Chapter 4

Audit on Rejuvenation and Conservation of the Harmu River

CHAPTER 4
URBAN DEVELOPMENT AND HOUSING DEPARTMENT

Audit on Rejuvenation and Conservation of the Harmu River

Executive Summary

A project for rejuvenation and conservation of the Harmu river (10.4 km of its urban stretch), with the objectives of transforming the river into a vibrant water asset, with sparkling clean water, increased water intake and carrying capacity; and development of riverfront and enhancement of public amenities, was sanctioned (August 2014) by the Urban Development and Housing Department (Department), Government of Jharkhand. The work of the urban stretch was completed (October 2018) at a cost of ₹ 92.78 crore. As of November 2022, the project was under the operation and maintenance phase.

In view of the continuing media coverage about the unsatisfactory condition of the Harmu river, despite execution of the rejuvenation and conservation works, audit of the project was taken up to assess whether: (i) the project of rejuvenation and conservation of Harmu river was properly planned and executed, to achieve the objective of transforming the river into a vibrant water asset with clean water, by controlling its pollution (ii) post-execution operation and maintenance of the project was ensured and (iii) activities relating to monitoring and inspection were prescribed and conducted, as required.

Audit was conducted between March 2021 and April 2022, by test-check of records of the Department and Jharkhand Urban Infrastructure Development Company (JUIDCO), covering the period from June 2014 to March 2022.

Audit findings

- *The project objectives of transforming the river into a vibrant water asset with clean water could not be achieved. Water quality tests, carries out by the contractor, after completion of the project, indicated that sewage water had been flowing in the river. Quality test of water flowing in the Harmu river, conducted (April 2022) by Audit, through MECON Limited, revealed presence of faecal coliform, among other pollutants.*

- *A committee, comprising the Engineer-in-chief, Water Resources Department; Birla Institute of Technology (BIT), Mesra; BIT, Sindri, and the National Environmental Engineering Research Institute (NEERI), Nagpur, had reported (July 2019) that the works carried out under the project had failed to achieve the intended objectives and had produced no visible results.*

- *The State Government had not planned the project according to procedures laid down under the National River Conservation Plan (NRCP) guidelines (such as, preparation of City Sanitation Plan, quantification of sewage generation etc.) despite the advice of IIT, Mumbai. As a result,*

Government of India had turned down the request of the State for Central funding under NRCP, amounting to ₹ 55.03 crore, depriving the State of Central assistance for the project.

- *Against 14 major inlets terminating into the Harmu river at different locations, only nine inlets were connected to the sewer network. Discharge from the connected inlets, carrying sewage, was found falling into the river even during the dry season, owing to defective design. The remaining five unconnected inlets were directly discharging sewage into the river. In addition, 56 minor inlets, left unconnected to the sewer network, were also discharging sewage into the river.*

- *The sewerage network was designed for channelising only 22.15 million litres per day (MLD) sewage, for the ultimate year 2048, against the estimated sewage generation (year 2048) of 47.12 MLD, as calculated by Audit.*

- *The project was designed on the basis of reduced catchment area of 8.49 sq. km., against the total catchment of 22.59 sq. km. of the river, in violation of the Central Public Health and Environmental Engineering Organisation (CPHEEO) Manual. Additional Sewerage Treatment Plant (STP) of 10.5 MLD capacity, required to treat the extra sewage generated from the additional catchment, could not be constructed, due to non-availability of land.*

- *As against the approved eight STPs with a total capacity of 11.50 MLD, only seven STPs, with a total capacity of 10 MLD, were functioning and processing 2.898 MLD sewage per day, instead of the installed capacity of 10 MLD.*

- *The river cross-sections were designed (ranging between 15.45 m^2 and 33.25 m^2) with reduced value of coefficient of runoff, on the basis of flood discharge for a return period of 25 years, instead of 100 years. Though several cross-sections were widened (between 23.18 m^2 and 49.43 m^2) subsequently, on the basis of flood discharge for a return period of 50 years, the design discharge of the river (between Muktidham and meeting point with Subarnarekha river) was understated, in comparison to the actual discharge. This poses a risk of substantial damage to the entire cross-section of the river, in the event of actual flood discharge.*

- *The purpose of construction of the storm-water drainage system along both sides of the river (10.4 km stretch), was not achieved. The drains were blocked with silt, mud and solid deposits etc., and were found discharging sewage into the river (between Amaravati bridge and STP-5).*

- *Solid waste management, along the Harmu river, was poor. During joint site verification, most of the area around the river was found filled with mud and piles of garbage.*

- *Satellite images of different stretches of the river, during the last 12 years (October 2009 to June 2021), revealed a gradual decline in the green cover around the river, with the passage of time. The satellite images also revealed changes in the course of the river, reduction in the width of the river by 18.70 metres at Karma Chowk Bridge near Muktidham, encroachment of the riverfront etc.*

- *Measures for the sustainability of the operation and maintenance (O & M) activities were not planned. As against ₹ 6 lakh per year, allocated for the daily operation of sewage lifting pumps, for the seven STPs (total capacity 10 MLD), JUIDCO had been incurring electric charges at the rate of around ₹ 33 lakh per year. This made the O & M of the project unsustainable, without additional government financing. Generation of revenue, to meet the O & M costs, for ensuring the sustainability of the project, as envisaged in the NRCP guidelines, had not been explored and was not in place.*

Recommendations

1. Government may undertake a detailed study on reviving the origin and catchment area of the Harmu river; revise the estimation for storm water; and formulate a comprehensive policy, which clearly recognises urban runoff as a potential source of water for the Harmu river.

2. Government may revise the estimation of sewage quantities generated, considering the present and future growth of the population and prepare a plan of action, within a definite time frame, to prevent sewage from flowing into the river.

3. Government may urgently take steps to rectify the defects in the design and carrying capacity of the underground sewer system and consider the construction of additional STPs.

4. The Department may survey and work out the quantity of: (i) sewage being discharged, from all the identified major and minor inlets (ii) sewage being passed into the sewerage network (iii) sewage getting into the STPs and (iv) sewage flowing directly into the river, instead of being routed through the sewerage network. The Department may also examine the duration for which these STPs should be in operation, for ensuring the required filtration of the sewage.

5. Government may take steps to educate the urban population, living alongside the Harmu river, on the adverse effects of the unauthorised discharge of sewage into the river and explore the possibility of involving Residential Welfare Associations/Non-Government Organisations, for effective management of solid waste. The Department may also draw up a plan urgently, to resolve the problems arising due to improper management of solid waste, in and around the river, by involving RMC.

6. Government may, in coordination with RMC, take necessary action to identify and evict all encroachments on the river banks and its tributaries and maintain the stipulated buffer zone. For this purpose, periodical inspection of the river sites and tributaries and proper surveillance mechanisms, preferably in coordination with the Command, Control and Communication Centre (C4) at Smart city Ranchi, may be established.

7. The Department may ascertain the exact date of commencement of O & M, so that the five-year period can be reckoned. The exact period of trial run, commissioning and operation, may be confirmed and fixed. The Department may immediately switch over to LT electric connection, to make O & M viable and also explore the possibility of levying user charges against property connections.

4.1 Introduction

Harmu, a tributary of the Subarnarekha river, originates in a small hilly region near *Hehal*, Ranchi. It flows for 17.8 km (Rural stretch: 7.4 km and Urban Stretch: 10.4 km), and has a catchment area[1] of 30.670 sq. km (8.080 sq. km rural stretch and 22.590 sq. km urban stretch) before meeting the Subarnarekha river, near *Namkum*, Ranchi. The rapid urbanisation of Ranchi city created problems, such as the excessive influx of sediments from the catchment area, as well as the discharge of untreated sewage and solid waste, into the river; and encroachment of land along the river banks *etc*., resulting in deterioration of the water quality of the river.

A High-Level Monitoring Committee, headed by the Chief Secretary, Government of Jharkhand, had sanctioned (March 2014) the work of rejuvenation, construction of STPs and beautification of the Harmu river, in a stretch of two km, by utilising the 13th Finance Commission grant, at an estimated cost of ₹ 15 crore, for execution through Jharkhand Urban Infrastructure Development Company (JUIDCO). During the review (June 2014) of departmental schemes, the Chief Minister of Jharkhand had issued instructions to clean the Harmu river and construct STPs in a stretch of nine km.

The Urban Development and Housing Department (Department) appointed (June 2014) a consultant (M/s Tandon Urban Solutions Pvt. Ltd[2].), for the preparation of a Detailed Project Report (DPR) and Project Management Consultancy (PMC) services, for the rejuvenation and conservation of the Harmu river. The objectives of the project were to transform the river into a vibrant water asset with sparkling clean water, increased water intake and carrying capacity; development of the riverfront and enhancement of public amenities.

[1] *The area from which rain flows into a river, lake or reservoir.*
[2] *TUSPL*

The Consultant submitted (July 2014) the DPR comprising two phases (phase I for the urban stretch in a length of 10.4 kms at an estimated cost of ₹ 86.15 crore and phase II for the rural stretch of 7.4 kms at an estimated cost of ₹ 1.29 crore), indicating a total cost of ₹ 87.44 crore. On the request of the Department, the Indian Institute of Technology (IIT), Mumbai, carried out a technical appraisal of the DPR (for the urban stretch), on payment of a consultancy fee of ₹ 11.31 lakh. IIT, Mumbai, sent (August 2014) its technical appraisal report on the DPR, with the following observations:

- The DPR needed to be modified, keeping in view the guidelines of the National River Conservation Directorate (NRCD)[3].
- For the sewage collection system, the actual catchment area (22.59 sq. km.), that would be producing and discharging sewage into the Harmu river, should be considered.
- The actual runoff coefficient, as envisaged in the CPHEEO Manual and IRC-Special Publication (SP) 13, needed to be applied for city pavements, instead of the weighted average runoff coefficient.
- Novel ideas needed to be introduced, to divert dry weather flow to the sewerage system and storm-water (flowing in *nallas* and storm-water drains) to the river, during the rainy season.

