5.6.2. Site 2: Strandfontein

5.6.2.1. Brief Description of the Project

The proposed infrastructure shall be implemented in two phases.

Phase 1 comprises the following:

The proposed 2 Mℓ/d containerized and modularised desalination plant, pump stations and generators will be located within the Strandfontein Resort's grounds off Baden Powell Drive, 2 km west of Strandfontein (refer to Locality Plan). The proposed plant footprint is in the order of 3800 m² and in accordance with building regulations shall not exceed a maximum element height of approximately 6,5 m. The Purchaser's Agent have completed a preliminary design and the indicative design details are presented below. The intention is that the duties and pipe sizing is to assist the Supplier wih their design approach. However, the design responsibility remains with the Supplier.

It is estimated that the raw water abstraction pipe work shall consist of a 1 x Ø315 mm HDPE PE 100 PN 10 pipe abstracting raw water from the tidal pool with the intake located south of the proposed treatment plant. The raw water abstraction pump station will be located onshore south of the plant. A holding tank with half an hour storage (based on 7 Mℓ/d) will be constructed on the intake side of the desalination plant. Excavation or dredging of sand may be required pending the depth of the tidal pool at the intake position.

The volume of raw water in the tidal pool will be supplemented by a pump-over scheme. The pump-over scheme serves to abstract raw water offshore (open ocean) and comprises a Ø355 mm HDPE PE 100 PN 10 suction pipe and Ø250 mm HDPE PE 100 PN 10 delivery pipe served by the pump station located onshore. Refer to the drawings included in Annexure 7C.

It is proposed that the onshore raw water abstraction pipe work to the pumpstation and plant, as well as the pump-over scheme's pipe works shall be buried for safety reasons and where necessary will be held in position by means of sandbags along the route for any above ground sections. The onshore water delivery from the plant to the injection point in the existing bulk water network will comprise 2 hours of storage capacity in a holding tank, a booster pump and HDPE pipework. The suction pipe will be a 1 x Ø355 mm HDPE PE 100 PN 10 pipe and the delivery pipe a 1 x Ø315 mm HDPE PE 100 PN 16 pipe. The delivery pipe will be approximately 100 m in length, run underground for safety reasons and cross just north of the existing parking area. The delivery pipe will be connected to the existing bulk water network on the western side of Strandfontein Road, via CCT tie-in infrastructure. The road crossing at Strandfontein Road will be underground.

A holding tank with half an hour storage will be constructed on the outfall side of the desalination plant. The outfall brine pipeline will be 1 x Ø355 mm HDPE PE 100 PN 10 extending in a roughly southerly direction from the plant to dispersement offshore. Refer to the drawings included in Annexure 7C.

It should be noted that although Phase 1 comprises only a 2 Mℓ/d containerized plant, it should be modularised, as the intention is to develop all the onshore infrastructure as would be for the full 7 Mℓ/d from the onset including the onshore pipework. This approach will be similarly applicable to pumps as it is envisaged that the pumps be placed in series and commissioned as the supply increases from 2 Mℓ/d to 7 Mℓ/d. All the necessary isolating and air valves need to be provided.

Phase 2 comprises the following:

Phase 2 will comprise the commissioning of a 7 Mℓ/d containerized and modularised desalination plant with associated works. The offshore raw water abstraction will be located at a suitable depth and served by the onshore pump station. It is envisaged that the suction pipe will comprise 3 x Ø400 mm HDPE PE 100 PN 10 pipes and the delivery pipes from the pump station to the plant will consist of 2 x Ø355 mm HDPE PE 100 PN 10 pipes. The onshore raw water abstraction pipe works to the plant will predominately be buried for safety reasons and where necessary will be held in position by means of sandbags along the route for any above ground sections.

Infrastructure associated with Phase 1 shall be removed upon the successful commissioning of Phase 2. The Supplier shall however aim to incorporate infrastructure from Phase 1 as far as possible. Consideration should therefore be given to sizing of pipework, pump duties, etc.

5.6.2.2. Location of the Site

The locations for the proposed SWRO plant and associated infrastructure are shown in Figures 1B and 2B (also refer to Annexure 7C).

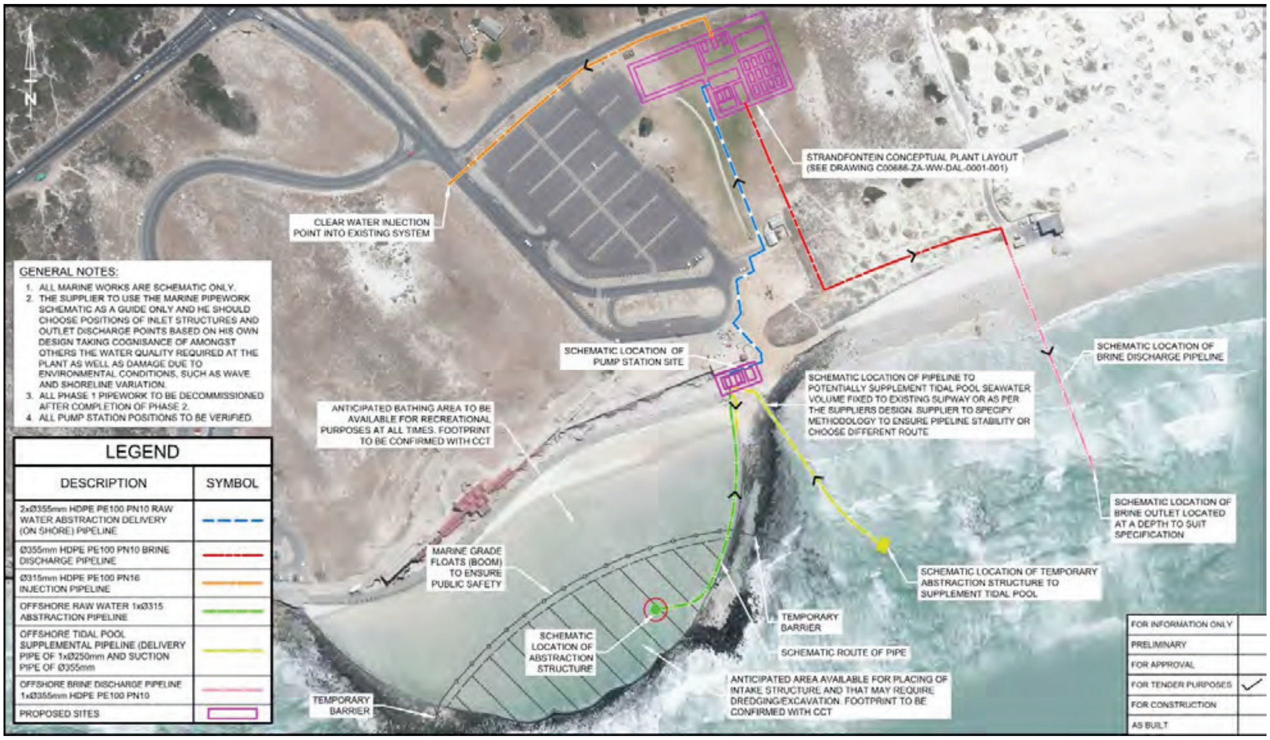


Figure 1B: Phase 1: Strandfontein Site Location

Figure 2B: Phase 2: Strandfontein Site Location

5.6.2.3. Raw Water Data

The anticipated sea water quality is included as Annexure 8. The Supplier's design of the SWRO Process Train is to be based on the indicative water quality data. The Supplier's design shall be of sufficient robustness to allow for a 20 % variation in raw water quality. Variations in quality beyond the 20 % threshold shall be addressed on a case by case evaluation and if it is found that the raw water data exceed the threshold due to extreme conditions, consideration shall be given by the Purchaser for such extreme events.

5.6.2.4. Specifications

5.6.2.4.1. Mechanical and Electrical

Abstraction and Pump-Over Pump Installations

1. General

This pumping system will pump sea water from the intake or abstraction position in the tidal pool to the raw water tanks situated on the Desalination Plant Site. The abstraction pump stations shall be installed in phases, to supply water to the plant as soon as possible.

Initially the plant shall be fed from the tidal pool, with the abstraction pump station working in conjunction with the Pump-Over pump station. This shall be sized to comply with the requirements of 2Ml/d desalination plant. Once the final raw water intake pipework, as described under the Marine section of this document, are in place to abstract sea water directly from the ocean, the abstraction pump station shall comply with the requirements of the full 7Ml/d plant.

The pump station abstracting water from the tidal pool shall consist out of either submersible pump sets installed in the tidal pool or drywell pumpsets installed in a container on the edge of the tidal pool, abstracting water from the tidal pool. Drywell pumpsets installed in a container shall be used for the ultimate installation and capable of abstracting water from the ocean.

The pump station abstracting water from the ocean shall consist out of drywell pumpsets installed in a container on the edge of the tidal pool, abstracting water from the ocean.

The layout and configuration of the installation and equipment orientation shall consider required free passages and space for repairs and maintenance of the equipment, including the handling of the respective equipment. The installation shall provide for suitable anchors and mounting platforms to ensure that rough ocean conditions will not damage the equipment and to accommodate the variation in the tidal water levels.

