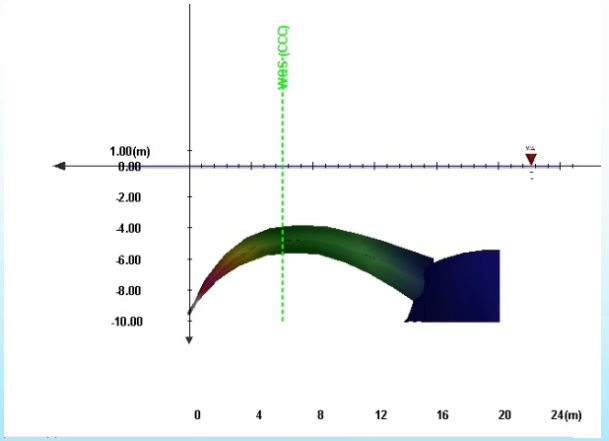
- Hydrodynamic Modelling

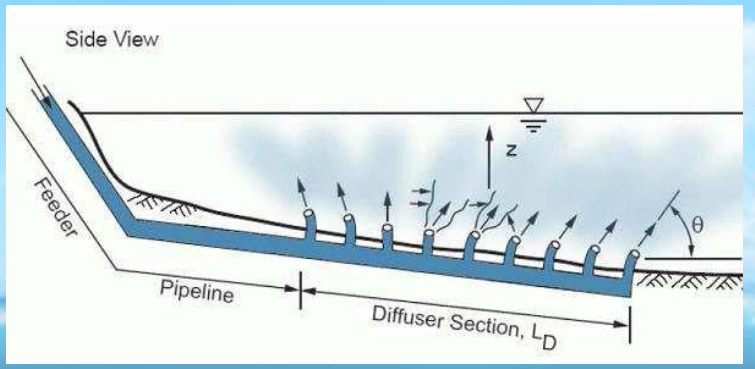
  to predict the flow condition around the area

- Dispersion Modelling

  to observe the dispersion pattern of Brine

  – Near Field Modelling (CORMIX software)
  – Far Field Modelling (Mike 21 AD Model)





Wave Transformation _ MIKE 21 SW Model

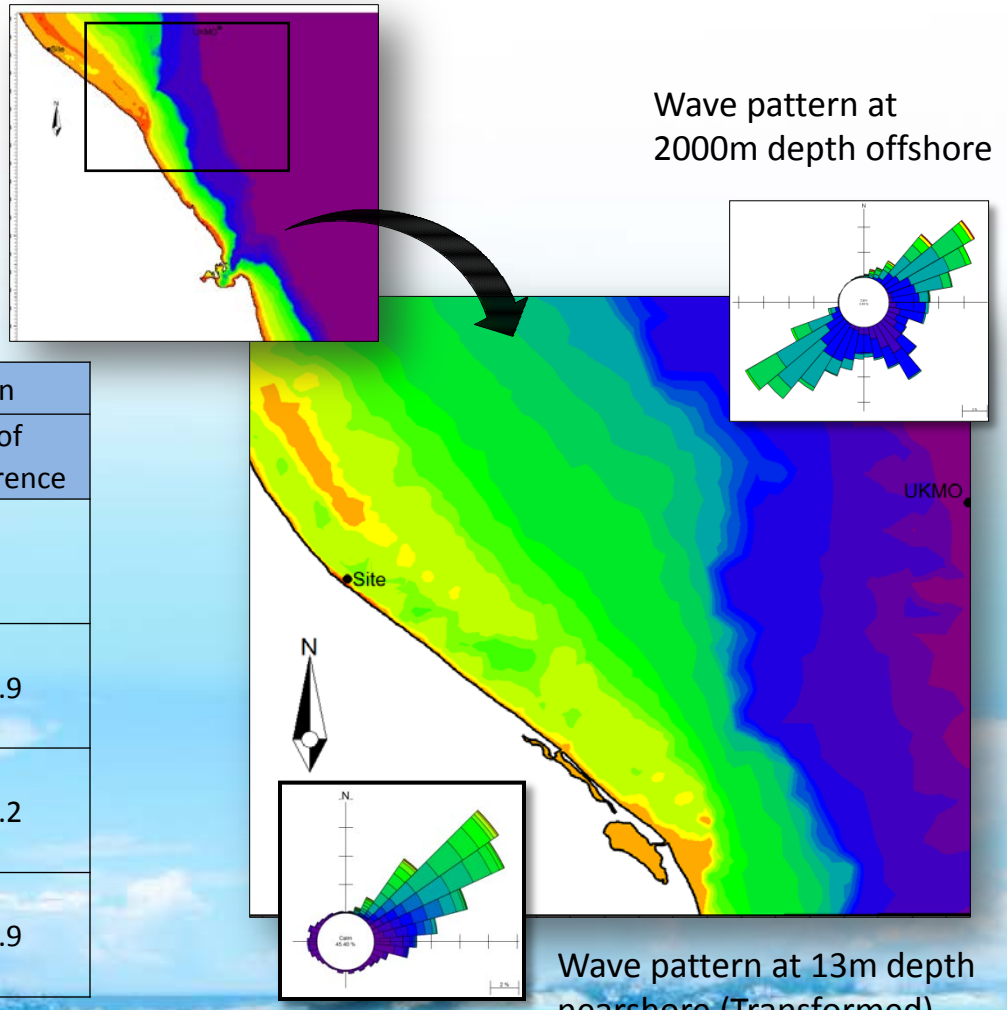
Hind-cast data from global wind & wave model of (UKMO)

5 1/2 years (2010-2015) of data

at 6 hourly intervals

Total number of 8028 data.