The DPR for both the phases was accorded (August 2014) technical sanction (TS) for ₹ 87.44 crore by the Chief Engineer (CE), Technical Cell, of the Department. However, the issues flagged by IIT, Mumbai, had not been addressed before granting the TS. The project was to be executed by JUIDCO Ltd. The works proposed to be carried out under phase I and phase II, and its present status, are detailed in **Table 4.1**:

Table 4.1: Activities, timeline and present status of the project (phase I and II)

Phase	Activities	Timeline	Status (as of April 2022)
Phase I	Bank protection and river boundary, Sewerage system along the river, Low-cost sanitation, Storm water drainage system, Environment Management Plan, Pathways, plantation and elevated pathways, Public Participation and Awareness including information signage.	To be completed by 31 October 2018.	Completed in October 2018. Presently, under O & M.
Phase II	Weir with sluice gates in rural stretch, boundary wall in urban stretch, management of solid waste in rural and urban stretch	DPR to be finalised by May 2016.	Only Feasibility Report submitted. DPR not finalised, due to frequent revisions in the scope of work.

[3] *NRCD is located within the Ministry of Environment, Forest & Climate change, (henceforth, 'Ministry') Government of India. The Directorate provides financial assistance under the National River Conservation Plan (NRCP), to State Governments/Local Bodies, to set up infrastructure for pollution abatement of rivers, in identified polluted river stretches, based on proposals received from State Governments/ Local Bodies.*

Leaving the rural stretch, JUIDCO invited (December 2014) tender for the work of urban stretch (Phase I) and awarded (February 2015) it to a contractor (M/s Eagle Infra India Ltd.), for ₹ 85.43 crore (9.97 *percent* above the BOQ[4] value of ₹ 77.69 crore). JUIDCO executed (February 2015) an agreement with the contractor, for the completion of the project, by August 2017.

In the work order (February 2015), JUIDCO instructed the contractor to obtain approval (vetting) of the drawing and designs of the project work, from IIT, Mumbai, or any other recognised technical body. The work order further stipulated that all the necessary design and drawings, which were in the scope of work of the contractor, were to be approved by JUIDCO, as per site conditions, before execution of works. In addition, the contractor inked (June 2015) a Memorandum of Understanding with NEERI, Nagpur, for technical support (as knowledge partner) to the project.

The DPR was subsequently revised (February 2018) to ₹ 101.60 crore and completion of the project was extended up to October 2018, due to delay in handing over of the work site and execution of additional items. A supplementary agreement for ₹ 7.01 crore was also executed (September 2018), with the contractor, to cover payments of extra items and approved deviations.

The work of the urban stretch was completed on 31 October 2018, at a cost of ₹ 92.78 crore (₹ 86.26 crore as contractor's payment, ₹ 5.52 crore as centage to JUIDCO, and ₹ one crore as utility shifting and electricity bills). As of November 2022, the project was under the operation and maintenance stage.

Meanwhile, JUIDCO engaged (February 2016) another consultant (M/s IK Worldwide) for preparation of DPR and PMC services, for Phase II (rural stretch) of the project, afresh, including rectification works of Phase I. The DPR was not finalised (April 2022), even after a lapse of more than five years, due to frequent revisions in the scope of work. The consultant was paid (October 2016) ₹ 48 lakh (against total payable consultancy fee of ₹ 1.60 crore) for submitting a Feasibility Report.

Audit was conducted from March 2021[5] to April 2022, by test-check of records at the Department and JUIDCO, covering the period from June 2014 to March 2022, to ascertain whether: (i) the project of rejuvenation and conservation of the Harmu river was properly planned and executed, to achieve the objective of transforming the river into a vibrant water asset with clean water, by controlling its pollution (ii) post-execution operation and maintenance of the project was ensured; and (iii) activities relating to monitoring and inspection were prescribed and conducted, as required.

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[4] *Bill of Quantity*

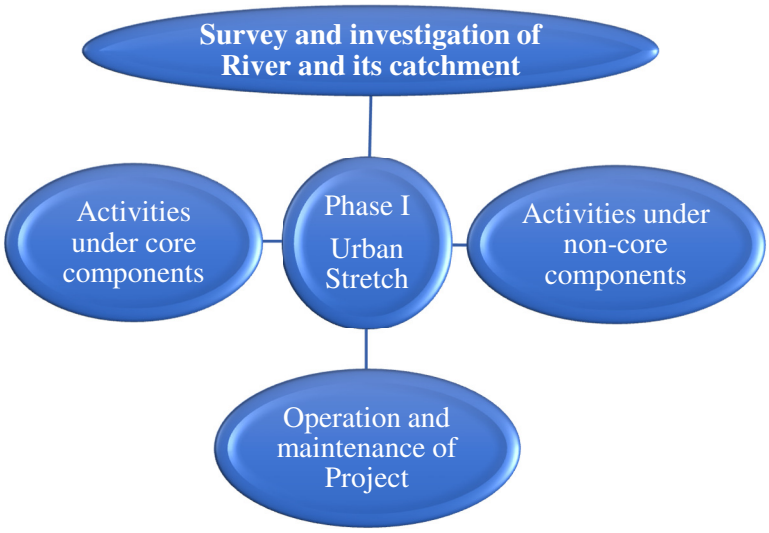
[5] *Excluding COVID restrictions imposed by the State Government from April 2021 to July 2021*

Entry (August 2021) and Exit (August 2022) Conferences were held with the Secretary of the Urban Development and Housing Department, to discuss the audit objectives, criteria[6], scope, methodology and audit findings. At the Exit Conference, the Secretary of the Department was briefed about the unabated flow of sewage water into the Harmu river, even after the completion of the rejuvenation and conservation project. The Secretary accepted the facts and agreed with the audit findings in the report. The Secretary also accepted all the audit recommendations and assured that remedial measures would be taken in this regard, in consultation with NEERI, Nagpur, which had been engaged as the knowledge partner of the project.

Audit findings

4.2 Planning

As per the technically sanctioned DPR of Phase I, rejuvenation and conservation of the river in the urban stretch was planned as under:



Activities, under the core and non-core components, were further planned to be taken up, as shown in **Table 4.2**.

Table 4.2: Components of the rejuvenation and conservation work of the Harmu river

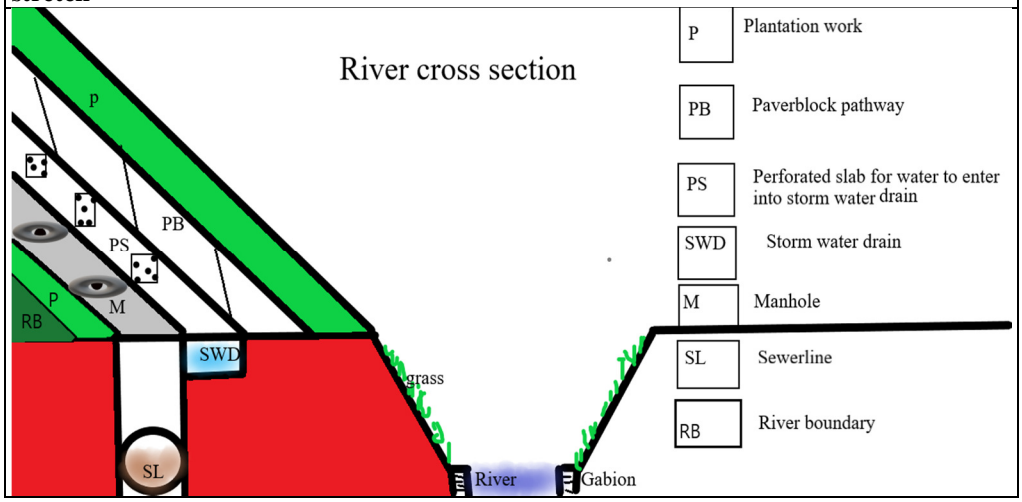
Core Components	Works to be done
Bank protection and river boundary	• Construction of gabion. • Construction of river boundary, with bollard and hedges.
Sewerage system along the river	• Improvement of six inlets, for channelising sewage into the underground sewerage collection network. • Construction of underground sewerage collection network, for interception and collection of sewage flowing through six inlets, sewage produced in riverside houses (250 metres on each side, covering a catchment area of 5.200 sq. km) and sewage generated in 33 low-cost toilet blocks.

[6] *(i) Manuals on sewerage and drainage issued by CPHEEO (ii) Jharkhand Public Works Accounts and Department Code (iii) Indian standard Codes (iv) Guidelines of Indian Road Congress on Urban Drainage (v) Guidelines issued under the National River Conservation Plan (NRCP) and (vi) Instructions issued by Central/ State Pollution Control Boards.*

Core Components	Works to be done
	• Construction of property connections from riverside houses. • Construction of nature-based Sewage Treatment Plants, for treatment of sewage flowing in the underground sewerage network. • Installation of solar street lighting poles, for area lighting around the operational area of the STPs.
Low-cost sanitation	• Construction of low-cost sanitation toilets, transformer, HT line and high yield drilled tube wells.
Storm water drainage system	• Construction of stormwater drainage system, for preventing solid waste and debris from getting into the river
Environment Management Plan	• Preparation of environment statement and analysis of samples, during the construction and operation phases.
Non-Core Components	**Works to be done**
Pathways, plantation and elevated pathways	• Construction of paver-block pathways. • Plantation of trees in bamboo guards. • Construction of elevated pathways for crossing the river.
Public Participation and Awareness including information signage	• Installation of retro-reflective signs, direction and place identification signs. • Organisation of seminars, workshops, educational material, banners *etc*.

Audit noticed that, neither the core nor the non-core components of the DPR, had any provision for creating a sustainable water source for the river, which is the main driver for rejuvenation of any water body. The pictorial representation of the cross-section of the Harmu river, in the urban stretch (prepared by Audit and authenticated by JUIDCO), along with the proposed execution of works, is shown in **Picture 4.1**:

Picture 4.1: Pictorial representation of the Harmu river cross-section in the urban stretch



The Department had submitted (November 2014) a proposal to take up the project, under the National River Conservation Plan (NRCP) of the Ministry of Environment, Forest and Climate Change, Government of India. Prior to the proposal, IIT, Mumbai, had advised (August 2014) the State Government to modify the DPR, as per NRCP guidelines. This was, however, not complied with. The NRCD rejected (March 2015) the proposal, as the project had not been planned in keeping with the guidelines of NRCP.

As a result, GoI did not accept the proposal for central funding under NRCP. Hence, the State Government could not avail the opportunity of Central assistance of ₹ 55.03 crore. In the absence of central assistance, the State Government sanctioned the entire cost of the project (except for ₹ 15 crore, sanctioned from 13 FC grants) under the State funds.