The position of the pump station shall consider available area, high level sea water mark, access and pump type and its respective technical constraints such as NPSH. This will be approved in conjunction with the Engineer and the Purchaser.

Proposed position and orientation of the system is shown on schematic layout plans and process-flow-diagrams (PFD) included in Annexure 7C.

All applicable datasheets included in the tender document related to equipment covered under this plant must be completed and submitted as part of the tender.

All work carried out, as well as equipment supplied, must fully meet and be in compliance with the requirements of the Occupational Health and Safety Act (Act 85 of 1993) and the Construction Regulations (2014) issued in terms of Section 43 of the Act.

Pricing of the plant shall make allowances for each and every applicable aspect: Design, Supply, Delivery, Installation (Including Handling and Rigging), Commissioning, Testing, Operation and Maintenance for the contract duration, Signage, decommissioning and removal if necessary.

Refer the General Electrical Section for compliance and regulatory standards, as well as general installation and control specifications.

2. Mechanical Installation

The pump station shall be fitted with a minimum of two (2) pumps acting in a duty/standby arrangement. This system is envisaged to operate as a “Tank Filling System”. Pumps shall be sized to pump the required raw water flow/flowrate required to suit the desalination plant raw water requirements. Total pressure head shall be calculated to suit, using the guideline system hydraulic information below.

All pumps will be connected to a common manifold, with connection to the single (1) or parallel rising main pipeline(s) to the raw water tank. The rising main pipeline is described under the onshore part of the specification.

Raw water abstraction pump system – Estimated hydraulic information:

Maximum Flow Required (per pump installation) – To Suit Desalination Plant Raw Water Flow Requirements: Estimated at 5.0 Mℓ/day over 24 hours = 57.9 ℓ/s or 208.4 m^3/hr per 2Mℓ/d plant train	
Estimated Suction pipework	
Suction static head	N/A
Estimate length of pipe	N/A
Estimated Delivery pipework	
Delivery static head	4.5 m
Estimate length of pipe	700 m
End pressure head required	5 m

Maximum Flow Required (per pump installation) – To Suit Desalination Plant Raw Water Flow Requirements: Estimated at 17.5 Mℓ/day over 24 hours = 202.5 ℓ/s or 729.2 m^3/hr per 7Mℓ/d plant train	
Estimated Suction pipework	
Suction static head	4.0 m
Estimate length of pipe	800 m
Estimated Delivery pipework	
Delivery static head	4.5 m
Estimate length of pipe	700 m
End pressure head required	5 m

Pump-Over pump system – Estimated hydraulic information:

Maximum Flow Required (per pump installation) – To Suit Desalination Plant Raw Water Flow Requirements: Estimated at 5.0 Mℓ/day over 24 hours = 57.9 ℓ/s or 208.4 m^3/hr per 2Mℓ/d plant train	
Estimated Suction pipework	
Suction static head	2.0 m
Estimate length of pipe	100 m
Estimated Delivery pipework	
Delivery static head	0.0 m
Estimate length of pipe	20 m
End pressure head required	1.0 m

Suction pipework, valves and fittings shall be sized to have a maximum flow velocity of 1.2 m/s. Rising Main, delivery pipework, valves and fittings shall be sized to have a maximum flow velocity of 1.5 m/s. All pipework and fittings shall be rated to handle the shut-off pressure of the proposed pump sets. Provision shall be made for all pipe connections to be on the outside of the containers with the relative suction and delivery pipes.

All pipework and associated fittings / couplings shall be manufactured of a material conducive to handling the medium being pumped. Pipework and fittings shall allow for tappings / sockets / saddles for process gauges and instrumentation where required.

Each pump shall include its own suction foot valve if applicable, suction (if applicable) and delivery isolating valves, non-return valves, air release valve, connections to suction and rising main pipework all as per rational design by the Supplier. All pipework and valves shall be properly supported and so arranged that all stresses created in the pipework by static and dynamic forces, including recoil shock, will be taken up by suitable anchors.

A main isolating valve shall be installed on the delivery pipework before connecting to the rising main.

Suction /Abstraction point shall make allowances for:

- Intake Sieve/Strainer with mesh and all related aspects sized to suit
- Orientation for accommodation of sand and other suspended solids
- Minimum constant submergence to prohibit vortices formation.
- Anchoring of intake pipe and structure
- Access for maintenance and cleaning

Further information can be found in Marine specification (part PB) of the specification.

Pump Set Characteristics / Considerations:

- Installed in a frame to support the pump set and pipework in the water
- Materials conducive to the pumped medium or protective coatings to ensure maximum reliability
- Suitability (and design / operation constraints) to operation with Variable Frequency Drives (VFDs)
- Motor sizing shall ensure that the pump does not overload the motor in runout conditions

3. Electrical Control and Instrumentation:

3.1 Initial Installation

3.1.1 Electrical:

The site is located on the main site area. A dedicated MCC (6kA, rated for the full load with VFDs) will have to be installed within the site area (either dedicated container or suitably and practically shared), fed from the main site distribution kiosk.

It must be noted that initially the abstraction pump system will consist of abstraction pumps pumping from the tidal pool to the main plant, as well as pump-over pumps, keeping the tidal pool full. This is a temporary measure whilst the final abstraction pipeline is being constructed. All equipment to be fed from the same MCC.

This system will become obsolete, or equipment re-used where possible in the final installation.

3.1.2 Control Philosophy:

The abstraction pumps must be level controlled from the raw water intake tank at the main plant site by means of analogue signals. Additional discrete emergency control must be provided in case the normal control mechanism fails for both high and low level protection. The tank must be kept as full as possible at all times.

The pump-over pumps must run in conjunction with the abstraction pumps, keeping the tidal pool full whilst the abstraction pumps are running.

All required pump protection must be provided for between the pump/motor configuration and the MCC. This could include motor overheat (thermistor, OTC or PT100), moisture ingress (seal fail), no-flow protection, high pressure protection, pipe-break detection as well as suction control and suction low level protection.

The pumps must alternate their pumping cycle every 3 hours, with the standby pump acting as a standby pump in case the duty pump fails.

3.1.3 Instrumentation:

a) Flow Meter and Detection

An electromagnetic flow meter of the highest billing class must be installed inline before the raw water tank at the plant, linked to the PLC for monitoring and trending purposes.

The flow meter can further be used for no-flow protection, or dedicated no-flow protection devices provided per pumpset.

This flow meter must be re-used under the final phase, but re-calibration and commissioning must be provided for.

b) Pressure Sensor

A common outlet analogue pressure sensor must be installed for monitoring of system and pump pressures, linked to the PLC for monitoring and trending purposes.

This pressure sensor must be re-used under the final phase, but re-calibration and commissioning must be provided for.

c) Level Control

An analogue level sensor must be installed in the raw water tank, with separate discrete high and low level emergency level backups. Alternatively two separate analogue level sensing technologies can be installed, one primary and the other backup (and suitable for calibration purposes).

<u>3.2 Final installation</u>

3.2.1 Electrical:

The site must be located on the main site area. A dedicated MCC (6kA, rated for the full load with VFDs) will have to be installed within the site area (either dedicated container or suitably and practically shared), fed from the main site distribution kiosk.

The final abstraction pump installation will involve a suction pipe extending far into the ocean.

3.2.2 Control Philosophy:

The abstraction pumps must be level controlled from the raw water intake tank at the main plant site by means of analogue signals. Additional discrete emergency control must be provided in case the normal control mechanism fails for both high and low level protection. The tank must be kept as full as possible at all times.

All required pump protection must be provided for between the pump/motor configuration and the MCC. This could include motor overheat (thermistor, OTC or PT100), moisture ingress (seal fail), no-flow protection, high pressure protection, pipe-break detection as well as suction control and suction low level protection.

The pumps must alternate their pumping cycle every 3 hours, with the standby pump acting as a standby pump in case the duty pump fails.

3.3.3 Instrumentation:

Initial phase equipment must be re-calbrated, commissioned and re-used into the new control, protection and billing systems.

<u>Potable Water Booster Pump Installation</u>

<u>1. General</u>

Each desalination plant (train) shall include a booster pumping system supplying pressurized potable water from the clear water tanks into the municipal reticulation system.

Where possible, this pump station and its ancillary mechanical equipment shall be built into a container for ease of delivering, installation and positioning on site. The size and configuration of the container and equipment orientation within it shall consider required free passages and space for repairs and maintenance of the equipment installed inside of it, including the handling of the respective materials. This container shall include applicable ventilation required and painted to suit the natural surrounding area.

Should the plant be small enough, it can be built into another applicable/suitable portion of the plant with all functional features as specified.

All applicable datasheets included in the tender document related to equipment covered under this plant must be completed and submitted as part of the tender.

Proposed position and orientation of the system is shown on schematic layout plans and process-flow-diagrams (PFD) included in Annexure 7C.

All work carried out, as well as equipment supplied, must fully meet and be in compliance with the requirements of the Occupational Health and Safety Act (Act 85 of 1993) and the Construction Regulations (2014) issued in terms of Section 43 of the Act.

