5.3.2. Project Components

As mentioned earlier, the proposed project consists of constructing the Doura/Bourj Hammoud WWTP which is divided into two phases: Phase 1 (pre-treatment headworks) and Phase 2 (development and construction of the primary and secondary treatment processes). Both phases are located on the same plot of land. Based on the Technical assessment report, the preferred design study was Lamella Clarifiers for primary treatment (Sedimentation/Clarification), Moving Bed Biofilm Reactor (MBBR) and Dense Sludge Secondary Clarifiers for secondary treatment. The FS will confirm whether this alternative is the most feasible secondary treatment option or not. The MBBR will be considered as the selected alterative for the purpose of this report. The most feasible alternative will be validated and used as the basis of the ESIA and any major changes to this alternative as described in this scoping report will be assessed and discussed further in the ESIA.

The components of the WWTP (both Phase 1 and Phase 2) are as follows:

Project Components under this Project

Pre-treatment headwork

The pre-treatment headworks plant is planned to be constructed during phase one and is planned to include the process components and facilities listed below which are further detailed in the following subsections:

- Inlet screens: these are used to protect equipment in the wastewater treatment plant from damage or clogging caused by large objects. Based on the peak flow rate for phase 2 (2050), which is 5.99 m3/s, the pre-treatment process will be equipped with three screen channels, including one standby, with 50mm openings
- Inlet pumping station: the related civil works will be executed during phase 1. The wet weather peak flow rate of wastewater is equal to 4.19 m3/s thus requiring the deployment of 3 duty pumps and 1 standby pump. Each pump will have a flow rate of 1.5m3/s. The latter 4 pumps will be installed in a 125 m2 wet well. In addition, the pumping station building structure will be equipped with wastewater level sensors, an efficient ventilation system, an H_2S detection system with an alarm, and it will be connected to an odor control unit.
- Coarse screens: the size and number of screens and corresponding channels is based on the wet weather peak flow rate which is estimated at 4.19 m3/s. As such, four main duty coarse screens and one additional standby screen with 15 mm openings will be electro-mechanically equipped.
- Fine screens: the wastewater will be conveyed to a finer screening stage whereby 4 main duty fine screens and an additional screen on standby will be installed with 6 mm openings. The collected screening waste from both the coarse and fine screens will be automatically removed to a lower floor in the screens' building structure where they will be washed, dewatered, and then collected in containers for landfilling at the nearest facility.
- Aerated grit and grease removal tanks: After the 2 stage-screens, the wastewater flow will be conveyed to the grit and grease removal tanks through submersible openings. The latter tanks will be aerated in order to facilitate the separation of the grease and grit from the organic solids that are present in the wastewater inflow. Four grit and grease removal channels shall

be used for the first phase of the project, each being 36 m long, 5.8 m wide, having a maximum depth of 5.6 m, and having a volume of 479.5 m^3.

Primary treatment (Sedimentation/Clarification): Lamella Clarifiers

Lamella clarifiers are comprised of a series of inclined parallel tubes traditionally used in water purification and wastewater treatment to create favourable conditions for particle settling. They take advantage of the theory that surface overflow loading, which can also be defined as particle settling velocity, is the important design parameter. Theoretically, a shallow basin (i.e., short settling distance) should be effective. By using several shallow parallel tubes or plates, surface area can be greatly increased and low flow-through velocity maintained in each tube to reduce scouring (Figure 5-8).