4.2.1 Planning deficiencies

River conservation projects are regulated by guidelines issued (December 2010) under the NRCP. The activities included under the NRCP, *inter alia*, cover components such as interception and diversion of raw sewage flowing into the river, construction of STP for treating the diverted sewage, low-cost sanitation works, river front development *etc*.

As per Annexure I of the NRCP guidelines, GoI considers River Action Plans or River Conservation Projects, on the basis of pre-feasibility report estimates, prepared by the concerned State Governments. After a project is approved *in-principle*, DPRs are to be prepared, with firmed up cost estimates for all components of the work. These DPRs are appraised and approved by the Ministry, following which administrative approval and financial sanctions are issued. The project costs, except for O & M cost which is to be solely borne by the concerned State Governments, are to be shared between the Central and State Governments in the ratio of 70:30. The guidelines further stipulate that the preparation of DPRs, for pollution abatement of rivers, should involve the following:

(i) Preparation of City Sanitation Plan (CSP), to convert the polluted stretch of a river, to a stretch having the desired quality of water.

(ii) Pre-feasibility/ Feasibility Report (FR) of sewerage schemes, to select the most suitable system for pollution abatement.

(iii) The DPR of sewerage schemes should ensure full coverage of the town, on the basis of detailed survey, investigation and engineering design, based on the standard procedures laid down in the CPHEEO Manual.

The above provisions were not followed by the Department while planning the project and the deviations, noticed by Audit, are as under:

✓ As per the guidelines, the FR of the project and CSP were to be submitted first and approved by the Ministry, before submission of the DPR. The FR needed to explain, in detail, the various alternatives considered for pollution abatement of the river and their cost comparison, along with justification for the selection of the alternative finally chosen. However, the State Government did not submit any FR and CSP to the Ministry before sending the DPR. This prevented the Ministry from getting assurance about the various alternatives considered by the State Government and the one finally chosen with justification. Accordingly, the Ministry informed the State

Government that the guidelines of NRCP were not adhered to before preparing the DPR.

✓ Basic details of sewage generation in the city, existing sewerage and STP facilities, gaps in sewage treatment capacity, quantity of sewage being drained into the river *etc*., though required, were not given in the project proposal. Also, the proposal submitted to the Ministry had little or no information about the mechanism to tackle the sewage load from Ranchi city, based on the existing and proposed sewerage system and STPs.

✓ The project proposal lacked details on river water quality data, indicating the pollution levels in the Harmu river, and the likely deterioration in the river water quality, due to sewage discharge.

✓ The sustainability of the project would depend on the generation of revenue, to meet the O & M costs of assets under the project. The proposal, however, did not have any O & M Cost Recovery Plan.

✓ Commitment of the State Government, to bear 30 *per cent* of the project cost, as well as the full O & M cost, was not provided.

The Department stated (July 2022) that the Rejuvenation and Conservation of the Harmu river project had been taken up considering the coverage in the proposed scope of the Sewerage and Drainage project of Ranchi, by the Ranchi Municipal Corporation (RMC).

The reply is not convincing, as: (i) RMC had not prepared any city sanitation plan for integrated disposal (existing and futuristic) of sewage for the entire city (ii) construction of the sewerage and drainage system though, taken up by RMC in Zone I of the city, had not been completed (April 2022), while, for the other zones, including where the Harmu river is located, no project for sewerage and drainage had been taken up (iii) the DPRs for the rejuvenation and conservation of the Harmu river and the sewerage and drainage projects, had been prepared and approved separately and were not integrated in any manner, which led to the rejection of the project, under NRCP Scheme, by the GoI.

During the exit conference (August 2022), the Secretary accepted the audit findings and stated that appropriate action would be taken, in keeping with the audit recommendations and through an impact study of the project, by NEERI.

4.3 Tendering and Project Supervision

4.3.1 Selection of contractor on the basis of experience certificate of a sub-contractor not involved in the work

As per condition 4.5 (c) of the Notice Inviting Tender (NIT), the contractor on its own, or identified subcontractor, was required to possess experience in the design, construction, and commissioning of STP (capacity of one MLD or

more), in phytorid[7] technology, or any such *in situ,* nature-based treatment process.

Scrutiny of the comparative statement prepared by JUIDCO showed that bids had been received from two contractors (M/s Jyoti Build Tech and M/s Eagle Infra India Ltd.). In the technical evaluation, the tender committee of JUIDCO disqualified M/s Jyoti Build Tech, due to non-submission of Form of Bid, bank solvency certificate and experience certificate (one MLD) of the identified subcontractor, as required in the tender conditions. However, the tender committee did not recommend re-tender and awarded (February 2015) the contract to the lone bidder, M/s Eagle Infra India Ltd., for ₹ 85.43 crore (9.97 *per cent* above the BOQ), on the Design, Build, Operate and Transfer (DBOT) model. The work included the execution of the project, followed by operation and maintenance for five years.

Audit examination of the tender files and bid documents, submitted by the successful bidder, revealed that the contractor (M/s Eagle Infra India Ltd.) did not have experience, either in phytorid technology, or in any nature-based treatment process, and had been considered qualified in the tender on the strength of experience certificate[8] of a subcontractor (M/s Inderdeep Construction Company, Ulhasnagar).

However, the contractor did not engage the said subcontractor, for executing the STP work and laying the sewer lines. This was confirmed to Audit by the concerned Project Engineers in JUIDCO, in reply to an audit questionnaire. Thus, the tender clause, which allowed contractors to bid for the tender on the strength of experience of identified subcontractors, was misused to bag the tender. Hence, an inexperienced and ineligible contractor was awarded the project work. This vitiated the entire tender process and requires further investigation.

The Department stated (July 2022) that the construction of STPs was done under the supervision of NEERI, which had patent over the phytorid technology. Further, in the exit conference (August 2022), the Secretary accepted the audit findings and stated that appropriate action would be taken in keeping with the audit recommendations and through an impact study of the project by NEERI.

The fact, however, remains that: (i) the overall supervision of the work by NEERI did not absolve the Department of its obligation to ensure that the contractor to whom the work was to be awarded complied with the tender requirements and (ii) the impact study of the project by NEERI was aimed at assessing the overall project outcome, besides measures for addressing the

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[7] *Phytorid technology, developed and patented by NEERI, Nagpur, works on the basis of natural method of treatment of sewage, using constructed wetlands.*

[8] *Three MLD capacity in soil bio-technology, claimed to have been done by the sub-contractor in Titiwala, Maharashtra, against which an experience certificate was issued by the Kalyan Dombivali Municipal Corporation.*

project shortcomings, but was, in no way, intended to set right the lapses in contract management.

4.3.2 Project Supervision

As per the DPR, the project work was to be supervised by the entities mentioned in **Table 4.3**.

Table 4.3: Entities mandated with supervision of the project

Entity	Contractual obligation	Audit observation
M/s Tandon Urban Solutions Pvt. Ltd., Mumbai (TUSPL)	Agreement (June 2014) between the Directorate of Municipal Administration and the Consultant	As per clause 2 (c) of the Agreement, the consultant was required to provide, in addition to the preparation of DPR, PMC services for the project, which included supervising the progress of work, in three visits, during the entire project execution period.
National Environmental Engineering Research Institute (NEERI), Nagpur	Memorandum of Understanding (June 2015) between NEERI and the Contractor.	NEERI was to provide an appropriate team to render technical guidelines *etc*., till successful completion of the project; supervise the execution of all works awarded under the MoU; provide supervision services for maintenance (for a period of two years, after the six months guarantee period, on completion of the project on need basis); and provide technical inputs *etc.,* for all the phases.

Audit scrutiny revealed the following:

(i) Though the agreement provided for PMC services by the Consultant through three supervisory visits of the works, the Consultant informed (April 2015) the Secretary of the Department that these visits would not be sufficient, and instead, stressed for full time supervision of the project, on the ground of the nature of the work being highly technical, such as laying sewer systems, improvement of storm water inlets, proper channelisation of the river *etc*. However, JUIDCO did not avail any supervision services by the Consultant during the construction phase of the works, for reasons not available on records in JUIDCO or the Department. The Department also did not respond to audit queries (December 2021) in this regard.

(ii) JUIDCO also did not avail of the supervision services of NEERI, during the maintenance phase of the project, after the end (April 2019) of the defect liability period.

Audit observed that, post-completion, the project had been suffering from continuous discharge of untreated sewage into the river (***paragraph 4.5.2, 4.6.1, 4.9***), deficiencies in the functioning of the STPs (***paragraph 4.6.2***), damaged storm-water drains (***paragraph 4.6.3***), poor solid waste management (***paragraph 4.6.4***), unabated encroachments, river fencing getting uprooted in the absence of any surveillance mechanism of river area (***paragraph 4.6.7***), poor water quality (equivalent to sewage water) in the river (***paragraph 4.6.5 (iii)***) *etc*. These operational failures indicate that the decision of the Department, in not availing of the PMC services (of TUSPL) during the construction phase, and supervision services (of NEERI), during the operation phase, adversely affected the project outcomes.

The Department stated (July 2022) that TUSPL did not offer a realistic scope of supervision of the project. The design and construction of STPs had been done by NEERI, which had a patent over phytorid technology and the services of NEERI could not be availed of during the O&M phase, due to travel restrictions under the COVID protocol.

The reply is not convincing, as the Department had not, in principle, agreed to the proposal of the Consultant for full time supervision of the project. Hence, in the absence of required consent from the Department, submission of detailed scope of supervision by the Consultant seems unrealistic. Further, in the exit conference (August 2022), the Secretary of the Department, accepted the audit findings and stated that appropriate action would be taken.

4.4 Survey and investigation

In the approved DPR, ₹ 43.92 lakh had been allocated for undertaking the survey and investigation. These included conducting a survey[9] of the river; hydrological studies (by taking measurements of the water levels at 500 metres intervals and taking 'current meter' observations[10] of the river); reporting (by printing of drawing on AutoCAD and preparation of area contour plan); geotechnical studies (through trial bores); and sampling of the river water (three samples at varying depths, at every 500 metres interval).

Scrutiny of the Measurement Books (MBs) of the concerned work, revealed that the components of the survey and investigation, except geotechnical and water sampling, were shown as having been completed in March 2016, but the recording of dimensions of river cross-sections at different intervals (500 metres, 50 metres etc.) had not been done. As a result of not conducting a proper survey of the cross-sections of the actual river course, the constructed portion of the river cross-sections (constructed without proper survey, identification of different inlets *etc*.) were damaged during the monsoon season (July 2016 and July 2017) near *Mukhtidham* (***paragraph 4.5.4***). The deficiencies noticed in regard to survey and investigation, are detailed below.