Pricing of the plant shall make allowances for each and every applicable aspect: Design, Supply, Delivery, Installation (Including Handling and Rigging), Commissioning, Testing, Operation and Maintenance for contract duration, Signage, decommissioning and removal if necessary.

2. Mechanical Installation

This pump station is envisaged to be a of the constant pressure booster pump system type, able to deliver constant pressure into the reticulation network irrespective of deviating flow to a maximum flow equivalent to the maximum instantaneous flow delivered by the desalination unit.

This shall be done with a combination of 1, 2 or 3 duty pumps and one standby pump. The total flow stipulated shall be divided equally across the chosen number of duty pumps so as to remain at or as close to best efficiency of pump/s selected and operating. The installation shall be capable of delivering up to a maximum of 7 Ml/d, and shall be capable of handling the initial injection rate of up to 2Ml/d by means of utilising less pumps and operating at a lower speed.

I.e. Pumps shall be driven by VFDs and a controller suitable for determining the number of pumps operating and the respective speeds in order to maintain the constant pre-set pressure.

Booster pump system – Estimated hydraulic information:

Maximum Flow Required (per pump installation) – 81.0 ℓ/s or 291.6 m^3/hr	
Estimated Suction pipework	
Suction static head	3.0 m (flooded)
Estimate length of pipe	10 m
Estimated Delivery pipework	
Delivery static head	1 m
Estimate length of pipe	100 m
End pressure head required at injection point / Constant Pressure into network	113 m

All pipework and associated fittings / couplings shall be manufactured of a material conducive to handling the medium being pumped. Pipework and fittings shall allow for tappings / sockets / saddles for process gauges and instrumentation where required.

Suction pipework, valves and fittings shall be sized to have a maximum flow velocity of 1.2 m/s. Rising Main, delivery pipework, valves and fittings shall be sized to have a maximum flow velocity of 1.5 m/s. All pipework and fittings shall be rated to handle the shut-off pressure of the proposed pump sets.

Each pump shall include its own suction and delivery isolating valves, non-return valves, air release valve, connections to suction and rising main pipework all as per rational design by the Supplier. All pipework and valves shall be properly supported and so arranged that all stresses created in the pipework by static and dynamic forces, including recoil shock, will be taken up by suitable anchors.

A main isolating shall be installed on the suction and delivery pipework/manifolds before connecting to the product water supply tank and rising main respectively. The installation shall make provision for surge protection devices as well as bypass for the pump installation to prevent excessive pressure head conditions and spikes.

Pumps/Booster Pump Set Characteristics/Considerations:

- Vertical Multistage pumps for smaller area footprint. – If Possible
- Installed on a baseplate with vibration damper mounting – If Applicable
- Space type coupling for back pull-out without disconnecting pump volute – If applicable
- Materials conducive to the pumped medium or protective coatings to ensure maximum reliability
- Suitability (and design constraints) to operation with Variable Frequency Drives (VFDs)
- Motor sizing shall ensure that the pump does not overload the motor in runout conditions
- Minimal Energy / Shock losses in Manifold pipework.

3. Electrical Control and Instrumentation

3.1. Electrical

The site is located on the main site area. A dedicated MCC (10kA, rated for the full load with VFDs) will have to be installed within the pump container, fed from the main site distribution kiosk.

Due to the initial and final phased approach to the sizing of the plant, this pump station must inject into the system what the actual plant demand can deliver. Should this require re-calibration, VFD adjustments, protection changes or any other means in upgrading from the initial to final approach, it must be provided for.

3.2. Control Philosophy

This potable booster pump station is absolutely key in the overall operation and effectiveness of the entire plant.

The pumps will be used to pump the potable water into an existing water reticulation network, at a specified constant pressure band. The pump configuration must be controlled to PID within this pressure band (as per the mechanical specification requirements).

The PID loop must be adjustable on all three parameters, including reaction time to pressure fluctuations, delay timers for spikes and fully networked control with the VFDs' minimum, maximum and ramping speeds.

Should the booster set's inherent PLC or control system not be able to provide these functional parameters, then dedicated PLC control must be scripted.

All required pump protection must be provided for between the pump/motor configuration and the MCC. This could include motor overheat (thermistor, OTC or PT100), moisture ingress (seal fail), no-flow protection, high pressure protection, pipe-break detection as well as suction control (analogue from the Clearwater tank) and suction low level protection.

The pumps must alternate their pumping cycle every 3 hours, with the standby pump acting as a standby pump in case the duty pump(s) fails.

3.3 Instrumentation

a) Flow Meter and Detection:

An electromagnetic flow meter of the highest billing class must be installed at the pump station, linked to a PLC for monitoring and trending purposes. This meter will further be utilized to calculate and indicate daily, weekly and monthly pumping trends. These values will also have to be transmitted to the Purchaser.

The flow meter can further be used for no-flow protection, or dedicated no-flow protection devices provided per pumpset.

b) Pressure Sensor:

A common outlet analogue pressure sensor must be installed for monitoring of system and pump pressures, linked to the PLC for monitoring and trending purposes. This pressure sensor is critical for the overall plant operation and injection pressures.

Additional pressure sensors must be installed at the injection point, all battery backed-up with communication protocols back to the RO plant's main control room. These sensors must be used for research to determine the system characteristics before any pumping is done, as well for logging and trending of what the system is doing while the pumps are running. These values will also have to be transmitted to the Purchaser.

One sensor must be installed on the new pipeline tie-in point, one upstream of the tie-in and other down-stream of the tie-in. Provision is made on the new bulk pipeline with a housing and connection point. The other two sensors must be installed as close as possible to the tie-in point and must include for all connection requirements, enclosure, security and Purchaser coordination to ensure a safe and reliable installation, transmitting accurate data continuously.

c) Level Control:

An analogue level sensor must be installed in the Clearwater discharge tank, with separate discrete high and low level emergency level backups. Alternatively two separate analogue level sensing technologies can be installed, one primary and the other backup (and suitable for calibration purposes).

Brine Pump Installation

1. General

Each Desalination plant (train) shall have a pump station/system to handle the brine/waste generated from it. This brine will be collected in a holding tank and pumped into the identified discharge point.

Subject to decided orientation of the Brine Tank and plant layout, these pumps could be of the submersible type on a typical auto-coupling installation within the tank or dry centrifugal type housed in a containerised installation or if small enough, housed/built into another applicable/suitable portion of the plant with all functional features as specified.

If containerised, this pump station and its ancillary mechanical equipment shall be built into a container for ease of delivering, installation and positioning on site. The size and configuration of the container and equipment orientation within it shall consider required free passages and space for repairs and maintenance of the equipment installed inside of it, including the handling of the respective materials. This container shall include applicable ventilation as required and painted to suit the natural surrounding area.

All applicable datasheets included in the tender document related to equipment covered under this plant must be completed and submitted as part of the tender.

Proposed position and orientation of the system is shown on schematic layout plans and process-flow-diagrams (PFD) included in Annexure 7C.

All work carried out, as well as equipment supplied, must fully meet and be in compliance with the requirements of the Occupational Health and Safety Act (Act 85 of 1993) and the Construction Regulations (2014) issued in terms of Section 43 of the Act.

Pricing of the plant shall make allowances for each and every applicable aspect: Design, Supply, Delivery, Installation (Including Handling and Rigging), Commissioning, Testing, Operation and Maintenance for contract duration, Signage, decommissioning and removal if necessary.

Refer the General Electrical Section for compliance and regulatory standards, as well as general installation and control specifications.

2. Mechanical Installation

The pump station shall be fitted with a minimum of two (2) pumps acting in a duty/standby arrangement. This system is envisaged to operate as a "Tank Emptying System". Pumps shall be sized to pump the required or expected flow / flowrate of brine discharge from the desalination plant. **Note:** This flowrate however limited to a maximum that the discharge point can handle, as provisionally stated in the hydraulic information below. For this reason flowrate flexibility by means of Variable Frequency Drives (VFDs) will be required. Total pressure head shall be calculated to suit (Based on the maximum flow), using the guideline system hydraulic information below.

Brine Pump System – Estimated hydraulic information:

Maximum Flow Required (per pump installation) – To Suit Desalination Plant Brine Disposal Rate Flow Requirements: Estimated at 10.5 Mℓ/day over 24 hours = 121 ℓ/s or 435.6 m^3/hr for a 7Ml/d train	
Estimated Suction pipework	
Suction static head	2.0 m (flooded)
Estimate length of pipe	10 m
Estimated Delivery pipework	
Delivery static head	1 m
Estimate length of pipe	400 m
End pressure head required	0 to 2 m

All pipework and associated fittings / couplings shall be manufactured of a material conducive to handling the medium being pumped. Pipework and fittings shall allow for tappings / sockets / saddles for process gauges and instrumentation where required.

Suction pipework, valves and fittings shall be sized to have a maximum flow velocity of 1.2 m/s. Rising Main, delivery pipework, valves and fittings shall be sized to have a maximum flow velocity of 1.5 m/s. All pipework and fittings shall be rated to handle the shut-off pressure of the proposed pump sets.

Each pump shall include its own suction and delivery isolating valves, non-return valves, air release valve, connections to suction and rising main pipework all as per rational design by the Supplier.

