Requirements for desalination unit of 96.768 MLD

Table 1. General data

No	Category	Value
1	Project id	S1000
2	Location	Australia/Perth
3	Description	SWRO plant of 96 MLD
4	Operation mode	constant monthly demand
5	Seismic design category	none
6	Area classification	none
7	Scope	EPC

Database for design and performance warranty

Feed source data are presented in the table below

Table 2. Feed water parameters (seawater)

No	Category	Unit	Value1	Value2
0	month		1	7
1	feed temperature	oC	10	28
2	feed TDS	kg/kg	0.04	0.04
3	feed turbidity	NTU	15	15
4	feed SDI	ppm	15	15
5	feed TSS	ppm	0	0
6	feed TOC	ppm	8	8
7	feed COD	ppm	10	10
8	feed oil and grease	ppm	0.02	0.02
9	feed SiO2	ppm	1	1
10	feed pH		7.6	7.6
11	feed BOD	ppm	2.1	2.1
12	feed total hardness	ppm	6630	6630
13	feed alkalinity	ppm	500	500
14	feed total chlorine	ppm	0.01	0.01
15	feed manganese	ppm	0.001	0.001
16	feed iron	ppm	0.001	0.001

Table 3. Preferred pretreatment options

Pretreatment shall ensure the following stable conditions before RO membranes at all the operation modes and production rates.

Table 4. Feed before membranes guaranteed conditions

No	Category	Unit	Value1	Value2
0	duration	%	99	1
1	feed SDI	ppm	3.5	5
2	feed turbidity	NTU	0.1	0.3
3	feed TSS	ppm	0.1	0.1
4	feed TOC	ppm	3	3
5	feed COD	ppm	10	10
6	feed aluminum	ppm	0.05	0.05
7	feed iron	ppm	0.05	0.05
8	feed oil and grease	ppm	0	0

Product water chemistry maximum values are presented in the table below

Table 5. Guaranteed product quality (potable)

No	Category	Unit	Value1	Value2
0	product duration	%	99	1
1	product TDS	ppm	370	470
2	product NTU	NTU	0.3	0.3
3	product pH		8.3	8.3
4	product calcium	ppm	40	40
5	product carbonate alkalinity	ppm	45	45
6	product LSI		0.1	0.1
7	product CCPP		0	0
8	product total chlorine	ppm	2.7	2.7

Product water production and schedule are given in the table below

Table 6. Guaranteed product capacity (potable)

No	Category	Unit	Value
1	Operation mode		constant monthly demand
2	unit capacity	kg/s	280
3	plant capacity	kg/s	1120

No	Category	Unit	Value
4	target reliability		0.96
5	turndown ratio		0.5

Plant electrical design input is summarized in the table below

Table 7. Power supply

No	Category	Unit	Value
1	low 1P	V	220
2	medium	V	6600
3	plc	V	24
4	low 1	V	415
5	power price	$USA/kWh	0.1
6	low 2	V	715
7	control air pressure	kPa	650
8	power frequency	Hz	50
9	instrument	V	240
10	FFEC		0.85
11	high	V	11000
11	ups		no
12	soft starting		no

Design standards and conditions are summarized in the table below

Table 8. Design standards

No	Category	Unit	Value
1	minimum feed temperature	oC	14
2	maximum feed temperature	oC	30
3	maximum site temperature	oC	40
4	minimum site temperature	oC	5
5	maximum site humidity	kg/kg	0.88

Design basis is summarized in the table below

Table 9. Design basis

No	Category	Unit	Value
1	energy recovery type		isobaric PX

No	Category	Unit	Value
			device
2	brine-out pressure	kPa	150
3	maximum trains number		6
4	service life	years	25
5	feed-in pressure	kPa	200
6	maximum 1st pass recovery		0.51
7	RO membranes fouling		0.75
8	product-out pressure	kPa	300
9	motor service factor		1.1
10	piping overload capacity		1.1
11	pump performance tolerance		0.1

Table 12. Fluid velocities for metal piping

No	Service	Water & Brine	Air	Chemicals
1	manifold suction	1.4	26	1.8
2	manifold discharge	4	44	1.8
3	suction	1.8	26	1.8
4	discharge	5.6	52	1.8
5	auxiliary	5.6	70	1.8
6	dosing	2.2	88	1.8
7	sampling	6.7	88	1.8
8	drainage	2.2	88	1.8
9	throttling	7.8	88	1.8
10	overflow	11.2	88	1.8

