IN THE NATIONAL GREEN TRIBUNAL
SOUTHERN ZONE, CHENNAI
ORIGINAL APPLICATION NO. 111/2020

IN THE MATTER OF:

Tribunal on its own motion Suo Motu based on the news item in Tamil Newspaper Dinamalar Chennai Edition dt. 13.07.2020, **"Frothing of Chemical Foam in the River Thenpennai"**

Versus

Principal Secretary to Government
Public Works Department, Chennai & Ors. …Respondents

INDEX

Filed by

Date: 02.04.2025

Darpan KM
Standing Counsel
State of Karnataka
K-6, Lower Ground Floor
Lajpat Nagar – 3, New Delhi – 110 024
darpan.advocate@gmail.com | +91 98991 25060

IN THE NATIONAL GREEN TRIBUNAL
SOUTHERN ZONE, CHENNAI
ORIGINAL APPLICATION NO. 111/2020

IN THE MATTER OF:

Tribunal on its own motion Suo Motu based on the news item in Tamil Newspaper Dinamalar Chennai Edition dt. 13.07.2020, **"Frothing of Chemical Foam in the River Thenpennai"**

Versus

Principal Secretary to Government
Public Works Department, Chennai &Ors. ...Respondents

ACTION TAKEN REPORT ON BEHALF OF THE CHIEF SECRETARY TO THE STATE OF KARNATAKA

MOST RESPECTFULLY SHOWETH:

1. That the instant Original Application pertains to pollution of Dakshina Pinakini/Thennepannai River. In this regard, the action taken on behalf of the State of Karnataka is as follows:

2. **Re: Flow Measurements:** It is submitted that KSPCB has identified 15 new locations for rigourous monitoring of qualitative analysis of water flowing in the Dakshina Pinakini river and drains leading to the river. The details of new locations including geo coordinates along with responsible organizations for monitoring the flow is annexed as **Annexure-I.** It is

NOTARY RAMACHANDRAPPA C. BENGALURU METROPOLITAN AREA Reg. No.:-4098 GOVT. OF INDIA

submitted that monitoring in the new locations is being carried out once in a month.

3. **Performance Study of STPs**: It is submitted that BWSSB has entrusted the work of performance evaluation of STPs (BNR removal studies) to Indian Institute of Science, (IISc) Bangalore. The IISc after detailed evaluation of STPs has submitted its report on 04-02-2022, with recommendations to BWSSB. True Copy of the report regarding performance evaluation of STPs is annexed herewith as **Annexure -II**.

4. It is submitted that BWSSB has submitted a copy of the report along with action taken on the recommendations. The catchment of Thenpennai has around 16 STPs. All these 16 STPs were functioning and compliant as per the existing norms, however in view of the new stringent norms prescribed by NGT in terms of 7 parameters, 4 STPs are compliant as per new norms. 12 STPs are being upgraded and the upgradation will be completed by December 2025. True copy of status report along with timelines submitted by BWSSB is attached as **Annexure –III.**

5. **Sewerage Network**: It is submitted that to cater to the needs of the 110 villages & other un-sewered areas in the Dakshina

Pinakini river catchment area, BWSSB has taken up constructions of 12 new STPs of total capacity 225 MLD and will be completed by December 2025. List of STPs under construction is enclosed as **Annexure-IV**.

6. Further the BWSSB has proposed to construct 10 new STPs with proposed capacity of 313 MLD; Government has accorded administrative approval for 04 STP's and tender is in progress. For remaining 06 STP's, an estimate of Rs. 1200.00 crores is prepared. List of proposed STPs is annexed herewith as **Annexure-V**.

7. The status of progress on compliance of the direction of Hon'ble NGT compared to 2020 is as follows:

Activity	**As per 2020**	**As on March 2025**
Number of STPs	16	26
Capacity of STP (MLD)	550	832.44
Sewer lines in Kilometer	5435	6285
No. of Households connected to UGD	13,71,925	16,13,372

8. **Water Quality Monitoring and Analysis**: With respect to water quality of the water flowing in River Thenpennai, it is submitted that KSPCB is monitoring the river water quality at Mugular

Bridge once in a month regularly. As per the analysis report of the river water quality meets the Class "E" (Irrigation, industrial cooling, controlled waste disposal) category, as per the classification set by the Central Pollution Control Board (CPCB). A quick analysis of the samples in the Mugulur bridge for a period 11 months, indicates an improving trend in BOD in February 2025 – 36 mg/l as compared to April 2024 – 71 mg/l. It is also observed that there is an improving trend in total Phosphate reduction. The total Phosphates in February 2025 - 0.67 mg/l as compared to April 2024 which 4.6 mg/l, which is the main cause for frothing of the river. True Copy of analysis report is annexed herewith as **Annexure-VI**.

9. **Random Verification of Industries/Establishments:** It is submitted that random verification of Industries is a continuous process. As per the March 2025 report from the Regional Offices of KSPCB, there are 531 industries/ organizations in the catchment area of Dakshina Pinakini River. In the year 2020, the KSPCB identified 330 industries/organizations in the catchment area of the Dakshina Pinakini River, out of which, 272 industries/ organizations have complied with norms of the Board. Out of the remaining 58, 19 organizations are discharging sewage to BWSSB existing UGD sewer with permission from the BWSSB and remaining 27 industries/organizations have been closed (on their own); 11 were found to be non-compliant and Show Cause Notices have

been issued by the Regional Offices, KSPCB and one industry was found discharging effluent into the storm water drain, for which the Board has issued closure directions under the provisions of the Water (Prevention and Control of Pollution) Act, 1974, and the Air (Prevention and Control of Pollution) Act, 1981. Additionally, a criminal complaint has been lodged having number CC 21/2024 (1065/2013) in the XLI Addl Chief Judicial Magistrate, Bengaluru City. Furthermore, after 2020, the Board has identified 201 new industries/organizations in the catchment area of the Dakshina Pinakini River, all of which are compliant with the Karnataka State Pollution Control Board's norms.

The Regional Offices of the KSPCB have conducted a total of 559 inspections of industries/organizations in the Thenpennai River Basin, from April 2024 to February 2025, for the non-compliances observed, Show Cause Notices to 260 organisations have been issued by the Regional Offices of the KSPCB.

11. **Environmental Compensation for STPs**: It is submitted that KSPCB has levied EC for 513 organisations under OA No.125/2017 falling in the catchment area of Bellandur Lake. As of February 2025, an amount of Rs.4.165 Cr has been collected

out of Rs.289.2 Cr Environmental Compensation levied. 18 organizations have approached Hon'ble Courts. The KSPCB is in the process of recovering balance amount of EC. Final notice is issued for recovering of balance EC and further action will be initiated.

12. **Installation of Continuous Online Water Quality Monitoring Station**: Based on this Hon'ble Tribunal order dated 28.06.2021 in the present Original Application, the CPCB issued directions for compliance under Section 18(1)(b) of the Water (Prevention and Control of Pollution) Act, 1974, instructing the KSPCB to install a Continuous Online Water Quality Monitoring Station at the interstate river boundary in Karnataka to ensure that improved water quality reaches Tamil Nadu.

13. In compliance with CPCB directions, the KSPCB has executed an agreement with M/s. Greenvironment Innovation and Marketing India Pvt. Ltd. on 19.03.2022 to provide services for a solar-powered IoT-based River Monitoring System. The equipment was operational from 07.04.2022 to 06.09.2022. However, after 06.09.2022, the equipment was damaged due to floods and ceased functioning. Consequently, the KSPCB terminated the agreement in January 2024. The KSPCB has floated tenders for procuring the Real-Time Water Quality

Monitoring System (RTWQMS) for installing at Mugalur Bridge to ensure continuous monitoring. The process will be completed in 2 months' time.

14. Until the installation of the RTWQMS at Mugulur Bridge is completed, the KSPCB has directed its Regional Office to manually monitor the river water quality once in 15 days.

15. **Action Taken by BDA**: It is submitted that as of February 2025, out of Rs.100.3 Crore allocated by BDA, the BDA has made significant progress in rejuvenation of Bellandur Lake with 70% of the physical progress, 88% of the financial progress and 30% of physical progress has been made on the wetland construction achieved. Out of the total 12.26 km perimeter of the lake, chain link fencing has been installed for 11.26 km. Due to an ongoing Court case pertaining to Ambedkar Nagar area, located to the north of the lake yard, wire fencing has been installed in the entire periphery, except for a 1.00 km stretch. With respect to Varthur Lake, 97% of physical progress and 94.46% of financial progress have been achieved out of Rs.53.8 Crore financial allocation. To prevent encroachment on the lake land, 8.06 km of chain link fencing has been constructed around the lake's perimeter. Additionally, approximately 17.22 lakh cubic meters of accumulated silt have

been removed from the lake. The dredging work has been completed, and 98% of physical progress has been made on the wetland construction. True copy of the BDA report is annexed herewith as **Annexure-VII**.

16. The CPCB, has identified the Dakshina Pinakini River along Mugalur as a Polluted River Stretch with Priority I (BOD > 30 mg/L). An action plan for the rejuvenation of the Dakshina Pinakini River is under preparation by the Deputy Commissioner (DC) of Bengaluru Urban and Bengaluru Rural districts in consultation with concerned stake holders and will be submitted in two months time. The Ministry of Jal Shakti, Government of India, is reviewing the progress of rejuvenating polluted river stretches under OA 673/2018.

17. The above information is hence placed on record for this Hon'ble Tribunal's consideration.

CHIEF SECRETARY
GOVERNMENT OF KARNATAKA

NOTARY RAMACHANDRAPPA. C. BENGALURU METROPOLITAN AREA Reg. No. - 40099 GOVT. OF INDIA

SWORN TO BEFORE ME

RAMACHANDRAPPA. C.
ADVOCATE & NOTARY PUBLIC
GOVERNMENT OF INDIA
CITY CIVIL COURT
BENGALURU

01/04/2025

01 APR 2025

FILED BY

DARPAN KM
STANDING COUNSEL
STATE OF KARNATAKA

Date:01.04.2025

IN THE NATIONAL GREEN TRIBUNAL
SOUTHERN ZONE, CHENNAI
ORIGINAL APPLICATION NO. 111/2020

IN THE MATTER OF:

Tribunal on its own motion Suo Motu based on the news item in Tamil Newspaper Dinamalar Chennai Edition dt. 13.07.2020, **"Frothing of Chemical Foam in the River Thenpennai"**

Versus

Principal Secretary to Government
Public Works Department, Chennai & Ors. ...Respondents

AFFIDAVIT

I, Dr. Shalini Rajneesh, wife of Dr Rajneesh Goel aged about 57 years, working as the Chief Secretary to the Government of Karnataka, having office at Vidhana Soudha, Bengaluru, 560001, Karnataka do hereby affirm and state on oath as under:

1. That I am working as Chief Secretary to the Government of Karnataka and in my official capacity and as verifiable from official records maintained with Government of Karnataka, as also the information provided by various departments of Government of Karnataka, I am familiar with the facts of the case and hence I am swearing to this affidavit.

2. That I have gone through the accompanying Report, drafted on my instructions. I say that the contents thereof are true and correct to the best of my knowledge and belief. Annexures are true copies of their respective originals.

Shalini

DEPONENT

VERIFICATION:

I, the above named deponent do hereby verify that the contents of my affidavit are true and correct to the best of my knowledge and belief, no part of which is false and nothing material has been concealed therefrom.

Verified at Bengaluru on this 31st day of March, 2025.

NOTARY RAMACHANDRAPPA BENGALURU METROPOLITAN AREA Reg. No. - 4068 GOVT. OF INDIA

SWORN TO BEFORE ME

RAMACHANDRAPPA. C.
ADVOCATE & NOTARY PUBLIC
GOVERNMENT OF INDIA
CITY CIVIL COURT
BENGALURU

01/04/25

Shalini

DEPONENT

Annexure-I

Sl. No.	Name of the Flow monitoring location (Dakshina Pinakini River Basin)	River/ drain	Water Quality monitoring department	Flow monitoring department (BBMP/Irrigation dept.)	Co-ordinates of the location
1	Venkatagirikote Lake	Lake	KSPCB	Zilla Panchayath	13.326583 N 77.725305 E
2	Budigere Lake	Lake	KSPCB	Zilla Panchayath	12.970657 N 77.783604 E
3	Hoskote Lake	Lake	KSPCB	Zilla Panchayath	13.065682 N 77.770628 E
4	Check Dam Near Samethanahalli Lake	River	KSPCB	Minor Irrigation Department	12.970657 N 77.783604 E
5	Inlet of BWSSB STP, Koraluru	Drain	KSPCB	BBMP	12.99648 N 77.77675 E
6	Rampura/Huvinene/ Maragondanahalli Lake	Towards West	KSPCB	BBMP Department	13° 02' 54.38" N 77° 40' 47.74" E
7	Yelemallappa Shetty Lake	Towards North West	KSPCB	Irrigation Department	13° 02' 28.79" N 77° 43' 09.11" E
		Towards West	KSPCB	Irrigation Department	13° 01' 16.06" N 77° 43' 14.73" E
8	K R Puram Lake	Towards West	KSPCB	BBMP Department	13° 00' 58.94" N 77° 41' 43.31" E
9	Channasandra Bridge	Channasandra Main Road	KSPCB	Irrigation Department	12° 59' 05.78" N 77° 46' 36.16" E
10	Mugaluru Bridge, Mugaluru, Sarjapura Hobli, Anekal Taluk, Bengaluru Urban District	River	KSPCB	Irrigation Dept.	N - 12.89318 E- 77.82773
11	Near Agara Lake Gate No.01	Drain	KSPCB	BBMP	12.916389 N, 77.638333 E
12	Y-Junction Srinivagilu Koramanagala	Drain	KSPCB	BBMP	12.929000N, 77.643111 E
13	Up-Stream of Jakkur Lake,Nehru Nagar, Bengaluru-560064.	Rajakaluve	KSPCB	BBMP	Lat: 13.094348, Long:77.607528
14	Up Stream of Rachenahalli Lake, Near JNU Institute, Srirampura Cross Road, Thanisandra, Bengaluru - 560064.	Rajakaluve	KSPCB	BBMP	Lat: 13.067760, Long:77.612207
15	Thanisandra Main road Brigade, Near Element Mall, (Rajacaluve Common Point- H & N Valley, Jakkur & Rachenahalli Valley Flow), Nagavara, Bangalore-560045	Rajakaluve	KSPCB	BBMP	Lat: 13.045618, Long:77.627286

Annexure-II

ನೀರನ್ನು ಮಿತವಾಗಿ ಬಳಸಿ

"ಕನ್ನಡದಲ್ಲೇ ವ್ಯವಹರಿಸಿ"

eenewater@bwssb.gov.in

BANGALORE WATER SUPPLY AND SEWERAGE BOARD

Office of the Executive Engineer, STP - Hebbal Valley, Opp. Nagavara Lake, BDA Outer Ring Road, Bengaluru- 560024

No. BWSSB /ESH/SH2/AE/ 1023 /2021-22

Date: 04/02/2022

Received: 5/2/22

To

ACE WWM-3(STP-K Valley) / EE (STP V Valley)
EE (STP-A Valley) / EE (STP-C Valley)

Sub: Work of conducting studies towards the upgradation of the existing Twenty (20) Sewage Treatment Plants of BWSSB, to meet the effluent discharge standards as directed by the Hon'ble National Green Tribunal – Regarding BNR Removal Studies - Final Report Submission from IISC

Ref:
1. Agreement executed with IISC No. 25 Dt: 07.12.2020
2. W. O No.BWSSB/CE(WWM)/ACE(WWM)/TA/1871/2020-21 Dt: 10.12.2020
3. No. BWSSB/CE(WWM)/ACE(WWM)-1/DCE(WWM)/TA-1/650/2021-22 Dt: 02.08.2021
4. No. BWSSB/ESH/SH2/AE/426/2021-22 Dt: 16/08/2021
5. IISC Ltr Dated 12.11.2021
6. No. BWSSB/ESH/SH2/AE/747 /2021-22 Dt: 23/11/2021
7. IISC Ltr Dated 04.02.2022

****

With reference to the above, in continuation to the letter issued vide ref(6), it is to inform that M/s IISC have submitted the final report on BNR Removal Studies as per their scope of work towards Work of conducting studies towards the upgradation of the existing Twenty (20) Sewage Treatment Plants of BWSSB, to meet the effluent discharge standards as directed by the Hon'ble National Green Tribunal as per the agreement and work order issued vide ref(1 & 2).

Hence, the final report is herewith attached for perusal and hereby requested to report any observations from your end within 7 days for further necessary action. The same final report will be submitted to Competent Authority for approval if no observations are submitted.

Encl: Final Report from M/s IISC

EE (STP)-HV
BWSSB

Copy submitted to CE (WWM)/ACE(WWM)-2 for kind information

Copy to AEE STP/HV-2 for information and necessary action

Office of the Chief Engineer (WWM)
6085
7/2/22
BWSSB, Bangalore

Dr. Lakshminarayana Rao
Assistant Professor
Prof. H N Chanakya
Former Chief Research Scientist
Centre for Sustainable Technologies
Indian Institute of Science
Bangalore 560 012, India.
Phone : 91-80 2293 2051/3046
Email : narayana@iisc.ac.in
chanakya@iisc.ac.in

भारतीय विज्ञान संस्थान

Prof. M S Mohan Kumar
Professor
Department of Civil Engineering
Indian Institute of Science
Bangalore 560 012, India.
Phone : 91-80 2293 2814
Email : msmk@iisc.ac.in

04th of February 2022

BNR Removal Studies – Revised Final Report Submission

To
The Chief Engineer (WWM)
BWSSB
Bangalore

Dear Sir

Ref : **1) No. BWSSB/CE(WWM)/ACE(WWM) /TA/187/2020-21 dated 10/12/2020**
2) MoU Agreement No. 25/2020-21 Dated 07-12-2020
3) No Cost extension letter dated August 11th 2021

In continuation with the above reference documents, please find attached the final report on BNR Removal Studies

Please do let me know if you need any other information from our side.

Sincerely

Dr. Lakshminarayana Rao
CST, IISc

Prof. H N Chanakya
CST, IISc

Prof. M S Mohan Kumar
(Former Prof.) CE, IISc

Final Report : Revision

BWSSB STP upgradation Project

IISc Bangalore

Executive Summary

To meet the new effluent discharge standards given by the Honorable National Green Tribunal (NGT), an effort is undertaken by the Bangalore Water Supply and Sewerage Board (BWSSB) to upgrade 17 old sewage treatment plants of Bengaluru. IISc team was engaged to inspect and recommend suitable modifications to the current treatment process to meet the required standards. The responsibilities included technical visits to all Sewage treatment plant (STP) sites to understand the process, detailed water quality analysis of samples taken from the STPs, giving recommendations based on the water quality analysis, and modeling to ensure effluent meets NGT standards. As part of this effort, technical site visits were carried out to all the 17 STPs, and samples were collected at all sites. A process simulation model was developed for each STP and the model was validated with "as-is" condition. Using the simulated model, process modifications were suggested to achieve BNR standards in the short term. The IISc team also has suggested certain recommendations to meet the BNR standards in the long run.

Out of 17, STPs studied, 8 STPs namely 1) K & C valley (60 MLD), 2) Bellandur Amani kere (90 MLD), 3) Horamavu Agara (20 MLD), 4) Nagasandra phase -2 (20 MLD), 5) Chikkabanavara (5 MLD), 6) Doddabele (20 MLD), 7) Rajacanal P-I and 8) Rajacanal P-II are meeting the NGT-BNR standards. Rajacanal P-I and P-II, previously did not meet the NGT-BNR standards. After implememting the suggestions given by IISc team on one stream out of two in each of the plants; the effluent water quality improved and meets the NGT standards. Further, 6 STPs namely 1) Mailasandra phase -1 (75 MLD), 2) Kempabudhi (1MLD), 3) Kadugodi (6 MLD), 4) Halasuru (2MLD), 5) Yelemallappa Chettikere (15 MLD) and 6) Mallathahalli (5 MLD) were marginally under performing. Three of the STPs namely 1) Kadubeesanahalli (50 MLD), 2) Nagasandra phase -1 (20 MLD) and 3) K R Puram phase -1 (20 MLD) were poorly performing in terms of NGT standards. Process modifications for both the marginally performing and poorly performing STPs based on simultaneous nitrification and denitrification principle have been recommended by the IISc team as a short-term measure. Also, the IISc team has recommended long-term measures to ensure compliance of discharge effluents from all these STPs. Maintenance of chlorine contact tanks is an issue across all STPs, and it is decreasing the quality of effluent. Effective chlorination and dichlorination cycles for each of these STPs should be implemented. Continuous monitoring for the 17 STPs is necessary to ensure long-term compliance with NGT standards.

Table of Contents:

1.0 BACKGROUND

To meet the new effluent discharge standards given by National Green Tribunal (NGT), an effort is undertaken by the Bangalore Water Supply and Sewerage Board (BWSSB) to upgrade old sewage treatment plants. IISc team was engaged to inspect and recommend suitable modifications to the current treatment process to meet the required standards. The responsibilities included technical visits to all Sewage treatment plant (STP) sites to understand the process, detailed water quality analysis of samples taken from the STPs, giving recommendations based on the water quality analysis, and modeling to ensure effluent meets NGT standards. As part of this effort, technical site visits were carried out to all the STPs, and samples were collected at all sites.

List of STPs:

1. K & C valley (60 MLD)
2. Bellandur Amani kere (90 MLD)
3. Kadubeesanhalli phase -1 (50 MLD)
4. Kadugodi (6 MLD)
5. Halasuru (2 MLD)
6. Rajacanal phase -1 (40 MLD)
7. Rajacanal phase -2 (40 MLD)
8. Horamvu Agara (20 MLD)
9. K R Puram phase -1 (20 MLD)
10. Yelemallappa Chettikere (15 MLD)
11. Nagasandra phase -1 (20 MLD)
12. Nagasandra phase -2 (20 MLD)
13. Mallathahalli (5 MLD)
14. Chikkabanavara (5 MLD)
15. Mailasandra phase -1 (75 MLD)
16. Kempabudhi (1MLD)
17. Doddabele (20 MLD)

The team was informed that Madiwala STP was under maintenance and hence was not operational; similarly, V Valley STP is under up-gradation and hence not operating. Further, the team was informed that the Kengeri STP was included in the list unintentionally. Therefore these three STP locations were not visited.

2.0 METHODOLOGY:

1. All STP sites were visited. Information about the plant capacity, treatment process, new construction/ rehabilitation, and possible issues was obtained at each location. The treatment facility at each location was visually inspected to assess its functioning.
2. Water samples were collected at each site and analyzed. Based on the analyzed effluent, the STPs were classified into three categories: 1) STPs meeting NGT-BNR standards, 2) Marginally underperforming STPs, and 3) Poorly performing STPs.
3. For STPs requiring intervention, 'as is' models were created using Biowin. The 'as is' models were validated using collected water quality data. The validated models were optimized at full flow.