4.4.1 Identification of river inlets

The IRC: SP: 50-2013 (Guidelines on Urban Drainage) stipulates that serious efforts should be made for identification and separation of sewerage drains and storm-water drains, to prevent sewage from flowing into storm-water drains, in any part of the urban area, in order to avoid serious damage to the environment.

IRC: SP: 50-2013 also classifies storm-water drains into three categories: primary drains, secondary drains and tertiary drains. 'Primary drains' are

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[9] *Taking cross-sections, by use of the Differential Global Positioning System (DGPS), on either side, 100 metres from the river; stream canal, roads etc., at intervals of 500 metres, including within river sections and within banks; and at 50 metres intervals on critical locations of the entire stretch of the river and transmission mains.*

[10] *'Current meter' records velocity*

natural drainage systems, connecting a series of major water bodies, till their termination in particular catchment areas. They originate as tributaries of a river basin and receive water from one or more watershed regions, through secondary drainage networks, tertiary drainage networks or directly from roadside drains, during their course of flow.

Audit noticed that the consultant, while preparing the DPR, had mentioned the existence of only six inlets[11] that were terminating into the Harmu river, at different locations. However, during survey and investigation, the contractor, who had reportedly verified the cross-sections of the entire stretch of the river, at every 500 metres interval and at every 50 metres at critical locations, did not make mention of any additional inlets or drains, opening into the river. As mentioned in the DPR, the project works were taken up, based on the volume of discharge from these six inlets.

The Department, however, observed (July 2016 and 2017) heavy discharges in two consecutive rainy seasons, from eight additional major inlets[12], which had neither been reported by the consultant (in the DPR), nor by the contractor (during the survey and before the execution of the project works).

Audit observed (using *Google Earth* images) that all these 14 inlets had been in existence before the preparation of the DPR and the failure to include eight of these, by the consultant (in the DPR) suggested that the consultant had not undertaken the required survey. Further, the CE of the Department had not applied the required checks before approving the DPR, as discussed in the case study below.

Case Study 4.1

Audit examined the topography around the Harmu river, using a Google Earth image of 19 May 2004. It was noticed that two primary inlets near *Muktidham,* having coordinates $23^0$21’56.10”N and $85^0$18’32.23”E, were terminating into the Harmu river. These are marked as Inlet-1 and Inlet-1A, in the Google map below.

Picture 4.2: Satellite image (May 2004) of inlet 1 and inlet 1A

[11] *Inlets 1, 2, 3, 4, 5 and 6*

[12] *Inlets: 1A (between chainage 1900-2040 metres); 3A, 3B, 3C (between chainage 2040 -4068 metres); 6A,6B,6C and 6D (between chainage 6550-8500 metres)*

Though both the inlets were clearly visible in the Google map of 2004, the consultant identified only Inlet-1 in the DPR and not Inlet-1A. The CE, who had approved the DPR and granted TS, also did not verify the same. Even the contractor, who had reportedly conducted the survey and investigation, did not mention the existence of Inlet-1A. Inlet-1A was subsequently factored into the revised design, in February 2018, after it had caused heavy inflow and damage to the river embankments.

The CE subsequently considered (2018) these eight major inlets as tributaries to the Harmu river and as primary storm-water drains. The design was accordingly revised (February 2018), factoring in all these 14 inlets as the primary sources of discharge into the river. Audit observed that these inlets had been found carrying mixed discharge (sewage along with storm-water), in violation of IRC provision SP: 50-2013.

Meanwhile, NEERI had also conducted an inspection (September 2016) of the entire urban stretch of the Harmu river and had identified 56 minor *nallas,* in addition to these 14 major inlets. Though these *nallas* were found to have been discharging untreated sewage directly into the river, none of the *nallas* was factored into the revised design.

Thus, approval of the faulty design twice, by the Chief Engineer of the Department, without including eight major inlets, before the commencement of the project work, and 56 minor inlets, in the revised estimate despite the inlets having been reported by NEERI, proved detrimental to the achievement of the project deliverables. A four-member Committee[13] had inspected (July 2019) the project post-completion and reported that the project works had failed to achieve the desired goals and were unable to produce visible results (***paragraph 4.9***).

4.4.2 Assessment of discharges from inlets

As per para 3.10 of the CPHEEO manual, non-sewered areas are required to have a set of drains, where the generated sewer is to flow out. Assessment of flows in drains can be made through a variety of methods[14].

Audit observed, from the concerned files in JUIDCO, that the theoretical assessment of discharges from inlets/drains, for dry and peak periods, had not been verified practically (by any of the prescribed methods), either by the Consultant (during the preparation of the DPR), or by the Contractor (during the survey and investigation phase of the construction). As a result, NRCD (GoI) turned down the project proposal under NRCP, citing the absence of details about the: (i) actual sewage generation in the city (ii) existing sewerage

[13] *Headed by the Engineer-in-Chief, WRD and representatives of the Civil Engineering Departments from BIT, Mesra; BIT Sindri and NEERI, Nagpur.*

[14] *Para 3.1 of the CPHEEO Manual prescribes the float method, V notch method, the rectangular weir method, Palmer Bowlus flume, the Venturi Pipe or the Dall Tube, for measurement of flow in sewers/ drains.*

and STP facilities (iii) gaps in sewage treatment capacity and (iv) the quantity of sewage being drained into the river etc. (***paragraph 4.2***). However, the project works had been executed without addressing these issues.

Audit further observed that a Committee[15] had conducted an inspection (July 2019) of the project post-completion and recommended that the storm water and sewage quantities be estimated afresh, considering the present population and future growth, in the Harmu river basin. The Committee also reported that: (i) only minimal quantities of wastewater were being collected and treated at present, with the existing STPs in the Harmu river project (ii) many major drains were discharging raw wastewater into the river and (iii) urgent attention was required to accomplish the goal of clean water in the Harmu river (***paragraph 4.9***).

4.4.3 Inadequate survey work

Audit observed wide variation in the DPR provisions, for laying the sewer network (initially 19,249.80 m, but subsequently reduced to 17,494.67 m), and property connections (initially for 2,100 houses, but subsequently reduced to 933 houses), *vis-à-vis* the revised provisions, due to hard rocks found along 2.97 km (near the *Tapovan* stretch) and absence of inhabitants along 2.73 km (near STP 8) of the river stretch.

This indicated that no proper survey had been conducted, either by the consultant (before preparing the DPR), or by the contractor (under the survey and investigation components of the project), before commencing the project works. This resulted in sewage flowing directly into the river, as sewer lines could not be laid in these stretches, in the approved alignment.

The Department stated (July 2022) that the additional inlets were to be taken care of under the Sewerage and Drainage project of Ranchi, which, once set up, would prevent the flow of sewage into the Harmu river.

The reply is not convincing, as all the 14 major inlets were reported as natural drainage systems of the Harmu river by the consultant (who had prepared the DPR), and by NIT, Jamshedpur, in the revised DPR, under the rejuvenation and conservation project. Further, no Sewerage and Drainage project had been planned or executed, for checking the sewage flowing from these 14 inlets, into the Harmu river.

During the exit conference (August 2022), the Secretary accepted the audit findings and stated that appropriate action would be taken, in keeping with the audit recommendations and through an impact study of the project by NEERI.

[15] *Headed by the Engineer-in-Chief, WRD and representatives of the Civil Engineering Departments of BIT, Mesra; BIT Sindri and NEERI, Nagpur*

4.5 Design and drawing of project works

The contractor got the design of various components of the project approved (vetted) by three institutions ***(Appendix 4.1)*** *viz*. IIT, Mumbai (October 2015); BIT, Mesra (January 2016) and NIT, Jamshedpur (between December 2016 and November 2017). Audit noticed that BIT, Mesra had only provided a vetting report on the STP, with comments, but had not approved the design. In reply, Management of JUIDCO stated that, after incorporating the suggestions of BIT, Mesra, the design of the STP was approved by JUIDCO. Audit noticed the following deficiencies in the designing of various components of the project works:

4.5.1 Assessment of catchment area of the river

IIT, Mumbai, was associated with the project at two stages: (i) in the first stage, for providing technical appraisal of the DPR and (ii) in the second stage, for vetting the approved drawings and design prepared by the contractor, before commencement of the execution phase.

During the technical appraisal (August 2014) of the DPR, IIT, Mumbai recommended that the actual catchment area (22.59 sq. km.), that would be producing and discharging sewage into the Harmu river, should be considered for the calculation of sewage generation. However, when the contractor sent the drawing and design to IIT, Mumbai, for vetting, the catchment area of the river was reduced to 8.49 sq. km. (5.20 sq. km. for sewage produced from the riverside houses in 250 metres on either side of the river and 3.29 sq. km. for catchment of inlets), by IIT, Mumbai, in the final vetted report (October 2015), with a rider that the other parts of the city would be covered under different programmes on sanitation and sewage collection.

Audit observed that the Department (through RMC) had taken up (March 2015) a project for the construction of sewerage and drainage system in Zone I of Ranchi city, while the Harmu river lies in Zone II. The work of Zone I had not been completed and time extensions had been given (till February 2023). In the remaining three zones of the city, no works for sewerage and drainage had been taken up, till the completion of audit (April 2022). Thus, the city had no sewerage network, for intercepting and channelising the sewage generated from households, and preventing it from being discharged into the Harmu river.

Though the Department was aware of the fact that no operational sewerage and drainage system existed in Ranchi city, the approval for the lower catchment area (8.49 sq. km. instead of 22.59 sq. km. on the recommendation of IIT, Mumbai) had led to the estimation of discharge only from the limited catchment of 8.49 sq. km. into the river. However, the unabated flow of sewage into the river, through untapped inlets spread over the entire catchment of the river (22.59 sq. km.) caused severe damage during the rainy season (July 2016 and July 2017), exposing the deficiencies in fixing the river

catchment, as well as in the synchronisation of the rejuvenation works of the river, with the sewerage and drainage works undertaken by the Department. Subsequently, the catchment area was increased to 19.51 sq. km. by the contractor, which was approved by NIT, Jamshedpur, between December 2016 and April 2017.

