MENAWARA

WP3. ACTIONS TO INCREASE THE QUALITY OF NON CONVENTIONAL WATER USED IN AGRICULTURE

Output 3.4. No. of pre and post-treatment and MAR systems realized.

A 3.4.2 Implementation of pre and post-treatments on non-conventional water. Carrión de los Céspedes Experimental Center, Spain

Responsible partner: AMAYA

30/10/2023

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The 2014-2020 ENI CBC Mediterranean Sea Basin Programme is a multilateral Cross-Border Cooperation (CBC) initiative funded by the European Neighbourhood Instrument (ENI). The Programme objective is to foster fair, equitable and sustainable economic, social and territorial development, which may advance cross-border integration and valorise participating countries' territories and values. The following 13 countries participate in the Programme: Cyprus, Egypt, France, Greece, Israel, Italy, Jordan, Lebanon, Malta, Palestine, Portugal, Spain, Tunisia. The Managing Authority (JMA) is the Autonomous Region of Sardinia (Italy). Official Programme languages are Arabic, English and French. For more information, please visit:

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The European Union is made up of 28 Member States who have decided to gradually link together their know-how, resources and destinies. Together, during a period of enlargement of 50 years, they have built a zone of stability, democracy and sustainable development whilst maintaining cultural diversity, tolerance and individual freedoms. The European Union is committed to sharing its achievements and its values with countries and peoples beyond its borders.

TABLE OF CONTENT

ABBREVIATIONS AND ACRONYMS

Acronym	Description
AMAYA	Environment and Water Agency of Andalusia
CENTA	Public Foundation Center for New Water Technologies
MAR	Managed Aquifer Recharge
TSS	Total Suspended Solids
TWW	Treated Wastewater
WP	Work Package
WWTP	Wastewater Treatment Plant

1. Background

This technical report has been written in the context of the MENAWARA project on Non-conventional Water Re-use in Agriculture in Mediterranean countries.

The joint challenges of the MENAWARA project consist in providing additional resources by recycling drainage and wastewater, rationalizing water use practices and setting operational governance models in line with national and international plans. The project is designed to enhance access to water through the treatment of wastewater to be re-used as complementary irrigation and to strengthen the capacity of governmental institutions, non-state actors operating in the sector, technicians, and farmers.

The document reports the activities carried out in third Work Package (WP3) of the MENAWARA project on *Non-conventional Water Re-use in Agriculture in Mediterranean countries* and, in particular, is related to the **Output 3. 4 "Number of pre and post treatment and Managed Aquifer Recharge systems realized"** and **Activity 3.4.2 "Implementation of pre and post-treatments on non-conventional water"** as described in infographic below (Figure 1).

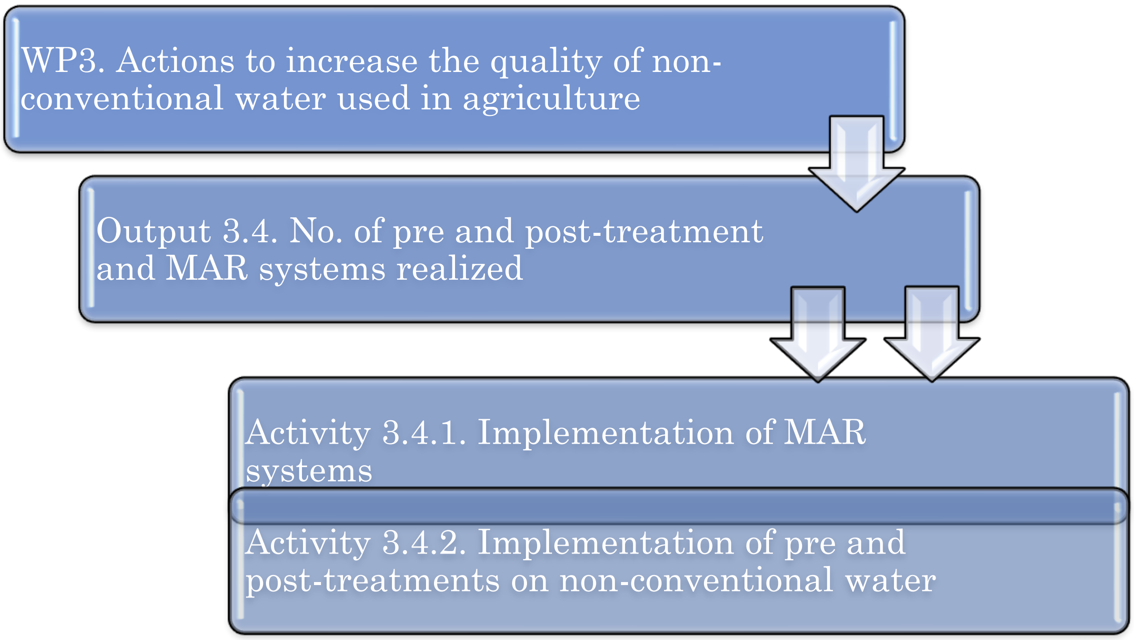

Figure 1. Infographic on the context of this technical report. MAR: Managed Aquifer Recharge.