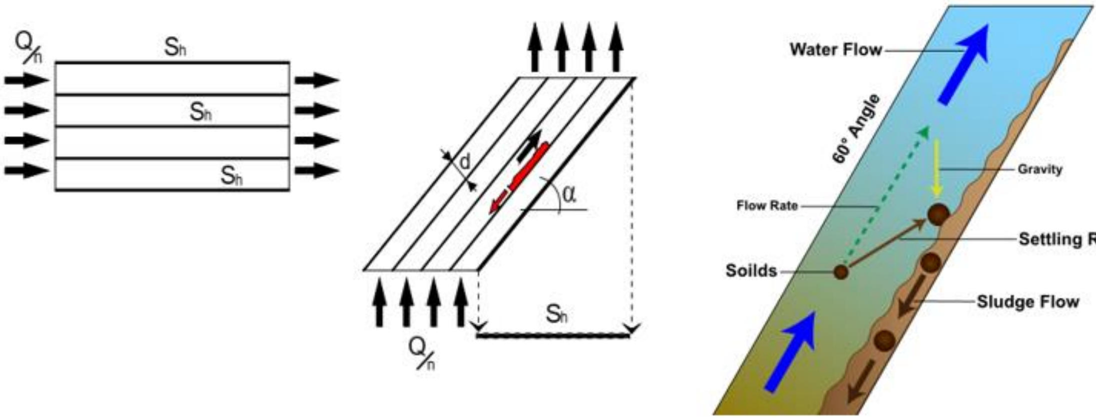

Figure 5-9: Diagram of a lamella clarifier basic operation

There will be six tanks (two groups of 3 tanks) with a total length of 24.65m, while the lamella section extends to 18.0m, tank width of 6.5m and a liquid depth of 4.0m (total height of 4.5m).

Tube settlers, also called lamella clarifiers or lamella separators will be used, in order to reduce the required primary sedimentation unit footprint, since they multiply the sedimentation area up to 10 times per square meter surface area.

Each tank will be equipped with a bottom scraper for sludge removing (zickert-type, operating under the lamella zone, scum removal system (separate section of the tank upstream of lamella) and effluent configuration with longitudinal overflow stainless steel overflow channels, spread in the tank surface above lamella settlers (ensuing equal flow per lamella tube) (Figure 5-9).

The pre-treated wastewater flows by gravity via an underground culvert (dimensions 2.0 x 3.0m) from the outlet of grit removal unit into the inlet section of each one of the two groups of three primary sedimentation tanks.

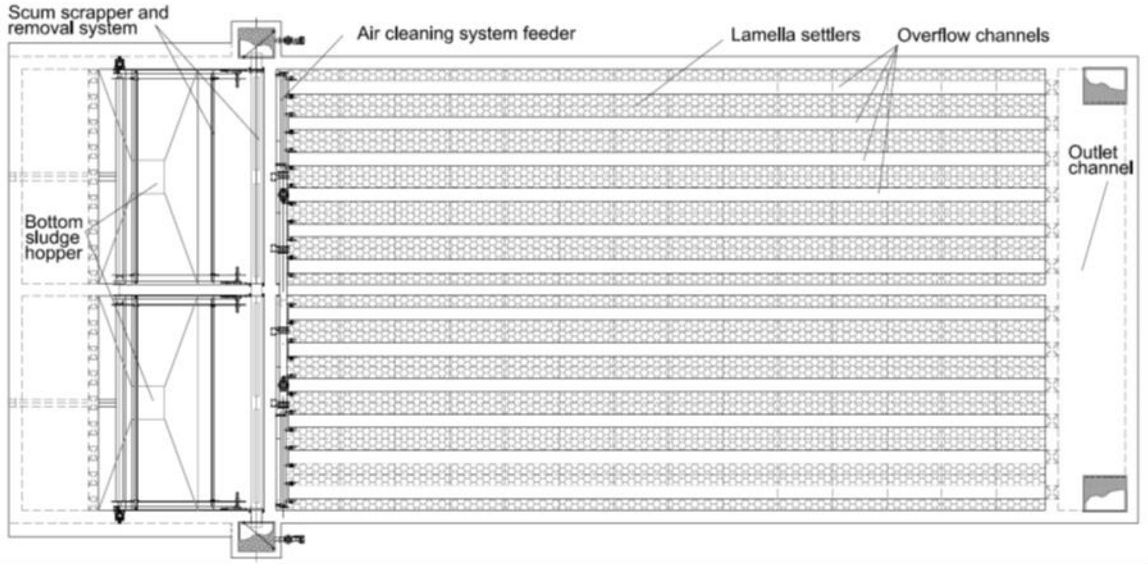

Figure 5-10: Primary sedimentation tanks proposed (with lamella settlers)

Secondary treatment: MBBR reactors and Dense Sludge Secondary Clarifiers

The biological treatment of the incoming wastewater will take place in an MBBR unit, consisting of:

- Aeration tanks
- Flocculation – coagulation and chemical enhanced sedimentation with lamella settlers
- Excess sludge pumping station

There will be six (6) aeration tanks, operating in parallel, with a volume of 4,270m3 each (total volume of 25,620m3 for 2050 horizon), with a length of 30.5m, width of 20.0 m and a water depth of 7.0m.

