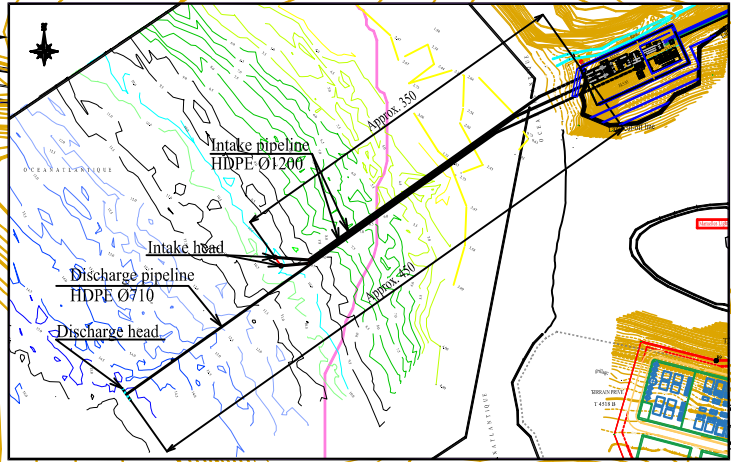
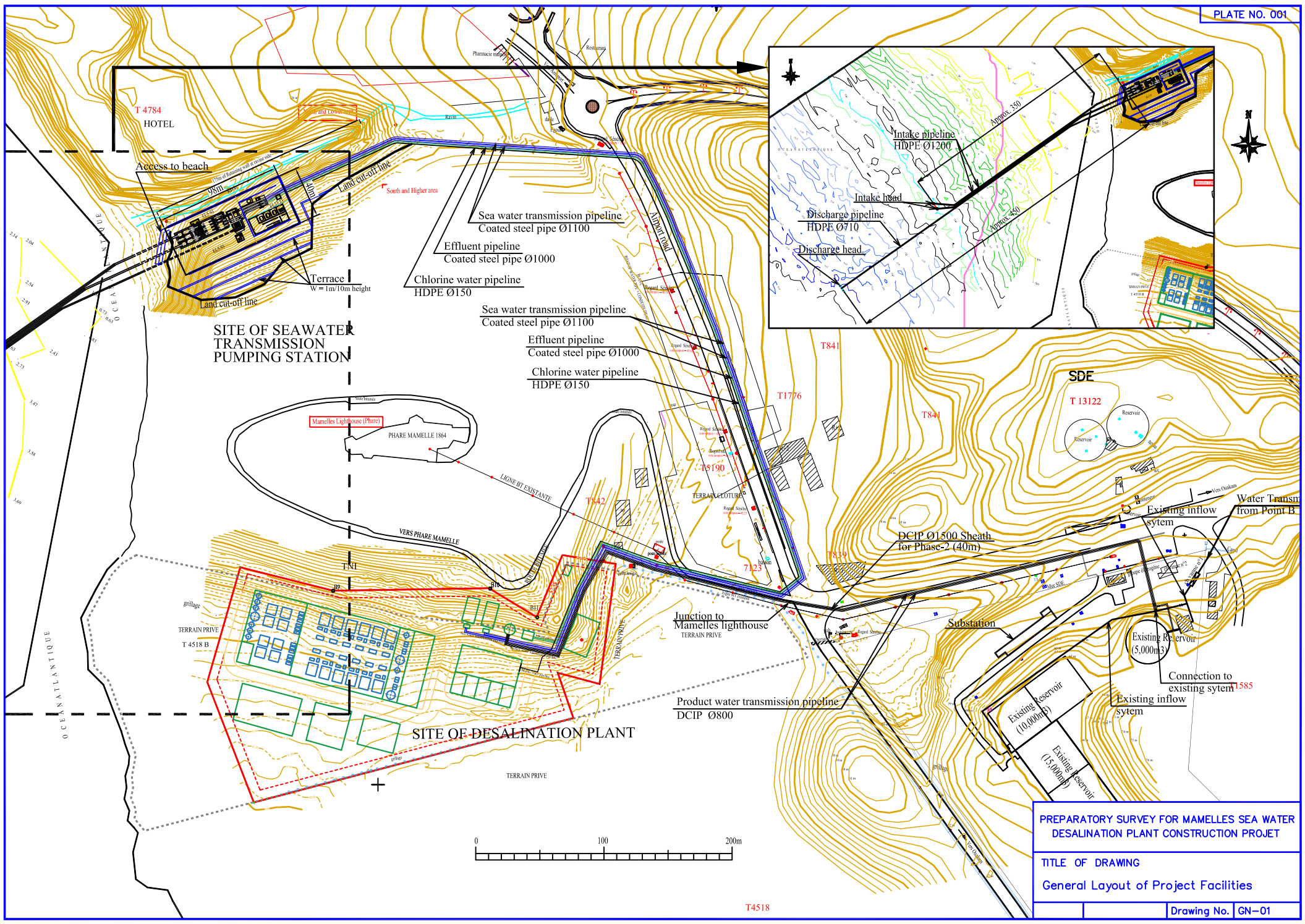


Appendix 5

Appendix 5-1 Drawings

List of Drawings

Plate No.	Drawing No.	Title
A. GENERAL		
001	GN-01	Layout of Project facilities
002	GN-02	Hydraulic Diagram
B. Seawater Intake and Brine Discharge Facility		
003	SWIF-01	Plan of Seawater Intake and Brine Discharge Facility
004	SWIF-02	Profile of Seawater Intake Pipeline
005	SWIF-03	Profile of Brine Discharge Pipeline (Seawater Transmission Pumping Station to Discharge Head)
C. Seawater Transmission Pumping Station		
006	SWTPS-01	Site plan of Seawater Transmission Pumping Station
007	SWTPS-02	Layout of Seawater Transmission Pumping Station
D. Seawater Desalination Plant		
008	SWDP-GN	Layout of Seawater Desalination Plant
009	SWDP-PFD-01	Process Flow Diagram (1/5): Pretreatment section
010	SWDP-PFD-02	Process Flow Diagram (2/5): Reverse Osmosis section
011	SWDP-PFD-03	Process Flow Diagram (3/5): Post-treatment section
012	SWDP-PFD-04	Process Flow Diagram (4/5): Waste water treatment plant
013	SWDP-PFD-05	Process Flow Diagram (5/5): Sewage treatment system
014	SWDP-LL	Land leveling
E. Sea Water Transmission Pipeline		
015	SWTP-P-01	Profile (1/4)
016	SWTP-P-02	Profile (2/4)
017	SWTP-P-03	Profile (3/4)
018	SWTP-P-04	Profile (3/4)
F. Product Water Transmission Pipeline		
019	PWTP-P-01	Profile (1/3)
020	PWTP-P-02	Profile (2/3)
021	PWTP-P-03	Profile (3/3)
G. Brine Discharge Pipeline (Effluent Tank to Seawater Transmission Pumping Station)		
022	BDP-P-01	Profile (1/4)
023	BDP-P-02	Profile (2/4)
024	BDP-P-03	Profile (3/4)
025	BDP-P-04	Profile (4/4)



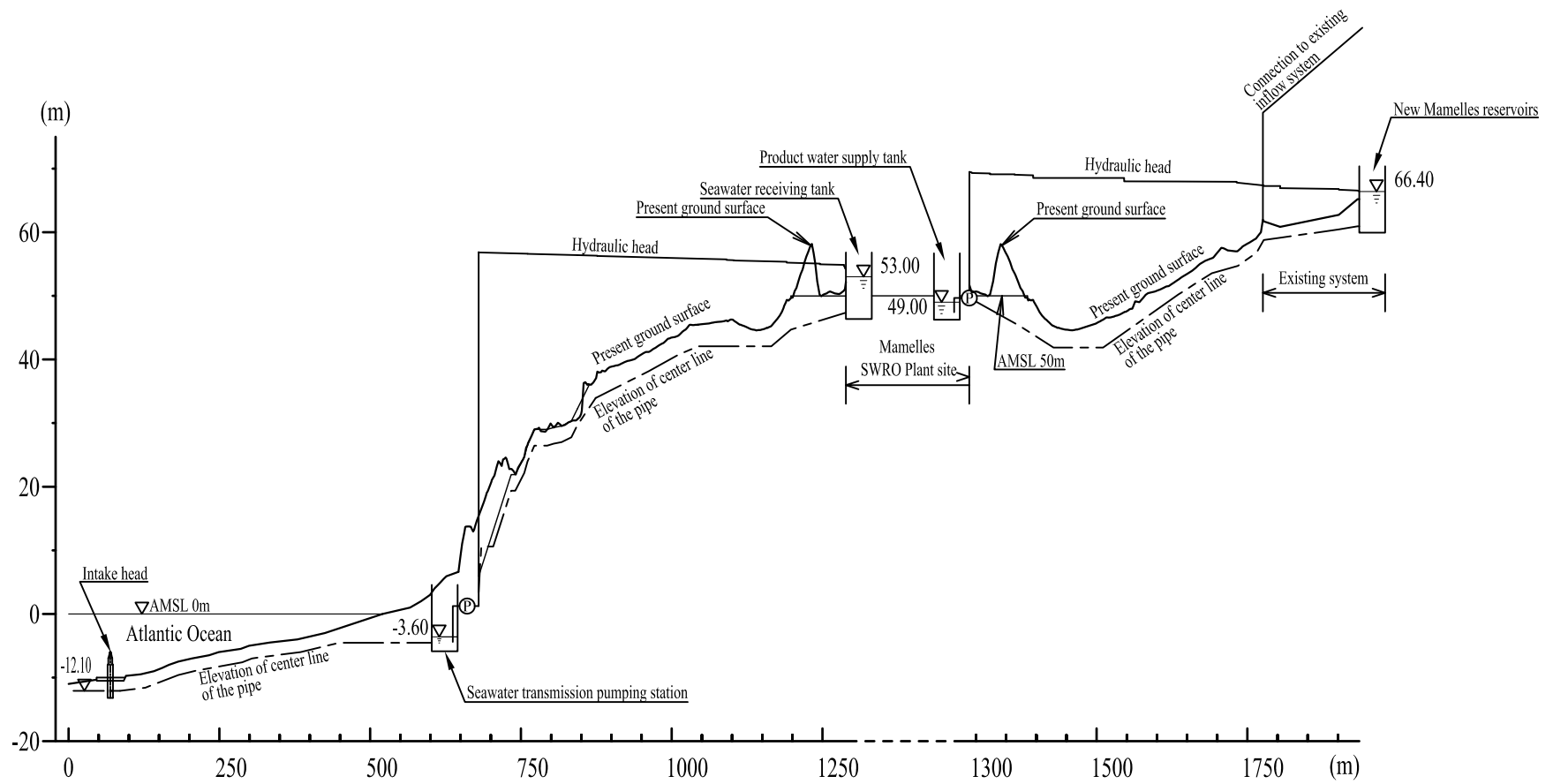
SITE OF SEAWATER TRANSMISSION PUMPING STATION

SITE OF DESALINATION PLANT

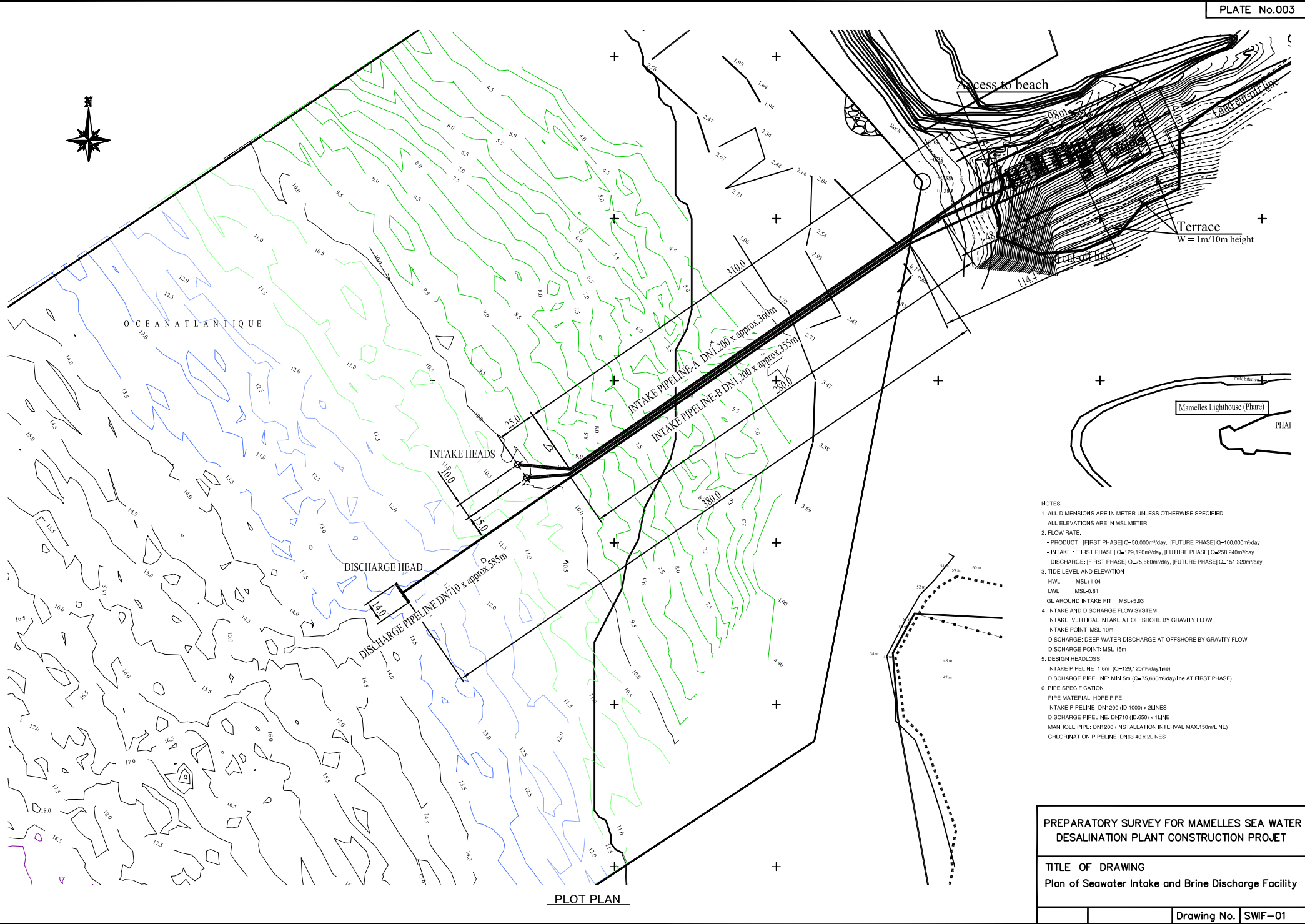
PREPARATORY SURVEY FOR MAMELLES SEA WATER DESALINATION PLANT CONSTRUCTION PROJ

TITLE OF DRAWING
General Layout of Project Facilities

Drawing No. GN-01



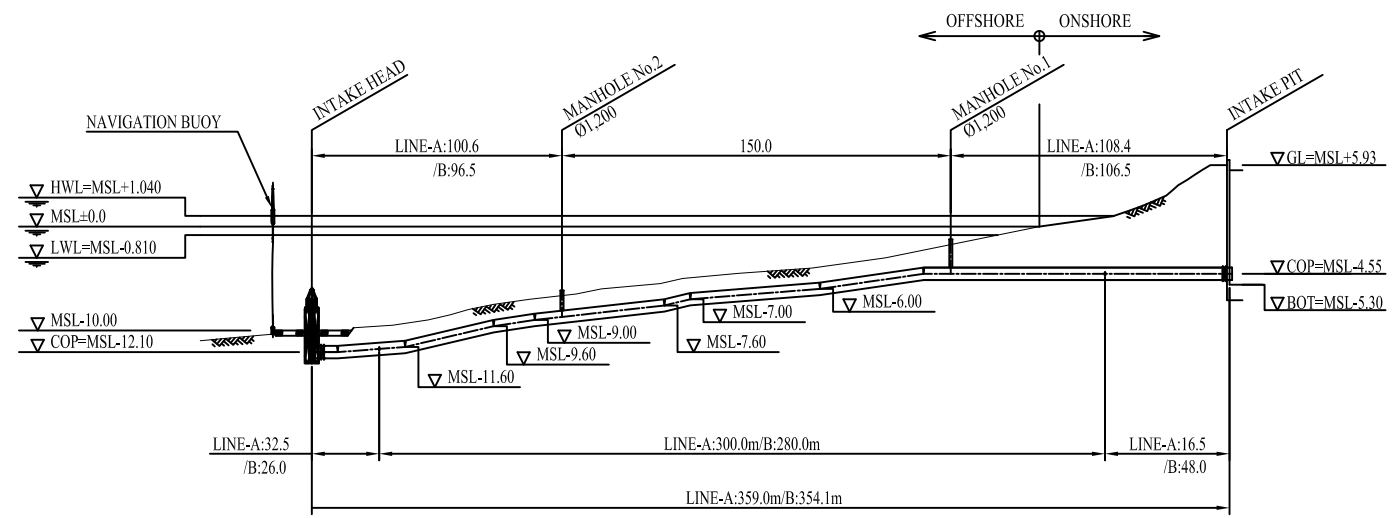
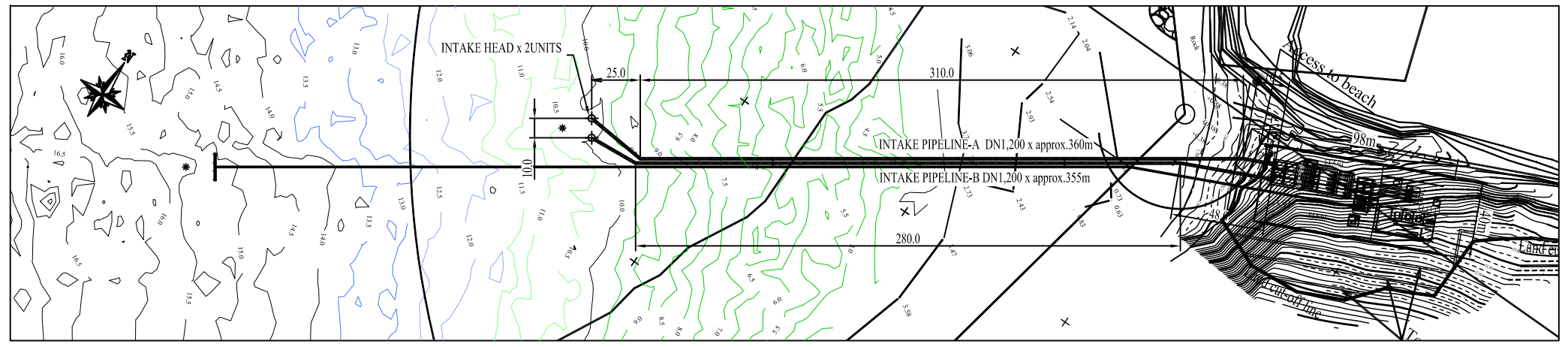
PREPARATORY SURVEY FOR MAMELLES SEA WATER DESALINATION PLANT CONSTRUCTION PROJCT	
TITLE OF DRAWING Hydraulic Diagram	
Drawing No.	GN-02



- NOTES:
1. ALL DIMENSIONS ARE IN METER UNLESS OTHERWISE SPECIFIED.
ALL ELEVATIONS ARE IN MSL METER.
 2. FLOW RATE:
 - PRODUCT : (FIRST PHASE) Q≈50,000m³/day, [FUTURE PHASE] Q≈100,000m³/day
 - INTAKE : (FIRST PHASE) Q≈129,120m³/day, [FUTURE PHASE] Q≈258,240m³/day
 - DISCHARGE: (FIRST PHASE) Q≈75,660m³/day, [FUTURE PHASE] Q≈151,320m³/day
 3. TIDE LEVEL AND ELEVATION
 - HWL MSL+1.04
 - LWL MSL-0.81
 - QL AROUND INTAKE PIT MSL-5.93
 4. INTAKE AND DISCHARGE FLOW SYSTEM
 - INTAKE: VERTICAL INTAKE AT OFFSHORE BY GRAVITY FLOW
 - INTAKE POINT: MSL-10m
 - DISCHARGE: DEEP WATER DISCHARGE AT OFFSHORE BY GRAVITY FLOW
 - DISCHARGE POINT: MSL-15m
 5. DESIGN HEADLOSS
 - INTAKE PIPELINE: 1.6m (Q≈129,120m³/day/line)
 - DISCHARGE PIPELINE: MIN.5m (Q≈75,660m³/day/line AT FIRST PHASE)
 6. PIPE SPECIFICATION
 - PIPE MATERIAL: HDPE PIPE
 - INTAKE PIPELINE: DN1200 (ID.1000) x 2LINES
 - DISCHARGE PIPELINE: DN710 (ID.650) x 1LINE
 - MANHOLE PIPE: DN1200 (INSTALLATION INTERVAL MAX.150m/LINE)
 - CHLORINATION PIPELINE: DN63-40 x 2LINES

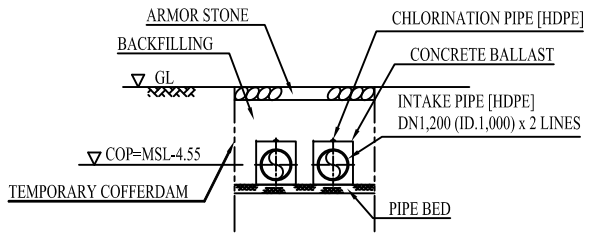
PREPARATORY SURVEY FOR MAMELLES SEA WATER DESALINATION PLANT CONSTRUCTION PROJ	
TITLE OF DRAWING Plan of Seawater Intake and Brine Discharge Facility	
Drawing No.	SWIF-01

PLOT PLAN

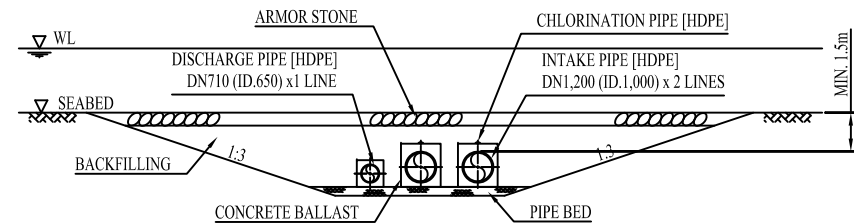


LONGITUDINAL SECTION

- NOTES:
1. ALL DIMENSIONS ARE IN METER UNLESS OTHERWISE SPECIFIED.
 2. ALL ELEVATIONS ARE IN MSL METER.
 3. FLOW RATE:
 - INTAKE (FIRST PHASE) Q=129,120m³/day, (FUTURE PHASE) Q=258,240m³/day
 4. TIDE LEVEL AND ELEVATION
 - HWL MSL+1.04
 - LWL MSL-0.81
 - GL AROUND INTAKE PIT MSL+5.93
 5. PIPE SPECIFICATION
 - PIPE MATERIAL: HDPE PIPE
 - INTAKE PIPELINE: DN1200 (ID.1000) x 2 LINES
 - MANHOLE PIPE: DN1200 (INSTALLATION INTERVAL MAX.150m/LINE)
 - CHLORINATION PIPELINE: DN63-40 x 2 LINES

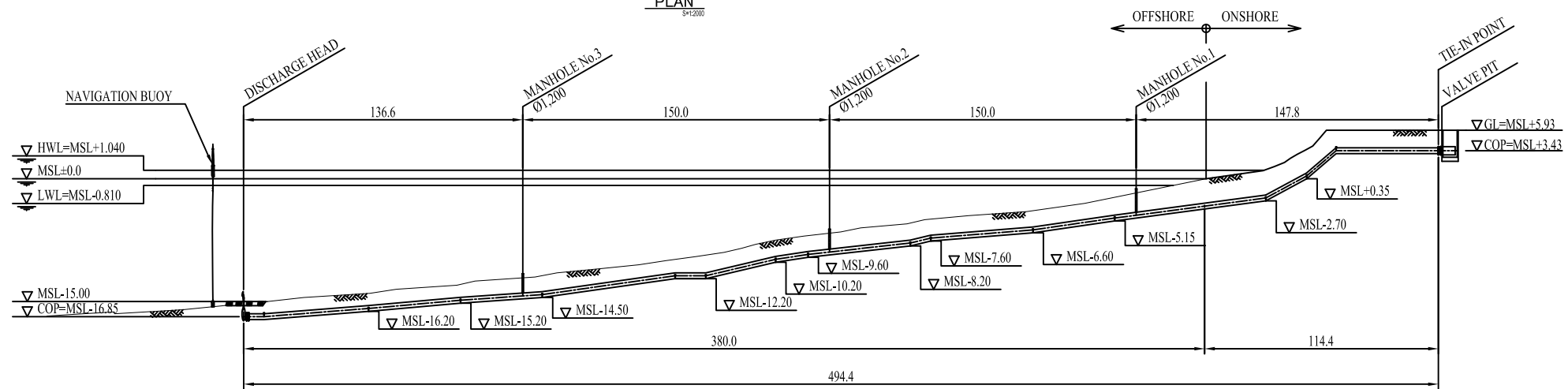
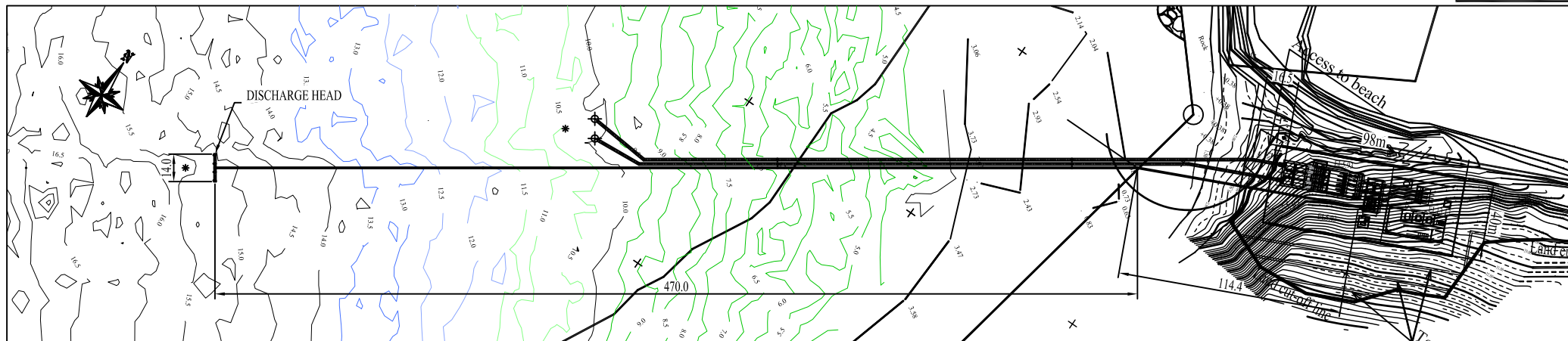


TYPICAL SECTION AT ONSHORE

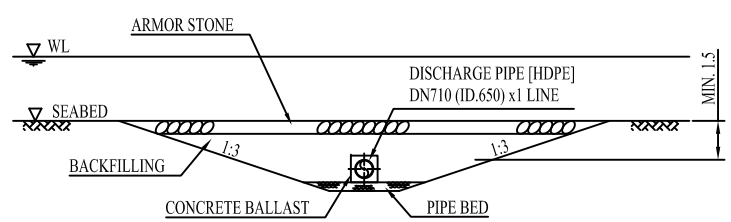
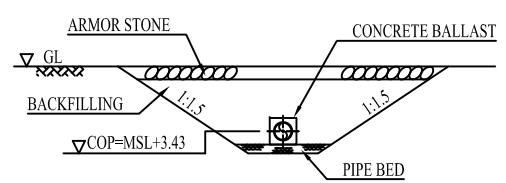