Table 13. Fluid velocities for non-metal piping

No	Service	Water & Brine	Air	Chemicals
1	manifold suction	1.1	18	1.3
2	manifold discharge	2	28	1.3
3	suction	1.4	18	1.3
4	discharge	2.8	34	1.3
5	auxiliary	2.8	46	1.3
6	dosing	1.1	56	1.3
7	sampling	3.4	56	1.3
8	drainage	1.1	56	1.3

No	Service	Water & Brine	Air	Chemicals
9	throttling	3.9	56	1.3
10	overflow	5.6	56	1.3

Materials shall be compatible with the fluids used.

Table 14. Materials - fluids compatability

No	Category	Value
1	pump casing, impeller (product, service water)	SS316
2	RO membranes	polyamide
3	low pressure piping and accessories	316 / Polypropylene / PVC
4	ferric chloride and sodium hypochlorite piping	CPVC
5	pump casing, impeller (brackish water)	duplex / 904L
6	chemical dosing piping	SS16
7	baseplates, skids and support works	epoxy painted carbon steel
8	pump casing, impeller (seawater, brine)	superduplex
9	H2SO4 dosing piping	Alloy 20
10	pressure vessels	FRP
11	high pressure piping and accessories	Duplex / Supper Duplex / 254 SMO

Table 15. Scope subsystems

No	Subsystem/equipment	Functionality
1	intake bar screen	
2	intake rotating band screen	
3	intake vertical pump	
4	pressure filter	
5	pressure filter	
6	seawater reverse osmosis membranes	
7	ERI energy recovery device	
8	brackish water reverse osmosis membranes	
9	gravity limestone reactor	
10	product delivery	

Commercial

Commercial data is summarized in the table below.

Table 17. General

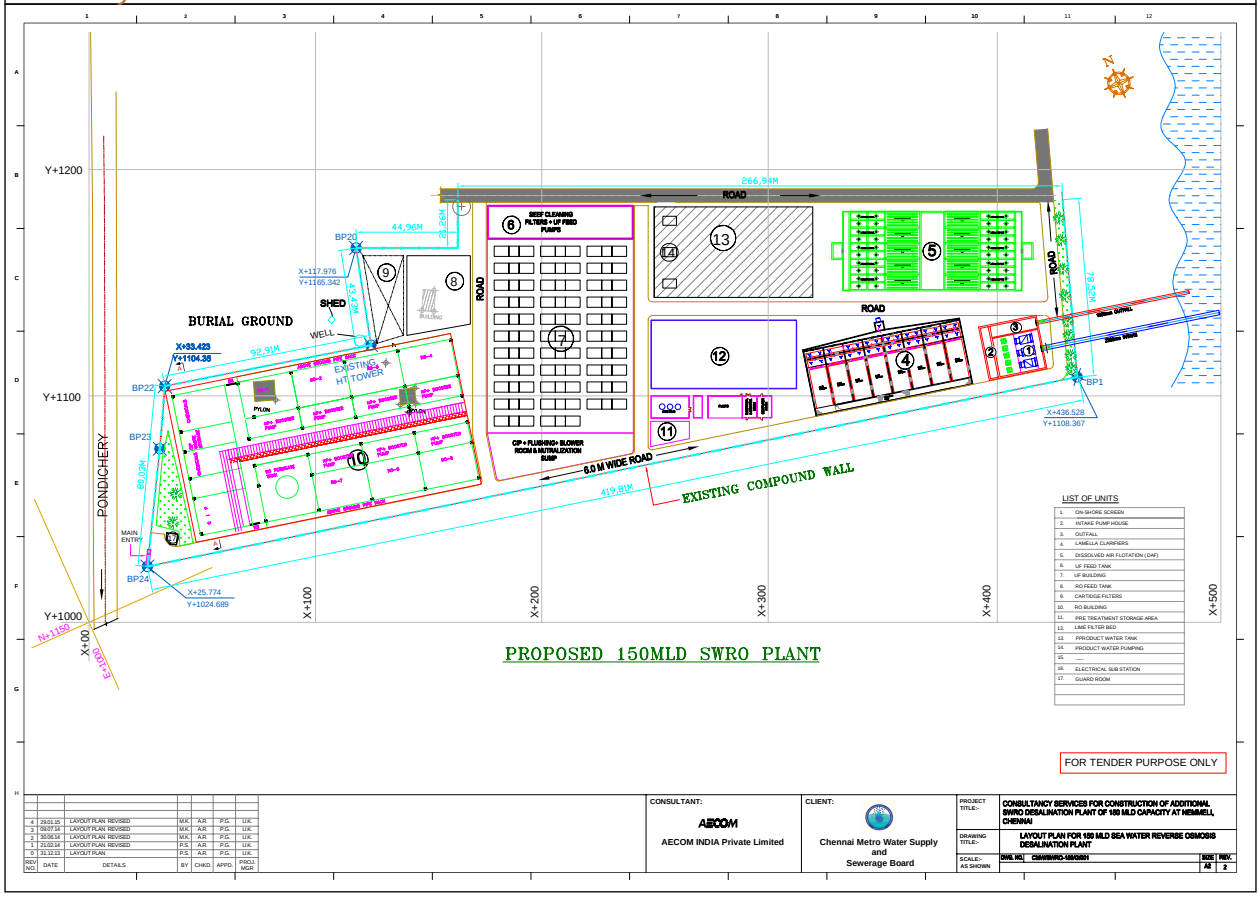
No	Category	Unit	Value
1	feed status		created
2	currency		US
3	scope		EPC
4	tac		true
5	guarantee	months	24
6	bid validity	days	60
7	nonconformity ratio		0.15
8	bidder sales ratio		12
9	spare parts stock	years	2
10	requested delivery	days	800