The outflow from the primary sedimentation tanks will be led into the aeration inlet channel via two DN 2000 pipes and it will be distributed into the six (6) tanks operating in parallel (Figure 5-10).

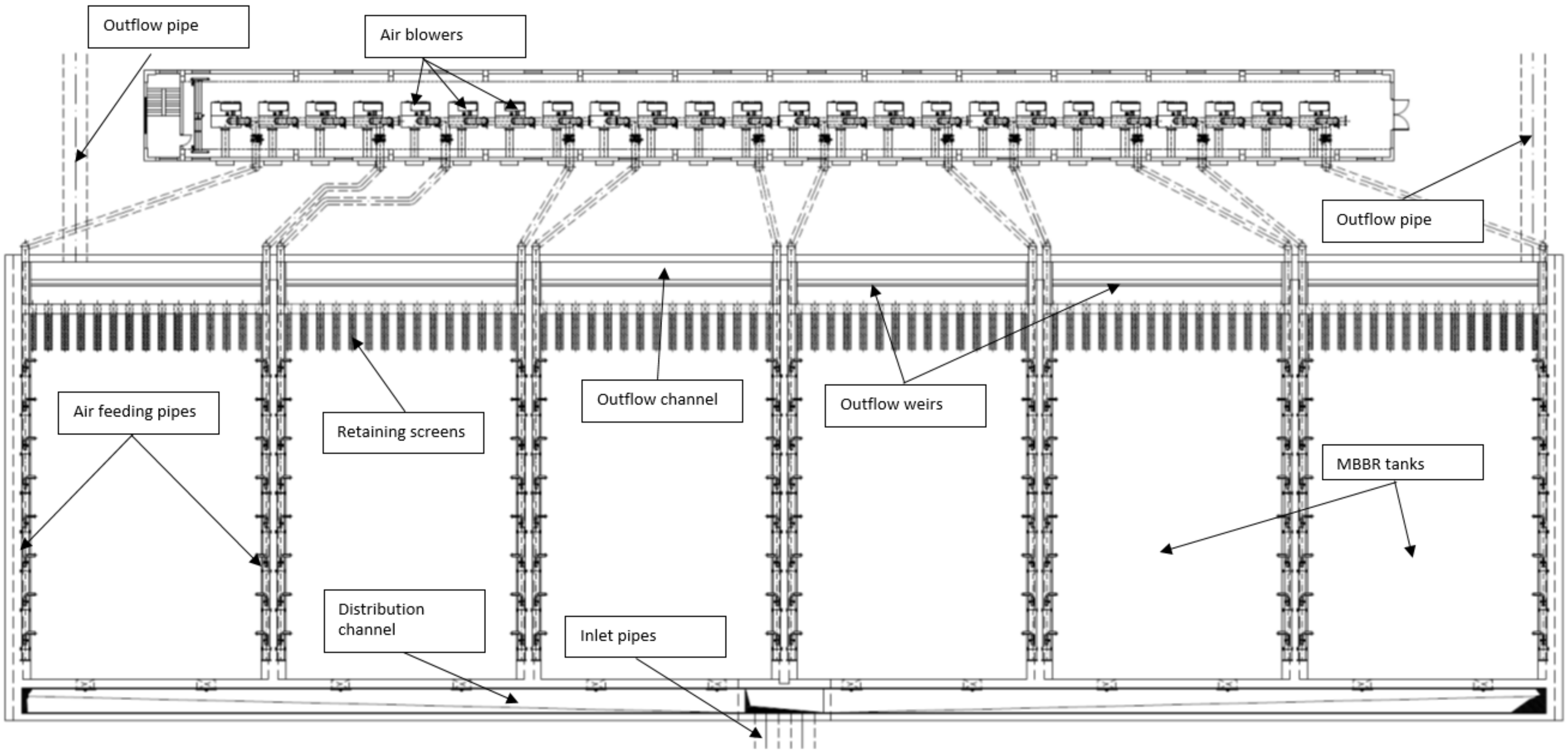

Figure 5-11: MBBR tanks proposed configuration

The outlet of the MBBR flows by gravity via two DN2000 pipes into two groups of 4 streams of solids-liquid separation units.

The flow is distributed via long overflow weirs into four streams for each group (8 in total) and enters, via a submerged hole equipped with a penstock, the rapid mixing tanks. There will be two parallel rapid square mixing tanks for each stream (16 tanks in total for 2050), with a length 3.60m, width of 3.60m and a liquid depth of 3.50m each. Each tank will be equipped with a vertical mixer with a motor power of 30KW each ensuring a velocity gradient of at least 500 s^{-1}, for efficient mixing. The alum solution will be dosed in the inlet of each stream.

The flow then will pass into flocculation tanks via a number of submerged holes. There will be two square flocculation tanks for each stream operating in series (16 tanks in total), with a length 7.60m, width of 7.60m and a liquid depth of 4.00m each. Each tank will be equipped with a specially designed low speed vertical paddle mixer with a motor power of 5.50 KW each ensuring a velocity gradient of at least 100 s^{-1}, for efficient mixing. The polymer solution will be dosed in the inlet of each flocculation tank of each stream (Figure 5-11).