TYPICAL SECTION AT OFFSHORE

PREPARATORY SURVEY FOR MAMELLES SEA WATER DESALINATION PLANT CONSTRUCTION PROJCT	
TITLE OF DRAWING Profile of Seawater Intake Pipeline	
Drawing No.	SWIF-02



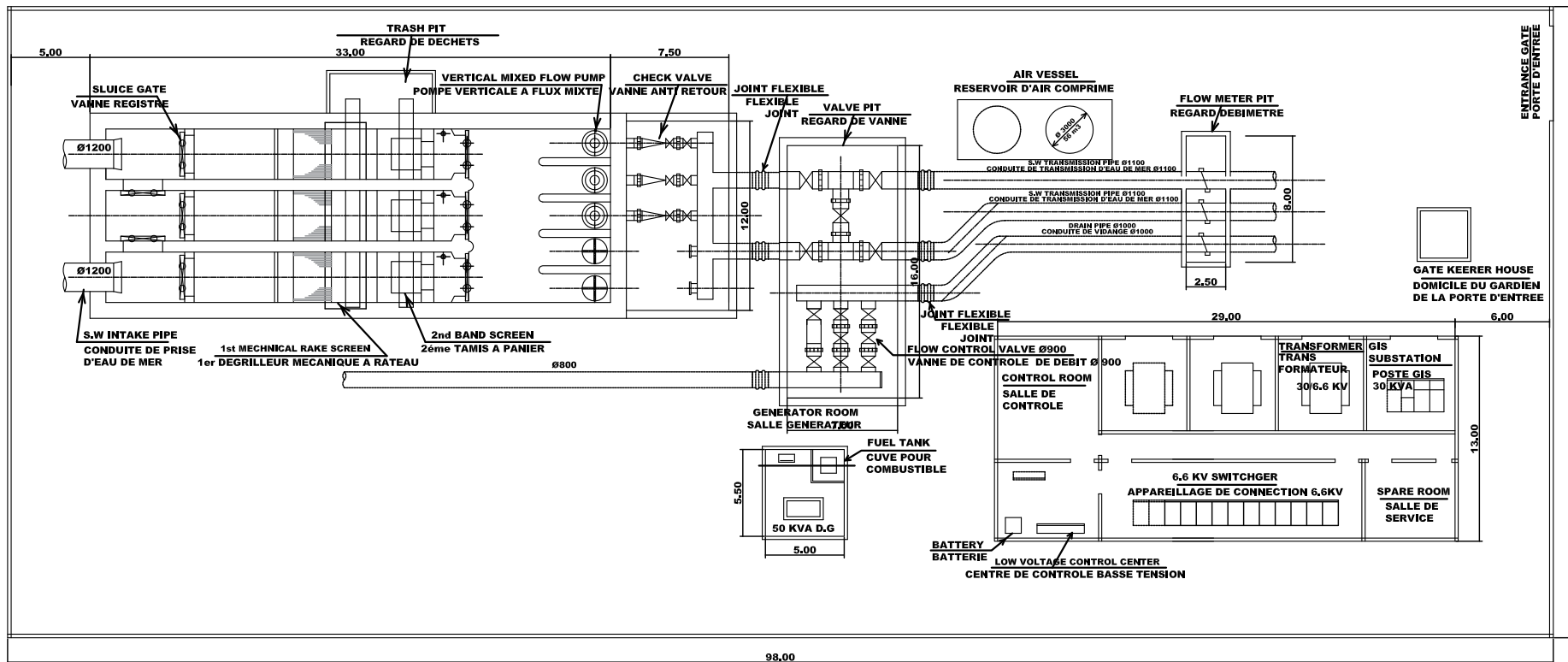
- NOTES:
- ALL DIMENSIONS ARE IN METER UNLESS OTHERWISE SPECIFIED.
ALL ELEVATIONS ARE IN MSL METER.
 - FLOW RATE:
- DISCHARGE: (FIRST PHASE) Q=75,660m³/day, (FUTURE PHASE) Q=151,320m³/day
 - TIDE LEVEL AND ELEVATION
HWL MSL+1.04
LWL MSL-0.81
GL AROUND VALVE PIT MSL+5.93
 - PIPE SPECIFICATION
PIPE MATERIAL: HDPE PIPE
DISCHARGE PIPELINE: DN710 (ID.650) x 1 LINE
MANHOLE PIPE: DN1200 (INSTALLATION INTERVAL MAX.150m/LINE)



PREPARATORY SURVEY FOR MAMELLES SEA WATER
DESALINATION PLANT CONSTRUCTION PROJCT

TITLE OF DRAWING
Profile of Brine Discharge Pipeline
(Seawater Transmission Pumping Station to Discharge Head)

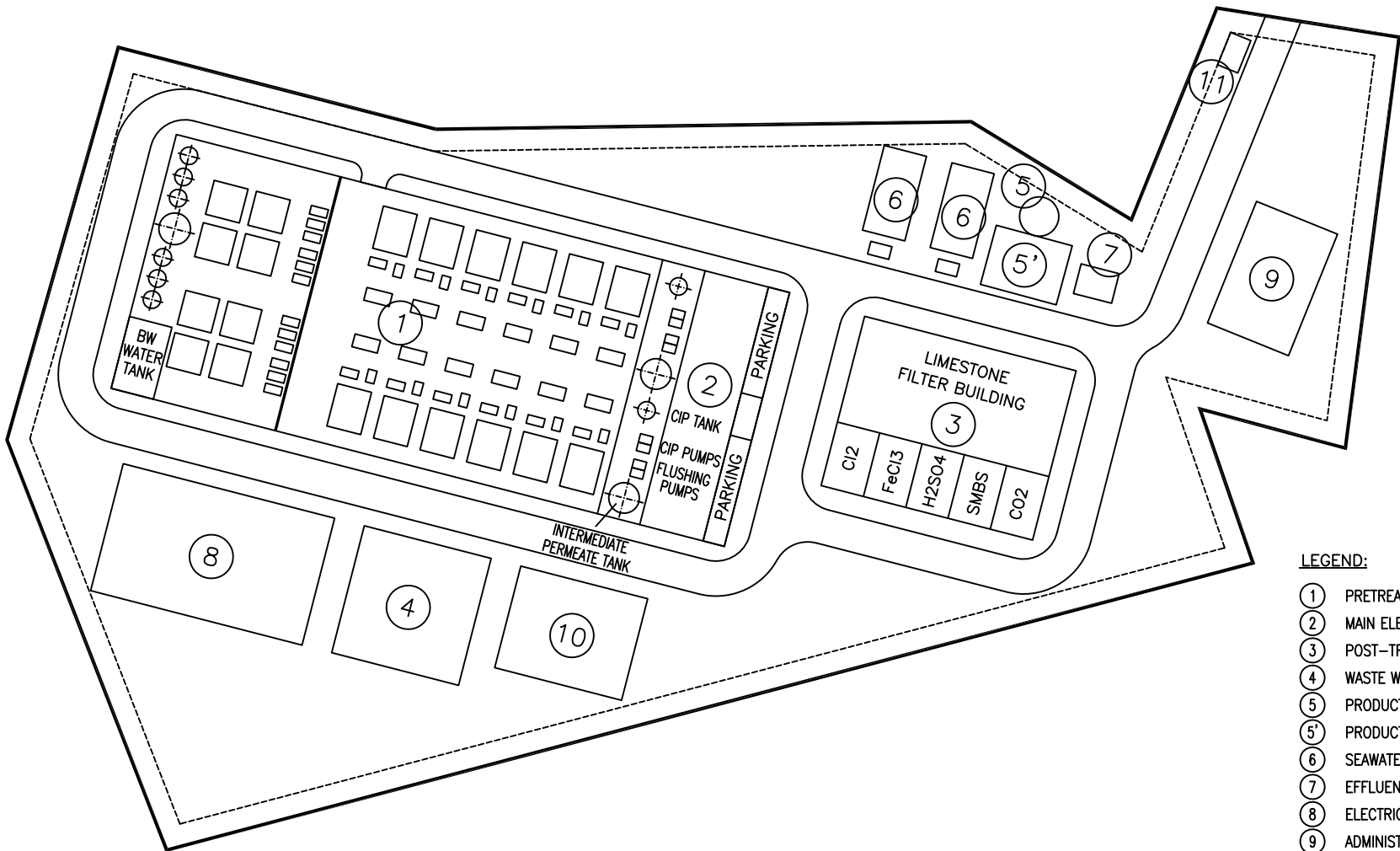
Drawing No. SWIF-03



PREPARATORY SURVEY FOR MAMELLES SEA WATER
DESALINATION PLANT CONSTRUCTION PROJCT

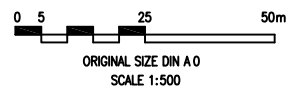
TITLE OF DRAWING
Layout of Seawater Transmission Pumping Station

Drawing No. SWTPS-02



LEGEND:

- ① PRETREATMENT / RO-BUILDING
- ② MAIN ELECTRICAL BUILDING & CCR
- ③ POST-TREATMENT / CHEMICAL STORAGE
- ④ WASTE WATER & SLUDGE TREATMENT BUILDING
- ⑤ PRODUCT WATER SUPPLY TANK
- ⑤' PRODUCT WATER TRANSMISSION PUMPING STATION
- ⑥ SEAWATER RECEIVING TANK
- ⑦ EFFLUENT TANK
- ⑧ ELECTRICAL & SWITCHGEAR
- ⑨ ADMINISTRATION BUILDING
- ⑩ WORKSHOP & STORAGE BUILDING
- ⑪ MAIN GATE / GATE HOUSE



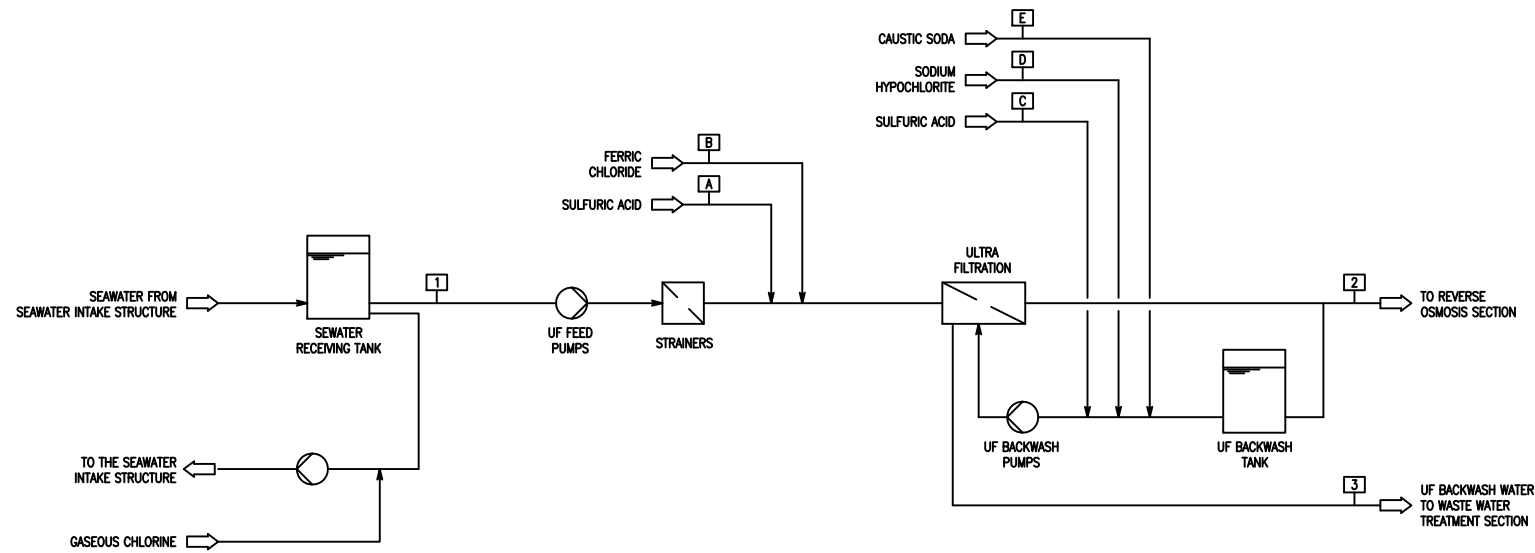
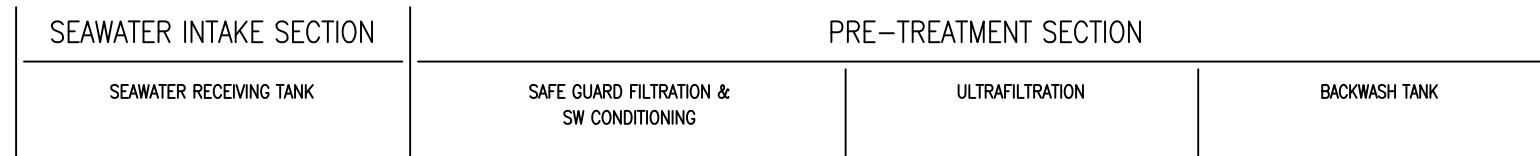
NOTES:

1. IF THE TREATED EFFLUENT IS IN ACCORDANCE WITH THE REQUIREMENTS IT WILL BE DISCHARGED TO THE SEA.
2. IF THE TREATED EFFLUENT IS NOT IN ACCORDANCE WITH IT WILL BE RETURNED TO THE PRE-TREATMENT SECTION.

PREPARATORY SURVEY FOR MAMELLES SEA WATER DESALINATION PLANT CONSTRUCTION PROJET

TITLE OF DRAWING
Layout of Seawater Desalination Plant

Drawing No. SWDP-GN

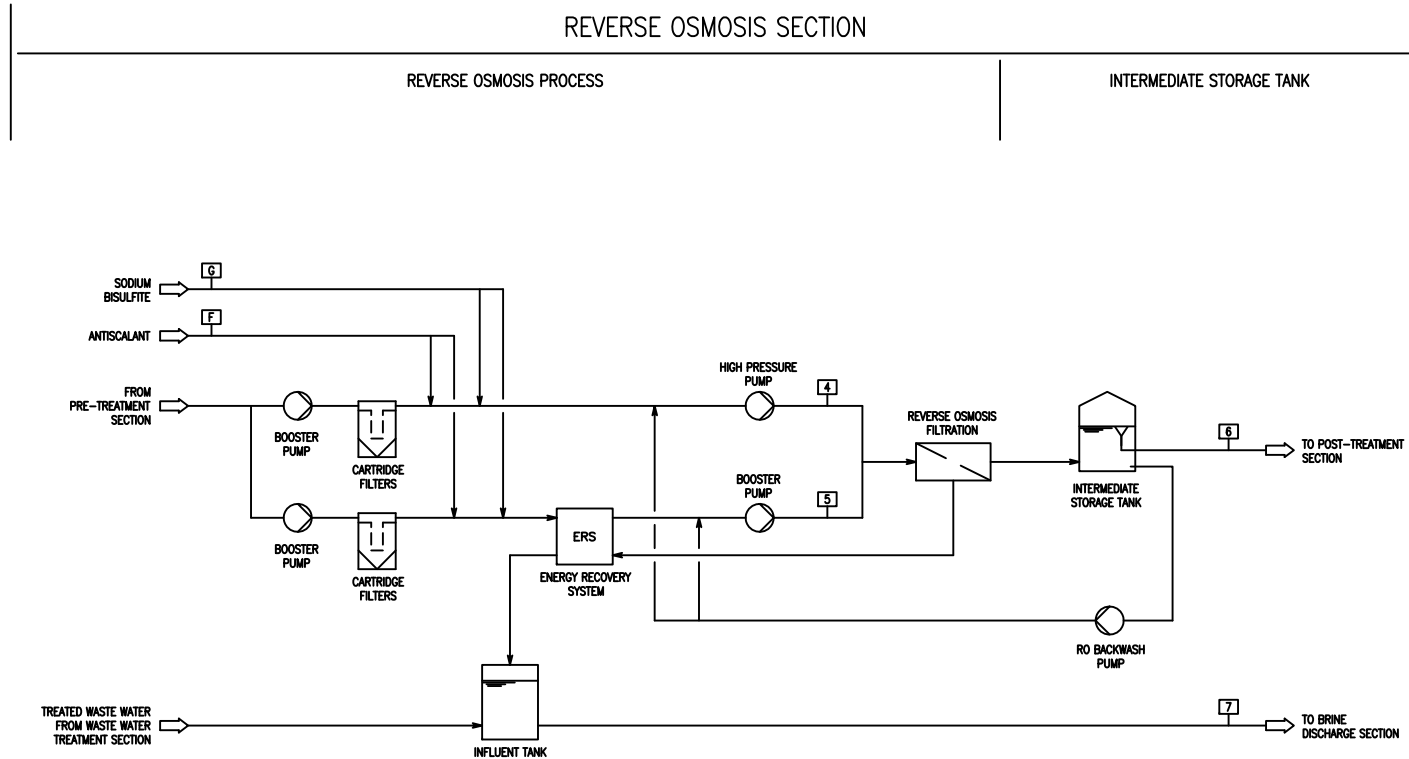


PREPARATORY SURVEY FOR MAMELLES SEA WATER
DESALINATION PLANT CONSTRUCTION PROJET

TITLE OF DRAWING
Process Flow Diagram (1/5)
Pre-treatment section

Drawing No. SWDP-PFD-01

REVERSE OSMOSIS SECTION

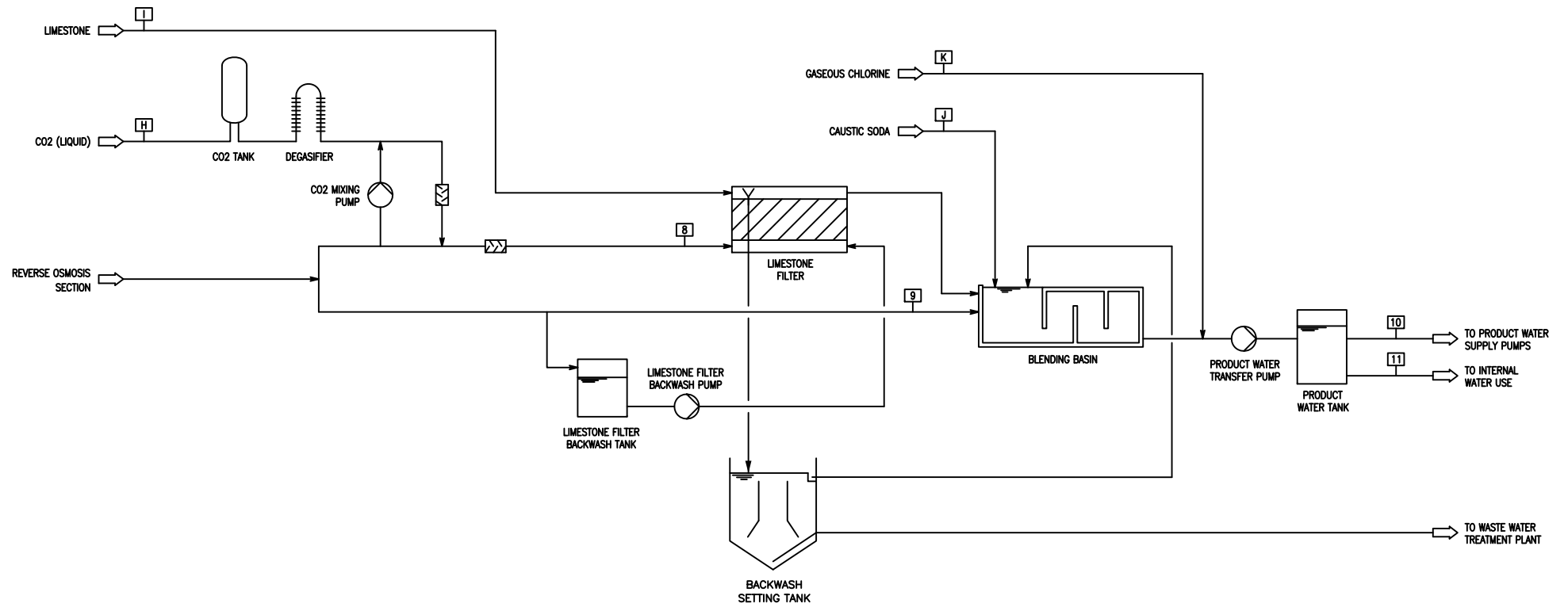


PREPARATORY SURVEY FOR MAMELLES SEA WATER
DESALINATION PLANT CONSTRUCTION PROJCT

TITLE OF DRAWING
Process Flow Diagram (2/5)
Reverse Osmosis Section

Drawing No. SWDP-PFD-02

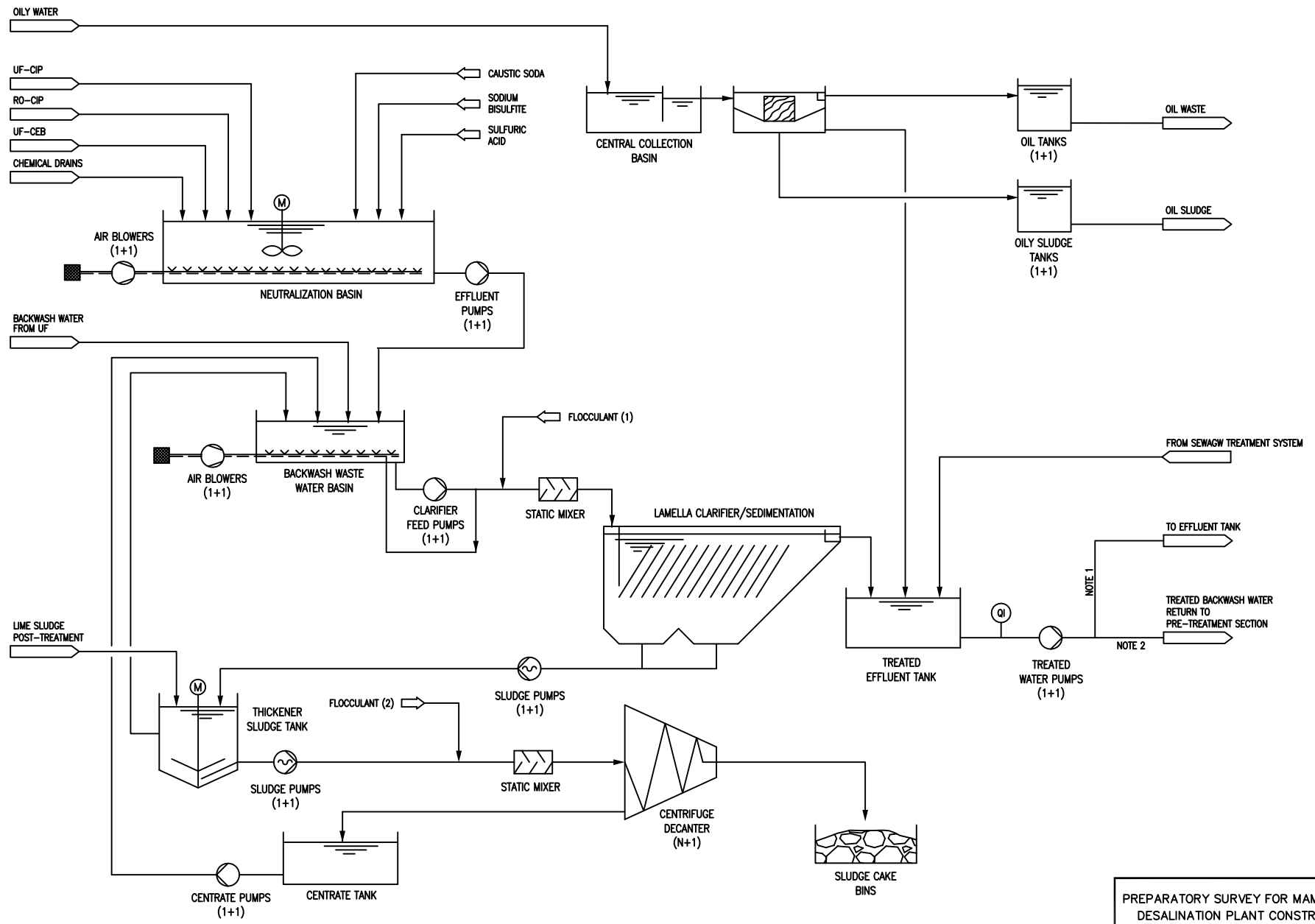
POST-TREATMENT SECTION



PREPARATORY SURVEY FOR MAMELLES SEA WATER
DESALINATION PLANT CONSTRUCTION PROJET

TITLE OF DRAWING
Process Flow Diagram (3/5)
Post-treatment Section

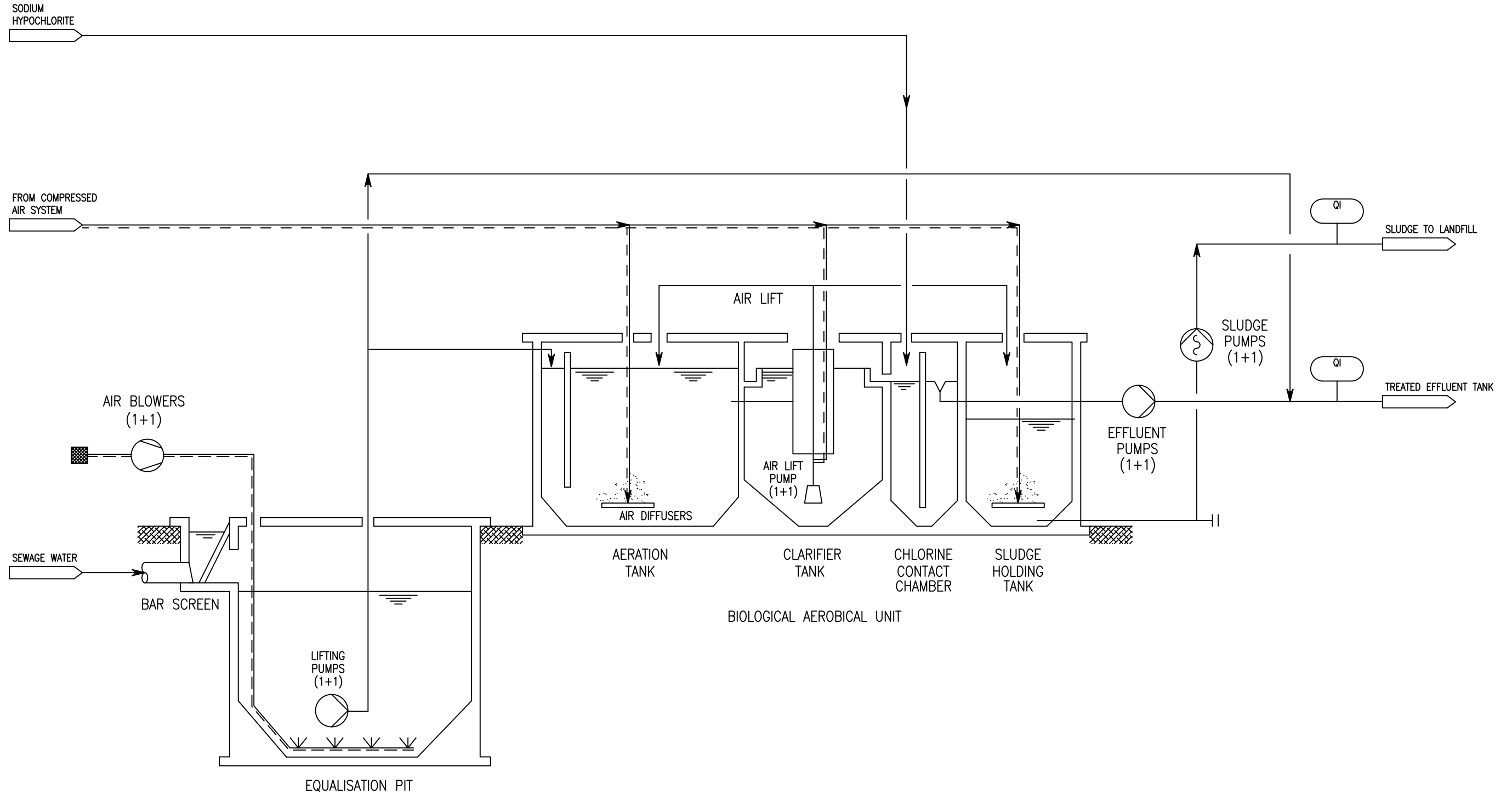
Drawing No.	SWDP-PFD-03
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PREPARATORY SURVEY FOR MAMELLES SEA WATER
DESALINATION PLANT CONSTRUCTION PROJCT