Period	Wave Climate		Wave Distribution	
	Occurrence level	Wave Height (m)	Dominant directions	% of occurrence
SW Monsoon	50%	0.25	no specific direction	-
	98%	0.35		
IM1 period	50%	0.25	50° to 110°	87.9
	98%	1.05		
NE Monsoon	50%	0.95	30° to 90°	96.2
	98%	1.45		
IM2 period	50%	0.35	20°-110°	75.9
	98%	1.25		

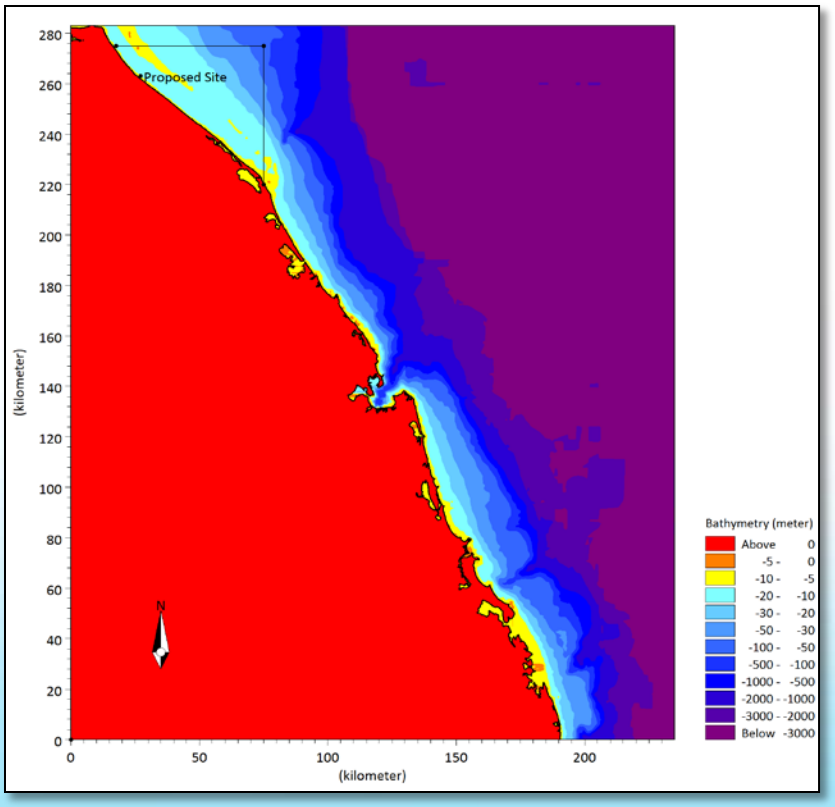


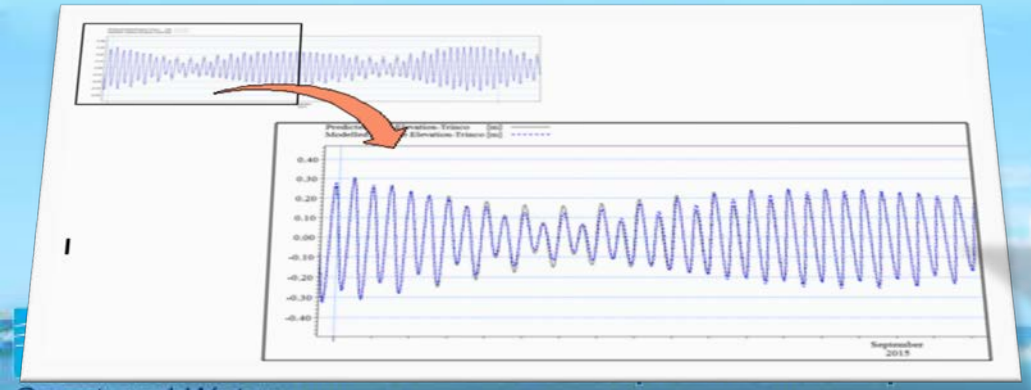
Hydrodynamic Condition _ MIKE 21 HD Model

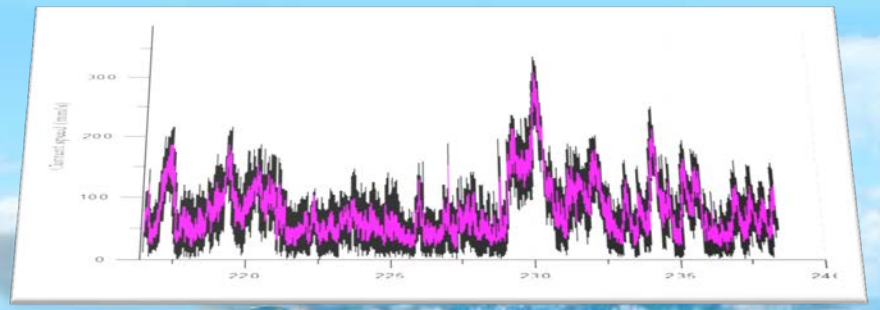
Ambient sea state is generated on the computer model and calibrated with measured parameters.