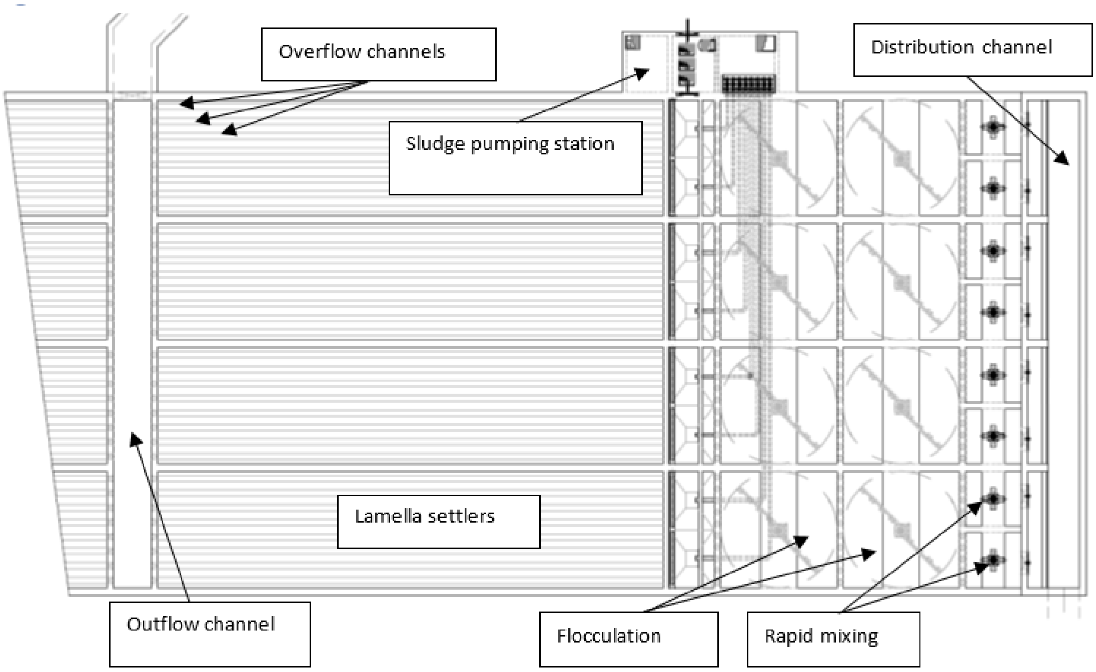

Figure 5-12: Chemical enhanced sedimentation – lamella settlers

After the flocculation tanks, the flow enters the final sedimentation tanks with lamella settlers. There will be eight tanks constructed, configurated in two groups of four streams each. Each tank shall have a length of 36.35m while the lamella section extends to 33.0m, a width of 7.60m, a total height of 5.0m and a liquid depth of 4.50 m. Tube settlers, also called lamella clarifiers or lamella separators will be used, in order to dramatically reduce the required primary sedimentation unit footprint, since they multiply the sedimentation area up to 15 times per square meter surface area. Each tank will be equipped with a bottom scraper for sludge removing (zickert-type, operating under the lamella zone, scum removal system (separate section of the tank upstream of lamella) and effluent configuration with longitudinal overflow stainless steel overflow channels, spread in the tank surface above lamella settlers (ensuing equal flow per lamella tube) (Figure 5-12).

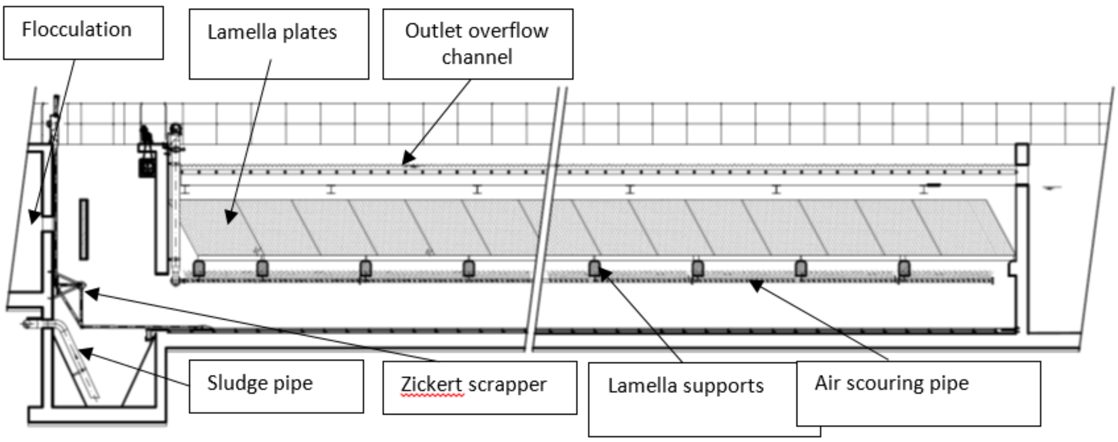

Figure 5-13: Lamella settlers proposed configuration

The sludge collected in the sludge hoppers will be transferred by gravity to the sludge pumping station. Each sludge withdrawal pipe will be equipped with a telescopic (bell mouth) valve on its end in the

The activated sludge collected in the bottom of the settling tanks is transferred by gravity to the sludge pumping station, where the excess sludge pumps shall be installed. In order to ensure equal sludge flow from each settling tank, a regulating telescopic (bell mouth) valve will be installed at the end of each sludge pipe entering the pumping station wet well.

There will be six (6) submersible sludge pumps installed (three in each of two pumping stations), four (4) in operation with a capacity of 70m3/h. The pumps will pump the sludge into the sludge storage tank prior to be mechanically thickened.

The discharge pipe of each pump will be equipped with a non-return valve and a gate valve before its connection to the collector pipe that leads excess sludge into excess sludge storage tank.

The fittings and the collector pipes will be installed in a dry well designed for easy access and maintenance.

The operation of pumps will be controlled by timers. A very low level switch will be installed in the wet well for dry-run protection of the pumps, while a high level switch in the sludge storage tank will stop the pumps operation if activated.

The treated effluent flows by gravity into the effluent pumping station (under construction along with the preliminary treatment works), via a culvert

Sludge Treatment

The proposed sludge treatment process consists of the following facilities:

- Thickening;
- Anaerobic Digestion and utilization of the biogas for energy production;
- Mechanical dewatering.