Table 18. Attached documents

No	Name	Size
1	Plant layout	172Kb
2	Sea bed map	2190Kb
3	Isopach map	1249Kb
4	Bathymetric map	1459Kb
5	Feed water analysis	146Kb

ATTACHMENT

Plant Layout



Sea Bed Map

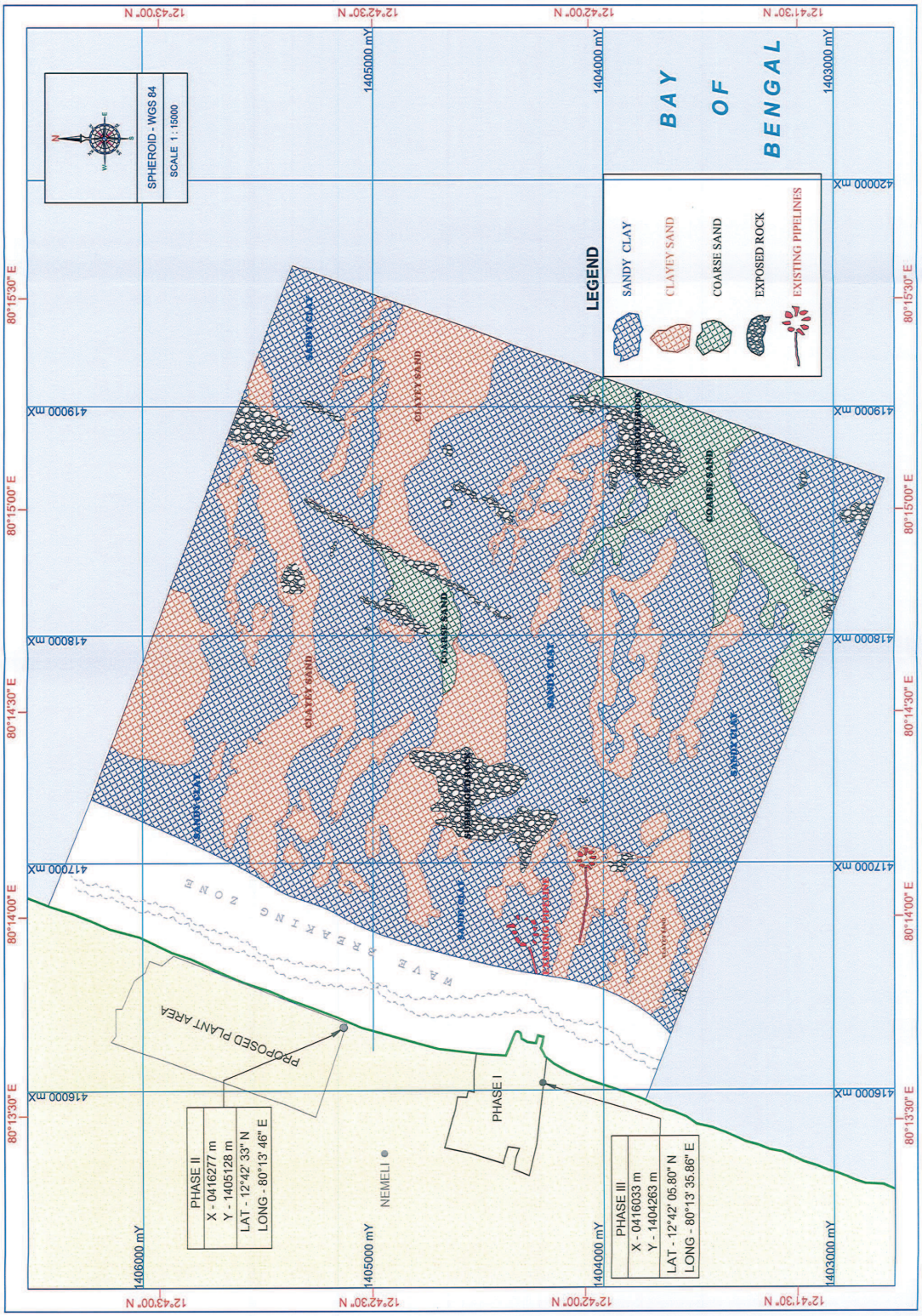


FIG. 10. SEABED MAP

Isopach Map

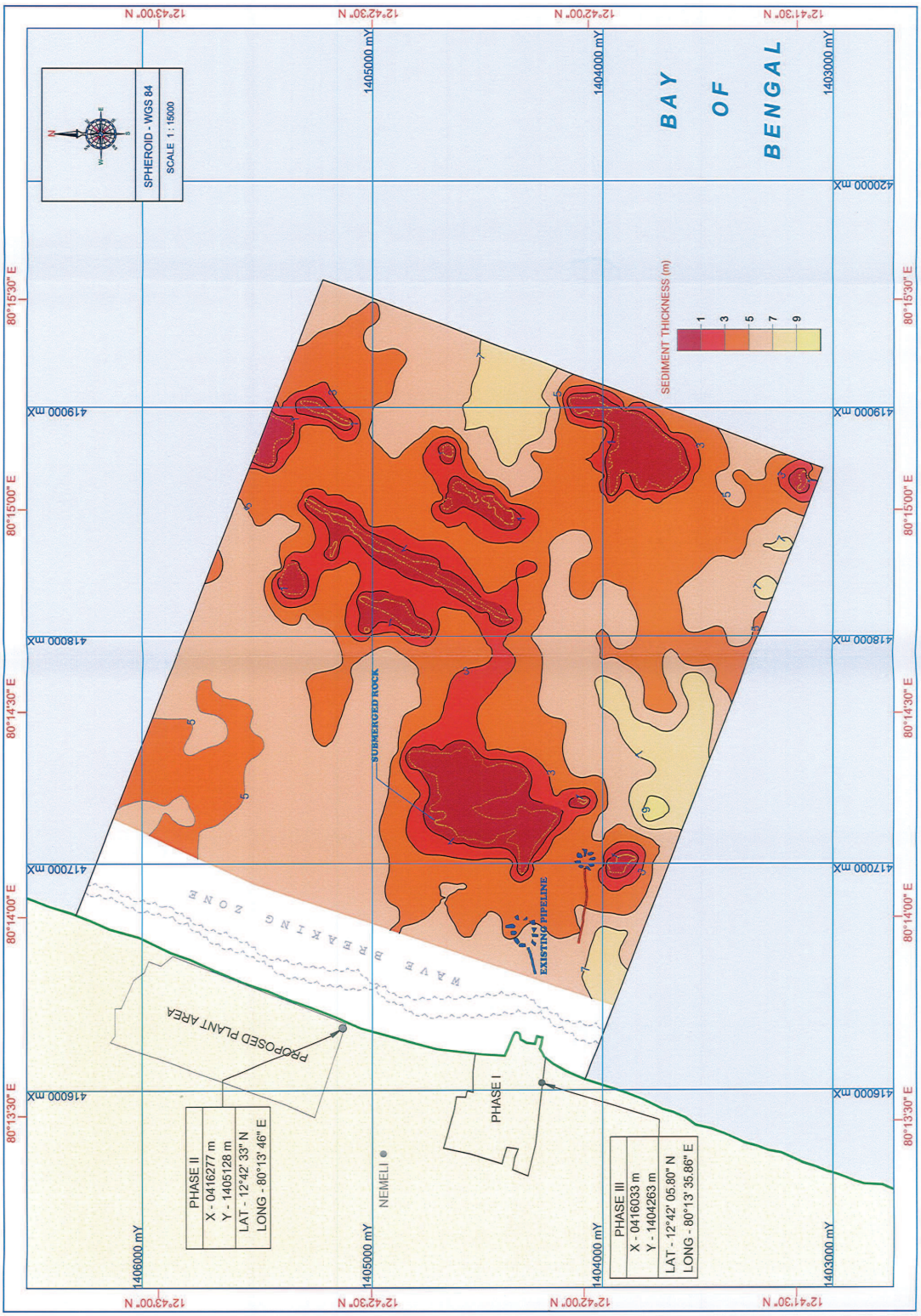


FIG. 9. ISOPACH MAP

Bathymetric Map

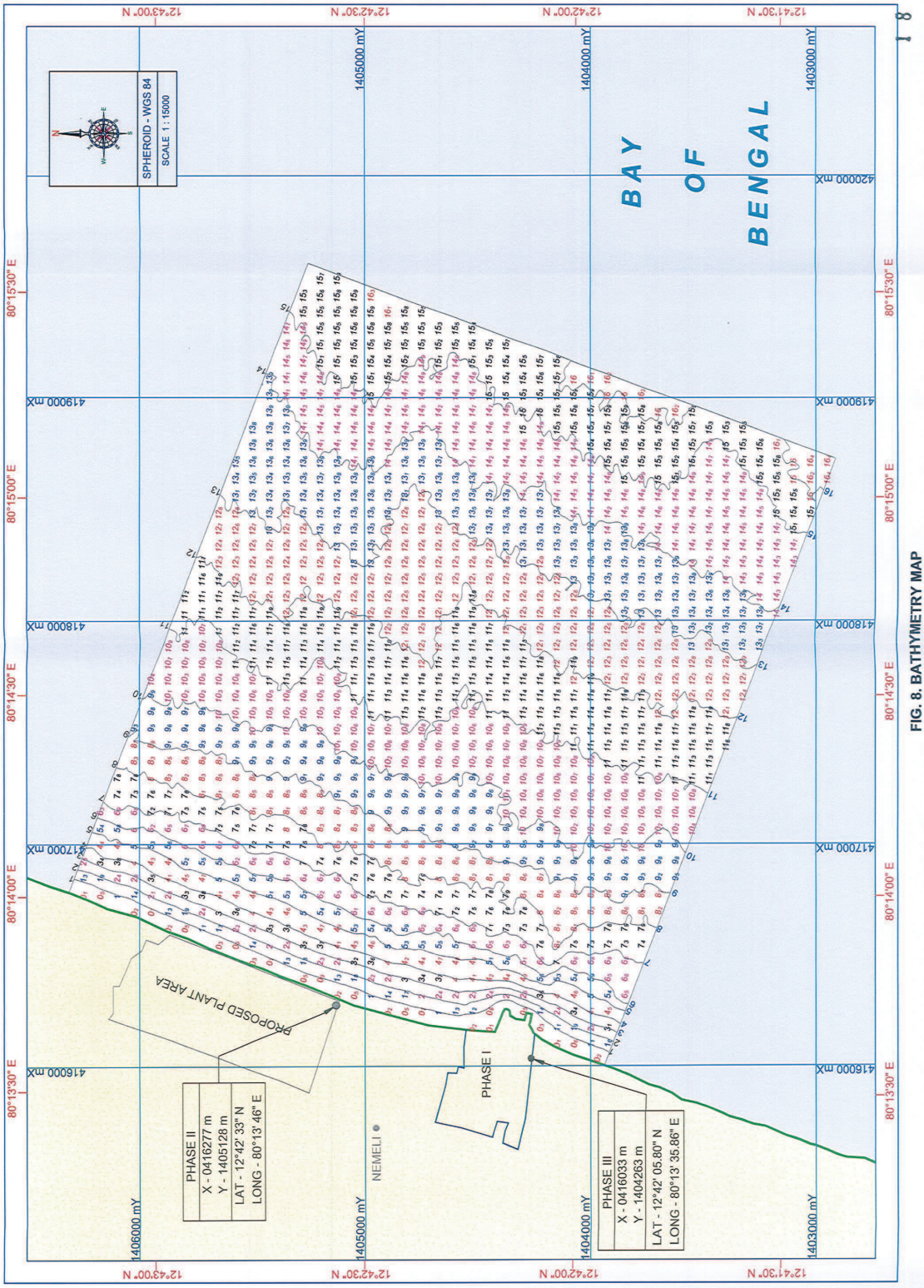


FIG. 8. BATHYMETRY MAP

Feed Water Analysis

Operation and Maintenance Of 100 MLD SWRO (Desalination) Plant, Nemmeli Sea Water Analysis Report					
Date	Sea Water Quality				