3.0 PROCEEDINGS OF THE PROJECT

- Trip reports for all site visits were submitted.
- A report with details of 6 STPs meeting NGT-BNR standards was submitted.
- A report with details of 11 STPs requiring intervention was submitted.
- A presentation was given in the presence of the Chairman of BWSSB and all BWSSB executives and assistant engineers.

- Some clarifications were sought by the BWSSB team after the final presentation. A final report with the clarifications and all of the above-mentioned reports attached as appendices was submitted.

In response to the request from the BWSSB team, this document is generated with data consolidated from the previously submitted reports for better clarity. The BWSSB team implemented some changes based on the recommendations given by IISc at a few STP locations. The results of these changes are also included in this report.

The analysis of collected samples showed that six out of the seventeen STPs studied are were operation optimally and conforming to NGT standards and the other eleven were not conforming to NGT-BNR standards. Three out of the eleven STPs were performing extremely poorly, and the other eight were borderline. The poorly performing plants included Kadubeesanhalli, K R Puram, and Nagasandra phase - 1. At two borderline STPs (Rajacanal phase I and II), measures suggested in Final report -B were implemented and as a result, they are currently operating optimally. Therefore they are described in a separate category.

4.0 FINAL RECOMMENDATIONS FOR STPS MEETING NGT-BNR STANDARDS:

4.1: Nagasandra phase 2: 20 MLD

4.1.1: Standard Operating Procedure recommended by IISc:

- The current operational procedures are adequate for achieving BNR removal as per NGT standards.
- Continue the current operational cycle, which includes 2 hrs of filling and aeration, 1hr of settling, and 1 hr of decantation. Continuous monitoring should be done to assure the NGT standards are met in the long term.

- At the current operating conditions, the plant can achieve adequate nutrient removal for a daily average flow of up to 20MLD, which is the plant's design capacity.
- A recommendation would be to keep an eye on the sludge settling and increase the settling time accordingly.
- The chlorine contact tank should be cleaned properly. It should be repainted with anti-algae paint, preferably blue.
- Toxicity Characteristic Leaching Procedure (TCLP) test should be done for the sludge before disposal. A year's worth of TCLP test reports should be kept in the records for the plant.
- A detailed inventory of the recycled and wasted sludge should be kept on the record.
- All equipment should be inspected to check whether they are functioning properly and efficiently. Any equipment needing maintenance or replacement should be tended to as soon as possible.

4.2: Chikkabanavara: 5 MLD

4.2.1: Standard Operating Procedure recommended by IISc:

- The current operational procedures are adequate for achieving BNR removal as per NGT standards.
- Continue with the current operational cycle, which includes 1.5hr of filling and aeration, 0.5 hrs of settling, and 1 hr of decanting. Continuous monitoring should be done to assure the NGT standards are met with long term
- Currently, two out of three SBR basins are being operated on 3hr cycles. The plant can achieve adequate nutrient removal at the current operating conditions for a daily average flow of up to 5.5MLD.

- If the incoming flow goes beyond this value, the third basin will have to be used, and operations will have to be altered to 3 basin/3hr conditions.
- A recommendation would be to reduce aeration time and increase settling time.
- The chlorine contact tank should be cleaned properly. It should be repainted with anti-algae paint, preferably blue.
- Toxicity Characteristic Leaching Procedure (TCLP) test should be done for the sludge before disposal. A year's worth of TCLP test reports should be kept in the records for the plant.
- A detailed inventory of the recycled and wasted sludge should be kept on the record.
- All equipment should be inspected to check whether they are functioning properly and efficiently. Any equipment needing maintenance or replacement should be tended to as soon as possible.

4.3: Horamavu: 20 MLD

4.3.1: Standard Operating Procedure recommended by IISc:

- The current operational procedures are adequate for achieving BNR removal as per NGT standards.
- Continue the current operational cycle, which includes 2 hrs of filling and aeration, 1hr of settling, and 1 hr of decantation. Continuous monitoring should be done to assure the NGT standards are met with in the long term.
- The plant is currently operating almost at its design capacity and cannot take on more load.
- The chlorine contact tank should be cleaned properly. It should be repainted with anti-algae paint, preferably blue.

- Toxicity Characteristic Leaching Procedure (TCLP) test should be done for the sludge before disposal. A year's worth of TCLP test reports should be kept in the records for the plant.
- A detailed inventory of the recycled and wasted sludge should be kept on the record.
- All equipment should be inspected to check whether they are functioning properly and efficiently. Any equipment needing maintenance or replacement should be tended to as soon as possible.

4.3.2: Amendment to the standard operating procedure:

- A project report with detailed cost estimates of electromechanical replacements, civil structure strengthening, and other permanent measures required should be prepared.

4.4: Doddabele: 20 MLD

4.4.1: Standard Operating Procedure recommended by IISc:

- The current operational procedures are adequate for achieving BNR removal as per NGT standards.
- Continue the current operational cycle, which includes 0.5 hrs of filling and mixing, 0.75hrs of filling and aeration, 1.75 hrs of aeration, 0.5 hrs of mixing, 0.5 hrs of settling, and 2hrs of decanting. Continuous monitoring should be done to assure the NGT standards are met with in the long term.
- The plant is currently operating almost at its design capacity and cannot take on more load.
- The chlorine contact tank should be cleaned properly. It should be repainted with anti-algae paint, preferably blue.
- Toxicity Characteristic Leaching Procedure (TCLP) test should be done for the sludge before disposal. A year's worth of TCLP test reports should be kept in the records for the plant.

- A detailed inventory of the recycled and wasted sludge should be kept on the record.
- All equipment should be inspected to check whether they are functioning properly and efficiently. Any equipment needing maintenance or replacement should be tended to as soon as possible.

4.4.2: Amendment to the standard operating procedure:

- The plant is currently operating at full capacity. The STP is likely to receive more sewage shortly. Therefore, it is recommended that provisions for increasing the plant's capacity be made to receive and treat the additional sewage.

4.4.3: Feasibility report for up-gradation of the plant capacity from 20 to 40 MLD:

Introduction:

Doddabele is a 20 MLD sewage treatment plant under the jurisdiction of the Bangalore Water Supply and Sewage Board. The operation and maintenance of the plant began in June-2018 and uses Sequential Batch Reactor (SBR) technology to treat incoming sewage.

Design flow parameters for the 20 MLD SBR Doddabele STP:

Sr. No.	Design Parameters	Capacity
1	Average Flow	20.00 MLD
2	Peak Factor	2.25
3	Peak Flow	45 MLD

Design raw sewage and treated effluent quality parameters:

Table 1: Design influent and effluent water quality parameters for Doddabele 20 MLD STP

Parameters	Raw Sewage	Treated Sewage	Unit
pH	6.5 – 7.5	6.5 - 8.0	
BOD5	350.00	<15	mg/L
COD	800.00	<250	mg/L
TSS	450.00	<30	mg/L
Ammonical Nitrogen (NH_4-N)	45	<1	mg/L
Total Nitrogen	-	-	mg/L
Total Phosphorous	7	<1	mg/L
Fecal Coliform	-	<200	MPN/100m^1

Project Objective:

As per the revised/latest NGT standards the effluent water quality standards have become stricter. Although the plant is currently achieving the revised treated effluent standards set by NGT most of the time, but there will be slight variation in these parameters occasionally since the plant is not designed to

achieve revised parameters. Hence it is necessary to re-design the plant to ensure that the treated effluent quality always meets the NGT norms.

The plant is currently operating at full capacity. However, it is likely to receive more sewage than its design capacity as the volume of the total sewage generated in the V.Valley catchment area is expected to increase shortly (as per the data provided by EE(WWM) division). Hence, the capacity of the existing STP also needs to be increased from 20 MLD to 40 MLD to treat the additional sewage generated in the V Valley catchment area shortly.

Given the above facts, rehabilitation of the existing plant is recommended. Hence, the up-gradation of the Doddabele STP is proposed for the following design parameters.

Design flow parameters for the proposed plant:

Sr. No.	Design Parameters	Capacity
1	Average Flow	40.00 MLD
2	Peak Factor	2.25
3	Peak Flow	90 MLD

Design treated water parameters:

Table 2: Design effluent water quality parameters for proposed Doddabele 40 MLD STP

Parameters	Value	Unit
pH	6.5 - 8.5	
BOD 5 at 20^0C	<10.00	mg/L
COD	<50.00	mg/L
TSS	<10.00	mg/L
Total Nitrogen	<5	mg/L

Total Phosphorous	<1	mg/L
Ammonical Nitrogen (NH4-N)	<5	mg/L
Fecal Coliform	< 100	MPN/100m^{l}

Existing treatment Units in the 20 MLD plant:

The technology used for secondary treatment in the plant is the Sequential Batch Reactor process followed by chlorination for disinfection.

- Sewage Pumping Station (SPS):
  - Receiving Chamber
  - Mechanical Coarse Screen
  - Raw Sewage Sump
  - Raw Sewage Transfer Pump
- Sewage Treatment Plant
    - Primary treatment: STP Inlet Chamber
    - Mechanical Fine Screens
    - Grit Basin
    - Parshall Flume
  - Secondary treatment:
    - Sequential Batch Reactor (SBR)
    - Coagulant Dosing System
  - Disinfection
    - Chlorine Contact Tank

- Sludge Treatment
  - Gravity Thickener
  - Sludge storage tank
  - Centrifuge
  - Polyelectrolyte Dosing Tank

Proposed modification to the existing plant:

- Upgradation of sewer line from manhole to pumping station: Currently sewage is coming to pumping station via an 800 dia. RCC pipe which is sufficient for 20 MLD but needs to be replaced with a 1200 dia. pipeline to receive a flow of 40 MLD.
- Upgradation of coarse screen chamber: At Present, there are 2 coarse screens of size 60mm (1w + 1s mechanical) to handle 20 MLD flow. To handle an additional 20 MLD one more screen module having 2 coarse screens with necessary electro-mechanical equipment and a complete piping system needs to be constructed adjacent to the existing screen chamber.
- Upgradation of Sewage Transfer Pumps: The currently installed sewage transfer pumps can handle 20 MLD flow. The capacity needs to be upgraded to handle 40 MLD. Furthermore, an additional wet well to handle a flow of 40 MLD with a peak factor of 2.25 also needs to be constructed along with the necessary civil, electromechanical, and instrumentation equipment.
- Upgradation of Rising Main from Pumping Station to STP Inlet Chamber: Currently a 700 mm dia. rising main sufficient for 20 MLD is present and one more rising main is required for the additional 20 MLD flow.
- Upgradation of primary treatment Units:

- Presently 3 (2 working + 1 standby) mechanical medium Screens are installed. These are sufficient to treat 40 MLD flow at a velocity of 1.2 m/s at peak flow without any further modification.
- 2 working mechanical detritus type grit chambers are installed which are not sufficient to cater to 40 MLD flow even at the maximum surface loading rate specified in the CPHEEO manual. At peak flow, it will reach around 1600 m3/m2/day which is very high. Due to this, an additional grit chamber shall be provided to cater the 40 MLD flow with all 3 grit chambers in working condition each for 1/3rd of peak flow.

- Change in aeration capacity of SBRs: Presently 4 working blowers are installed which are not sufficient for aeration of 40 MLD flow. Additional 4 air blowers of the same capacity are required along with piping network, civil, electromechanical & instrumentation equipment.
- Change in cycle timing of SBR for Nitrification and Denitrification: To increase the removal of BOD, COD, and Nitrogen in SBR, it is proposed to revise/change in the cycle time so that proper nitrification and denitrification shall be carried out in SBR.
- Upgradation of decanters of SBR Basins: Currently there are 4 decanters for 20 MLD flow. The decanting system needs to be upgraded. The new decanters shall be installed to cater to 40 MLD flow.
- Upgradation of Chlorinator: Currently there are 2 chlorinators of 15 kg capacity which are sufficient for 40 MLD flow with a dosing rate of 5 ppm. Therefore, there is no need to upgrade the chlorinator.
- Sludge Handling system: Currently there are 2 sludge thickeners of 13.9 m dia. and 2 sludge storage tanks of 400 m^3 capacity each, which are present at the STP. In addition to this, 1 more

sludge thickener of 400cum capacity needs to be constructed including piping, electro mechanical, and instrumentation equipment.

- Sludge Dewatering Machines: Currently there are 2 sludge dewatering machines of a capacity of 27 m3/hr are available and these can be used for 18 hours per day to handle incoming sludge.
- Additional Electrical Load: Additional power requirement may be met through the existing power infrastructure.

The above technical requirements are recommended based on the site conditions and available data. But a detailed design analysis has to be carried out by considering the complete feasibility of the up-gradation of the plant.

4.5: K&C Valley: 60 MLD

4.5.1: Standard Operating Procedure recommended by IISc:

- The current operational procedures are adequate for achieving BNR removal as per NGT standards.
- The plant is operating at its capacity and cannot take any more load. Continuous monitoring should be done to assure the NGT standards are met with in the long term.
- The chlorine contact tank should be cleaned properly. It should be repainted with anti-algae paint, preferably blue.
- Toxicity Characteristic Leaching Procedure (TCLP) test should be done for the sludge before disposal. A year's worth of TCLP test reports should be kept in the records for the plant.
- A detailed inventory of the recycled and wasted sludge should be kept on the record.
- All equipment should be inspected to check whether they are functioning properly and efficiently. Any equipment needing maintenance or replacement should be tended to as soon as possible.

4.6: Bellandur: 90 MLD

4.6.1: Standard Operating Procedure recommended by IISc:

- The current operational procedures are adequate for achieving BNR removal as per NGT standards.
- The plant is operating at its capacity and cannot take any more load. Continuous monitoring should be done to assure the NGT standards are met with in the long term.
- The chlorine contact tank should be cleaned properly. It should be repainted with anti-algae paint, preferably blue.
- Toxicity Characteristic Leaching Procedure (TCLP) test should be done for the sludge before disposal. A year's worth of TCLP test reports should be kept in the records for the plant.
- A detailed inventory of the recycled and wasted sludge should be kept on the record.
- All equipment should be inspected to check whether they are functioning properly and efficiently. Any equipment needing maintenance or replacement should be tended to as soon as possible.

4.6.2: Amendment to the standard operating procedure:

- Sludge storage yard should be constructed since there is no provision for sludge (Centrifuge) storage at the site.
- Chlorine contact tanks should be thoroughly cleaned, tiled, and painted with algae-resistant paint or coating, preferably in blue colour.

5.0 SUMMARY OF RECOMMENDATIONS FOR MODIFIED BORDERLINE STPs WHICH ARE NOW MEETING THE NGT-BNR STANDARDS:

5.1 Rajacanal phase 1: 40 MLD

5.1.1 Past status of the plant:

Current flow	Year	Operation technology	Claimed MLSS	RAS	WAS	Claimed DO levels	Chlorination
35 MLD	2004	EAP	2700 mg/L	85%	400 m^3/day	1.8 2 mg/L	Yes

1. The Dissolved oxygen level maintained in the aeration basin is at par with the claimed DO levels. The plant uses surface aerators.
2. The current MLSS in the aeration tank are most likely lower than the claimed value
3. The water quality analysis shows that the plant meets the BOD and phosphorus standards but does not meet the total Nitrogen and COD standards.
4. Unclean Chlorine contact tanks with settled sludge and algal growth are increasing the COD of effluent.

5.1.2 Modifications suggested to meet NGT-BNR standards

1. Turn the aerators on and off in such a way as to split the aeration tank into three separate zones
2. Zone 1 is aerated at 3 mg/L. Zone 2 is unaerated, and zone 3 is aerated at 2 mg/L.
3. This modification will result in the removal of Nitrogen. Further increasing the MLSS in the tank will improve nitrogen removal.
4. The MLSS in the aeration tank should be increased by at least 1000 mg/L.
5. Chlorine contact tanks should be thoroughly cleaned, tiled, and painted with algae-resistant paint or coating, preferably in blue color.

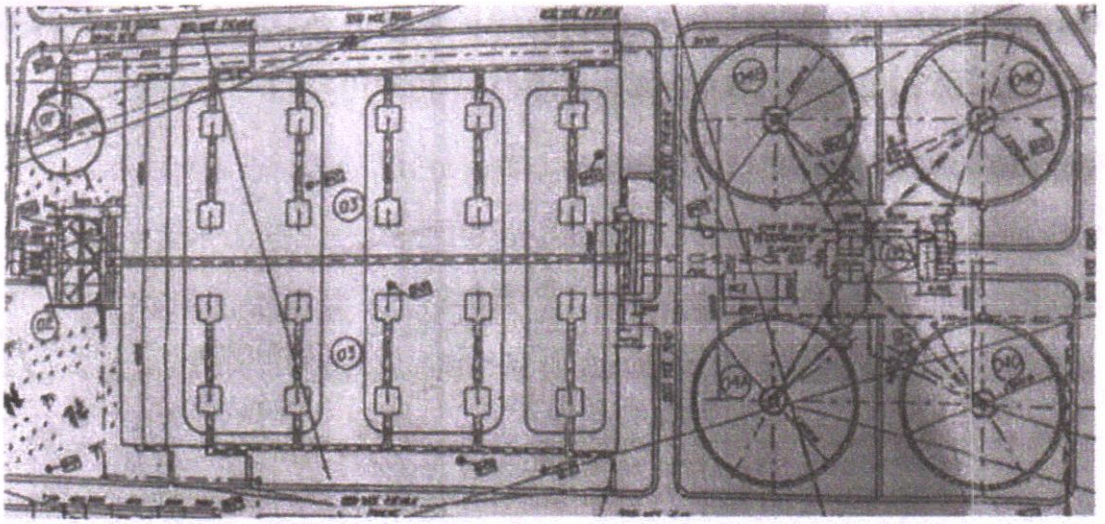


Figure 1: Layout of Rajacanal phase – 1 indicating which aerators to turn on and off. Blue: Aerators ON, Orange: Aerators OFF

5.1.3 Standard Operating Procedure recommended by IISc:

- Split the aeration basin to create three zones: aerated-unaerated-aerated.
- Turn on the first two rows (4 aerators) of surface aerators to achieve a dissolved oxygen concentration of 3 mg/L. The hydraulic retention time of the aeration zone at the inflow of 40 MLD should be 4 hrs.
- Turn off the next two rows (4 aerators) of surface aerators to create an anoxic zone with a retention time of 4 hrs at 40 MLD inflow.
- Turn on the last row of (2 aerators) of surface aerators to achieve a dissolved oxygen concentration of 2 mg/L. The hydraulic retention time of the aeration zone should be 2hrs at 40 MLD inflow.
- The MLSS in the tank should be increased to fall between 3500-4000 mg/L by controlling RAS and WAS.

- The chlorine contact tank should be cleaned properly. It should be repainted with anti-algae paint, preferably blue.
- Toxicity Characteristic Leaching Procedure (TCLP) test should be done for the sludge before disposal. A year's worth of TCLP test reports should be kept in the records for the plant.
- A detailed inventory of the recycled and wasted sludge should be kept on the record.
- All equipment should be inspected to check whether they are functioning properly and efficiently. Any equipment needing maintenance or replacement should be tended to as soon as possible.

5.1.3 Results of applied modifications:

The plant has two aeration basins. The suggested standard operating procedure was implemented in one out of the two aeration basins at the sewage treatment plant leading to overall better effluent quality. The plant effluent is now meeting the NGT-BNR standards. The graph below shows a comparison between the outlet parameters before and after the modification.

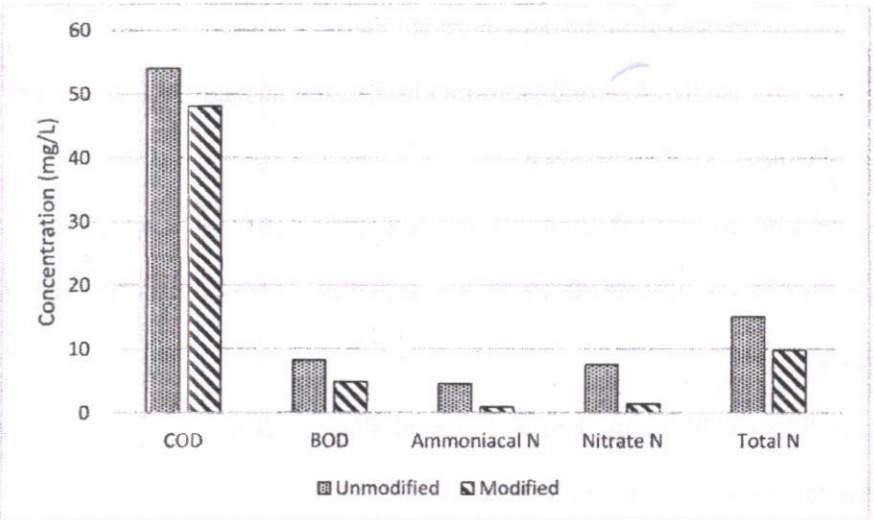


Figure 2: Comparison of outlet water quality parameters before and after implementing the modification at Rajacanal phase I

5.1.5 Amendment to the standard operating procedure:

- Above recommendations should not be implemented in the event the effluent from the plant is being for irrigation purposes.
- A project report with detailed cost estimates of electromechanical replacements, civil structure strengthening, and other permanent measures required should be prepared.
- A separate grit Chamber should be provided before the screen chamber
- Mechanical Fine Screen and its allied works to be upgraded
- Mechanical raked coarse screens, belt conveyors along with all its accessories and allied civil works should be replaced.
- Deteriorated raw sewage pumps should be replaced.
- Columns and platform area of the aeration tank are severely damaged. Therefore, the aeration tank should be refurbished after strengthening the RCC structure.
- Diffused Aeration system should be provided in the Aeration tank through Blowers/Blower room.
- Anaerobic zone should be introduced after the Anoxic zone in the Aeration tank
- A SCADA system should be installed for continuous monitoring and management of all electro-mechanical equipment including all Electrical related works.
- New TSPS with necessary electro-mechanical equipment & Civil cum Electrical work should be constructed along with the construction of ISPS for the new proposed Horamavu STP, inside the Rajacanal STP premises.
- To avoid the necessity of a sludge drying bed and manual sludge loading, Sludge Thickener, Centrifuge system should be installed with all its accessories.

- Following Electro-Mechanical Equipment appear to have reached the end of their service and should be replaced after detailed inspections.
    - Motorized Valve – 4 nos
    - Grit Chamber Detritor – 2 nos
    - Submersible Mixers – 2 nos
    - Grit Classifier – 2nos
    - Surface Aerator – 4 nos
    - Sluice Gates – 4 nos
    - 2MT EOT crane – 2nos
    - DO Analyser for the Aeration Tank – 2nos
    - Classifier Assembly with its accessories – 4 nos
    - RAS Pumps – 3 nos
    - Thickener Sludge Transfer pump – 2 nos
    - Supernatant pumps – 2 nos
    - Chlorination System to be upgraded – 1 no
    - Scrubber to be provided for neutralization system
    - Service Water Pumps – 2 nos
    - Streetlights – all to be replaced with LED along with Cables

5.2 Rajacanal phase -2: 40 MLD

5.2.1 Past status of the plant:

Current flow	Year	Operation technology	Claimed MLSS	RAS	WAS	Claimed DO levels	Chlorination
45 MLD	2018	EAP	3500 mg/L	80%	~2000 m^3/day	3 mg/L	Yes

1. The dissolved oxygen level maintained in the aeration basin is at par with the claimed DO levels. The plant uses diffuse aerators
2. The water quality analysis shows that the plant meets the BOD and phosphorus standards but does not meet the total Nitrogen and COD standards.
3. Unclean Chlorine contact tanks with settled sludge and algal growth are increasing the COD of effluent.