TITLE OF DRAWING
Process Flow Diagram(4/5)
Waste Water Treatment Plant

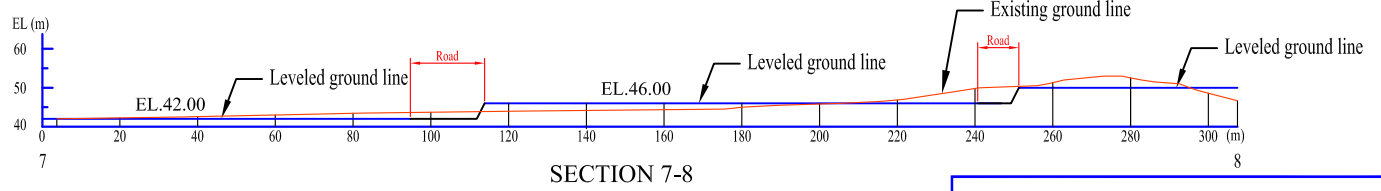
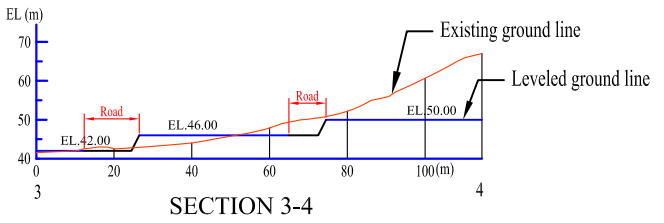
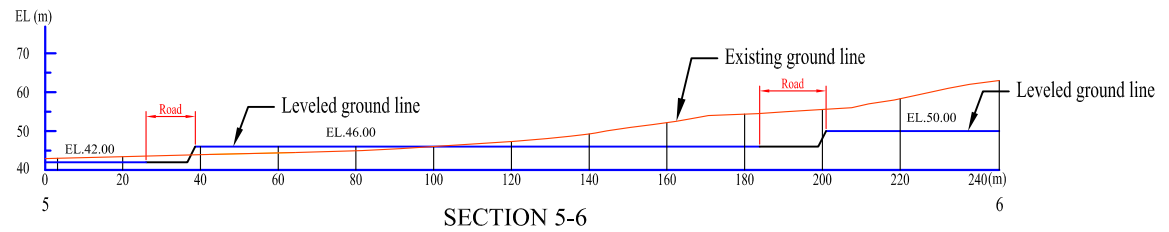
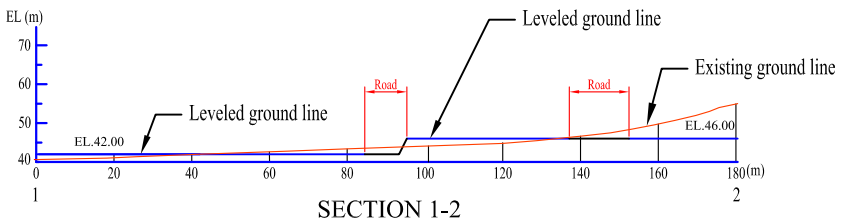
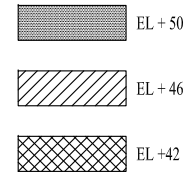
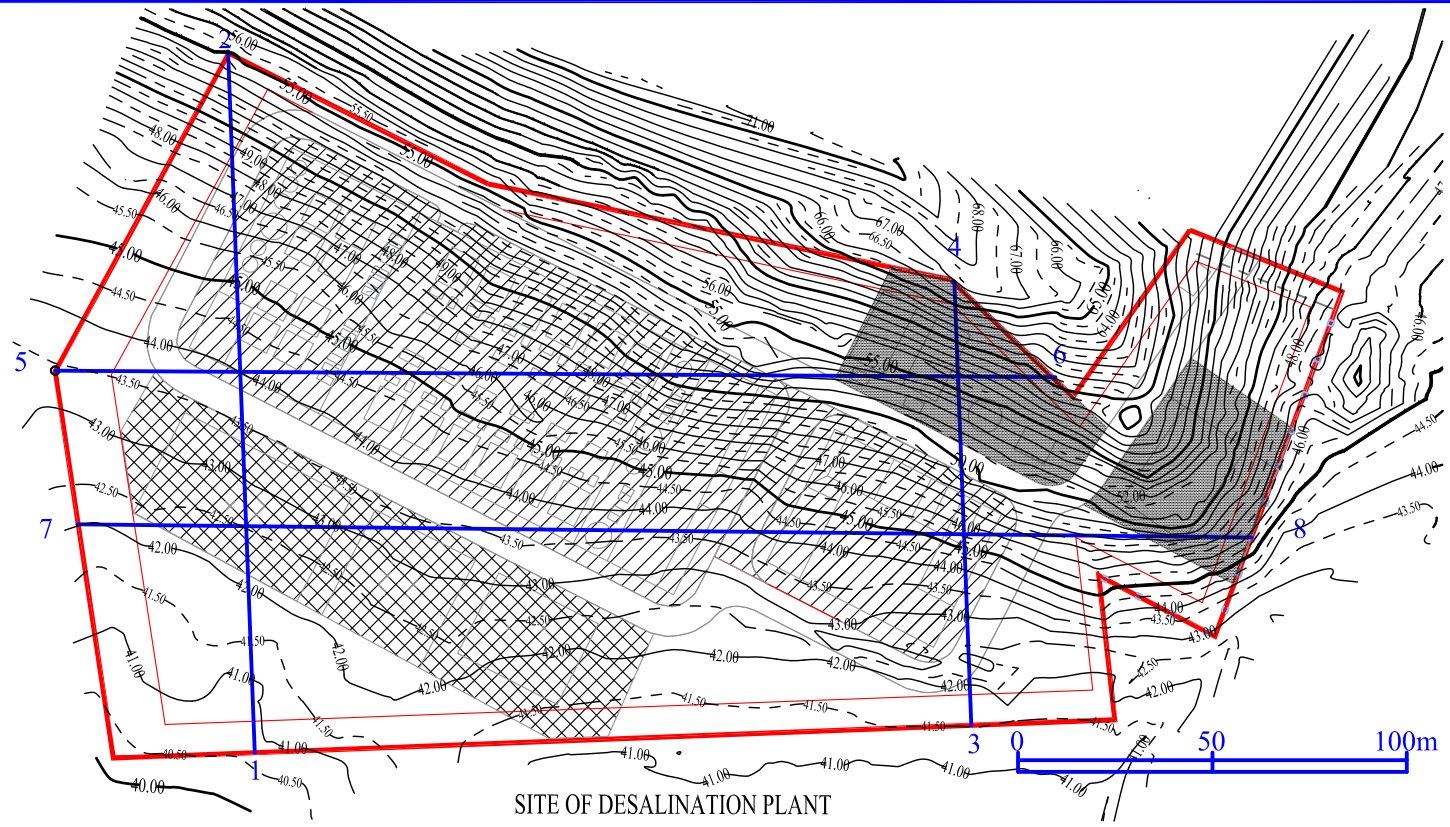
Drawing No.	SWDP-PFD-04
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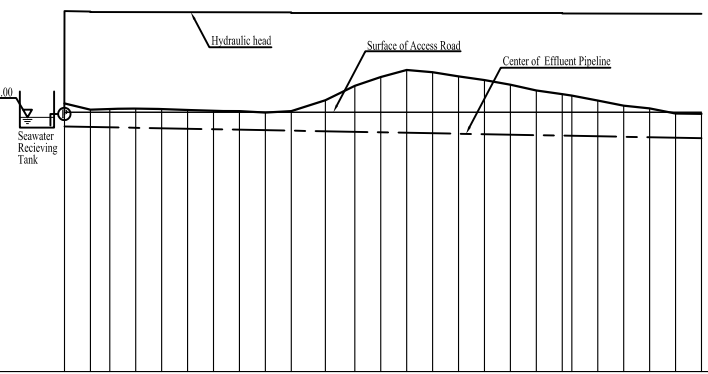
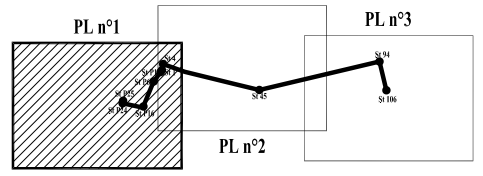
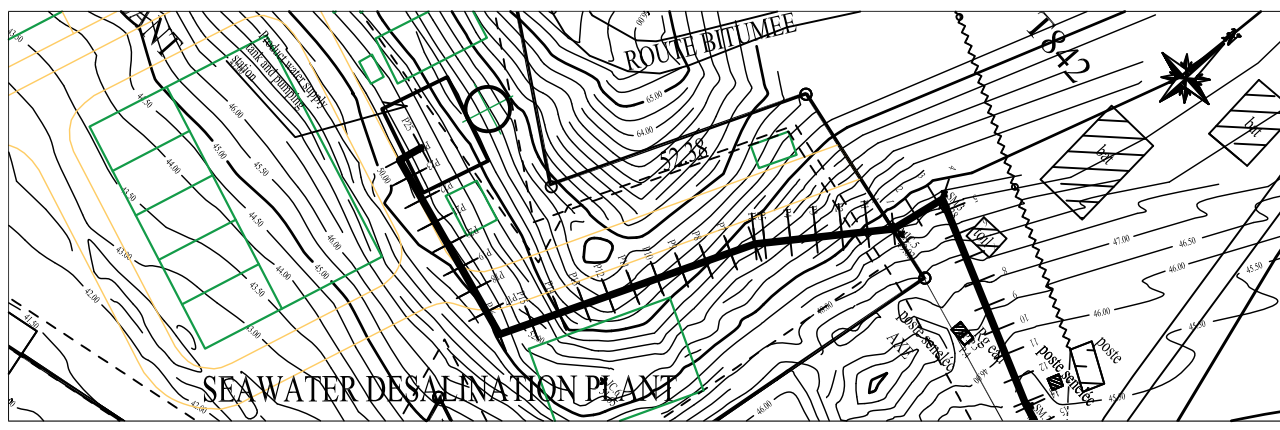
PREPARATORY SURVEY FOR MAMELLES SEA WATER
DESALINATION PLANT CONSTRUCTION PROJET

TITLE OF DRAWING
Process Flow Diagram (5/5)
Sewage Treatment System

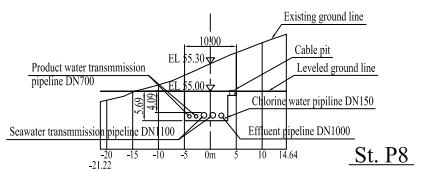
Drawing No. SWDP-PFD-05



PREPARATORY SURVEY FOR MAMELLES SEA WATER DESALINATION PLANT CONSTRUCTION PROJET	
TITLE OF DRAWING Land Leveling	
Drawing No.	SWDP-LL



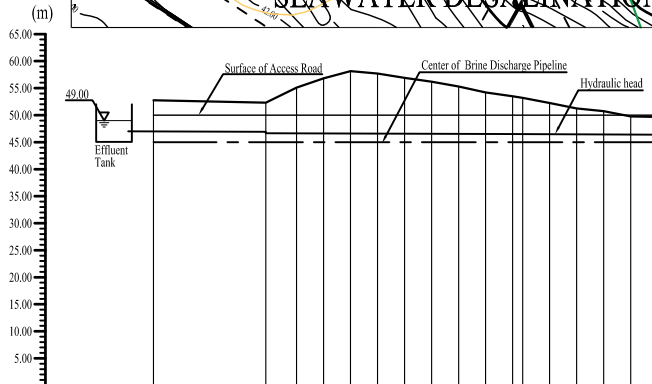
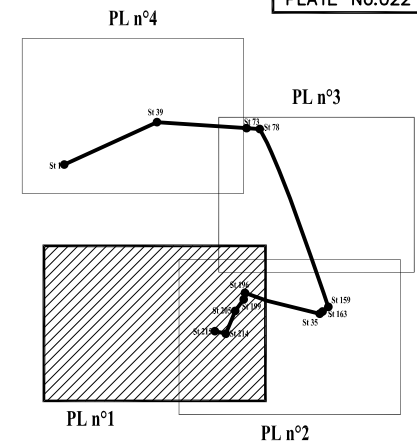
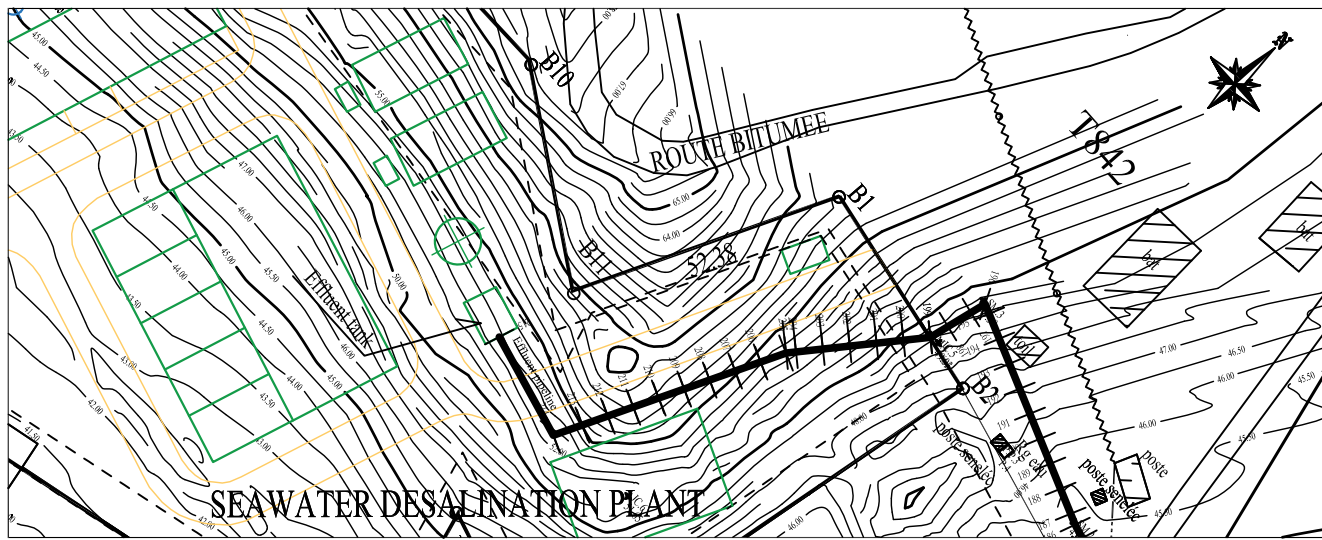
Station N°	P25	P24	P23	P22	P21	P20	P19	P18	P17	P16	P15	P14	P13	P12	P11	P10	P9	P8	P7	P6	P5	P4	P3	P2	P1	I
Numéros de profils																										
Ground surface elevation (m)																										
Altitude du Terrain Naturel (m)		51.70	50.50	50.60	50.70	50.40	50.30	50.20	49.95	50.20	52.30	55.10	56.80	58.15	57.70	56.90	56.20	55.30	54.20	53.50	53.50	52.25	51.25	50.75	49.75	49.68
Elevation of road surface (m)		50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00
Elevation of center of pipeline (m)		47.25	47.16	47.09	47.00	46.91	46.81	46.72	46.63	46.54	46.45	46.32	46.22	46.13	46.04	45.94	45.85	45.76	45.67	45.58	45.48	45.38	45.36	45.27	45.17	45.08
Hydraulic head (m)		69.50	69.41	69.32						69.25	69.13										69.13	69.05				
Distances (m)		4.74	3.75	5.00	5.00	5.00	5.00	5.00	5.00	6.59	5.69	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Accumulated distances (m)		0.00	4.74	8.49	13.49	18.49	23.49	28.49	33.49	38.49	43.49	50.08	55.77	60.77	65.77	70.77	75.77	80.77	85.77	90.77	95.77	100.77	105.77	110.77	115.77	120.77
Pipe diameter (mm) and material		DCIP Ø800x1																								
Diamètre conduite (mm) et matériaux		DCIP Ø800x1																								



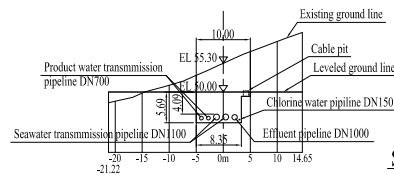
PREPARATORY SURVEY FOR MAMELLES SEA WATER DESALINATION PLANT CONSTRUCTION PROJCT

TITLE OF DRAWING
Product water Transmission Pipeline (1/3)

Drawing No. FWTP-P-01



Station N°	215	214	213	212	211	210	209	208	207	206	205	204	203	202	201	200	199
Numéros de profils																	
Ground surface elevation (m) Altitude du Terrain Naturel (m)	52.75	52.30	55.10	56.80	58.15	57.70	56.90	56.20	55.30	54.20	53.80	53.20	52.25	51.25	50.75	49.75	49.68
Elevation of road surface (m) Altitude de la route d'accès (m)	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00
Elevation of center of pépeline (m) Altitude axe de la conduite (m)	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00
Hydraulic head (m) Hauteur hydraulique (m)	47.00	46.93	46.85								46.30	46.34					
Distances (m)		20.78	5.69	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Accumulated distances (m) Distances cumulées (m)	0.00	20.78	26.47	31.47	36.47	41.47	46.47	51.47	56.47	61.47	66.47	71.47	76.47	81.47	86.47	91.47	96.47
Pipe diamètre (mm) and material Diamètre conduite (mm) et matériaux	Coated steel pipe Ø1000x1																



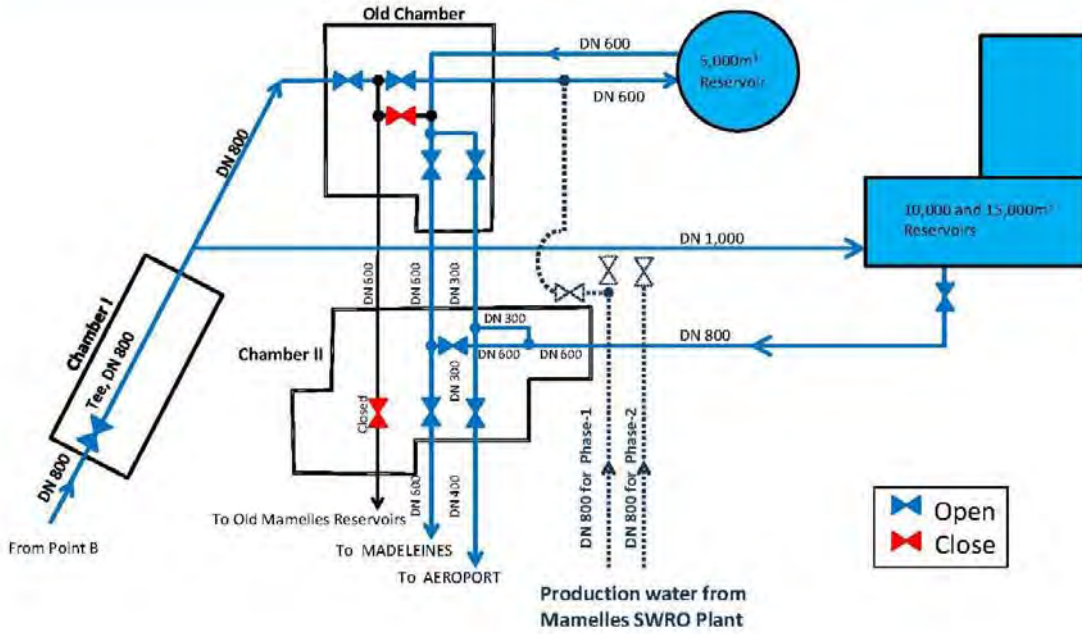
St.207

PREPARATORY SURVEY FOR MAMELLES SEA WATER DESALINATION PLANT CONSTRUCTION PROJCT

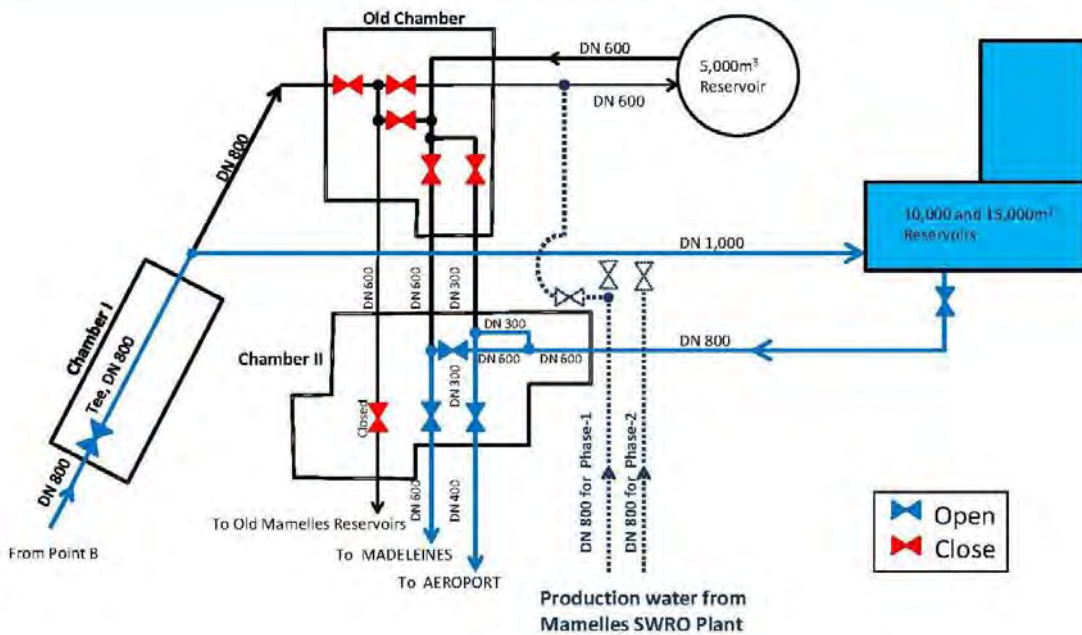
TITLE OF DRAWING
Brine Discharge Pipeline (1/4)

