UCR Project Concept Note & Monitoring Report (PCNMR)

Project Name : Contaminated River Treatment Project by SIIPL, Pune, India

PCNMR Version 1.0

Date of PCNMR: 02/04/2023

1st RoU Crediting Period: 01/01/2017 to 31/12/2022 (06 years, 00 months)

1st RoU Monitoring Period: 01/01/2017 to 31/12/2022

UCR RoU Scope: Scope 4

UNDP Human Development Indicator: 0.645 (India)

National Water Security Index: 2 (India)

RoUs Generated During 1st Monitored Period: 7,920,000 RoUs

A.1 Location & Details of Project Activity

Title	**Contaminated River Treatment Project by SIIPL, Pune, India**
Type and Scope of RoU Project Activity	Large Scale Project Type Scope 4: Measures that remove bacteriological and other impurities from *seawater**, sewage and waste water, contaminated water bodies or unutilized water, so that water is made suitable for re-use and/or recycling. The project activity prioritizes and showcases best in class contaminated river water treatment and treated sludge management, along with the reuse of treated river water for captive industrial use as a key corporate environmental intervention towards a more water secure India.
Address of Project Activity	SEZ Biotech Services Pvt Ltd Village: Manjri Taluka: Haveli
State	Maharashtra
District	Pune
Block Basin/Sub Basin/Watershed	Pune city is located in the North Bhima River Basin
Latitude & Longitude	Geo Tag: 18.51559, 73.96310 Latitude: 18°30'56.1”N, Longitude: 73° 57'47.2"E
Project Commissioning Date	2017
Influent Area Extent	Mula and Mutha Rivers originate in the Sahyadri ranges and traverse across Pune. The two rivers further meet and upon their confluence Mula-Mutha river is formed which further drains itself into the Bhima River. The total length of these three rivers traversing through Pune Municipal Corporation is 44km approximately. Out of this, 22.2km is Mula River, 10.4km is Mutha River and 11.8km is Mula Mutha River.
SDG Impacts	1 – SDG 1 No Poverty 2 – SDG 3 Good health and well being 3 – SDG 6 Ensure access to water and sanitation for all 4 – SDG 8 Decent work and economic growth 5 – SDG 13 Climate Action 6 – SDG 15 Life on Land 7 – SDG 17 Partnerships for the goals
Climatic Conditions	Annual Mean Maximum Temperature: 39°C Annual Mean Minimum Temperature: 12°C Annual Mean Maximum Rainfall: 722 mm

Predominant Hydro-Geological Formations	Hydrogeology of the entire area of the district is underlain by the basaltic lava flows of upper Cretaceous to lower Eocene age. The shallow alluvial formation of recent age also occurs as narrow stretch along the major rivers flowing in the area
Calculated RoUs per year	

Year	Quantity (1 RoU = 1000 liters)
2017	1320000
2018	1320000
2019	1320000
2020	1320000
2021	1320000
2022	1320000
Total	**7920000**

A.2. Project owner information, key roles and responsibilities

Project Proponent (PP):	**Project Owner**: Serum Institute of India Pvt Ltd (SIIPL), Pune, Maharashtra
UCR Project Aggregator	**Aggregator**: Egis India Consulting Engineers Pvt Ltd **UCR ID**: 467947294
Contact Information:	Email: sneha.k@egis-india.com
Date PCNMR Prepared	02/04/2023
External Links and Reports	Environmental Impact Assessment Report for Mula, Mutha & Mula-Mutha river rejuvenation project by PMC, June 2018.

Purpose of the project activity:

Serum Institute of India Pvt Ltd (SIIPL), the project proponent (PP), is an Indian biotechnology and biopharmaceuticals company founded in 1966 and since then it has established itself as the world's largest manufacturer of vaccines.

The project, **Contaminated River Treatment Project by SIIPL, Pune, India** is located at Village: Manjri, District: Pune, State: Maharashtra, Country: India. The project activity by the PP, is the installation and operation of a membrane bioreactor based river water treatment and recycling plant since 2017, which results in clean and safe drinking water from a previously contaminated and unutilized water resource (Mula-Mutha River, Pune). This contaminated river (Mula-Mutha) is outside the project activity boundary and showcases the PP's commitment towards water stewardship and efficiency. The PP highlights the catalytic role that corporate India must play in reducing industrial water consumption as well as water pollution per unit of industrial output. The PP has showcased technologies that **creates safe drinking water from a known contaminated river resource and has overcome the challenges faced by the alternate methods implemented and being proposed for the same by regulators.** The project activity is an example of local stakeholders, especially corporates to reconnect with the rivers to build positive sustainable water conservation action. For any vaccine production, water is the most widely used substance, raw material or starting material in the production, processing and formulation of pharmaceutical products. As the neighboring area to the project activity are residential, the PP did not want to reduce the drinking water level by diverting huge quantities water daily either through bore well or approvals from PMC. Further, the digging of numerous bore wells in the absence of the project activity would have also created acute ground water shortage for the local residents of Hadapsar, Pune. The project activity prioritizes and showcases best in class contaminated river water treatment and treated sludge management technologies, along with the reuse of treated river water for captive industrial use as a key corporate environmental intervention towards a more water secure India.

Hence the project activity is pre-approved under the UCR RoU program for the following scope:

- *Scope 4: Measures that remove bacteriological and other impurities from contaminated water bodies or unutilized water, so that water is made suitable for re-use and/or recycling purposes.*

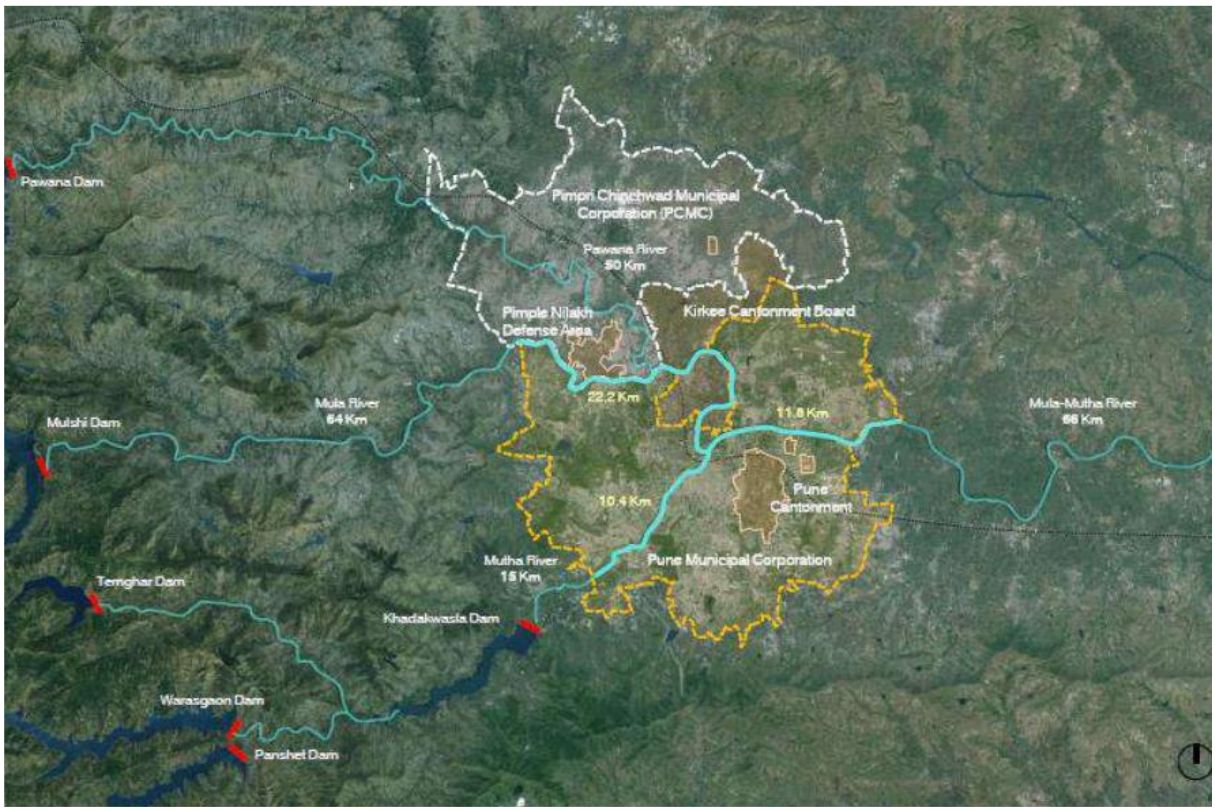
Contaminated River History:

Mula River originates from Mulshi dam and it navigates around 64 km to meet Mutha River at Sangamwadi in Pune district. Around 22.2 km of the downstream stretch of the river is within the Pune Municipal Corporation (PMC) controlled area. Several villages lie along the Mula River within the PMC and Pimpri Chinchwad Municipal Corporation (PCMC) area.

Similarly, Mutha River originates from Khadakwasla dam and it navigates around 15km to meet Mula River at Sangam wadi. Out of which around 10.4 km of downstream stretch of the river is within PMC area. Many villages and old city area are along the Mutha River within the PMC area. Whereas after the confluence of Mula and Mutha rivers, the combined river Mula-Mutha navigates from east to west part of the city and meets Bhima river downstream around 50km away from the confluence, out of which 11.8 km lies within PMC area. The total length of the three rivers is 44 km approximately.

The entire 44 km of river length in project area is not only under PMC, but also PCMC and Defense Area. The biological oxygen demand of the river, an indicator of organic pollution, is over 30 mg/l, more than 10 times the permissible limit for bathing.