5.2.2 Modifications suggested to meet NGT-BNR standards

1. Turn the aerators on and off in such a way as to split the aeration tank into two separate zones
2. Zone 1 is aerated at 3.5 mg/L, and Zone 2 is unaerated.
3. This modification will result in the removal of Nitrogen. Further increasing the MLSS in the tank will improve nitrogen removal.
4. Chlorine contact tanks should be thoroughly cleaned, tiled, and painted with algae-resistant paint or coating, preferably in blue color.

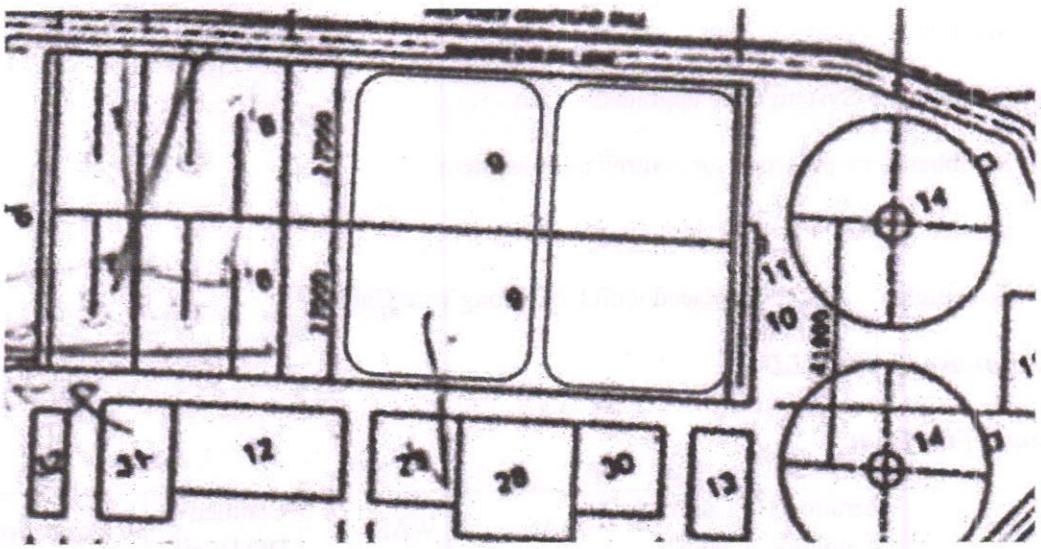


Figure 3: Layout of Rajacanal phase – 2 indicating which aerators to turn on and off. Blue: Aerators ON, Orange: Aerators OFF

5.2.3 Standard Operating Procedure recommended by IISc:

- Split the aeration basin to create an aeration zone followed by an anoxic zone.
- Turn on the first 16 rows of diffusers to achieve a dissolved oxygen concentration of 3.5 mg/L. The hydraulic retention time of the aeration zone at an inflow of 45.5 MLD should be 4.1 hrs.
- Turn off the next 16 rows of diffusers to create an anoxic zone with a retention time of 3.8 hrs at 45.5 MLD inflow.
- Turn on the last row of diffusers to polish the water. The retention time would be 0.3 hrs.
- The chlorine contact tank should be cleaned properly. It should be repainted with anti-algae paint, preferably blue.
- Toxicity Characteristic Leaching Procedure (TCLP) test should be done for the sludge before disposal. A year's worth of TCLP test reports should be kept in the records for the plant.
- A detailed inventory of the recycled and wasted sludge should be kept on the record.
- All equipment should be inspected to check whether they are functioning properly and efficiently. Any equipment needing maintenance or replacement should be tended to as soon as possible.

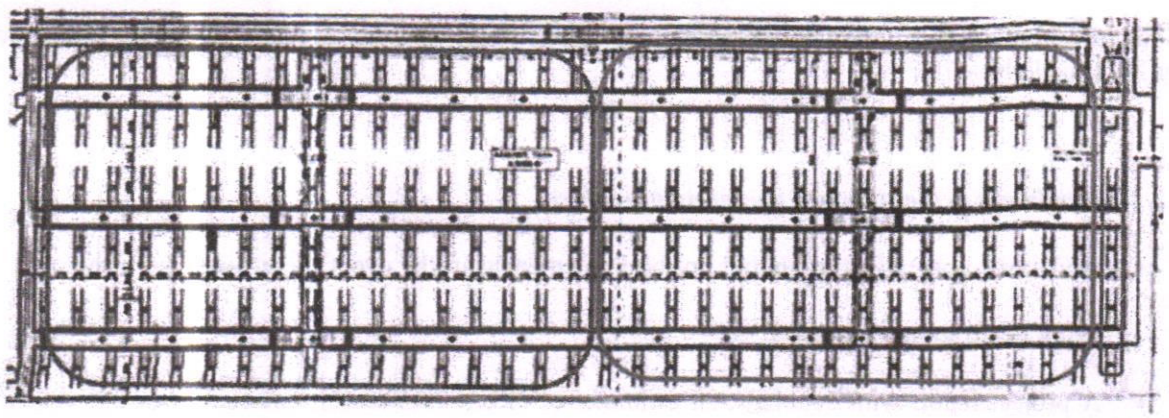


Figure 4: Layout of Rajacanal phase – 2 indicating which aerators to turn on and off. Blue: Aerators ON, Orange: Aerators OFF

5.2.4 Results of applied modifications:

The plant has two aeration basins. The suggested standard operating procedure was implemented in one out of the two aeration basins at the sewage treatment plant leading to overall better effluent quality. The plant effluent is now meeting the NGT-BNR standards. The graph below shows a comparison between the outlet parameters before and after the modification.

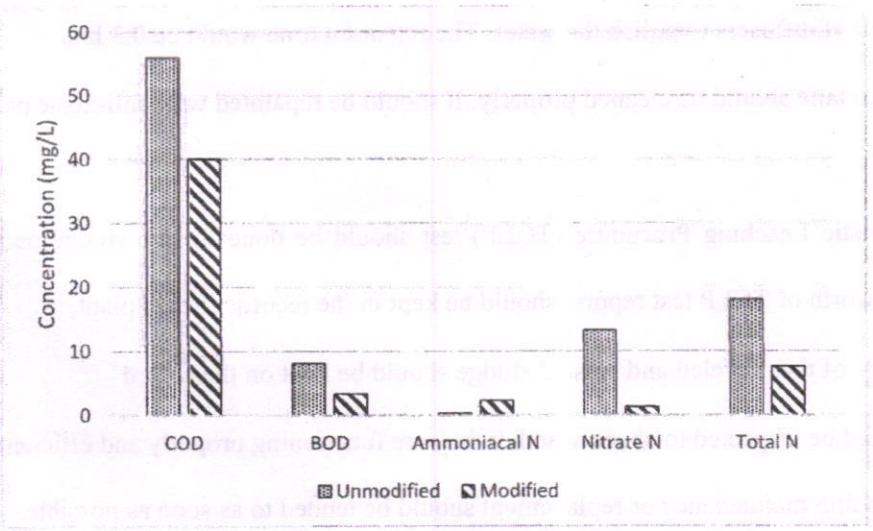


Figure 5: Comparison of outlet water quality parameters before and after implementing the modification for Rajacanal phase II

5.2.5 Amendment to the standard operating procedure:

- Above recommendations should not be implemented in the event the effluent from the plant is being for irrigation purposes.
- A project report with detailed cost estimates of electromechanical replacements, civil structure strengthening, and other permanent measures required should be prepared.
- Grit/Silt removing Chamber should be installed before Coarse Screen

- Consideration of IFAS process inside the Aeration Basin to reduce Total Nitrogen and COD parameters.
- Recirculation Pump Capacity should be increased as per the requirement
- Chlorine contact tanks should be thoroughly cleaned, tiled, and painted with algae-resistant paint or coating, preferably in blue color.

6.0 FINAL RECOMMENDATIONS FOR BORDERLINE STPS:

6.1 Mailasandra phase -1: 75 MLD

6.1.1 Current status of the plant:

Current flow	Year	Operation technology	Claimed MLSS	RAS	WAS	Claimed DO levels	Chlorination
70 MLD	2015	EAP	3500 mg/L	73%	~550 m^3/day	-	Yes

1. The Dissolved oxygen level maintained in the aeration basin is 2-3 mg/L. The plant uses surface aerators
2. The MLSS in the aeration tank is not adequate.
3. The water quality analysis shows that the plant meets the BOD and phosphorus standards but does not meet the total Nitrogen and COD standards.
4. Unclean Chlorine contact tanks with settled sludge and algal growth are increasing the COD of effluent.

6.1.2 Modifications required to meet NGT-BNR standards

1. Turn the aerators on and off in such a way as to split the aeration tank into three separate zones
2. Zone 1 is aerated at 3.5 mg/L. Zone 2 is unaerated, and zone 3 is aerated at 3.5 mg/L

3. This modification will result in the removal of Nitrogen. Further increasing the MLSS in the tank will improve nitrogen removal. MLSS should be increased by at least 1000 mg/L.
4. Chlorine contact tanks should be thoroughly cleaned, tiled, and painted with algae-resistant paint or coating, preferably in blue color.

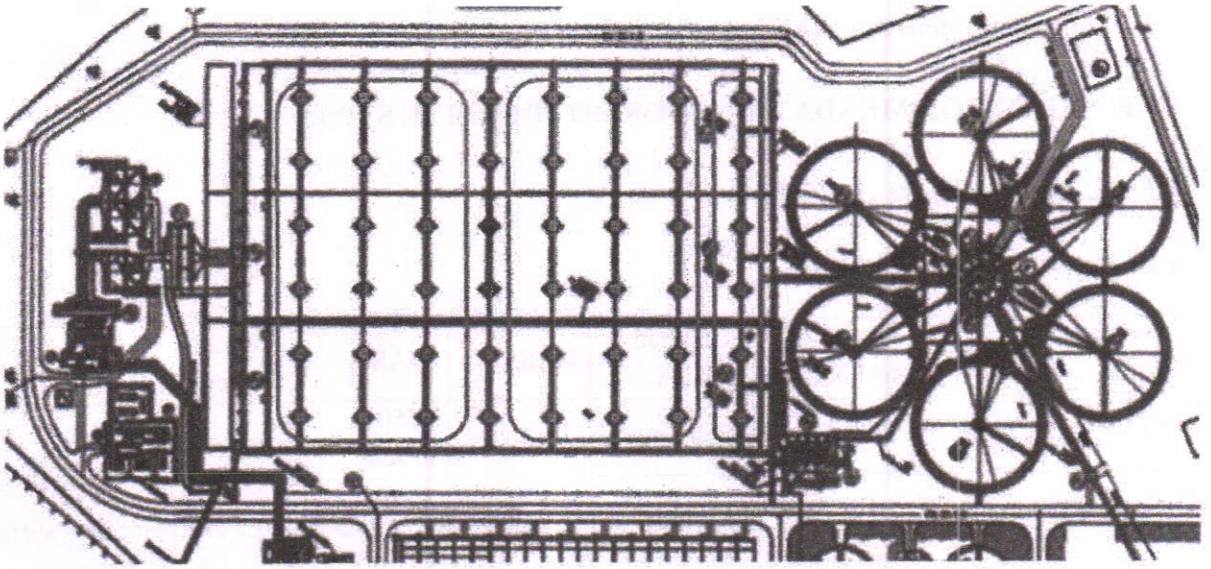


Figure 6: Layout of Mailasandra phase – 1 indicating which aerators to turn on and off. Blue: Aerators ON, Orange: Aerators OFF

6.1.3 Standard Operating Procedure recommended by IISc:

- Split the aeration basin to create three zones: aerated-unaerated-aerated.
- Turn on the first three rows of surface aerators to achieve a dissolved oxygen concentration of 3 mg/L. The hydraulic retention time of the aeration zone at an inflow of 75 MLD should be 5.4 hours.
- Turn off the next four rows of surface aerators to create an anoxic zone with a retention time of 5.4 hours at 75 LD inflow.

- Turn on the last row of surface aerators to achieve a dissolved oxygen concentration of 2 mg/L. The retention time of the aeration zone should be 1.5 hrs.
- The MLSS in the aeration basin is claimed to be 3500 mg/L but is most likely less than 2000 mg/L. Therefore increase the MLSS level in the aeration basin to a concentration between 3500-4000 mg/L by altering RAS and WAS.
- The chlorine contact tank should be cleaned properly. It should be repainted with anti-algae paint, preferably blue.
- Toxicity Characteristic Leaching Procedure (TCLP) test should be done for the sludge before disposal. A year's worth of TCLP test reports should be kept in the records for the plant.
- A detailed inventory of the recycled and wasted sludge should be kept on the record.
- All equipment should be inspected to check whether they are functioning properly and efficiently. Any equipment needing maintenance or replacement should be tended to as soon as possible.

6.1.4: Amendment to the standard operating procedure:

- Upgrade the current STP to meet NGT standards. In addition, increase the capacity of the existing treatment plant from 75 MLD to 100 MLD.

6.1.5: Feasibility report for up-gradation of the plant capacity from 75 to 100 MLD:

Introduction:

BWSSB has installed a 75MLD STP at Mailasandra village adjacent to Mysore road, near Kengeri, Bengaluru-560059 in the year 2002 – 2005. This plant is treating the sewage generated from Kanakapura road, ISRO layout, Kethamaranahalli, and Arkavathi valley areas. It is located on 32 Acres and 36 guntas lands and has a built-up area of about 23 acres.

The plant is operating at a full designed capacity of 75MLD. The Treatment process adopted in this plant is an Extended Aeration system with an anoxic zone. The treatment process includes coarse bar screen, inlet wet well chamber, fine bar screen, grit chamber, anoxic zone, aeration basin, secondary clarifier, treated water storage tank, sludge thickener, sludge feed pumping station, centrifuge units, chlorination unit, and sludge drying beds.

The plant was designed for the following influent quality parameters:

Table 3: Design influent water quality parameters for Mailasandra 75 MLD STP

Sr.no	Parameters	Unit	Limit
1	pH	-	6.8 – 8.1
2	Total Solids	mg/l	636 – 1356
3	Total Suspended solids	mg/l	300 - 600 mg/l
4	BOD5,	mg/l	259 - 343 mg/l
5	COD	mg/l	505 – 770
6	Chlorides (as Cl)	mg/l	82 – 140
7	Sulphates (as SO4)	mg/l	21 – 42

The plant was designed for the following effluent quality parameters:

Table 4: Design effluent water quality parameters for Mailasandra 75 MLD STP

Sr.no	Parameters	Unit	Limit
1	pH	-	5.5 - 9
2	Total Solids	mg/l	≤ 10
3	Total Suspended solids	mg/l	≤ 30
4	BOD5,	mg/l	≤ 20
5	COD	mg/l	≤ 250
6	Chlorides (as Cl)	mg/l	Not more than 1000
7	Sulphates (as SO4)	mg/l	Not more than 1000
8	Colour & Odour		Not objectionable
9	Total residual chlorine	mg/l	Not more than 1
10	Ammonical Nitrogen	mg/l	Not more than 50

11	Total Kjeldahal Nitrogen	mg/l	Not more than 100
12	Free ammonia	mg/l	Not more than 5
13	Total Phosphate	mg/l	Not more than 5
14	Dissolved Oxygen	mg/l	Not less than 2
15	Bio-Assy test		90% of fishes should

Treatment scheme at existing 75MLD STP at Mailsandra:

This plant is designed for the following flow rates:

Constant flow	75 MLD
Peak flow	155 MLD
Minimum flow	45 MLD

The overall treatment process is divided into Pre-treatment, Biological Treatment, Disinfection, and Sludge Treatment systems.

- **Pre-treatment system which includes the following:**
  - De-gritting Unit
- **Biological treatment system which includes the following:**
  - Anoxic Tanks
  - Aeration Tank
  - Secondary Clarifier
- **Disinfection system which includes the following**
  - Mixing Tank
  - Chlorine Contact Tank
  - Chlorination Building
  - Treated Sewage Discharge Channel

- **Sludge treatment system which includes the following**
    - Gravity Thickeners
    - Dewatering of Sludge – Sludge Drying Beds

Need for enhancement of Mailsandra STP capacity from 75MLD to 100MLD:

The quantity of sewage generated in the V.Valley's catchment area is about 574 MLD. The present capacity of existing and under construction STP's coming under the V.Valley division are as follows:

The capacity of existing STP's:

- 180 MLD STP: V.Valley Nayandanahalli
- 75 MLD STP: Mailasandra Kengeri.
- 1 MLD STP: Kemambudhi
- 60 MLD STP: Kengeri
- 20 & 40 MLD STP: Doddabele

The total capacity of the existing STP at present is **376 MLD**.

The capacity of STPs under construction:

Sr. no.	Location and Capacity	Status
1	150 MLD STP at V.Valley, Nayandanahalli	Commissioning under progress

The total capacity of existing and under construction STP's coming under the VValley division is 526 MLD. Therefore, the available treatment capacity will be 45 MLD less than the total sewage generated sewage in the Vrishbhavathi valley catchment. To be able to treat all of the sewage generated in the Vrishbhavathi Valley catchment zone, the capacity of Mailsandra STP needs to be increased from 75MLD to 100MLD.

Need for up-gradation of Mailsandra STP:

The existing Mailsandra STP is constructed based on an extended aeration process and is meeting design parameters given in the contract condition. However, these parameters are not designed to meet the new NGT standards. Though KSPCB has issued consent for operation (CFO) for the STP which is valid up to 30-06-2025, they are insisting that BWSSB treat the sewage to meet all parameters as per NGT standards.

To meet new effluent discharge standards given by Hon. National Green Tribunal (NGT), BWSSB had entrusted the IISc team to inspect and recommend suitable modifications to the current treatment process at Mailsandra STP. The IISc team gave SOP in the final report for operating the STP to meet NGT standards. Further, the IISc team directed BWSSB to give their opinion regarding individual plants in terms of up-gradation / enhancement capacity considering NGT requirements.

The plant is currently running at full design capacity and to treat the sewage generated in Vrishbhavathi valley in the future (as per data provided by WWM Division), the plant capacity needs to be increased from the existing 75 MLD to 100MLD.

The details for up-gradation and increasing capacity from 75MLD to 100 MLD STP are as follows:

- Civil work:

Table 5: Description of civil work for up-gradation of Mailsandra STP

Sr. No	Description of works
1	TSPS: Minor repair works at Inlet & Screen chamber, arresting leakages, and flooring repair works
2	Construction of new Screen & Degritting Chamber with pretreated effluent channel including demolishing the existing system
3	Construction of new Primary clarifier with primary treated effluent channel up to Distribution chamber of Aeration Tank
4	Construction of new primary sludge sump & pump house
5	The modification works at Aeration Tank to enhance capacity & Biological nutrients removal (A2O Process)

Sr. No	Description of works
6	Construction of New Process Air Blower Building with Panel Room
7	Construction of New Chemical Building
8	Secondary Clarifiers Distribution Chamber – Civil Repair works
9	Secondary Clarifiers 6 nos – Civil Repair works
10	Return Activated Sludge Sump & Pump House – Civil repair works
11	Chlorine Building – Civil repair works
12	Chlorine Contact Tank – Civil repair works
13	Demolishing existing Sludge Drying beds
14	Construction of new Thickener Feed sump & Pump
15	Gravity Sludge Thickeners – Civil Repair works and construction of one number GST
16	Thickened Sludge Sump & Pump House – Civil Repair works
17	The modification works at Centrifuge Building to enhance the capacity
18	Construction of Plant Drain Sump & Pump
19	Construction of SCADA Room at existing Administration Building and repair work if any
20	Civil repair works for remaining structures (Except stated above)
21	Road works (Which will damage due to Construction)
22	Drainworks (Which will damage due to Construction)
23	Landscaping works (which will Damage due to Construction)
24	Painting
25	RCC retaining wall / Boundary wall

- Mechanical work:

Table 6: Description of mechanical work for up-gradation of Mailsandra STP

Sr. No	Description of works
1	TSPS: 4 numbers brand new Raw sewage Pumps (Centrifugal Type), brand new Belt Conveyor Drive system of capacity and Replacement of existing piping system, Existing valves (KGV/NRV) with brand new, existing gates with brand new, dewatering pumps with brand new and Host
2	New Screen & Degritting Unit: (a) Removing & re-fixing 2 numbers mechanical Fine screens, (b) Replaced with a brand new mechanical fine screen with 6mm opening size – 2 numbers, (c) brand new Belt Conveyor Drive system, (d) Providing, supplying, and installing brand new

Sr. No	Description of works
	degritting / Vortex units 2 numbers with all accessories (e) Piping Systems, Valves and Gates, Etc.
3	New Primary Clarifier & Distribution Structure: (a) Inlet & Outlet gates, (b) Central Drive, Bridge, Scrappers, Scum removal and accessories, (c) Treated water outlet hardware – Tubes / Plates, (d) De-sludging valves and piping system & (e) Hoists / Jib crane, etc.
4	New Primary Sludge Sump & Pump House with primary scum pit: (a) Submersible Pumps, (b) Submersible mixer, (c) Valves, and piping system (d) Hoist, (e) Dewatering pumps, etc.
5	Aeration Tank: (a) Inlet & Outlet gates, (b) Submersible Mixers with complete accessories, (c) Fine bubble diffuser system complete with pipe grid and accessories including all piping, (d) Mixed liquor Internal recycle pumps, (e) valves and piping accessories, (f) Hoist, (g) Lifting system, etc.
6	New Process Air Blower Building: (a) Process Air blowers with Suction & Discharge Silencers, Filters, Acoustic Hood, etc. with all accessories (b) SS piping System (c) Valves, (d) EOT crane, etc.
7	Chemical Building: Alum Preparation and Dosing system (preparation tank, agitator, Dosing pumps, Valves, piping)
8	Secondary Clarifiers Distribution Chamber: Replacement of Valves / Gates with brand new
9	Secondary Clarifiers: (a) Repairing existing scraper mechanism, (b) Replacement of Valves / Gates with brand new, etc.
10	Return Activated Sludge Sump & Pump House: (a) Replaced with brand new Return Sludge Pumps (Centrifugal Type) 2 numbers, (b) Replacement of existing piping system, (c) Replacement of Existing valves (KGV/NRV) with brand new, (d) Replacement of existing gates with brand new, (e) Replacement of dewatering pumps with brand new, (f) Replacement of existing crane with brand new, etc.
11	Chlorine Building: (a) Chlorine Storage Equipment with accessories, (b) Chlorinators, Dosing system, Leak detection, Diffusers, Chlorine scrubbers, ventilation, and all accessories, (c) Safety Equipments, (d) Cranes and accessories, etc.
12	Chlorine Contact Tank: (a) Inlet & Outlet gates, etc.