A main isolating shall be installed on the suction (If Applicable) and delivery pipework/manifolds before connecting to the brine tank and rising main respectively.

Brine Pumps Characteristics/Considerations:

- Submersible auto-coupling Type Installation for smallest area footprint. – If Applicable
- Installed on a baseplate with vibration damper mounting – If Applicable
- Spacer type coupling for back pull-out without disconnecting pump volute – If applicable
- Materials conducive to the pumped medium or protective coatings to ensure maximum reliability
- Suitability (and design constraints) to operation with Variable Frequency Drives (VFDs)
- Motor sizing shall ensure that the pump does not overload the motor in runout conditions
- Minimal Energy/Shock losses in Manifold pipework.

3. Electrical Control and Instrumentation

3.1 Electrical:

The site is located on the main site area. A dedicated MCC (6kA, rated for the full load with VFDs) will have to be installed within the pump container, fed from the main site distribution kiosk.

3.2 Control Philosophy:

The brine pumps must continuously pump brine from the suction brine discharge tank into the sewer outfall system.The pumps must be level controlled from the suction tank, pumping when there is brine and only stop when the tank is drawn down. The pumps must operate on a selected fixed speed, determined in conjunction with the sewer outfall capacity capability. Additional discrete emergency control must be provided in case the normal control mechanism fails for low level protection.

All required pump protection must be provided for between the pump/motor configuration and the MCC. This could include motor overheat (thermistor, OTC or PT100), moisture ingress (seal fail), no-flow protection, high pressure protection, pipe-break detection as well as suction control and suction low level protection.

The pumps must alternate their pumping cycle every 3 hours, with the standby pump acting as a standby pump in case the duty pump fails.

3.3 Instrumentation:

a) Flow Meter and Detection

An electromagnetic flow meter of the highest billing class must be installed at the pump station, linked to a PLC for monitoring and trending purposes.

The flow meter can further be used for no-flow protection, or dedicated no-flow protection devices provided per pumpset.

b) Pressure Sensor

A common outlet analogue pressure sensor must be installed for monitoring of system and pump pressures, linked to the PLC for monitoring and trending purposes.

c) Level Control

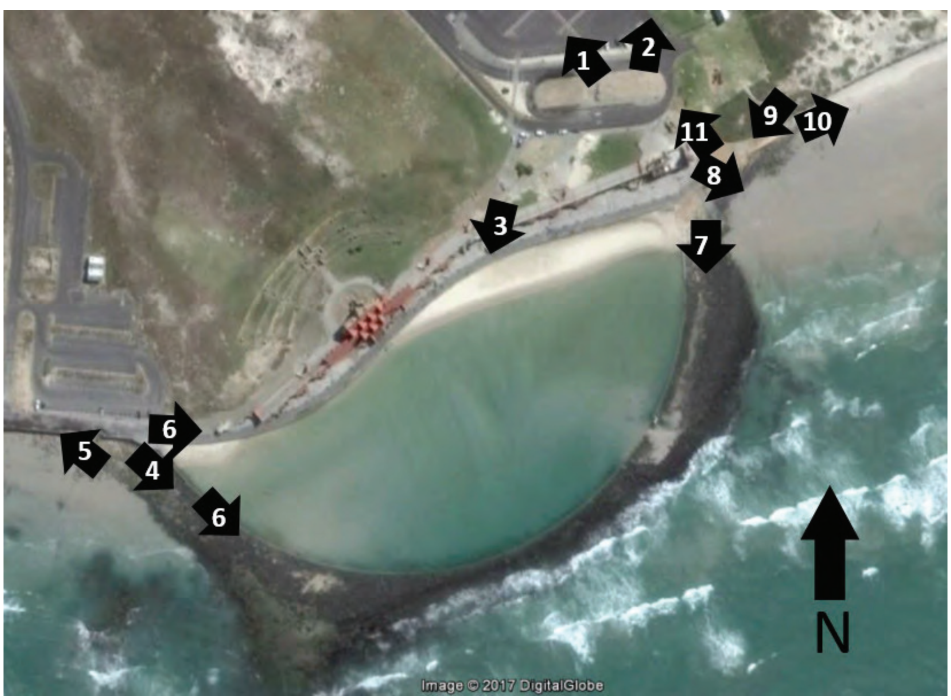
An analogue level sensor must be installed in the brine discharge tank, with separate discrete high and low level emergency level backups. Alternatively two separate analogue level sensing technologies can be installed, one primary and the other backup (and suitable for calibration purposes).

5.6.2.4.2. Marine

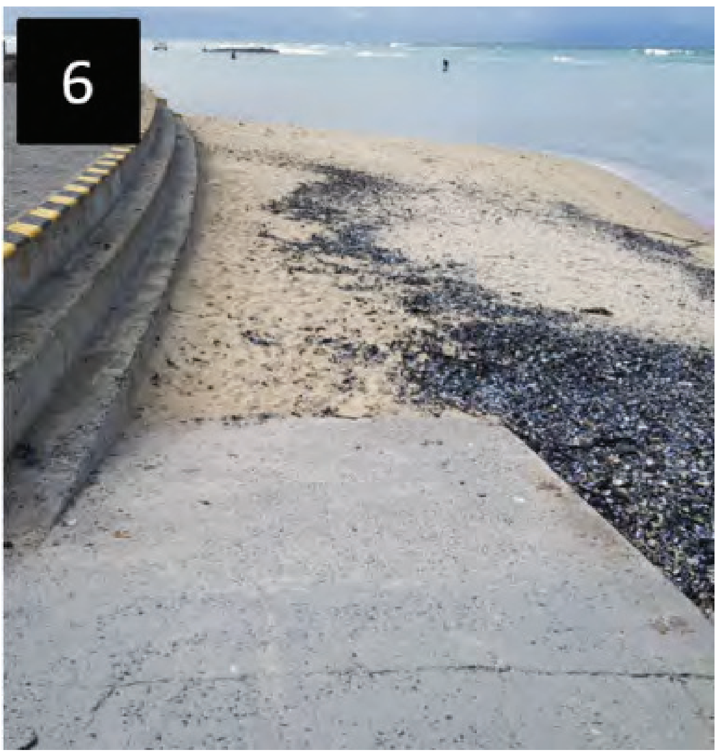
1. Site Visit

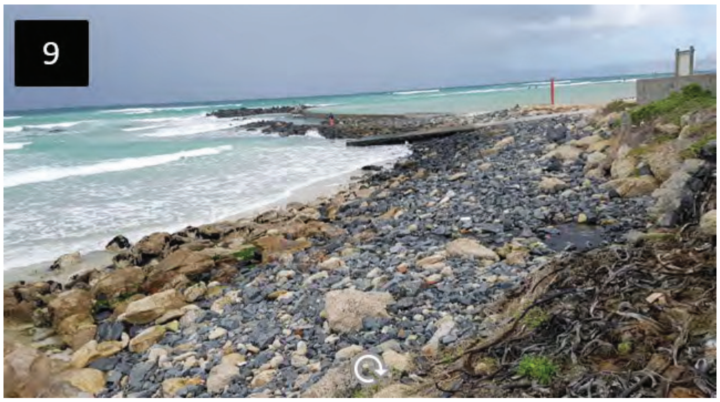
A site visit was carried out in August 2017 at the Strandfontein tidal pool in False Bay. This is the proposed location for the intake structure for the initial desalination phase.

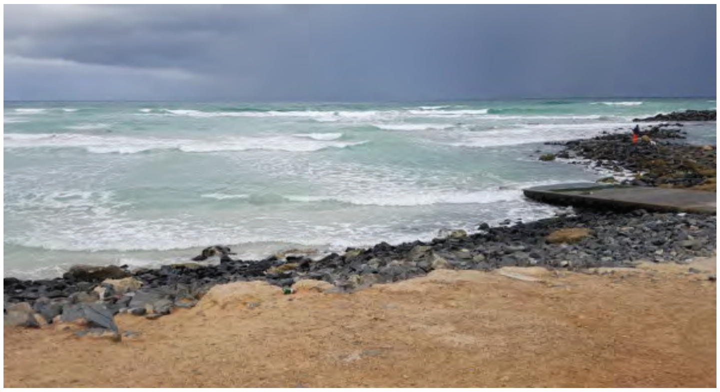
PHOTO	**NOTES**
Key Plan	



	**Parking Area**: The parking area, land side of the tidal pool facilities, is approximately 9,400 m^2.
	**Open Space**: East of the parking area is wide green open space situated behind the dunes
	**Tidal Pool:** Strandfontein Tidal Pool is very shallow with the water depth not exceeding 0.5 m. Access to the beach, situated at the landward side of the pool, is provided via steps along the promenade.
	**Tidal Pool Wall:** The concrete wall along the outer perimeter of the pool are used by fishermen to access the rocks just seaward of the pool

	**Damage to Road:** The seawall on the western side of the tidal pool has been severely damaged due to wave exposure. The western side is marginally more exposed than the eastern side of the pool
	**Pool Beach Ramp:** On the western side of the pool, wheelchair access to both the beach and pool are provided via a concrete ramp.
	**Eastern Side:** The eastern side of the tidal pool is slightly less exposed with some sediment build-up along the wall towards the land.