Appendix 5-2 Connection to existing inflow system

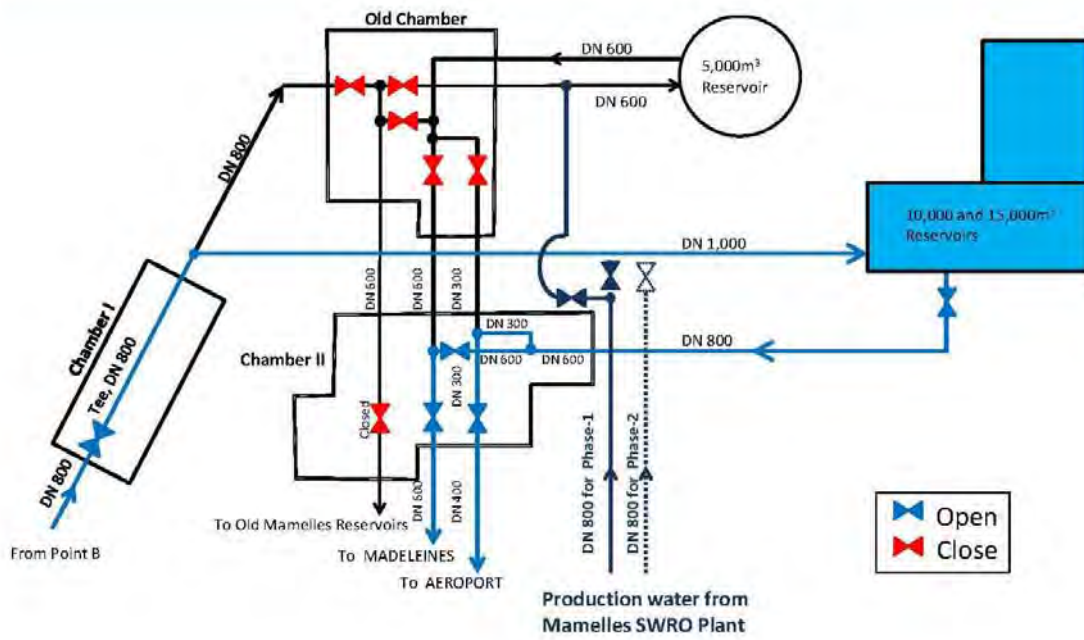
Current Situation



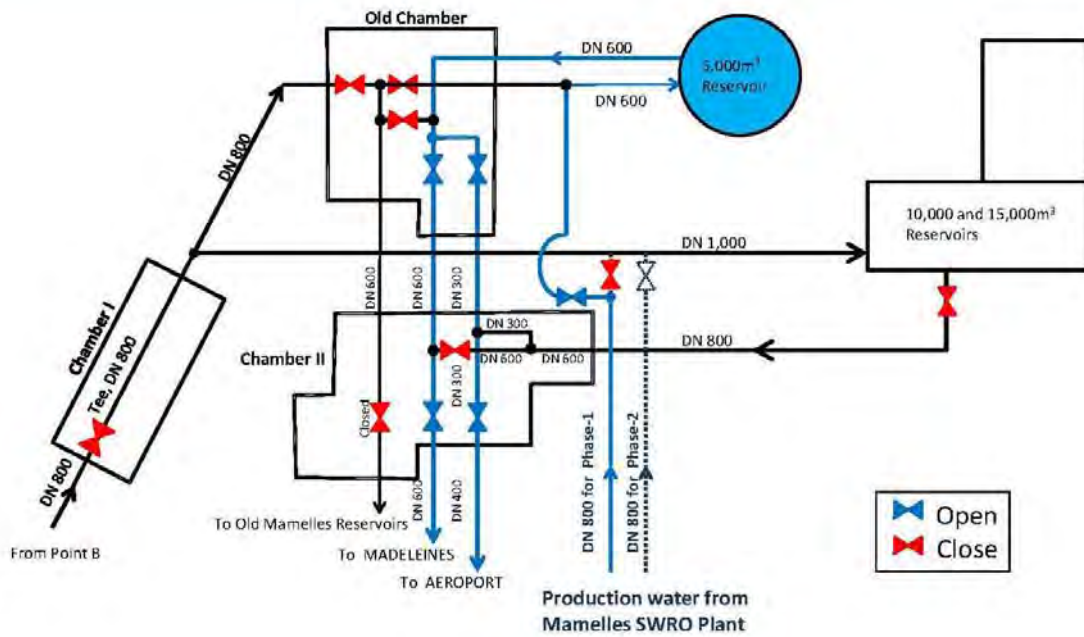
Temporary work step-1



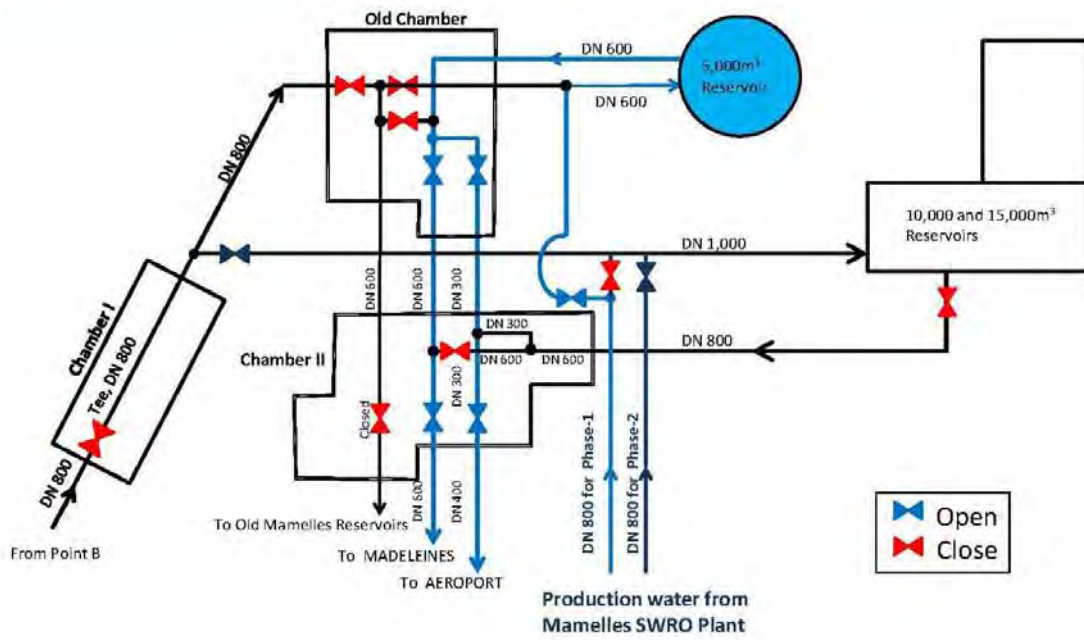
Temporary work step-2



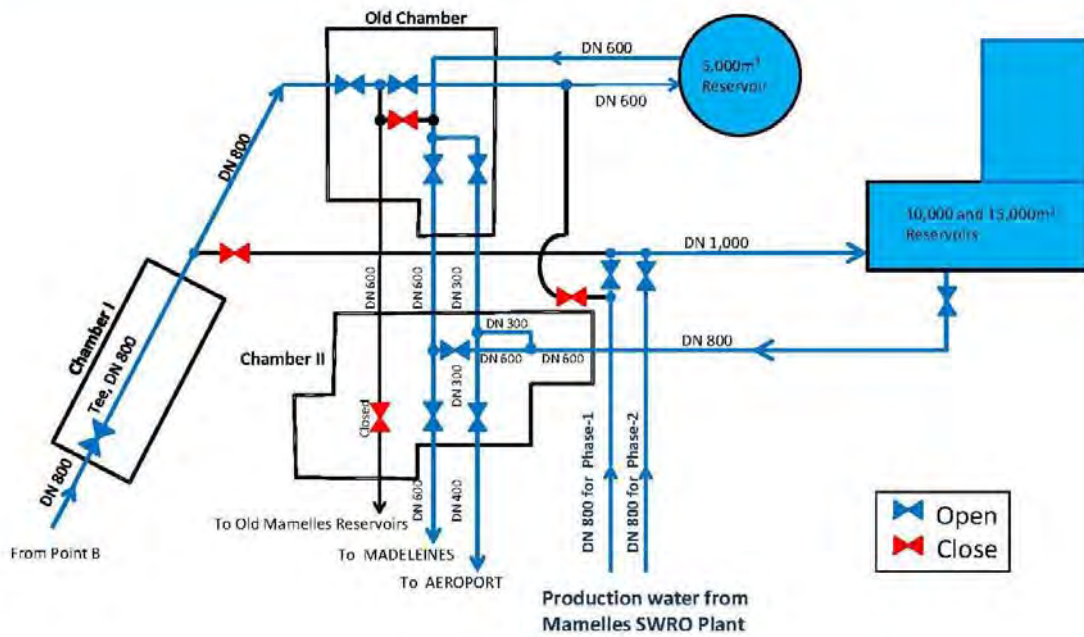
Temporary work step-3



Temporary work step-4



Completion of connection



Source: JICA Study Team

Appendix 6-1 Environmental check list

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
1 Permits and Explanation	(1) EIA and Environmental Permits	(a) Have EIA reports been already prepared in official process? (b) Have EIA reports been approved by authorities of the host country's government? (c) Have EIA reports been unconditionally approved? If conditions are imposed on the approval of EIA reports, are the conditions satisfied? (d) In addition to the above approvals, have other required environmental permits been obtained from the appropriate regulatory authorities of the host country's government?	(a) N (b) N (c) - (d) -	(a) EIA Report is not prepared. But, TOR of the EIA Report was approved by the authorities of Senegal. (b) EIA Report will be prepared by December 2015 and will be approved by the authorities on March, 2016.
	(2) Explanation to the Local Stakeholders	(a) Have contents of the project and the potential impacts been adequately explained to the Local stakeholders based on appropriate procedures, including information disclosure? Is understanding obtained from the Local stakeholders? (b) Have the comment from the stakeholders (such as local residents) been reflected to the project design?	(a) N (b) N	(a) Stakeholder meetings with relevant agencies will be held after July 2015 within the EIA study period. (b) Comments from the stakeholders are not reflected to the project design because the stakeholder meeting are not held so far.
	(3) Examination of Alternatives	(a) Have alternative plans of the project been examined with social and environmental considerations?	(a) Y	(a) Alternative analysis was examined by environmental aspects such as environmentally-friendly discharging pipe design, which will be minimized possible adverse impacts on the ecosystem, and social aspects such as stable water supply for the local peoples.
2 Pollution Control	(1) Air Quality	(a) Is there a possibility that desalination plant and other facilities such as electric generation facilities will cause air pollution?	(a) N (b) Y	(a) There is no possibility that the proposed desalination plant and other facilities will cause air pollution, except the construction period.
	(2) Water Quality	(a) Do pollutants, such as TSM, BOD, COD, pH contained in treated effluent from the desalination plant comply with the country's effluent standards? (b) Does untreated water contain heavy metals?	(a) Y (b) N	(a) Effluent standards of pH, TSM, BOD, and COD complied in treated effluent from the proposed desalination plant. (b) Untreated water from the proposed plant is not included in heavy metals.
	(3) Wastes	(a) Are wastes, generated by the plant and facility operations properly treated and disposed of in accordance with the country's standards?	(a) Y	(a) Wastes such as exchanged old RO and UF membrane will properly managed in accordance with Environmental Code in Senegal.
	(4) Noise and Vibration	(a) Do noise and vibrations generated from the facilities, such as pumping stations and construction activities of renewal of pipe line comply with the country's standards?	(a) Y	(a) The proposed facilities, which may generate heavy noise, such as pumping station is layout within the indoor, noise and vibrations generated from construction activities including renewal of pipe line keep in the operation time and so on, and will be operated in order to comply with Environmental Code in Senegal.
	(5) Odor	(a) Are adequate control measures taken for odor sources, such as proposed pump station?	(a) Y	(a) Mitigation measures for odor such as regular cleaning of the detached fishes with putrefactive smell of the pumping station is taken as the countermeasure.
3 Natural Environment	(1) Protected Areas	(a) Is the project site or discharge area located in protected areas designated by the country's laws or international treaties and conventions? Is there a possibility that the project including renewal of pipe line will affect the protected areas?	(a) N	(a) The Project sites are not located within the designated protected by Senegalese laws and international treaties/conventions sites. However, designated historical site is located near the desalination plant.
3 Natural Environment	(2) Ecosystem	(a) Does the project site encompass primeval forests, tropical rain forests, ecologically valuable habitats (e.g., coral reefs, mangroves, or tidal flats)? (b) Does the project site or discharge area encompass the protected habitats of endangered species designated by the country's laws or international treaties and conventions? (c) If significant ecological impacts are anticipated, are adequate protection measures taken to reduce the impacts on the ecosystem? (d) Is there a possibility that the discharging of wastewater from the plant by project will adversely impacts on the marine ecosystem?	(a) N (b) N (c) - (d) N	(a) No primeval forests, tropical rain forests, ecologically valuable habitats are found in and around the project sites. (b) No protected habitats of endangered species are found in and around the project sites. (c) (d) The project will not cause significant impacts on the marine ecosystem. Because, environmentally-friendly discharging pipe design, which will be minimized the possible adverse impacts on the marine ecosystem, are applied.
		(1) Resettlement	(a) Is involuntary resettlement caused by project implementation? If involuntary resettlement is caused, are efforts made to minimize the impacts caused by the resettlement? (b) Is adequate explanation on compensation and resettlement assistance given to affected people prior to resettlement? (c) Is the resettlement plan, including compensation with full replacement costs, restoration of livelihoods and living standards developed based on socioeconomic studies on resettlement? (d) Is the compensations going to be paid prior to the resettlement? (e) Is the compensation policies prepared in document? (f) Does the resettlement plan pay particular attention to vulnerable groups or people, including women, children, the elderly, people below the poverty line, ethnic minorities, and indigenous peoples? (g) Are agreements with the affected people obtained prior to resettlement? (h) Is the organizational framework established to properly implement resettlement? Are the capacity and budget secured to implement the plan? (i) Are any plans developed to monitor the impacts of resettlement? (j) Is the grievance redress mechanism established?	(a) N (b) - (c) - (d) - (e) - (f) - (g) - (h) - (i) - (j) -
4 Social Environment	(2) Living and Livelihood	(a) Is there a possibility that the project will adversely affect the living conditions of inhabitants? Are adequate measures considered to reduce the impacts, if necessary? (b) Is there a possibility that the amount of water used (e.g., surface water, groundwater) by the project will adversely affect the existing water uses and water area uses?	(a) N/Y (b) N	(a) There is few possibilities that stakeholders such as fishermen will affect the significant livelihood. But, if significant decrease of the income of the fisheries by the project, appropriate assistances for the livelihood of the affected fishermen are considering. (b) There is few possibilities.
	(3) Heritage	(a) Is there a possibility that the project will damage the local archeological, historical, cultural, and religious heritage? Are adequate measures considered to protect these sites in accordance with the country's laws?	(a) N	(a) Although there is a designated historical site is located close to the proposed site, appropriate countermeasures such preventing possible noises and the other nuisances are taken.
	(4) Landscape	(a) Is there a possibility that the project will adversely affect the local landscape?	(a) N	(a) There is no possibility that the proposed facilities will not adversely affect the present local landscape in the sites, although the sites includes a beach, and is closed to archeological site.
	(5) Ethnic Minorities and Indigenous Peoples	(a) Are considerations given to reduce impacts on the culture and lifestyle of ethnic minorities and indigenous peoples? (b) Are all of the rights of ethnic minorities and indigenous peoples in relation to land and resources respected?	(a) - (b) -	(a) No ethnic minorities or indigenous peoples live in the project site. (b) Not applicable due to the above reason
	(6) Working Conditions	(a) Is the project proponent not violating any laws and ordinances associated with the working conditions of the country which the project proponent should observe in the project? (b) Are tangible safety considerations in place for individuals involved in the project, such as the installation of safety equipment which prevents industrial accidents, and management of hazardous materials? (c) Are intangible measures being planned and implemented for individuals involved in the project, such as the establishment of a safety and health program, and safety training (including traffic safety and public health) for workers etc.?	(a) Y (b) Y (c) Y (d) Y	(a) The project will be implemented in compliance with relevant laws/ordinances, which associated with labor, safety (b) Safety countermeasures such as installation of safety equipment to prevent labor accidents and chemical subsistence are planned in the project. And also safety equipment such as masks, goggles, and boots are provided for workers. (c) Continuous safety awareness trainings for worker will be conducted. (d) The project will provide appropriate education to security guards not to violate safety of other individuals and/or local residents.
	(1) Impacts during Construction	(a) Are adequate measures considered to reduce impacts during construction (e.g., noise, vibrations, turbid water, dust, exhaust gases, and wastes)? (b) If construction activities adversely affect the natural environment (ecosystem), are adequate measures considered to reduce impacts? (c) If construction activities adversely affect the social environment, are adequate measures considered to reduce impacts? (d) If the construction activities might cause traffic congestion, are adequate measures considered to reduce such impacts?	(a) Y (b) Y (c) Y (d) Y	(a) Construction equipment of low-noise and/or low-vibration type will be selected as far as practicable. And water sprinkling is conducted in dry season not to scatter dust during construction works. (b) Coastal ecosystem may not deteriorate due to the environmentally friendly construction methods. (c) No significant impact to social environment is predicted during construction including renewal of pipe line. (d) Sign board are set up to prevent traffic congestion in and around project sites during construction including renewal of pipe line.
6 Note	Reference to Checklist of Other Sectors	(a) Where necessary, pertinent items described in the Dam and River Projects checklist should also be checked.	(a) N	(a) It was not refer to check items described in the Dam and River Projects checklist. But, the check items were considered based on the characteristics of the desalination plant and the other proposed facilities.
	Note on Using Environmental Checklist	(a) If necessary, the impacts to transboundary or global issues should be confirmed (e.g., the project includes factors that may cause problems, such as transboundary waste treatment, acid rain, destruction of the ozone layer, or global warming).	(a) N	(a) There is no transboundary issues due to scale of the construction works and operation. The operation of the plant will be contributed to mitigation as one of the climate change adaptation measures

1) Regarding the term "Country's Standards" mentioned in the above table, in the event that environmental standards in the country where the project is located diverge significantly from international standards, appropriate environmental considerations are required to be made.
 In cases where local environmental regulations are yet to be established in some areas, considerations should be made based on comparisons with appropriate standards of other countries (including Japan's experience).
 2) Environmental checklist provides general environmental items to be checked. It may be necessary to add or delete an item taking into account the characteristics of the project and the particular circumstances of the country and locality in which the project is located.

Appendix 6-2 Monitoring Form

1. Responses/Actions to Comments and Guidance from Government Authorities and the Public

Monitoring Item	Monitoring Results during Report Period
Implementation of the following monitoring item 2 to 4	

2. Pollution

< Construction Period >

- Air Quality (Emission Gas / Ambient Air Quality)

Item, Unit (µg/m ³)	Measured Value (Mean)	Measured Value (Max.)	Country's Standards	Referred International Standards (WHO)	Remarks (Measurement Point, Frequency, Method, etc.)
PM10			24 hour value: 260	24 hour value: 50	4 points in the desalination plant and the surrounding area * 3 times
NO _x			1 hour value: 200	1 hour value: 200	4 points in the desalination plant and the surrounding area * 3 times
SO ₂			24 hour value: 125	24 hour value: 125	4 points in the desalination plant and the surrounding area * 3 times

- Water Quality (Effluent/Wastewater/Ambient Water Quality)

Item, Unit (mg/l)	Measured Value (Mean)	Measured Value (Max.)	Country's Standards	Referred International Standards	Remarks (Measurement Point, Frequency, Method, etc.)
BOD ₅			80		4 points in the desalination plant and the surrounding area * 3 times
TSS			50		4 points in the desalination plant and the surrounding area * 3 times
T-N			30		4 points in the desalination plant and the surrounding area * 3 times

- Noise

Item, Unit (mg/l)	Measured Value (Mean)	Measured Value (Max.)	Country's Standards	Referred International Standards	Remarks (Measurement Point, Frequency, Method, etc.)
Noise level dB(A)			55 – 60 (daytime) 40 (night time)		2 points in the desalination plant, and 2 points at pumping station * 1 time per month

< Operation Period >

- Noise

Item, Unit (mg/l)	Measured Value (Mean)	Measured Value (Max.)	Country's Standards	Referred International Standards	Remarks (Measurement Point, Frequency, Method, etc.)
Noise level dB(A)			55 – 60 (daytime) 40 (night time)		2 points in the desalination plant, and 2 points at pumping station * 1 time per month

- Odor

Monitoring Item	Measurement Points, Frequency
Complaints for bad odor	2 points at pumping station and the surroundings * 1 time per month

3. Natural Environment

< Operation Period >

- Ecosystem

Monitoring Item	Measurement Points, Frequency
Salinity level at the discharging point and the surroundings of desalination plant	Total 10 points (every 5 m from the discharging point to perpendicular direction) * 1 time per 6 months

4. Social Environment

< Construction Period >

- Living / Livelihood

Monitoring Item	Measurement Points, Frequency
Fish catch volume at Fisheries Cooperative at Ouakam municipality	Fishing ground at Ouakam area, 1 time per month

< Operation Period >

- Living / Livelihood

Monitoring Item	Measurement Points, Frequency
Fish catch volume at Fisheries Cooperative at Ouakam municipality	Fishing ground at Ouakam area, 1 time per month

Appendix 6-3 Letter from DEEC regarding Survey on Environmental and Social Consideration necessary for CP-2, CP-3 and CP-4

République du Sénégal
Un Peuple – Un But – Une Foi

N° 022 MEDD/DEEC/DEIE.as

MINISTÈRE DE L'ENVIRONNEMENT
ET DU DÉVELOPPEMENT DURABLE

Dakar, le 23 OCT. 2015

Direction de l'Environnement
et des Établissements Classés

LA DIRECTRICE

A
Monsieur Charles FALL
Directeur Général Société Nationale
des Eaux du Sénégal (SONES)

DAKAR

Réf : BN/FMB/n° 002107 en date du 17 septembre 2015

Objet : Demande d'avis d'évaluation environnementale relatif au renouvellement du réseau de distribution d'eau Dakar ville, composante du projet de construction d'une usine de dessalement d'eau de mer aux Mamelles.

Monsieur le Directeur Général,

J'accuse bonne réception de la correspondance citée en référence et relative à l'objet susmentionné.

Après examen du document et la visite du tracé du lundi 19 octobre 2015, la Direction de l'Environnement et des Établissements Classés (DEEC) a pris bonne note que le projet consiste : à l'amélioration du réseau existant de distribution d'eau potable dans la zone de Dakar par l'installation d'une conduite principale de distribution de 13,5 km de longueur et le renouvellement des conduites de distribution existantes sur 442 km de longueur.

Pris globalement, ce projet est visé par l'**annexe 2** du décret n°2001-282 portant application du Code de l'environnement, en son **point 10 : Adduction d'eau rurale et urbaine et assainissement**. Ainsi, il est soumis à un régime d'autorisation avec la réalisation d'une analyse environnementale initiale (AEI) préalable.

Cette AEI pourra prendre en charge toutes les problématiques environnementales et sociales associées à ce projet.

A cet effet, veuillez vous rapprocher de la Division Régionale de l'Environnement et des Établissements Classés de Dakar (Boulevard Djily MBAYE, Immeuble FAHD 13^{ème} étage ; Tel : (221) 33 823 15 30 ; Email : dreecdakar@yahoo.fr) pour la poursuite d'instruction de ce dossier.

Je vous prie d'agréer, Monsieur le Directeur Général, l'assurance de ma considération distinguée.

Ampliation :

- DCPN (pour information) ;
- DREEC DK (pour information et suivi).

**P/ La Directrice de l'Environnement
et des Établissements Classés, pi**

Cheikh FOFANA

Parc Forestier et Zoologique de Hann - Route des pères maristes- Tél +221 33 859 13 43
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Translated in English

Republic of Senegal
One People one Aim One Faith
Ministry of Environment and Sustainable Development
Directorate of Environment and Classified Establishments

N° 3 22MEDD/DEEC/DEIE.as
Dakar, October 23rd 2015

THE DIRECTOR
Attention to
Mr Charles FALL
General Director the Senegal National
Water Company (SONES)
DAKAR

Reference: BN/FMB/n° 002107 as of September 17, 2015

Object: Advisory request on environmental assessment relating to the water distribution network replacement in Dakar City, component of the Mamelles Sea Water Desalination Plant Construction Project

Dear Director General,

I acknowledge receipt of the letter issued in the above reference and relating to the Project aforementioned.

After reviewing the document and the visit of the pipe route on October 19th 2015, the Directorate of Environment and Classified Establishments took note that the Project consists of: *the improvement of the existing potable water distribution network in the Dakar area through the installation of one main distribution pipe of 13.5 km of length and the replacement of the existing distribution pipes with a length of 442 km.*

Globally taken, this Project is concerned by the **Annex 2** of the Decree N° 2001-282 implementing the Code of Environment in its **point N° 10 Rural and Urban Water Supply and Sanitation**. Therefore, it is subjected to an authorization regime with the implementation a prior initial environmental analysis (IEA).

This IEA will be able to cover all the environmental and social issues relating to the implementation of the Project.

With regard to this, please contact the Regional Division of Environment and Classified Establishments of Dakar (Address: Boulevard Djily MBAYE, Immeuble FAHD 13^{ème} Etage, Telephone: 33 823 15 30, Email: dreecdakar@yahoo.fr for the next instructions relating to this Project.

Best regards,

The Director of Directorate of
Environment and Classified Establishments
Cheikh FOFANA

Cc

- DCPN (for informing)
- DREEC DK (for informing and monitoring)

Appendix 8

Appendix 8-1 Estimated Construction Cost

Item	Specification	Unit	Quantity	Unit Price (Yen)	Amount (Yen)
1. Constructon of the seawater desalination plant					
1a. Seawater intake and brine discharge facilities					
(1) Material Procurement					
1) Intake Pipe and Head					
Intake pipe	DN 1200 PE100 SDR26	m	715	148,000	105,820,000
Intake head	DN 1200 TYPE	unit	2	18,000,000	36,000,000
2) Discharge Pipe and Head					
Discharge pipe	DN 710 PE100 SDR26	m	495	53,000	26,235,000
Discharge head	Header:DN1600/1100 Nozzele:DN500	unit	1	17,395,000	17,395,000
3) Accessories					
Chlorination pipes diffuser	DN40	unit	2	49,000	98,000
pipe	DN63	m	760	4,000	3,040,000
Bolt Nut		LS	1	1,200,000	1,200,000
Gasket		LS	1	960,000	960,000
Expansion joint 1200A	1200A	set	2	3,600,000	7,200,000
710A	710A	set	1	1,440,000	1,440,000
Cathodic protection		LS	1	1,080,000	1,080,000
Navigation Buoy		set	2	4,800,000	9,600,000
Miscellauneous		LS	1	6,000,000	6,000,000
4) Material transportation	Imported material	LS	1	36,000,000	36,000,000
				Sub-total	252,068,000
(2) Transportation					
1) Intake pipe and Head	Ocean transportation from assembly yard to installation site	LS	1.0	12,000,000	12,000,000
2) Discharge pipe and Head	Ocean transportation from assembly yard to installation site	LS	1.0	7,200,000	7,200,000
3) Miscellaneous	Ocean transportation from assembly yard to installation site	LS	1	3,600,000	3,600,000
				Sub-total	22,800,000
(3) Offshore civil works					
1) Dredging	Intake and Dischareg	m3	22,000	2,400	52,800,000
2) Backfilling	Intake and Dischareg	m3	14,000	2,640	36,960,000
3) Scour protection	Rock material	m3	5,200	6,000	31,200,000
	Scour protection filling	m3	5,200	9,600	49,920,000
				Sub-total	170,880,000
(4) Pipe Installation Works					
1) Intake pipe Installation					
Crusher-run for foundation		m3	2,160	13,000	28,080,000
Concrete ballast block		pcs	240.0	43,000	10,320,000
Installation		m	715.0	72,000	51,480,000
2) Intake Head installation					
Crusher-run for foundation		m3	192	13,000	2,496,000
Installation		unit	2	10,200,000	20,400,000
3) Discharge pipe Installation					
Crusher-run for foundation		m3	990	13,000	12,870,000
Concrete ballast block		pcs	165.0	14,000	2,310,000
Installation		m	495.0	64,800	32,076,000
4) Discharge Head Installation					
Crusher-run for foundation		m3	102	13,000	1,326,000
Installation		unit	1	9,600,000	9,600,000
				Sub-total	170,958,000
(5) Onshore Civil Works					
1) Temporary cofferdam					
Materials of sheet pile	L=200m*2 Lane	m	400.0	90,000	36,000,000
Sheet piling work		m	400.0	150,000	60,000,000
2) Excavation	Intake and Dischareg	m3	30,000	1,800	54,000,000
3) Backfilling	Intake and Dischareg	m3	25,000	2,160	54,000,000
				Sub-total	204,000,000
(6) Onshore Pipe Installation Works					
1) Connection pipe installation	Intake	pcs	2	1,200,000	2,400,000
2) Connection pipe installation	Discharge	pcs	1	1,200,000	1,200,000
				Sub-total	3,600,000

(7) Temporary Works					
1) Mobilization and Demobilization of Construction Equipment					
Dredging and backfilling equipment	Grub Dredger or equivalent, including tag boat, anchor boat, e	LS	2	18,000,000	36,000,000
Offshore installation equipment					
Crane barge	100t including tag boat	LS	2	18,000,000	36,000,000
Flat top of barge	For transportation of intake unit pipe and intake head	LS	2	6,000,000	12,000,000
Other offshore equipment	Diving boat and other equipment for offshore works	LS	2	6,000,000	12,000,000
Onshore construction equipment					
Cofferdam construction equipme	Crawler crane and other piling equipment	LS	2	6,000,000	12,000,000
Excavation and backfilling equip	Back hoe, Truck, Cram shell etc.	LS	2	6,000,000	12,000,000
2) Site Survey		LS	2.0	2,400,000	4,800,000
3) Site Office setup	Site office and necessary facilities in construction site	LS	2.0	1,200,000	2,400,000
4) Assembling yard expenses		LS	1.0	2,400,000	2,400,000
5) Temporary yard expenses		LS	1.0	2,400,000	2,400,000
6) Access Road Expenses		LS	1.0	2,400,000	2,400,000
7) Site Clearance		LS	1.0	2,400,000	2,400,000
8) Site Cleaning		LS	1.0	2,400,000	2,400,000
				Sub-total	139,200,000
(8) Site Management					
1) Construction management	Foreign	MM	66.0	1,800,000	118,800,000
	Local	MM	66.0	240,000	15,840,000
2) Site expenses	personal	MM	66.0	360,000	23,760,000
	site office	Mth	18.0	1,200,000	21,600,000
	fabrication office	Mth	12.0	360,000	4,320,000
				Sub-total	184,320,000
(9) Engineering					
		LS	1	18,000,000	18,000,000
				Total of (1)-(9)	1,165,826,000
(10) General Expense					
		LS	1		205,734,000
				Total of 1a	1,371,560,000
Ib. Seawater transmission pumping station					
(1) Mechanical works					
1) Travel Screen	H=11m, W=3m	no.	2	51,477,000	102,954,000
2) Pump	Vertical mixed flow, Q=45m ³ /min, H=62m	no.	3	35,398,500	106,195,500
3) Piping		%	70 % of 2)		74,337,000
4) Miscellaneous equipment		%	16 % of 1)+2)+3)		45,358,000
				Sub-total	328,844,500
(2) Electrical Works					
1) Switchgear	30kV	no.	1	32,206,000	32,206,000
2) Transformer	30/6.6 kV, 2,500 kVA	no.	2	14,399,000	28,798,000
3) Motor control panel	for (1)-2)	no.	3	5,573,000	16,719,000
4) Miscellaneous equipment		%	38 % of 1) - 3)		29,534,740
5) Diesel engine generator	50kVA	no.	1	1,764,000	1,764,000
				Sub-total	109,021,740
(3) Civil Works					
1) Civil and Building works		%	45 % of (1)		147,980,000
				Sub-total	147,980,000
				Total of Ib	585,846,000
Ic. Seawater transmission and brine discharge pipeline					
(1) Pipe material					
1) Pipe material (Influent pipeline)	Coated steel pipe for water service D1100	m	2,216	88,000	195,008,000
2) Fittings, valves for the above		Ls	21 % of 1)		40,952,000
3) Pipe material (Effluent pipeline)	Coated steel pipe for water supply service D1000	m	952	70,000	66,640,000
4) Fittings, valves for the above		Ls	21 % of 3)		13,994,000
				Sub-total	316,594,000
(2) Installation					
1) Pipe laying and valve installtion	including valve pit and thrust block	Ls	5 % of (1)-[1) +3)		13,082,000
2) Excavation (trench excavation)		m3	19,285	363	7,001,741
3) Backfill		m3	16,720	441	7,379,790
4) Transport of backfill material		m3	11,068	775	8,577,139
5) Disposal of surplus material		m3	13,633	1,880	25,634,072
6) Pavement demolition		m2	240	1,570	376,800
7) Pavement restoration		m2	240	6,170	1,480,800
8) Timbering and shuttering	Sheet pile III	m2	280	26,844	7,516,193
9) Timbering and shuttering		m2	6,370	1,120	7,134,400
				Sub-total	78,182,934
				Total of Ic	394,777,000