Water level & Current measurements 2 weeks period in each monsoon;

- Mar – Apr 2016
- Sep – Oct 2016
- Feb 2017
- Jul 2017



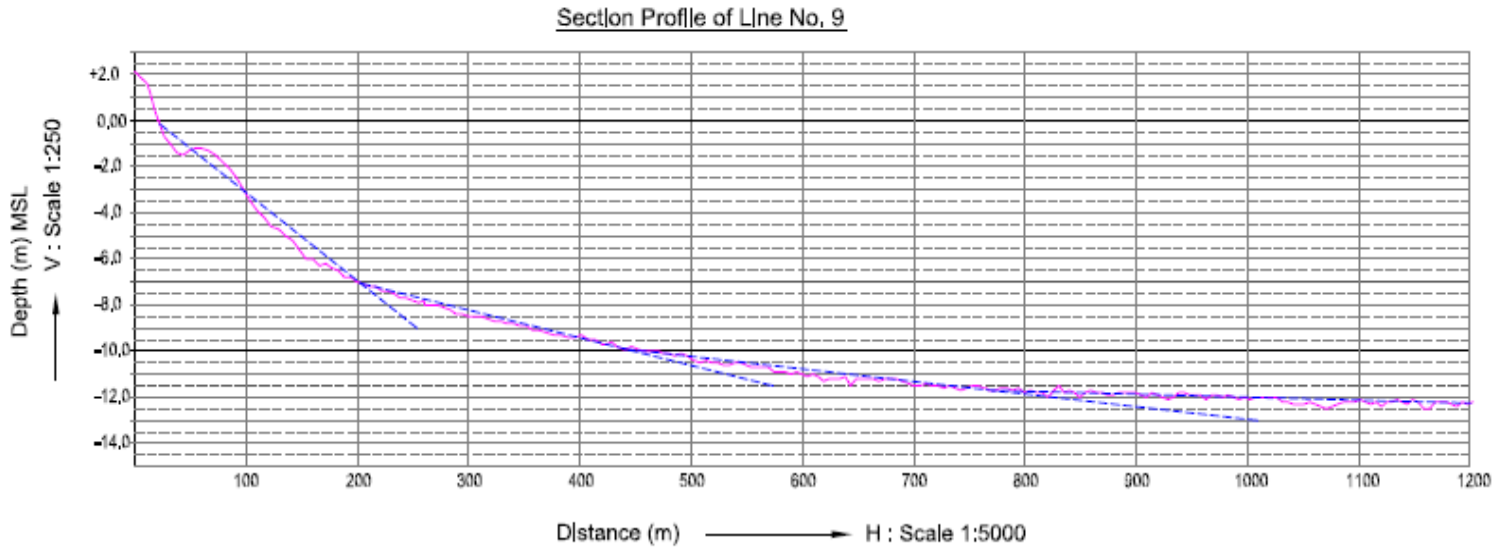




Sea Status

- Water quality – Good
- Current pattern – Average
- Water level - max variation 0.4m
- Bathymetry (steep slope upto 7m depth, moderate slope upto 11m depth & mild slope thereafter)

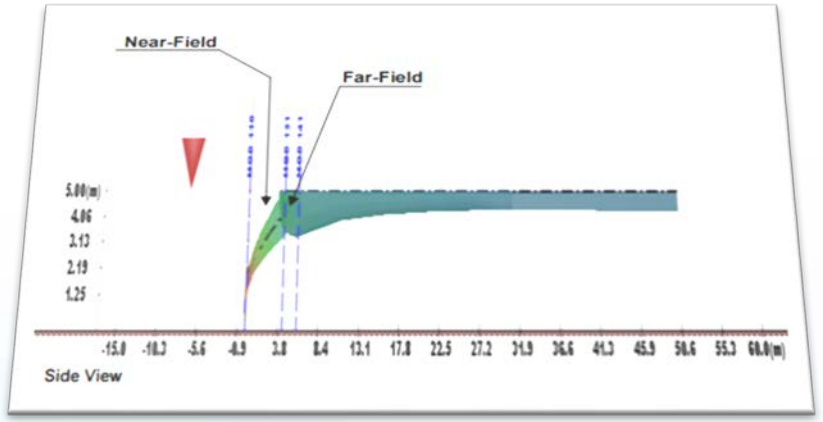
Well-mixed and quite dynamic marine environment



Mixing Characteristics

Near Field mixing

- Close to source
- Region of buoyant jet mixing
- **Source properties dominate mixing**