The Department stated (July 2022) that the rejuvenation and conservation project was scoped based on the catchment area of 8.49 sq. km., on the premise that the Sewerage and Drainage Project would be treating the sewage generated (14.10 sq. km.) outside the catchment area of 8.49 sq. km.

The reply is not convincing, as the Department had not planned any integrated sewerage system for the city. The conception of rejuvenation and conservation of the Harmu river, by limiting it to 8.49 sq. km. and by claiming that the sewage generation, in the remaining 14.10 sq. km. of the catchment area of the river, would be taken care of through another project (Sewerage and Drainage Project), was not backed by any evidence, such as DPR *etc*. Further, it was in contravention of the CPHEEO Manual, which stipulates designing the sewer capacity based on the total tributary area (22.59 sq. km.).

During the exit conference (August 2022), the Secretary of the Department accepted the audit findings and stated that appropriate action would be taken, in keeping with the audit recommendations and through an impact study of the project by NEERI.

4.5.2 Designing of sewer networks

As per the CPHEEO Manual, the design period of conventional sewers should be 30 years from the base year. *Paragraph 3.5* of the Manual requires that, for the purpose of hydraulic design, estimated peak flows be adopted. Considering the design life of 30 years (with the base year being 2018 and the ultimate year being 2048), the sewerage system for the Harmu river should be designed taking the ultimate year as 2048.

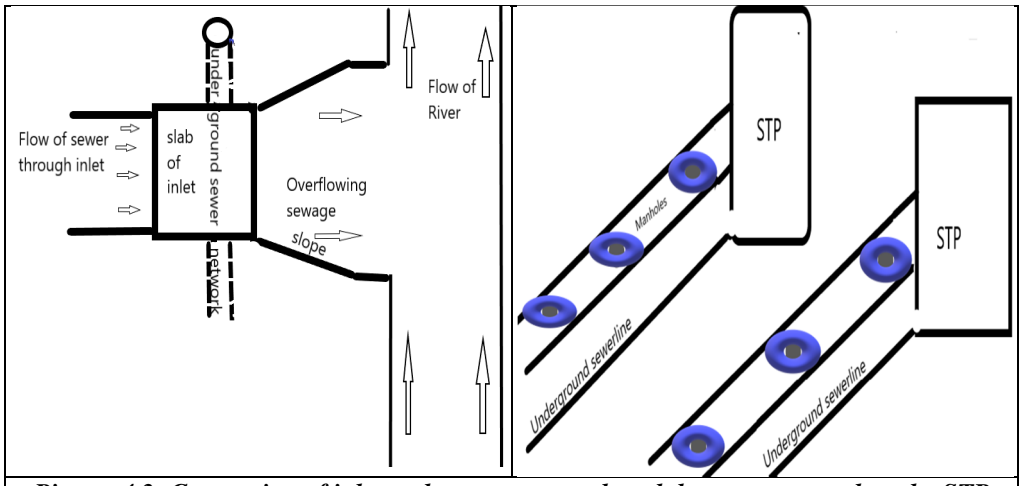
IIT, Mumbai, vetted the hydraulic design of the underground sewerage system, considering the inflow of sewage produced from riverside houses, six inlets and 33 toilet blocks and estimated (October 2015) 22.15 MLD of peak sewage generation, that would be directly discharged into the Harmu river for the ultimate year 2048. Based on these discharges, IIT, Mumbai, recommended 18,985 metres (17,254 metres of 300 mm diameter pipes and 1,731 metres of 450 mm diameter pipes) of sewer line (excluding manholes), in the underground sewerage network. These suggestions were approved by the Project Director (Technical), JUIDCO, and the works were executed based on these designs. However, the works of the river cross-section were damaged, due to heavy discharges during the rainy season (July 2016 and July 2017), in which eight additional major inlets, contributing to the discharges, were

noticed. Hence, the design was revised by the contractor and vetted by NIT, Jamshedpur, between December 2016 and April 2017.

Audit observed that, in the revised design, the catchment area of these inlets (14 inlets) was increased from 3.29 sq. km. to 14.31 sq. km. and the peak sewage discharge for the ultimate year was increased from 22.15 MLD to 47.12 MLD[16]. However, NIT, Jamshedpur, did not factor in the corresponding impact of the increase in sewage, on the width of the entire sewerage system (20.8 km long), except for a stretch of 150 metres[17].

This showed that a proper survey and investigation had not been carried out, before and after designing the sewerage network and the commencement of the work. The design vetted (with a rider) by IIT, Mumbai, was not examined, by the CE of the Department, before granting approval. The impact of the additional sewage discharge, on the dimensions of the sewerage network, left out by NIT, Jamshedpur, was also not examined by the CE of the Department. Thus, the CE of the Department failed to exercise mandatory checks, which led to a series of omissions and deficiencies ***(paragraphs 4.5.1, 4.5.3 and 4.6)*** in the design, drawing, construction and functioning of the project.

Audit noticed from concerned files that only nine[18] (out of the 14 major inlets) were connected to the sewer line, for disposal of sewage to STPs, for treatment. A pictorial representation (prepared by Audit) of the connection of inlets to the sewer line and the sewer line to STPs, is shown in **Picture 4.3**.



Picture 4.3: Connection of inlet to the sewer network and the sewer network to the STP

The connection of the inlet to the sewer network was designed to pass through a hump-like structure, so that excess discharge (*i.e.* discharge more than the capacity of the sewer line) from the inlets would cross the hump and fall directly into the river. The design was adopted to protect the sewer network from excessive flow of storm water in the rainy season.

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[16] *Sewage flowing through inlets: 32.43 MLD, Sewage produced from riverside houses (250 metres on either side of river): 12.97 MLD and Sewage produced from the proposed 33 toilet blocks: 1.72 MLD*

[17] *Near Muktidham, between manholes 63 and 67, where the width of the sewer line was increased from 350 mm to 800- 900 mm, for connection to STP 1*

[18] *1, 1A, 2, 3, 3A, 3B, 3C, 5 and 6*

Audit observed, from the files of the concerned works and during site verification of these inlets with the engineers of JUIDCO that discharge from nine of the 14 major inlets was overflowing the hump structure, even during the dry season (March 2021) and falling into the river. The remaining five major inlets[19] remained unconnected to the sewer line and were directly discharging sewage into the river. This indicated that the design of the sewerage network and its structures was faulty and could neither intercept the sewage from the inlets, nor prevent it from falling into the river.

Two case studies of major inlets (one connected to the sewer network and the other not connected to any sewer network) are presented below, to indicate how the inlets actually functioned, after they were put into operation, subsequent to completion of the project work, in October 2018.

Case Study 4.2

During joint physical verification (March 2021), Audit noticed that two primary storm water drains (categorised as Inlets 1 and 1A) were intercepted near *Muktidham* of the Harmu river and were connected to the underground sewer network (left side chainage 0-2050 metres). The excess sewage (*i.e.* sewage exceeding the capacity of the sewer network at the junction point of the inlet and the sewer network) from the drains was found directly flowing into the Harmu river, even during the dry season (March 2021). These drains originated near *Hehal pahar*, *Ratu road* and *Pahari Mandir,* respectively, and carried sewage, solid waste, *etc*., from a distance of about 1.300 km to 3.320 km (covering a catchment area of 4.3 sq. km.). As per Audit analysis, a four MLD dedicated STP was required ***(Appendix 4.2)*** for treating the sewage flowing through these drains. However, these drains were connected to STP 1 (1.5 MLD) through the underground sewer network, which was not sufficient to intercept the sewage and treat it before it was discharged into the river.

As a result, the excess sewage was being directly discharged into the Harmu river, without any treatment, despite the designs having been vetted by IIT, Mumbai; BIT, Mesra and NIT, Jamshedpur. This defeated the basic objective of rejuvenating and conserving the river.

Picture 4.4: Overflowing inlet 1 in the dry season (March 2021)

[19] *4, 6A, 6B, 6C and 6D*

Case Study 4.3

Argora Nalla (a primary drain, categorised as inlet 4), a tributary of the Harmu river, originates 9.17 km away from the Harmu river, near the *Argora bypass road* and meets the river near *Nibaranpur*. During joint physical verification (4 May 2022), Audit noticed that the junction point was located in the *Tapovan* stretch ***(Paragraph 4.6.1)***, where no underground sewer network had been constructed. In the absence of a sewer network, the drain was carrying sewage (0.47 MLD) from its catchment (0.64 sq. km.) and discharging it directly into the Harmu river. In addition, the *Argora nalla* had been encroached upon by unauthorised *khattals*[20], particularly in *Gouri Shankar Nagar*, Doranda, resulting in discharge of a significant quantity of cow-dung and other solid waste *etc*., directly into the *nalla*. The *Argora nalla* was carrying this untreated sewage to the Harmu river, contaminating its water. Government, therefore, needs to take urgent steps, to prevent discharge of sewage, dung, solid waste *etc*. into the storm water drains (*Argora nalla*) by taking steps to remove encroachments; ensure cleaning of the inlets at regular intervals; ensure monitoring of the area through satellite images; and consider constructing a STP on the *Argora nalla* itself, before it meets the Harmu river at *Tapovan*.

Picture 4.5: Discharge of sewage directly, through Inlet 4, into the Harmu river

The Department stated (July 2022) that, after implementation of the Sewerage and Drainage Project, the additional flow of sewage (*i.e.* sewage exceeding the design capacity) into the Harmu river would be restricted.

The reply is not convincing, as: (i) the Department did not provide any evidence that the Sewerage and Drainage Project has been designed to cater to the inflows from the natural inlets of the Harmu river (ii) additional STPs for the increased flow from additional inlets were proposed, in the Phase II DPR,

[20] *Sheds for cows and buffaloes*

but were dropped due to non-availability of land (iii) nine out of 14 major inlets were connected to the under-capacity sewerage system, which had been designed for connection of only six major inlets.

During the exit conference (August 2022), the Secretary of the Department accepted the audit findings and stated that appropriate action would be taken, in keeping with the audit recommendations and through an impact study of the project by NEERI.

4.5.3 Designing of STPs

4.5.3.1 Designing of under-capacity STPs

As per paragraph 2.5 of the CPHEEO Manual, the design period of an STP has to be for 15 years from the base year. As the base year of sewerage system of the Harmu river was 2018, the design of the STP should have been for the intermediate year 2033. The peak/ average sewage generation, for the intermediate year (2033), is shown in **Table 4.4**.