This is the third technical report for the intervention in the Experimental Center Carrión de los Céspedes, in Seville, Spain; after the technical report written for the minor interventions (Activity 3.2.1) of November 2022 and the preliminary report written on the design of major interventions by the Spanish Public Foundation Center for New water Technologies (CENTA) of July 2020, currently fully incorporated into the Environment and Water Agency of Andalusia (AMAYA).

More specifically the output 3.4 is described as follows: "Low-cost pre and post-treatments for each WWTP in the intervention areas realized and high quality TWW supplied to irrigation distribution networks adopting more rational irrigation techniques compared to the pre-project situation. MAR systems (FIA) realized in Arborea by using improved non-conventional water to recharge the phreatic sandy aquifer exploited for agricultural purposes"

This document details the technical aspects of the post-treatment implemented on the Carrión de los Céspedes Experimental Center site in Spain, under this output 3.4 over the period of September 2021 and August 2023 as part of Activity 3.4.2 "Implementation of the post-treatment on non-conventional water" and complementary to Activity 3.2.1 "Minor interventions on wastewater treatment plants to improve efficiency" under output 3.2 "Efficient infrastructures and technical reports".

The document is structured considering as follows:

1. A general introduction of the area of intervention and wastewater flow (Section 2);
2. A general overview of the post-treatment design, technical specifications and civil works (Section 3);
3. Mention to the annexed documents to this report (Section 4)
4. Concluding remarks (Section 5).

2. Area of intervention

The area of intervention is located at the Carrión de los Céspedes Experimental Plant, in the small village of Carrión de los Céspedes, in Seville, Spain.

The Experimental Plant was created in 1990, in the context of the R+D Plan for Non-Conventional Technologies for the treatment of wastewater in small municipalities, launched in 1987 by the General Directorate of Hydraulic Works of the Junta de Andalucía.

After the first major expansion of the Experimental Center in 2003, research, dissemination and demonstration activities increased significantly: in the same physical space (currently 41,000 m^2) a wide variety of treatment technologies are available, allowing combinations between them under the identical technical and environmental conditions.

Currently, Carrión de los Céspedes Experimental Center is working as a Living-Lab for the co-creation, innovation and experimentation in the frame of wastewater treatment, reuse and circular economy; focused on the user, operating in a territorial context and involving stakeholders of the quintuple helix (Figure 2).

Figure 2. Location of the Spanish intervention site in MENAWARA project: Living lab, Experimental Center of Carrión de los Céspedes and olive trees plot

Carrión de los Céspedes village's population is around 3,000 people. The main economic activities are linked to agriculture (irrigated crops: sunflower, olive grove and almonds; and rain-fed crops: sunflower, olive grove, barley).

Experimental Plant is also working as the WWTP of Carrión de los Céspedes population and treats a daily wastewater flow of around 230-300 m^3/d.

2.1. General wastewater flow in the experimental plant

The wastewater from Carrión de los Céspedes reaches the plant through a 300 mm collector.

Once inside the plant, the wastewater undergoes pretreatment consisting of:

- Self-cleaning channel
  - Thick screening: 3 cm straight screen with movable comb.
  - Fine screening: 3 mm self-cleaning ladder screen.
- Manual cleaning channel
- Thick screening: 2 cm straight screen.
- Air desanding and degreasing, sand classifier and grease concentration.

The distribution of the influent flow to the different systems implemented in the Center is carried out from an accumulation tank elevated above the average level of the plant ("distribution tank"). It is 18 m^3 reservoir, with 11 outlets connected to different systems of the experimental plant.

Pre-treated wastewater is distributed by gravity to the different treatment systems implemented (Figure 3).

Figure 3. General overview of the pretreatment, homogenization and distribution tank outlets.

From the distribution tank, a significant portion of the pre-treated water is sent to a double units Imhoff tank located in the northern part of the plant. The tanks feed the subsurface vertical flow constructed wetlands and an aerated floating helophytic wetland developed in the framework of the Life INTEXT project that worked in synergy with the MENAWARA; as well feed another treatment systems already existing in the Experimental Center (High Rate Algae Pond-HRAP-, and a set of aerobic-anaerobic trickling filters. In total, about 50-60 m^3/d are diverted to the Imhoff tanks.