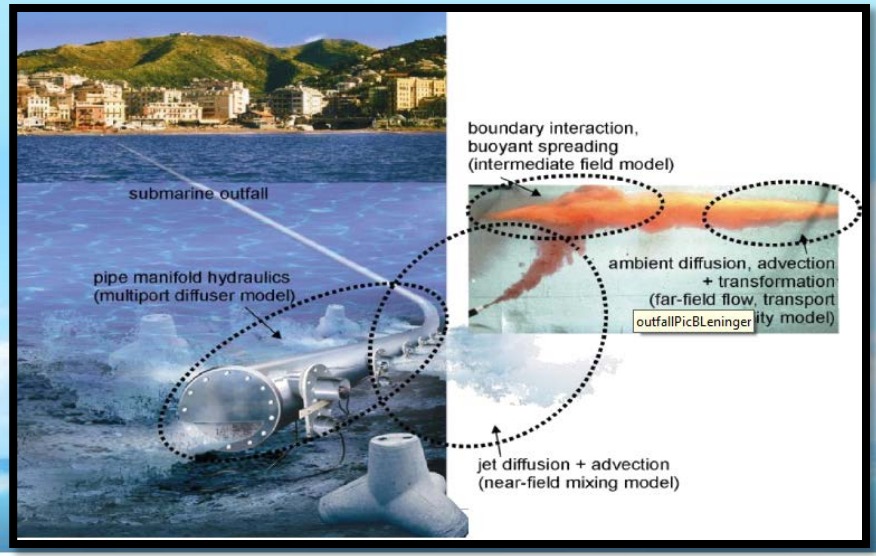


Far field mixing

- **Ambient conditions dominate mixing**

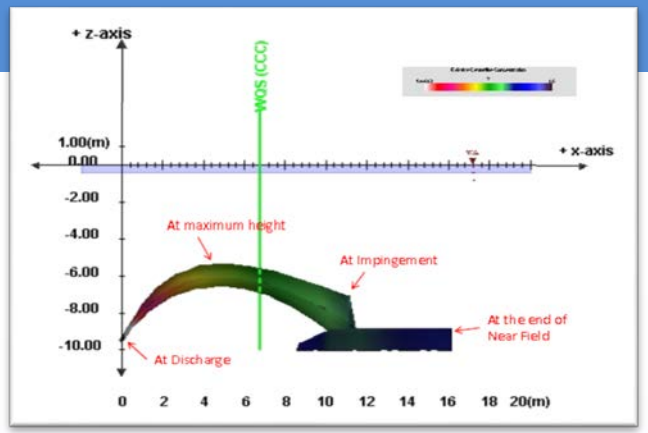
- ***No single model can cover these different scales efficiently and accurately***

Cormix & MIKE 21 AD Model



Factors considered…

Discharge



Near field governs the jet properties

Diffuser system (single / multi port)

If multi port, effective number of diffuser units (2, 3, 4, 5, 6, 10)

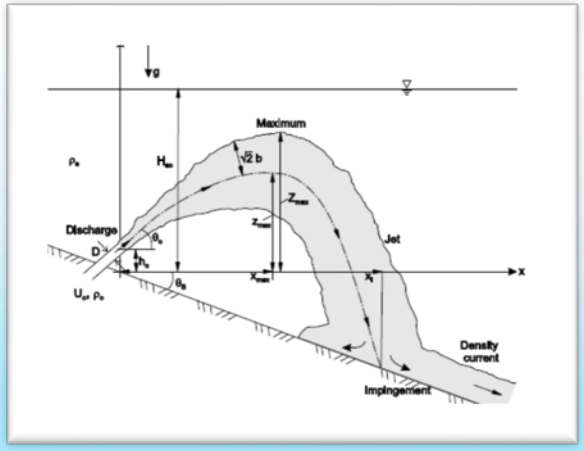
Alignment of the diffuser port (45°, 50°, 60°)

Discharge velocity (> 3m/s)

Depth of discharge location (8m, 9m, 10m)

Slope of the sea bed (sloping bed provides more dispersion)