Sr. No	Description of works
13	New Thickener Feed Sump & Pump: (a) Submersible Pumps, (b) Submersible Mixers, (c) Valves, (d) Piping system, (e) Hoists, etc.
14	Gravity Sludge Thickeners: (a) Repairing existing 2 nos scrapper mechanism and one number new mechanism (b) Replacement of existing Valves / Gates with brand new and providing valves and piping for one number new mechanism, etc.
15	Thickened Sludge Sump & Pump: (a) Valves and Piping system, etc.
16	Centrifuge Building: (a) Replaced with brand new Centrifuge Feed Pumps (b) Replaced with brand new dewatering centrifuge 3 numbers (c) Polyelectrolyte dosing systems, Storage tanks, and piping works *(Polymer Dosing tanks, Agitator, Dosing pumps, Valves)* (d) Belt Conveyor (e) Crane / Hoist, etc.
17	New Plant drain sump & Pump: (a) Submersible pumps (b) Submersible Mixers (c) Valves (d) Piping system (e) Hoists, etc.
18	Replacement of Pumps if any (utility service water / Borewell)
19	Replacement of interconnecting pipes with brand new (which will Damage during Construction)
20	Replacement of Valves with brand new (which will Damage during Construction)
21	Ventilation system

- Electrical and instrumentation work

Table 7: Description of electrical and instrumentation work for up-gradation of Mailsandra STP

Sl. No	Description of works
1	11kV U/G cable & Terminations
2	Low Voltage Switchgear
3	L.T Cabling with Cable Carrier System
4	Battery & Battery Chargers
5	Lighting System
6	Earthing system
7	Lightning Protection System

Sl. No	Description of works
8	Safety procedures
9	Flow measuring systems
10	Level measuring system
11	Pressure indicating transmitters
12	Pressure gauges
13	Temperature measuring system
14	Junction box, Earthing, Panel mounted digit indicator, Temperature scanner indicator, Surge protection devices, Alarm annunciators, Weight indicator transmitter
15	Analyzers – DO, ORP, Residual Chlorine, pH, MLSS, Hardness, etc.
16	Instrumentation cables / Cable trays
17	Automation system (PLC based SCADA System)
18	UPS system
19	CCTV for complete STP area with centralized monitoring at the admin building

The above requirements are recommended based on the site conditions and available data. But the detailed design analysis has to be carried out by considering the complete feasibility of new STP construction.

6.2 Kempabudhi: 1 MLD

6.2.1 Current status of the plant:

Current flow	Year	Operation technology	Claimed MLSS	RAS	WAS	Claimed DO levels	Chlorination
1 MLD	2002	EAP	3500-3600 mg/L	21 m^3/hr for 22 hrs	21 m^3/hr for 2 hrs	2-2.4 mg/L	No

1. The grit chamber is clogged.
2. The Dissolved oxygen level maintained in the aeration basin is most likely < 1 mg/L. The plant uses surface aerators.
3. The MLSS in the aeration tank is most likely less than the claimed value. The sludge in the aeration tank is lean and filamentous. The RAS ratio is low.

4. The water quality analysis shows that the plant meets the COD and phosphorus standards however do not meet the total Nitrogen and BOD standards.

6.2.2 Modifications required to meet NGT-BNR standards

1. Turn the aerators on and off in such a way as to split the aeration tank into two separate zones
2. Zone 1 is aerated at 1.75 mg/L. Zone 2 is unaerated.
3. This modification will result in the removal of Nitrogen.
4. Increase the RAS ratio to increase the MLSS in the tank; this will improve the nitrogen removal as well as BOD and COD removal and increase the settling quality of the sludge. The MLSS should be increased by at least 1000 mg/L.
5. The grit and screen chamber should be cleaned properly to increase the efficiency of its use
6. It is recommended that the plant be operated at a lower inflow rate and the rest of the sewage be diverted to other STPs.

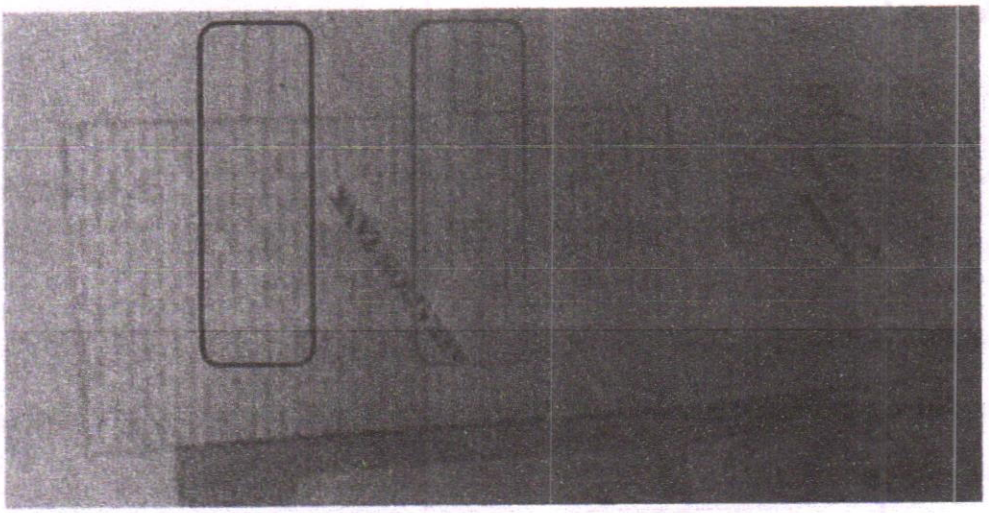


Figure 7: Layout of Kempabudhi indicating which aerators to turn on and off. Blue: Aerators ON, Orange: Aerators OFF

6.2.3 Standard Operating Procedure recommended by IISc:

- Split the aeration basin into two zones: aerated followed by unaerated.
- Turn on the first row of surface aerators to achieve a dissolved oxygen level of 2 mg/L. The hydraulic retention time in the aeration zone should be 9.72 hrs at an inflow of 1 MLD.
- Turn off the second row of surface aerators to create an anoxic zone with a retention time of 9.72 hrs.
- The MLSS in the aeration tank, though claimed to be between 3500-3600 mg/L, is most likely less than 2000 mg/L. The MLSS in the aeration basin should be brought up to the claimed concentration.
- The chlorine contact tank should be cleaned properly. It should be repainted with anti-algae paint, preferably blue.
- Toxicity Characteristic Leaching Procedure (TCLP) test should be done for the sludge before disposal. A year's worth of TCLP test reports should be kept in the records for the plant.
- A detailed inventory of the recycled and wasted sludge should be kept on the record.
- All equipment should be inspected to check whether they are functioning properly and efficiently. Any equipment needing maintenance or replacement should be tended to as soon as possible.

6.2.4: Amendment to the standard operating procedure:

- Increase the capacity of the existing treatment plant from 1 MLD to 5 MLD.

6.2.5: Feasibility report for up-gradation of the plant capacity from 1 to 5 MLD:

Introduction:

In the year 2002 BWSSB installed 1 MLD Sewage Treatment Plant at Kempambudhi to treat incoming sewage. The treated sewage is being pumped to Kempambudhi Lake for rejuvenating the lake. The plant

is located on 1.50 Acres of land. The treatment process adopted is an extended aeration system without nutrient removal facilities. The plant is operating at full designed capacity. The units of the plant are the inlet chamber, bar and grit chamber, aeration basin, secondary clarifier, and treated water storage tank. It was designed for the following design parameters:

Table 8:Design effluent water quality parameters for Kempambudhi 1 MLD plant

Sr.no	Parameters	Unit	Tolerance limit
1	pH	-	5.50 – 9.0
2	BOD	mg/l	Not more than 20
3	COD	mg/l	Not more than 250
4	TSS	mg/l	Not more than 30
5	Oil & Grease	mg/l	Not more than 10

Presently the plant is not designed to treat the effluent as per NGT standards. KSPCB has issued consent for operation (CFO) which is valid up to 30-06-2022 and they are insisting that BWSSB should treat the sewage to meet all the parameters as per NGT standard.

Purpose of increasing the plant capacity:

To meet new effluent discharge standards given by Hon. National Green Tribunal (NGT), BWSSB had entrusted the IISc team to inspect and recommend suitable modifications to the current treatment process at Kempambudhi STP. During detailed discussion issues regarding 1 MLD STP Kempambudhi, the IISc team has suggested reducing the treatment capacity in the STP to less than 1 MLD to meet NGT standards. Further, they directed plant engineers to give their opinion regarding individual plants in terms of up-gradation / enhancement capacity considering NGT requirements.

The inlet pipeline to the Kempambudhi STP is 450mm in dia and is currently carrying a load of about 4 - 5 MLD. Hence it is proposed a new 5 MLD STP based on SBR technology be constructed instead of upgrading the existing 1 MLD capacity STP. Presently the plant has an LT power supply operating 35

KW sanctioned load to operate the 1 MLD STP. HT power supply can be obtained in place of the existing LT power supply after a detailed inspection.

The above requirements are recommended based on the site conditions and available data. But the detailed design analysis has to be carried out by considering the complete feasibility of new STP construction.

6.3: Kadugodi: 6 MLD

6.3.1 Current status of the plant:

Current flow	Year	Operation technology	Claimed MLSS	RAS	WAS	Claimed DO levels	Chlorination
4.6 MLD	2018	SBR	3000-3500 mg/L	30 m^3/hr for 1.5 hr/cycle	~ 207 m^3/day	1-4 mg/L	Yes

1. There are three SBR units, out of which one unit is on standby. Diffuse aerators are used during the aeration cycle.
2. Adequate aeration is maintained during the aeration phase.
3. Surfactants are present in the influent but are removed during the treatment process.
4. The effluent did not meet COD, BOD, and total nitrogen standards.
5. The Chlorine contact tank had algal growth, insect larva growth, and mould growth, leading to higher COB and BOD in the effluent water.

6.3.2 Modifications required to meet all NGT-BNR standards

1. The current cycle includes an unaerated filling stage. The aeration should begin with filling so that the total aeration time is 1.5 hrs. (keep the filling stage unaerated only if nitrates in the influent are high and are not removed during the primary process). Dissolved oxygen during aeration time should be maintained at 3.5 mg/l

2. The current cycle includes a settling time of 45 mins which should be increased to 102 mins.
3. In the case of diluted sewage, additional carbon may have to be added to the sewage to assure proper nutrient removal.

6.3.3 Standard Operating Procedure recommended by IISc:

- The current cycle includes 45 mins filling, 45 mins aeration, 45 mins settling, and 45 mins decanting.
- This operational cycle should be altered to include 1.5 hrs of filling and aeration, 40 mins of unaerated mixing, 60 mins of settling, and 45 mins of decanting. The dissolved oxygen concentration during the aeration stage should be maintained at 3.5 mg/L.
- In case carbon limiting conditions occur, extra carbon should be added before the unaerated mixing stage.
- The chlorine contact tank should be cleaned properly. It should be repainted with anti-algae paint, preferably blue.
- Toxicity Characteristic Leaching Procedure (TCLP) test should be done for the sludge before disposal. A year's worth of TCLP test reports should be kept in the records for the plant.
- A detailed inventory of the recycled and wasted sludge should be kept on the record.
- All equipment should be inspected to check whether they are functioning properly and efficiently. Any equipment needing maintenance or replacement should be tended to as soon as possible.

6.3.4: Amendment to the standard operating procedure:

- A project report with detailed cost estimates of electromechanical replacements, civil structure strengthening, and other permanent measures required should be prepared.

- Chlorine contact tanks should be thoroughly cleaned, tiled, and painted with algae-resistant paint or coating, preferably in blue colour.
- Bypass channel with gate valve provision should be made for periodical cleaning of the Chlorine contact tanks.
- Diesel Generator capacity should be raised to full electricity requirement capacity of the plant to run the plant during times of power failure without any interruption.

6.4: Halasuru: 2 MLD

6.4.1 Current status of the plant:

Current flow	Year	Operation technology	Claimed MLSS	RAS	WAS	Claimed DO levels	Chlorination
2 MLD	2018	SBR	3500 mg/L	30 m^3/hr for 2 hr/cycle	As needed	2.5-3 mg/L	Yes

1. There are two SBR units; both are operational. Diffuse aerators are used during the aeration cycle.
2. The influent included a high quantity of oil and grease, which was observed in the SBR chambers in the form of frothing.
3. The effluent did not meet COD, BOD, and total nitrogen standards.
4. The sludge settling was poor, which led to high BOD and COD values in the effluent.

6.4.2 Modifications required to meet NGT-BNR standards:

1. The MLSS in the SBR tank should be increased by at least 1000 mg/L by controlling the RAS ratio. Currently, the RAS is at 33-36% and should be increased. Dissolved oxygen during aeration time should be maintained at 3.5 mg/l
2. The current cycle includes a settling time of 1 hr, which should be increased to 2 hrs.

3. Oil and grease traps should be installed in the primary treatment to remove excess oil and grease in the influent.
4. In the case of diluted sewage, additional carbon may have to be added to the sewage to assure proper nutrient removal.
5. A lot of oil and grease were observed in the incoming sewage and SBR basins. It is recommended that the nearby restaurants be given a warning about not letting water with a high concentration of oil and grease get into the mainline. They should be given a directive to install oil and grease traps. Furthermore, an oil and grease trap should be installed at the STP as part of primary treatment.

6.4.3 Standard Operating Procedure recommended by IISc:

- The current cycle includes 2hrs of filling and aeration, 1 hr of settling, and 1 hr of decanting.
- This operational cycle should be altered to include 2 hrs of filling and aeration, 1 hr of unaerated mixing, 1 hr of settling, and 1 hr of decanting. The dissolved oxygen concentration during the aeration stage should be maintained at 3.5 mg/L.
- In case carbon limiting conditions occur, extra carbon should be added before the unaerated mixing stage.
- The chlorine contact tank should be cleaned properly. It should be repainted with anti-algae paint, preferably blue.
- Toxicity Characteristic Leaching Procedure (TCLP) test should be done for the sludge before disposal. A year's worth of TCLP test reports should be kept in the records for the plant.
- A detailed inventory of the recycled and wasted sludge should be kept on the record.
- All equipment should be inspected to check whether they are functioning properly and efficiently. Any equipment needing maintenance or replacement should be tended to as soon as possible.

6.4.4: Amendment to the standard operating procedure:

- A project report with detailed cost estimates of electromechanical replacements, civil structure strengthening, and other permanent measures required should be prepared.
- Grit Chamber with grit trap unit should be provided to remove grit waste seamlessly.
- Oil and grease trap unit should be provided in primary treatment.
- Recirculation Pump Capacity should be increased as per the requirement.
- For better disinfection of the treated effluent Chlorine contact tank capacity should be increased to have proper retention time for Chlorination.
- Chlorine contact tanks should be thoroughly cleaned, tiled, and painted with algae-resistant paint or coating, preferably in blue colour.
- Bypass channel with gate valve provision should be made for periodical cleaning of the Chlorine contact tanks.
- Diesel Generator for full electricity requirement capacity of the plant to run the plant during a power failure without any interruption.

6.5: Yellamallappa Chettikere:

6.5.1 Current status of the plant:

Current flow	Year	Operation technology	Claimed MLSS	RAS	WAS	Claimed DO levels	Chlorination
14.6 MLD	2018	SBR	-	-	310 m^3/day	-	Yes

1. There are four SBR units. Diffuse aerators are used during the aeration cycle.
2. The effluent did not meet the BOD and total nitrogen standards.

6.5.2 Modifications required to meet NGT-BNR standards

1. The MLSS in the SBR tank should be increased by controlling WAS. Dissolved oxygen during aeration time should be maintained at 3.5 mg/l
2. The current cycle includes a settling time of 1.5 hr, which should be increased to 3 hrs.
3. In the case of diluted sewage, additional carbon may have to be added to the sewage to assure proper nutrient removal.

6.5.2 Standard Operating Procedure recommended by IISc:

- The current cycle includes 1.5 hrs of filling, 1.5 hrs of aeration, 1.5 hrs settling, and 1.5 hrs decanting.
- This operational cycle should be altered to include 1.5 hrs of filling, 1.5 hrs aeration, 1.5 hrs of unaerated mixing, 1.5 hrs of settling, and 1.5 hrs of decanting. The dissolved oxygen concentration during the aeration stage should be maintained at 3.5 mg/L.
- In case carbon limiting conditions occur, extra carbon should be added before the unaerated mixing stage.
- The MLSS in the SBR should be maintained at a concentration between 3500-4000 mg/L
- The chlorine contact tank should be cleaned properly. It should be repainted with anti-algae paint, preferably blue.
- Toxicity Characteristic Leaching Procedure (TCLP) test should be done for the sludge before disposal. A year's worth of TCLP test reports should be kept in the records for the plant.
- A detailed inventory of the recycled and wasted sludge should be kept on the record.
- All equipment should be inspected to check whether they are functioning properly and efficiently. Any equipment needing maintenance or replacement should be tended to as soon as possible.

6.6: Malathahalli:

6.6.1 Current status of the plant:

Current flow	Year	Operation technology	Claimed MLSS	RAS	WAS	Claimed DO levels	Chlorination
4.7 MLD	2018	SBR	3500-3600 mg/L	-	391 m^3/day	< 2 mg/L	No

1. There are two SBR units; both are operational. Diffuse aerators are used during the aeration cycle.
2. The effluent did not meet the BOD and total nitrogen standards.
3. The effluent of SBR passes through a cloth filter and chlorine contact tank. Both tanks are unclean and lead to the addition of BOD and COD to the effluent.

6.6.2 Modifications required to meet NGT-BNR standards

1. The aeration should begin with filling so that the total aeration time becomes 2.24 hrs. (However, if the influent has a high nitrate-N concentration, which is not removed during primary treatment, the fill time should be unaerated). Dissolved oxygen during aeration time should be maintained at 3.5 mg/l
2. The current cycle includes a settling time of 69 mins which should be increased to 3.2 hrs.
3. Oil and grease traps should be installed in the primary treatment to remove excess oil and grease in the influent.
4. One Inlet screen needs repair, one blower needs to be replaced, and one centrifuge that is not working should be replaced.
5. In the case of diluted sewage, additional carbon may have to be added to the sewage to assure proper nutrient removal.

6.6.3 Standard Operating Procedure recommended by IISc:

- The current cycle includes 64 mins of filling, 80 mins of aeration, 15 mins rection time, 69 mins of settling, and 60 mins of decanting.
- This operation cycle should be altered to include 144 mins of filling and aeration, 2 hrs of unaerated mixing, 1.2 hrs of settling, and 60 mins of decanting.
- The chlorine contact tank should be cleaned properly. It should be repainted with anti-algae paint, preferably blue.
- Toxicity Characteristic Leaching Procedure (TCLP) test should be done for the sludge before disposal. A year's worth of TCLP test reports should be kept in the records for the plant.
- A detailed inventory of the recycled and wasted sludge should be kept on the record.
- All equipment should be inspected to check whether they are functioning properly and efficiently. Any equipment needing maintenance or replacement should be tended to as soon as possible.

6.6.4: Amendment to the standard operating procedure:

- A separate grit chamber should be introduced before the screen chamber.
- Oil skimmer should be replaced.
- Out of 4 air blowers, one is worn out and should be replaced. The remaining 3 air blowers have also their efficiency due to aging (more than 10 years) and repeated repairs. It is recommended that these also should be replaced.
- Guide mechanisms for sludge pumps and diffusers should be replaced for both SBR tanks.
- Cloth disc filter media is completely worn out and should be replaced.
- Chlorination system is not working. Hence chlorine dosing system should be provided.
- Chlorine contact Tank should be tiled and painted.

- One of the centrifuges is not working and should be replaced.
- Two Ullal pumps of capacity 75 Hp each should be replaced.
- Flowmeters at inlet & outlet points (3 Nos) should be replaced.
- Existing laboratory should be assessed for the necessity of additional lab equipment.
- One additional stand-by Transformer of 630 KVA should be provided.
- All the electrical panels inside the panel room should be assessed thoroughly for refurbishment.
- Following electro-mechanical equipment appear to have reached the end of their service age and should be replaced after a detailed inspection.

    1. Transformer-1 No
    2. Air blower-4 Nos
    3. Chlorine dosing system
    4. Cloth media filter-1 No
    5. Centrifuge-2 Nos
    6. Flow meters -3 Nos
    7. Screw Conveyor-2 Nos
    8. Ullal pumping main
    9. Ullal pump 75 Hp-2 Nos
    10. Oil skimmer-1 No

- As the STP is more than 10 years old, a detailed conditional assessment of all electro-mechanical components, electrical systems, instrumentation equipment should be done. Required repairs/replacements should be done to achieve the prescribed standards of effluent.

7.0 FINAL RECOMMENDATIONS FOR POORLY PERFORMING STPs:

7.1 Kadubeesanahalli phase - 1:

7.1.1 Current status of the plant:

Current flow	Year	Operation technology	Claimed MLSS	RAS	WAS	Claimed DO levels	Chlorination
43 MLD	2005	EAP	-	60%	40%	-	No

1. The IISc team suspected that the plant operation had been suspended for some time and had only resumed a few hours before the visit. The high concentration of ammoniacal Nitrogen in the effluent supported this assessment.
2. The MLSS in the aeration tank is not adequate.
3. The effluent quality was not satisfactory and included suspended matter. The water quality analysis shows that the plant met none of the Hon'ble NGT standards. However, if operated properly, the effluent quality will improve.

7.1.2 Modifications required to meet NGT-BNR standards:

1. Turn the aerators on and off in such a way as to split the aeration tank into three separate zones
2. Zone 1 is aerated at 2 mg/L. Zone 2 is unaerated, and zone 3 is aerated at 1 mg/L.
3. This modification will result in the removal of Nitrogen. However, a further increase in MLSS is required to improve nitrogen and carbon removal capacity.
4. Increase the RAS ratio to increase the MLSS in the tank; this will improve the nitrogen removal as well as BOD and COD removal and increase the settling quality of the sludge. The MLSS value should be between 2500-3500 mg/L.