The sludge treatment system for the MBBR option has the following specifications:

- The storage tank will have a length of 13.2m, a width of 8m and a liquid depth of 5.0m, thus a storage volume of 528 m3. The aeration system will be also slightly smaller, with a capacity of 420 Nm3/h.
- The mechanical thickening unit will include 5 (and not 8) sludge thickeners with a capacity of 110 m3/h (1,420 kgSS/h) each.
- The anaerobic treatment unit will include 6 (and not 8) digesters of the same capacity to the ones described in CAS system. The associated equipment installed will be for 6 and not 8 digesters, while the CHP units will be also smaller (2x1800KW), as well as the biogas holders (each one with a capacity of 4,500 m3).
- The dewatering unit will also include four centrifuges but with lower capacity (32m3/h – 1100 kgSS/h).

Other advanced options include thermal hydrolysis and/or thermal drying. These options depend on the local conditions and sludge disposal options and will be investigated further in the FS.

Odour control Systems

For Phase 2, all sludge treatment facilities will be installed with an odour control unit in order to capture the generated odour. Process units included in Phase 1 are also equipped with odour control units (at pumping station, screen area, and grit handling areas, and non-critical building area)

Disinfection

Disinfection is usually required to minimize the risks to the human health and the environment, eliminating the pathogens present in the wastewater. For the Daoura Bourj Hammoud WWTP, since a long outfall with a length of almost 2km and a disposal depth of 65m is applied, disinfection is not required. Provision is however taken for free space for the optional future installation of a disinfection unit.

Pumping stations

The construction of the WWTP will require the installation of an inlet lift pumping station and other pumps in order to convey the wastewater from the pre-treatment to the secondary treatment facilities located within the same site. In addition, the WWTP process will require the installation of sludge pumping stations.

Sea outfall

The project also includes the rehabilitation of the two existing sea outfall pipes (not used to date) which are described below:

- The main outfall pipe having a diameter of 1,700 mm, a length of 1,777 m, and located around 61.5 m below sea level;
- The emergency overflow pipe having a diameter of 2,000 mm, a length of 620 m, and is around 7.75 m below sea level.

Both outfall pipes are made of steel and are protected by a reinforced concrete layer of 210 mm and 270 mm thickness, respectively. Figure 5-14 presents the main sea outfall pipe and the emergency overflow pipe. At this stage of the assessment, the issue of replacing the outfalls is still pending. Nevertheless, the technical consultant proposed three alternative options for the sea outfall works including:

- Alternative 1: Rehabilitation – reconstruction of the existing pipe: This solution is the cheapest one but also the riskiest one and should not be assessed and designed without a prior proper inspection and testing. It should be noted though that identification of the damaged pipeline spots cannot be 100% successful due to the concrete jacketing and very low visibility along the pipeline route. Also even if testing proves no profound leakages, the possibility / risk of steel pipe wall within the next few years of operations will be high. Last point to mention is that the hydraulic performance of the pipeline will be unknown until flow commences, due to the friction losses significant increase because of debris, inner shell corrosion and marine fouling.
- Alternative 2: Installation of a HPDE pipe of a smaller diameter (e.g. 1500mm) inside the existing pipe: The cost of this solution will be significantly higher compared to solution (a) but also significantly cheaper than installing a new pipe. This solution has a lower risk compared to (a) but also involves a significant construction feasibility risk related to the existing pipe situation mainly regarding the possible marine fouling and pipe section blocking inside the pipe (that would be an obstacle in installing the inner plastic pipe). Pipe stability also should be reassessed due to additional buoyancy by the plastic pipe. Due to the aforementioned problems, the pipeline diffuser may needs significant repair and most probably replacement. Using a smaller diameter pipe will probably not cause major increment of the hydraulic head due to the lower roughness and friction factor compared to an old steel pipe.
- Alternative 3: Installing a new HDPE, parallel to the existing. This solution is a no-risk solution, especially if additional protection measures are taken against the marine activities, but with probably double cost or higher compared to (b) solution.