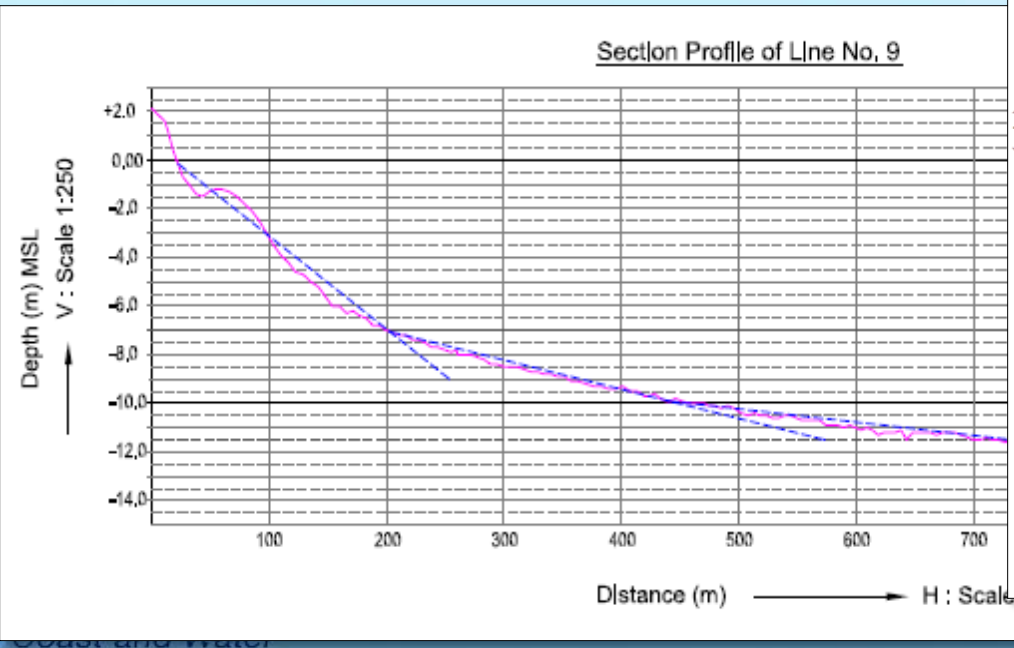
More dispersion on dynamic area

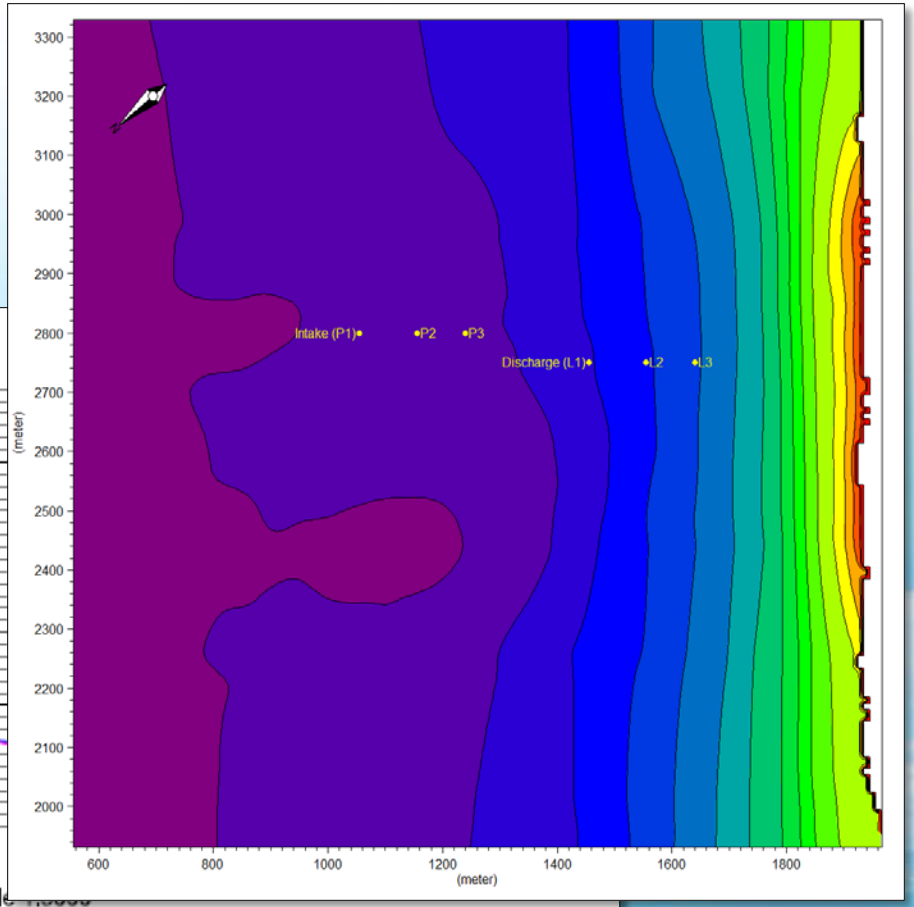


Water Demand (m3/day)		Recovery rate (%)	Intake		Reject / Discharge		No. of Diffusers	Diffuser Diameter (m)	Discharge (jet) velocity (m/s)
			m3/day	m3/s	m3/day	m3/s			
Current demand (max)	28500	45	63333	0.73	34833	0.40	3	0.2	4.28
	28500	50	57000	0.66	28500	0.33	3	0.2	3.50
Future expansion (max)	50000	45	111111	1.29	61111	0.71	5	0.2	4.36
	50000	50	100000	1.16	50000	0.58	5	0.2	3.57

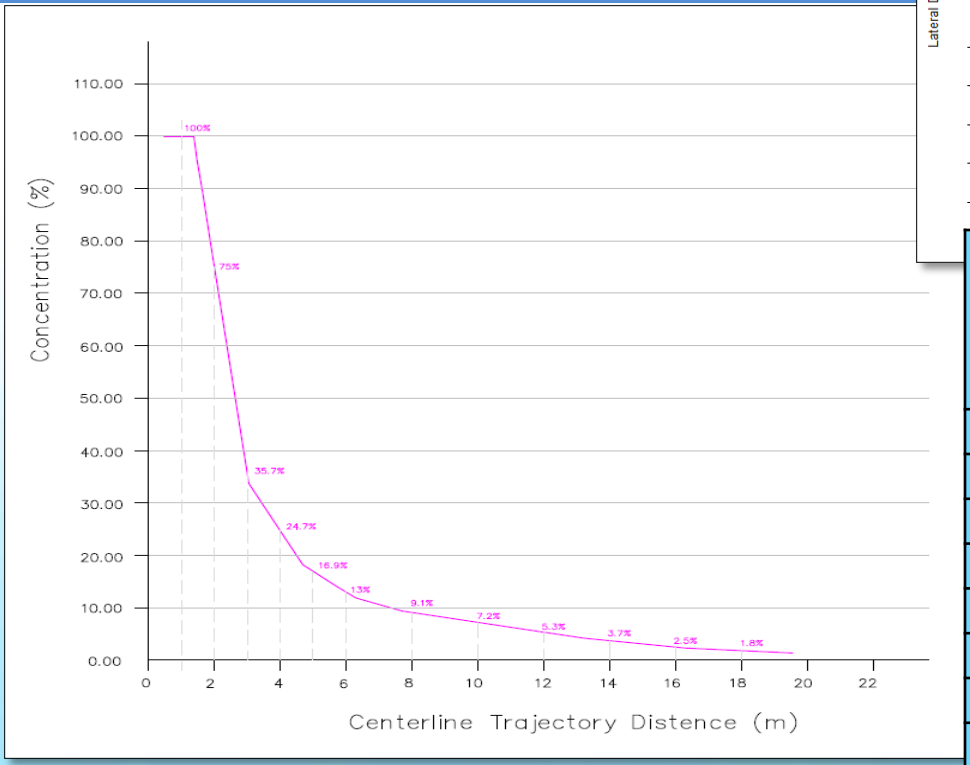
Alternative Locations for Intake & Outfall