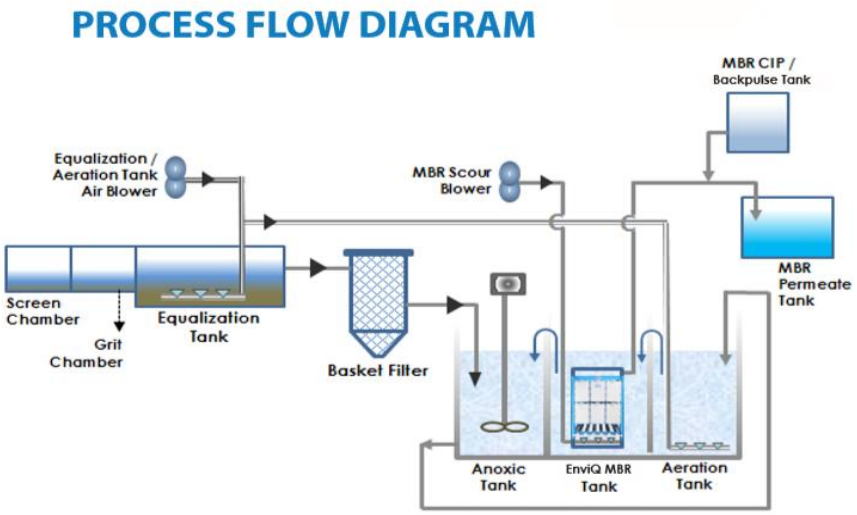
The sewage generated by the city's 3.7 million inhabitants is nearly 800 million litres a day; less than 40 per cent of this is untreated and mixes with treated sewage. All of this enters the river and percolates into the aquifers (*source: https://questionofcities.org/punes-mula-mutha-sinks-into-ecological-disaster/*).



River Boundary

The Mula-Mutha has been steadily reduced to a large sewer, randomly concrete-fenced, prone to flooding and clogging with the city's waste. Photo: Ishan Sadwelka

In 2017, the PP initiated an expansion of its manufacturing facility that resulted in an additional water requirement for the entire facility in Pune. The options available were the local drinking water resources or deep borewells which would consume the areas groundwater resources, however, the PP opted to use the unutilized river water source which was heavily polluted with city sewage and industrial waste, with very high organics. A key challenge for this project was that the BOD of the feed water could be as high as 50 mg/L. Another challenge was that the project boundary had limited space for construction of a new system to accommodate the extra flow.



The PP evaluated two options: a membrane bioreactor (MBR) solution and conventional physical/chemical treatment, followed by media filters or ultrafiltration. Due to the space constraints the membrane bioreactor (MBR) solution was chosen due to its capability of minimizing unit operations while still producing high quality and ultrafiltration-grade water.

Water pollution affects human health, economic development and ecosystem functions. The project activity protects fresh water, which is an exhaustible resource essential for sustaining life, development and the environment. The project activity prioritizes and showcases best in class contaminated river water treatment and treated sludge management technologies, along with the reuse of treated river water for captive industrial use as a key corporate environmental intervention towards a more water secure India.

MBR technology is well-suited to help address the reuse of wastewater or contaminated river water, one of the most important challenges of the 21st century. Combining biological treatment with a membrane separation step, MBR produces reusable water from physical disinfection. With the membrane pores of the MBR being of a small size (<0.5), the treated effluent has a very high clarity and significantly reduced pathogen concentration. The MBR process has long solid retention times (SRT) that allow for an improved biological treatment over the one from the conventional biological processes. This longer SRT tends to provide better overall bio-treatment due to encouraging the development of the slower-growing micro-organisms, specifically nitrifiers. This fact makes MBRs very effective at the biological removal of ammonia ('nitrification').

In general MBRs have been applied to treat effluent in a number of industrial sectors, like:

- food and beverage − high in organic loading
- petroleum industry − exploration, refining and petrochemical sectors
- pharmaceutical industry – have active pharmaceutical ingredients (APIs)
- pulp and paper industry − high levels of suspended solids, COD and BOD
- textile industry effluent − re-biodegradability, toxicity, FOG content and colour
- landfill leachate − wide variety of dissolved and suspended organic and inorganic compounds
- ship effluents − legislative requirements and space restrictions.

The key disadvantages of an MBR are the operational process complexity and the cost for installation, hence the PP hopes that the sale of RoUs from this project activity will offset the installation costs and help make such projects viable for the industrial sector.

A.2.1 UCR RoU Scope & Project Details

UCR **RoU Scope 4**	*Measures that remove bacteriological and other impurities from contaminated water bodies or unutilized water, so that water is made suitable for re-use and/or recycling purposes.*

The PP initiated an expansion of its manufacturing facility in 2017, which resulted in an additional water requirement for the plants operated by the PP. Being the world's largest vaccine manufacturer and socially responsible corporate with excellent ESG credentials, the PP decided not to consume/burden the city's existing clean drinking water resources or construct deep bore wells to further deplete the surrounding groundwater aquifers, but instead opted to voluntarily treat, recycle and reuse a highly contaminated unutilized local water resource (Mula-Mutha river) for its in-house water requirements.

The project, **Contaminated River Treatment Project by SIIPL, Pune, India** is located at Village: Manjri, District: Pune, State: Maharashtra, Country: India.

The project activity is the installation of a four (4) million litre per day (MLD) capacity MBR (Membrane Bioreactor) based water treatment and recycling plant that results in the production of clean and safe water from previously contaminated and unutilized water resources. In the absence of the project activity, the PP would have installed bore wells that would have depleted the local groundwater resources and/or continued to use existing drinking water resources in the surrounding area.

The PPs daily water requirement is as follows:

Activity	Water Requirement (KL/d)
Potable water (for further purification)	2000
Cooling Tower	1800
Boiler	500
Domestic Use (washrooms, canteen, drinking)	150
Gardening	600
Total	**5050 KL/d (~5MLD)**

Of the daily water requirement, the project activity supplies 4 MLD. This pretreated river water is further purified through Ultrafiltration + Reverse Osmosis + UV to generate safe drinking water. This potable water complies with all national and international standards like USEPA/WHO/BIS-10500.

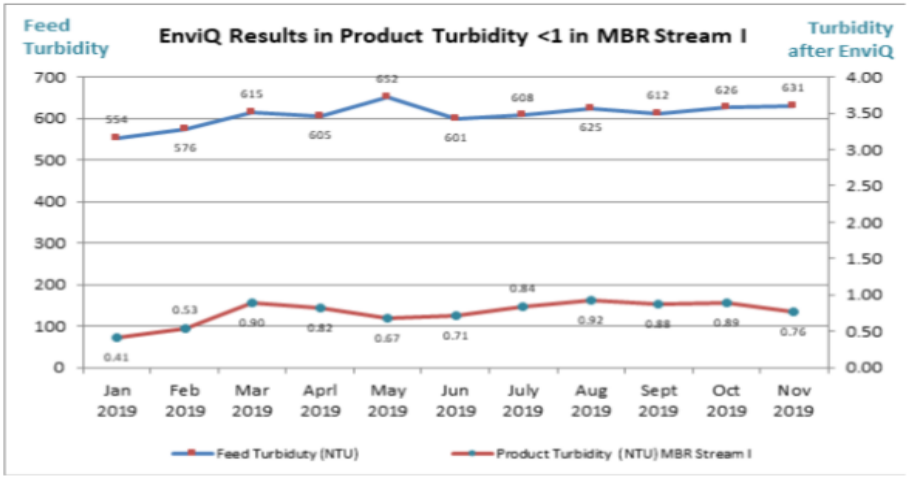
Technology Description:

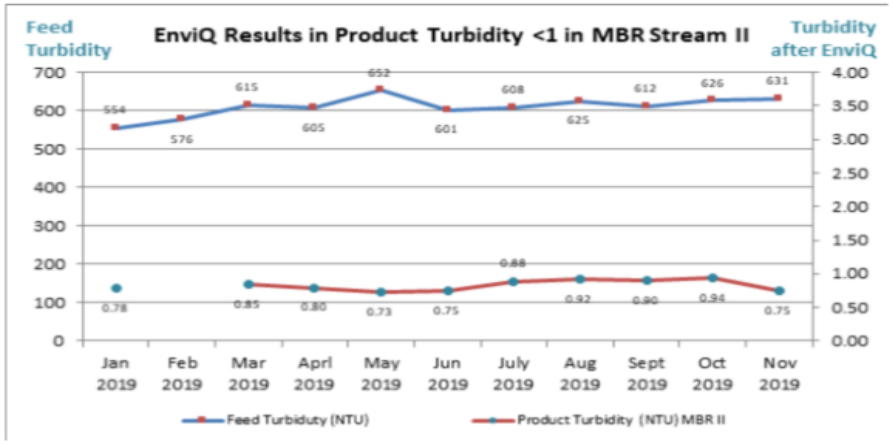
Description	Data
Model	EnviQ E32C
Manufacturer	QUA Group
Capacity	2 x 2 MLD (4 MLD)
Number of Modules	24 (12 Per Stream)
Outlet Turbidity	< 1 NTU
Outlet BOD	< 5 mg/L
Outlet COD	< 20 mg/L
Membrane Pore Size	0.04µ

The installed MBR systems are robust and can handle organic river water fluctuations in load easily. As membranes are used as a physical barrier for solid liquid separation, these systems offer consistent high effluent quality in term of TSS and organic removal, and also require less chemical for disinfection. MBR systems take approximately one fourth the space of a conventional activated sludge system. The EnviQ flat sheet submerged ultrafiltration

membranes have been specially developed to improve the ease of operation and maintenance of MBR facilities.

EnviQ is based on a unique patented technology that offers ultrafiltration quality product water with a stronger and more rugged PVDF flat sheet membrane. The unique features in EnviQ consist of reverse diffusion and specially designed air diffusers, which maximize scrubbing efficiency, lower pressure, and reduce cleaning. EnviQ membranes, with a pore size of 0.04µ, are less prone to clogging, easy to operate and do not require any forced back wash.





The project activity achieves the following key water and sanitation related Sustainable Development Goals under the United Nation (UN-SDGDs):

- ensures universal and equitable access to safe and affordable drinking water for all by 2030,

- ensures halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally by 2030,
- substantially increases water-use efficiency across all sectors and ensures sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity by 2030, and;
- expands capacity-building support within India in water and sanitation-related activities and programs, including water efficiency, wastewater treatment, recycling and reuse technologies by 2030.