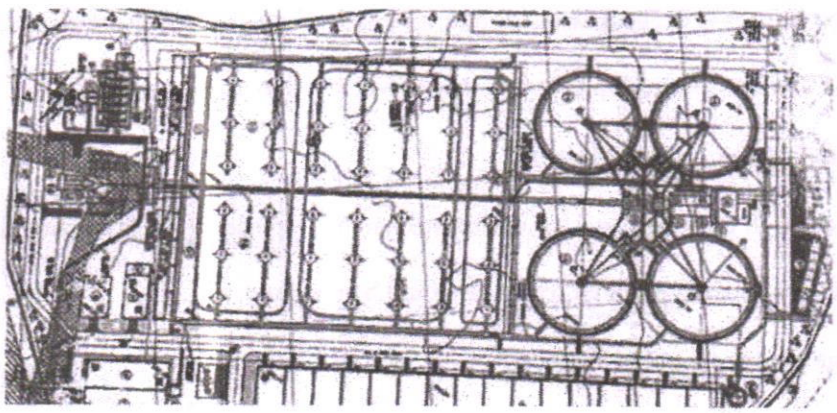


Figure 8: Layout of Kadubeesanahalli – 1 indicating which aerators to turn on and off. Blue: Aerators ON, Orange: Aerators OFF

7.1.3 Standard Operating Procedure recommended by IISc:

- The aeration basin should be split into three zones: aerated-unaerated-aerated
- Turn on the first two rows of aerators to achieve a dissolved oxygen concentration of 2 mg/L. The hydraulic retention time in the aeration zone should be 3.5 hrs at an inflow of 50 MLD.
- Turn off the next four rows of surface aerators to create an anoxic zone of retention time of 6.9 hrs.
- Turn on the last row of the surface aerators to achieve a dissolved oxygen concentration of 1 mg/L. The hydraulic retention time in the aeration zone should be 1.7 hrs at 50 MLD inflow.
- The MLSS in the aeration basin should be maintained between 3000-3500 mg/L.
- The chlorine contact tank should be cleaned properly. It should be repainted with anti-algae paint, preferably blue.
- Toxicity Characteristic Leaching Procedure (TCLP) test should be done for the sludge before disposal. A year's worth of TCLP test reports should be kept in the records for the plant.
- A detailed inventory of the recycled and wasted sludge should be kept on the record.

- All equipment should be inspected to check whether they are functioning properly and efficiently. Any equipment needing maintenance or replacement should be tended to as soon as possible.

7.1.4 Amendment to the standard operating procedure:

- A project report with detailed cost estimates of electromechanical replacements, civil structure strengthening, and other permanent measured required should be prepared.
- Deteriorated raw sewage pumps should be replaced.
- A separate grit chamber should be provided before the screen chamber.
- New Manual Screens should be installed along with gate valves.
- Mechanical raked coarse screens, belt conveyor along with all its accessories and allied civil works should be replaced.
- Mechanical Fine Screen and its allied works should be upgraded.
- A primary clarifier should be introduced before the biological treatment.
- Anaerobic zone should be introduced after the anoxic zone inside the aeration tank along with MLR Pump.
- Diffused aeration system should be provided inside the aeration tank through Blowers/Blower room.
- Columns, walls, and platform area of the aeration tank are severely damaged. The aeration tank should be refurbished after strengthening the RCC structure.
- Chlorine contact tanks should be thoroughly cleaned, tiled, and painted with algae-resistant paint or coating, preferably in blue color.
- Bypass channel with gate valve provision should be made for periodical cleaning of the Chlorine contact tanks.

- To avoid the necessity of a sludge drying bed and manual sludge loading, Sludge Thickener, Centrifuge system should be installed with all its accessories.
- Laboratory Equipment should be provided to carry out the necessary tests to ensure compliance with the latest NGT standards.
- A SCADA system should be installed for continuous monitoring and management of all electro-mechanical equipment including all Electrical related works.
- Diesel Generator capacity should be raised to full electricity requirement capacity of the plant to run the plant during times of power failure without any interruption.
- Following electro-mechanical equipment appear to have reached the end of their service life and should be replaced after a detailed inspection.

    1) Motorized Valve – 6 nos
    2) Grit Chamber Detritor – 2 nos
    3) Submersible Mixers – 4 nos
    4) Grit Classifier – 2nos
    5) Surface Aerator – 15 nos
    6) Sluice Gates – 10 nos
    7) 2MT EOT crane – 2nos
    8) DO Analyser for the Aeration Tank – 2nos
    9) Clarifier Assembly with its accessories – 4 nos
    10) RAS Pumps – 3 nos
    11) Thickener Sludge Transfer pump – 2 nos
    12) Supernatant pumps – 2 nos
    13) Chlorination System to be upgraded – 1 no

14) Service Water Pumps – 2 nos

15) Streetlights – all to be replaced with LED along with Cables

7.2 Nagasandra phase - 1:

7.2.1 Current status of the plant:

Current flow	Year	Operation technology	Claimed MLSS	RAS	WAS	Claimed DO levels	Chlorination
11 MLD	2005	EAP	-	-	-	-	No

1. Oil and grease, and algae were observed in the grit chamber
2. The plant uses surface aerators. Aeration is not being done properly. Aerators are not run 24 hrs and are turned off during nighttime. The high ammoniacal nitrogen concentration in the effluent fortifies this assessment.
3. The MLSS in the aeration tank is not adequate. Sludge settling is not adequate.
4. The effluent quality was not satisfactory. The water quality analysis shows that the plant met none of the Hon'ble NGT-BNR standards.

7.2.2 Modifications required to meet NGT-BNR standards

1. Turn the aerators on and off in such a way as to split the aeration tank into two separate zones
2. Zone 1 is aerated at 2 mg/L. Zone 2 is unaerated.
3. This modification will result in the removal of Nitrogen. However, a further increase in MLSS is required to improve nitrogen and carbon removal capacity. MLSS levels should be between 3000-3500 mg/L.
4. Increase the RAS ratio to increase the MLSS in the tank; this will improve the nitrogen removal as well as BOD and COD removal and increase the settling quality of the sludge.

5. The scraper mechanism should be inspected for rust, flow directional gates are broken, and should be replaced. Other equipment should be checked and replaced.
6. Anoxic mixers are not working and should be replaced.
7. Surface aerators are running with noise and vibrations. There is a reduction in rpm due to rewinding. Gearboxes have outlived their service life. If possible, shift to diffuse aerators.
8. The strength of material for clarifiers should be analyzed, and the system should be assessed and replaced accordingly.
9. Major flow meters are not working and should be replaced.

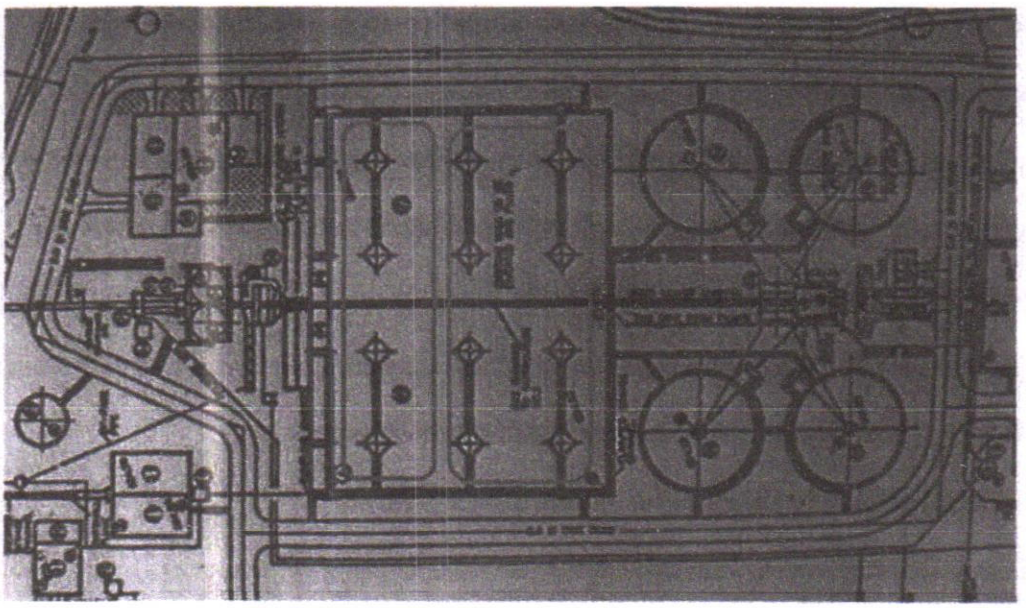


Figure 9: Layout of Nagasandra phase – 1 indicating which aerators to turn on and off. Blue: Aerators ON, Orange: Aerators OFF

7.2.3 Standard Operating Procedure recommended by IISc:

- Split the aeration basin into two zones, aerated followed by unaerated

- Turn on the first row of aerators to achieve a dissolved oxygen concentration of 2 mg/L. The hydraulic retention time in the aeration zone should be 4hrs at 20 MLD inflow.
- Turn off the next two rows of aerators to create an anoxic zone of retention time 8 hrs at 20 MLD inflow.
- The MLSS in the aeration basin should be maintained at a concentration of 3500 mg/L.
- The chlorine contact tank should be cleaned properly. It should be repainted with anti-algae paint, preferably blue.
- Toxicity Characteristic Leaching Procedure (TCLP) test should be done for the sludge before disposal. A year's worth of TCLP test reports should be kept in the records for the plant.
- A detailed inventory of the recycled and wasted sludge should be kept on the record.
- All equipment should be inspected to check whether they are functioning properly and efficiently. Any equipment needing maintenance or replacement should be tended to as soon as possible.

7.2.4: Amendment to the standard operating procedure:

- A project report with detailed cost estimates of electromechanical replacements, civil structure strengthening, and other permanent measures required should be prepared.
- A Grit Chamber should be introduced before the Screen chamber.
- Mechanical raked fine screens, manual screen, belt conveyor along with its accessories and allied civil works should be replaced.
- In the Detritor unit, scrapper mechanism, flow directional gates, organic return pump, and Grit collector drive should be replaced due to aging.
- Anoxic mixers along with the electrical system are not working and should be replaced.

- Surface Aerators have reached the end of their service life (as per manufacturers). Gears are worn out and aerators are running with noise and vibrations and should be replaced. (Providing Diffused Aeration through blowers/blower room is recommended).
- Existing SCADA system is not working and should be replaced with a new system.
- Columns, walls, and platform area of the aeration tank are severely damaged. The aeration tank should be refurbished after strengthening the RCC structure.
- Electro-mechanical components of the secondary clarifiers need to be replaced due to aging. The civil structure also should be strengthened.
- Chlorination system is not working. A chlorine dosing system should be provided along with a scrubber unit.
- Chlorine contact Tank should be tiled and painted.
- To avoid the necessity of a sludge drying bed and manual sludge loading, Sludge Thickener, Centrifuge system should be installed with all its accessories.
- Other utilities needing attention:
    1. Bore wells should be replaced/repaired as needed.
    2. Major flowmeters such as inflow, outflow, RAS flow are not working and should be replaced. Additional flowmeters should be provided as needed.
    3. Existing laboratory should be assessed for the necessity of additional lab equipment.
    4. The electrical panels of the 500KVA diesel generator should be replaced.
    5. All the electrical panels/switch gears/breakers in MCC-I and MCC-II should be refurbished.
    6. All valves/gates inside the STP should be assessed thoroughly and non-operational valves/gates should be replaced.
    7. All STP lighting systems should be replaced.

8. Bypass line for the NK Halli pumping main should be constructed for diverting the sewage from NK halli, by tapping the line near the drying beds of Phase I and connecting it to the inlet of Phase II (about 220 mm to 450 mm dia DI pipe).

- Following electro-mechanical equipment appear to have reached the end of their service life and should be replaced after a detailed inspection.

1) Fine bar screen- 2 Nos
2) Mechanical fine screen- 2Nos
3) Manual fine screen- 1No
4) Belt conveyor- 1 No
5) Grit classifier and Grit collector drive- 2 Nos
6) Organic return pump- 2Nos
7) Raw sewage feed pump- 2 Nos
8) Slow mixer for Anoxic Mixer- 8 Nos
9) Fixed surface Aerators- 12 Nos
10) Secondary clarifiers- 4 Nos
11) Return sludge pumps- 2 Nos
12) Sludge Thickener- 2 Nos
13) Surplus Anoxic mixer- 1 No
14) Chlorination Booster pumps- 2 Nos
15) Service water pumps- 4 Nos
16) Autosampler- 1 No
17) All Instrumentation systems inside the STP.
18) All electrical systems inside MCC I room MCC II room, and others.

19) Diesel Generator- 1 No

20) Chlorination System and allied system

21) Pressure gauge-16 Nos of different capacity

22) SCADA and PLC System

23) Borewells – 2Nos

24) All major flowmeters

25) All STP lighting system

- To undertake the total refurbishment of all equipment and utilities detailed above, the operation of nagasandra phase I STP needs to be halted. At present both phases I and II plants are running at ~50% capacity. Currently the average flow to the phase I plant from N.K.Halli ISPS is about 9 MLD. Whereas the adjacent phase II, the plant receives an average inflow of about 12.06 MLD from Bagalagunte ISPS, Karibhuvanahalli ISPS, and Nagasandra ISPS. To halt the operation of phase I till refurbishment work is done, the sewage inflow from N.K. Halli ISPS should be diverted to Phase II by providing a diversion pipeline of ~ 215 m.
- The electro-mechanical equipment replacement needed at 3 ISPS constructed during Phase I

1. 25MLD ISPS at N.K.Halli :
    - 3 64kW capacity pumps along with respective electrical systems should be replaced.
    - One out of the two transformers is in good condition and the other should be refurbished.
    - The DI pumping main from NK Halli ISPS to 20 MLD STP phase I is worn out due to aging & should be replaced.
    - Borewells should be provided.
    - All gates/valves inside the ISPS which are beyond repair should be replaced.
    - All ISPS lighting systems to be replaced.

- This ISPS has 3 Pumps (2W + 1S). The designed capacity of each pump is 550m3/hr. With two pumps working per hour, the total pumping capacity of the ISPS is about 1ML/hr. In the peak hours of the day, the inflow to the ISPS is more than 1ML/hr. Hence, in peak hours the design capacity is inadequate. Therefore, to pump all the sewage received through sub mains, either existing ISPS should be upgraded to have a higher capacity or one more ISPS should be constructed.

2. 30MLD ISPS at Bagalgunte:
   - Electrical system for pumps should be replaced.
   - The DI pumping main from Bagalagunte ISPS to 20 MLD STP Phase I is worn out due to aging & should be replaced.
   - Borewells should be provided
   - All gates/valves inside the ISPS which are beyond repair should be replaced.
   - All ISPS lighting systems to be replaced
   - This ISPS has 3 Pumps (2W + 1S). The designed capacity of each pump is 695 m3/hr. With two pumps working per hour, the total pumping capacity of the ISPS is about 1.3 ML/hr. In the peak hours/during monsoon, the inflow to the ISPS is more than 1.3ML/hr. Hence, in peak hours the design capacity is inadequate. Therefore, to pump all the sewage received through the sub-mains, either an existing ISPS should be upgraded to have a higher capacity or one more ISPS should be constructed.
3. 15MLD ISPS at Medarahalli:
   - 3 110 kW capacity pumps along with respective electrical systems should be replaced.

- The DI pumping main from Medarahalli ISPS to Bagalgunte ISPS is worn out due to aging & should be replaced.
- Borewells should be provided
- All gates/valves inside the ISPS which are beyond repair should be replaced.
- All ISPS lighting systems to be replaced.
- This ISPS has 3 Pumps (2W + 1S). The designed capacity of each pump is 340m3/hr. With two pumps working per hour pumping is about 0.65ML/hr. In the peak hours of the day, the inflow to the ISPS is more than 0.65ML/hr. Hence, in peak hours the design capacity is inadequate. Further, in recent years additional sub-main are linked to the existing ISPS. Therefore, to pump all the sewage received through sub-mains, either an existing ISPS should be upgraded to have a higher capacity or one more ISPS should be constructed.

7.3: K R Puram:

7.3.1 Current status of the plant:

Current flow	Year	Operation technology	Claimed MLSS	RAS	WAS	Claimed DO levels	Chlorination methodology
11 MLD	2005	UASB + EAP	3500 mg/L	100%	0.8 MLD	2 mg/L	No chlorination

1. The UASB is blocked, and some of the sewage is bypassing the UASB and directly entering the ASP system leading to higher nitrogen levels in the effluent.
2. The DO level in the aeration tank is significantly lower than the claimed levels. The sludge collected from the aeration tank shows the same.
3. The ammoniacal nitrogen content in the effluent is very high, indicating that sufficient aeration is not taking place and raw sewage is bypassing the UASB

4. The effluent did not meet the COD and total nitrogen standards.
5. The plant is designed for effluent Nitrogen of no more than 50 mg/l

7.3.2 Modifications required to meet NGT-BNR standards

1. The UASB should be made operational so that no influent is bypassing it and proper nutrient removal occurs.
2. MLSS in the aeration tank should be increased to optimal levels, ensuring proper removal of nutrients.
3. The modification to the plant operation is suggested in the layout below; it includes splitting one of the UASB tanks into two and altering the flow in the extended aeration process.

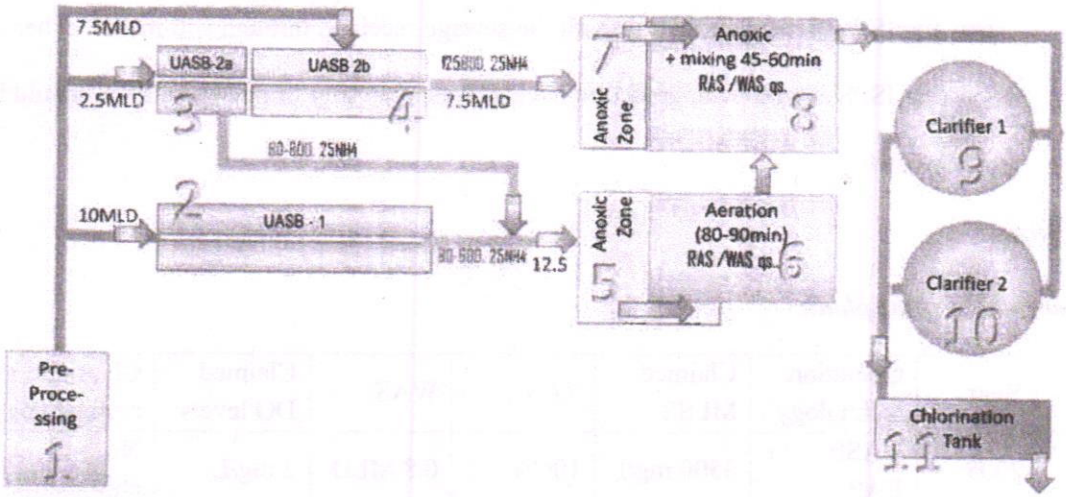


Figure 10: Modified layout for K R Puram STP

7.3.2 Standard Operating Procedure recommended by IISc:

- The primary treatment unit should be fixed. Any equipment broken or needing maintenance should be attended to immediately.
- The UASB downflow inlet pipes should be unclogged.

- Inspect and fix any other blockages causing sewage to bypass the UASB.
- The feed levels to the UASB should never be less than one-third of the rated capacity of the UASB (here, it is 20 MLD). If the feed levels are low for more than a week, proper start-up procedures should be taken up. Shock loads of more than 10% to the UASB should be prevented.
- The quality of sludge in the UASB and aeration basin should be monitored continuously.
- Once the UASB tanks are made properly operational, one of the UASB tanks should be divided into two zones, as shown in the image below. The smaller zone will have 25% of the volume of the full tank, whereas the larger zone will have a volume that is 75% that of the full tank. Feed to different UASB tanks should be kept proportional to the numbers given in the diagram below.
- There are two aeration basins on the plant. One should be converted into an anoxic mixing basin, and the other should be kept as an aeration basin.
- The smaller zone and the other full UASB tank should be loaded at a normal rate to achieve an effluent BOD of about 80 mg/L. The effluent from these tanks should be directed towards the aeration basin, where a retention time of 80-90 mins should be ensured.
- The larger zone of the UASB should be loaded at a higher rate to achieve effluent BOD of about 125 mg/L.
- The effluent from the larger UASB zone and effluent of the aeration basin should be mixed in the anoxic mixing basin, allowing for a retention time of 45-60 mins.
- The effluent from the anoxic mixing tank should be taken to the clarifiers. Necessarily activated sludge should be returned from the clarifiers to the aeration basin.
- The chlorine contact tank should be cleaned properly. It should be repainted with anti-algae paint, preferably blue.

- Toxicity Characteristic Leaching Procedure (TCLP) test should be done for the sludge before disposal. A year's worth of TCLP test reports should be kept in the records for the plant.
- A detailed inventory of the recycled and wasted sludge should be kept on the record.
- All equipment should be inspected to check whether they are functioning properly and efficiently. Any equipment needing maintenance or replacement should be tended to as soon as possible.

7.3.4: Amendment to the standard operating procedure:

- TSPS motors should be replaced along with electromechanical equipment and screens.
- New wet well should be constructed with a depth of 6 to 8 meters.
- A separate grit Chamber should be provided before the screen chamber.
- Primary unit should be upgraded to include vertex technology and oil and grease traps.
- Mechanical Raked Coarse Screens, Belt Conveyor along with its accessories and allied civil works should be replaced
- UASB feeder channel level must be increased, and the complete Gas Flare system should be replaced completely.
- Anoxic zone should be upgraded to have a higher number of mixers with higher capacity.
- Diffused Aeration/Aspiration aeration system should be provided inside the aeration tank through new blower equipment with all allied accessories and civil structures.
- SCADA system should be installed for continuous monitoring and one-point access for all electro-mechanical equipment including all Electrical allied works
- Sensors should be installed throughout the plant.
- Chlorination system should be upgraded completely to include a de-chlorination system as well

- To avoid sludge drying bed and manual sludge loading, a new sludge thickener, centrifuge/belt filter press system should be included with all its accessories and civil structures.
- New DG should be installed to run the plant completely without any interruption during power outages.
- Following Electro-Mechanical Equipment have reached the end of the service live (15 years) and hence should be replaced.
  a. Motorized Valve – 3
  b. Grit Chamber Detroiter – 2
  c. Submersible Mixers – 4
  d. Grit Classifier – 2
  e. Surface Aerator – 8
  f. Sluice Gates – 4
  g. 2 MT EOT crane – 2
  h. DO Analyzer for the Aeration Tank – 2
  i. Classifier Assembly with its accessories – 4
  j. RAS Pumps – 4
  k. Thickener Sludge Transfer pump – 2
  l. Supernatant pumps – 2
  m. Chlorination System to be upgraded – 1
  n. Service Water Pumps – 2
  o. Street Lights – all to be replaced with LED along with Cables

8.0 FINAL RECOMMENDATIONS FOR OTHER STPs:

8.1: V Valley STP: 180 MLD

8.1.1: Recommendation:

- The entire biological treatment units (bio-filters) are below the highest flood level (HFL). As such, even after minor rainfall events, all treatment units get flooded from backwater from the drain. This completely disturbs the treatment process and kills the microbial population in the biological treatment units. Regeneration of microbial population takes weeks, during which time the quality of effluent is affected.

- Hence the construction of a new 150 MLD treatment plant is recommended instead of rehabilitation of the old plant.