Figure 4. General overview of the Imhoff Tank

Seven Constructed Wetlands (CW), already implemented in Carrión de los Céspedes intervention site, have been also included in the treatment train of the MENAWARA project to improve the wastewater treatment processes according to the "fit for purpose" principle, including technical solutions allowing reconciling the requirements of low cost and simplicity in the O&M, while guaranteeing safe water quality for public health and the environment and giving priority to aspects related to sustainable development and the circular economy. The Constructed Wetlands used for the MENAWARA project have been the following:

1. Combination of subsurface vertical and horizontal flow CWS, (VSSF-1 and HSSF, respectively) to improve the performance of nitrification-denitrification processes.

Figure 5. General overview of the Vertical Subsurface (VSSF-1) and Horizontal Subsurface (HSSF) flow Constructed Wetlands

The most important characteristics of the wetlands are as follows:

Vertical subsurface flow wetland (VSSF1)

(a) Area: 317 m²

(b) Filling material:

i. Bottom: Gravel 25-40 mm, 15 cm

ii. Top: Gravel 4-12 mm, 60 cm

(c) Vegetation: *Phragmites australis*

Horizontal subsurface fow wetland (HSSF)

(a) Area: 120 m²

(b) Filling material:

Gravel 4-12 mm, 60 cm

(c) Vegetation: *Phragmites australis*

2. Combination of vertical subsurface and free water surface CWs, (VSSF-3 and FWS, respectively). The free water surface CW is working as tertiary treatment, improving the final performance.

Figure 6. General overview of the Vertical Subsurface (VSSF-3) and Free Water Surface (FWS) Flow Constructed Wetlands

The most important characteristics of the wetlands are:

Vertical subsurface flow wetland (VSSF-3)

(a) Area: 317 m2

(b) Filling (from bottom to top):

i. Gravel 25-40 mm, 15 cm

ii. Gravel 4-12 mm, 10 cm

iii. Gravel 3-8 mm, 30 cm

iv. Gravel 4-12 mm, 30 cm

(c) Vegetation: *Cyperus papyrus*, *Iris*

Free water surface wetland (FWS)

(a) Area: 237 m2

(b) Water sheet: 20 – 50 cm

(c) Bottom gravel layer, 30 cm

(d) Vegetation: *Iris, Thypa, Scirpus, Cladium*

3. Subsurface vertical flow CW unplanted.

One of the problems detected during several years of operation with vertical subsurface flow CWs is the burial of feeding pipes by the filling material of the wetland. In this sense, with the aim of avoiding it, the design has been innovated, incorporating feeding pipes of larger diameters and elevated above the surface of the filling material. In this way, the water is distributed throughout the entire effective surface of the bed and achieve an increase on performance.

Figure 7. General overview of the Vertical Subsurface Flow (VSSF-2) Constructed Wetland

The main characteristics of the VSSF-2 are:

Area: 227 m^2 (24 × 11.5 m)

Filling material:

Bottom: Gravel 20-40 mm, 30 cm

Top: Gravel (chickpea) 4-8 mm, 90 cm

Plant species: Unplanted.

Treated wastewater from the aforementioned (5) CWs are discharged to a reception chamber from where water is diverted to a storage pond for irrigation purposes. The working configurations of the (5) above mentioned CWs is as follows:

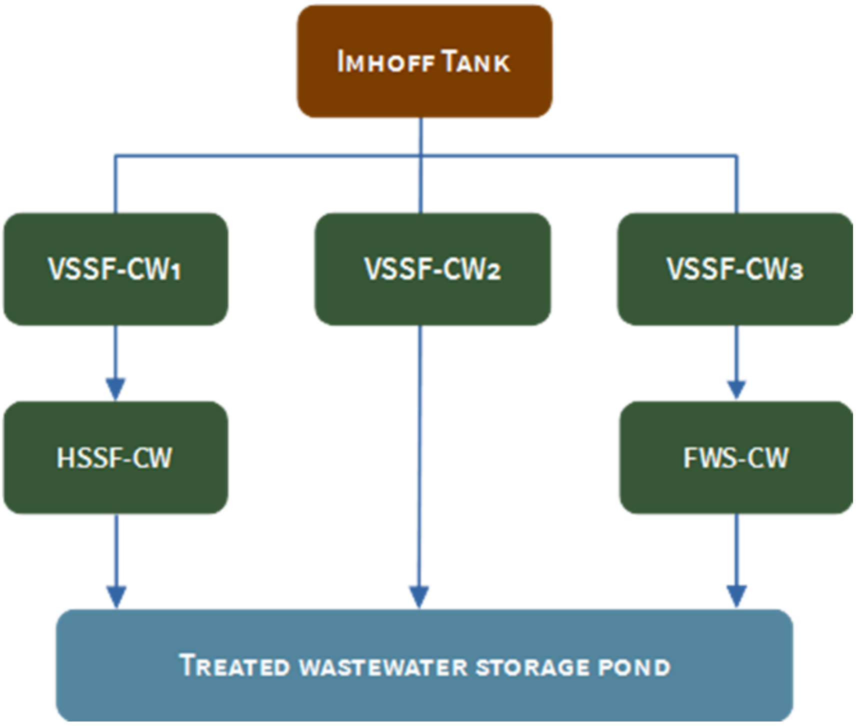

Figure 8. Working configuration of the Constructed Wetlands

4. In synergy with the European project (LIFE INTEXT, https://life-intext.eu/), in the Carrion de los Céspedes Experimental Center, the following innovative wetlands have been realized to increase outlet performances, also reducing the implementation surface and increasing the operation control:

- Intermittent and aerated vertical-horizontal CW. The CW is innovative not only for its configuration and intensification of the process, but also because it works as a primary treatment, receiving pre-treated water;

- Floating macrophytes, with the possibility of operating with aeration and recirculation, with several aerated and non-aerated zones.

Treated wastewater through the aforementioned (2) CWs are discharged to a reception chamber from where water is diverted to a storage pond for irrigation purposes.

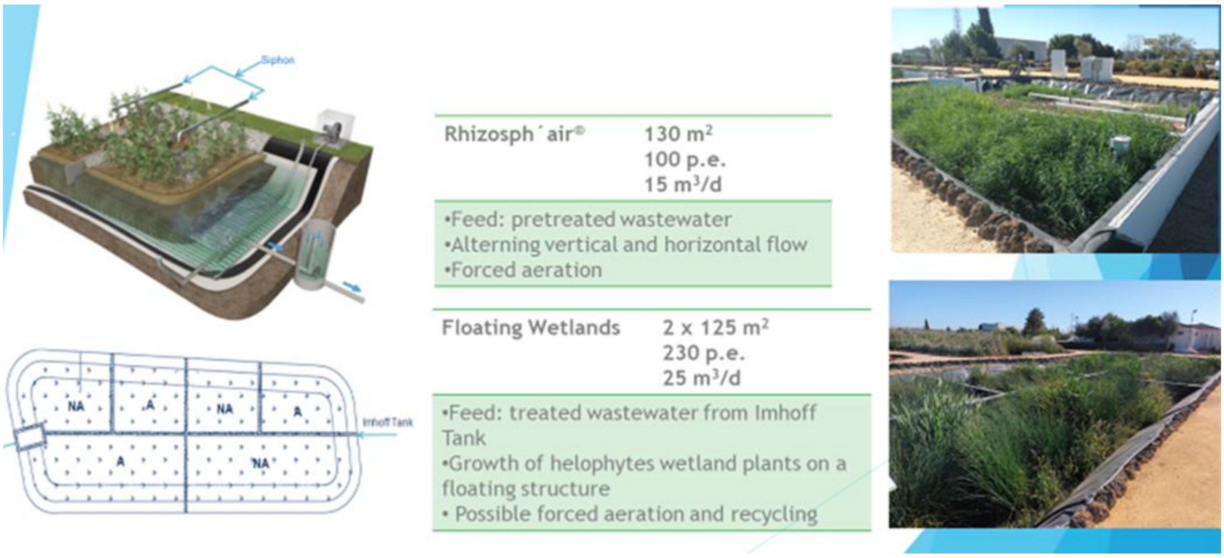

Figure 9. General overview and characteristics of two innovative Constructed Wetlands

The MENAWARA post-treatment starts in the storage lagoon, with the installation of an ultrasound treatment for microalgae and *E.coli* removal, followed by a filtration system consisting of a pressure sand filter followed by manual cleaning mesh filter. Finally, reclaimed water is conveyed from this post-treatment to the olive grove plot, by means of a pressure group, where irrigation is carried out by surface dripping. The complete working configuration is shown below:

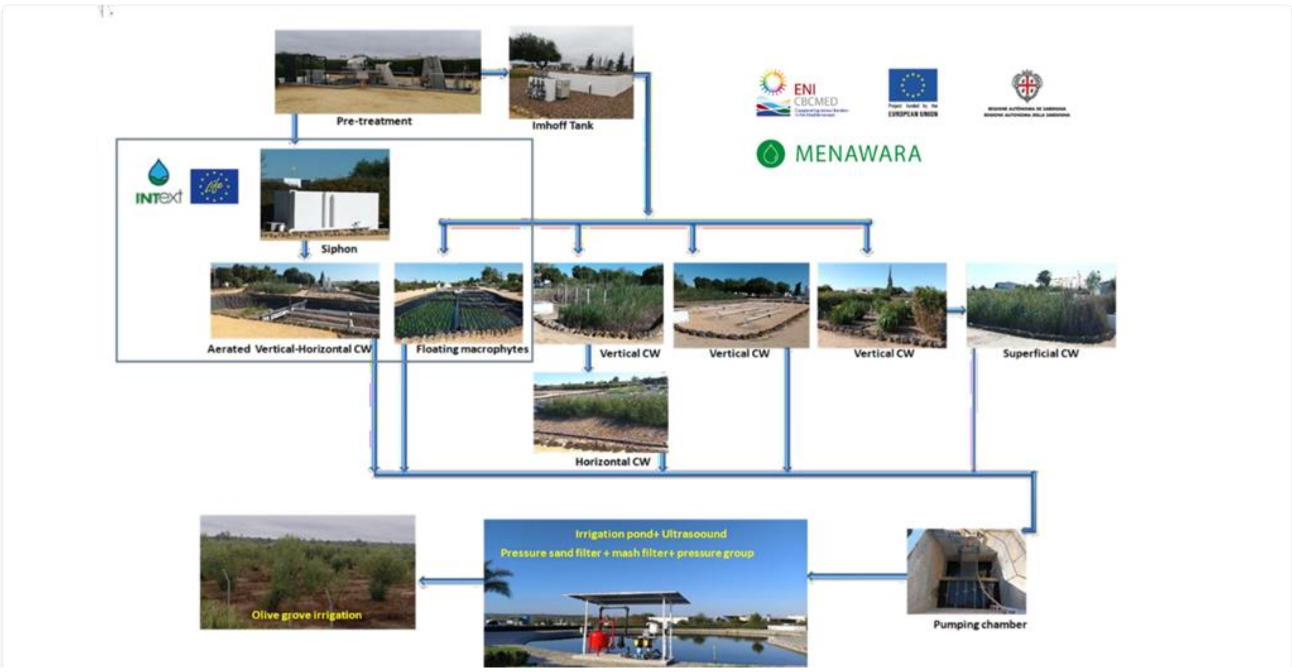

Figure 10. Schematic representation of the working configuration, including Pre-treatment, Imhoff Tank, reception and pumping chamber, storage pond and post-

treatment train implemented in MENAWARA project and plot for irrigation of olive groves experiences.

Figure 11. Aerial view of treatment units at Carrión de los Céspedes Experimental Center, Seville, Spain: 1- Pre-treatment; 2-Homogenization tank; 3- Distribution channels; 4- Imhoff Tank; 5- Vertical Subsurface CW-1; 6- Vertical Subsurface CW-2; 7- Vertical Subsurface CW-3; 8- Free Water Surface CW; 9- Horizontal Subsurface CW; 10- Aerated vertical-horizontal CW; 11- Floating helophytes; 12- reception and distribution chamber; 13-Storage pond; 14- Post-treatment: ultrasound unit + automatic pressure sand filter + manual cleaning mesh filter + pressure group; 15- Olive grove plot.

3. Carrión de los céspedes post-treatment technical specifications and civil works

This section presents the technical specifications of the installed items and performed work included in the implemented post-treatment.

Aiming to improve the wastewater treatment processes to be treated at the intervention site Carrión de los Céspedes, Seville, Spain; after previous discussions and definitions with the technicians and experts working for CENTA and according to the "*fit for purpose*" principle, the post-treatment system implemented is based on an algae and *E. coli* removal treatment by ultrasound emission and a subsequent filtration process using pressure sand filter and mesh filter. To push the reclaimed water to the nearby olive grove irrigation plot, a pressure group has also been implemented.

This projected post-treatment train is fed from the already existing treatment based on anaerobic primary treatment (Imhoff tank) and Constructed Wetlands, workings with different configurations (vertical and horizontal subsurface flow, surface flow, aerated vertical-horizontal and floating helophytes).

A supply connection line has been executed for the treatment line from the outlet of already existing (7) Constructed Wetlands, up to a maximum distance of 10 m. To this end, the mechanical excavation of sanitation trenches on soil of hard consistency, breakage has been carried out, connection and repair of the existing collector, laying of 50 mm corrugated PVC pipe. internal diameter, subsequent covering of the connection and replacement of the pavement.