Table 4.4: Comparison of total sewage generation

Particulars	Calculated by Audit for the intermediate year (2033). Peak/average (in MLD) (*Appendix* 4.2)	Estimate vetted by IIT, Mumbai, for intermediate year (2033). Peak/average (in MLD)
Sewage flowing through inlets	26.41/13.20	6.08/3.02
Sewage likely to be produced from riverside houses (250 m on either side of river)	10.55/5.28	10.55/5.28
Sewage likely to be produced from the proposed 33 toilet blocks	1.72/1.72	1.72/1.72
Total	38.68/20.20	18.35 /10.02
Note- The main reason for difference in quantities of peak/average sewage generation was on account of factoring in catchment area of six inlets by IIT, Mumbai and 14 inlets by Audit.		

Audit noticed that the consultant, who had prepared the DPR, had recommended eight STPs, with a total capacity of 11.50 MLD. The contractor submitted this to BIT, Mesra, for vetting. In its initial vetting report (January 2016), BIT, Mesra, did not approve the design period, design basis and the method adopted by the consultant for working out the capacity of the STPs. BIT, Mesra, advised that these issues be checked by the client (JUIDCO).

Audit worked out the total capacity (due to increase in catchment area arising from recognition of eight additional inlets) of the STPs, that would be necessary, to treat the increased quantity of sewage and noticed that STPs, with a total capacity of 20.20 MLD (*i.e.,* an additional capacity of 8.70 MLD) were required, instead of 11.50 MLD, as approved in the DPR (based on consideration of six inlets only). JUIDCO also assessed (February 2018) the requirement of additional STPs of 10.5 MLD capacity (factoring in the additional inlets), but the proposal was dropped, due to non-availability of land.

Thus, due to the installation of under-capacity STPs, untreated sewage is being discharged directly into the river.

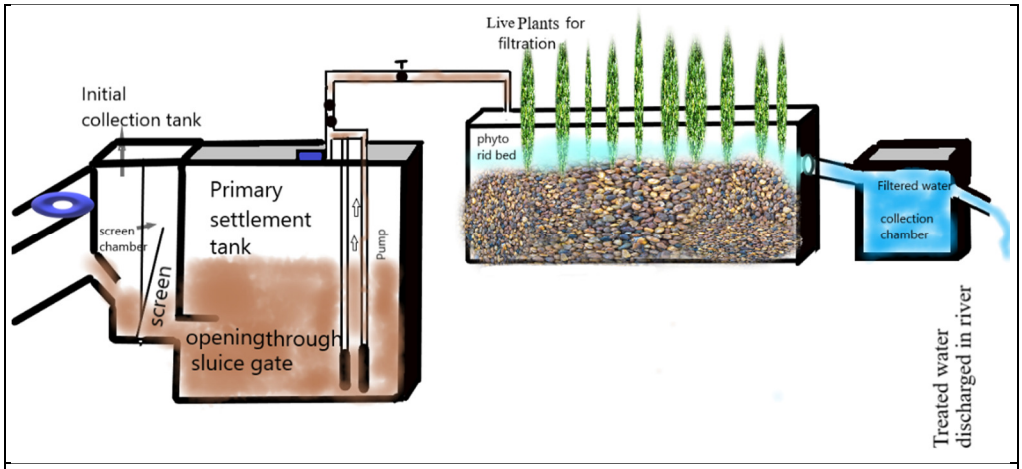
The Department stated (July 2022) that the additional inlets were to be taken care of under the proposed Ranchi Sewerage and Drainage Scheme and, once it becomes operational, the flow of sewage from the additional inlets would be taken care of.

The reply is not convincing, as (i) the additional STPs of 10.5 MLD capacity was dropped due to non-availability of land and not because of these being proposed to be taken care of by Ranchi Sewerage Scheme; (ii) the claim of the Department that the sewage from additional inlets would be taken care of through the Sewerage and Drainage Project, was not backed by any evidence, such as DPR *etc*. and (iii) the Department had not planned any integration between the Sewerage and Drainage Project and the Harmu River projects for the city.

In the exit conference (August 2022), the Secretary of the Department accepted the audit findings and stated that appropriate action would be taken, in keeping with the audit recommendations and through an impact study of the project by NEERI.

4.5.3.2 Designing of the components of STPs

As per the approved design, the sewage, after flowing through the sewer network, is to be collected in the initial collection tank (ICT) of the STP. Thereafter, floating matter, such as sachets, plastic milk packets, grocery bags *etc*., are to be screened out in the screen chamber and the sewage is to enter the primary settlement tank (PST), through the sluice gate, where its retention time is 48 hours. Then, the sewage is to be pumped through the sewage lifting pumps, from the PST, to the phytorid bed, where it is to be retained for another 48 hours, for carrying out the process of filtration. Thereafter, the filtered water is to be collected in the collection tank, for chlorination. The treated water is to then be discharged into the river, or reused. Pictorial representation of the design of the STP, prepared by Audit, is shown in **Picture 4.6**.



Picture 4.6: Design of the STP

As per the CPHEEO Manual[21], for retention of wastewater for 48 hours in the Primary Settlement Tank (PST) and the Phytorid bed, the size of these two structures should be double of the per day filtration capacity of the STP. Thus, for treatment of 11.5 MLD of wastewater, as per the DPR, their capacity should be 23,000 cubic metres (m^3), for retention of 23 MLD (11.5 MLD*2) of wastewater for 48 hours.

(i) Under-capacity of PST and Phytorid beds of STP

In seven STPs (10 MLD capacity[22]), Audit noticed that, instead of providing Primary Settlement Tanks (PSTs) and phytorid beds of 20,000 m^3 each, for retaining wastewater, these structures were designed and constructed for a total capacity of 5,399.68 m^3 for PSTs and 7,734.24 m^3 for phytorid beds[23]. This resulted in designing of lower capacity of the PSTs (by 14,600.3 m^3) and phytorid beds (by at least 12,265.76 m^3), ultimately, resulting in reduction of retention hours. BIT, Mesra, also suggested increasing the capacity of PST and phytorid bed, in its initial vetting report, but this was not done. Thus, the STPs were not designed and constructed, as per the requirements specified in the CPHEEO Manual.

Audit conducted (October 2021) joint physical verification of STP-2 (capacity 1 MLD) and observed that it had two phytorid beds, each having a capacity of 571.20 m^3. The motor operator of STP-2 informed Audit, in the presence of the Project Engineer, that the pump (having capacity of 46 m^3 per hour) was being operated in three spells (8 to 9.30 AM in the morning, 12 PM to 1.30 PM in the afternoon and 4 to 5.30 PM in the evening). He further stated that, after operation of the motor for one and half hours, one phytorid bed gets filled.

Thus, in one and half hours, the motor could pump only 69 m^3 (46 m^3 x 1.5 hours) of wastewater, indicating that there was only empty space of 69 m^3 for sewage, with the rest being occupied by gravel, boulders, and plants. Further, within two to three hours, sewage passed from the first to the second phytorid bed of the STP, through gravity. Thus, the maximum retention time for wastewater, in the STP, was four and a half hours, in place of 48 hours. Further, STP-2 could filter only 0.207 MLD (69*3= 207 m^3 of water *i.e.,* 2,07,000 litre), instead of one MLD of wastewater per day.

Thus, the STPs were not working as designed, which was evident from the quality test report of the treated water, as discussed in ***Paragraph 4.6.2.4***.

(ii) Approval of under capacity collection tanks of STPs

BIT, Mesra, recommended, in its initial vetting report, that the capacity of the final collection tank (for treated water) should be 41.7 m^3/hour (41,700 litres

[21] *Retention time= volume of tank (m^3)/sewage inflow (m^3/day)*
[22] *STP-3, having 1.5 MLD capacity, was not constructed, as no land was available*
[23] *Occupied by gravel, plants and empty space for wastewater*

per hour*24 hours= 1.0008 MLD), for an STP of one MLD capacity and 62.5 m^3/hour (62,500 litres per hour*24 hours= 1.5 MLD) for an STP of 1.5 MLD capacity.

On the contrary, JUIDCO approved 60 m^3 per hour, as the capacity of the final collection tank, for every STP. Thus, instead of 62.5 m^3 per hour for 1.5 MLD capacity (STP 1, 3 and 5) and 83.34 m^3/hour for 2 MLD (STP 4 and 6), a lesser capacity of 60 m^3 was approved, entailing the risk of overflow of treated water in the STP.

(iii) Absence of sludge management in the STPs

BIT, Mesra, stated that the design of the eight STPs did not have any scope for solid (sludge) management from the PST (primary treated sludge), the phytorid bed and from the collection tank.

During joint physical verification (October 2021), Audit noticed solid (sludge) deposits in chambers before STP-5 and in front of the screen chamber of STP-5, as shown in **Picture 4.7**.

Picture 4.7: Chamber before STP-5 and the screen chamber of STP-5, filled with solid deposits

The engineers, who accompanied Audit during the site verification, stated that these solid wastes were being cleaned regularly. However, the approved sludge management technique and the manner of disposal of the sludge, could not be explained to Audit.

During the exit conference (August 2022), the Secretary accepted the audit findings and stated that appropriate action would be taken, in keeping with the audit recommendations and through an impact study of the project by NEERI.

4.5.4 Designing of river cross-sections and embankments

As per clause 3.2 (degree of protection) of IS 12094: 2000 (Guidelines for planning and design of river embankments), the height of the embankment and the corresponding cost and benefit-cost ratio should be worked out for various

flood frequencies[24], taking into account the damage likely to occur. The degree of protection which yields the maximum benefit-cost ratio should be adopted. Till such time as the details of all relevant parameters are available, embankment schemes should be prepared for flood frequency of 100 years, for works pertaining to protection of towns.

Audit noticed that the consultant/contractor had not calculated the benefit-cost ratio for designing the embankments of the Harmu river, and, instead of taking into account a flood frequency of 100 years, the river cross-section (chainage 0-10,400 metres) was designed for a return period[25] of 25 years. After damage of the river reaches[26] during two consecutive monsoon seasons, the river cross-sections of the damaged reaches, along with downstream reaches[27], were redesigned at a cost of ₹ 10.58 crore, which included widening of stretches by gabion work, boulder pitching and crated apron in the riverbed, based on a return period of 50 years. Even in the revision, the flood frequency of 100 years was not considered, in violation of the specified norms.