1d. Seawater desalination facility						
(1) Mechanical works		Main Component				
1) Pre-treatment section	Receiving tank, feed pump and automatic backwash strainer UF membrane skids UF backwash tank and UF backwash pump	Ls	1	-	1,180,000,000	
2) Reverse osmosis section	High pressure pump and related booster pump Energy recovery system and related booster pump RO membrane skids Intermediate tank and flushing pump	Ls	1	-	2,712,000,000	
3) Post treatment section	Carbonization system and alkalization system pH control and disinfection system Product water transfer pump	Ls	1	-	685,000,000	
4) Waste water treatment plant	Chemical treatment system Oily water treatment system	Ls	1	-	231,000,000	
					Sub-total	4,808,000,000
(2) Electrical works		Ls	1	-	1,039,000,000	
(3) I&C works		Ls	1	-	346,000,000	
(4) Auxilliary systems		Ls	1	-	462,000,000	
(5) Civil works		Ls	1	-	1,154,000,000	
(6) SENELEC Power Receiving		Ls	1	-	634,000,000	
					Total of 1d	8,443,000,000
1e. Product water transmission pumping station						
(1) Mechanical works						
1) Pump	Horizontal double suction, Q=18.5m ³ /min, H=22m	no.	3	2,633,000	7,899,000	
2) Piping		%	228	% of 1)	18,010,000	
3) Miscellaneous equipment		%	6	% of 1)+2)	1,555,000	
					Sub-total	27,464,000
(2) Electrical Works						
1) Motor control panel	for (1)-1)	no.	3	1,217,000	3,651,000	
2) Miscellaneous equipment		%	274	% of 1)	10,004,000	
					Sub-total	13,655,000
(3) Civil Works						
1) Civil and Building works		%	33	% of (1)	9,063,000	
					Total of 1e	50,182,000
1f. Product water transmission pipeline						
(1) Pipe material						
1) Pipe material	DCI D800	m	622	68,696	42,729,000	
2) Fittings, valves		Ls	21	% of 1)	8,973,000	
					Sub-total	51,702,000
(2) Installation						
1) Pipe laying and valve installation	including valve pit and thrust block	Ls	5	% of (1)-1)	2,136,000	
2) Excavation (trench excavation)		m ³	2,354	363	855,000	
3) Backfill	Manual	m ³	2,120	988	2,095,000	
4) Transport of backfill material		m ³	691	775	536,000	
5) Disposal of surplus material		m ³	925	1,880	1,739,000	
6) Pavement demolition		m ²	81	1,570	127,000	
7) Pavement restoration		m ²	81	6,170	500,000	
8) Timbering and shuttering		m ²	2,615	1,120	2,929,000	
8) Pipe sheath for Phase-2	DCI D1000	m	36	90,579	3,261,000	
					Sub-total	14,178,000
					Total of 1f	65,880,000
1g. Land development for the plant sites						
(1) Temporary Work		Temporary drain and road, etc.	Ls	8	% of [2) - 5)]	20,593,000
(2) Earth Work						
1) Excavation (ground excavation)		m ³	182,693	148	27,075,000	
2) Embankment		m ³	17,510	320	5,602,000	
3) Soil disposal		m ³	165,183	627	103,535,000	
					Sub-total	136,212,000
(3) Slope Protection and Retaining Wall						
1) Structure concrete	300kg/m ³ including formwork and re-bar	m ³	2,176	20,690	45,022,000	
2) Masonry work	Cement 400kg/m ³	m ³	4,427	2,090	9,253,000	
3) Miscellaneous work		Ls	5	% of [1) +2)]	2,714,000	
					Sub-total	56,989,000
(4) Road work						
Asphalt pavement		m ²	8,420	6,170	51,952,000	
					Sub-total	51,952,000
(5) Miscellaneous Work		Fence, gate, landscaping, drain, etc.	Ls	5	% of [2) - 4)]	12,258,000
					Total of 1g	278,004,000
					Grand Total of 1	11,189,249,000

2. Improvement works of the existing distribution network					
2a. Installation of main distribution pipes (D700, L=13.5km)					
(1) Pipe material					
1) Pipe material	DCI D700	m	13,500	54,538	736,258,000
2) Fittings, valves		Ls	21 % of 1)		154,615,000
Sub-total					890,873,000
(2) Installation					
1) Pipe laying and valve installtion	including earthworks and concrete works	Ls	21 % of (1) - 1)		154,615,000
2) Pavement demolition		m2	27,000	1,570	42,390,000
3) Pavement restpration		m2	27,000	6,170	166,590,000
Sub-total					363,595,000
(3) Miscellaneous					
	connection to existing pipeline, etc.	Ls	5 % of (1)+(2)		62,723,000
Total of 2a					1,317,191,000
2b. Replacement of the existing distribution pipes in the distribution area of the Mamelles SWRO Plant (L= 243km)					
1) DCI DN 300	including earth works, pressure test, fittings, valves, etc.	m	10,635	22,205	236,151,000
2) DCI DN 350	including earth works, pressure test, fittings, valves, etc.	m	3,828	26,130	100,026,000
3) DCI DN 400	including earth works, pressure test, fittings, valves, etc.	m	134	31,947	4,281,000
4) DCI DN 500	including earth works, pressure test, fittings, valves, etc.	m	13,357	44,483	594,160,000
5) DCI DN 600	including earth works, pressure test, fittings, valves, etc.	m	4,153	59,632	247,652,000
6) DCI DN 700	including earth works, pressure test, fittings, valves, etc.	m	2,305	77,382	178,366,000
1) PE DN 100 (OD125)	including earth works, pressure test, fittings, valves, etc.	m	92,992	3,345	311,059,000
2) PE DN 150 (OD180)	including earth works, pressure test, fittings, valves, etc.	m	62,500	5,554	209,063,000
3) PE DN 200 (OD250)	including earth works, pressure test, fittings, valves, etc.	m	37,139	9,277	206,271,000
4) PE DN250 (OD300)	including earth works, pressure test, fittings, valves, etc.	m	15,671	17,166	145,380,000
7) House connection	including DN15 water meter	no.	63,749	18,090	1,153,220,000
8) House connection (public)	including DN30 water meter	no.	154	40,250	6,199,000
9) Pavement demolition (DCI)		m2	28,390	1,570	44,573,000
6) Pavement demolition (PE)		m2	211,602	1,570	332,216,000
10) Pavement restpration (DCI)		m2	28,390	6,170	175,167,000
7) Pavement restpration (PE)		m2	211,602	6,170	1,305,585,000
8) Connection to sector (PE DN200)	including earth works, pressure test, fittings, valves, etc.	m	2,200	9,467	20,827,000
9) Installation of flow meter for sec DN 200		no.	22	238,400	5,245,000
10) Installation of valve for sector	Refer to the cae of PE DN100 replacement (5m /location)	m	1,100	3,413	3,755,000
11) Installation of booster pumps	a install at sector inlets which has high elevation area	no.	2	20,000,000	40,000,000
Total of 2b					5,319,196,000
2c. Replacement of the existing distribution pipes in the other area in the Dakar 1 Zone (L=199km)					
1) DCI DN 300	including earth works, pressure test, fittings, valves, etc.	m	8,701	23,111	201,089,000
2) DCI DN 350	including earth works, pressure test, fittings, valves, etc.	m	3,132	27,197	85,182,000
3) DCI DN 400	including earth works, pressure test, fittings, valves, etc.	m	110	33,251	3,658,000
4) DCI DN 500	including earth works, pressure test, fittings, valves, etc.	m	10,929	46,299	506,002,000
5) DCI DN 600	including earth works, pressure test, fittings, valves, etc.	m	3,398	62,066	210,901,000
6) DCI DN 700	including earth works, pressure test, fittings, valves, etc.	m	1,886	80,540	151,899,000
1) PE DN 100 (OD125)	including earth works, pressure test, fittings, valves, etc.	m	76,084	3,481	264,849,000
2) PE DN 150 (OD180)	including earth works, pressure test, fittings, valves, etc.	m	51,136	5,781	178,005,000
3) PE DN 200 (OD250)	including earth works, pressure test, fittings, valves, etc.	m	30,387	9,656	175,668,000
4) PE DN250 (OD300)	including earth works, pressure test, fittings, valves, etc.	m	12,821	17,867	123,800,000
7) House connection	including DN15 water meter	no.	52,159	18,090	943,557,000
8) House connection (public)	including DN30 water meter	no.	126	40,250	5,072,000
9) Pavement demolition (DCI)		m2	42,234	1,570	66,308,000
6) Pavement demolition (PE)		m2	173,128	1,570	271,811,000
10) Pavement restpration (DCI)		m2	42,234	6,170	260,584,000
7) Pavement restpration (PE)		m2	173,128	6,170	1,068,200,000
8) Connection to sector (PE DN200)	including earth works, pressure test, fittings, valves, etc.	m	1,800	9,467	17,041,000
9) Installation of flow meter for sec DN 200		no.	18	238,400	4,292,000
10) Installation of valve for sector	Refer to the cae of PE DN100 replacement (5m /location)	m	900	3,413	3,072,000
11) Installation of booster pumps	a install at sector inlets which has high elevation area	no.	1	20,000,000	20,000,000
Total of 2c					4,560,990,000
Grand Total of 2					11,197,377,000
Grand Total of 1 and 2					22,386,626,000

Appendix 8-2 Estimated Project Cost

Annual Fund Requirement

Base Year for Cost Estimation: Oct. 2015
 Exchange Rates: XOF = JPY : million XOF ; million JPY
 Price Escalation: 1.8% ; 2.6%
 Physical Contingency: 5%
 Physical Contingency for Consultant: 5%

Item	Total		2015		2016		2017		2018		2019		2020		2021		2022		
	FC	LC	FC	LC	FC	LC	FC	LC	FC	LC	FC	LC	FC	LC	FC	LC	FC	LC	
A. ELIGIBLE PORTION																			
I. Procurement / Construction	19,916	28,373	25,704	0	0	0	0	0	1,938	2,719	2,493	5,096	10,118	10,161	9,485	9,068	2,746	6,051	3,962
CP-1: Construction of the seawater desalination plant	9,657	7,513	11,169	0	0	0	0	0	965	751	1,119	4,628	3,756	5,959	4,705	0	0	0	0
CP-2: Installation of the main distribution pipe	3,922	1,997	316	0	0	0	0	0	372	794	522	1,177	2,591	1,659	217	1,568	1,117	2,327	1,556
CP-3: Installation of the existing distribution pipe	3,193	7,672	4,163	0	0	0	0	0	315	621	459	1,959	2,012	1,368	2,012	1,368	918	2,012	1,368
CP-4: Replacement of the existing distribution pipe	17,485	23,979	22,387	0	0	0	0	0	1,243	2,388	2,335	7,190	8,648	8,524	6,214	7,495	2,331	4,940	3,339
Base cost for JICA financing	1,473	3,043	2,093	0	0	0	0	0	96	132	135	531	840	723	860	1,088	802	266	433
Physical contingency	948	1,351	1,224	0	0	0	0	0	92	129	139	396	482	484	482	432	131	288	190
II. Consulting services	917	3,474	1,626	0	0	0	0	0	134	486	488	1,669	740	320	169	711	314	82	359
Base cost	821	3,016	1,437	0	0	0	0	0	121	437	210	1,501	636	280	147	595	268	70	293
Physical contingency	52	293	112	0	0	0	0	0	13	35	14	11	69	25	14	82	30	8	49
III. Dispute board cost by Client	44	165	77	0	0	0	0	0	6	24	6	8	35	15	8	34	15	4	17
Total (I + II + III)	20,970	31,847	27,467	0	0	0	0	0	2,082	3,215	2,738	8,308	10,658	10,523	7,345	10,195	9,424	2,858	6,410
B. NON ELIGIBLE PORTION																			
a. Procurement / Construction	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Base cost for JICA financing	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Physical contingency	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
b. Land Acquisition	0	8,696	1,807	0	1,518	310	0	5,193	1,099	0	1,599	328	0	547	112	0	0	0	0
Base cost	0	8,194	1,672	0	1,446	259	0	4,820	983	0	1,446	293	0	482	98	0	0	0	0
Physical contingency	0	240	83	0	76	18	0	223	46	0	39	8	0	39	8	0	0	0	0
c. Administration cost	0	1,432	293	0	15	3	0	140	28	0	140	28	0	518	105	0	482	94	0
Base cost	0	6,542	1,334	0	6	0	0	637	142	0	2,104	429	0	1,934	405	0	1,245	250	0
VAT	0	2,929	597	0	0	0	0	433	93	0	433	93	0	1,038	214	0	404	82	0
Import Tax	0	19,761	4,031	0	5,316	1,094	0	2,078	424	0	1,688	340	0	3,810	777	0	1,835	374	0
Total (a+b+c+d+e)	20,970	51,608	31,498	0	1,533	313	0	8,308	3,078	2,082	4,883	922	0	7,345	13,690	10,137	2,858	8,245	4,540
C. Interest during Construction	622	0	622	0	0	0	0	0	18	0	18	89	0	89	153	0	153	181	0
Interest during Construction (Const.)	622	0	622	0	0	0	0	0	18	0	18	89	0	89	153	0	153	181	0
Interest during Construction (Consult.)	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
D. Front End Fee	55	0	55	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GRAND TOTAL (A+B+C+D)	21,647	51,608	32,175	0	1,533	366	0	8,308	3,096	2,100	4,883	922	0	7,497	13,690	10,290	3,039	8,245	4,721
E. JICA finance portion (A)	20,970	31,847	27,467	0	0	0	0	0	2,082	3,215	2,738	8,308	10,658	10,523	7,345	10,195	9,424	2,858	6,410

Administration Cost = 1%
 VAT = 18% of the expenditure in local currency of the eligible portion
 Import Tax = 3%

Appendix 8-4 Estimated Dispute Board Cost

Cost for Dispute Board (DB)

[Each CP] in JPY

Item	CP-1	CP-2	CP-3	CP-4	Total
I. Cost for the regular Site Visits	106,827,750	40,729,770	40,729,770	40,729,770	229,017,060
1) Cost for the regular Site Visits - 2)	89,518,950	37,844,970	37,844,970	37,844,970	203,053,860
2) Monthly Retainer Fee during DNP	17,308,800	2,884,800	2,884,800	2,884,800	25,963,200
II. Cost for the referral	22,717,800	7,572,600	7,572,600	7,572,600	45,435,600
Total	129,545,550	48,302,370	48,302,370	48,302,370	274,452,660

[CP-1] in JPY

	2018	2019	2020	2021	2022	Construction	DNP*	Total
	Cosntruction	Cosntruction	Cosntruction	DNP*	DNP*			
Month	5Months	12Months	12Months	12Months	12Months	29Months	24Months	53Months
I. Cost for the regular Site Visits								
1) Cost for the regular Site Visits - 2)	15,434,302	37,042,324	37,042,324			89,518,950		89,518,950
2) Monthly Retainer Fee during DNP				8,654,400	8,654,400		17,308,800	17,308,800
Sub-total	15,434,302	37,042,324	37,042,324	8,654,400	8,654,400	89,518,950	17,308,800	106,827,750
II. Cost for the referral	2,143,189	5,143,653	5,143,653			12,430,495		12,430,495
				5,143,653	5,143,653		10,287,306	10,287,306
Sub-total	2,143,189	5,143,653	5,143,653	5,143,653	5,143,653	12,430,495	10,287,306	22,717,801
Total	17,577,491	42,185,977	42,185,977	13,798,053	13,798,053			129,545,551

[CP-2 to 4] in JPY

	2018	2019	2020	2021	2022	Construction	DNP*	Total
	Cosntruction	Cosntruction	Cosntruction	Cosntruction	DNP*			
Month	1Months	12Months	12Months	12Months	12Months	37Months	12Months	49Months
I. Cost for the regular Site Visits								
1) Cost for the regular Site Visits - 2)	3,068,511	36,822,133	36,822,133	36,822,133		113,534,910		113,534,910
2) Monthly Retainer Fee during DNP					8,654,400		8,654,400	8,654,400
Sub-total	3,068,511	36,822,133	36,822,133	36,822,133	8,654,400	113,534,910	8,654,400	122,189,310
II. Cost for the referral	463,629	5,563,543	5,563,543	5,563,543		17,154,258		17,154,258
					5,563,543		5,563,543	5,563,543
Sub-total	463,629	5,563,543	5,563,543	5,563,543	5,563,543	17,154,258	5,563,543	22,717,801
Total	3,532,140	42,385,676	42,385,676	42,385,676	14,217,943			144,907,111

[TOTAL] in JPY

	2018	2019	2020	2021	2022	TOTAL
TOTAL	21,109,631	84,571,653	84,571,653	56,183,729	28,015,996	274,452,662
Cost sharing (By Contractor)	10,554,816	42,285,827	42,285,827	28,091,865	14,007,998	137,226,333
Cost sharing (By Client)	10,554,816	42,285,827	42,285,827	28,091,865	14,007,998	137,226,333

NOTE: DNP*: Defect Notofication Period

The above calculation was carried out based on JICA DB Manual in Mar. 2012.

Appendix 9 Terms of the Reference of the Consulting Services

1. Background and Project Outlines

1.1 Background

The Dakar Region, which is the capital region of Republic of Senegal (hereinafter, “Senegal”), is the most populated urban area in the country. According to the census implemented by National Agency of Statistics and Demography (ANSD), its population in 2013 was approximately 3.1 million, which had grown by 50% from the previous census results in 2002.

Water resources of the Dakar Region depend on surface water of Lac de Guiers located 250 km away from the capital and the groundwater from wells constructed along the water transmission lines named as ALG1 & ALG2 which are extended from Water Treatment Plants (WTPs) treating the surface water of Lac de Guiers. In the recent decade, however, upcoming water shortage has been a social concern due to the rapid population growth in the region and the limited capacity of the existing water production facilities.

In order to prepare for water security in the capital region and its surrounding area, from 2009 to 2011, the Water Company of Senegal or “Société Nationale des Eaux du Sénégal” (SONES) implemented a master plan study, called “Etude de Schéma Directeur de Mobilisation des Ressources en Eau de la Region de Dakar et de la Zone de la Petite Côte (hereinafter, “Water Resources MP 2011”)", to estimate future water demand and establish a water resources development scenario. In Water Resources MP 2011, three (3) major water production facilities were set, and among them, the Mamelles Seawater Desalination Plant Construction Project (hereinafter refer to “the Project”) is one of the key projects for the water security in the capital region.

On July 2013, Government of Senegal (GOS) sent a request letter for a financial assistance to the Government of Japan (GOJ) regarding this Project. Corresponding to the request from GOS, Japan International Cooperation Agency (JICA) carried out a series of studies, which are to carry out information collection and feasibility study, which is named as the Preparatory Survey on the Mamelles Sea Water Desalination Plant Construction Project.

Through the appraisal and negotiation processes, based on the study results, GOJ and GOS finally agreed to utilize Japanese ODA Loan for eligible payments for the Project. This terms of reference (TOR) is issued for consulting services for the Project (hereinafter refer to “the Services”).

1.2 Objectives of the Project

The Project aims to deliver an additional water production of 50,000 m³/day by seawater desalination for the Dakar Region, and to improve efficiency of the existing water distribution network in the distribution area of the seawater desalination plant.

1.3 Scope of the Project

The Project consists of the following components:

- a) Construction of a seawater desalination plant, which is named as the “Mamelles Seawater Desalination Plant” (hereinafter refer to “Mamelles SWRO”), having a daily capacity of 50,000 m³/day and extendable to 100,000 m³/day in the future in the Ouakam Municipality, the Dakar Region;
- b) Construction of a product water transmission system to connect the desalination plant and existing Mamelles Reservoirs;
- c) Improvement of the existing water distribution network by which the product water from the desalination plant will be distributed.

Construction items in the Project are listed in Table 1.1.

Table 1.1 Construction Items in the Project

Component	Construction items
a) Construction of Mamelles Seawater Desalination Plant (daily capacity of 50,000 m ³ /day and extendable to 100,000 m ³ /day in the future)	<ul style="list-style-type: none"> - Seawater intake - Seawater transmission pipelines (marine and terrestrial) - Seawater transmission pumping station - Seawater treatment facilities by reverse osmosis (RO) process - Effluent discharge pipelines - Substation for power receiving - All other facilities necessary for seawater desalination process
b) Construction of product water transmission system	<ul style="list-style-type: none"> - Product water transmission pumping station - Product water transmission pipelines (Approximately 800 m in length x 1 lines)
c) Improvement of the existing distribution network	<ul style="list-style-type: none"> - New distribution mains (D700mm, 13.5 km, DCIP) - Replacement of the existing distribution pipes (D75-700mm, 442 km, DCIP or HDPE) - Replacement of the service connections including water meters - Setup of district metered areas

1.4 Procurement Package and Procedure

All contract packages from Package 1 to Package 4 will be procured through International Competitive Bidding (ICB), based on Single-Stage Two-Envelope Bidding Procedure with Pre-qualification in accordance with the JICA’s Procurement Guideline (Section 2.03, Part II) a shown in Table 1.2.

Table 1.2 Procurement Package and Procedure of the Project

Package	Component	Procurement procedure
CP-1	[Construction of Mamelles Seawater Desalination Plant] a. Seawater intake and brine discharge facilities b. Seawater intake pumping station c. Seawater transmission and brine discharge pipelines d. Seawater desalination facility e. Product water transmission pumping station f. Product water transmission pipeline g. Land development for the plant	<ul style="list-style-type: none"> - International Competitive Bid (ICB) - Design-Build or Engineering-Procurement-Construction (EPC) contract - O&M of the desalination plant after commissioning will be included in the EPC contract
CP-2	Installation of a new distribution main (D700, L=13.5 km)	<ul style="list-style-type: none"> - International Competitive Bid (ICB) - Design-Bid-Build contract
CP-3	Improvement of the existing distribution network in the influence area of the Mamelles SWRO Plant (D75-700, L=243 km)	

Package	Component	Procurement procedure
CP-4	Improvement of the existing distribution network in the other areas in the Dakar 1 Zone (D75-700, L=199 km)	

1.5 Funding Source

Funding source of the Project, including that for the Services, is Japanese ODA Loan.

1.6 Executing Agency

The Executing Agency of the Project is Water Company of Senegal or “Société Nationale des Eaux du Sénégal” (SONES).

1.7 Technical Information

The final report on the “Preparatory Survey on the Mamelles Sea Water Desalination Plant Construction Project” is available at SONES. Also, the natural condition survey results implemented by SONES are available as below:

- Bathymetric survey of the seabed;
- Sounding tests, and geotechnical studies;
- Analysis and monitoring of the water quality;
- Measurement and monitoring of marine and atmospheric conditions;
- Assessment (inventory) of marine fauna and flora;
- Maritime Hydraulics Studies;
- Environmental studies.

2. Objectives of the Consulting Services

The objectives of the consulting services are to achieve the efficient and proper preparation and implementation of the Project through the following works:

- Design works
- Tender assistance
- Construction supervision
- Facilitation of implementation of Environmental Management Plan (EMP) and Environmental Monitoring Plan (EMoP)

3. Scope of the Consulting Services

3.1 Design Works

- (1) Part A: Construction of the seawater desalination plant

The Consultant shall carry out a conceptual design of Mamelles SWRO through the following work items:

- a) Review of the technical information on the Project as listed in Section 1.7;
- b) Implementation of the supplementary natural condition surveys which will be provided as a part of the tender document;
- c) Conceptual design of Mamelles SWRO which includes but not limited to:
 - Intake structures
 - Seawater screening and pumping station
 - Pre-treatment system
 - RO process
 - Post treatment system
 - Wastewater treatment system
 - Chemical storage and handling
 - Effluent discharge system
 - Handling of waste sludge
 - Power receiving substation
 - Product water storage
 - Product water transmission pumping station
 - Product water transmission pipelines
- d) Preparation of conceptual design report which includes but not limited to description of the all processes, general layout plan, a water and material balance sheet, overall process flow diagram, and instrumentation plan.
- e) Preparation of technical specification to be included in the bid documents

(2) Part B: Improvement of the existing water distribution network

The Consultant Shall carry out a detailed design of improvement works of the existing distribution network through the following work items:

- a) Review of the technical information on the Project as listed in Section 1.7
- b) Review of the inventory data of the distribution network map to be provided by SONES
- c) Implementation of topographic and geotechnical surveys for the Dakar 1 Zone
- d) Preparation of large sectorization plan for the Dakar Region, which includes
 - Identifications of the locations of the macro meters for the respective large sectors
 - Identifications of the locations of the valves to divide the existing distribution network into the large sectors physically
 - Preliminary cost estimation for setup of the large sectors

- e) Preparation of detailed sectorization plan for water loss and pressure control for the Dakar 1 Zone as the basic plan for the detailed design
- f) Hydraulic modelling and analysis of the distribution network for the Dakar 1 Zone
- g) Selection of the target sections for pipe renewal for the Dakar 1 Zone
- h) Preparation of detailed design drawings for the improvement of the existing distribution network for the Dakar 1 Zone (CP 2 to 4)
- i) Preparation of technical specifications and bill of quantities to be included in the bid documents

3.2 Tender Assistance

(1) Assistance in Pre-Qualification (PQ) of applicants

The Consultant shall assist SONES in the PQs for the both packages respectively by the following works:

- a) Definition of PQ criteria: technical and financial requirements, capacity and/or experience taking into consideration technical feature of the Project;
- b) Preparation of PQ documents in accordance with the latest version of Standard Prequalification Documents under Japanese ODA Loans;
- c) Assistance to SONES in PQ announcements, addendum/corrigendum, and clarifications to the applicants' queries;
- d) Evaluation of PQ applications in accordance with the criteria set forth;
- e) Preparation of PQ evaluation reports to be submitted to SONES;

(2) Assistance in bids for award of contractors;

The Consultant shall assist SONES in bids for the both packages respectively by the following works:

- a) Preparation of bid documents in accordance with the latest version of Standard Bidding Documents under Japanese ODA Loans for Procurement of Works together with all relevant specifications, drawings and other documents;
- b) Assistance to SONES in issuing bid invitations, conducting pre-bid conferences, issuing addendum/corrigendum, and clarifications to bidders' queries;
- c) Evaluations of the bids in accordance with the criteria set forth in the bidding documents, laws, regulations;
- d) Preparation of bid evaluation reports for approval to be submitted to SONES;
- e) Assistance to SONES in contract negotiations by preparing agenda and facilitating negotiations including preparation of minutes of negotiation meetings;
- f) Preparation of draft and final contract agreements.