8.1.2: Feasibility report for the construction of new 150 MLD plant at V Valley location:

Introduction:

The existing 180 MLD sewage treatment plant is located adjacent to Vrishabhavathi Valley, Nayandanahalli. Construction activity for the above plant began in 1971 and the STP was completed and commissioned in the year 1974. During Stage -1, only preliminary, primary, and sludge treatment units consisting of screening, grit removal, primary settling, sludge digestion, and sludge drying beds were constructed. The design capacity of the Stage -1 plant was 123 MLD. In the year 1986, the plant was upgraded to secondary standards under CWSS Stage – II and the treatment capacity of the existing plant was also increased to 180 MLD by providing additional units. The work was taken up under the stage - 2 scheme included the installation of additional screen, grit chamber, primary settling tanks, digester, and sludge drying beds, and construction of new secondary trickling filters and secondary settling tanks. The plant was designed for an influent BOD_5 concentration of 300 mg/l and a TSS concentration of 460 mg/l.

The design parameters for the plant effluent are as follows:

Table 9: Design effluent parameters for 180 MLD V Valley STP

Sr.no	Designed parameters	Unit	Limit's
1	pH	-	5.5 - 9
3	Total Suspended solids (TSS)	mg/l	≤ 30
4	BOD5,	mg/l	≤ 20
5	COD	mg/l	≤ 250

Details of existing Treatment units at 180 MLD V- Valley STP:

Table 10: Existing treatment units at 180 MLD V Valley STP

Sr. No.	**Unit Description**	**Size of Unit**	**No. of Units**
1	Primary settling tanks	47.26 m dia., 3.80 m SWD 58.00 m dia, 3.99 m SWD	2 3
2	Primary biofilters (trickling filters)	61.80 m dia, 1.67 m depth	4
3	Secondary biofilters (trickling filters)	61.80 m dia, 1.17 m depth	4
4	Secondary settling tanks	59.00 m dia, 2.08 m SWD	4

In addition to the above units, the existing plant has inlet chambers, distribution chambers, sludge outlet chambers, re-circulation pumping station, primary sludge pumping station, and secondary pumping station.

Performance of the existing 180 MLD STP:

Presently the existing 180 MLD STP is receiving a total of about 120-130 MLD of sewage is from the newly constructed TSPS. But the Plant is not designed for the required parameters prescribed by the NGT.

Flooding of Existing STP:

The invert level at the outlet of 180 MLD STP is the same as the level of flow in the valley during the dry season. HFL near V.Valley STP is 803.30 m. It is observed that many of the structures in the existing STP are below HFL. Structures below HFL are 4 Secondary Clarifier and Bio-filter, 4 Primary Bio-filter, Re-circulation pump house, Secondary Sludge pump house, and Inlet pump house for TTP. Further with the increase of sewage in the valley, flows from the valley enter the existing STP, directly affecting the treatment process.

Due to the lower level of the units, huge quantities of plastic waste, silt, and floating materials directly enter the secondary clarifier launders and in turn into secondary clarifiers. Recirculation pump house tanks for primary and secondary recirculation pipe lines get choked up due to the incoming solid waste and secondary sludge pump house gets submerged. Furthermore, the approach roads for the above-mentioned units also get submerged during flooding. Dewatering of all secondary clarifiers and removal of silt and floating materials which has been accumulated at the bottom of clarifiers and clearing of the sludge withdrawal line requires weeks of work. Dewatering and removal of plastic and floating material that has entered the primary and secondary tanks of the recirculation pump house and recirculation pipeline are required to avoid damage to recirculation pumps.

Rehabilitation of existing 180 MLD plant and new under construction 150 MLD plant at V Valley:

The gauged sewage inflow into V Valley near Rajarajeshwarinagar Bridge is about 300 MLD and there are design inadequacies in the existing STP, BWSSB contemplated constructing a 300 MLD STP by demolishing the existing 180 MLD STP. In this regard, BWSSB had awarded consultancy services to TATA Consulting Engineers Limited (TCE) for preparation of Detailed Project Report and Tender Document for the construction of new 300 MLD Sewage Treatment Plant with Biological Nutrient Removal (BNR) and Power Generation facility.

Further, during inspection of V.Valley plant by the competent authority in the year 2014, it was instructed to initially only construct a new 150 MLD (phase – 1) capacity STP at V-Valley with TSPS & sludge handling system and also carry out the rehabilitation work of existing old 180 MLD Nayandanahalli STP. The space provision was made for the construction of the additional 150 MLD STP (phase-2) in the future to provide an overall treatment facility of up to 300 MLD capacity.

At present, the work of Design and Construction of 150 MLD Sewage Treatment Plant (STP) (phase – 1) based on Activated Sludge Process with Biological Nutrient removal system (ASP with BNR) and Power Generation at V Valley, Bangalore including Operation & Maintenance of Constructed Facilities for Ten (10) Years (Trunkey Basis) has been awarded to M/s Suez India PVT. ltd. vide ref No. BWSSB/CE (WWM)/ACE (WWM)-1/TA-2/810/2017-18, dated:31.07.2017 with project duration of 36 months. This work includes 150 MLD capacity STP at V-Valley with TSPS & sludge handling system of 300 MLD capacity along with rehabilitation of existing 180 MLD STP.

Availability of secondary treated water for Minor Irrigation Department:

During the meeting held with the competent authority of BWSSB along with the minor irrigation department on 10.01.2020, it has been confirmed that 243 (135 +108) MLD can be supplied after up-

gradation of STP to minor irrigation department in 2023 from 180 MLD STP @ V.Valley and the same has been informed vide ref No.BWSSB /CH/CE(WWM) /ACE(WWM)-1&2/3097/2019-20, dt: 22.01.2020.

Proposal of additional 150 MLD (Phase –II) STP at V.valley:

To meet new effluent discharge standards given by National Green Tribunal (NGT), the competent authority has entrusted the work to the IISc team to inspect and recommended suitable modifications to the current treatment process to meet the required standards by NGT.

In this regard, the IISc team has visited the site and submitted the report and recommendations as listed below;

The entire biological treatment units (Biofilters) are below the HFL. As such, even after minor rainfall events, all treatment units get flooded from backwater from the drain (Nala). This completely disturbs the treatment process and kills the microbial population in the biological treatment units. Regeneration of microbial population takes weeks, during which time the quality of effluent is affected.

Hence the construction of a new 150 MLD (phase-2) STP is recommended instead of up-gradation / rehabilitation of the old plant.

Further, an interaction meeting was conducted with the IISc team in CE(WWM) chamber on 26th Nov 2021. As per the final recommendation of the existing 180 MLD STP at V.Valley, a proposal for construction of new 150 MLD STP (Phase II) is here with prepared as below;

Presently the existing 180 MLD STP is being operated & treated the sewage about 110 – 120 MLD of sewage. However, the parameters are not meeting the standards prescribed by the NGT.

Now as per the recommendation of IISc, it is proposed to construct new 150 MLD STP (Phase II) in place of the existing 180 MLD STP. The existing 180 MLD STP is located on 40 Acres of land. Out of that, about 10 acres of land will be used to set up new 150 MLD STP (Phase II). This will enable the running of the existing 180 MLD STP (partially) during and after the construction of the proposed new 150 MLD STP (phase-2).

The newly constructed (ongoing) 150 MLD STP (phase-1) has a common TSPS, Headworks, sludge handling system & power generation for 300 MLD capacity. Only water line-related structures and associated/allied works need to be taken up in proposed (piping, electromechanical equipment, Instrumentations, etc.,) additional 150 MLD STP (Phase II).

The newly constructed 150 MLD STP (phase-1) is constructed with ASP and BNR process, the same technology can be adopted for additional 150 MLD STP (Phase II).

However, a detailed project report (DPR) shall be prepared by calling a tender for arriving cost for design and construction of the new 150 MLD STP (Phase II).

The details for the new 150 MLD STP (Phase II) construction are as follows:

Table 11: Details for new 150 MLD plant at V Valley location

Item	Description
Civil and Building Works	
1	**Primary Clarifiers**
2	Primary Sludge Sump & Pumping Station
3	**Aeration Basin**
4	Process Air Blower Building
5	Electrical Panel Room
6	Transformer yard

7	Chemical building/Alum Building (Ground Floor)
8	Chemical building/Alum Building (First Floor)
9	**Secondary Clarifiers**
10	Return Activated Sludge Sump & Pumping Station
11	**Chlorine Contact Tank**
12	Chlorine Building
13	Chlorine Scrubber Area/ Foundation
14	**Substation for STP**
15	Switchgear room
16	Transformer yard
17	**Miscellaneous**
18	Roads
19	Drains
20	Landscaping with Sprinkler System
21	Shifting of existing utilities of 180 MLD STP (pipes, electromechanical equipment)
21	Site Clearing, Excavation, Leveling, Grading, and Backfilling Activities
	Process, Mechanical, Electrical Works and Instrumentation & Control Works
1	Alum Preparation and Dosing system for proposed STP
2	Detroiter with complete scraping mechanism, Rake Classifier, Organic return pump, and accessories for proposed STP
3	Primary Clarifier and Distribution Structure
4	Inlet & Outlet sluice gates and hardware
5	Central Drive, Bridge, Scrappers, and ancillaries
6	Tube settler mechanism

7	Treated Sewage outlet hardware
8	Desludging valves and pipework
9	Primary sludge sump and Pumps, valves and Piping, and accessories
10	Hoists & Jib Cranes
11	Anaerobic Zone
12	Submersible Mixer and complete accessories
13	Anoxic and Aeration Zone
14	Inlet & Outlet sluice gates and hardware
15	Submersible Mixer for Anoxic Zone and complete accessories
16	Retrievable Fine Bubble Diffuser Aeration system complete with Pipe Gird and accessories
17	Process Air Blowers with suction & Discharge Silencers, Acoustic Hood, Piping with Valves and accessories
18	Mixed Liquor Internal Recycle Pumps, Valves, and Piping complete
19	EOT Cranes and Hoists, Jib Cranes
20	Ventilation system for Blower House & Mixed Liquor Internal Recycle Pumping Station
21	Aeration Basins Effluent Channel and Secondary Clarifiers
22	Inlet & Outlet sluice gates and hardware
23	Central Drive, Bridge, Scrappers, Scum Remover and ancillaries
24	Secondary Treated Water outlet hardware
25	Desludging valves and pipework
26	Return sludge sump Sluice Gate and Hardware
27	Return sludge Pumps, Valves, Piping, and accessories
28	Crane & Hoists, Jib Cranes
29	Ventilation system for Return sludge Pump House

30	Chlorination System
31	Chlorine storage equipment
32	Chlorinators, chlorine pipework, dosing system, leak detection, diffusers, ventilation, and accessories
33	Safety Equipment
34	EOT Cranes, Lifting Beam, and Accessories
35	Motive water Pumps and Piping
36	Service Water System
	Electrical Systems
1	Installation, testing, and commissioning of 11kV underground Cables, termination Kits, and straight joints at the following locations as per scope, specification, and drawings.
2	Installation, testing, and commissioning of electrical equipment at STP Substation building & Process Air Blower Building at Sewage treatment plant with following major equipment as per scope, specification, and drawings.
3	Installation, testing, and commissioning of Motor Control Centres, Distribution boards, etc at various locations in the Sewage Treatment Plant and Terminal Sewage Pumping station with the following major equipment, items as per scope, specification, and drawings.
4	Installation, testing, and Commissioning of LED Lighting System at Sewage Treatment plant and Terminal pumping station with the following major equipment, items as per scope, specification, and drawings.
5	Installation, testing, and Commissioning of L.T Cabling System, HT/LT Cable Carrier System at Sewage Treatment Plant, and Terminal Sewage Pumping Station with following major components as per scope, specification, and drawings.
6	Installation, testing, and Commissioning of Earthing & Lightning Protection System at the Sewage Treatment Plant and Terminal Sewage Pumping Station with the following major components as per scope, specification, and drawings.
7	Installation, testing, and Commissioning of safety procedures for Electrical Equipments at Sewage Treatment Plant and Terminal Sewage Pumping station as per scope, specification, and drawings.

8	Installation, testing, and Commissioning of safety procedures for Electrical Equipments at Sewage Treatment Plant and Terminal Sewage Pumping station as per scope, specification, and drawings.

The above technical requirements are recommended based on the site conditions and available data. But the detailed design analysis has to be carried out by considering the complete feasibility of the project.

9.0 GENERAL RECOMMENDATIONS FOR ALL PLANTS:

1. Chlorine dose should be given to the effluent at all locations to reduce the concentration of pathogenic micro-organisms.
2. Unclean Chlorine contact tanks with settled sludge and algal growth are increasing the COD of effluent.
3. Chlorine contact tanks should be thoroughly cleaned, tiled, and painted with algae-resistant paint or coating, preferably in blue color.
4. Residual chlorine is measured at various stages of chlorination, however, it is recommended that appropriate residual chlorine content is measured after adequate chlorine addition, retention time and needs to be measured before discharge point. Unclean Chlorine contact tanks with settled sludge and algal growth are increasing the COD of effluent.
5. All plant equipment such as screens, grit scrappers, flow meters, and aerators should be inspected thoroughly and broken/non-operational equipment should be replaced.

10.0 CONCLUSIONS:

- All STPs on the list were visited and inspected
- Water quality analysis was done for samples collected from STPs
- Process modifications were suggested for STPs not meeting NGT standard
- Out of 17, STPs studied, 6 STPs are meeting NGT-BNR standards. Out of these 6 STPs, 4 are working at maximum capacity and cannot be expected to take on more load. 2 STPs, namely Chikkabanavara and Nagasandra phase 2 can take on more load. Chikkabanavara is currently only using two of the three SBR basins available on site; with the used use of the third basin, it can take up more load. Nagasandra phase 2 is currently operating at half its capacity and therefore can take up an additional load till it meets its design capacity. Details for these six plants are given in Appendix - 1 And Appendix - 3.
- Two STPs namely Rajacanal Phase I and Rajacanal Phase II implemented some of the process modifications suggested by IISc and post these modifications, the effluent from these two STPs are meeting the BNR standards.
- Out of the 17, STPs studied, 6 were marginally underperforming in terms of nutrient removal. Out of these 6, 2 were Extended aeration plants, and 4 were SBRs. Simultaneous nitrification and denitrification by creating aerated and unaerated zones in the aeration basin were suggested as modifications for the Extended aeration plants. The addition of an unaerated mixing stage after the aeration stage was suggested as a modification for the SBR plant. Details of modifications for individual plants are given in Appendix - 4. The standard operating procedure based on the modifications is given in Appendix - 1.

- Out of the 17 STPs studied, 3 were performing very poorly. 2 of these plants were Extended aeration plants, and the remaining one was a UASB plant. The main issue with Extended aeration plants were intermittent operations and insufficient aeration. Inspection and repair of all required equipment were recommended for these plants. Additionally, simultaneous nitrification-denitrification by creating aerated and unaerated zones in the aeration basin were suggested as modifications for proper nutrient removal when the plants are operating continuously. The UASB plant maintenance modifications were suggested for the proper functioning of the technology. Further system modification was given to ensure proper nutrient removal. The details of the modifications suggested for individual plants are given in Appendix - 4. The standard operating procedure based on the modification suggested for individual plants is given in Appendix – 1.
- Maintenance of chlorine contact tanks is an issue across all STPs, and it is decreasing the quality of effluent. Hence it is recommended that periodic maintenance of chlorine contact tanks be done to keep them clean. It is also recommended that they be repainted, preferably blue and with anti-algae paint.
- Continuous monitoring for 6 STPs meeting the NGT standards is necessary to ensure long-term compliance with NGT standards. Similarly, continuous monitoring will be required for all other plants after given modifications are applied to ensure long-term compliance.

Appendix-1

Table: Values used for simulation purposes

STP	Inlet Parameters						Outlet Parameters					
	pH	COD (mg/L)	BOD (mg/L)	TKN (mg/L)	Nitrate Nitrogen (mg/L)	Total Phosphorus (mg/L)	pH	TSS (mg/L)	COD (mg/L)	BOD (mg/L)	Total Nitrogen (mg/L)	Total Phosphorus (mg/L)
Nagasandra phase 2	7.3	725	310	55	8	6.2	7.3	9	49.9	4.7	5.1	0.65
Chikkabanavara	6.9	623	307	40	8.2	4	7.5	5	49.9	7.5	9.7	0.12
Horamavu	6.7	570	350	45	7.5	8.5	7.4	8	48.8	4.4	9.8	0.49
Doddabele	7	413	203	50	7	4.5	7.6	7	54.4	3.2	9.4	0.78
K&C Valley	8.5	448	193	40	6	15.3	7	9	27	3.4	5	0.7
Belandur	8	460	200	45	7	13	7.6	13	47	7	6.7	0.8
Rajacanal phase 2	7.5	743	310	50	3.2	5.4	7.8	6	56	8.1	17.7	0.5
Rajacanal phase 1	7.2	660	280	40	8.6	3	7.3	6	54	8.2	15	0.09
Mailsandra	7.5	552	224	37	8.1	4.5	7.7	11	64	8.3	13.8	0.8
Kempambudhi	7	450	230	35	5.8	3	7.5	7	48.8	10.56	15.8	0.2
Kadugodi	7.4	375	190	50	6.9	6.9	7.5	9	72.7	25.33	17.2	0.3
Halasuru	7	331	125	35	6	2.3	7.4	8	56	14.4	14.7	0.4
Yellamellappa chettikere	7.4	365	125	35	6	3.3	7.5	8	40.4	14.6	17.8	0.3
Malathahalli	7.2	511	228	48	10.6	4.5	7.5	11	48.8	16.2	17.3	0.2
Kadubeesanhalli	7.2	650	139	71	3.3	13.5	7.6	100	92	10	35	10.3
Nagasandra phase 1	7.4	580	261	73	6.6	5.6	7.2	16	58	28.25	47.7	0.5
K R Puram	7.4	437	306	55	3	7	7.4	183	56	8.2	50.9	0.7

Please note: These values are based on average data and single grab sample; some variations are expected.

Please note that the outlet parameters included in this appendix for Rajacanal phases 1 and 2 are before the modifications were applied.

Table Comparison of outlet data before and after implementing suggestions given by IISc team in one of the two aeration basins at the plant

STP	Outlet parameters before implementation						Outlet parameters after implementation					
	pH	TSS	COD	BOD	TN	TP	pH	TSS	COD	BOD	TN	TP
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Rajacanal PI	7.8	6	56	8.1	17.7	0.5	7.5	8	48	4.8	9.8	0.26
Rajacanal PII	7.3	6	54	8.2	15	0.09	7.2	7	40	3.3	7.6	0.36

Comparison of outlet parameters for Rajacanal phase I and II, before and after implementation of modifications suggested by IISc. The results are for the final effluent when modifications were applied to one of the two aeration basins at the plants.

Appendix-2

BWSSB

STP COMPLIANCE WITH NGT-BNR STANDARDS

DR. L N RAO, PROF. MOHAN KUMAR AND PROF. H N CHANAKYA

SCOPE OF WORK:

The scope of work included:

1. On site inspection of all 20 STPs included in the list
2. Collection and analysis of water samples
3. Recommendations for modifying the operation of STPs to meet the new BNR standards

NGT Standards:

Parameter	Unit	Standard
pH	-	5.5-9
Biological Oxygen Demand	mg/L	10
Chemical Oxygen Demand	mg/L	50
Total Suspended Solids	mg/L	20
Total Nitrogen	mg/L	10
Total Phosphorus	mg/L	1
Total Coliforms	MPN/100 ml	<100 desirable, <230 OK

Details of the STPs studied:

The list included 20 STPs. Out of the 20 STPs, **V Valley** STP is under upgradation and hence not completely operational, similarly **Madiwala** STP is also under construction and hence non-operational. Further the team was informed that **Kengeri** STP was put on the list unintentionally. Therefore, these were not visited.

List of STPs Studied:

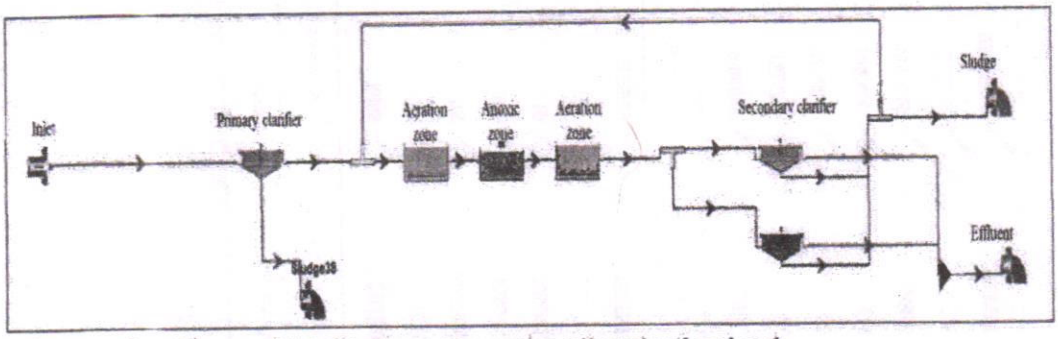
9. Mailasandra phase -1 (75 MLD)
10. Kempabudhi (1MLD)
11. Kadugodi (6 MLD)
12. Halasuru (2MLD)
13. Yelemallappa Chettikere (15 MLD)
14. Mallathahalli (5 MLD)

7. Rajacanal phase -1 (40 MLD)**
8. Rajacanal phase -2 (40 MLD)**

** Suggested modification were applied at these plants. As a result, these now meet the required NGT-BNR standards.

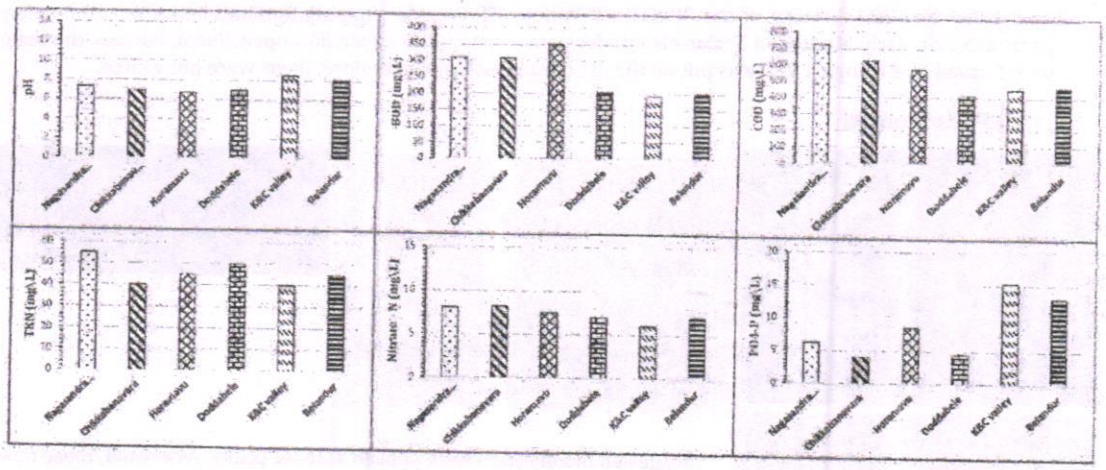
Methodology used :

1. An 'As-Is BioWin' Simulation model for each of the STPs was created

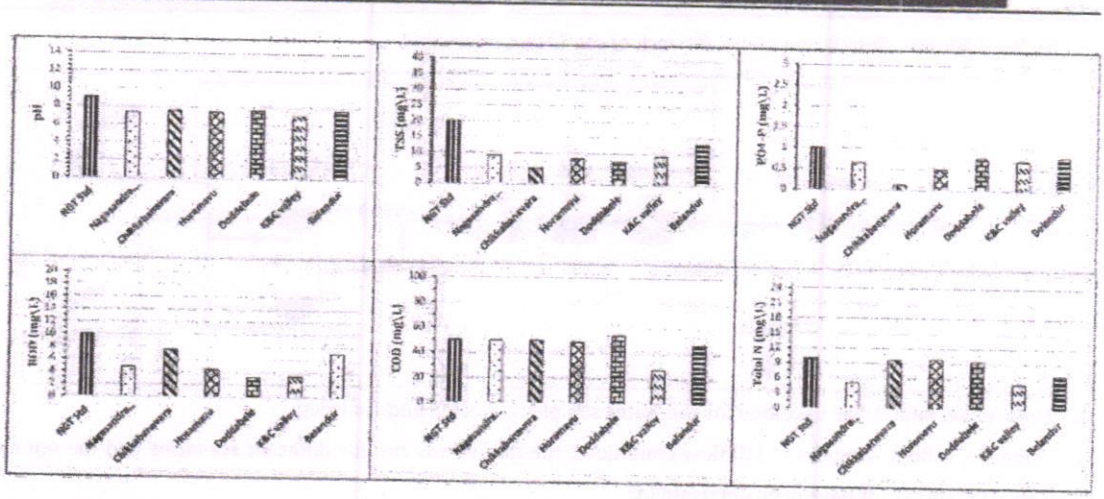


2. The created model was validated for the water samples collected and analyzed
3. Using the validated model at full flow conditions, the model was run for different scenarios and the optimum values for each STPs have been determined.