The outlet chamber for the effluent from the Constructed Wetlands has been provided with a set of valves and interconnections to provide operational flexibility to the pressure sand filter feeding system.

The treated wastewater by CWs is diverted to an accumulation pond to be used for irrigation of olive groves by surface drip irrigation. The outlet of this pond is treated by the projected filtration automatic unit-pressure sand filter followed by a manual cleaning mesh filter. Also, in order to reduce the microalgae growing and remove *E. coli* in the storage pond, an ultrasound treatment has been implemented in the pond.

3.1. Description of the technical solutions adopted and civil works carried out

The facilities are planned with a treatment capacity of 50 m^3/d.

The design adopted allows the reuse of the treated water for irrigation of agricultural crops (olive grove by surface drip irrigation). The following requirements have also been considered as basic objectives when designing and projecting this project:

• Provide a quality of execution to civil works, equipment and facilities that allow a value for money that fits this type of works, paying particular attention to the task that they are going to perform.

• Provide facilities with sufficient flexibility to facilitate operating manoeuvres and achieve low O&M costs.

It has been chosen to design a sustainable treatment line for the reclamation of secondary and tertiary treated wastewater by low-cost technologies as the Constructed Wetlands. The reclamation treatment is based on a sedimentation and solar UV radiation in a shallow accumulation pond, ultrasound treatment and subsequent filtration treatment.

As a stage prior to the water reclamation installation, it is necessary to have accumulation basin of the tributary coming from the Constructed Wetlands treatments existing in the Carrión de los Céspedes Plant. Its objective is double: on the one hand, it serves to laminate possible variations in the effluent flow of the projected treatment line and, on the other, it allows water with a more constant quality to be introduced into the reclamation treatment train. A pressure group has also been installed to achieve the pressures required by the irrigation system.

3.1.1. Algae and *E. coli* Removal Treatment by Ultrasound Emission

The removal system consisting of an ultrasonic emitter placed under the surface of the water (with float), a control module to activate the emitter, installed in a dry or non-floodable area, powered by alternating current and connection cable between the emitter and the control module.

The main characteristics of the projected algae and *E. coli* removal equipment are shown below:

- Electrical power supply: 220 Vca. – 350 mA.
- Nominal power: 4W/h.
- Emitter protection: IP-68.
- Controller protection: IP-66.
- Probe length: 35 m.
- Temperature range (max., Min): -10 / 60ºC.
- Weight: 4 kg.

Figure 12. General view of the ultrasound equipment installed in the storage pond.

3.1.2. Pumping to Treatment Line

The existing storage pond has been equipped with a pumping system. The pump is able to raise the nominal design flow of the filtration treatment (6.25 m^3/h).

The main characteristics of the projected pumping equipment are shown below:

- Curve number: 53-252.
- Impeller diameter: 104 mm.
- Impeller type: Vortex.

- Installation type: X = Retrofit.
- Electric motor: 1.7 KW / 400V. three phase - 50Hz.
- Speed: 2700 rpm.
- Cooling: Using heat dissipating fins.
- Max. liquid temperature: 40ºC.
- Thermal protection: By means of thermal probes.
- Motor protection: IP 68.
- Operation type: S1 (24h/day).
- Insulation class F (155ºC).
- Housing material: H F GG 25.
- Impeller Material: H F GG 20.
- O-Ring Material: FPM.
- Shaft material: EN 1.4057 (AISI 431).
- Watertightness: Through two mechanical seals.
- Interior / Top: Charcoal – Ceramic.
- Exterior / Bottom: WCCr – Ceramic.
- Self-lubrication: Oil sump that enables them to work dry.
- Paint: According to manufacturer standard.
- Electric cable SUBCAB 4G1.5 + 2x1.5mm2 (10 m.) Electric cable

For the lifting of submersible pumps, a system consisting of guide tubes, support and automatic coupling will be supplied and installed.

3.1.3 Pressure Sand and mesh Filtration

In order to obtain an effluent with a lower TSS level, a sand and mesh filtration process has been implemented to subject the previously secondary and tertiary treated wastewater by Constructed Wetlands, after passing it through the storage pond and ultrasound treatment.

This filtering treatment also contributes to improving quality in terms of microbiological characteristics, since most viruses and bacteria remain bound to suspended solids.

The filtration through sand is produced by physical retaining the dirt into the gaps formed between the granules laid throughout the whole mantle. This is an in-depth filtration, characteristic that gives sand filtration to be a highly efficient system.