3.3 Construction Supervision

The Consultant shall perform his duties during the construction period in accordance with the contracts to be executed between SONES and the contractors. In this context, the Consultant shall act as the Engineer to execute construction supervision and contract administration services in accordance with the power and authority delegated by SONES. Construction supervision by the Consultant will include the following works:

- a) Assistance to SONES concerning variations and claims which are to be ordered/issued at the initiative of SONES;
- b) Issuance of the commencement order to the contractors;
- c) Provision of recommendations to SONES for acceptance of the contractor performance security, advance payment security and required insurances;
- d) Reviews and approvals the proposals submitted by the contractors which include work program, method statements, material sources, manpower and equipment deployment;
- e) Explanation and/or adjustment of ambiguities and/or discrepancies in the contract documents and issuance of any necessary clarifications or instructions;
- f) Reviews and verifications and approvals of the contractors' detailed or working drawings and, if necessary, issuance of instructions to the contractors;
- g) Liaison with the appropriate authorities to ensure that all the affected utility services are promptly relocated;
- h) Field inspections on the contractor's setting out to ensure that the works are carried out in accordance with approved drawings and other design details;
- i) Regular monitoring of physical and financial progress against the milestones as per the contract so as to ensure completion of the contract in time;
- j) Supervision of the site works, field tests, sampling and laboratory test by the contractors so that all the contractual requirements will be met by the contractors, including those in relation to i) quality of the works, ii) safety and iii) protection of the environment;
- k) Inspection of the construction method, equipment to be used, workmanship at the site, and attend shop inspection and manufacturing tests in accordance with the specifications;
- l) Survey and measurement of the work output performed by the contractors and issuance of payment certificates as specified in the contract;
- m) Modification of the designs, technical specifications and drawings, relevant calculations and cost estimation may be necessary in accordance with the actual site conditions, and issue variation orders (This work item is applied only to CP 2.);

- n) Inspection of the works and to issuance of the Taking-Over Certificate and Performance Certificate as specified in the contract documents;
- o) Supervision of testing and commissioning;
- p) Inspection services during defects liability period (Defect Notification Period defined in FIDIC Conditions of Contract) and instruction to the contractor for rectification, if any defects are noted;
- q) Check and certification of as-built drawings submitted by the contractors;
- r) Review of operation manual of the desalination plant to be prepared by the contractor and instruction for improvement to the contractor, if necessary.

3.4 Facilitation of Implementation of Environmental Management Plan (EMP) and Environmental Monitoring Plan (EMoP)

The Consultant shall assist SONES in the environmental management and monitoring through the following works:

- a) Review and update of EMP according to the actual site conditions, designs, technical specifications and contract documents;
- b) Review and update of EMoP according to the updated EMP;
- c) Supervision of EMP implementation and implementation of regular compliance monitoring according to EMoP to ensure that the construction works are implemented in accordance with the EMP;
- d) Assistance to SONES in the capacity building of SONES staff on environmental management through on-the-job training so that the EMoP would be carried out appropriately in the O&M of the seawater desalination plant.

4. Expected Time Schedule

The total duration of consulting services will be 71 months including 24 months of Defect Liability Period. The expected implementation schedule is shown in Table 4.1.

Table 4.1 Implementation of Expected Schedule

Key Activities	Date	Duration in Months
[CP-1]		
Conceptual design	1 February 2017 - 30 June 2017	5
Tender assistance	1 March 2017 - 31 July 2018	17
Bid document preparation	1 March 2017 - 31 July 2017	5
Pre-qualification	1 June 2017 - 30 August 2017	3
Bid and contract negotiation	1 September 2017 - 31 July 2018	11
Construction supervision	1 August 2018 - 31 December 2022	53
Detailed design	1 August 2018 - 30 April 2019	9
Construction	1 December 2018 - 30 September 2020	22

Key Activities	Date			Duration in Months
Commissioning	1 October 2020	-	31 December 2020	3
Defect liability period	1 January 2021	-	31 December 2022	24
[CP-2, 3, 4]	-			
Detailed design	1 February 2017	-	31 January 2018	12
Tender assistance	1 September 2017	-	30 November 2018	15
Bid document preparation	1 September 2017	-	28 February 2018	6
Pre-qualification	1 December 2017	-	28 February 2018	3
Bid and contract negotiation	1 March 2018	-	30 November 2018	9
Construction supervision	1 December 2018	-	31 December 2022	49
Construction supervision	1 December 2018	-	31 December 2021	37
Defect liability period	1 January 2022	-	31 December 2022	12

5. Staffing

5.1 Staffing and Consulting Input for the Respective Phase

16 of Professional (A) consultants (Foreign Persons) and 26 of Professional (B) consultants (Local Persons) will be engaged, over 71 months duration of the Services, for a total of 258 man-months for Professional (A) and 406 man-months for Professional (B). Total consulting input is estimated to 664 man-months.

The Consultant Team for the design works, tender assistances and construction supervisions consists of the members listed in Table 5.1.

Table 5.1 List of Consulting Team Members

Position		Package and Phase					
		Package 1			Packages 2 to 4		
		Conceptual Design	Tender Assistance	Construction Supervision	Detailed Design	Tender Assistance	Construction Supervision
Professional (A): Foreign Experts							
1	Project Manager	✓	✓	✓	✓	✓	✓
2	Desalination Expert	✓	✓	✓			
3	Water Supply Engineer	✓	✓		✓	✓	
4	Civil Engineer	✓	✓	✓	✓	✓	✓
5	Pipeline Engineer 1	✓	✓	✓	✓	✓	✓
6	Pipeline Engineer 2				✓		
7	Mechanical Engineer	✓	✓	✓	✓	✓	✓
8	Electrical Engineer	✓	✓	✓	✓	✓	✓
9	Structural Engineer	✓		✓			
10	Specification Engineer 1	✓	✓				
11	Specification Engineer 2				✓	✓	
12	Contract Specialist 1		✓				
13	Contract Specialist 2					✓	
14	Financial Specialist		✓				
15	Environmental / Social Campaign Specialist	✓		✓	✓		✓
16	Commissioning Engineer			✓			
Professional (B): Local Experts							
1	Senior Civil Engineer	✓	✓	✓			
2	Civil Engineer				✓	✓	✓
3	Pipeline Engineer 1				✓	✓	✓
4	Pipeline Engineer 2				✓	✓	✓
5	Pipeline Engineer 3				✓	✓	
6	Water Supply Engineer				✓		
7	Structural Engineer	✓	✓	✓	✓	✓	✓
8	Mechanical Engineer	✓	✓	✓			
9	Electrical Engineer	✓	✓	✓			
10	Mechanical and Electrical Engineer				✓	✓	✓
11	Hydraulic System Modeller 1				✓		
12	Hydraulic System Modeller 2				✓		
13	Architect	✓	✓	✓			
14	Building Mechanical and Electrical Engineer	✓	✓	✓			
15	Topographic Specialist	✓			✓		
16	Geotechnical Specialist	✓			✓		
17	Construction Planner/Cost Estimator 1	✓	✓				
18	Construction Planner/Cost Estimator 2				✓		
19	Specification Specialist 1	✓	✓				
20	Specification Specialist 2				✓	✓	
21	Contract Specialist 1		✓				
22	Contract Specialist 2					✓	
23	Legal Specialist		✓				
24	Environmental Specialist	✓		✓	✓		✓
25	Social Communication Expert	✓		✓	✓		✓
26	Quantity Surveyor	✓	✓	✓	✓	✓	✓
Supporting Staff							
1	Secretary	✓	✓	✓	✓	✓	✓
2	Translator	✓	✓	✓	✓	✓	✓
3	CAD Operator	✓	✓	✓	✓	✓	✓
4	Office Keeper	✓	✓	✓	✓	✓	✓
5	Inspector			✓			✓

5.2 Qualification of Key Team Members

The qualifications of key members of Professional (A) are shown in Table 5.2.

Table 5.2 Qualifications of Key Professional (A) Members

Designation	Qualifications
Professional (A)	
Project Manager	<ul style="list-style-type: none"> - Licensed or Registered water supply engineer - Should have at least 15 years' experience in water supply or water related projects. - Should have handled at least one international water supply project as a project manager. - Should have handled at least one Japanese ODA loan project.
Desalination Expert	<ul style="list-style-type: none"> - Should have at least 15 years' experience in seawater desalination projects. - Should have handled at least three reverse osmosis plant projects involving tender assistance and construction supervision.
Water Supply Engineer	<ul style="list-style-type: none"> - Licensed or Registered water supply engineer - Should have at least 10 years' experience in water supply projects. - Should have handled at least 3 water supply projects involving planning, design or detailed design of water treatment plants or distribution networks. - Should have handled more than international 2 water supply projects involving design of water loss reduction program.
Civil Engineer	<ul style="list-style-type: none"> - Should have at least 7 years' experience in water supply or water related projects. - Should have handled at least 3 international water supply projects involving detailed design and construction supervision.
Pipeline Engineer 1	<ul style="list-style-type: none"> - Should have at least 7 years' experience in water supply projects - Should have at least one international water supply project involving detailed design and construction supervision of water conveyance system and distribution network for a minimum length of 30 km.
Mechanical Engineer	<ul style="list-style-type: none"> - Should have at least 10 years' experience of water supply projects involving design of mechanical works. - Should have at least 3 water supply projects involving detailed design, tender assistance and construction supervision. - Should have at least one international desalination project involving conceptual design and tender assistance.
Electrical Engineer	<ul style="list-style-type: none"> - Should have at least 10 years' experience of water supply projects involving design of mechanical works. - Should have at least 3 water supply projects involving detailed design, tender assistance and construction supervision.
Contract Specialist 1	<ul style="list-style-type: none"> - Should have at least 10 years' experience of water supply projects involving tender assistance. - Should have at least 3 water supply projects involving tender assistance. - Should have at least 3 public-private partnership (PPP) water supply projects involving O&M by private sector. - Should have at least one desalination project involving tender assistance.
Contract Specialist 2	<ul style="list-style-type: none"> - Should have at least 10 years' experience of water supply projects involving tender assistance. - Should have at least 3 water supply projects involving installation of water distribution pipes.
Professional (B)	
Senior Civil Engineer	<ul style="list-style-type: none"> - Should have at least 20 years' experience in water supply or water related projects. - Should have handled at least 5 water supply projects involving detailed design and construction supervision.

Also, the Consultant may propose other experts and supporting staff required to accomplish the tasks outlined in the TOR. It is the Consultant's responsibility to select the optimum team and to propose the professionals, which he believes to be the best to meet the needs of SONES.

Appendix 10-1. Calculation of FIRR (at Present Tariff Rate)

(Unit: Million FCFA)

Year	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046					
Water Production Amount by Mamelles Plant	0	0	0	13,674	20,966	23,151	27,907	34,066	36,849	37,687	42,951	48,240	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000						
Saved Water by Water Recovery Portion (m3/day)	Saleable	0	0	4,929	0	1,564	8,100	14,637	22,294	34,953	47,678	60,470	66,928	68,280	69,659	71,066	72,502	73,966	75,460	76,592	77,741	78,907	80,091	81,292	82,512	83,749	85,006	86,281	87,575	88,888					
	Not saleable	0	0	9,788	28,858	37,925	35,772	33,925	31,285	23,700	16,369	5,133	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0					
Number of Beneficiaries (people) 71.2L/p	71.2	0	0	69,200	148,500	249,600	365,100	508,500	683,000	891,000	1,078,800	1,315,600	1,463,700	1,501,800	1,521,200	1,541,000	1,561,100	1,581,700	1,602,700	1,618,600	1,634,700	1,651,100	1,667,700	1,684,600	1,701,700	1,719,100	1,736,700	1,754,600	1,772,800	1,791,300					
Year	NPV (D.R.=0.64%)	2,017	2,018	2,019	2,020	2,021	2,022	2,023	2,024	2,025	2,026	2,027	2,028	2,029	2,030	2,031	2,032	2,033	2,034	2,035	2,036	2,037	2,038	2,039	2,040	2,041	2,042	2,043	2,044	2,045	2,046				
Initial Investment Cost																																			
CAPEX - Water Production Portion	73,569	6,250	7,429	31,781	26,077	2,952	103																												
CAPEX - Water Recovery Portion	57,928	4,911	5,863	16,430	16,258	15,327	81																												
O&M Cost																																			
O&M - Desalination Plant	178,015	0	0	0	3,937	4,839	5,109	5,698	6,460	6,804	6,908	7,559	8,214	8,432	8,432	8,432	8,432	8,432	8,432	8,432	8,432	8,432	8,432	8,432	8,432	8,432	8,432	8,432	8,432	8,432	8,432				
Replacement Cost, Residual Value (water production)	-6,054	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
Reduction of Electricity Cost	-6,670	0	0	0	-90	-138	-152	-184	-224	-242	-248	-283	-317	-329	-329	-329	-329	-329	-329	-329	-329	-329	-329	-329	-329	-329	-329	-329	-329	-329	-329				
Reduction of O&M Cost for Pipes	-6,896	0	0	0	-294	-294	-294	-294	-294	-294	-294	-294	-294	-294	-294	-294	-294	-294	-294	-294	-294	-294	-294	-294	-294	-294	-294	-294	-294	-294	-294				
Reduced Cost for Water Production	-15,492	0	0	-710	-2,093	-2,751	-2,595	-2,461	-2,269	-1,719	-1,187	-372	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
Residual Value (water recovery)	-23,485	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
Total Cost	250,915	11,161	13,292	48,211	41,625	19,738	1,840	2,068	2,759	3,672	4,548	5,178	6,610	7,602	7,808	7,808	7,808	7,808	7,808	7,808	7,808	7,808	7,808	7,808	7,808	7,808	7,808	7,808	7,808	7,808	7,808				
Incremental Revenue																																			
Incremental Revenue - Water Production Portion	146,706	0	0	0	1,979	3,035	3,351	4,039	4,930	5,333	5,455	6,216	6,982	7,237	7,237	7,237	7,237	7,237	7,237	7,237	7,237	7,237	7,237	7,237	7,237	7,237	7,237	7,237	7,237	7,237	7,237				
Incremental Revenue - Water Recovery Portion	264,885	0	0	923	0	293	1,517	2,740	4,174	6,544	8,927	11,322	12,531	12,784	13,043	13,306	13,575	13,849	14,129	14,341	14,556	14,774	14,996	15,221	15,449	15,681	15,916	16,155	16,397	16,643					
Total Revenue	411,591	0	0	923	1,979	3,327	4,867	6,779	9,105	11,878	14,381	17,538	19,513	20,211	20,279	20,543	20,811	21,086	21,365	21,577	21,792	22,011	22,232	22,457	22,686	22,917	23,153	23,391	23,634	23,880					
Cash Flow	NPV (D.R.=0.64%)	2,017	2,018	2,019	2,020	2,021	2,022	2,023	2,024	2,025	2,026	2,027	2,028	2,029	2,030	2,031	2,032	2,033	2,034	2,035	2,036	2,037	2,038	2,039	2,040	2,041	2,042	2,043	2,044	2,045	2,046	FIRR	B/C		
Balance of whole project	160,676	-11,161	-13,292	-48,211	-40,702	-17,759	1,487	2,799	4,020	5,432	7,329	9,203	10,928	11,911	12,213	12,471	12,734	13,003	13,277	13,557	13,769	13,984	14,203	14,424	14,649	-3,060	15,109	15,344	15,583	15,825	70,133	5.6%	1.64		
(i) Water Production Portion	-92,154	-6,250	-7,429	-31,781	-26,077	-4,820	-1,770	-1,606	-1,475	-1,305	-1,229	-1,205	-1,060	-914	-866	-866	-866	-866	-866	-866	-866	-866	-866	-866	-866	-866	-866	-866	-866	-866	-866	-866	24,937	-9.2%	0.61
(ii) Water Recovery Portion	252,830	-4,911	-5,863	-16,430	-14,625	-12,940	3,257	4,406	5,496	6,738	8,558	10,409	11,989	12,826	13,079	13,337	13,600	13,869	14,143	14,423	14,635	14,850	15,068	15,290	15,515	15,743	15,975	16,210	16,449	16,691	45,195	13.6%	21.97		

WACC 0.64%
 CAPEX: Water Production Portion 74,591.2 million FCFA
 CAPEX: Water Recovery Portion 58,870.5 million FCFA
 Water Treatment Cost at Mamelles WTP 462 FCFA/m3 Fixed Cost Rate 26.6% Fixed 123 FCFA/m3 Variable 339 FCFA/m3
 SCF 1.0 (Financial Analysis: 1.0, Economic Analysis: 0.9)
 Billed Water Rate 0.789 Actual in 2014
 Collection Rate 0.980 Actual in 2013
 Revenue Water Rate 0.773
 Average Water Tariff in 2015 (predicted) 512.97 FCFA/m3 Predicted Average Water Tariff Rate in 2015, excluding TAX
 512.97 FCFA/m3 100.0%
 Saved O&M Cost 0.5% of initial investment cost for Water Recovery Portion
 Total Treatment Cost of SDE in 2014 26,088 million FCFA supplies, materials, energy cost 26,088 million FCFA 100%
 Billed Water Amount 131,281,610 m3
 Treatment Cost 198.72 FCFA/m3

Appendix 10-2. Calculation of FIRR at Affordability to Pay Level

(Unit: Million FCFA)

Year	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046				
Water Production Amount by Mamelles Plant	0	0	0	0	13,674	20,966	23,151	27,907	34,066	36,849	37,687	42,951	48,240	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000				
Saved Water by Water Recovery Portion (m3/day)	Saleable	0	0	4,929	0	1,564	8,100	14,637	22,294	34,953	47,678	60,470	66,928	68,280	69,659	71,066	72,502	73,966	75,460	76,992	77,741	78,907	80,091	81,292	82,512	83,749	85,006	86,281	87,575	88,888				
	Not saleable	0	0	0	9,788	28,858	37,925	35,772	33,925	31,285	23,700	16,369	5,133	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
Number of Beneficiaries (people) 71.2L/p	71.2	0	0	69,200	148,500	249,600	365,100	508,500	683,000	891,000	1,078,800	1,315,600	1,463,700	1,501,800	1,521,200	1,541,000	1,561,100	1,581,700	1,602,700	1,618,600	1,634,700	1,651,100	1,667,700	1,684,600	1,701,700	1,719,100	1,736,700	1,754,600	1,772,800	1,791,300				
Year	NPV (D.R.=0.64%)	2,017	2,018	2,019	2,020	2,021	2,022	2,023	2,024	2,025	2,026	2,027	2,028	2,029	2,030	2,031	2,032	2,033	2,034	2,035	2,036	2,037	2,038	2,039	2,040	2,041	2,042	2,043	2,044	2,045	2,046			
Initial Investment Cost																																		
CAPEX - Water Production Portion	73,569	6,250	7,429	31,781	26,077	2,952	103																											
CAPEX - Water Recovery Portion	57,928	-4,911	-5,863	16,430	16,258	81																												
O&M Cost																																		
O&M - Desalination Plant	178,015	0	0	0	3,937	4,839	5,109	5,698	6,460	6,804	6,908	7,559	8,214	8,432	8,432	8,432	8,432	8,432	8,432	8,432	8,432	8,432	8,432	8,432	8,432	8,432	8,432	8,432	8,432	8,432	8,432			
Replacement Cost, Residual Value (water production)	-6,054	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-25,803			
Reduction of Electricity Cost	-6,670	0	0	0	-90	-138	-152	-184	-224	-242	-248	-283	-317	-329	-329	-329	-329	-329	-329	-329	-329	-329	-329	-329	-329	-329	-329	-329	-329	-329	-329			
Reduction of O&M Cost for Pipes	-6,896	0	0	0	-294	-294	-294	-294	-294	-294	-294	-294	-294	-294	-294	-294	-294	-294	-294	-294	-294	-294	-294	-294	-294	-294	-294	-294	-294	-294	-294			
Reduced Cost for Water Production	-15,492	0	0	-710	-2,093	-2,751	-2,595	-2,461	-2,269	-1,719	-1,187	-372	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
Residual Value (water recovery)	-23,485	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-28,258			
Total Cost	250,915	11,161	13,292	48,211	41,625	19,738	1,840	2,068	2,759	3,672	4,548	5,178	6,610	7,602	7,808	7,808	7,808	7,808	7,808	7,808	7,808	7,808	7,808	7,808	7,808	7,808	7,808	7,808	7,808	7,808	-46,253			
Incremental Revenue - Water Production Portion	230,328	0	0	0	3,107	4,764	5,261	6,341	7,741	8,373	8,564	9,760	10,962	11,361	11,361	11,361	11,361	11,361	11,361	11,361	11,361	11,361	11,361	11,361	11,361	11,361	11,361	11,361	11,361	11,361	11,361			
Incremental Revenue - Water Recovery Portion	415,869	0	0	1,449	460	2,381	4,303	6,554	10,275	14,015	17,775	19,674	20,071	20,477	20,890	21,312	21,743	22,182	22,515	22,853	23,195	23,543	23,896	24,255	24,619	24,988	25,363	25,743	26,129	26,519				
Total Revenue	646,198	0	0	1,449	3,107	5,224	7,642	10,644	14,294	18,648	22,579	27,535	30,636	31,433	31,838	32,252	32,674	33,104	33,544	33,876	34,214	34,557	34,905	35,258	35,616	35,980	36,349	36,724	37,105	37,491				
Cash Flow	NPV (D.R.=0.64%)	2,017	2,018	2,019	2,020	2,021	2,022	2,023	2,024	2,025	2,026	2,027	2,028	2,029	2,030	2,031	2,032	2,033	2,034	2,035	2,036	2,037	2,038	2,039	2,040	2,041	2,042	2,043	2,044	2,045	2,046	FIRR	B/C	
Balance of whole project	395,283	-11,161	-13,292	-48,211	-40,176	-16,631	3,384	5,574	7,885	10,622	14,100	17,400	20,925	23,034	23,625	24,030	24,444	24,866	25,296	25,735	26,068	26,406	26,749	27,097	27,450	9,871	28,172	28,541	28,916	29,297	83,744	10.4%	2.58	
(i) Water Production Portion	-8,532	-6,250	-7,429	-31,781	-26,077	-3,691	-40	304	827	1,505	1,811	1,904	2,483	3,065	3,259	3,259	3,259	3,259	3,259	3,259	3,259	3,259	3,259	3,259	3,259	3,259	3,259	3,259	3,259	3,259	3,259	29,062	0.0%	0.96
(ii) Water Recovery Portion	403,815	-4,911	-5,863	-16,430	-14,099	-12,940	3,424	5,270	7,058	9,117	12,288	15,497	18,442	19,968	20,366	20,771	21,185	21,607	22,037	22,476	22,809	23,147	23,490	23,838	24,191	24,549	24,913	25,282	25,657	26,038	26,482	17.6%	34.50	

WACC	0.64%						
CAPEX: Water Production Portion	74,591.2 million FCFA	63% : Equipment part (20 years)	37% : Facility Part (50 years)	2,150 million FCFA	: Cost of Membranes	40% : Percentage of Replacement in 20 year out of total Equipment Cost	
CAPEX: Water Recovery Portion	58,870.5 million FCFA						
Water Treatment Cost at Mamelles WTP	462 FCFA/m3	Fixed Cost Rate	26.6%	Fixed	123 FCFA/m3	Variable	339 FCFA/m3
SCF	1.0	(Financial Analysis: 1.0, Economic Analysis: 0.9)					
Billed Water Rate	0.789	Actual in 2014					
Collection Rate	0.980	Actual in 2013					
Revenue Water Rate	0.773						
Average Water Tariff in 2015 (predicted)	512.97 FCFA/m3	Predicted Average Water Tariff Rate in 2015, excluding TAX					
	805.36 FCFA/m3	157.0%					
Saved O&M Cost	0.5%	of initial investment cost for Water Recovery Portion					
Total Treatment Cost of SDE in 2014	26,088 million FCFA	supplies, materials, energy cost	26,088	million FCFA	100%		
Billed Water Amount	131,281,610 m3						
Treatment Cost	198.72 FCFA/m3						

Appendix 10-3. Calculation of EIRR (at the Willingness to Pay (=the present tariff level))

(Unit: Million FCFA)

Year	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046			
Water Production Amount by Mamelles Plant (m3/day)	0	0	0	0	13,674	20,966	23,151	27,907	34,066	36,849	37,687	42,951	48,240	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000			
Saved Water by Water Recovery Portion (m3/day)	Saleable	0	0	0	4,929	0	1,564	8,100	14,637	22,294	34,953	47,678	60,470	66,928	68,280	69,659	71,066	72,502	73,966	75,460	76,992	77,741	78,907	80,091	81,292	82,512	83,749	85,006	86,281	87,575	88,888		
Number of Beneficiaries (people)	71.2	0	0	0	69,200	151,500	254,300	370,300	514,800	690,600	899,300	1,087,300	1,325,300	1,474,600	1,513,100	1,532,400	1,552,200	1,572,400	1,592,900	1,613,900	1,629,800	1,645,900	1,662,300	1,678,900	1,695,800	1,712,900	1,730,300	1,748,000	1,765,900	1,784,100	1,802,500		
NPV (D.R.=10%)	2,017	2,018	2,019	2,020	2,021	2,022	2,023	2,024	2,025	2,026	2,027	2,028	2,029	2,030	2,031	2,032	2,033	2,034	2,035	2,036	2,037	2,038	2,039	2,040	2,041	2,042	2,043	2,044	2,045	2,046			
Initial Investment Cost																																	
CAPEX - Water Production Portion	59,157	5,731	7,237	31,142	25,521	2,776	62																										
CAPEX - Water Recovery Portion	44,626	4,503	5,642	15,834	15,668	14,798	49																										
O&M Cost																																	
O&M - Desalination Plant	42,193	0	0	0	3,543	4,355	4,598	5,128	5,814	6,124	6,217	6,803	7,392	7,588	7,588	7,588	7,588	7,588	7,588	7,588	7,588	7,588	7,588	7,588	7,588	7,588	7,588	7,588	7,588	7,588	7,588		
Replacement Cost, Residual Value (water production)	188	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Reduction of Electricity Cost	-1,504	0	0	0	-81	-124	-137	-165	-202	-218	-223	-254	-286	-296	-296	-296	-296	-296	-296	-296	-296	-296	-296	-296	-296	-296	-296	-296	-296	-296	-296		
Reduction of O&M Cost for Pipes	-1,750	0	0	0	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254		
Reduced Cost for Water Production	-7,897	0	0	0	-639	-1,884	-2,476	-2,335	-2,215	-2,042	-1,547	-1,069	-335	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Residual Value (water recovery)	-1,709	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Total Economic Cost	133,303	10,235	12,879	46,976	40,550	18,898	1,612	1,872	2,494	3,316	4,104	4,671	5,960	6,853	7,038	7,038	7,038	7,038	7,038	7,038	7,038	7,038	7,038	7,038	7,038	7,038	7,038	7,038	7,038	7,038	7,038		
Incremental Production																																	
Incremental Production - Water Production Portion	42,019	0	0	0	2,262	3,468	3,830	4,616	5,635	6,096	6,234	7,105	7,980	8,271	8,271	8,271	8,271	8,271	8,271	8,271	8,271	8,271	8,271	8,271	8,271	8,271	8,271	8,271	8,271	8,271	8,271		
Incremental Production - Water Recovery Portion	62,301	0	0	0	1,033	0	328	1,698	3,069	4,674	7,328	9,996	12,678	14,032	14,315	14,604	14,899	15,200	15,507	15,821	16,058	16,299	16,543	16,792	17,043	17,299	17,559	17,822	18,089	18,361	18,636		
Reduction of Medical Cost	19,466	0	0	0	193	422	708	1,031	1,434	1,924	2,505	3,029	3,691	4,107	4,215	4,268	4,323	4,380	4,437	4,495	4,540	4,584	4,630	4,676	4,723	4,771	4,820	4,869	4,919	4,969	5,021		
Time saved for Water Fetching	4,387	0	0	0	43	95	160	232	323	434	565	683	832	926	950	962	974	987	1,000	1,013	1,023	1,033	1,044	1,054	1,065	1,075	1,086	1,097	1,109	1,120	1,132		
Prevention of Water Stop	6,975	0	0	0	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013		
Total Economic Benefit	135,148	0	0	0	1,270	5,677	7,805	10,455	13,680	17,507	20,955	25,320	28,058	28,764	29,119	29,482	29,852	30,229	30,614	30,905	31,201	31,501	31,806	32,116	32,430	32,749	33,073	33,401	33,734	34,073			
Cash Flow	NPV (D.R.=10%)	2,017	2,018	2,019	2,020	2,021	2,022	2,023	2,024	2,025	2,026	2,027	2,028	2,029	2,030	2,031	2,032	2,033	2,034	2,035	2,036	2,037	2,038	2,039	2,040	2,041	2,042	2,043	2,044	2,045	2,046	EIRR	B/C
Balance of whole project	1,845	-10,235	-12,879	-46,976	-39,280	-15,105	4,066	5,933	7,962	10,364	13,402	16,283	19,360	21,206	21,726	22,081	22,444	22,814	23,191	23,576	23,867	24,163	24,463	24,768	25,078	25,391	25,711	26,035	26,363	26,696	27,033	10.2%	1.01
- Economic Benefit of (i) portion	59,876	0	0	0	3,792	5,289	5,779	6,782	8,073	8,684	8,886	9,997	11,101	11,468	11,470	11,472	11,475	11,477	11,480	11,481	11,483	11,485	11,487	11,489	11,490	11,492	11,494	11,496	11,497	11,499			
- Economic Cost of (i) portion	-100,033	-5,731	-7,237	-31,142	-25,521	-6,238	-4,293	-4,461	-4,963	-5,612	-5,996	-6,549	-7,107	-7,292	-7,292	-7,292	-7,292	-7,292	-7,292	-7,292	-7,292	-7,292	-7,292	-7,292	-7,292	-7,292	-7,292	-7,292	-7,292	-7,292	-7,292		
(i) Water Production Portion	-40,157	-5,731	-7,237	-31,142	-25,521	-2,445	997	1,318	1,820	2,461	2,779	2,892	3,448	3,995	4,175	4,178	4,180	4,183	4,185	4,187	4,189	4,191	4,193	4,195	4,196	4,198	4,200	4,202	4,203	4,205	29,259	1.8%	0.60
- Economic Benefit of (ii) portion	75,272	0	0	0	1,270	0	388	2,026	3,673	5,607	8,822	12,069	15,323	16,957	17,297	17,649	18,009	18,377	18,751	19,134	19,424	19,718	20,016	20,319	20,627	20,940	21,257	21,579	21,905	22,237	22,573		
- Economic Cost of (ii) portion	-33,271	-4,503	-5,642	-15,834	-15,029	-12,660	2,681	2,589	2,469	2,296	1,801	1,323	589	254	254	254	254	254	254	254	254	254	254	254	254	254	254	254	254	254	254		
(ii) Water Recovery Portion	42,002	-4,503	-5,642	-15,834	-13,759	-12,660	3,069	4,615	6,142	7,903	10,624	13,391	15,912	17,211	17,551	17,904	18,264	18,631	19,006	19,388	19,678	19,972	20,271	20,574	20,881	21,194	21,511	21,833	22,159	22,491	22,827	16.5%	2.26