Water hyacinth and untreated sewage choke the Mula River at various locations

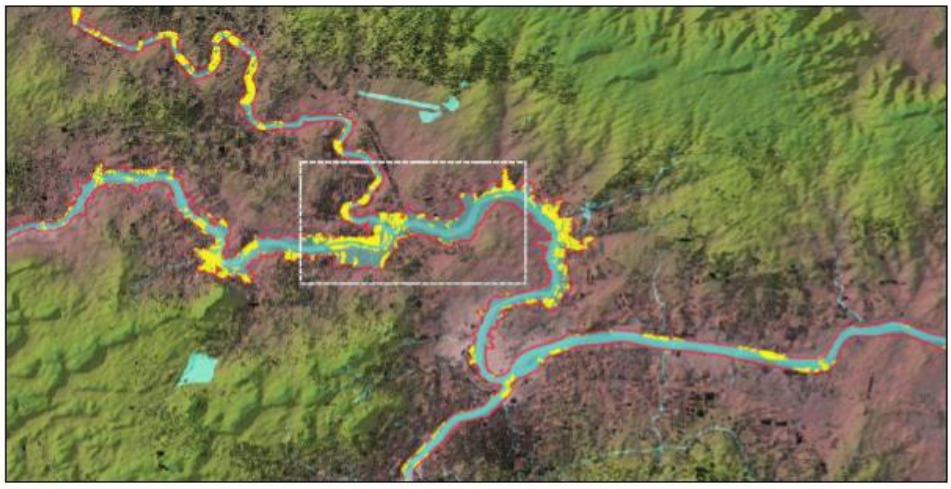
River Status:

The city of Pune generates 750 MLD of wastewater. Pune Municipal Corporation (PMC) is responsible to provide water supply and sewerage services to the city. PMC has so far established 10 Sewage Treatment Plants (STPs) in the city with a total treatment capacity of 567 MLD. However, 535 MLD of wastewater is actually being treated through secondary treatment technologies like activated sludge process, modified activated sludge process, sequential batch

reactor etc. Out of 535 MLD of the total treated wastewater, around 400 MLD is reused for irrigation purposes as per requirement from irrigation department. Wastewater is also reused for various other purposes like construction, road cleaning etc. wherein tankers are sent to different STPs in the city to facilitate the water requirements. The local municipal corporation has announced plans in 2023, to build 11 new sewage treatment plants and their capacity will be around 850 MLD per day. Therefore, 100 percent of the wastewater generated in the city due to old and new projects will be treated and released into the Mula-Mutha river in the coming years.

The Mula-Mutha river has been degraded over time due to a number of factors as follows:

Urbanization along the river - Heavy urbanization in PMC and PCMC areas over the past few decades has led to haphazard urban development along the river. At some locations, the development extends right up to the edge of the river.



Showing Development within Inundation Area

Construction of Dams - The Mutha and Mula Rivers in Pune have dams in their upstream, controlling the discharge of water into them. Presently, the dams have stopped the flow of water into the rivers, keeping them dry.

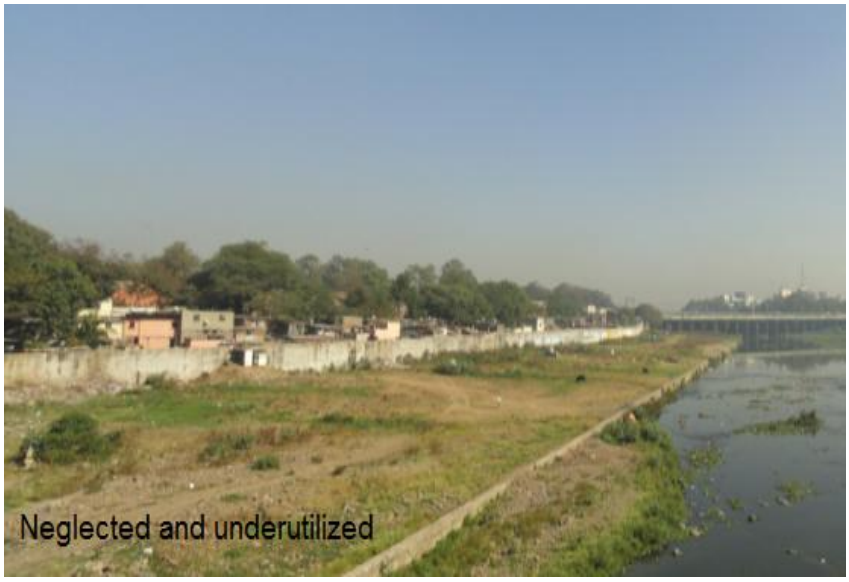
Release of untreated sewage - Significant number of naalas and piped outfalls discharge untreated sewage directly into the rivers, converting the river into a polluted 'drain'.

Nalla near Agriculture College (Model Colony)&Piped outfall near Bund Garden

Nalla near Mhatre Bridge on Mutha River&Erandwane STP outfall

There are a significant number of nallas like Ambill Odha, Bhairoba Nalla, Nagzari Nalla, Erandwana Nalla, etc. which bring untreated sewage into the rivers. Many of these nallas are in natural state, while some are also channelized.

The urban development along the river has taken place in a haphazard manner and at quite a few locations, nallas are getting encroached by the urban development, resulting into spillover of water during the rainy season.



Additionally, piped outfalls discharge untreated water from STP into the river directly, thereby polluting it. There are 88 piped outfalls and more than 50 natural outfalls on the Mula, Mutha & Mula-Mutha River terminating into the river. Of these, outfalls in the Mutha river are 14, that in the Mula river are 19 and in Mula- Mutha are 17.

Lack of Access - Pune's rivers are not easily accessible. In the areas that are already developed, there are very few points where one can approach the Rivers. While along most of its length, the banks are lined by private properties making the River inaccessible for citizens.

Poor connectivity across the banks - results in the river becoming a barrier that divides the city. All of the above has over a period of time transformed a beautiful river into a polluted drain.

Studies have shown that polluted rivers emit more greenhouse gases and in 2018, the Mula-Mutha river was found to be the second-most polluted river in the state by the Maharashtra Pollution Control Board.

The sewage network in Pune has been laid obstructing the natural drainage (Streams / Nallah). Even in case of the existing trunk lines leading to STPs in Pune, outfalls are not connected to it and open directly into the river, as seen in the case of trunk sewer mains connected to Vitthalwadi STP.

The situation of the river stream is highly polluted due to the abutting slums discharging sewage into the nallahs. Ambil odha, a major Nallah connecting to Mula-Mutha, is polluted due to the discharge from the slums.

The maintenance of the discharge networks is also not being carried out periodically which causes the sewer mains to overflow at peak discharge. During the monsoon, the sewage network gets flooded due to the runoff connected to the sewage network.

This flooding discharges the sewage water into the river. The natural drainage is connected to the river without any treatment as seen in the newly developed suburbs like Warje, Wadgaon. The reason for the same may be insufficient treatment facility and inadequate drainage networks.

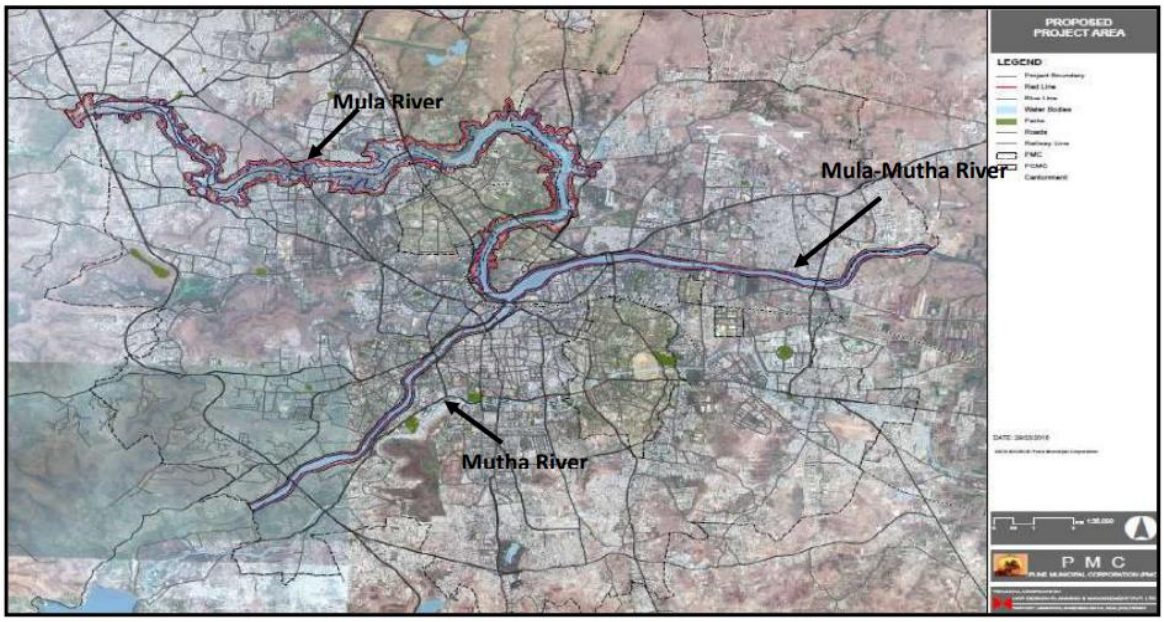
The diversity of native fish species & other aquatic life, in both Mula andMutha rivers, has gone down significantly due to pollution and loss of habitat. The fish diversity loss has been observed for last 2 decades (*source: https://greentribunal.gov.in/sites/default/files/news_updates/Part-2%20Affidavit%20in%20Reply%20of%20R-1%20in%20Appeal%20No.%2012-2020%20(page%20nos.%20679-1048).pdf*).