The filter station consisting of one filter, constructed of carbon steel and a set of manifold arms, including backwash globe valve and carbon steel manifolds, suction cup, gaskets and bolts, and a set consisting of a plastic manual mesh filter, mesh filter cartridge made of PVC frame and AISI 316 stainless steel mesh, as well as raw water inlet and filtered water outlet collectors, and drain, carbon steel and even equipment automatic control.

The process consists on a filter, driven by pressure, whose characteristics are:

Table 1. Characteristics of the Pressure Sand Filter

SAND FILTER	
Filter	
Type of filter	LOW BED (VERTICAL)
Model of filter	FA1200
Number of filters	4
Installation	INDOOR / OUTDOOR
Design Parameters	
Estimated total flow	37.50 m^3/h
Volume unit	450 l.
Design pressure	8 bar
Maximum work pressure	8 bar
Test pressure	12 bar
Filter diameter	1,200 mm
Cylindrical height	500 mm
Filter height with feet	1,275 mm
Filtration surface per filter	1.13 m^2
Total filtration surface	4.52 m^2
Specifications	
Body filter	Carbon Steel S235JR
Klopper funds	Carbon Steel S235JR
Nozzles plate	Carbon Steel S235JR
Manifold arm slot	0.25 mm
Manifold arm material	PP
Manifolds material	Carbon Steel S235JR
Inlet tubing:	
Connection	4"

SAND FILTER	
Material	Carbon Steel S235JR
Outlet tubing:	
Connection	4”
Material	Carbon Steel S235JR
Inlet feed distributor	Carbon Steel S235JR
Treatment and Painting	
Exterior surface treatment of the filters:	
Previous treatment	Degreasing, pickling, phosphating and base coat
Painting	Epoxy polyester powder
Color of the final coat	*To be determined*
Interior surface treatment of the filters:	
Previous treatment	Degreasing, pickling, phosphating and base coat
Painting	Epoxy polyester powder
Color of the final coat	*To be determined*

Filter is powered by a centrifugal pump. Another pump with the same characteristic will remain inactive.

The characteristics of the pumps and, therefore, the operating parameters of the filtration are:

- Feeding pump flow: 37.50 m^3/h.
- Nominal pressure: 8 bar.

When the pressure drop through the filter reaches the preset level, the feeding stops and the backwash begins. Active and inactive wash pumps are projected.

Cleaning takes place by reverse filtration, by opening the drain valve to the exterior dislodging through it all the dirt. The systems can be automatic if a *globo* valve is used. The cleaning process is guaranteed thanks to manifold arms or nozzles which are along the media filter basis.

- Maximum pressure: 8 kg/cm^2

- Minimum cleaning pressure: 2.5 kg/cm^2
- Testing pressure: 12 kg/cm^2

3.1.4. Pressure Group

To achieve the pressures required by the irrigation system, the installation of a pressure group has also been implemented for feeding water under pressure with operation controlled by a variable speed drive and a pressure transducer. The start and stop of the pumps are determined based on the pressure values determined in the instructions for the variable speed drives. Each of them are connected to a pressure transducer and communicate with each other to perform alternation functions.

The start and stop of the pumps are determined based on the pressure values determined in the instructions for the variable speed drives. Each of them will be connected to a pressure transducer and communicate with each other to perform alternation functions.

Due to the demand for flow, the water leaves the expansion tank. When the pressure drops below the set point reference value, the first pump starts by adjusting the speed to keep the pressure value constant. If the water consumption increases and the pump rises to maximum speed, the second pump starts adjusting the speed to the selected pressure set point. When the consumption decreases, the speed is reduced until a minimum speed is reached and one of the pumps stops. If the consumption continues to decrease, the pump slows down and fills the expansion tank until reaching the set point reference value.

Main unit characteristics of pumps are:

- Brand: LOWARA.
- Model: GHV20/A/46SV2/2AG055T/4.
- Nominal flow rate: 37.50 m^3/h.
- Nominal pressure: 8 bar.
- Pump body: AISI 304 stainless steel.
- Impulsion: AISI 304 stainless steel.
- Aspiration: AISI 304 stainless steel.
- Shaft: AISI 304 stainless steel.
- Axis covering: Tungsten Carbide.
- Mechanical seal: Silicon Carbide / Carbon / EPDM.
- Three-phase squirrel cage electric motor of size IEC 112 in a V18/B14 construction, IE3 efficiency, manufactured according to EN 60034-1, directly coupled to the vertical of the pump.
- Engine Power: 5.50 kW.
- Voltage: 400 V.

- Frequency: 50 Hz.
- Rated current: 10.60 A.
- Speed: 2,900 rpm
- Maximum ambient temperature: 40°C.
- Protection class: IP 55.
- Insulation class: F.