	**Launching Ramp:** A concrete launching ramp, approximately 4.5 m wide, is located on the eastern side of the tidal pool. It seems that the toe of the ramp has been damaged due to wave exposure.
	**Rip-rap:** Rock and rip-rap shore protection can be seen along the shoreline east of the ramp.
	**Beach:** A narrow beach with vegetated sand dunes can be seen further east of the tidal pool. A structure is situated on the beach crest approximately 130 m from the rip-rap. The ownership and use of this structure is presently unknown.
	**Access road:** On the eastern side of the tidal pool facilities, vehicle access to the launching ramp is provided via a gravel road. Top: View towards parking area Bottom: View towards launching ramp



2. Bathymetry

No bathymetry data is currently available for Strandfontein.

3. Wind Data

A wind rose for Strandfontein, obtained from www.meteoblue.com, is shown in 3B**Error! Reference source not found.**. The strongest winds are predominantly from the north-west and south-east.

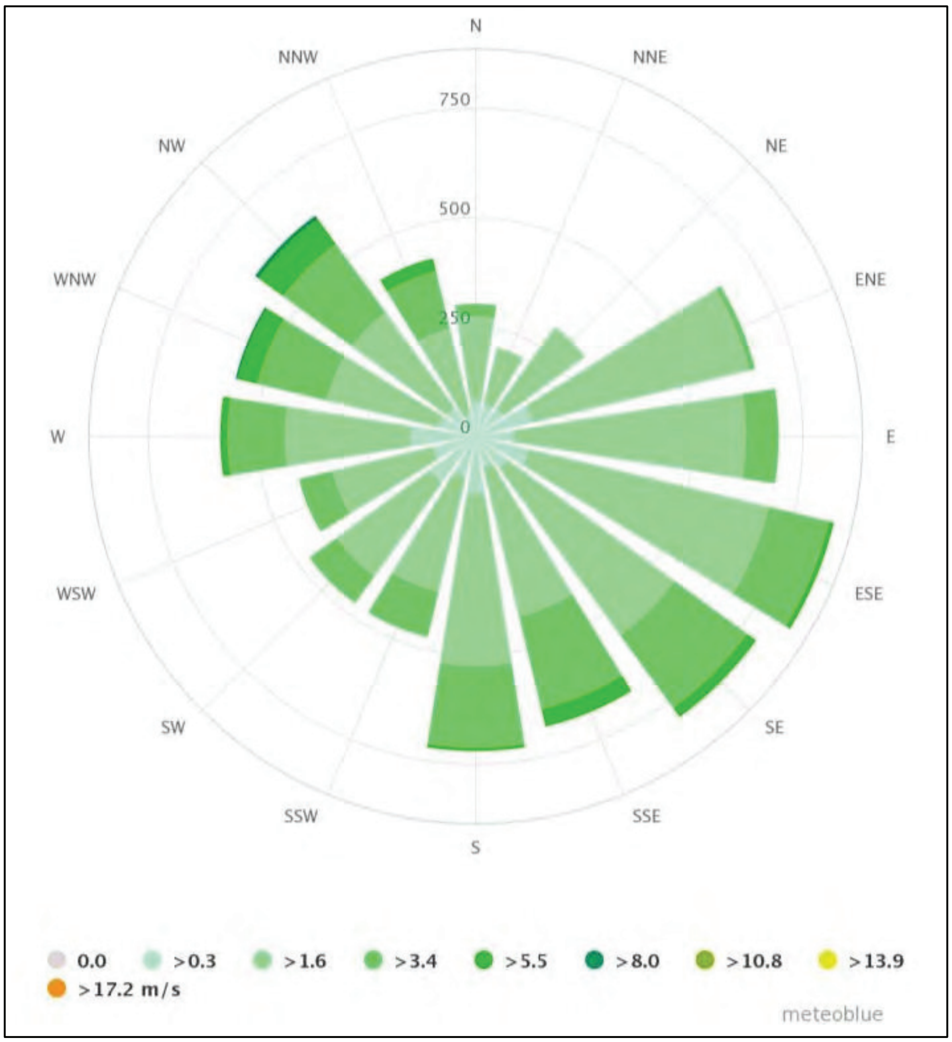


Figure 3B: Annual Wind Rose for Strandfontein (Source: www.meteoblue.com)

No further wind measurements are available at present.

4. Sea Water Temperature and Salinity

The yearly average surface seawater temperature of False Bay water is about 17.8℃. The temperatures vary between 13.8℃ and 21.1℃. The salinity for False Bay varies between 34.2 -36 ppt[6].

5. Sea Water Sampling

Sea water sampling was undertaken at three locations as shown in Figure 4B near Strandfontein on 15th August 2017 by Lwandle[7]. The results are presented in the Table 1B below.

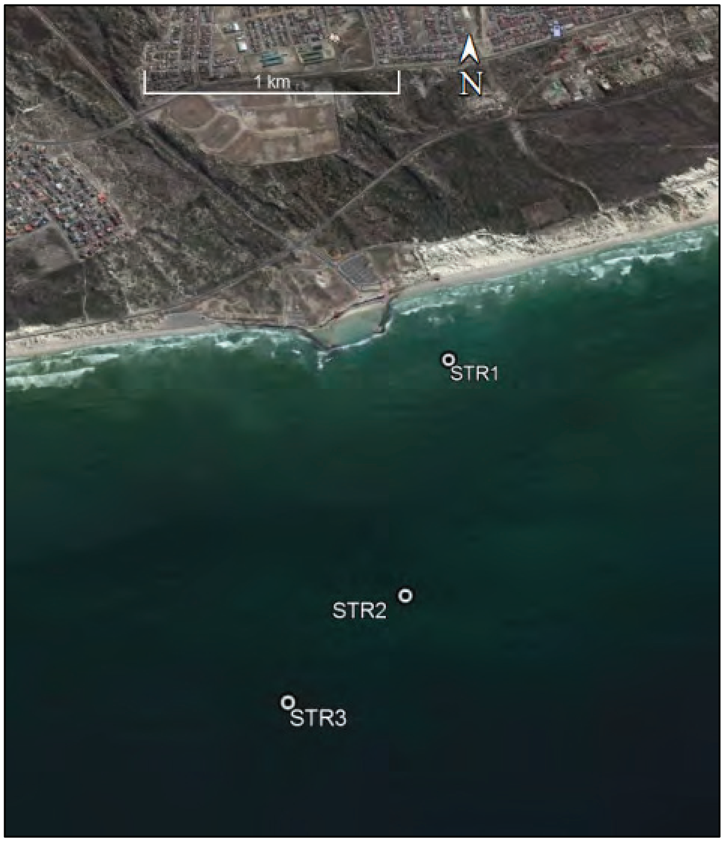


Figure 4B: Water sampling locations near Strandfontein

Table 1B: Mean values for parameters measured at Strandfontein on 15 August 2017. Source Lwandle (2017)[2]

Location	Depth (m)	Temp (C)	Salinity (PSU)	Turb (NTU)	Diss. O_2 %	Diss. O_2 (mg/ℓ)
STR1	4.5	14.93	35.27	15.57	106.10	8.61
STR2	7.0	15.47	35.44	1.50	103.28	8.29
STR3	10.0	15.49	35.46	2.30	102.70	8.23

6. Jet Probing

Jet probing was undertaken by Subtech at Strandfontein Tidal Pool between 21 to 23 August 2017. The approximate sand depths within the tidal pool are shown in Figure 5B.

6 CSIR. (1991). Ocean Outfall Studies in False Bay Report No.2 MEC-C 9117. Stellenbosch: CSIR
7 Lwandle (2017). Report Ref: LT-621 Field and Data Report V1 Monwabisi and Strandfontein