JUIDCO reported that the main damage, particularly riverbed scouring and bed erosion, had resulted from heavy discharge from the inlets and flood flow of the river. Audit analysis revealed the following shortcomings in the designing of the river cross-sections.

4.5.4.1 Designing of narrow river cross-sections

Cross-sections of the Harmu river was designed to accommodate the dry weather flow, monsoon flow and flood discharge[28] for a rainfall of 25 years return period. The design was made on the premise that the cross-sections of the river should be able to safely accommodate any discharge equivalent to the highest ever flood discharge noticed during the last 25 years.

To ensure this, IIT Mumbai, used the rational formula[29] for estimation of flood discharge, which, denotes the run-off from the river catchment[30]. This was arrived at by the multiplication of three factors- the coefficient of runoff[31], catchment area and rainfall intensity[32].

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[24] *Flood frequency means a period of years, based on a statistical analysis, during which a flood of a stated magnitude may be expected to be equaled or exceeded.*

[25] *The probability of occurrence of the highest flood in a period of 25 years.*

[26] *Damage of chainage: 1900 -2040 metres in July 2016 and 2069 -4068 metres in July 2017*

[27] *Chainage 1900- 2040 metres, 2040 -2180 metres, 2069 -4068 metres, 4630 -4883 metres, 6950- 7800 metres, 7800 -8500 metres*

[28] *The volume of water flowing through a river channel*

[29] *A method for calculating flood discharge through runoff from catchment Q= 10 CiA, where Q= Runoff from catchment in m^3/hour, C: Runoff co-efficient, i= intensity of rainfall, A= area of drainage, in hectare.*

[30] *Runoff from the catchment is that portion of precipitation, which drains over the ground and reaches the river. It depends upon the coefficient of runoff.*

[31] *As per Para 3.9 of the CPHEEO manual and IRC-SP-13-2004, it is the imperviousness of the drainage area (which restricts absorption of water by the ground) to allow the water to flow through the ground into the river. It varies from 0.10 to 0.90, for sparsely to densely built-up areas, in the river catchment.*

[32] *Rainfall intensity= Total rainfall (in centimeter)/Time interval of rainfall*

IIT, Mumbai, in a meeting (July 2014) with the CE of the Department and the Consultant (TUSPL), stated (July 2014) that the coefficient of run-off (for storm water) should be 0.95, in a developed area. However, in the final vetted (October 2015) report, IIT, Mumbai, reduced the coefficient of runoff to 0.29, based on the weighted average, on the premise that, in the river stretch, the urban area was very less, compared to other areas. Further, the vetting was made with a rider that, with the increase in urbanisation, the value of the coefficient of runoff may change, and JUIDCO should revise it accordingly, after 10 to 15 years.

Audit noticed that the observation of IIT, Mumbai, was not backed by any specific rationale, as 10.4 km (catchment 2,259 Ha.) of the river stretch (out of 17.8 km length of the river) was inside the urban area (comprising mostly of city pavements, *i.e.,* concrete structures), for which a weighted average (for soil comprising of a mixed nature[33] having different coefficient of runoff) was not required. The coefficient of runoff, therefore, should have been worked out on the basis of the nature of the soil, the extent of urbanisation and concrete structures, for different chainages.

Comparison of the actual design discharge of the river, calculated in the vetting report of IIT, Mumbai, and the calculations of design discharge later forwarded (July 2017) to NIT, Jamshedpur, by JUIDCO (based on the data of consultant- IK Worldwide, engaged for preparation of the DPR of Phase II of the project) for vetting, are shown in **Table 4.5**.

Table 4.5: Comparison between the discharge of river, calculated in the vetting report of IIT, Mumbai, and the calculations of design discharge forwarded to NIT, Jamshedpur, by JUIDCO

Chainage[34] (m)	Design Discharge in m^3/sec			
	(25-year return period)		50-year return period	100-year return period
	IIT, Mumbai (report)	Calculations of design discharge forwarded to NIT by JUIDCO		
843m before 0m	24.34	56.26	64.99	73.73
0	30.07	-	-	
2050	32.94	84.38	97.49	110.60
Chainage 10,400[35]	64.11	177	206	235

As may be seen from the table, the design discharge for the 25-year return period, calculated by IIT, Mumbai, was far below the calculations of design discharge forwarded by JUIDCO to NIT, Jamshedpur. Based on these understated discharges, IIT, Mumbai, proposed narrow river cross-sections (ranging between 15.45 m^2 and 33.25 m^2) for the 10.4 km urban stretch of the river. Accordingly, the river cross-sections were damaged in different

[33] *As per IRC -SP 13, run-off co-efficient of soil comprising of - bare rock and city pavement is 0.90; plateau (0.70-0.80), clayey soil (0.50-0.60), loam (0.30-0.40) and sandy soil (0.10-0.20)*
[34] *An imaginary line used to measure distance.*
[35] *Chainage 10,400 denotes the end point of the Harmu river.*

stretches during the monsoon season, when they were subjected to heavy flood discharge.

Audit noticed that the river cross-sections in the damaged stretches, as well as downstream stretches, were subsequently increased, to a significant extent, by NIT, Jamshedpur, in different reaches (ranging from 23.18 m^2 to 49.43 m^2), as detailed in ***Appendix 4.1***.

4.5.4.2 Revision of river cross-sections

The basis of design discharges, sent to NIT, Jamshedpur, by JUIDCO, was the design discharges calculated by M/s IK Worldwide (another consultant appointed for the preparation of the DPR of Phase II in the rural stretch). Audit noticed that M/s IK Worldwide had calculated the design discharge at three locations. Scrutiny of the co-ordinates of these locations revealed that the first location was at 843 metres before the zero point of urban stretch, the second location was near *Muktidham* and the third location was at the endpoint of the river. NIT, Jamshedpur, wrongly interpreted these locations and considered discharges of the first location (843 metres before the zero point of the urban stretch) for revision of the river cross-sections near *Muktidham* (which was 2,893 metres away from the point that had mistakenly been reckoned).

This led to further understating of the design discharge (50-year return period), as the different reaches (as shown in **Table 4.5**) were designed for a lesser discharge, *vis-à-vis* the actual discharge, as indicated in **Table 4.6**:

Table 4.6: Designing of river section by NIT, on the basis of understated discharge (50-year return period

Chainage	Tentative location	Actual discharge[36]	Discharge considered	Designed discharge	Area of cross-section	Width of channel
In metres		In (m^3/sec)			in m^2	in metre
2100	Near *Muktidham*	97.49	65	77.96	23.18	4.50
2130		97.49	65	83.54	24.95	5.0
2769-4068	between the Harmu bypass bridge and the meeting point with the Subarnarekha river	120	64.99	65.07	20.01	3.0
4068-6440		155	102.00	102.01	27.11	4.0
6440 -7818		170	118.00	118.02	40.00	6.0
7818-10400		206	137.00	137.10	49.19	7.0

During joint physical verification (25 October 2021) by Audit, with the engineers of JUIDCO, a stretch of the redesigned river cross-section on the left side of the river was found to have been damaged (approximately 100 metres of riverbank between inlet 6B and 6C), as shown in **Picture 4.8**. The Project Manager, who accompanied Audit for the site verification, stated that heavy discharges from inlets during the rainy season had caused the damage.

[36] *River/Flood discharges, which were to be considered by NIT, Jamshedpur, based on a return period of 50 years.*

Picture 4.8: Damaged riverbank on the left side, between inlets 6B and 6C

Thus, the designing of the river sections, based on understated discharges, resulted in the creation of narrow river sections. As a result, the entire river section (as mentioned in **Table 4.6**) is fraught with the risk of damage, in the event of maximum discharge for a 50/100-year period.

During the exit conference (August 2022), the Secretary of the Department accepted the audit findings and stated that appropriate action would be taken in keeping with the audit recommendations and through an impact study of the project by NEERI.

4.5.4.3 Narrowing of the river width

Clause 3.3.1 of IS 12094:2000 (Guidelines for planning and design of river embankments) stipulates that, as far as possible, embankments should be aligned on the ridge of the natural banks of the river, where land is high and soil is suitable for the construction of embankments. The alignment should be determined in such a way that the high-velocity flow, which can erode the embankment material, is sufficiently distant from it. Hydraulic models are useful guides in this regard.

Details/information, on the actual cross-section of the river that had initially been surveyed, were not furnished to Audit. In the absence of the actual cross-section, Audit compared the satellite images of the river, prior (November 2004) to the rejuvenation work, with images after the completion (June 2021) of the work.

The comparison revealed that the natural course of the river was reduced substantially (by 18.70 metres), at the *Karma chowk* bridge, near *Muktidham,* through mechanical interventions, as could be seen in the satellite images (**Picture 4.9**).

Date of image: 28 November 2004, before rejuvenation of the river (Average width: 28 metres)

Date of image: 3 June 2021, after rejuvenation of the river was completed (Average width: 9.30 metres)

Picture 4.9: Satellite images of the river (Geographical co-ordinates: 23^{0}21' 52.15''N and 85^{0}18'29.75"E, Karma chowk bridge near Muktidham), showing reduction in the width of the river (in a stretch of 110 metres), from 28 metres to 9.30 metres

Thus, after the completion of the project, the average width of the river became narrower, when compared to its width prior to taking up the project. One of the major reasons, as noticed by Audit, was the designing of narrow river cross-sections, as discussed in ***paragraphs 4.5.4.1 and 4.5.4.2***.

During the exit conference (August 2022), the Secretary of the Department accepted the audit findings and stated that appropriate action would be taken, in keeping with the audit recommendations and through an impact study of the project by NEERI.

Recommendation 1: *Government may undertake a detailed study on reviving the origin and catchment area of the Harmu river; revise the estimation for storm water; and formulate a comprehensive policy, which clearly recognises urban runoff as a potential source of water for the Harmu river.*

Recommendation 2: *Government may revise the estimation of sewage quantities generated, considering the present and future growth of the population and prepare a plan of action, within a definite time frame, to prevent sewage from flowing into the river.*

Recommendation 3: *Government may urgently take steps to rectify the defects in the design and carrying capacity of the underground sewer system and consider the construction of additional STPs.*

4.6 Construction and functioning of the project components

4.6.1 Underground sewerage system

As per the DPR, an underground sewerage system was to be constructed, on both sides of the river (20.8 km), at a cost of ₹ 13.73 crore, to intercept sewage from riverside houses, low-cost sanitation toilet blocks, as also the sewage flowing through the six identified inlets, into the Harmu river. The sewage produced from these sources was to be taken to STPs for treatment and discharged into the Harmu river.