	pH	Conductivity	TDS	Turbidity	TSS
		uS/cm	ppm	NTU	ppm
01 January 2014	8.11	44475.00	31366.09	6.84	18.00
02 January 2014	8.13	44525.00	31620.82	7.59	34.58
03 January 2014	8.13	44375.00	31504.64	7.20	24.00
04 January 2014	PLANT SHUTDOWN				
05 January 2014	8.14	43275.00	30725.25	15.90	38.00
06 January 2014	7.99	43750.00	31059.27	20.30	46.20
07 January 2014	8.04	43566.67	30943.09	19.10	46.50
08 January 2014	8.04	43775.00	31072.18	10.40	34.00
09 January 2014	8.04	44650.00	31270.91	6.99	24.00
10 January 2014	8.06	46658.33	32607.27	4.05	14.00
11 January 2014	8.07	46658.33	33157.00	3.62	12.12
12 January 2014	8.12	45958.33	32724.55	2.43	16.00
13 January 2014	8.01	45933.33	32153.33	2.40	13.00
14 January 2014	8.01	45158.33	31610.83	2.02	14.00
15 January 2014	7.97	45508.33	31855.83	2.74	15.00
16 January 2014	8.04	44866.67	31855.33	1.79	10.00
17 January 2014	8.09	45408.33	31785.83	1.50	13.00
18 January 2014	8.01	45400.00	32234.00	1.68	10.00
19 January 2014	8.09	45425.00	32251.75	1.78	8.00
20 January 2014	8.11	45600.00	32376.00	1.70	20.00
21 January 2014	8.10	45858.33	32100.83	2.99	19.00
22 January 2014	8.11	46633.33	32643.33	9.30	26.50
23 January 2014	8.12	46391.67	32783.92	5.70	23.00
24 January 2014	8.11	46591.67	32925.17	3.89	13.00
25 January 2014	8.11	46775.00	33054.83	4.80	19.80
26 January 2014	8.11	46800.00	33072.92	3.94	16.00
27 January 2014	8.10	46572.73	30194.50	5.80	22.50
28 January 2014	8.11	46800.00	32760.00	6.05	26.00
29 January 2014	8.10	46550.00	32585.00	6.69	19.00
30 January 2014	8.11	42996.67	30097.67	4.78	21.00
31 January 2014	8.11	46683.33	32678.33	4.80	22.00
Average	**8.08**	**45522.12**	**32002.98**	**5.87**	**20.92**
Maximum	**8.14**	**46800.00**	**33157.00**	**20.30**	**46.50**
Minimum	**7.97**	**42996.67**	**30097.67**	**1.50**	**8.00**