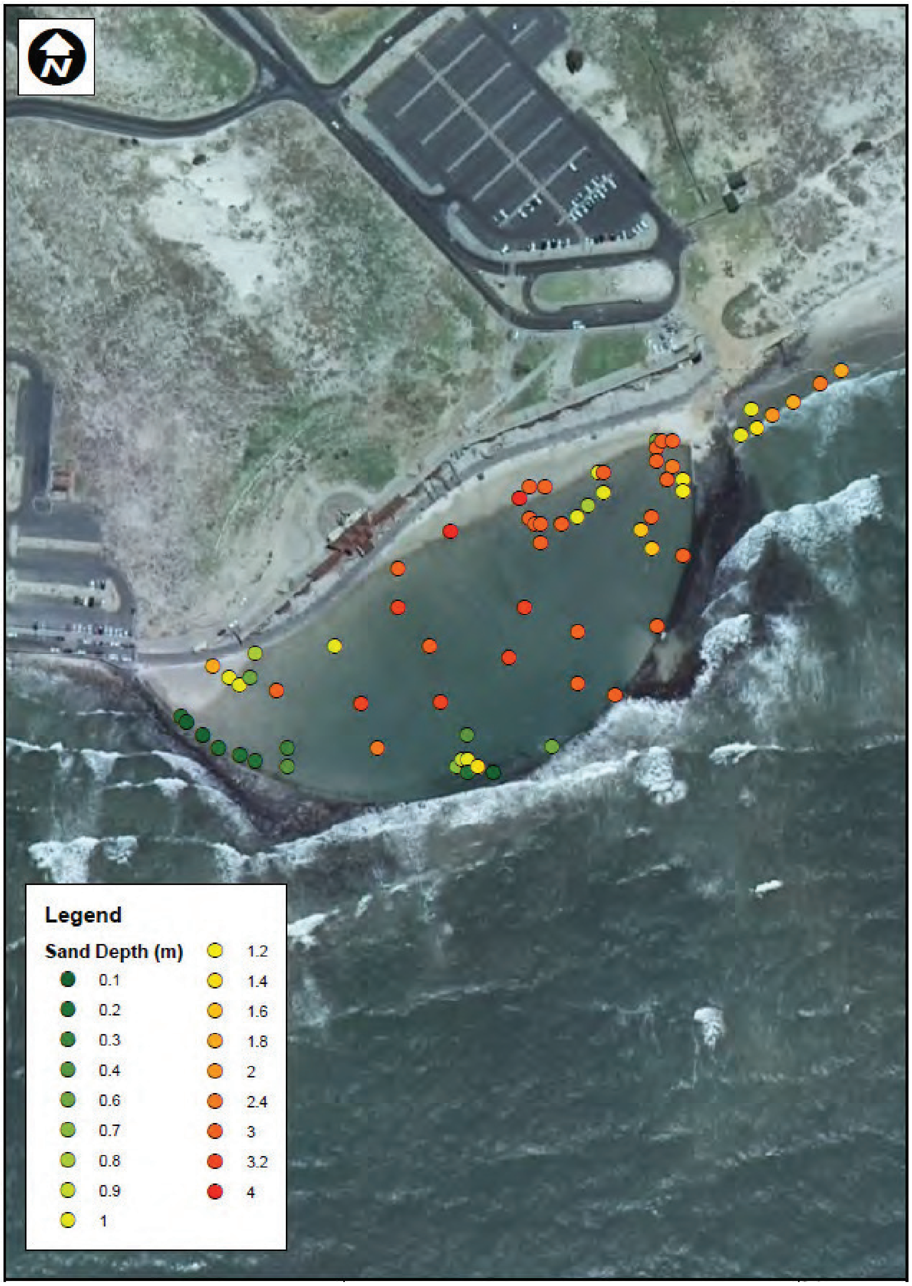


Figure 5B: Jet probing near Strandfontein

7. Water Levels

The tidal levels, related to Chart Datum (CD) at Cape Town and Simon's Town is given in Table 2B below.

Table 2B: Tidal Levels of Simon's Town and Cape Town (Source: SANHO, 2017)[8]

Location	LAT	MLWS	MLWN	ML	MHWN	MHWS	HAT
Cape Town	0	0.25	0.70	0.98	1.26	1.74	2.02
Simons Town	0	0.24	0.73	1.00	1.29	1.79	2.09

8 The Hydrographer, S. N. (2017, July 31). Tide Information. Retrieved from South African Navy Hydrographic Office: http://www.sanho.co.za/tides/tide_index.htm

8. Waves

Indicative wave conditions at the project site were estimated at Position 1 and Position 2 shown in Figure 6B**Error! Reference source not found.** through numerical modelling.

It should be noted that the annual conditions and derived extreme estimated have not been validated and are provided as an indication only. It is incumbent on the Supplier to ascertain wave conditions at the site to the level required for any design or operational procedure.

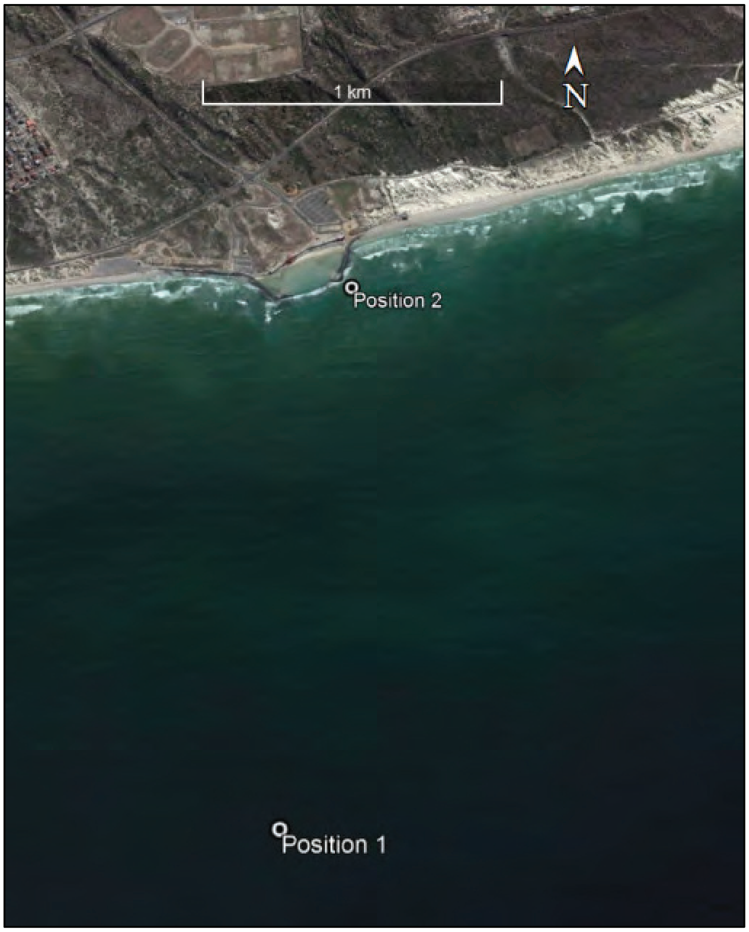


Figure 6B: Wave extraction locations near Strandfontein

<u>Indicative Annual Wave Climate</u>

Indicative annual wave roses for the extraction points are presented in **Error! Reference source not found.**Figures 7B and 8B. The wave parameters are summarised in Table 3B**Error! Reference source not found.**.

Table 3B: Indicative Wave Climate Parameters

Parameter	Position 1	Position 2
Sea bed level	10.6 m CD	0.6 m CD
Spectral wave height (H_{mo}) Annual Maximum Annual Average	 3.5 m 1.0 m	 1.3 m 0.9 m
Peak Wave Period (T_p) Annual Maximum Annual Average	 19.7 s 8.4 s	 20.6 s 10.4 s