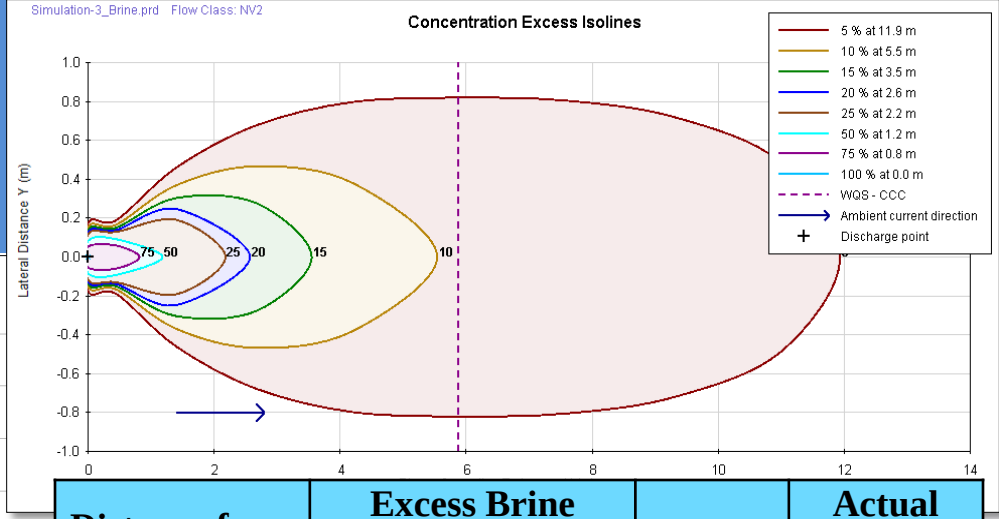
Proposed point	Type	Depth (m)	Distance from the shoreline (m)
L3	Outfall	8	300
L2		9	400
L1		10	500
P3	Intake	11.3	700
P2		11.6	800
P1		11.8	900





Dispersion of Brine Plume





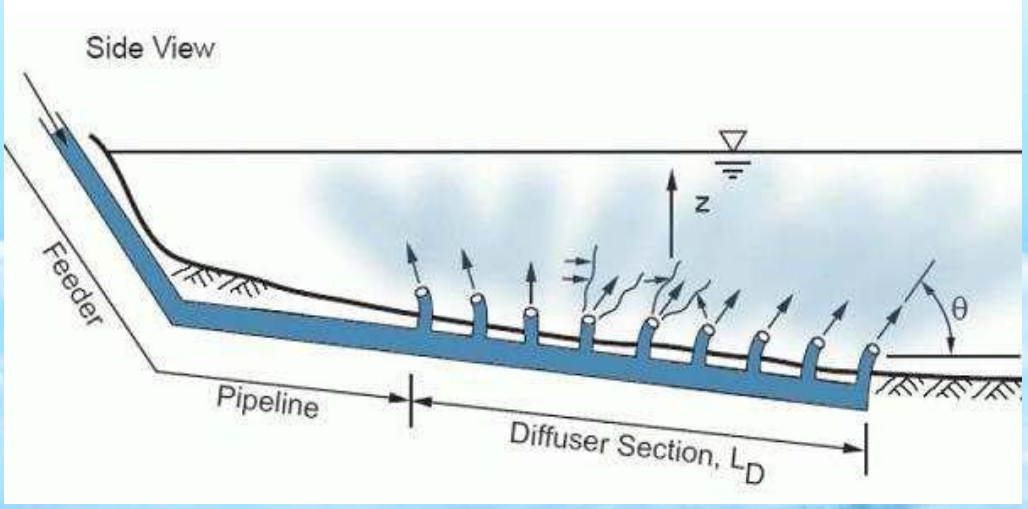
Distance from point of discharge (m)	Excess Brine concentration		Dilution	Actual Brine concentration
	%	ppt		
1	100	32.00	0.82	64.00
2	70	22.40	1.17	54.40
3	35.7	11.42	2.29	43.42
4	24.7	7.90	3.31	39.90
5	16.9	5.41	4.84	37.41
6	13	4.16	6.29	36.16
8	9.1	2.91	8.99	34.91
10	7.2	2.30	11.36	34.30
12	5.3	1.70	15.44	33.70
14	3.7	1.18	22.11	33.18
16	2.5	0.80	32.73	32.80
18	2	0.64	40.91	32.64
20	1.7	0.54	48.13	32.54
22	1.49	0.48	54.91	32.48
beyond 25	0.6	0.19	136.35	32.19
beyond 50	0.3	0.10	272.71	32.10
beyond 100	0.025	0.01	3272.50	32.01