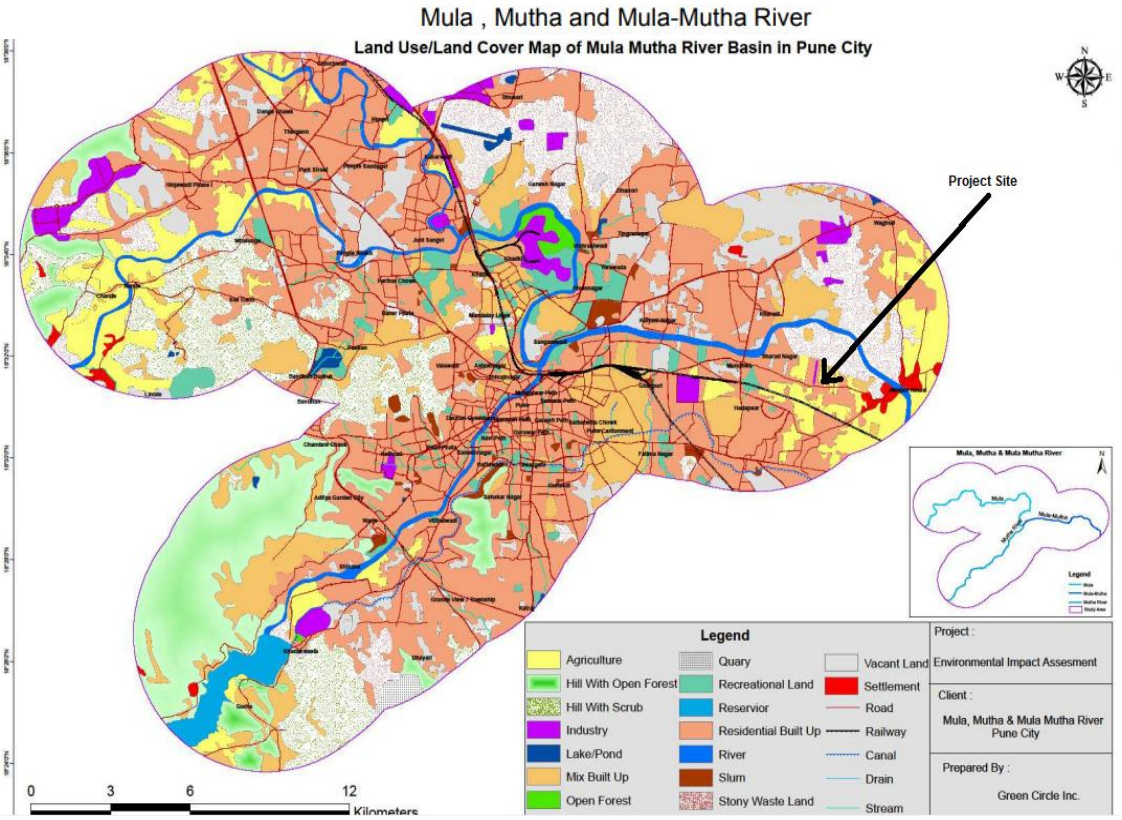
Past Studies of Water Quality Parameters of Mula-Mutha River		
Title/Authors	**Date of Publication**	**Conclusion**
Pali Sahu,Sonali Karad and et.al	2015	The study was done for pH, total hardness, DO, BOD, COD. Study concluded that due to domestic sewage and industrial effluents the river water quality has deteriorated totally which shows the increasing load of pollution in the river.
A.B.More, C.S.Chavan and et.al	2014	As per the study analysis, it was observed that due to agricultural run-off through non point sources, the river Mula was polluted. Also due to addition of domestic sewage and industrial effluents river Mutha was polluted. And, hence after merging with each other, both the rivers are polluted.
Vinaya Fadtare and T T Mane	2007	The physico-chemical study found that prior to the river entrying the city area, the river water was tested to be safe for drinking and other applications, but post city entry, there was discharge of pollutants into the river water. This led to decreasing DO levels and increasing the levels of sodium, chlorides, nitrates, sulphates and TDS in the river.

EIA Report June 2018, PMC	
Dissolved Oxygen	< 4 mg/L
pH	6.94 to 8.06
Biochemical Oxygen Demand	6-14 mg/l
Total Coliform MPN/100 ml	350-1600
Faecal Coliform MPN/100 ml	110-540

Project Boundary

A.3. Land use and Drainage Pattern





LAND USE & GEOLOGY RELATED TO THE CONTAMINATED RIVER

Pune is the second largest district of Maharashtra State in respect of area. The district has a geographical area of 15642 sq.km which is 5.08% of the total area of State. It is situated in the western part of the State and lies between north latitude 17°54' and 19°24' and east longitudes 73°29' and 75°10'. The population of the district is 3124458 as per 2011 census with density of 462 persons/sq.km.

There are 25 towns and 1866 villages in the district, out of which 18 villages are not habited. The district has 13 Panchayat Samitis, 11 Nagar Parishads, 2 Municipal Corporation and 1407 Gram Panchayats. The district has an area of 1720 sq.km occupied by forest. The gross cultivable area of district is 10150 sq.km whereas net sown area is 9920 sq.km.

The land use & land cover (LULC) classification consists of

- Reservoir (1.05%),
- River (8.05%),
- Hill with Scrub (7.87%),
- Hill with Open Forest (9.44%),
- Village Settlement (0.52%),
- Agriculture (7.90%),
- Open Forest (0.28%),
- Slum (0.68%),
- Residential Built up (37.82%),
- Recreational Land (2.80%), etc.
- It is also to mention that the project area i.e 44 km of area of river (.e Mutha, Mula & Mula - Mutha) has no slum area

The subsurface comprises of mainly three horizons -

• Stratum 1 This overburden stratum consists mainly of alluvial and residual soils. This stratum is superficial and has thickness of about 0.5 to 2.5m. The thickness of over burden increases and

reaches up to about 5m at certain locations. Soils are typically saturated. The general consistency of the soil is soft becoming stiff towards depth.

• Stratum 2 This consists of moderate to highly weathered and fractured rock with soil infilling. This stratum does not exist all over Pune, but at random locations.

• Stratum 3 This stratum consists of moderate to slightly weathered, moderately weak to moderately strong and massive Amygdaloidal Basalt.

PHYSIOGRAPHY

The district of Pune forms part of Western Ghat and Deccan Plateau. Physio-graphically the district can be divided in to three distinct belts i.e.

- (1) The western belt stretching from 16 to 31 km east of Sahayadri- an extremely rugged country cut by deep valleys, divided and crossed by hill ranges.
- (2) The central belt extending for about 30 km east of western belt across the tract whose eastern belt is roughly marked by a line drawn from Pabal in the north to south up to Purandhar through Pune. In this belt a series of small hills stretch in to valleys and large spurs from Plateaux and
- (3) The eastern belt with a rolling topography and low hills sinking slowly in to the plains with relatively broader valleys.

Therefore, the physiography of the district has given rise to four major characteristic land forms namely;

- (1) The hills and Ghats
- (2) The foot hills
- (3) The plateau and
- (4) The plains.

The district has three major drainage systems namely (i) The Bhima River System in northern, northeastern and eastern part of which Bhima River has a total length of about 355 km and Ghod river has a drainage of about 196 km. (ii) Mula-Mutha River System covering the central part and having total length of 242 km in the district. (iii) Nira River system covering south, south-east and eastern part and has total length of about 231 km in the district. The other Important

rivers that are flowing through the district are Bhima, Andhra, Karna, Shivganga, Pushpavati, Pawane and Indrayani. All the rivers have mostly semi-dendritic drainage pattern and the drainage density is quite high. Based on geomorphological setting and drainage pattern the district is divided into 71 watersheds.

DRAINAGE / WATER RETENTION (EXISTING)

Mula and Mutha rivers are no more perennial in nature. The upstream reservoirs control the flow of water in the river and release water during monsoon depending upon the rainfall and water storage capacity of the reservoirs. The existing few, small check dams and weirs built on Mula and Mula-Mutha rivers within PMC area, hold some amount of water in upstream; however these water retention structures are not able to hold enough water. Thus, the river remains dry for a considerable length. Major portion of water in the existing river is the drainage water directly discharged from the city and treated and untreated effluent from the existing STPs. Majority of river bed is dry or mostly holds polluted water. This polluted water creates unhygienic conditions and odious environment.

HYDROGEOLOGY

Hydrogeology of the entire area of the district is underlain by the basaltic lava flows of upper Cretaceous to lower Eocene age. The shallow alluvial formation of recent age also occurs as narrow stretch along the major rivers flowing in the area.

Deccan Trap Basalt: Basaltic lava flows occupies more than 95% of the area of the district. These flows are normally horizontally disposed over a wide stretch and give rise to table land type of topography also known a plateau. These flows occur in layered sequences ranging in thickness from 7 to 45 m and represented by massive unit at the bottom and vesicular unit at the top of the flow. These flows are separated from each other by marker bed known as 'bole bed'. The water bearing properties of these flows depend upon the intensity of weathering, fracturing and jointing which provides availability of open space within the 8 rock for storage and movement of ground water. The thickness of weathering in the district varies widely up to 20 m bgl. However, the weathered and fractured trap occurring in topographic lows forms the potential aquifer in the district. The ground water in the district occurs under phreatic, semi – confined and confined conditions.

Generally the shallower zones down to the depth of 20 to 22 m bgl form the phreatic aquifer. The water bearing zones occurring between the depth 20 and 40 m bgl when weathered or having shear zones yield water under semi-confined condition. The deep confined aquifers generally

occur below the depth of 40 m bgl. The vesicular unit of lava flow when exposed or lying just few meters below the surface forms a potential aquifer in the district. However, the vesicular portion of different lava flows varies in thickness from few m to 10 m and nature and density of vesicles, their distribution, interconnection and weathering are the decisive factors for occurrence and movement of water in these units. The massive portions of basaltic flows are normally devoid of water, but when it is weathered, fractured and jointed forms potential aquifer. In Deccan Trap Basalt, the yield of the dug wells in different formations ranges from 30 to 150 lpm/day depending upon the local hydrogeological conditions. The yields of borewells also show wide variations and it ranges from traces to 30.62 lps (Lavle) a seen from CGWB exploration data.

Alluvium: Alluvium occurs in small areas along banks and flood plains of major rivers like Bhima, Ghod, Mula, Mutha and their tributaries. In alluvium the granular detrital material like sand and gravel usually occurring as thin layer in the district yields water. But due to its limited extent the ground water potential in this formation is negligible.

In general it can be said that after about 1.5 to 2m from bed level rocky stratum is encountered.

WATER LEVEL

Shallow water level of less than 2 mbgl is reported in almost entire western part, in central part and in southeastern part of the district. In a major part of the district in central, northern and southern parts, the water level occurs between 2 to 5 m bgl. Deeper water levels of more than 10 m bgl are restricted in extreme northern parts of the district.

RIVER FEATURES

River Mutha originates at a village named Vegare, in the Western Ghats, about 45 km to the west of Pune and has two tributaries, Ambi and Moshi. The Mutha is dammed at Temghar, while its two tributaries Ambi and Moshi are dammed at Panshet and Warasgaon respectively. The Ambi and Moshi join together and flow as the Mutha river through the rural areas around Pune before being dammed at Khadakwasla.

The river enters the city after the Khadakwasla dam and meets the Mula river at Sangam bridge. The Mula-Mutha eventually meets river Bhima and later the Krishna before they drain into the Bay of Bengal. Starting from its source, the Mutha travels approximately 1,100 to 1,200 kilometers till it reaches the Bay of Bengal.

Panshet and Khadakwasla are the two main sources of water supply to Pune city. While flowing through rural Pune the river appears clean, the Mutha turns toxic as it enters the city. Recent reports show that the pollution of the river has been consistently rising.