Main variable speed drives features are as follows:

- Inverters have an integrated control panel with a keyboard for parameterizing various operating values, working hours, the number of revolutions of the engine control parameters, fault indication.
- The LCD screen has the ability to present information in 28 languages, as well as three-color LED for signaling "Switched on", "Operation" and "Fault".
- The parameterization of the variable speed drives can be, partially or totally, blocked by a password.
- Contain terminal connection to remote start and stop.
- Lack of water contact.
- Contact heat of the engine (PTC).
- Pump status signaling.
- Fault signaling.
- Output analog signal.
- Pressure transducer.
- RS 485 interface.
- Mains supply.

Main features of the control system and instrumentation are as follows:

- Electrical protection panel and power supply to the variable speed drives, made of sheet metal, including fuse groups, indicator lamps, general cut-off switch, and fixed terminal strip.
- Pressure transducer built in 304 stainless steel for each electric pump, in the impulsion manifold.
- Brass shut-off valves.
- Brass check valves.
- Impulsion manifold in AISI 304 stainless steel of DN 160 (6”).
- Aspiration manifold in AISI 304 stainless steel DN 160 (6”).
- Connection accessories.
- Painted steel bench.

Figure 13. General view of the filtration treatment (pressure sand filter followed by mesh filter) and pressure group.

3.1.5 Electric Equipment

3.1.5.1. Electricity Supply

The compact post-treatment equipment is fed from the existing facility. The maximum power demand is 5.05kW.

The supply of electricity is out of the scope of this technical report. It is the local authority liability to guarantee that the electrical connection is available in time for the starting up of the projected treatment line.

4.1.5.2. Low Tension Facilities

Design and installation have been carried out in accordance with local regulations on insulation materials, cable cross-section, grounding systems and other applicable provisions.

3.1.6 Civil Works & Buildings

3.1.6.1. Construction Building for Equipment Protection

A building has been constructed to protect installed treatment equipment, consisting of a booth for protection of treatment equipment consisting of a metal structure, galvanized sheet steel enclosure with a thickness of 0.25 mm., with pre-lacquered paint finish, sheet metal cover, sheet metal entrance door with lock for easy access and water-resistant chipboard flooring. Construction actions have been carried out according to the local standards, and with the materials commonly used in the area.

3.1.6.2. Piping

For the piping, the material are:

- High-density polyethylene (HDPE) pipes in pump-driven streams.
- Polyvinyl chloride (PVC) pipes in gravity driven currents.
- Stainless steel pipes at the pump outlets, pressure and suction manifolds in pressure groups, inlet and outlet manifolds in the filter station, feed manifolds to the treatment reactor by ultraviolet radiation.

Construction actions have been carried out according to the local standards, and with the materials commonly used in the area.

4. Annexed Documents to this report

The basic design of post-treatment train implemented in the intervention site of Carrión de los Céspedes Experimental Center consists of the following documents included in Output 3.3. Post Treatment_Technical design.

Basic Sizing and Calculations

- Basic Sizing.
- Hydraulic Calculations.
- Electrical Calculations.

Plans

- P01-H01. Flow Diagram.
- P02-H01. Irrigation Pond: Pump.
- P02-H02. Filtration Treatment by Pressure Sand Filters.

- P03-H03. Pressure Group.
- P03-H04. Flowmeter.
- P03-H05. Unifilar Diagram.

Budget

- Measuring.
- Budget.
- Budget Summary.

5. Conclusion

Compared to the original proposed design in the preliminary technical report, there were no deviations done for the post-treatment implementation.

The low-cost treatment train composed by Constructed Wetlands (including different types, working configurations and innovative systems), joined to the subsequent treatments such as disinfection by solar UV radiation in the shallow storage pond, sedimentation on the pond, ultrasound treatment for microalgae and *E. coli* removal and final filtration by pressure sand filter and mesh filter, has allowed to obtain a reclaimed water with the quality established in the new EU Regulation 2020/741 of the European Parliament and of the Council on minimum requirements for water reuse, according to Classe C where olive groves by drip irrigation is included. This is described in detail in the report "Output 3.5: Report on the efficiency of the implemented pre and post treatments and MAR systems".

The wastewater treatment train based on low-cost technologies as Constructed wetlands followed by storage pond with ultrasound treatment and final filtration allows to obtain reclaimed water with sufficient quality to be used in drip irrigation of a strategic crop as the olive grove, enhancing the socio-economic development of many rural or local areas in the Mediterranean countries, where the irrigated agriculture constitutes the basis of this development.