Excess brine concentration beyond 22m from the point of discharge is obtained as 0.48 ppt

Proposed system to minimize the impact

Discharge

- Sloping bed is preferred to increase dilution
- Multi port diffusers are proposed
- Minimum distance from the shore to reduce the cost
- Proper gap between intake & discharge point is maintained to reduce recirculation

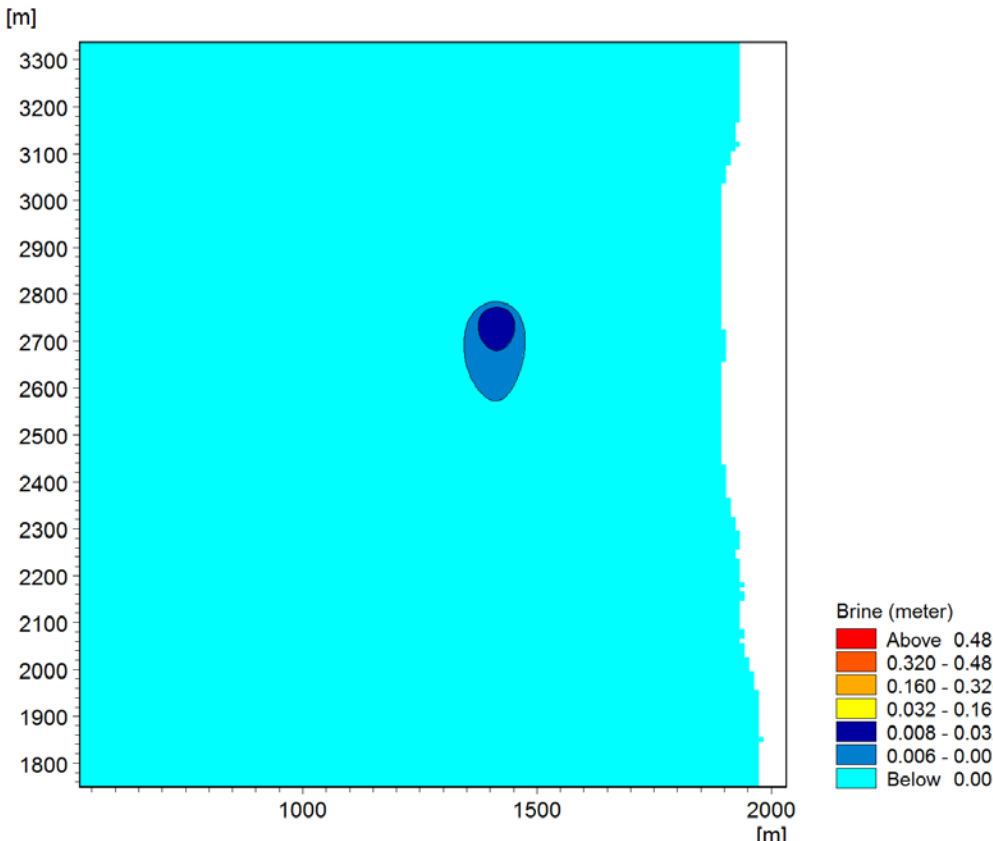


Dispersion in Far Field

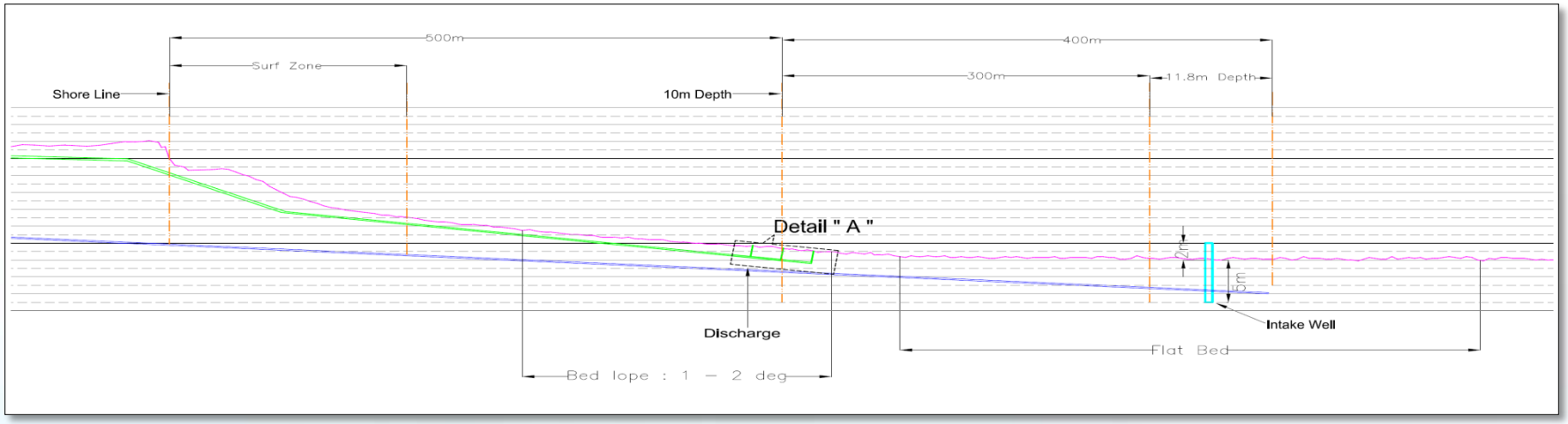
- Far field: MIKE 21 Hydrodynamic and Advection-Dispersion Model (HD & AD)
- 32 scenarios - all 4 four seasons (NE, SW & 2 inter monsoons), average (50% occurrence) & peak (98% occurrence) wave conditions, spring & neap tidal variations and recovery rates (45% & 50%)