The river waters have been showing a consistent rise in chemical oxygen demand (COD), biochemical oxygen demand (BOD) and lower dissolved oxygen (DO) which signify high levels of pollution of the waters (Hindustan Times, Pune, January 18, 2018).

The impact of the high pollution levels in the river have also been found to pose a threat to health. Recent research has found that high level of contamination of water from untreated sewage and industrial wastes have led to growth of antibiotic resistant bacteria in the river water.

Rivers in Pune are fast becoming poisonous and inhabitable for a number of fish species. Fresh water catch has declined by 93 per cent during the past two decades, most prominent among them is Mahseer (Tor tor), which was found only in the Pune river basin, and has now become extinct.

The decline is mainly because of discharge of untreated industrial effluents into the rivers. 13 amphibian species have been found in Pune City. Nine of these today occur only outside the city while four of them are recorded only beyond 20 km from city center (*source: https://greentribunal.gov.in/sites/default/files/news_updates/Part-2%20Affidavit%20in%20Reply%20of%20R-1%20in%20Appeal%20No.%2012-2020%20(page%20nos.%20679-1048).pdf)*

A.4. Rainfall

NA-The project activity is not a rainwater harvesting project.

A.5. Alternate methods to the Project Activity

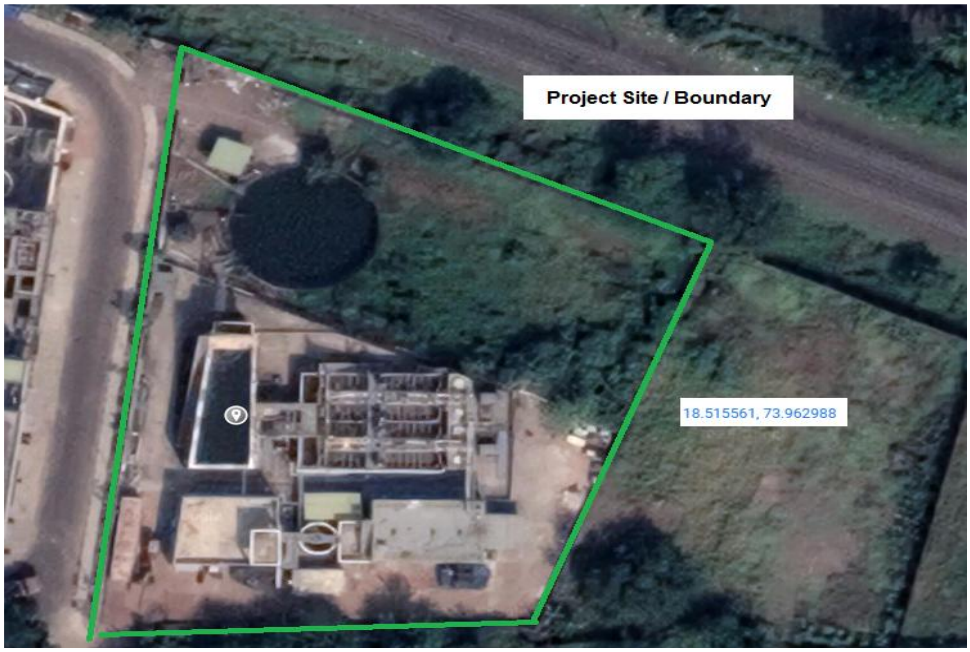
Pune is one of the major cities of Maharashtra with urban population of 31 Lakhs (as per 2011 census) living in 243.96 Sq. km of municipal corporation area. The city generates 750 MLD of wastewater. Pune Municipal Corporation (PMC) is responsible to provide water supply and sewerage services to the city. PMC has so far established 10 Sewage Treatment Plants (STPs) in the city with a total treatment capacity of 567 MLD. However, 535 MLD of wastewater is actually being treated through secondary treatment technologies like Activated sludge process, modified activated sludge process, sequential batch reactor etc. Out of 535 MLD of the total treated wastewater, around 400 MLD is reused for irrigation purposes as per requirement from irrigation department. Wastewater is also reused for various other purposes like construction, road cleaning etc. wherein tankers are sent to different STPs in the city to facilitate the water requirements. New Naidu STP, Bopodi STP and Erandawane STP have been presented as successful recycle and reuse of wastewater projects in Pune.

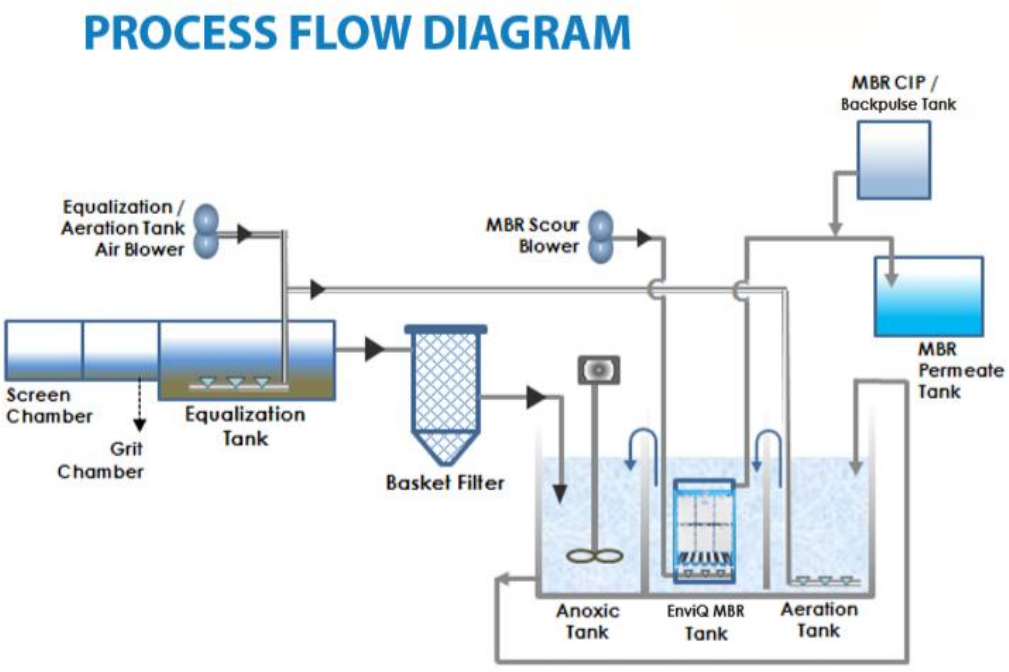
The Pune Municipal Corporation (PMC), the city's civic body, first announced its intention to beautify the river in 2016 and is now (May 2022) geared to start the execution of the Pune River Rejuvenation Project. The project is to be implemented as a public-private partnership by the civic body. The estimated cost of this project, approved in 2021, is Rs 4,727 crores (Rs 47.2 billion). The project is proposed to be completed in 11 phases over 10 years. The beautification project aims to address concerns of frequent flooding, discharge of untreated sewage, solid waste and debris dumping, and poor condition of the river bed and banks. For flood control, the project aims to remove obstructions in the flow of the river and add engineering interventions to the cross section of the river to channelize the banks.

None of the alternate methods to the project activity results in water treatment that results in the generation of safe drinking water. The revenue for the PP from the UCR RoU program would encourage similar high quality treatment alternatives in the country.

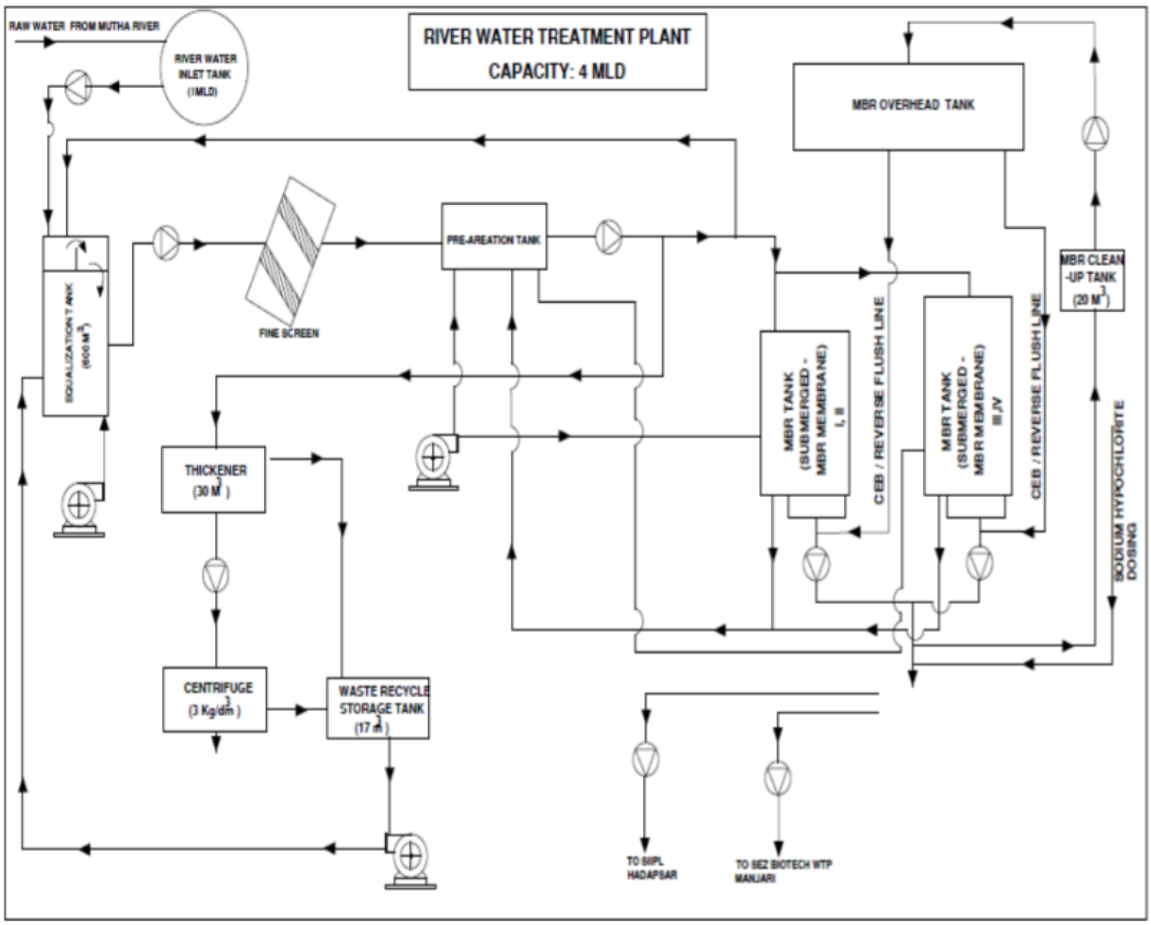
A.6. Design Specifications

The project activity boundary is as below:





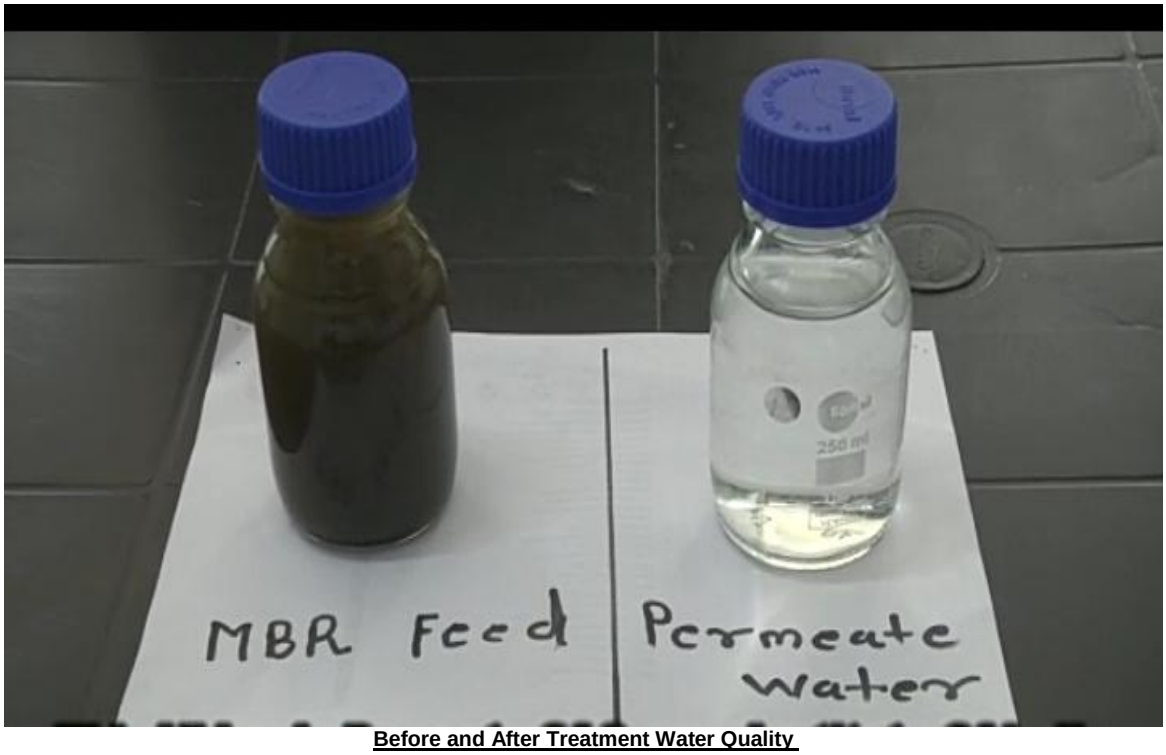
Circular Untreated River Water Inlet Tank



Equalization Tank

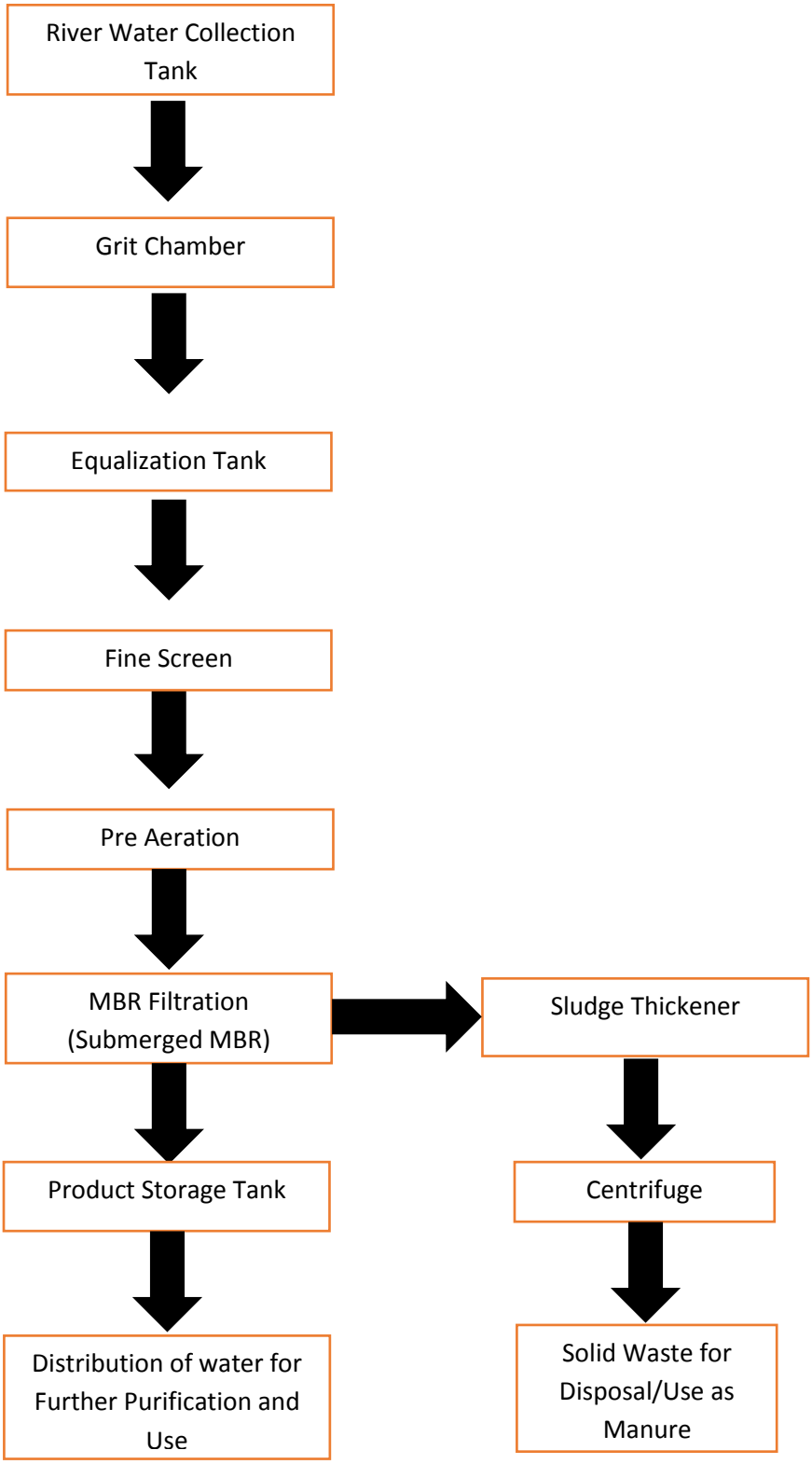
Fine Screen/Pre-aeration Tank

Treatment and Distribution



Before and After Treatment Water Quality

Treatment Flow Chart



Treatment Process

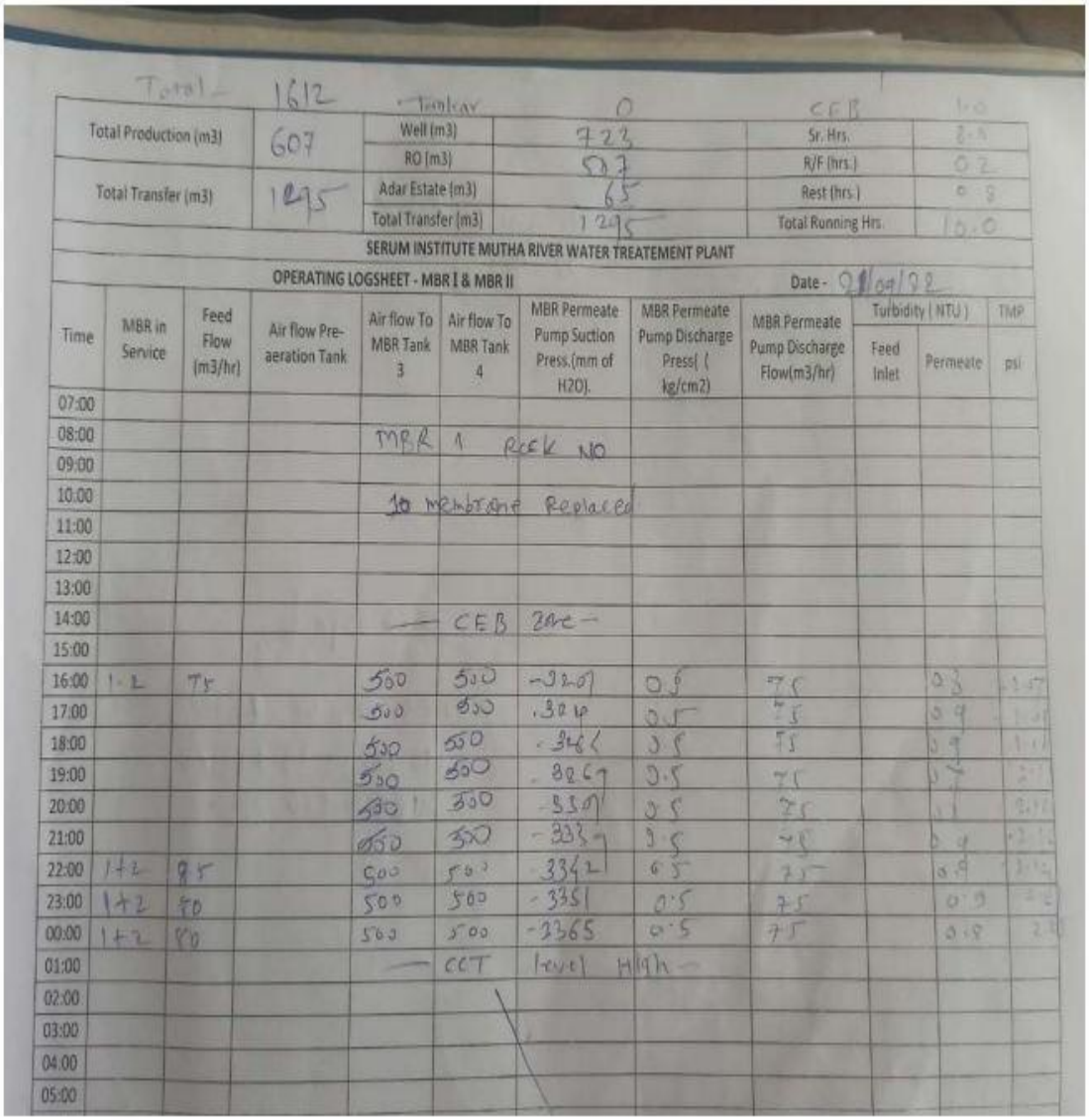
River water containing city sewage is pumped and stored in 1.0 Million liter capacity storage tank. From this storage tank, the river water is pumped to the equalization tank while passing through a grit chamber. The flow of the water is slowed down in the grit chamber so that dissolved solids, such as sand and other heavy particles, settle at the bottom of the chamber as sludge. The equalization tank acts as an additional buffer plus provides aeration to ensure proper distribution of sludge in the water and enhance microbial growth. The river water from equalization tank pumped to MBR tank through fine screens. The fine screens removes heavy and floating particles from the river water to protect the core filtration membrane. The pre aeration tank improves the microbial culture growth and provides even distribution of sludge.