CAPEX: Water Production Portion 72,469 million FCFA 63% : Equipment part (20 years) 37% : Facility Part (50 years) 2,150 million FCFA : Cost of Membranes 40% : Percentage of Replacement in 20 year out of total Equipment Cost

CAPEX: Water Recovery Portion 56,493 million FCFA

Desalination Cost 462 FCFA/m³ Fixed Cost Rate 26.6% Fixed 123 FCFA/m³

SCF 0.9 Financial Analysis: 1.0, Economic Analysis: 0.9 Variable 339 FCFA/m³

Billed Water Rate 0.789 Actual in 2014

Collection Rate 1.000 1.00 for economic analysis

Revenue Water Rate 0.789

Average Water Tariff in 2015 (predicted) 574.40 FCFA/m³ Predicted Average Tariff Rate in 2015 (Willingness to Pay)

Saved O&M Cost 574.40 FCFA/m³ 100.0%

0.5% of initial investment cost

Total Variable Cost of SDE in 2014 26,088 million FCFA supplies, materials, energy cost 26,088 million FCFA 100%

Billed Water Amount 131,281,610 m³

Treatment Cost 198.72 FCFA/m³

Average Family Member 10 people/house

Rate without Pipe Connection 10% GNI per Capita (World Bank, 2013) 1,050 US Value per hour 344 FCFA/hour

Average Daily Income 1078 FCFA/day 154 FCFA/hour

Per Capita Total Expenditure on Health 46 US\$ 608 FCFA/US\$ 27,968 0.7% 2013 2014 -1.1% 0.996 27,854

Reduction Rate of Medical Cost 10%

Appendix 10-4. Calculation of EIRR under (i) Initial Investment Cost +20%

(Unit: Million FCFA)

Year	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046				
Water Production Amount by Mamelles Plant (m3/day)	0	0	0	0	13,674	20,966	23,151	27,907	34,066	36,849	37,687	42,951	48,240	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000				
Saved Water by Water Recovery Portion (m3/day)	0	0	0	9,788	28,858	37,925	35,772	33,925	31,285	23,700	16,369	5,133	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
Number of Beneficiaries (people)	71.2	0	0	69,200	151,500	254,300	370,300	514,800	690,600	899,300	1,087,300	1,325,300	1,474,600	1,513,100	1,532,400	1,552,200	1,572,400	1,592,900	1,613,900	1,629,800	1,645,900	1,662,300	1,678,900	1,695,800	1,712,900	1,730,300	1,748,000	1,765,900	1,784,100	1,802,500				
NPV (D.R.=10%)	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046				
Initial Investment Cost																																		
CAPEX - Water Production Portion	70,988	6,878	8,685	37,371	30,625	3,331	74																											
CAPEX - Water Recovery Portion	53,552	5,404	6,770	19,000	18,801	17,758	58																											
O&M Cost																																		
O&M - Desalination Plant	42,193	0	0	0	3,543	4,355	4,598	5,128	5,814	6,124	6,217	6,803	7,392	7,588	7,588	7,588	7,588	7,588	7,588	7,588	7,588	7,588	7,588	7,588	7,588	7,588	7,588	7,588	7,588	7,588	7,588			
Replacement Cost, Residual Value (wa	235	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-30,183			
Reduction of Electricity Cost	-1,504	0	0	0	-81	-124	-137	-165	-202	-218	-223	-254	-286	-296	-296	-296	-296	-296	-296	-296	-296	-296	-296	-296	-296	-296	-296	-296	-296	-296	-296			
Reduction of O&M Cost for Pipes	-2,100	0	0	0	-305	-305	-305	-305	-305	-305	-305	-305	-305	-305	-305	-305	-305	-305	-305	-305	-305	-305	-305	-305	-305	-305	-305	-305	-305	-305	-305			
Reduced Cost for Water Production	-7,897	0	0	-639	-1,884	-2,476	-2,335	-2,215	-2,042	-1,547	-1,069	-335	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
Residual Value (water recovery)	-2,051	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-32,540			
Total Economic Cost	153,415	12,282	15,455	56,371	48,787	22,362	1,583	1,821	2,443	3,265	4,053	4,620	5,909	6,802	6,987	6,987	6,987	6,987	6,987	6,987	6,987	6,987	6,987	6,987	6,987	6,987	6,987	6,987	6,987	6,987	-55,736			
Incremental Production																																		
Incremental Production - Water Produc	42,019	0	0	0	2,262	3,468	3,830	4,616	5,635	6,096	6,234	7,105	7,980	8,271	8,271	8,271	8,271	8,271	8,271	8,271	8,271	8,271	8,271	8,271	8,271	8,271	8,271	8,271	8,271	8,271	8,271			
Incremental Production - Water Recove	62,301	0	0	1,033	0	328	1,698	3,069	4,674	7,328	9,996	12,678	14,032	14,315	14,604	14,899	15,200	15,507	15,821	16,058	16,299	16,543	16,792	17,043	17,299	17,559	17,822	18,089	18,361	18,636				
Reduction of Medical Cost	19,466	0	0	193	422	708	1,031	1,434	1,924	2,505	3,029	3,691	4,107	4,215	4,268	4,323	4,380	4,437	4,495	4,540	4,584	4,630	4,676	4,723	4,771	4,820	4,869	4,919	4,969	5,021				
Time saved for Water Fetching	4,387	0	0	43	95	160	232	323	434	565	683	832	926	950	962	974	987	1,000	1,013	1,023	1,033	1,044	1,054	1,065	1,075	1,086	1,097	1,109	1,120	1,132				
Prevention of Water Stop	6,975	0	0	0	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013			
Total Economic Benefit	135,148	0	0	0	1,270	3,792	5,677	7,805	10,455	13,680	17,507	20,955	25,320	28,058	28,764	29,119	29,482	29,852	30,229	30,614	30,905	31,201	31,501	31,806	32,116	32,430	32,749	33,073	33,401	33,734	34,073			
Cash Flow	NPV (D.R.=10%)	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	EIRR	B/C	
Balance of whole project	-18,267	-12,282	-15,455	-56,371	-47,518	-18,569	4,095	5,984	8,012	10,415	13,453	16,334	19,411	21,257	21,777	22,132	22,495	22,864	23,242	23,626	23,918	24,214	24,514	24,819	25,129	4,388	25,762	26,085	26,414	26,747	89,808	8.7%	0.88	
- Economic Benefit of (i) portion	59,876	0	0	0	3,792	5,289	5,779	6,782	8,073	8,684	8,886	9,997	11,101	11,468	11,470	11,472	11,475	11,477	11,480	11,481	11,483	11,485	11,487	11,489	11,490	11,492	11,494	11,496	11,497	11,499				
- Economic Cost of (i) portion	-111,911	-6,878	-8,685	-37,371	-30,625	-6,793	-4,305	-4,461	-4,963	-5,612	-5,906	-5,994	-6,549	-7,107	-7,292	-7,292	-7,292	-7,292	-7,292	-7,292	-7,292	-7,292	-7,292	-7,292	-7,292	-7,292	-7,292	-7,292	-7,292	-7,292	-7,292			
(i) Water Production Portion	-52,036	-6,878	-8,685	-37,371	-30,625	-3,000	984	1,318	1,820	2,461	2,779	2,892	3,448	3,995	4,175	4,178	4,180	4,183	4,185	4,187	4,189	4,191	4,193	4,195	4,196	4,196	4,196	4,196	4,196	4,196	4,196	4,196	0.8%	0.54
- Economic Benefit of (ii) portion	75,272	0	0	0	1,270	0	388	2,026	3,673	5,607	8,822	12,069	15,323	16,957	17,297	17,649	18,009	18,377	18,751	19,134	19,424	19,718	20,016	20,319	20,627	20,940	21,257	21,579	21,905	22,237	22,573			
- Economic Cost of (ii) portion	-41,504	-5,404	-6,770	-19,000	-18,162	-15,569	2,722	2,640	2,520	2,347	1,852	1,374	640	305	305	305	305	305	305	305	305	305	305	305	305	305	305	305	305	305	305			
(ii) Water Recovery Portion	33,768	-5,404	-6,770	-19,000	-16,892	-15,569	3,110	4,666	6,193	7,954	10,675	13,442	15,963	17,262	17,602	17,954	18,314	18,682	19,057	19,439	19,729	20,023	20,322	20,625	20,932	21,245	21,562	21,884	22,210	22,542	55,418	14.6%	1.81	

CAPEX: Water Production Portion 86,963 million FCFA 63% : Equipment part (20 years) 37% : Facility Part (50 years) 2,150 million FCFA : Cost of Membranes 40% : Percentage of Replacement in 20 year out of total Equipment Cost

CAPEX: Water Recovery Portion 67,791 million FCFA

Desalination Cost 462 FCFA/m³ Fixed Cost Rate 26.6% Fixed 123 FCFA/m³

SCF 0.9 Financial Analysis: 1.0, Economic Analysis: 0.9 Variable 339 FCFA/m³

Billed Water Rate 0.789 Actual in 2014

Collection Rate 1.000 1.00 for economic analysis

Revenue Water Rate 0.789

Average Water Tariff in 2015 (predicted) 574.40 FCFA/m³ Predicted Average Tariff Rate in 2015 (Willingness to Pay)

574.40 FCFA/m³ 100.0%

Saved O&M Cost 0.5% of initial investment cost

Total Variable Cost of SDE in 2014 26,088 million FCFA supplies, materials, energy cost 26,088 million FCFA 100%

Billed Water Amount 131,281,610 m³

Treatment Cost 198.72 FCFA/m³

Average Family Member 10 people/house GNI per Capita (World Bank, 2013) 1,050 US

Rate without Pipe Connection 10% Value per hour 344 FCFA/hour

Average Daily Income 1078 FCFA/day 154 FCFA/hour

Per Capita Total Expenditure on Health 46 US\$ 608 FCFA/US\$ 27,968 2013 2014 CPI 0.7% -1.1% 0.996 27,854

Reduction Rate of Medical Cost 10%

Appendix 10-5. Calculation of EIRR under (ii) Production Amount of Mamelles Plant -10,000m3/day

(Unit: Million FCFA)

Year	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046			
Water Production Amount by Mamelles Plant (m3/day)	0	0	0	0	3,674	10,966	13,151	17,907	24,066	26,849	27,687	32,951	38,240	40,000	40,000	40,000	40,000	40,000	40,000	40,000	40,000	40,000	40,000	40,000	40,000	40,000	40,000	40,000	40,000	40,000			
Saved Water by Water Recovery Portion (m3/day)					4,929	1,564	8,100	14,637	22,294	34,953	47,678	60,470	66,928	68,280	69,659	71,066	72,502	73,966	75,460	76,992	77,741	78,907	80,091	81,292	82,512	83,749	85,006	86,281	87,575	88,888			
Number of Beneficiaries (people)	71.2	0	0	69,200	40,700	143,500	259,500	404,000	579,800	788,400	976,400	1,214,400	1,363,800	1,402,200	1,421,600	1,441,400	1,461,500	1,482,100	1,503,100	1,519,000	1,535,100	1,551,500	1,568,100	1,585,000	1,602,100	1,619,500	1,637,200	1,655,100	1,673,200	1,691,700			
NPV (D.R.=10%)	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046			
Initial Investment Cost																																	
CAPEX - Water Production Portion	59,157	5,731	7,237	31,142	25,521	2,776	62																										
CAPEX - Water Recovery Portion	44,626	4,503	5,642	15,834	15,668	14,798	49																										
O&M Cost																																	
O&M - Desalination Plant	34,528	0	0	0	2,429	3,242	3,485	4,014	4,700	5,010	5,104	5,690	6,279	6,475	6,475	6,475	6,475	6,475	6,475	6,475	6,475	6,475	6,475	6,475	6,475	6,475	6,475	6,475	6,475	6,475			
Replacement Cost, Residual Value (water)	188	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
Reduction of Electricity Cost	-1,097	0	0	0	-22	-65	-78	-106	-143	-159	-164	-195	-226	-237	-237	-237	-237	-237	-237	-237	-237	-237	-237	-237	-237	-237	-237	-237	-237	-237			
Reduction of O&M Cost for Pipes	-1,750	0	0	0	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254			
Reduced Cost for Water Production	-7,897	0	0	-639	-1,884	-2,476	-2,335	-2,215	-2,042	-1,547	-1,069	-335	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
Residual Value (water recovery)	-1,709	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
Total Economic Cost	126,046	10,235	12,879	46,976	40,550	17,843	557	818	1,440	2,261	3,050	3,617	4,905	5,798	5,984	5,984	5,984	5,984	5,984	5,984	5,984	5,984	5,984	5,984	5,984	5,984	5,984	5,984	5,984	5,984			
Incremental Production																																	
Incremental Production - Water Production	30,634	0	0	0	608	1,814	2,175	2,962	3,981	4,441	4,580	5,451	6,326	6,617	6,617	6,617	6,617	6,617	6,617	6,617	6,617	6,617	6,617	6,617	6,617	6,617	6,617	6,617	6,617	6,617			
Incremental Production - Water Recovery	62,301	0	0	1,033	0	328	1,698	3,069	4,674	7,328	9,996	12,678	14,032	14,315	14,604	14,899	15,200	15,507	15,821	16,058	16,299	16,543	16,792	17,043	17,299	17,559	17,822	18,089	18,361	18,636			
Reduction of Medical Cost	17,341	0	0	193	113	400	723	1,125	1,615	2,196	2,720	3,383	3,799	3,906	3,960	4,015	4,071	4,128	4,187	4,231	4,276	4,322	4,368	4,415	4,462	4,511	4,560	4,610	4,661	4,712			
Time saved for Water Fetching	3,908	0	0	43	26	90	163	254	364	495	613	762	856	880	892	905	918	930	944	954	964	974	984	995	1,006	1,017	1,028	1,039	1,050	1,062			
Prevention of Water Stop	5,580	0	0	0	811	811	811	811	811	811	811	811	811	811	811	811	811	811	811	811	811	811	811	811	811	811	811	811	811	811			
Total Economic Benefit	119,764	0	0	1,270	1,557	3,442	5,570	8,220	11,445	15,271	18,719	23,084	25,823	26,529	26,884	27,247	27,616	27,994	28,379	28,760	28,966	29,266	29,571	29,881	30,195	30,514	30,837	31,166	31,499	31,838			
Cash Flow	NPV (D.R.=10%)	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	EIRR	B/C
Balance of whole project	-6,282	-10,235	-12,879	-46,976	-39,280	-16,286	2,885	4,753	6,781	9,183	12,221	15,102	18,179	20,025	20,545	20,900	21,263	21,633	22,010	22,395	22,687	22,982	23,283	23,588	23,897	6,809	24,530	24,884	25,182	25,515	78,023	9.5%	0.95
- Economic Benefit of (i) portion	44,316	0	0	0	1,557	3,053	3,534	4,532	5,819	6,421	6,615	7,723	8,829	9,195	9,197	9,199	9,201	9,203	9,205	9,206	9,208	9,209	9,210	9,212	9,213	9,214	9,216	9,217	9,218	9,219			
- Economic Cost of (i) portion	-92,775	-5,731	-7,237	-31,142	-25,521	-5,183	-3,238	-3,407	-3,908	-4,558	-4,851	-4,940	-5,495	-6,052	-6,238	-6,238	-6,238	-6,238	-6,238	-6,238	-6,238	-6,238	-6,238	-6,238	-6,238	-6,238	-6,238	-6,238	-6,238	-6,238	-6,238		
(i) Water Production Portion	-48,460	-5,731	-7,237	-31,142	-25,521	-3,626	-185	127	623	1,261	1,570	1,675	2,229	2,777	2,958	2,960	2,961	2,963	2,965	2,967	2,968	2,970	2,971	2,972	2,974	2,976	2,978	2,979	2,980	2,984			
- Economic Benefit of (ii) portion	75,448	0	0	1,270	0	389	2,036	3,689	5,626	8,850	12,104	15,361	16,994	17,333	17,687	18,047	18,415	18,791	19,174	19,464	19,758	20,058	20,361	20,669	20,982	21,299	21,622	21,949	22,281	22,618			
- Economic Cost of (ii) portion	-33,271	-4,503	-5,642	-15,834	-15,029	-12,660	2,681	2,589	2,469	2,296	1,801	1,323	589	254	254	254	254	254	254	254	254	254	254	254	254	254	254	254	254	254			
(ii) Water Recovery Portion	42,178	-4,503	-5,642	-15,834	-13,759	-12,660	3,070	4,625	6,158	7,922	10,651	13,427	15,950	17,248	17,587	17,941	18,302	18,669	19,045	19,428	19,718	20,013	20,312	20,615	20,923	21,236	21,554	21,876	22,203	22,535	49,989	16.5%	2.27

CAPEX: Water Production Portion 72,469 million FCFA 63% : Equipment part (20 years) 37% : Facility Part (50 years) 2,150 million FCFA : Cost of Membranes 40% : Percentage of Replacement in 20 year out of total Equipment Cost
 CAPEX: Water Recovery Portion 56,493 million FCFA
 Desalination Cost 462 FCFA/m3 Fixed Cost Rate 26.6% Fixed 123 FCFA/m3
 SCF 0.9 Financial Analysis: 1.0, Economic Analysis: 0.9 Variable 339 FCFA/m3
 Billed Water Rate 0.789 Actual in 2014
 Collection Rate 1.000 1.00 for economic analysis
 Revenue Water Rate 0.789
 Average Water Tariff in 2015 (predicted) 574.40 FCFA/m3 Predicted Average Tariff Rate in 2015 (Willingness to Pay)
 574.40 FCFA/m3 100.0%
 Saved O&M Cost 0.5% of initial investment cost
 Total Variable Cost of SDE in 2014 26,088 million FCFA supplies, materials, energy cost 26,088 million FCFA 100%
 Billed Water Amount 131,281,610 m3
 Treatment Cost 198.72 FCFA/m3
 Average Family Member 10 people/house GNI per Capita (World Bank, 2013) 1,050 US
 Rate without Pipe Connection 10% Value per hour 344 FCFA/hour
 Average Daily Income 1078 FCFA/day 154 FCFA/hour
 Per Capita Total Expenditure on Health 46 US\$ 608 FCFA/US\$ 27,968 2013 2014 CPI 0.7% -1.1% 0.996 27,854
 Reduction Rate of Medical Cost 10%

Appendix 10-6. Calculation of EIRR under (iii) Reduction of Production Cost at Mamelles Plant -20%

(Unit: Million FCFA)

Year	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046			
Water Production Amount by Mamelles Plant (m3/day)	0	0	0	0	13,674	20,966	23,151	27,907	34,066	36,849	37,687	42,951	48,240	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000			
Saved Water by Water Recovery	0	0	0	0	4,929	0	1,564	8,100	14,637	22,294	34,953	47,678	60,470	66,928	68,280	69,659	71,066	72,502	73,966	75,460	76,992	77,741	78,907	80,091	81,292	82,512	83,749	85,006	86,281	87,575	88,888		
Portion (m3/day)	0	0	0	0	9,788	28,858	37,925	35,772	33,925	31,285	23,700	16,369	5,133	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Number of Beneficiaries (people)	71.2	0	0	0	69,200	151,500	254,300	370,300	514,800	690,600	899,300	1,087,300	1,325,300	1,474,600	1,513,100	1,532,400	1,552,200	1,572,400	1,592,900	1,613,900	1,629,800	1,645,900	1,662,300	1,678,900	1,695,800	1,712,900	1,730,300	1,748,000	1,765,900	1,784,100	1,802,500		
Year	NPV (D.R.=10%)	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046		
Initial Investment Cost																																	
CAPEX - Water Production Portion	59,157	5,731	7,237	31,142	25,521	2,776	62																										
CAPEX - Water Recovery Portion	44,626	4,503	5,642	15,834	15,668	14,798	49																										
O&M Cost																																	
O&M - Desalination Plant	33,754	0	0	0	2,834	3,484	3,679	4,102	4,651	4,899	4,974	5,443	5,914	6,071	6,071	6,071	6,071	6,071	6,071	6,071	6,071	6,071	6,071	6,071	6,071	6,071	6,071	6,071	6,071	6,071	6,071		
Replacement Cost, Residual Value (water recovery)	188	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-25,052	
Reduction of Electricity Cost	-1,504	0	0	0	-81	-124	-137	-165	-202	-218	-223	-254	-286	-296	-296	-296	-296	-296	-296	-296	-296	-296	-296	-296	-296	-296	-296	-296	-296	-296	-296	-296	
Reduction of O&M Cost for Pipes	-1,750	0	0	0	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254		
Reduced Cost for Water Production	-7,897	0	0	0	-639	-1,884	-2,476	-2,335	-2,215	-2,042	-1,547	-1,069	-335	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Residual Value (water recovery)	-1,709	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-27,117	
Total Economic Cost	124,865	10,235	12,879	46,976	40,550	18,189	741	952	1,468	2,153	2,880	3,428	4,599	5,374	5,520	5,520	5,520	5,520	5,520	5,520	5,520	5,520	5,520	5,520	5,520	5,520	5,520	5,520	5,520	5,520	5,520	46,648	
Incremental Production																																	
Incremental Production - Water Production	42,019	0	0	0	2,262	3,468	3,830	4,616	5,635	6,096	6,234	7,105	7,980	8,271	8,271	8,271	8,271	8,271	8,271	8,271	8,271	8,271	8,271	8,271	8,271	8,271	8,271	8,271	8,271	8,271	8,271	8,271	
Incremental Production - Water Recovery	62,301	0	0	1,033	0	328	1,698	3,069	4,674	7,328	9,996	12,678	14,032	14,315	14,604	14,899	15,200	15,507	15,821	16,058	16,299	16,543	16,792	17,043	17,299	17,559	17,822	18,089	18,361	18,636			
Reduction of Medical Cost	19,466	0	0	193	422	708	1,031	1,434	1,924	2,505	3,029	3,691	4,107	4,215	4,268	4,323	4,380	4,437	4,495	4,540	4,584	4,630	4,676	4,723	4,771	4,820	4,869	4,919	4,969	5,021			
Time saved for Water Fetching	4,387	0	0	43	95	160	232	323	434	565	683	832	926	950	962	974	987	1,000	1,013	1,023	1,033	1,044	1,054	1,065	1,075	1,086	1,097	1,109	1,120	1,132			
Prevention of Water Stop	6,975	0	0	0	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	
Total Economic Benefit	135,148	0	0	1,270	3,792	5,677	7,805	10,455	13,680	17,507	20,955	25,320	28,058	28,764	29,119	29,482	29,852	30,229	30,614	30,905	31,201	31,501	31,806	32,116	32,430	32,749	33,073	33,401	33,734	34,073			
Cash Flow	NPV (D.R.=10%)	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	EIRR	B/C
Balance of whole project	10,283	-10,235	-12,879	-46,976	-39,280	-14,397	4,937	6,853	8,987	11,527	14,627	17,527	20,721	22,684	23,244	23,599	23,961	24,331	24,708	25,093	25,385	25,681	25,981	26,286	26,595	9,507	27,228	27,552	27,881	28,214	80,721	10.8%	1.08
- Economic Benefit of (i) portion	59,876	0	0	0	3,792	5,289	5,779	6,782	8,073	8,684	8,886	9,997	11,101	11,468	11,470	11,472	11,475	11,477	11,480	11,481	11,483	11,485	11,487	11,489	11,489	11,490	11,492	11,494	11,496	11,497	11,499		
- Economic Cost of (i) portion	-91,594	-5,731	-7,237	-31,142	-25,521	-5,529	-3,422	-3,542	-3,937	-4,449	-4,681	-4,751	-5,188	-5,628	-5,775	-5,775	-5,775	-5,775	-5,775	-5,775	-5,775	-5,775	-5,775	-5,775	-5,775	-5,775	-5,775	-5,775	-5,775	-5,775	-5,775	19,278	
(i) Water Production Portion	-31,718	-5,731	-7,237	-31,142	-25,521	-1,737	1,868	2,238	2,845	3,624	4,003	4,135	4,809	5,473	5,693	5,698	5,700	5,703	5,705	5,707	5,709	5,710	5,712	5,714	5,714	-11,687	5,718	5,719	5,721	5,723	30,777	3.9%	0.65
- Economic Benefit of (ii) portion	75,272	0	0	0	1,270	0	388	2,026	3,673	5,607	8,822	12,069	15,323	16,957	17,297	17,649	18,009	18,377	18,751	19,134	19,424	19,718	20,016	20,319	20,627	20,940	21,257	21,579	21,905	22,237	22,573		
- Economic Cost of (ii) portion	-33,271	-4,503	-5,642	-15,834	-15,029	-12,660	2,681	2,589	2,469	2,296	1,801	1,323	889	254	254	254	254	254	254	254	254	254	254	254	254	254	254	254	254	254	254	27,371	
(ii) Water Recovery Portion	42,002	-4,503	-5,642	-15,834	-13,759	-12,660	3,069	4,615	6,142	7,903	10,624	13,391	15,912	17,211	17,551	17,904	18,264	18,631	19,006	19,388	19,678	19,972	20,271	20,574	20,881	21,194	21,511	21,833	22,159	22,491	49,944	16.5%	2.26