Operation and Maintenance Of 100 MLD SWRO (Desalination) Plant, Nemmeli Sea Water Analysis Report					
Date	Sea Water Quality				
	pH	Conductivity	TDS	Turbidity	TSS
		uS/cm	ppm	NTU	ppm
01 April 2014	8.10	49200	34440	1.50	13.00
02 April 2014	8.12	49800	34860	1.62	13.00
03 April 2014	8.12	49800	34860	1.85	14.00
04 April 2014	8.11	49100	34370	1.50	14.00
05 April 2014	8.15	49300	34510	3.50	16.00
06 April 2014	8.15	49900	34930	1.86	16.00
07 April 2014	8.15	49500	34650	1.30	14.00
08 April 2014	8.12	49100	34370	1.60	17.00
09 April 2014	8.12	49600	34720	1.65	18.00
10 April 2014	8.10	48500	33950	1.64	15.00
11 April 2014	8.11	49000	34300	3.00	21.00
12 April 2014	8.11	49300	34510	2.54	20.00
13 April 2014	8.12	49400	34580	1.65	21.00
14 April 2014	8.11	51400	35980	1.81	23.00
15 April 2014	8.11	51000	35700	27.50	87.50
16 April 2014	8.01	49800	34860	29.10	88.00
17 April 2014	8.14	50500	35350	26.90	46.00
18 April 2014	8.11	49900	34930	1.26	11.00
19 April 2014	8.12	49900	34930	1.32	14.60
20 April 2014	7.99	49600	34720	1.85	17.00
21 April 2014	8.11	50900	35630	30.00	61.00
22 April 2014	8.06	50200	35140	28.60	72.30
23 April 2014	8.14	50900	35630	36.30	85.00
24 April 2014	8.11	51200	35840	24.10	78.00
25 April 2014	8.10	50300	35210	27.50	68.00
26 April 2014	8.02	49800	34860	23.60	60.00
27 April 2014	8.10	49800	34860	24.00	70.00
28 April 2014	8.06	50100	35070	5.74	27.00
29 April 2014	8.08	51900	36330	3.22	25.0
30 April 2014	8.11	52600	36820	27.30	68.0
Average	***8.10***	***50043***	***35030***	***11.51***	***37.11***
Maximum	***8.15***	***52600***	***36820***	***36.30***	***88.00***
Minimum	***7.99***	***48500***	***33950***	***1.26***	***11.00***

Operation and Maintenance Of 100 MLD SWRO (Desalination) Plant, Nemmeli Sea Water Analysis Report					
Date	Sea Water Quality				
	pH	TDS	Turbidity	TSS	Temp
		ppm	NTU	ppm	deg C
01 July 2014	8.14	39480	62.2	132	28
02 July 2014	8.16	39410	26.4	80	28.8
03 July 2014	8.26	39200	10.88	38	29.2
04 July 2014	8.22	39340	14	22	29.2
05 July 2014	8.22	39060	14.3	39	29.4
06 July 2014	8.16	39130	10.98	28	30.4
07 July 2014	8.16	39410	6.86	21.5	29.5
08 July 2014	8.27	39480	7.88	17	29.9
09 July 2014	8.24	39060	8.6	24	29
10 July 2014	8.22	39830	18	30	28.2
11 July 2014	8.23	38990	20	38	27.8
12 July 2014	8.26	39060	32.1	56	28.6
13 July 2014	8.24	39760	49.5	66	28.8
14 July 2014	8.21	39130	47.2	95.5	27.4
15 July 2014	8.21	39410	42.4	112	27.5
16 July 2014	8.21	39620	42.54	112	28.1
17 July 2014	8.2	39480	36	102	28
18 July 2014	8.21	38640	48.3	110	28.3
19 July 2014	8.23	39270	45.2	63.2	27.2
20 July 2014	8.18	39060	40.6	126	27.8
21 July 2014	8.18	39900	38.5	96	27.8
22 July 2014	8.24	40040	10.56	36.5	28.1
23 July 2014	8.23	39830	16.6	32.5	27.4
24 July 2014	8.25	39130	16.5	28	28.4
25 July 2014	8.22	39410	18.5	32	27.9
26 July 2014	8.26	39410	14.3	18	27.8
27 July 2014	8.32	39480	5	18	27.7
28 July 2014	8.22	40390	5.5	25	27.3
29 July 2014	8.25	39480	36.88	88	28.1
30 July 2014	8.26	39410	30.1	76	27.7
31 July 2014	8.31	39970	9.40	18.00	28
Average	**8.22**	**39428.06**	**25.35**	**57.43**	**28.30**
Maximum	**8.32**	**40390**	**62.2**	**132**	**30.4**
Minimum	**8.14**	**38640**	**5**	**17**	**27.2**