Membrane Bioreactor (MBR)

MBR is a biological based submerged filtration system. MBR membranes are submerged in the water with continuous aeration. Aeration improves microbial growth and prevents sludge settlement on the membranes.

The pore size of the MBR is same as that of ultra-filtration membranes for water purification purposes. The river water is filtered through the MBR by applying suitable vacuum pressure. This filtered river water is stored in the product water storage tank where it's then chlorinated to maintain a level of 1.0 ppm to prevent microbial growth.

Microbes consume most of the contaminants in the MBR chamber. Part of the remaining solid waste (sludge) is passed through centrifuge to remove moisture and convert it to solid form. Solid waste from the centrifuge is reach in nutrients and used as manure for surrounding agricultural farms. The treated river water is then distributed for further purification and captive water use within the project boundary. The quality of the treated water is checked regularly by in-house labs. This pretreated river water is further purified through a combination of ultrafiltration, reverse osmosis and UV light to create safe drinking water that complies with all national and international standards such a like USEPA/WHO/BIS-10500.



Total - 1612 Tanker 0 CEB 1.0

Total Production (m3)	607	Well (m3)	723	Sr. Hrs.	8.5
		RO (m3)	507	R/F (hrs.)	0.2
Total Transfer (m3)	1295	Adar Estate (m3)	65	Rest (hrs.)	0.8
		Total Transfer (m3)	1295	Total Running Hrs.	10.0

SERUM INSTITUTE MUTHA RIVER WATER TREATEMENT PLANT

OPERATING LOGSHEET - MBR I & MBR II Date - 9/09/22

Time	MBR in Service	Feed Flow (m3/hr)	Air flow Pre-aeration Tank	Air flow To MBR Tank 3	Air flow To MBR Tank 4	MBR Permeate Pump Suction Press.(mm of H2O).	MBR Permeate Pump Discharge Press((kg/cm2)	MBR Permeate Pump Discharge Flow(m3/hr)	Turbidity (NTU)		TMP
									Feed Inlet	Permeate	psi
07:00											
08:00				MBR 1	Rack	NO					
09:00											
10:00				10 Membrane	Replaced						
11:00											
12:00											
13:00											
14:00				—	CEB	20c —					
15:00											
16:00	1+2	75		500	500	-3201	0.5	75		0.3	
17:00				500	500	-3214	0.5	75		0.9	
18:00				500	500	-3461	0.5	75		0.9	
19:00				500	500	-3269	0.5	75		0.7	
20:00				500	500	-3307	0.5	75		1.1	
21:00				500	500	-3339	0.5	75		0.4	
22:00	1+2	75		500	500	-3342	0.5	75		0.9	
23:00	1+2	50		500	500	-3351	0.5	75		0.9	
00:00	1+2	50		500	500	-3365	0.5	75		0.8	
01:00				—	CCT	level	High —				
02:00											
03:00											
04:00											
05:00											

Sample Log Books with daily data sets maintained By PP

A.7. Implementation Benefits to Water Security and/or SDG Impact

Access to safe water, sanitation and hygiene is the most basic human need for health and well-being. Billions of people will lack access to these basic services in 2030 unless progress quadruples. Demand for water is rising owing to rapid population growth, urbanization and increasing water needs from agriculture, industry, and energy sectors.

Decades of misuse, poor management, over extraction of groundwater and contamination of freshwater supplies have exacerbated water stress worldwide. In addition, countries are facing growing challenges linked to degraded water-related ecosystems, water scarcity caused by climate change, underinvestment in water and sanitation and insufficient cooperation on trans boundary waters.

The project activity showcases best-in-class wastewater treatment technology that improves surface water quality by reducing pollution, reducing the proportion of untreated wastewater and substantially increasing recycling and safe reuse in India.

The project activity uses US-based filtration and treatment systems, thus expanding international cooperation and capacity-building support between the US and India (developing country) in wastewater and sanitation-related activities and programs, which in this case includes water efficiency, wastewater treatment, recycling and reuse technologies.

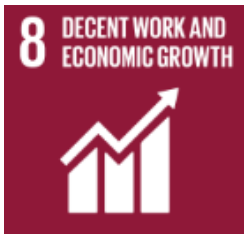
The project activity achieves the sustainable management and efficient use of India's natural resources since the PP had the option to install bore wells that would have depleted the local groundwater resources and/or continued to use existing drinking water resources in the surrounding area. The PP has instead chosen to treat and reuse the city's unutilized, contaminated and neglected water body voluntarily, thus saving millions of liters of safe drinking water for the city.

The project activity also encourages companies, especially large and transnational companies in the biotechnology and biopharmaceuticals sector, to adopt similar sustainable practices in regards to captive water requirements and groundwater management.

The project activity also helps in ending water-borne diseases due to bathing and drinking of contaminated river water. The use of post river treated sludge in agriculture can be an alternative to the growing lack of chemical fertilizers and to the continuous increase in their price against the background of an energy crisis. It can also be a complementary solution to the decrease in manure as a result of the decrease in the number of animals in the county, especially in conditions where the soil requires increased amounts of fertilizer to obtain high, stable and efficient yields. Applying chemical fertilizers to the soil can degrade the soil, air and water.

Agriculture practiced on acidic, heavy soils, with a chemical composition unfavorable to plants, reduces the profitability of farmers. On the other hand, the management of the sludge resulting from the processing of river water constitutes one of the priority problems of the water regime in large human communities, due to the large quantities that are processed.

Sustainable Development Goals Targeted	Most relevant SDG Target/Impact	Indicator (SDG Indicator)
 13 Climate Action (mandatory)	13.2: Integrate climate change measures into national policies, strategies and planning	Amount of litres of unutilized water being treated and reused by the PP.
 1 - End poverty in all its forms everywhere	1.4: By 2030, ensure that all men and women, in particular the poor and the vulnerable, have equal rights to economic resources, as well as access to basic services, ownership and control over land and other forms of property, inheritance, natural resources, appropriate new technology and financial services, including microfinance	The PP prevents unequal distribution of natural groundwater resources- which prevents poverty of natural economic resources (groundwater). The PP ensures that the citizens of Pune get a chance to preserve their natural groundwater resources for future generations since PP is recycling and reusing non-potable sources of water such as the Mula-Mutha river, which is currently unutilized by the local industry. The PP could have alternately dug fresh borewells or used existing drinking water sources for their captive water requirements.

 3 – Ensure healthy lives and promote well-being for all at all ages	3.9: By 2030, substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination	The PP showcases best in class wastewater and water purification technology for further prevention of water contamination and groundwater management.
 **6**-Ensure access to water and sanitation for all	6.3: By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally	The PP has reduced the proportion of untreated wastewater that future generations would need to recycle and has showcased recycling and safe reuse within the industry for unutilized water resources.
 8 – Promote inclusive and sustainable economic growth, employment and decent work for all	8.5: By 2030, achieve full and productive employment and decent work for all women and men, including for young people and persons with disabilities, and equal pay for work of equal value 8.6 By 2020, substantially reduce the proportion of youth not in employment, education or training	Number of jobs created Number of people trained

 17 – Strengthen the means of implementation and revitalize the global partnership for sustainable development	17.7: Promote the development, transfer, dissemination and diffusion of environmentally sound technologies to developing countries on favourable terms including on concessional and preferential terms, as mutually agreed	MBR technology installed that are produced in the USA..
 15 – Life on Land	15.9: Integrate ecosystem and biodiversity values into national and local development planning, poverty reduction strategies and accounts. Other targets highlight the importance of particular ecosystems, including freshwater, forests, deserts and degraded lands, and mountain ecosystems.	The project activity showcases sustainable use of terrestrial and inland freshwater ecosystems for sustainable development and for achieving SDG 15. The project activity reduces biodiversity loss, since seventy species of freshwater invertebrates were identified along the 1 km long Mutha river stretch at Vitthalwadi, and sixty four species of freshwater invertebrates were found with high zooplankton diversity at the 1 km river stretch at Mula-Ram confluence. This shows the species and biodiversity richness at these urban waterbodies.*

** source: https://www.indiawaterportal.org/articles/urban-waterbodies-treasure-troves-biodiversity*

A.7.1 Objectives or Outcomes

The impact assessment or objectives of this project activity can generally be enumerated as follows:

- The project activity highlights the catalytic role that corporate India must play in reducing industrial water consumption as well as water pollution per unit of industrial output.

- The PP has showcased technology that **creates safe drinking water from a known contaminated river resource and has overcome the challenges faced by the alternate methods implemented and/or being proposed for the same.**

- By treating a known contaminated river body located outside its corporate project boundary, the PP has showcased the successful wastewater treatment of contaminated and neglected water bodies, thus saving millions of liters of safe drinking water for the city dwellers from existing resources.

- Micro-scale projects using the same technology can be used to provide safe drinking water to rural India.