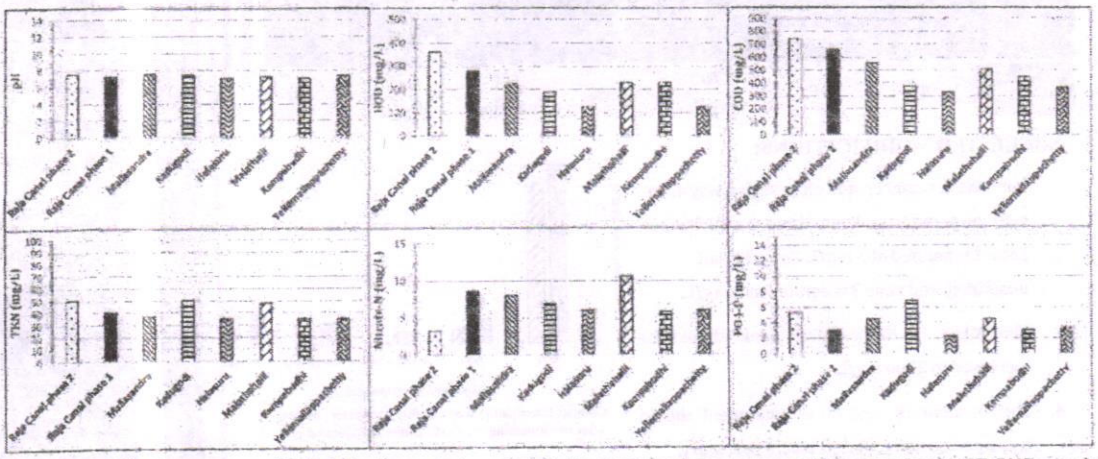
STPs meeting NGT-BNR standards: Inlet parameters



STPs meeting NGT-BNR standards: Outlet parameters

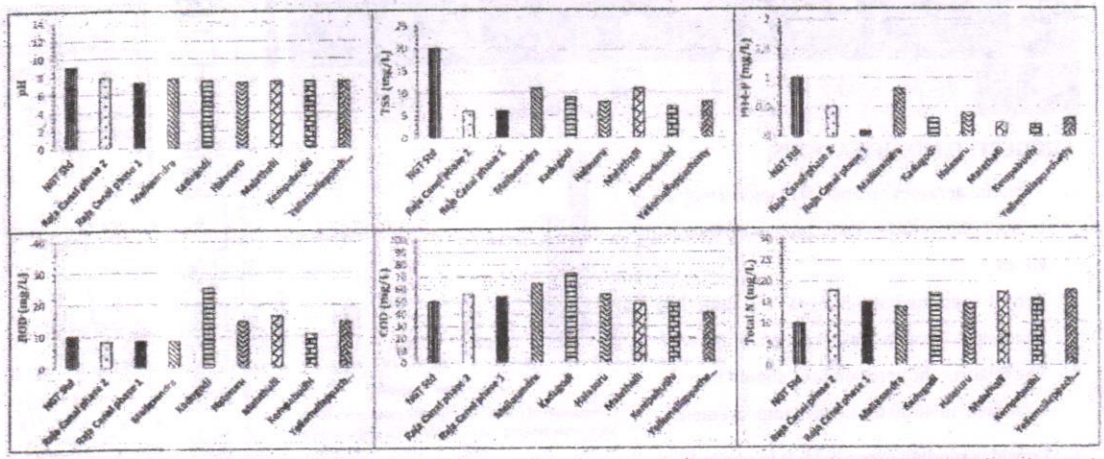


Marginally underperforming STPs: Inlet parameters



Suggested modification were applied at Ranjacanal phase 1 & 2. As a result, these now meet the required NGT-BNR standards.

Marginally underperforming STPs: Outlet parameters



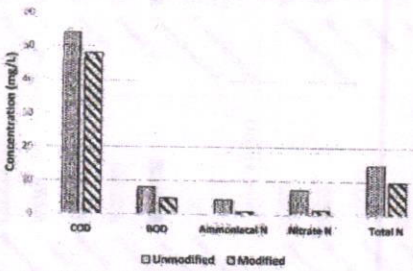
Suggested modification were applied at Ranjacanal phase 1 & 2. As a result, these now meet the required NGT-BNR standards.

Rajacanal phase -1: 40 MLD

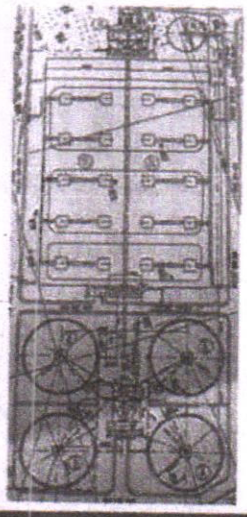
Current flow	Year	Operation technology	Claimed MLSS	RAS	WAS	Claimed DO levels	Chlorination
35 MLD	2004	EAP	2700 mg/L	85%	400 m^3/day	1.8-2.0 mg/L	Yes

SUGGESTED MODIFICATIONS:

1. Turn the aerators on and off in such a way as to split the aeration tank into three separate zones
2. Zone 1 is aerated at 3 mg/L. Zone 2 is left unaerated, and zone 3 is aerated at 2 mg/L.
3. The MLSS in the aeration tank should be increased to 3500 mg/L.
4. Surface aerators and other equipment should be inspected and replaced where necessary.



Comparison of outlet water quality parameters before and after implementing the modification at Rajacanal phase I

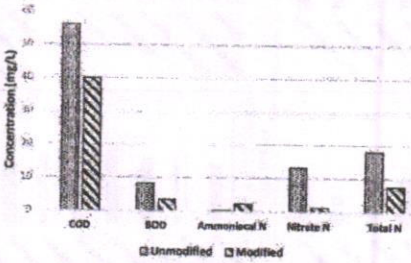


Rajacanal phase - 2: 40 MLD

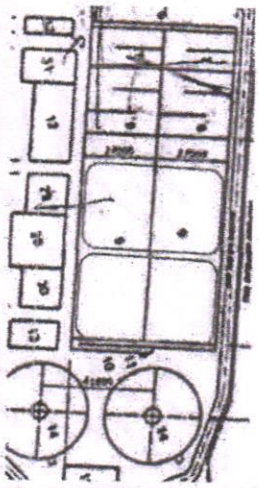
Current flow	Year	Operation technology	Claimed MLSS	RAS	WAS	Claimed DO levels	Chlorination
45 MLD	2018	EAP	3500 mg/L	80%	~2000 m^3/day	3 mg/L	Yes

SUGGESTED MODIFICATIONS:

1. Turn the aerators on and off in such a way as to split the aeration tank into two separate zones
2. Zone 1 is aerated at 3.5 mg/L, and Zone 2 is unaerated. Turn on the last set of aerators.
3. The MLSS in the aeration tank should be increased to 4000 for further improvements
4. Consider sending excess 5 MLD to phase 1

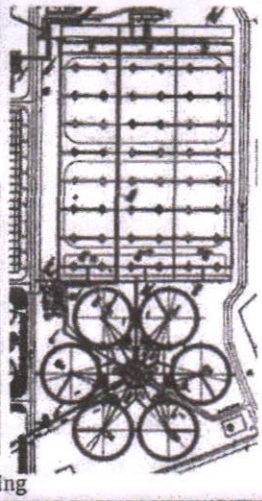


Comparison of outlet water quality parameters before and after implementing the modification at Rajacanal phase II



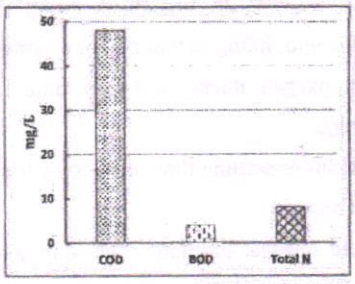
Mailasandra phase -1: 75 MLD

Current flow	Year	Operation technology	Claimed MLSS	RAS	WAS	Claimed DO levels	Chlorination
70 MLD	2015	EAP	3500 mg/L	73%	~550 m^3/day	-	Yes



SUGGESTED MODIFICATIONS:

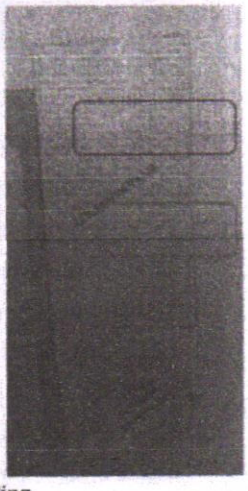
1. Turn the aerators on and off in such a way as to split the aeration tank into three separate zones
2. Zone 1 is aerated at 3 mg/L. Zone 2 is left unaerated, and zone 3 is aerated at 2 mg/L.
3. The MLSS in the aeration tank should be increased to 4000 mg/L.



Expected Output Parameters from Modelling

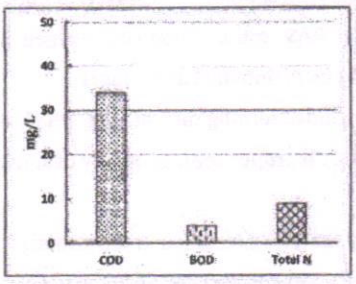
Kempambudhi: 1 MLD

Current flow	Year	Operation technology	Claimed MLSS	RAS	WAS	Claimed DO levels	Chlorination
1 MLD	2002	EAP	3500-3600 mg/L	21 m^3/hr for 22 hrs	21 m^3/hr for 2 hrs	2-2.4 mg/L	No



SUGGESTED MODIFICATIONS:

1. Turn the aerators on and off in such a way as to split the aeration tank into two separate zones
2. Zone 1 is aerated at 2 mg/L. Zone 2 is left unaerated.
3. The MLSS should be increased to 4000 mg/L.
4. It is recommended that the plant is operated at a lower inflow rate (0.6 MLD) and the rest of the sewage be diverted to downstream STPs



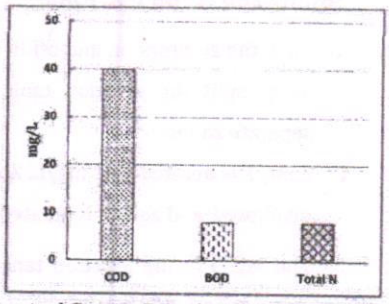
Expected Output Parameters from Modelling

Kadugodi: 6 MLD

Current flow	Year	Operation technology	Claimed MLSS	RAS	WAS	Claimed DO levels	Chlorination
4.6 MLD	2018	SBR	3000-3500 mg/L	30 m^3/hr for 1.5 hr/cycle	~ 207 m^3/day	1-4 mg/L	Yes

SUGGESTED MODIFICATIONS:

1. The current cycle includes an unaerated filling stage. The aeration should begin with filling so that the total aeration time is 1.5 hrs. Dissolved oxygen during aeration time should be maintained at 3.5 mg/l
2. The current cycle includes settling time of 45 mins which should be increased to 100 mins.
3. In the case of diluted sewage, additional carbon may have to be added to the sewage to assure proper nutrient removal.



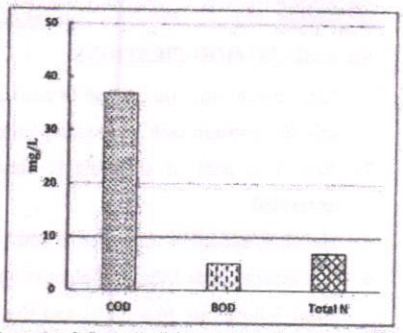
Expected Output Parameters from Modelling

Halasuru: 2 MLD

Current flow	Year	Operation technology	Claimed MLSS	RAS	WAS	Claimed DO levels	Chlorination
2 MLD	2018	SBR	3500 mg/L	30 m^3/hr for 2 hr/cycle	As needed	2.5-3 mg/L	Yes

SUGGESTED MODIFICATIONS:

1. The MLSS in the SBR tank should be increased to 4000 mg/L by controlling the RAS ratio. Dissolved oxygen during aeration time should be maintained at 3.5 mg/l
2. The current cycle includes settling time of 1 hr., which should be increased to 2 hrs. till proper settling quality of sludge is recorded.
3. Oil and grease traps should be installed in the primary treatment to remove excess oil and grease in the influent.



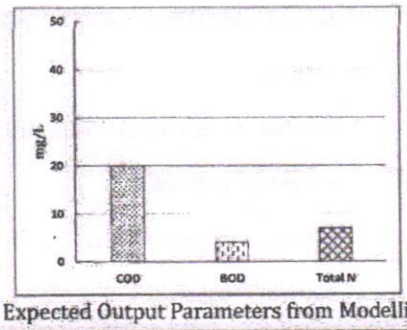
Expected Output Parameters from Modelling

Yellamallappa chettikere: 15 MLD

Current flow	Year	Operation technology	Claimed MLSS	RAS	WAS	Claimed DO levels	Chlorination
14.6 MLD	2018	SBR	-	-	310 m^3/day	-	Yes

SUGGESTED MODIFICATIONS:

1. The MLSS in the SBR tank should be increased by controlling WAS. Dissolved oxygen during aeration time should be maintained at 3.5 mg/l
2. The current cycle includes settling time of 1.5 hr., which should be increased to 3 hrs.
3. In the case of dilute sewage being received, additional carbon may have to be added to the sewage to assure proper nutrient removal.
4. Make provisions for diverting rainwater and increase BOD levels



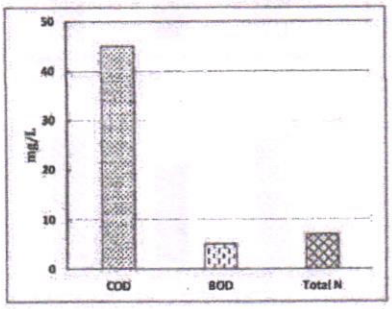
Expected Output Parameters from Modelling

Malathahalli: 5 MLD

Current flow	Year	Operation technology	Claimed MLSS	RAS	WAS	Claimed DO levels	Chlorination
4.7 MLD	2015	SBR	3500-3600 mg/L	-	391 m^3/day	< 2 mg/L	No

SUGGESTED MODIFICATIONS:

1. The aeration should begin with filling so that the total aeration time becomes 2.24 hrs. (However, if the influent has a high nitrate-N concentration, which is not removed during primary treatment, the fill time should be unaerated). Dissolved oxygen during aeration time should be maintained at 3.5 mg/l
2. The current cycle includes settling time of 69 mins which should be increased to 3.2 hrs. till proper sludge quality is achieved.



Expected Output Parameters from Modelling

Malathahalli: 5 MLD

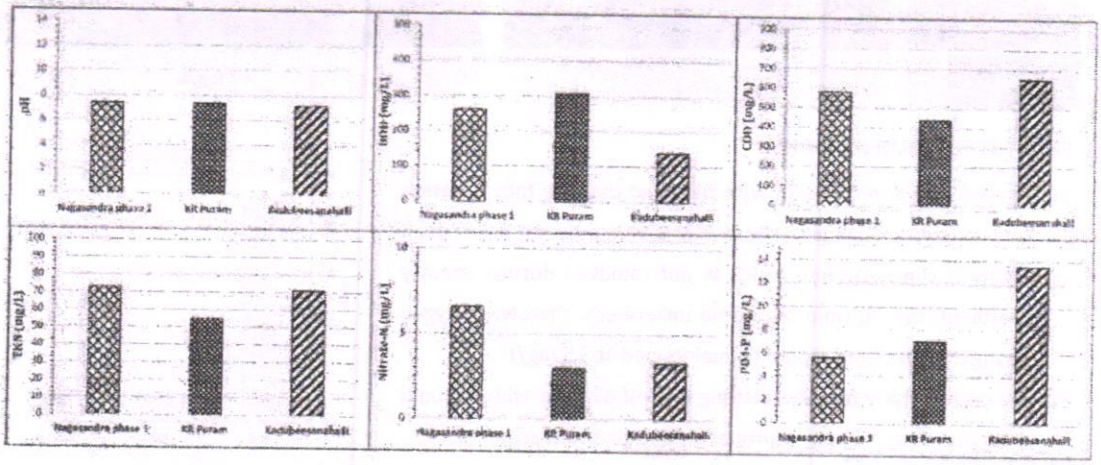
Current flow	Year	Operation technology	Claimed MLSS	RAS	WAS	Claimed DO levels	Chlorination
4.7 MLD	2018	SBR	3500-3600 mg/L	-	391 m^3/day	< 2 mg/L	No

FURTHER MODIFICATIONS REQUIRED:

1. Oil and grease traps should be installed in the primary treatment to remove excess oil and grease in the influent.
2. One Inlet screen needs repair, one blower needs to be replaced, and one centrifuge that is not working should be replaced.
3. In the case of diluted sewage, additional carbon may have to be added to the sewage to assure proper nutrient removal.

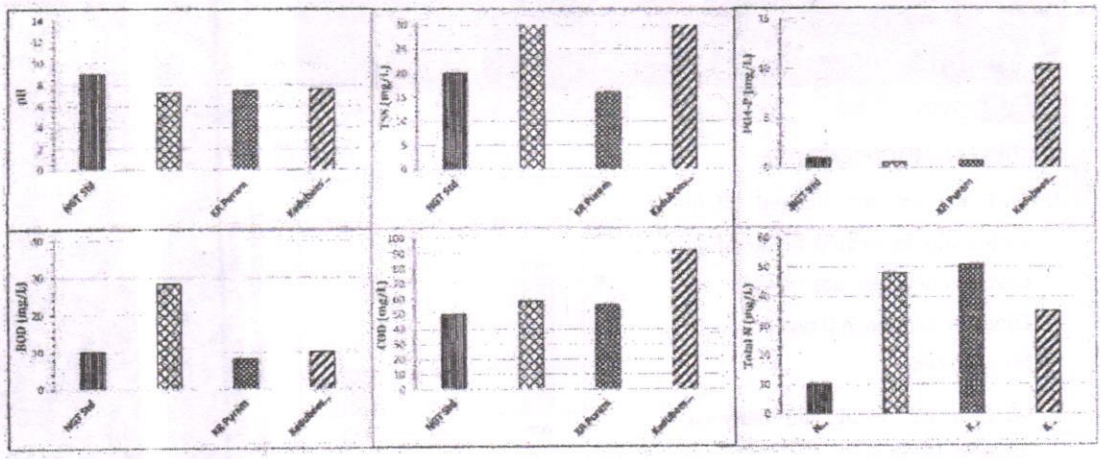
[redacted]

Poorly performing STPs: Inlet parameters



[redacted]

Poorly performing STPs: Outlet parameters

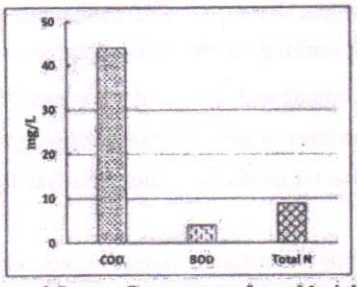


Kadubeesanahalli: 50 MLD

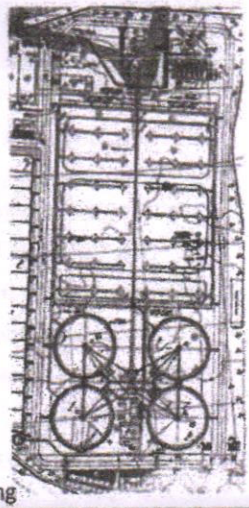
Current flow	Year	Operation technology	Claimed MLSS	RAS	WAS	Claimed DO levels	Chlorination
43 MLD	2005	EAP	-	60%	40%	-	No

SUGGESTED MODIFICATIONS:

1. Turn the aerators on and off in such a way as to split the aeration tank into three separate zones
2. Zone 1 is aerated at 2 mg/L. Zone 2 is unaerated, and zone 3 is aerated at 1 mg/L.
3. The MLSS value should be between 2500-3500 mg/L



Expected Output Parameters from Modelling

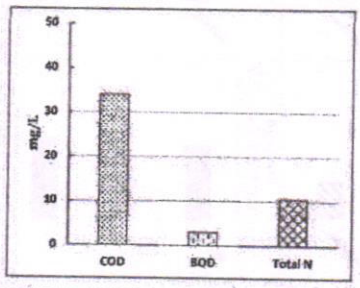


Nagasandra phase -1: 20 MLD

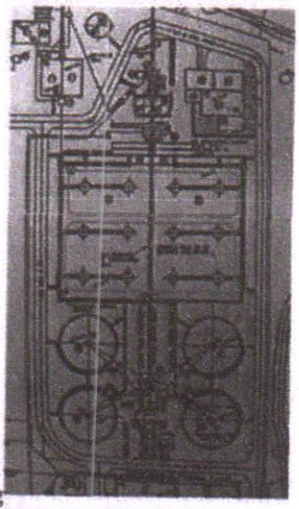
Current flow	Year	Operation technology	Claimed MLSS	RAS	WAS	Claimed DO levels	Chlorination
11 MLD	2005	EAP	-	-	-	-	No

SUGGESTED MODIFICATIONS:

1. Turn the aerators on and off in such a way as to split the aeration tank into two separate zones
2. Zone 1 is aerated at 2 mg/L. Zone 2 is unaerated.
3. MLSS levels should be between 3000-3500 mg/L.