Excess Brine Concentration		
Excess (ppt)	Excess (%)	Dilution
0.32-0.48	Above 1%	81.8
0.16-0.32	Above 0.5%	163.6
0.032-0.16	Above 0.1%	818.1
0.008-0.032	Above 0.025%	3272
0.006-0.008	Above 0.02%	4363
0.004-0.006	Above 0.0125%	6545
below 0.004	below 0.006%	13090

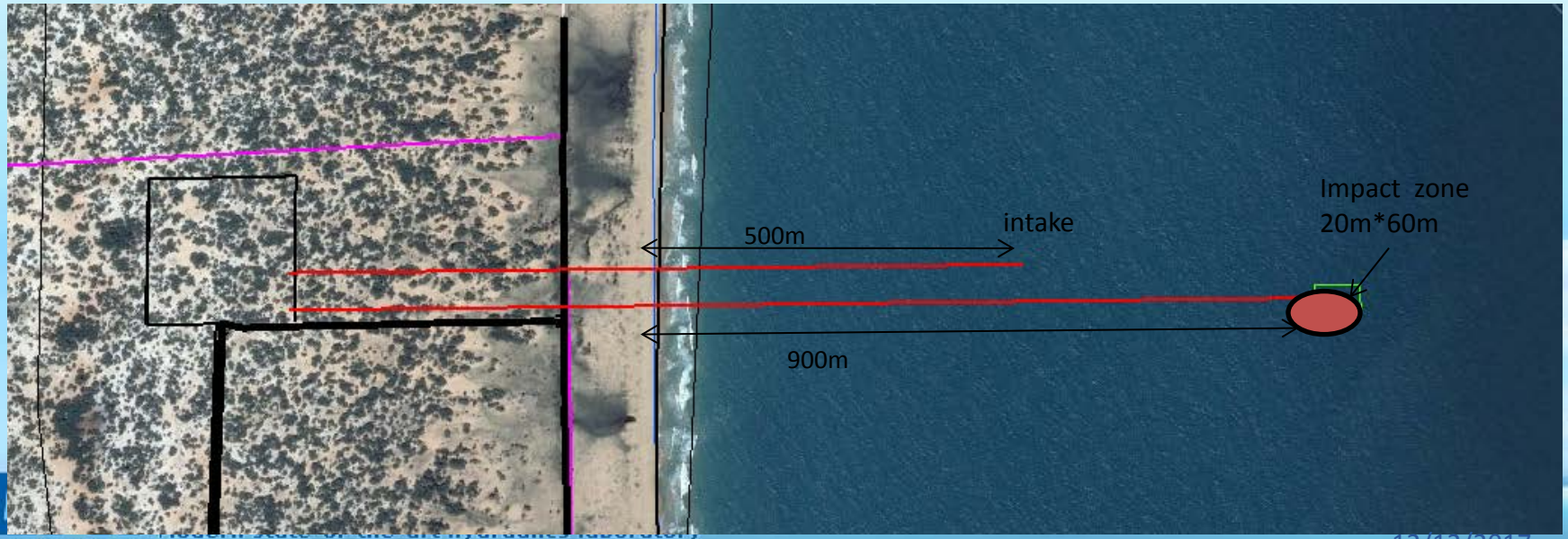
Not significant – No impact to the far field



Impact Zone



Impact zone is limited to a radius of **20-22m** from the point of discharge.



Lesson learnt from the Project

Impact of water extraction & intake structure can be mitigated through

- Selecting a proper location
- Adopting a proper design for the structure
- Adopting a proper installing methodology

Impact due to brine discharge can be mitigated through

- Selecting a proper location
- Adopting a proper discharge mechanism
- Introducing a effective diffuser system

Lesson learnt from the Project

Impact due to flora & fauna during construction can be mitigate though

- Adopting a proper management plan
- Performing conformity surveys before construction
- Translocation of protected species (marine) if they exists
- Translocation of plants if required
- Replanting buffer zones
- Proper monitoring mechanism

Key Personnel involvement for EIA

Name and Title	Expert /Work Allocation
Dr. Mahesh Jayaweera & Dr. Jagath Manathunga	Environmental Expert
Dr. Rekha Maldeniya & Mr. Arjan Rajasooriya	Marine Biologist
Ms. Samangi Hewage & Ms. Maheni Samarakoon	Terrestrial Ecologist
Dr. K. Arulanathen & Dr. H.B. Jayasiri	Biological Oceanography
Mr. Jinapala Kiribandage	Sociologist
Ms. Manori Fernando & Dr. K. Raveenthiran	Coastal Engineering & Numerical Modelling Expert
Ms. Kaushalya Subasinghe	Hydraulic Engineering Expert


DESALINATION
ENERGY
FRESH WATER
SALT/MINERALS
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Water for Jaffna

Thank you