A.7.2 Interventions by Project Owner / Proponent / UCR Member

The ancient river, Mula-Mutha, has been battered by floods, encroachments, and rampant constructions causing massive environmental damage. Turned into a sewer and a dumping site over the years, the neglected river is heavily polluted and filthy, according to published news reports. As the river enters Pune city, it is suffocated and reduced to a large sewer with a tell-tale stink. The city's domestic waste, industrial waste, raw sewage and religious waste are directed into it. Under the Sangam bridge and Kalyani Nagar bridge, methane bubbles and surf are regular sights, plastic and cloth rags stuck on rocks and overhanging branches are a common sight. Black-winged stilts, one of the few birds still spotted in the Mula-Mutha, stand as ecological markers of pollution with their slender pinkish red legs wading through blackish-green water. The once bird-populated banks and islands within the river have only a few species such as spot-billed ducks, the occasional heron or pair of storks, sandpipers, a few cormorants, and black kites. The Mula-Mutha river, that flows along a 22-km stretch through Pune city, was Maharashtra's second-most polluted river (2018), containing human and animal excreta three times more than the safe limit, according to the Maharashtra Pollution Control Board (MPCB) (*source: https://www.hindustantimes.com/india-news/excreta-in-mula-mutha-three-times-above-safe-limit-mpcb/story-f1IOlpTOAtKYJakNIV6LQK.html*.)

The project activity hence achieves the sustainable management and efficient use of India's natural resources since the PP had the option to install bore wells that would have depleted the local groundwater resources and/or continued to use existing drinking water resources in the surrounding area. The PP has instead intervened and chosen to treat and reuse the city's unutilized, contaminated and neglected water body voluntarily at significant costs, thus saving millions of liters of safe drinking water for the city.

Increase in population density and improvement in quality of life has resulted in an increase in demand of natural resources like water. Groundwater being the major source of water supply catering to about 85% of rural water supply, the stress on groundwater is ever increasing. It has resulted in over-exploitation of the resources at places. The situation demands for a reorientation of the strategy for its development and management. Scientific understating of the hydro geological conditions and the aquifer systems are the important inputs for sustainable management of ground water resource so that the requirement of present generation is met without compromising the ability of future generations to meet their own needs.

The intervention of the PP has had a direct impact on the water security of the area. Over-development of the ground water resources results in declining ground water levels, shortage in water supply, intrusion of saline water in coastal areas and increased pumping lifts necessitating deepening of ground water structures and increase in power costs.

A.8. Feasibility Evaluation

The installed MBR systems by the PP are robust and can handle organic river water fluctuations in load easily. As membranes are used as a physical barrier for solid liquid separation, these systems offer consistent high effluent quality in term of TSS and organic removal, and also require less chemical for disinfection. MBR systems take approximately one fourth the space of a conventional activated sludge system

A.9. Ecological Aspects:

The project activity achieves the sustainable management and efficient use of India's natural resources since the PP had the option to install bore wells that would have depleted the local groundwater resources and/or continued to use existing drinking water resources in the surrounding area. The PP has instead chosen to treat and reuse the city's unutilized, contaminated and neglected water body voluntarily, thus saving millions of liters of safe drinking water for the city.

The project activity also encourages companies, especially large and transnational companies in the biotechnology and biopharmaceuticals sector, to adopt similar sustainable practices in regards to captive water requirements and groundwater management.

The project activity also helps in ending water-borne diseases due to bathing and drinking of contaminated river water. The use of post river treated sludge in agriculture can be an alternative to the growing lack of chemical fertilizers and to the continuous increase in their price against the background of an energy crisis. It can also be a complementary solution to the decrease in manure as a result of the decrease in the number of animals in the county, especially in conditions where the soil requires increased amounts of fertilizer to obtain high, stable and

efficient yields. Applying chemical fertilizers to the soil can degrade the soil, air and water. Agriculture practiced on acidic, heavy soils, with a chemical composition unfavorable to plants, reduces the profitability of farmers. On the other hand, the management of the sludge resulting from the processing of river water constitutes one of the priority problems of the water regime in large human communities, due to the large quantities that are processed

Ecological Issues addressed by the project activity in terms of	
Inundation of habitated land	The project does not lead to inundation of residential land.
Creation of water logging and vector disease prevention mitigation	The pretreated river water is purified through a combination of ultrafiltration, reverse osmosis and UV light to create safe drinking water that complies with all national and international standards such a like USEPA/WHO/BIS-10500
Deterioration of quality of groundwater	By avoiding the use of borewells the project activity does not deplete aquifers and hence prevents the depletion of groundwater resources.

A.10. Recharge Aspects :

NA.

A.10.1 Solving for Recharge

Water Budget Component	Typical Estimated Uncertainty (%)	Description
Surface Inflow	NA	The total quantity of treated water is measured via flow meters.
Precipitation	NA	NA
Surface Outflow	NA	NA.

Evapotranspiration	NA	NA
Deep Percolation	NA	NA

A.11. Quantification Tools

Baseline scenario

The baseline scenario is the situation where, in the absence of the project activity, the PP would have installed multiple bore wells within the project boundary which would have depleted the local groundwater resources (aquifers) and/or diverted existing safe drinking water resources from the surrounding residential area.

Hence the baseline scenario, is:

"the net quantity of treated water consumed daily post MBR treatment"

The net quantity of treated water used is measured via flow meters installed at the site. For conservative purposes, the working days or operational days have been assumed at 330 days in a year.

Quantification

Year	RoUs (1000 litres) /yr UCR Cap (2 million RoUs/yr)
2017	1320000
2018	1320000
2019	1320000
2020	1320000
2021	1320000
2022	1320000
Total	7920000

A.12. UCR Rainwater Offset Do No Net Harm Principles

According to the UCR RoU Standard principles, the project activity accomplishes the following:

• *Increases the sustainable water yield in areas where over development has depleted the aquifer*
According to the data released by the Central Groundwater Board in 2021, the total amount of groundwater that can be utilised in India in a year is 398 billion cubic meters (BCM), of which, approximately 245 BCM is currently being utilised, which is about 62 per cent of the total. But the level of exploitation of groundwater is very high in States like Punjab, Rajasthan, Haryana, Delhi and Tamil Nadu. This project activity was commissioned in 2017, and the PP has reduced the proportion of untreated wastewater that future generations would need to recycle and has showcased recycling and safe reuse within the industry from unutilized water resources. Revenue from the sale of UCR RoUs will enable scaling up of such project activities.
• *Collect unutilized water or rainwater and preserve it for future use*
In India, at the district level, in 24 states/UTs, as many as 267 districts had stages of groundwater extraction more than 63 per cent, ranging from 64 per cent to 385 per cent (source: https://www.business-standard.com/article/current-affairs/from-58-to-63-india-pumped-more-groundwater-between-2004-and-2017-121122101377_1.html). This project activity serves as an example to recycle and reuse unutilized water and contaminated water resources and encourages companies, especially large and transnational companies in the biotechnology and biopharmaceuticals sector, to adopt similar sustainable practices in regards to captive water requirements and groundwater management.
• *Conserve and store excess water for future use*
The project activity decreases the dependence on groundwater, thereby preventing excessive depletion.

A.13. Scaling Projects

While cities in India are facing water supply and demand issues, India's water sources – groundwater, rivers and other water bodies – are facing contamination from domestic and industrial pollution leading to deteriorating water quality. Direct disposal of untreated wastewater and fecal sludge into the open, increases the burden of cities to provide drinking water supply to its residents.

The Central Pollution Control Board (CPCB) has identified 351 polluted river stretches on 323 rivers across the county that do not meet the water quality criteria. According to CPCB's national inventory of Sewage Treatment Plants (STP) published in March 2021, urban India treats only 37 per cent of the 72,368 million liters of sewage generated every day, with about two-thirds of the wastewater ending up polluting the environment.

If India could implement 100 percent treatment and reuse of treated wastewater and fecal sludge from Indian cities by 2025, it can potentially meet over 70 percent of water requirement of industry and energy sector and irrigate 2 to 6 million hectares of land annually while yielding benefits from reduced fertilizer usage. Nutrient recovery from wastewater can yield up to 4,000

to 5,500 tons per day which can meet the demand for integrated nutrient management for about 400,000 ha of farmland annually. Reuse of wastewater in agriculture has the potential to reduce greenhouse gas emissions by over 2 million tons of CO_{2e} annually through decreased groundwater pumping and replacing chemical fertilizer (source: *https://timesofindia.indiatimes.com/blogs/voices/wastewater-and-faecal-sludge-reuse-to-address-indias-water-and-food-security/?source=app&frmapp=yes*)

As per Japan International Cooperation Agency (JICA)-funded pollution abatement of Mula-Mutha river project, the PMC is scheduled to construct 11 new STPs for pollution abatement of the river Mula-Mutha. The PMC will also convert treated river sludge by conversion to bio-fertilizers with advanced technology subjects the dried sludge to crushing, exposure to radiation and spraying of bio-nitrogen phosphorus potassium (NPK) to provide organic carbon and other nutrients to the soil.

The process adopted by the PP also helps in recycling treated water sludge to useful bio-fertilizers.

Pune city generates a total of 750 million litres per day (MLD) sewage. Out of that, the PMC treats 567 MLD water in 10 sewage treatment plants (STPs) in the city along the Mula-Mutha river.

Revenue from water credits (RoUs) will provide a much needed incentive to encourage treatment and reuse of similar contaminated water resources, with treatment plants being built at scale and faster payback on investments undertaken for such installations.

With countless predictions that most major cities around the world are on the brink of running out or exhausting their groundwater supplies in the near future, it is extremely important to look beyond the conventional sources of sustenance and look towards adopting and adapting the non-conventional, renewable sources, essential for our survival. Rainwater is a renewable source prevalent in areas with little to no rainfall, and treated contaminated river water can be put to uses like irrigation and other domestic chores like toilet flushing, washing, etc. It needs to be purified further in order to make it fit for drinking or use in the production of vaccines, showcased via this project activity.

Appendix 1

Human Development Index (HDI) Ranking

From the 2020 Human Development Report

India

-	Rank	Country	HDI value (2019)	Life expectancy at birth (years) SDG3	Expected years of schooling (years) SDG 4.3	Mean years of schooling (years) SDG 4.6	Gross national income (GNI) per capita (PPP $) SDG 8.5
	131	India	0.645	69.7	12.2	6.5	6,681

Source: **Human Development Report Office 2020.** • Created with **Datawrapper**