Operation and Maintenance Of 100 MLD SWRO (Desalination) Plant, Nemmeli Sea Water Analysis Report					
Date	Sea Water Quality				
	pH	TDS	Turbidity	TSS	Temp
		ppm	NTU	ppm	*c
01 October 2014	8.16	38360	5.00	26.0	28.4
02 October 2014	8.16	38430	4.10	21.0	28.3
03 October 2014	8.19	38360	4.50	26.0	28.9
04 October 2014	8.16	38360	6.20	26.0	28.3
05 October 2014	8.17	38360	6.35	26.0	28.6
06 October 2014	8.16	38360	4.76	28.0	28.5
07 October 2014	8.16	38430	4.00	26.0	28.9
08 October 2014	8.15	38430	3.95	22.0	28.5
09 October 2014	8.15	38430	3.50	22.0	28.6
10 October 2014	8.16	38360	32.70	**64.0**	28.4
11 October 2014	8.18	38430	31.50	**62.0**	28.6
12 October 2014	8.16	38430	36.10	**70.0**	28.3
13 October 2014	8.16	38430	36.50	**86.0**	27.5
14 October 2014	8.16	38430	37.10	**91.0**	28.9
15 October 2014	8.16	38500	38.30	**88.0**	28.1
16 October 2014	8.16	38430	26.80	**69.0**	28.2
17 October 2014	8.16	38360	8.16	34.0	28.5
18 October 2014	8.16	34310	6.33	27.0	27.8
19 October 2014	8.15	34380	5.20	27.0	28.1
20 October 2014	8.13	34100	5.60	24.0	27.3
21 October 2014	8.14	34380	4.80	24.0	28.1
22 October 2014	8.13	34310	10.30	28.0	28
23 October 2014	8.11	34450	4.50	22.0	28.1
24 October 2014	8.12	34450	3.50	21.0	28.5
25 October 2014	8.12	34310	3.32	19.0	28.4
26 October 2014	8.11	34240	33.65	**92.0**	28.3
27 October 2014	8.10	34240	39.50	**103.0**	28.8
28 October 2014	8.11	34100	26.70	**72.0**	28.7
29 October 2014	8.11	34100	3.79	20.0	28.5
30 October 2014	8.11	34380	4.20	20.0	28.6
31 October 2014	8.11	34310	7.18	28.0	28.5
Average	***8.14***	***36621***	***14***	***42***	***28***
Maximum	***8.19***	***38500***	***39.50***	***103.0***	***28.90***
Minimum	***8.10***	***34100***	***3.32***	***19.0***	***27.30***

GENERAL REQUIREMENTS

Conformity to requirements

The SWRO plant operation shall be fully automatic, meet the client functional requirements and be designed to the worst scenario conditions detailed below.

The RO membrane flushing and CIP shall be automatic as well.

The SWRO plant shall meet the chemical composition of the feed water and the target quality of the product at all operation patterns.

The SWRO plant shall meet the operation reliability requirements at all operation patterns and for full range of the feed water chemical composition.

The SWRO plant shall be equipped with the product storage tank. Its volume shall be selected based on the 4 hours of the plant nominal production.

The plant shall be equipped with UPS to provide plant fail-safe shutdown.

The plan life shall be designed for multiple startups and stops without affecting the plant systems service.

The RO trains shall be designed for extended periods of no flow. The no-flow regime for standby train shall be executed automatically with dedicated subsystems (flushing, CIP, etc.).

The plant shall have controllable turn-down ratio not more than 50%.

The selected materials of instruments, piping, equipment pieces, fittings, tanks and vessels shall be chemically compatible with the fluids to be used and be selected for the plant life of 20 years.

Design and construction

All the equipment shall be designed for outdoor installation suitable for highly corrosive marine environment.All metal parts of the equipment and enclosure shall be thoroughly painted, using epoxy base paints.

Painting should be considered as a protective coating against the local climatic conditions.

Electrical equipment enclosures shall be not less than IP54.

Only new equipment and instruments shall be utilized. Equipment not having good operating records in industry shall not be used.

The plant design shall be modular and multi-train. All the subsystems shall be skid-mounted and factory-tested.

The design shall provide easy accesses to the equipment pieces,

valves, instruments, manholes, etc. Equipment removal space shall be provided for motors, pumps, vessels, etc.

Replacement of the damaged or inoperable equipment pieces and instruments shall be without the removal of the adjacent items. Chemical storage area shall be accessible for reagents safe unloading.