Expected Output Parameters from Modelling



Nagasandra phase -1:

Current flow	Year	Operation technology	Claimed MLSS	RAS	WAS	Claimed DO levels	Chlorination
11 MLD	2005	EAP	-	-	-	-	No

FURTHER MODIFICATIONS:

1. The scraper mechanism should be inspected for rust, flow directional gates are broken and should be replaced. Other equipment should be checked and replaced.
2. Anoxic mixers are not working and should be replaced.
3. Surface aerators are running with noise and vibrations. There is a reduction in rpm due to multiple rewindings. Gearboxes have outlived their service life. If possible, shift to diffuse aerators.
4. The strength of material for clarifiers should be analyzed, and the system should be assessed and replaced accordingly.
5. Major flow meters are not working and should be replaced.

K R Puram: 20 MLD

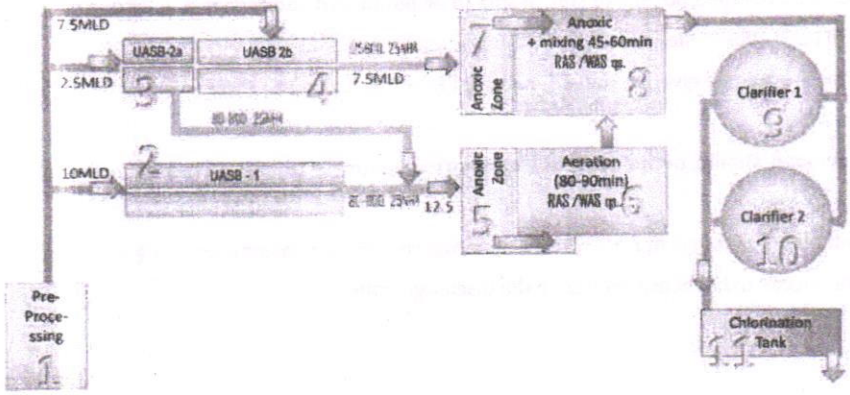
Current flow	Year	Operation technology	Claimed MLSS	RAS	WAS	Claimed DO levels	Chlorination methodology
11 MLD	2005	UASB + EAP	3500 mg/L	100%	0.8 MLD	2 mg/L	No chlorination

INITIAL SUGGESTED MODIFICATIONS:

- Primary treatment needs to be fixed. Any units/equipment that are not working should be inspected and repaired
- UASB downflow inlet pipes are blocked/clogged. These should be unclogged and made sure that they are working properly
- The UASB should be made operational so that no influent is bypassing it and proper nutrient removal occurs. The sludge quality and performance need to be monitored from time to time.
- The surface aerators should be inspected and fixed to make sure they are aerating properly
- MLSS in the aeration tank should be increased to optimal levels, ensuring proper removal of nutrients.

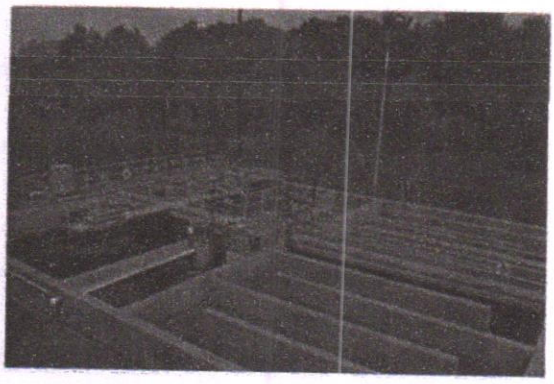
K R Puram: 20 MLD

FURTHER MODIFICATION:



General Recommendations:

1. Unclean Chlorine contact tanks with settled sludge and algal growth are increasing the COD of effluent.
2. Chlorine contact tanks should be thoroughly cleaned, tiled and painted with algae-resistant paint or coating, preferably in blue color.



General Recommendations:

3. All plant equipment such as screens, grit scrappers, flow meters, and aerators should be inspected and replaced wherever necessary.
4. The extent of non-settled portion of sludge should be monitored and reported daily as part of routine SVI and SSI test. This will allow timely tweaking of the process through SCADA.
5. Chlorine dose should be given to the effluent at all locations to reduce the concentration of pathogenic micro-organisms.
6. Chlorine demand should be monitored and reported routinely to ensure satisfactory disinfection is being done.
7. It is recommended that appropriate residual chlorine content is measured after at least 30 mins after chlorine addition and needs to be measured before the discharge point.

Acknowledgement :

BWSSB TEAM:
Sri Suresh S T
Sri Pavan N
Sri Miraganje M
Sri Raghu R
Sri Dharanish J
Srimati Vidya K
Sri Prakash S
Sri Girivasa M N

IISc TEAM:
Anirudha T P
Santrupt R M
Srimati Kavita Verma
Sohan Yadav
Shivani Kulkarni

THANK YOU!

Annexure-III

Additional information pertaining to National Green Tribunal Original Application No:111/2020 (SZ)

On the Original Application filed the Hon'ble National Tribunal has directed the Board to take up the rehabilitation / upgradation of existing old wastewater treatment plants to treat the wastewater to the following revised effluent treatment standards as prescribed by KSPCB:

Parameter	Measured unit	Standards prescribed by KSPCB	Revised standards prescribed by Hon'ble NGT in its original Application No.1069/2019 Dated 30.04.2019.
pH	pH Units	6.5 – 9.0	6.5 – 9.0
BOD-5	MG/L	20	10
TSS	MG/L	30	10
COD	MG/L	250	50
Total Nitrogen	MG/L	10	10
Total Phosphorus	MG/L	5	1
Total Coliform	MPN / 100 ML	100	Prescribed < 230 required < 100

Further as per the orders of the Hon'ble National Green Tribunal in O.A. No.1069/2018, it is required for the Board to take up similar upgradation works of existing 33 wastewater treatment plants of the City. The work of preparation of the feasibility report has been entrusted to M/s. Indian Institute of Science (M/s. IISc). After conducting site visits, detailed investigation, M/s. IISc have submitted the final feasibility report to the Board with recommendation to upgrade 20 nos STPs out of 33 existing STPs.

Further, based on the recommendations of M/s. IISc the 12 STP's upgradation works have been taken up under Dakshina Pinakini River basin and status of which are as follows:

Sl no	Name of STP	IISc recommendation	BWSSB Action Taken Status	Remarks
1	40 MLD STP at Rajacanal (Phase II)	BNR Removal, and CCT Tile laying and painting	The upgradation work awarded to the firm for installation of disc filter in order to achieve prescribed NGT parameters and CCT rehabilitation works	The work is under progress and shall be completed by end of 2025
2	20 MLD STP at Horamavu and construction of new 60MLD STP	BNR Removal, and CCT Tile laying and painting	The upgradation work awarded to the firm for installation of disc filter in order to achieve prescribed NGT parameters	The work is under progress and shall be completed by end of 2026

			and CCT rehabilitation works and Construction of new 60 MLD capacity STP.	
3	60 MLD STP at Hebbal	Construction of new 60 MLD capacity STP in lieu of existing 60 MLD STP	Construction of new 60 MLD capacity STP.	The work is under progress and shall be completed by end of 2026
4	40 MLD STP at Rajacanal (Phase I)	Electro-Mechanical equipments replacements, civil structures strengthening and other permanent measures	The upgradation work awarded to the firm for replacement of Electro-Mechanical equipments in order to achieve prescribed NGT parameters	The work is under progress and shall be completed by end of 2026
5	10 MLD STP at Yelahanka	Electro-Mechanical equipments replacements, civil structures strengthening and other permanent measures	The upgradation work awarded to the firm for replacement of Electro-Mechanical equipments in order to achieve prescribed NGT parameters	The work is under progress and shall be completed by end of 2026
6	50 MLD STP at Kadubeesinahalli	Electro-Mechanical equipments replacements, civil structures strengthening and other permanent measures	The upgradation work awarded to the firm for replacement of Electro-Mechanical equipments in order to achieve prescribed NGT parameters	The work is under progress and shall be completed by end of 2026
7	20 MLD STP at K R PURAM	Electro-Mechanical equipments replacements, civil structures strengthening and other permanent measures	The upgradation work awarded to the firm for replacement of Electro-Mechanical equipments in order to achieve prescribed NGT parameters	The work is under progress and shall be completed by end of 2026
8	90 MLD STP at Bellandur & Amanikere	BNR Removal, and CCT Tile laying and painting	The upgradation work awarded to the firm for installation of disc filter in order to achieve prescribed NGT parameters and CCT rehabilitation works	The work is under progress and shall be completed by end of 2025
9	60 MLD STP at K and C Valley	BNR Removal, and CCT Tile laying and painting	The upgradation work awarded to the firm for installation	The work is under progress and shall be completed by end of

			of disc filter in order to achieve prescribed NGT parameters and CCT rehabilitation works	2025
10	15 MLD STP at Yellammallpachetty	BNR Removal, and CCT Tile laying and painting	The upgradation work awarded to the firm for installation of disc filter in order to achieve prescribed NGT parameters and CCT rehabilitation works	The work is under progress and shall be completed by end of 2025
11	2 MLD STP at Ulsoor	BNR Removal, and CCT Tile laying and painting	The upgradation work awarded to the firm for installation of disc filter in order to achieve prescribed NGT parameters and CCT rehabilitation works	The work is under progress and shall be completed by end of 2025
12	6 MLD STP at Kadugodi	BNR Removal, and CCT Tile laying and painting	The upgradation work awarded to the firm for installation of disc filter in order to achieve prescribed NGT parameters and CCT rehabilitation works	The work is under progress and shall be completed by end of 2025

During 2020 BWSSB was treating 450 MLD of sewage only and after completion of 5 nos of STPs under Amrut and 2nos of STPs under Megacity Revolving Funds project, presently around 776.89 MLD is being treated under Dakshina Pinakin catchment.

After 2020 BWSSB has laid the Laterals, Submains and Trunk Sewers under 110 villages/CMC area which comes under Dakshina Pinakin catchment around 850KMs.

CE(WWM-E)
BWSSB

CE(WWM-W)
BWSSB

CE(P)
BWSSB

Annexure-IV

List of Under Construction STPs (BWSSB)						
Sl. No.	STP location	Proposed capacity (MLD)	Amount in crore	Technology used	Proposed date of completion of work	Status of the project
1	Kaggadasapura	5	26.38	SBR	31.12.2025	Under construction
2	Varthur	25	95.25	EA	-	After clearance of court case pending in Hon'ble Supreme Court and High Court, the construction work will be taken up
3	Bilishivale	17	61.61	SBR	31.12.2025	Under construction
4	Doddabetta hally	7	36.30	SBR	31.12.2025	Under construction
5	Jakkur	7	31.27	SBR	30.08.2025	Under construction
6	Yelahanka	6	38.29	SBR	31.12.2025	Under construction
7	Jakkur-down stream	10	29.33	SBR	23.9.2025	Under construction
8	Byrahikanne	13	49.68	SBR	26.9.2025	Under construction
9	Anjanapura	5	28.20	SBR	23.9.2025	Under construction
10	Rachenahalli	10	32.85	SBR	31.12.2025	Under construction
11	Horamavu	60	149.55	IFAS	23.9.2025	Under construction
12	Hebbal	60	139.40	IFAS	23.9.2025	Under construction
Total		**225.00**	**718.11**			

CE(WWM-East)
BWSSB

CE(WWM-West)
BWSSB

CE(P)
BWSSB

Annexure-V

List of proposed STPs (BWSSB)

Sl. No.	STP location	Proposed capacity (MLD)	Amount in crore	Technology used	Proposed date of completion of work	Status of the project
1	Madiwala	75	306.48	Sequential Batch Reactor (SBR)	After award of 36 months	DPR submitted to GoK for administrative approval and seeking for financial assistance
2	Kadabeesanahalli	50	234.46	Sequential Batch Reactor (SBR)	After award of 36 months	
3	Kadugodi	20	134.51	Integrated fixed –Film Activated sludge(IFAS)	After award of 24 months	
4	Koramangala	20	123.32	Integrated fixed –Film Activated sludge(IFAS)	After award of 24 months	
5	Basavanapura	10	75.64	Sequential Batch Reactor (SBR)	After award of 24 months	
6	Bellandur	60	324.75	Conventional ASP	After award of 36 months	
7	Kogilu	15	39.97	-	After award of 24 months	PMC appointed and Tender will be invited shortly
8	Channasandra	20	48.18	-	After award of 24 months	
9	Sowlkere	28	59.02	-	After award of 24 months	
10	Chikkabegur	15	39.97	-	After award of 24 months	
Total						

CE(P)
BWSSB

CE(WWM-East)
BWSSB

Annexure-VI

Analysis Report of Dakshina Pinakini River at Mugaluru Bridge from April - 2024 to February - 2025

Parameters	Units	Apr-24	May-24	Jun-24	Jul-24	Aug-24	Sep-24	Oct-24	Nov-24	Dec-24	Jan-25	Feb-25
Temperature	ºC	22	28	22	22	22	22	25	28	23	21	24
pH@25ºC		7.2	6.9	6.9	6.8	7	7.3	6.5	7.6	7.2	7.2	7.5
Conductivity @25^{0}C	us/cm	974	1439	1406	1235	968	1345	1224	1324	1458	1291	1234
Dissolved Oxygen	mg/L	BDL	BDL	BDL	BDL	2.2	BDL	BDL	1.4	1.2	BDL	BDL
BOD	mg/L	71	58	25	21	42	44	71	17	36	75	36
COD	mg/L	232	280	200	152	236	220	360	137	200	265	344
Nitrates as N	mg/L	5.6	5.01	BDL	4.98	3.4	5	4.7	1.4	6.8	5	4.74
Ammonical Nitrogen NH4-N	mg/L	---	---	---	---							
Ammonia as N		30	24	20.4	---	20	18	22.1	42	7.6	45	43
Total Kjeldahl Nitrogen	mg/L	40	32	26.5	36.4	28	24	25.8	54	8.4	58.5	60.2
Turbidity	mg/L	30	15.2	80.7	32.8	144	81	31.8	28	29	17.8	90
Total Hardnees as CaCO3	mg/L	276	292	380	300	212	460	332	296	400	316	340
Calcium as CaCO3	mg/L	144	152	196	156	112	232	172	168	204	156	176
Calcium as Ca	mg/L	58	61	78	63	45	93	69	67	82	62	70
Magnesium as CaCO3	mg/L	132	140	184	144	100	228	160	128	196	160	164
Magnesium as Mg	mg/L	32	34	45	35	24	55	39	31	48	39	40
Chloride as Cl	mg/L	196	160	220	172	120	244	204	120	244	196	192
Sodium as Na	mg/L	164	140	136	84	94	148	116	132	117	137	104
potassium as K	mg/L	32	29	18	7	31	23	24	32	29	26	32
Percent Sodium	mg/L	53	48	47	37	45	40	41	46	36	46	37
Sulphate as SO4	mg/L	23	22		21	32	33	50	34	59	24	21
P-Alkalinty as CaCO3	mg/L	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
T-Alkalinty as CaCO3	mg/L	428	340	396	392	220	436	284	248	340	464	112
Sodium Absorption Ratio (SAR)	mg/L	5.9	4	3	3	3	3	2.77	3.3	2.54	3.3	2.5
Free Ammonia	mg/L	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
TDS	mg/L	666	948	952	826	648	922	826	900	984	900	840
Total Suspended Solids	mg/L	40	22	106	42	14	110	36	36	34	26	118
Total Phoshate as P	mg/L	4.6	0.6	2.7	2.11	1.4	0.3	1.44	0.24	0.62	0.53	0.67
Ortho Phosphate	mg/L	1.4	1.6	7.4	5.57	3.6	0.9	4.24	0.65	1.64	8	1.6
Fluoride as F	mg/L	0.2	0.23	0.48	0.38	0.26	0.28	0.26	0.14	0.18	0.17	0.29
Boron as B	mg/L	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Bicarbonate(HCO3)	mg/L	BDL	340	396	392	220	436	284	248	340	464	112
Carbonate(CO3)	mg/L		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Total Coliform	MPN/100m	790	230000	7900	330000	3500	630000	4600000	14000	2800	110	4800
Fecal Coliform	MPN/100m	140	45000	780	68000	260	170000	920000	2700	170	14	2100
Cadmium	mg/L	BDL	---	---	---	---	---	BDL	---	---	---	---
Copper	mg/L	BDL	---	---	---	---	---	BDL	---	---	---	---
Lead	mg/L	BDL	---	---	---	---	---	BDL	---	---	---	---
Total Chromium	mg/L	BDL	---	---	---	---	---	BDL	---	---	---	---
Nickel	mg/L	BDL	---	---	---	---	---	BDL	---	---	---	---
Zinc	mg/L	BDL	---	---	---	---	---	0.138	---	---	---	---
Iron	mg/L	6.744	---	---	---	---	---	2.295	---	---	---	---
Manganese	mg/L	0.144	---	---	---	---	---	0.18	---	---	---	---
Fecal Streptococi	mg/L	---	---	---	---	---	---	---	---	---	---	---
Aluminum	mg/L	---	---	---	4.975	126	---	5.959	1354	2.986	1.35	---
Nitrite as N	mg/L	---	---	---	---	0.72	BDL	0.3	---	---	---	---
Total Dissolved Phosphate	mg/L	---	---	---	---	---	---	---	---	---	---	---
Oil & Grease	mg/L	---	---	---	---	---	---	---	---	---	---	---
INFERENCE		Class"E"	Class"E"	Class"E"	Class"E"	Class"E"	Class"E"	Class"E"	Class"E"	Class"E"	Class"E"	Class"E"

Class "B" - Out door bathing (organized).

Class "C" - Drinking water souce with conventional treatment followed by disinfection

Class "D" - Propogartion of wild life. Fisheries.

Class "E" - Irrigation, Industrial cooling, controlled Waste disposal.

Class "Below E" - Not meeting A,B,C,D & E Criteria.

Annexure-VII

BANGALORE DEVELOPMENT AUTHORITY

No.BDA/EE(E)/1142/2024-25 Dated: 26.03.2025

To:

The Member Secretary,
Karnataka State Pollution Control Board,
Parisara Bhavan, Church Street,
Bengaluru.

Sir,

Sub: Submission of report to the Petition No.125/2017 filed before the Hon'ble National Green Tribunal – reg.

******

With reference to the subject above, the latest progress report of the works undertaken in Bellandur Lake and Varthur Lake of Varthur Hobli, Bengaluru East Taluk as per the directions of the Hon'ble National Green Tribunal in Petition No.: 125/2017 is enclosed with this letter as per Annexures - 1 and 2 and forwarded for further action.

Thanking you,

Yours faithfully,

Sd/-
Executive Engineer,
East Division,
BDA, Bengaluru.

ANNEXURE – A

REJUVENATION WORK OF BELLANDUR LAKE

- As per the order of Hon'ble National Green Tribunal, rejuvenation work of Bellandur lake is being undertaken by the Bangalore Development Authority.

- The area of Bellandur lake is 916 acres and 17 guntas and it has a capacity of 0.42 TMC.

- After the completion of the comprehensive rejuvenation work, the capacity can be expanded from the existing 0.42 to 0.54 TMC and with an additional capacity of 0.12 TMC, the flooding that was happening in the catchment areas of the lake during monsoons can be prevented.

- A contract for Rs.100.30 Crores has been entered into with the contractor, M/s. RMN Infrastructures Ltd. on 23.11.2020, to carry out revival and development work of Bellandur lake and the work is scheduled to be completed within 18 months.

- During the removal of silt accumulated in the lake, due to high humidity and during the rainy season, obstruction of vehicular traffic in the yard of the lake, due to untimely rains, there is a delay in the work due to the protest of the local people at the specified places for removing the water stored in the lake and disposal of the silt, and due to non-cooperation of the traffic police to transport the silt in the morning (Day Time).

- At present, 70 percent physical progress and 88 percent economic progress has been achieved in the work.

- A permanent solution is being devised for the problems caused to the surrounding public due to foul smell and foam problem from the lake water.

- A diverted canal has been constructed to separate the polluted water coming from different sources into the lake.

- Sluice gates have been installed in the Kodi (Sluice) area of the lake to avoid the problems which were being caused by the flood situation due to the intensity of water during the rainy season.

- Disasters that may be caused by rain water in the surrounding area can be reduced by maintaining the Sluice Gates in a planned manner during floods.

- Chain link fencing has already been installed by the authority along the length of 11.26 km out of a total of 12.26 km. As there is a case in the court, excluding 1.00 km in Ambedkar Nagar limits on the northern direction of the lake yard, barbed wire fence has been installed in the remaining parts.

- Residents of Ambedkar Nagar have been rehabilitated by the Revenue Department and the Slum Clearance and during the clearance of the unauthorized buildings the slum dwellers have approached the court and brought an order of injunction. After the Court Case W.P.No.50953/2019 is

vacated and the unauthorized buildings are vacated, steps shall be taken to install chain link fencing.

- About 22.5 lakh cubic meters of silt accumulated in the lake has been removed. 70% of the work is complete. 30% physical progress has been achieved in wetland the works.

- At present rain water has been accumulated in 200 acres of the lake yard and as there is lack of grant, a proposal has been submitted to the Government for the grant and after the approval is obtained, it has been planned to take up and complete the work.

- Water coming from Koramangala - Agara Valleys is planned to be filled into the lake after treatment by Bengaluru Water Board.

ANNEXURE – B

REJUVENATION WORK OF VARTHUR LAKE

- As per the order of Hon'ble National Green Tribunal, rejuvenation work of Varthur lake is being undertaken by the Bangalore Development Authority.

- The area of Bellandur lake is 439 acres and 34 guntas and it has a capacity of 0.14 TMC.

- A contract for Rs.53.81 Crores has been entered into with the contractor, M/s. Star Infratech on 23.11.2020, to carry out revival and development work of Varthur lake and the work is scheduled to be completed within 18 months.

- During the removal of silt accumulated in the lake, due to high humidity and during the rainy season, obstruction of vehicular traffic in the yard of the lake, due to untimely rains, there is a delay in the work due to the protest of the local people at the specified places for removing the water stored in the lake and disposal of the silt, and due to non-cooperation of the traffic police to transport the silt in the morning (Day Time).

- A permanent solution is being devised for the problems caused to the surrounding public due to foul smell and foam problem from the lake water.

- A diverted canal has been constructed to separate the polluted water coming from different sources into the lake.

- At present, 97 percent physical progress and 94.46 percent economic progress has been achieved in the work.

- Sluice gates have been installed in the Kodi (Sluice) area of the lake to avoid the problems which were being caused by the flood situation due to the intensity of water during the rainy season.

- Disasters that may be caused by rain water in the surrounding area can be reduced by maintaining the Sluice Gates in a planned manner during floods.

- 8.06 km Chain link fencing has been installed around the perimeter of the lake to prevent encroachment of land area of the lake. About 17.22 lakh cubic meters of silt accumulated in the lake has been removed and the slit removal work has been completed and 98% physical progress has been achieved in the construction of wetland, remaining work is in progress and it has been planned to complete the same by 30.03.2025.