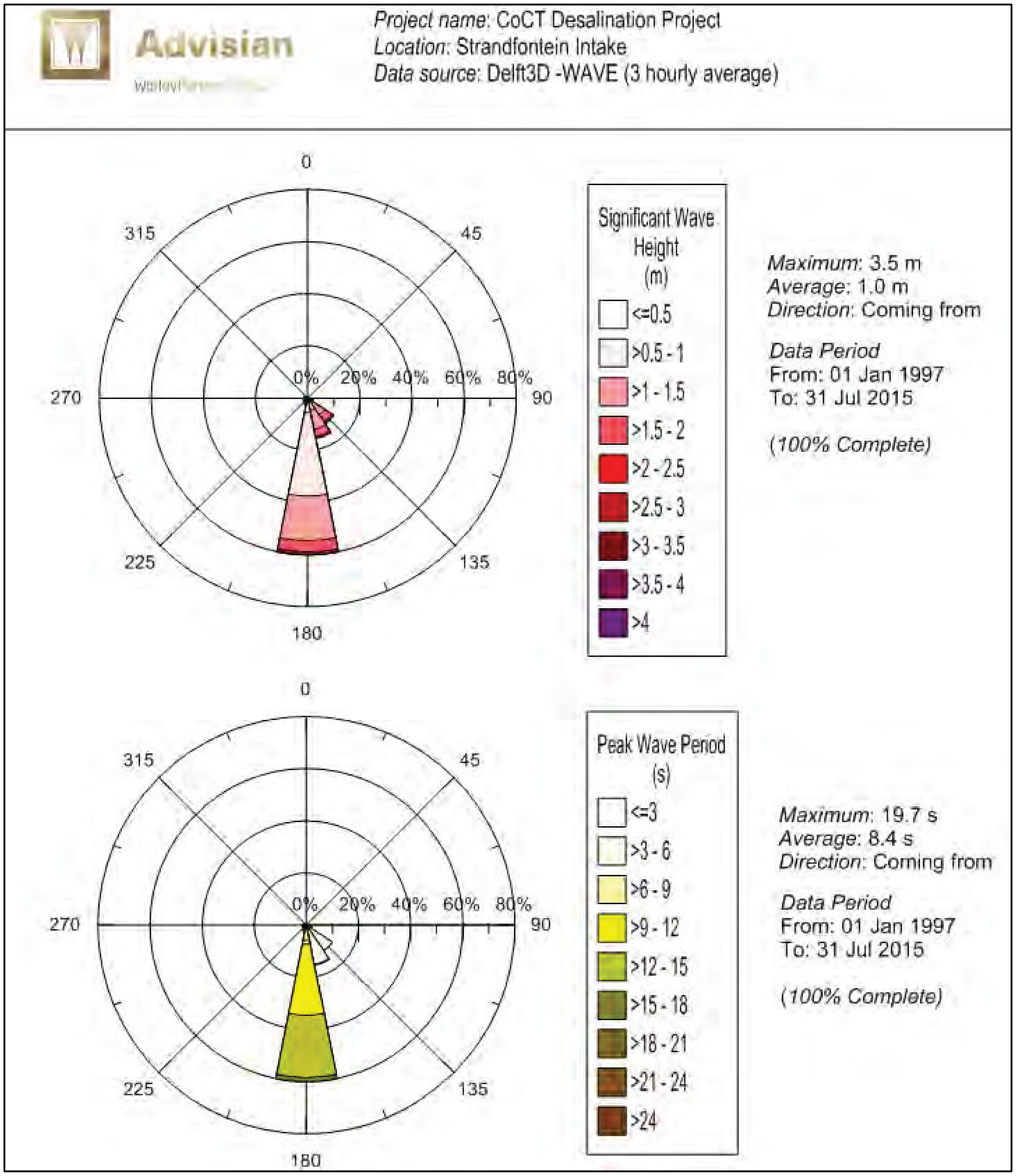


Figure 7B: Indicative annual wave rose for Position 1, Strandfontein

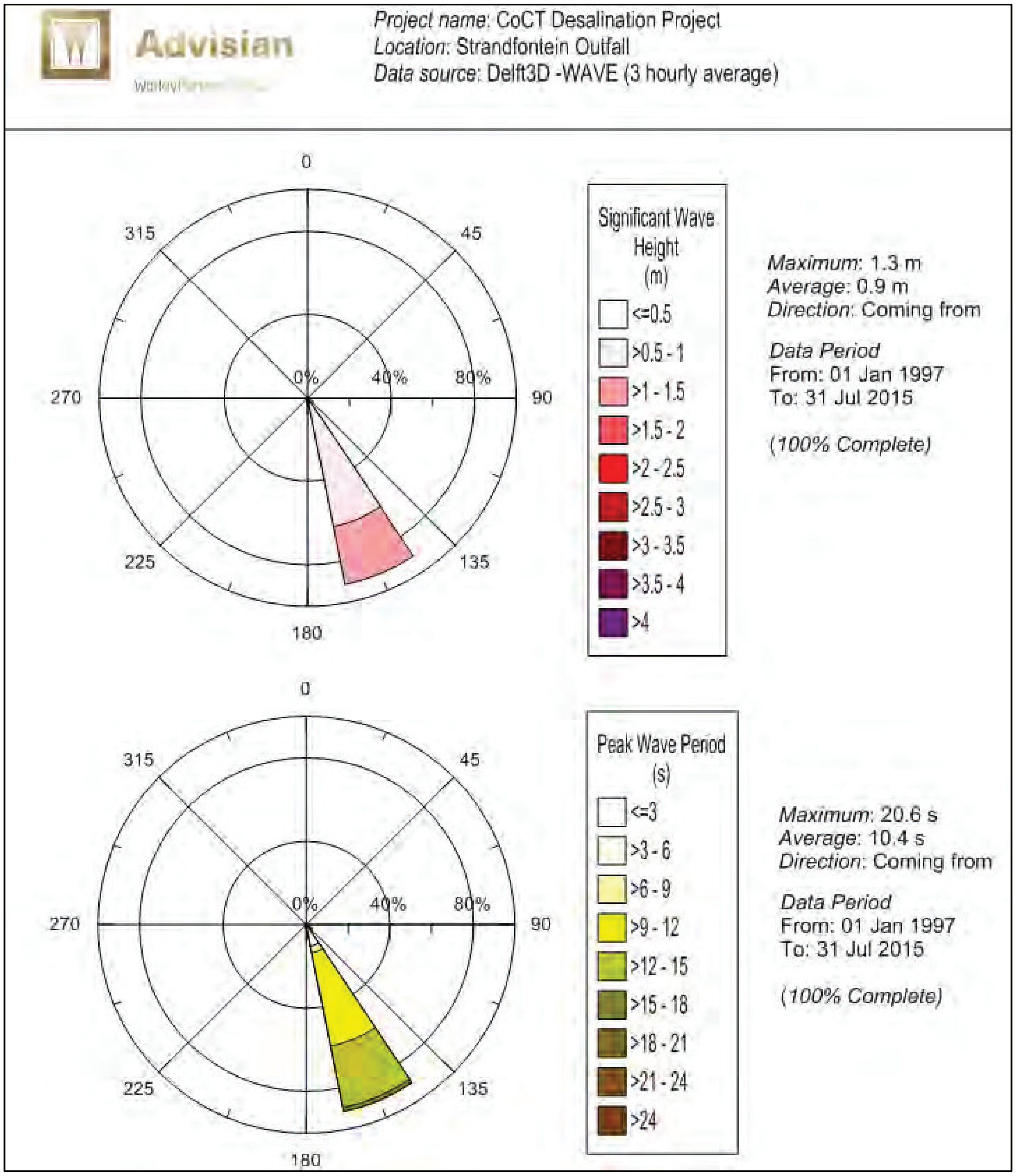


Figure 8B: Indicative annual wave rose for Position 2, Strandfontein

__Indicative Extreme Waves__

Estimated extreme waves with their associated average return intervals (ARI) are presented in Figure 4B**Error! Reference source not found.** for Position 1 and Figure 5B for Position 2.

Table 4B: Extreme waves for various ARI at Position 1

ARI (yr)	Wave Direction S			
	Wave characteristics		95% Confidence Interval	
	H_s (m)	T_P (s)	Lower Limit	Upper Limit
1	2.5	14.4	2.4	2.7
5	3.2	15.0	2.9	3.4
10	3.4	15.1	3.1	3.7
25	3.7	15.4	3.4	4.0
50	4.0	15.5	3.6	4.3
100	4.2	15.6	3.8	4.5

Table 5B: Extreme waves for various ARI at Position 2

ARI (yr)	Wave Direction S			
	Wave characteristics		95% Confidence Interval	
	H_s (m)	T_P (s)	Lower Limit	Upper Limit
1	1.3	13.5	1.3	1.3
5	1.3	13.6	1.3	1.3
10	1.3	13.7	1.3	1.4
25	1.4	13.8	1.3	1.4
50	1.4	13.8	1.4	1.4
100	1.4	13.9	1.4	1.4

9. Currents

Limited current data at the project site is available. Drogue current velocities measured by the CSIR[1] for False Bay indicate that the mean surface velocities are less than 0.17 m/s and the mean subsurface velocities at -5 m are less than 0.09 m/s. The maximum measured surface velocity is 0.41m/s and the maximum measured subsurface velocity is 0.43 m/s

10. Marine Works: Functional Specification

This specification is the functional specification of the marine works. The works comprise two phases that need to be completed in accordance with the time frames stipulated in this document. Phase 1 is for the works to supply a guaranteed 2 Mℓ/day. Phase 2 is for the works to supply a guaranteed 7 Mℓ/day. Phase 1 and Phase 2 construction operations are expected to commence simultaneously. Phase 1 is a temporary facility to be performed in a short time frame whereby water is pumped from the tidal pools with possible supplementary water pumped into the tidal pools in order to guarantee the necessary water volumes from the tidal pools to the treatment plant. All Phase 1 marine works shall be decommissioned once Phase 2`becomes operational.

The tidal pools shall have an area allocated to the public for recreational purposes. The exact extent of the pool areas available for construction/ recreational purposes shall be confirmed with the Purchaser.

All drawings provided in this tender are schematics only and are for information purposes only. Any reference to extraction/ discharge point locations, intake/ outfall pipeline routes, pump station location is for schematic purposes only and the Supplier shall develop his own concepts and perform detail design thereof. Should the Supplier want to utilize the drawings and concepts contained in this tender then he shall verify and validate the concepts, extraction points and pipeline routes prior to performing detail design thereof.

The Supplier should take cognisance of the fact that all design related information such as levels, pipe sizes, etc. shall be verified by him prior to using it.

All designs shall be based on acceptable design standards and norms. Unless specified in this document the Supplier shall be responsible for determining the design period.

10.1 Marine pipeline and intake structure

The scope of work includes:

- Detail methodology, design of marine raw water pipeline system, intakes, anchoring, raising and all necessary ancillary structures and equipment in order to meet the Phase 1 and Phase 2 target values.
- Design and construct suitable wave protection to the pipelines on the shore side.
- Submission of detailed calculations for intake head, pipeline, anchors, sinkers, etc.
- Submission of design drawings, construction methodology statement and control testing.
- Submission of final “as-built” drawings.
- Supply, transport and install of marine pipelines, intake structure and any ancillary structures. In addition it shall include all anchoring, sinkers, weighting, etc.
- Specify, supply and install Aids to Navigation system.
- Supply and place a acceptable protection system, such as geocontainers, to protect the pipelines along shore/beach crossing.
- Decommissioning of Ph 1 marine inlets, intake pipelines as well as replacing beach sand back to initial levels in the tidal pools. The Supplier shall discuss with the CTC the source of the new sand to be used for reinstatement of the pool.