CAPEX: Water Production Portion	72,469 million FCFA	63%	Equipment part (20 years)	37%	Facility Part (50 years)	2,150 million FCFA	Cost of Membranes	40%	Percentage of Replacement in 20 year out of total Equipment Cost
CAPEX: Water Recovery Portion	56,493 million FCFA								
Desalination Cost	370 FCFA/m ³	Fixed Cost Rate	26.6%	Fixed	98 FCFA/m ³				
SCF	0.9	Financial Analysis:	1.0, Economic Analysis:	0.9	Variable	271 FCFA/m ³			
Billed Water Rate	0.789	Actual in 2014							
Collection Rate	1.000	1.00 for economic analysis							
Revenue Water Rate	0.789								
Average Water Tariff in 2015 (predicted)	574.40 FCFA/m ³	Predicted Average Tariff Rate in 2015 (Willingness to Pay)							
	574.40 FCFA/m ³	100.0%							
Saved O&M Cost	0.5%	of initial investment cost							
Total Variable Cost of SDE in 2014	26,088 million FCFA	supplies, materials, energy cost	26,088 million FCFA	100%					
Billed Water Amount	131,281,610 m ³								
Treatment Cost	198.72 FCFA/m ³								
Average Family Member	10 people/house	GNI per Capita (World Bank, 2013)	1,050 US						
Rate without Pipe Connection	10%	Value per hour	344 FCFA/hour						
Average Daily Income	1078 FCFA/day	154 FCFA/hour							
Per Capita Total Expenditure on Health	46 US\$	608 FCFA/US\$	27,968	0.7%	2013	2014	CPI	27,854	
Reduction Rate of Medical Cost	10%								

Appendix 10-7. Calculation of EIRR under (iv) Increase of Production Cost at Mamelles Plant +20%

(Unit: Million FCFA)

Year	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046		
Water Production Amount by Mamelles Plant (m3/day)	0	0	0	0	13,674	20,966	23,151	27,907	34,066	36,849	37,687	42,951	48,240	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000			
Saved Water by Water Recovery	Saleable	0	0	0	4,929	0	1,564	8,100	14,637	22,294	34,953	47,678	60,470	66,928	68,280	69,659	71,066	72,502	73,966	75,460	76,592	77,741	78,907	80,091	81,292	82,512	83,749	85,006	86,281	87,575	88,888	
Portion (m3/day)	Not saleable	0	0	0	9,788	28,858	37,925	35,772	33,925	31,285	23,700	16,369	5,133	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Number of Beneficiaries (people)	71.2	0	0	0	69,200	151,500	254,300	370,300	514,800	690,600	899,300	1,087,300	1,325,300	1,474,600	1,513,100	1,532,400	1,552,200	1,572,400	1,592,900	1,613,900	1,629,800	1,645,900	1,662,300	1,678,900	1,695,800	1,712,900	1,730,300	1,748,000	1,765,900	1,784,100	1,802,500	
Year	NPV (D.R.=10%)	2,017	2,018	2,019	2,020	2,021	2,022	2,023	2,024	2,025	2,026	2,027	2,028	2,029	2,030	2,031	2,032	2,033	2,034	2,035	2,036	2,037	2,038	2,039	2,040	2,041	2,042	2,043	2,044	2,045	2,046	
Initial Investment Cost																																
CAPEX - Water Production Portion	59,157	5,731	7,237	31,142	25,521	2,776	62																									
CAPEX - Water Recovery Portion	44,626	4,503	5,642	15,834	15,668	14,798	49																									
O&M Cost																																
O&M - Desalination Plant	50,631	0	0	0	0	4,252	5,226	5,518	6,154	6,977	7,349	7,461	8,164	8,871	9,106	9,106	9,106	9,106	9,106	9,106	9,106	9,106	9,106	9,106	9,106	9,106	9,106	9,106	9,106	9,106	9,106	9,106
Replacement Cost, Residual Value (wat	188	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Reduction of Electricity Cost	-1,504	0	0	0	0	-81	-124	-137	-165	-202	-218	-223	-254	-286	-296	-296	-296	-296	-296	-296	-296	-296	-296	-296	-296	-296	-296	-296	-296	-296	-296	-296
Reduction of O&M Cost for Pipes	-1,750	0	0	0	0	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254
Reduced Cost for Water Production	-7,897	0	0	0	-639	-1,884	-2,476	-2,335	-2,215	-2,042	-1,547	-1,069	-335	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Residual Value (water recovery)	-1,709	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Total Economic Cost	141,742	10,235	12,879	46,976	40,550	19,606	2,483	2,792	3,520	4,478	5,329	5,915	7,320	8,331	8,556	8,556	8,556	8,556	8,556	8,556	8,556	8,556	8,556	8,556	8,556	8,556	8,556	8,556	8,556	8,556	8,556	8,556
Incremental Production																																
Incremental Production - Water Product	42,019	0	0	0	0	2,262	3,468	3,830	4,616	5,635	6,096	6,234	7,105	7,980	8,271	8,271	8,271	8,271	8,271	8,271	8,271	8,271	8,271	8,271	8,271	8,271	8,271	8,271	8,271	8,271	8,271	8,271
Incremental Production - Water Recove	62,301	0	0	0	1,033	0	328	1,698	3,069	4,674	7,328	9,996	12,678	14,032	14,315	14,604	14,899	15,200	15,507	15,821	16,058	16,299	16,543	16,792	17,043	17,299	17,559	17,822	18,089	18,361	18,636	
Reduction of Medical Cost	19,466	0	0	0	193	422	708	1,031	1,434	1,924	2,505	3,029	3,691	4,107	4,215	4,268	4,323	4,380	4,437	4,495	4,540	4,584	4,630	4,676	4,723	4,771	4,820	4,869	4,919	4,969	5,021	
Time saved for Water Fetching	4,387	0	0	0	43	95	160	232	323	434	565	683	832	926	962	974	987	1,000	1,013	1,023	1,033	1,044	1,054	1,065	1,075	1,086	1,097	1,109	1,120	1,132		
Prevention of Water Stop	6,975	0	0	0	0	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	
Total Economic Benefit	135,148	0	0	0	1,270	3,792	5,677	7,805	10,455	13,680	17,507	20,955	25,320	28,058	28,764	29,482	29,852	30,229	30,614	30,905	31,201	31,501	31,806	32,116	32,430	32,749	33,073	33,401	33,734	34,073		
Cash Flow																																
Year	NPV (D.R.=10%)	2,017	2,018	2,019	2,020	2,021	2,022	2,023	2,024	2,025	2,026	2,027	2,028	2,029	2,030	2,031	2,032	2,033	2,034	2,035	2,036	2,037	2,038	2,039	2,040	2,041	2,042	2,043	2,044	2,045	2,046	
Balance of whole project	-6,594	-10,235	-12,879	-46,976	-39,280	-15,814	3,195	5,014	6,936	9,201	12,178	15,040	17,999	19,727	20,208	20,563	20,926	21,296	21,673	22,058	22,349	22,645	22,946	23,251	23,560	6,472	24,193	24,517	24,845	25,179	25,517	
- Economic Benefit of (i) portion	59,876	0	0	0	0	3,792	5,289	5,779	6,782	8,073	8,684	8,886	9,997	11,101	11,468	11,470	11,472	11,475	11,477	11,480	11,481	11,483	11,485	11,487	11,489	11,490	11,492	11,494	11,496	11,497	11,499	
- Economic Cost of (i) portion	-108,471	-5,731	-7,237	-31,142	-25,521	-6,946	-5,164	-5,381	-5,988	-6,775	-7,130	-7,237	-7,910	-8,585	-8,810	-8,810	-8,810	-8,810	-8,810	-8,810	-8,810	-8,810	-8,810	-8,810	-8,810	-8,810	-8,810	-8,810	-8,810	-8,810	-8,810	
(i) Water Production Portion	-48,595	-5,731	-7,237	-31,142	-25,521	-3,154	125	398	794	1,298	1,554	1,649	2,087	2,516	2,658	2,660	2,662	2,665	2,667	2,670	2,672	2,673	2,675	2,677	2,679	-14,722	2,682	2,684	2,686	2,688	2,741	
- Economic Benefit of (ii) portion	75,272	0	0	0	1,270	0	388	2,026	3,673	5,607	8,822	12,069	15,323	16,957	17,297	17,649	18,009	18,377	18,751	19,134	19,424	19,718	20,016	20,319	20,627	20,940	21,257	21,579	21,905	22,237	22,573	
- Economic Cost of (ii) portion	-33,271	-4,503	-5,642	-15,834	-15,029	-12,660	2,681	2,589	2,469	2,296	1,801	1,323	589	254	254	254	254	254	254	254	254	254	254	254	254	254	254	254	254	254	254	
(ii) Water Recovery Portion	42,002	-4,503	-5,642	-15,834	-13,759	-12,660	3,069	4,615	6,142	7,903	10,624	13,391	15,912	17,211	17,551	17,904	18,264	18,631	19,006	19,388	19,778	20,171	20,574	20,981	21,394	21,811	22,231	22,654	23,081	23,511		
EIRR																																16.5%
B/C																																0.95

CAPEX: Water Production Portion 72,469 million FCFA 63% : Equipment part (20 years) 37% : Facility Part (50 years) 2,150 million FCFA : Cost of Membranes 40% : Percentage of Replacement in 20 year out of total Equipment Cost

CAPEX: Water Recovery Portion 56,493 million FCFA

Desalination Cost 554 FCFA/m3 Fixed Cost Rate 26.6% Fixed 148 FCFA/m3

SCF 0.9 Financial Analysis: 1.0, Economic Analysis: 0.9 Variable 407 FCFA/m3

Billed Water Rate 0.789 Actual in 2014

Collection Rate 1.000 1.00 for economic analysis

Revenue Water Rate 0.789

Average Water Tariff in 2015 (predicted) 574.40 FCFA/m3 Predicted Average Tariff Rate in 2015 (Willingness to Pay)

574.40 FCFA/m3 100.0%

Saved O&M Cost 0.5% of initial investment cost

Total Variable Cost of SDE in 2014 26,088 million FCFA supplies, materials, energy cost 26,088 million FCFA 100%

Billed Water Amount 131,281,610 m3

Treatment Cost 198.72 FCFA/m3

Average Family Member 10 people/house GNI per Capita (World Bank, 2013) 1,050 US

Rate without Pipe Connection 10% Value per hour 344 FCFA/hour

Average Daily Income 1078 FCFA/day 154 FCFA/hour

Per Capita Total Expenditure on Health 46 US\$ 608 FCFA/US\$ 27,968 2013 2014 CPI 0.7% -1.1% 0.996 27,854

Reduction Rate of Medical Cost 10%

Appendix 10-8. Calculation of EIRR under (v) Lower Outcome of Water Recovery Portion (NRW rate +5%)

(Unit: Million FCFA)

Year	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046				
Water Production Amount by Mamelles Plant (m3/day)	0	0	0	0	13,674	20,966	23,151	27,907	34,066	36,849	37,687	42,951	48,240	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000				
Saved Water by Water Recovery					4,929	0	1,564	8,100	14,637	22,294	34,953	47,678	52,482	53,542	54,624	55,727	56,853	58,001	59,173	60,368	61,274	62,193	63,126	64,073	65,034	66,009	66,999	68,004	69,025	70,060	71,111			
Portion (m3/day)					4,593	19,310	26,461	24,017	21,874	18,929	11,094	3,508	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
Number of Beneficiaries (people)	71.2	0	0	69,200	151,500	254,300	370,300	514,800	690,600	899,300	1,087,300	1,213,100	1,286,600	1,321,300	1,336,800	1,352,600	1,368,700	1,385,200	1,401,900	1,414,700	1,427,600	1,440,700	1,454,000	1,467,500	1,481,200	1,495,100	1,509,200	1,523,500	1,538,100	1,552,800				
Year																																		
NPV (D.R.=10%)																																		
Initial Investment Cost																																		
CAPEX - Water Production Portion	59,157	5,731	7,237	31,142	25,521	2,776	62																											
CAPEX - Water Recovery Portion	44,626	4,503	5,642	15,834	15,668	14,798	49																											
O&M Cost																																		
O&M - Desalination Plant	42,193	0	0	0	3,543	4,355	4,598	5,128	5,814	6,124	6,217	6,803	7,392	7,588	7,588	7,588	7,588	7,588	7,588	7,588	7,588	7,588	7,588	7,588	7,588	7,588	7,588	7,588	7,588	7,588	7,588			
Replacement Cost, Residual Value (wat	188	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
Reduction of Electricity Cost	-1,504	0	0	0	-81	-124	-137	-165	-202	-218	-223	-254	-286	-296	-296	-296	-296	-296	-296	-296	-296	-296	-296	-296	-296	-296	-296	-296	-296	-296	-296			
Reduction of O&M Cost for Pipes	-1,750	0	0	0	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254			
Reduced Cost for Water Production	-4,748	0	0	0	-300	-1,261	-1,727	-1,568	-1,428	-1,236	-724	-229	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
Residual Value (water recovery)	-1,709	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
Total Economic Cost	136,452	10,235	12,879	46,976	40,889	19,521	2,360	2,639	3,281	4,122	4,927	5,511	6,295	6,853	7,038	7,038	7,038	7,038	7,038	7,038	7,038	7,038	7,038	7,038	7,038	7,038	7,038	7,038	7,038	7,038	7,038			
Incremental Production																																		
Incremental Production - Water Product	42,019	0	0	0	2,262	3,468	3,830	4,616	5,635	6,096	6,234	7,105	7,980	8,271	8,271	8,271	8,271	8,271	8,271	8,271	8,271	8,271	8,271	8,271	8,271	8,271	8,271	8,271	8,271	8,271	8,271			
Incremental Production - Water Recove	52,674	0	0	0	1,033	0	528	1,698	3,069	4,674	7,328	9,996	11,003	11,225	11,452	11,684	11,920	12,160	12,406	12,657	12,846	13,039	13,235	13,433	13,635	13,839	14,047	14,258	14,471	14,688	14,909			
Reduction of Medical Cost	17,669	0	0	0	193	422	708	1,031	1,434	1,924	2,505	3,029	3,379	3,584	3,680	3,724	3,768	3,812	3,858	3,905	3,941	3,976	4,013	4,050	4,088	4,126	4,164	4,204	4,244	4,284	4,325			
Time saved for Water Fetching	3,982	0	0	0	43	95	160	232	323	434	565	683	762	808	830	839	849	859	870	880	888	896	904	913	921	930	939	947	956	966	975			
Prevention of Water Stop	6,975	0	0	0	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013			
Total Economic Benefit	123,320	0	0	0	1,270	3,792	5,677	7,805	10,455	13,680	17,507	20,955	23,262	24,610	25,246	25,531	25,821	26,116	26,418	26,726	26,959	27,196	27,436	27,680	27,928	28,179	28,434	28,693	28,956	29,223	29,493			
Cash Flow																																		
NPV (D.R.=10%)																																		
Balance of whole project	-13,132	-10,235	-12,879	-46,976	-39,619	-15,729	3,317	5,166	7,175	9,557	12,579	15,444	16,967	17,758	18,208	18,493	18,783	19,078	19,380	19,688	19,921	20,158	20,398	20,642	20,890	3,739	21,396	21,655	21,918	22,185	74,624	8.9%	0.90	
- Economic Benefit of (i) portion	59,792	0	0	0	3,792	5,289	5,779	6,782	8,073	8,684	8,886	9,982	11,075	11,440	11,442	11,445	11,447	11,450	11,452	11,454	11,456	11,458	11,460	11,461	11,461	11,463	11,465	11,467	11,471	11,471	11,472			
- Economic Cost of (i) portion	-100,033	-5,731	-7,237	-31,142	-25,521	-6,238	-4,293	-4,461	-4,963	-5,612	-5,906	-5,994	-6,549	-7,107	-7,292	-7,292	-7,292	-7,292	-7,292	-7,292	-7,292	-7,292	-7,292	-7,292	-7,292	-7,292	-7,292	-7,292	-7,292	-7,292	-7,292			
(i) Water Production Portion	-40,241	-5,731	-7,237	-31,142	-25,521	-2,445	997	1,318	1,820	2,461	2,779	2,892	3,433	3,968	4,147	4,150	4,152	4,155	4,157	4,160	4,162	4,164	4,166	4,167	4,169	-13,231	4,173	4,175	4,177	4,178	29,232	1.8%	0.60	
- Economic Benefit of (ii) portion	63,528	0	0	0	1,270	0	388	2,026	3,673	5,607	8,822	12,069	13,280	13,536	13,807	14,089	14,376	14,669	14,969	15,274	15,505	15,740	15,979	16,221	16,466	16,716	16,969	17,226	17,487	17,752	18,021			
- Economic Cost of (ii) portion	-36,419	-4,503	-5,642	-15,834	-15,368	-13,283	-1,933	1,822	1,682	1,490	978	483	254	254	254	254	254	254	254	254	254	254	254	254	254	254	254	254	254	254	254	27,371		
(ii) Water Recovery Portion	27,109	-4,503	-5,642	-15,834	-14,098	-13,283	2,321	3,848	5,355	7,096	9,801	12,552	13,534	13,790	14,061	14,343	14,630	14,923	15,223	15,528	15,760	15,994	16,233	16,475	16,721	16,970	17,223	17,480	17,741	18,006	45,392	14.5%	1.74	

CAPEX: Water Production Portion	72,469 million FCFA	63%	Equipment part (20 years)	37%	Facility Part (50 years)	2,150 million FCFA	Cost of Membranes	40%	Percentage of Replacement in 20 year out of total Equipment Cost
CAPEX: Water Recovery Portion	56,493 million FCFA								
Desalination Cost	462 FCFA/m3	Fixed Cost Rate	26.6%	Fixed	123 FCFA/m3				
SCF	0.9	Financial Analysis: 1.0, Economic Analysis: 0.9		Variable	339 FCFA/m3				
Billed Water Rate	0.789	Actual in 2014							
Collection Rate	1.000	1.00 for economic analysis							
Revenue Water Rate	0.789								
Average Water Tariff in 2015 (predicted)	574.40 FCFA/m3	Predicted Average Tariff Rate in 2015 (Willingness to Pay)							
	574.40 FCFA/m3	100.0%							
Saved O&M Cost	0.5%	of initial investment cost							
Total Variable Cost of SDE in 2014	26,088 million FCFA	supplies, materials, energy cost	26,088	million FCFA	100%				
Billed Water Amount	131,281,610 m3								
Treatment Cost	198.72 FCFA/m3								
Average Family Member	10 people/house	GNI per Capita (World Bank, 2013)	1,050 US						
Rate without Pipe Connection	10%	Value per hour	344 FCFA/hour						
Average Daily Income	1078 FCFA/day	154 FCFA/hour							
Per Capita Total Expenditure on Health	46 US\$	608 FCFA/US\$	27,968	2013	2014	CPI	0.7%	-1.1%	0.996
Reduction Rate of Medical Cost	10%								27,854

Appendix 10-9. Calculation of EIRR under (vi) Increase of Willingness to Pay +57%

(Unit: Million FCFA)

Year	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046			
Water Production Amount by Mamelles Plant (m3/day)	0	0	0	0	13,674	20,966	23,151	27,907	34,066	36,849	37,687	42,951	48,240	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000			
Saved Water by Water Recovery Portion (m3/day)					4,929	0	1,564	8,100	14,637	22,294	34,953	47,678	60,470	66,928	68,280	69,659	71,066	72,502	73,966	75,460	76,992	77,741	78,907	80,091	81,292	82,512	83,749	85,006	86,281	87,575	88,888		
Number of Beneficiaries (people)	71.2	0	0	0	69,200	151,500	254,300	370,300	514,800	690,600	899,300	1,087,300	1,325,300	1,474,600	1,513,100	1,532,400	1,552,200	1,572,400	1,592,900	1,613,900	1,629,800	1,645,900	1,662,300	1,678,900	1,695,800	1,712,900	1,730,300	1,748,000	1,765,900	1,784,100	1,802,500		
NPV (D.R.=10%)	2,017	2,018	2,019	2,020	2,021	2,022	2,023	2,024	2,025	2,026	2,027	2,028	2,029	2,030	2,031	2,032	2,033	2,034	2,035	2,036	2,037	2,038	2,039	2,040	2,041	2,042	2,043	2,044	2,045	2,046			
Initial Investment Cost																																	
CAPEX - Water Production Portion	59,157	5,731	7,237	31,142	25,521	2,776	62																										
CAPEX - Water Recovery Portion	44,626	4,503	5,642	15,834	15,668	14,798	49																										
O&M Cost																																	
O&M - Desalination Plant	42,193	0	0	0	0	3,543	4,355	4,598	5,128	5,814	6,124	6,217	6,803	7,392	7,588	7,588	7,588	7,588	7,588	7,588	7,588	7,588	7,588	7,588	7,588	7,588	7,588	7,588	7,588	7,588	7,588		
Replacement Cost, Residual Value (wat	188	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Reduction of Electricity Cost	-1,504	0	0	0	0	-81	-124	-137	-165	-202	-218	-223	-254	-286	-296	-296	-296	-296	-296	-296	-296	-296	-296	-296	-296	-296	-296	-296	-296	-296	-296		
Reduction of O&M Cost for Pipes	-1,750	0	0	0	0	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254		
Reduced Cost for Water Production	-7,897	0	0	0	-639	-1,884	-2,476	-2,335	-2,215	-2,042	-1,547	-1,069	-335	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Residual Value (water recovery)	-1,709	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-27,117		
Total Economic Cost	133,303	10,235	12,879	46,976	40,550	18,898	1,612	1,872	2,494	3,316	4,104	4,671	5,960	6,853	7,038	7,038	7,038	7,038	7,038	7,038	7,038	7,038	7,038	7,038	7,038	7,038	7,038	7,038	7,038	7,038	7,038		
Incremental Production																																	
Incremental Production - Water Product	65,970	0	0	0	0	3,551	5,445	6,012	7,248	8,847	9,570	9,788	11,155	12,528	12,985	12,985	12,985	12,985	12,985	12,985	12,985	12,985	12,985	12,985	12,985	12,985	12,985	12,985	12,985	12,985			
Incremental Production - Water Recove	97,812	0	0	0	0	515	2,666	4,818	7,338	11,505	15,694	19,904	22,030	22,475	22,929	23,392	23,865	24,347	24,839	25,211	25,589	25,973	26,363	26,758	27,160	27,567	27,980	28,400	28,826	29,259			
Reduction of Medical Cost	19,466	0	0	0	193	422	708	1,031	1,434	1,924	2,505	3,029	3,691	4,107	4,215	4,268	4,323	4,380	4,437	4,495	4,540	4,584	4,630	4,676	4,723	4,771	4,820	4,869	4,919	4,969	5,021		
Time saved for Water Fetching	4,387	0	0	0	43	95	160	232	323	434	565	683	832	926	950	962	974	987	1,000	1,013	1,023	1,033	1,044	1,054	1,065	1,075	1,086	1,097	1,109	1,120	1,132		
Prevention of Water Stop	6,975	0	0	0	0	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013		
Total Economic Benefit	194,610	0	0	0	1,859	5,082	7,841	10,956	14,836	19,556	25,158	30,206	36,596	40,605	41,638	42,158	42,689	43,230	43,782	44,346	44,773	45,206	45,646	46,092	46,545	47,005	47,472	47,945	48,426	48,914	49,410		
Cash Flow	NPV (D.R.=10%)	2,017	2,018	2,019	2,020	2,021	2,022	2,023	2,024	2,025	2,026	2,027	2,028	2,029	2,030	2,031	2,032	2,033	2,034	2,035	2,036	2,037	2,038	2,039	2,040	2,041	2,042	2,043	2,044	2,045	2,046	EIRR	B/C
Balance of whole project	61,307	-10,235	-12,879	-46,976	-38,691	-13,816	6,230	9,084	12,342	16,240	21,054	25,535	30,636	33,752	34,600	35,120	35,651	36,192	36,744	37,308	37,735	38,168	38,608	39,054	39,507	22,564	40,434	40,907	41,388	41,876	94,540	14.3%	1.46
- Economic Benefit of (i) portion	83,827	0	0	0	0	5,082	7,266	9,962	14,144	11,285	12,159	12,439	14,047	15,650	16,182	16,184	16,187	16,189	16,192	16,194	16,196	16,198	16,199	16,201	16,203	16,205	16,207	16,208	16,210	16,212	16,214		
- Economic Cost of (i) portion	-100,033	-5,731	-7,237	-31,142	-25,521	-6,238	-4,293	-4,461	-4,963	-5,612	-5,906	-5,994	-6,549	-7,107	-7,292	-7,292	-7,292	-7,292	-7,292	-7,292	-7,292	-7,292	-7,292	-7,292	-7,292	-7,292	-7,292	-7,292	-7,292	-7,292	-7,292		
(i) Water Production Portion	-16,206	-5,731	-7,237	-31,142	-25,521	-1,156	2,973	3,501	4,451	5,673	6,253	6,445	7,498	8,543	8,890	8,892	8,895	8,897	8,899	8,902	8,904	8,905	8,907	8,909	8,911	-8,490	8,914	8,916	8,918	8,920	33,974	7.2%	0.84
- Economic Benefit of (ii) portion	110,784	0	0	0	1,859	0	575	2,994	5,422	8,271	12,999	17,766	22,549	24,955	25,456	25,974	26,502	27,041	27,591	28,152	28,577	29,008	29,446	29,891	30,342	30,800	31,265	31,737	32,216	32,702	33,196		
- Economic Cost of (ii) portion	-33,271	-4,503	-5,642	-15,834	-15,029	-12,660	2,681	2,589	2,469	2,296	1,801	1,323	589	254	254	254	254	254	254	254	254	254	254	254	254	254	254	254	254	254	254		
(ii) Water Recovery Portion	77,513	-4,503	-5,642	-15,834	-13,170	-12,660	3,256	5,583	7,891	10,567	14,801	19,089	23,138	25,209	25,711	26,228	26,756	27,295	27,845	28,406	28,831	29,262	29,700	30,145	30,596	31,054	31,519	31,991	32,470	32,957	60,567	20.3%	3.33

CAPEX: Water Production Portion 72,469 million FCFA 63% : Equipment part (20 years) 37% : Facility Part (50 years) 2,150 million FCFA : Cost of Membranes 40% : Percentage of Replacement in 20 year out of total Equipment Cost
 CAPEX: Water Recovery Portion 56,493 million FCFA
 Desalination Cost 462 FCFA/m3 Fixed Cost Rate 26.6% Fixed 123 FCFA/m3
 SCF 0.9 Financial Analysis: 1.0, Economic Analysis: 0.9 Variable 339 FCFA/m3
 Billed Water Rate 0.789 Actual in 2014
 Collection Rate 1.000 1.00 for economic analysis
 Revenue Water Rate 0.789
 Average Water Tariff in 2015 (predicted) 574.40 FCFA/m3 Predicted Average Tariff Rate in 2015 (Willingness to Pay)
 901.81 FCFA/m3 157.0%
 Saved O&M Cost 0.5% of initial investment cost
 Total Variable Cost of SDE in 2014 26,088 million FCFA supplies, materials, energy cost 26,088 million FCFA 100%
 Billed Water Amount 131,281,610 m3
 Treatment Cost 198.72 FCFA/m3
 Average Family Member 10 people/house GNI per Capita (World Bank, 2013) 1,050 US
 Rate without Pipe Connection 10% Value per hour 344 FCFA/hour
 Average Daily Income 1078 FCFA/day 154 FCFA/hour
 Per Capita Total Expenditure on Health 46 US\$ 608 FCFA/US\$ 27,968 2013 2014 CPI
 Reduction Rate of Medical Cost 10% 0.7% -1.1% 0.996 27,854