The Supplier shall specify the number of intake pipelines, material, diameter, length and stability/protection design.

The Intake structure(s) shall be located within the allocated area and the intake pipeline(s) shall be designed and located in such a manner that it does not impact on normal recreational activities (i.e. form a physical hazard/barrier and hinder access).

Any temporary marine components required to supplement the water in the tidal pool shall be located in the areas referred to in the drawings. The Supplier shall specify the configuration of all the temporary components as well as the stability and protection thereof.

10.2 Raw water intake pipeline route

Possible routes for this site may require crossing rocky bed as well as sandy beach crossing.

The suitability of such routes shall be investigated and validated by the Supplier. The layout drawing depicts the route for reference only. The Supplier may select the alternative that better suits his design and/ or installation method and minimize impacts on the activities of the recreational beach area.

The Supplier shall select pipeline materials, sizes and types that suit his designs. The Supplier shall be responsible for designing suitable measures to protect the pipelines from damage caused by wave actions, boat propellers and other external forces, and ensure pipeline stability employing appropriate methods such as anchors, collars, concrete coating, sinkers, chains, etc.

Special attention shall be taken for ensure the stability and protection of the section of the pipeline crossing the surfzone.

The Supplier’s design of the intake head, pipeline and ancillary structure needs to be stable based on the 1:20 year storm conditions.

The extraction structure and pipeline(s) shall ensure that the required feedwater volumes are extracted.

The Supplier shall specify the configuration of the intake structure.

10.3 Pipe type, size and class

Pipe type and size shall be selected as to minimize the marine growth, prevent sediment deposition and mitigate the potential reduction in hydraulic efficiency of the pipeline. Pipe material shall be able to prevent damage during installation.

10.4 Intake head structure

Intake structure shall be designed to limit intake velocities at the extraction point and ensure horizontal flow.

The intake structure comprises of solid roof panels, screens, frame and a connection to the pipeline.

The design shall make provision for reverse flow out the intake heads for cleaning of marine growth.

The following shall apply:

- Intake structures shall be sufficiently stable against wave and current action
- Total required extraction rate of intake system: : Phase 1: 231 m^3/h Phase 2: 648 m^3/h
- Max through-screen velocity shall be 0.15 m/s
- Intake head configuration shall prevent vertical flow (i.e. velocity cap)
- Bar opening/ screen width shall be 100mm
- Allowance has to be made for 50% marine growth for Ph2 (and 20% on Ph1) on intake bar screens, therefore through screen velocities shall be calculated on 50 mm bar openings for Phase 2 and 80mm bar openings for Phase 1.
- Phase 1: Extraction point (screens) of intake structure in tidal pool shall be located minimum 400mm above the bed level. Minimum water depth above intake screens shall be sufficient to ensure optimum hydraulic performance and shall be specified by Supplier.
- Phase 2: Intake structure shall be located at sufficient depth to ensure top of intake structure located minimum 5 m below the surface at all time and bottom of extraction point (intake screens) located minimum 2.5 m above the seabed.

The table below depicts an example of calculation for screen sizing of the intake head. The Supplier shall submit his own detailed calculation.

Example: Screen dimensions – 7 Mℓ/day		
v (Through screen velocity - **requirement)**	0.15	m/s
Q (total extraction = 15.6 Mℓ/day - **requirement**)	0.18	m^3/s
A	1.20	m^2
Bar opening width (100mm **requirement**)	0.1	m
Bar opening length (**recommended** 300 - 500 mm)	0.5	m
Required bar opening area (based on above)	0.05	m^2
$Area_{50}$ (**required** bar opening area - allowing 50% clogged up due to marine growth)	0.025	m^2
Nr of openings (based on above)	48	no
Bar width (example - using 40 mm rods)	0.04	m
Above for total flow rate (Assume 3 separate intakes)		
Therefore, each individual intake head diameter (example)	0.7	m

10.5 Concrete weighting/anchors/sinkers

Suitable means to ensure stability of the pipeline shall be installed along entire length of pipeline. Adequate measures shall be provided to ensure necessary connection between the pipelines and anchors/sinkers in order to prevent sliding of the weights.

Materials and pre-cast reinforced concrete fabrication shall comply with concrete specification provided elsewhere in this document

10.6 Pipe fabrication, tests, welding, assembly, joints

Refer to pipeline specification included elsewhere in this document

10.7 Buoys

Supplier shall design the Aids to Navigation system suitable to the proposed intake and pipeline design. Cautionary isolated danger marker buoy(s) part of the AtoN system shall have self-contained led light with GPS synchronization. The light colour and flashing parameters shall comply with IALA guidelines as well as SAMSA requirements. Consultation with the harbour master of adjacent harbour(s) is fundamental in order to ensure consistency with the existing AtoN system(s).

The minimum buoyance shall be defined talking into account the met-ocean conditions at the site as well as any additional mass of other elements that might be connected to the buoy.

The buoy(s) shall be moored on sinker blocks (either reinforced concrete or cast iron).

The mass of the mooring block as well as type and size of chains, shackles and cables shall be defined based on the site specific met-ocean conditions and 1:20 year’s wave height.

10.8 Sand bags

It’s anticipated that sandbags may be necessary to provide stability and protection to overland and shore crossing sections of the intake pipeline.

10.9 Corrosion protection

All structural steelwork shall be painted and protected by cathodic protection by sacrificial anodes. The anode design, composition, electrochemical characteristics and installation specifications shall be in accordance with ISO 15589. The anodes shall be sized for a 5 year design life.

10.10 Concrete structures and ancillary works

The Supplier shall conduct a visual condition inspection of the tidal pool upon contract award. The assessment shall identify any cavities, holes, broken valves, excessive seepage through the tidal wall.

The existing structure of the tidal pool, including concrete outer wall, concrete block edge, jetty, etc. shall be fully reinstated if damaged by the Supplier.

Any holes and/or cavities along the outer tidal pool walls shall be repaired. Prior to any repairs, the number of repairs and repair methodology shall be submitted to the Purchaser for approval

Any broken valves shall be sealed off/plugged. Prior to this the Purchaser shall be informed with regards to the number of broken vales and block/seal procedure.

10.11 Slope protection

Any slope protection work shall be done in order to protect the works for the period stipulated in the document.

10.12 Dredging/excavation works

The scope shall include:

- Detail design of the dredging/ reclamation works required in order to guarantee the required throughputs. This shall include confirmation of allowable dredge areas as well as safety protection measures of the public utilizing part of the facilities.

- Removal by means of dredging/ excavation of the required volume of sand necessary to create space for an adequate volume of water in accordance with the Suppliers detail design to be contained in the tidal pool area. This sand shall be disposed of along the beach at a site pointed out by the Purchaser.

- Reinstatement of the dredged/ excavated areas from a sand source that is to be confirmed by the Supplier with the Purchaser.

The Supplier shall conduct a survey of the tidal pool bed level upon contract award. The results shall be submitted to the Purchaser and shall be assumed as the “in-survey” for any excavation/dredging work carried out by the Supplier. The survey shall be submitted to the Purchaser in AutoCad format to the agreed datum and coordinate system. Upon completion of the dredge/ excavation operations an “out-survey” shall be conducted in order to calculate the total volume of sand removed.

The bed material of the tidal pools is estimated to consist of fine to course sand, small rock (5 – 10%). The Supplier is responsible to investigate the material and suitable excavation and/or dredging equipment for material removal.

Any large scale dredging/excavation activities (> 10 m3) clashing with the public utilising these areas shall be conducted within a maximum period of 12 working days so as not to disrupt the public utilising these facilities, during which time the tidal pool and facilities shall be closed to the public. Any dredging/excavation activities during operation and volume less than 10 m^3 shall be conducted when the pool and any other recreational area is not used by the public.

All dredging/excavation material shall be stockpiled/ pumped/ placed to an area provided by the Purchaser.

10.13 Decommissioning

All Phase 1 tidal pool extraction infrastructure, including but not limited to extraction head, intake pipelines, pipe anchors, barrier/fencing/ signage shall be removed within 5 working days following the successful commissioning of Phase 2. In addition the dredged/ excavated areas shall be refilled within 10 working days.

The Supplier shall reinstate the tidal pool bed with material pointed out by the Purchaser to the same level prior to excavation/dredging work of Phase 1. The Purchaser may request the Supplier to replenish the tidal pool to a bed level lower than the original bed level prior to excavation/dredging work. This shall be confirmed by the Purchaser prior to decommissioning of the Phase 1 marine work.

The close-out operations shall not exceed a period of 3 weeks and the tidal pool shall be fully fenced during this period. No access to the public shall be allowed during this period.

All Phase 2 marine work shall be decommissioned after it had been operational for a period of 19 months and the area reinstated to the condition in which it was prior to commencement of Phase 2 operations. All marine infrastructure shall be decommissioned and removed within 1 month following the 24 months leasing period.

5.6.2.4.3. Occupational Health and Safety

Specification

Refer to Particular Specification PH: Occupational Health and Safety Specification.

Project Description

Refer to Section 5.7.1.2.

5.6.2.4.4. Environmental Management

Refer to Particular Specification PJ: Environmental Management Specification.