Audit observed that the length of the underground sewer system and the number of property connections were reduced, for reasons indicated in **Table 4.7**.

Table 4.7: Changes in the quantity of items in the underground sewerage system

Particulars	As per DPR	As per the revised DPR	Actual	Unit	Remarks
300 mm pipe	17,730.95	15,682.68	15,600.5	Metre	Reduction due to the existence of hard rock
450 mm pipe	1,518.85	1,661.99	1661	Metre	
700-800 mm pipe	0	150	150	Metre	
Manholes	710	562	548	Number	
Property connections	31,500 (2,100 houses)	14,000 (933 houses)	13,985.61 (932 houses)	Metre	Absence of inhabitants in and around 3 km of the river stretch

The impact of these revisions on the project outcomes are discussed below:

(i) Sewage flowing directly into the river, in the absence of sewer lines

Out of 20.8 km, the sewage generated in 4,270 metres (chainage 2050-6320 metres) on the left side and 1,745 metres (495 metres between chainage 0-495 metres and 1,250 metres between 4750-6000 metres) on the right side, was not being treated in STPs, in the absence of an underground sewer network and non-establishment of STP-3.

The sewage generated in these stretches was being directly discharged into the Harmu river. These stretches of the river are densely populated and generate huge quantities of sewage. NEERI proposed (September 2016) *in-situ* bioremediation/ phytoremediation treatment, for the unconnected portion of the *Tapovan* stretch, at a cost of ₹ 20.50 lakh. This had, however, not been done, till the conclusion of audit (March 2022).

(ii) Absence of alternative mechanism for intercepting sewage

Property connections for 2,100 riverside houses were initially proposed but were later extended to only 933 houses. JUIDCO stated that, out of the 20.8 km long sewer line, property connections were not provided: (i) in a stretch of 2,730 metres (between chainage 7550 and 10280 metres) on the right side, due to the area being uninhabited and (ii) 2,970 metres in the *Tapovan* stretch, due to the absence of an underground sewer network.

A four-member Committee, headed by the Engineer-in-Chief of the Water Resources Department, reported (July 2019) that only a few channels had been draining wastewater, from households to the STP, for treatment, while most of the channels were discharging raw wastewater directly into the river. This was also confirmed by Audit, during joint physical verification (March 2021 and October 2021) in those areas, where JUIDCO had claimed to have provided property connections (***paragraph 4.6.3***).

(iii) Inadequate capacity of sewer lines

As per the CPHEEO Manual, sewers are to be designed for flow, not exceeding 80 *per cent* of full pipe diameter, in order to ensure proper ventilation and prevent septic effects. The velocity of flow inside the sewer should be at least 0.6-0.8 metres/second, for maintaining a self-cleansing velocity, but should not exceed the maximum flow of 3 metres/second, to prevent scouring in the pipe. In keeping with these parameters, Audit analysed the capacity of the installed sewer pipes to handle the quantity of discharges from four inlets, in their respective stretches. The observations are detailed in **Table 4.8**.

Table 4.8: Comparison between the discharge from inlets and the carrying capacity of the sewer pipes

Inlets	Velocity of flow (m/sec)	Discharge (litre/ sec) in inlets	Diameter of pipe in which inlets connected (mm)	(Calculation[37] by Audit) Maximum carrying capacity of the sewer pipes at corresponding velocity (in litre/sec)		Connection of sewer network to STP No.
				100 *per cent* flow (per cent of discharge in the inlet)	80 *per cent* flow (per cent of discharge in the inlet)	
1, 1A	3.6-5.2	39,540	900	1,909.29 (4.84)	1,848.19 (4.67)	1
2	2.12	15,870	300	149.63 (0.94)	144.84 (0.91)	3
3	0.76	5,660	300	53.81 (0.95)	52.09 (0.91)	4

Data source: *Information provided by the contractor, to NIT, Jamshedpur, for calculation*

As may be seen from the table, the capacity of sewer lines, even at full capacity, was far below the requirement (ranging from 0.94 to 4.84 *per cent*), when compared to discharge from the inlets. Thus, the capacity of the underground sewerage network was far below the actual discharges in the inlets. As a result, the discharges from these inlets may potentially damage the network or directly flow into the river, defeating the objectives of the project of rejuvenating the river.

4.6.2 Working of STPs

As per the contract terms, eight STPs, with a total capacity of 11.50 MLD, costing ₹ 16.42 crore, were proposed for construction, on a turnkey basis. These STPs would receive sewage from the respective sections of the underground sewer network. Against these, seven STPs were constructed, at a cost of ₹14.14 crore, while one STP (STP-3) was left incomplete (since May 2017), after payment of ₹ 84.83 lakh, due to land dispute at the identified site. Audit examined the working of the constructed STPs and observed the following:

4.6.2.1 Operation of STPs for shorter duration

As per the design, the STP should be operational for 24 hours per day, so that the sewage collected in the Initial Collection Tank (ICT) is transferred to the Primary Settlement Tank (PST) and, from there, to the Phytorid bed, for

[37] *PiR^2V, where R is the radius. The velocity of flow in Inlets 1 and 1A was taken as 3 metres/second (non-scouring velocity), for the purpose of calculation.*

further treatment, through the sewage lifting pumps. The capacity and operational timings of the sewage lifting pumps, recommended in the design, are shown in **Table 4.9**:

Table 4.9: Recommended capacity of sewage lifting pumps in STPs

STP (MLD)	Number of pumps	Discharge capacity of pumps (in m^3/hour)	Discharge in (MLD) in 24 hours
1.5	(1 working +1 stand-by)	68.19	1.64
1	(1 working +1 stand-by)	45.46	1.09
2	(2 working +1 stand-by)	45.46	1.09*2=2.18

During joint physical verification (25 October 2021), with the engineers of JUIDCO, it was noticed that the sewage lifting pumps, of capacity 46 m^3/hour (one working and one stand-by), had been installed uniformly, in all the seven STPs, instead of being installed as per the recommended capacity and numbers.

After the project works were completed in October 2018, operation and maintenance activities had begun on 1 November 2018. Scrutiny of bills raised by the contractor, for operation and maintenance (November 2018 to March 2021), revealed that the daily overall operation of the pumps in each STP was for nine hours (the first pump for six hours in the forenoon and the second pump for three hours in the afternoon), instead of 24 hours. Thus, these seven STPs were filtering only 2.898 MLD (46,000 litres per hour*9 hours* 7 nos.) per day, as against the installed capacity of 10 MLD. This indicated two possibilities, first, that the sewage from inlets or other sources was not being channelised through the sewer network to the STP and was flowing directly into the river, or, second, the STPs were releasing sewage in very quick succession, without retaining it for the required filtration time of 48 hours, due to the lower capacity of the PST and phytorid bed. Both these scenarios were noticed by Audit, as brought out in ***paragraphs 4.5.2* and *4.5.3.2***. In addition, during the inspection by a Committee in July 2019, these scenarios were reported (***paragraph 4.9***).

The Department stated (July 2022) that the capacity of the STPs was 10 MLD for the ultimate year (2048). The reply was factually incorrect, as the STPs were designed for the intermediate year (2033) and JUIDCO itself had assessed (February 2018) the requirement of additional STPs of 10.5 MLD. Thus, the requirement of STPs, in the event of optimal sewage generation was inadequate and counterproductive to the project outcomes.

During the exit conference (August 2022), the Secretary of the Department accepted the audit findings and stated that appropriate action would be taken, in keeping with the audit recommendations, and through an impact study of the project by NEERI.

4.6.2.2 Non-functional STP

STP-8, with capacity of one MLD, was located between chainage 7550 metres and 10280 metres (right side) and the feeder sewer had no property connection or inlets (except a toilet block), due to its location in an uninhabited area. The toilet block, located in the same area, could also deliver only 0.015 MLD of sewage. Thus, the construction of STP-8, at a cost of ₹ 1.36 crore, without any inlet or property connections, except for a toilet block (producing 0.015 MLD sewage), could have been avoided. This would also have saved regular expenses on the operation and maintenance of live plants in the phytorid bed.

During joint physical verification (October 2021), the toilet block was found non-functional, as the motor installed for the operation of the tube well was not in working condition. When asked about the source of water for this STP, the senior supervisor of the contractor informed Audit that, during the dry season, the water did not reach the STP and in other seasons, groundwater automatically reaches the manhole of the sewer network.

The Department stated (July 2022) that STP-8 was constructed to meet the transitional demand and future growth in the adjoining area.

The reply is not convincing, as: (i) no property chamber or inlet has been connected to this STP, to back the claim of transitional demand (ii) the expenditure incurred on operation and maintenance of live plants for the non-functional STP-8 was wasteful and (iii) the idle and non-functional STP, constructed at a cost of ₹ 1.36 crore, had not been serving the intended purpose.

4.6.2.3 Incomplete and idle STP

As per the CPHEEO manual, land acquisition, for the sewerage system, should be done, in keeping with the design period of 30 years (*i.e.* for the ultimate year 2048).

Audit noticed that the construction of STP-3 (capacity 1.5 MLD) on the left bank, near Radisson Blue Hotel, was held up, due to land dispute. The STP was to be constructed at a cost of ₹ 1.82 crore.

The Jharkhand High Court, Ranchi, had stayed (May 2017) further construction on the disputed land. The project was considered complete (30 October 2018), despite the non-completion of STP-3. Works, amounting to ₹ 109.78 lakh, had been executed on the construction of STP-3, against which ₹ 84.83 lakh, had been paid to the contractor. This proved wasteful, as the incomplete structure was of no use and had remained abandoned since May 2017.

4.6.2.4 High pH, BOD and TSS, at STPs

As per the Agreement, the performance parameters, specified by the phytorid technology provider, should be maintained, in the form of records, by the

contractor, on a daily basis. No records of performance parameters were however being maintained, on a daily basis, by the contractor. Audit found that only a single test report (done on 24 September 2020) of the State Pollution Control Board was available on record. The samples for the test were taken at the inlets and outlets of different STPs. The results of the test were as under:

- The effluent values of total suspended solids (TSS), in all the seven STPs, was more than the permissible limits[38].

- The effluent value of the TSS of four STPs (Nos: 5, 6, 7 and 8) and Total Dissolved Solids (TDS) in two STPs (5 and 8), were more than the influent/inlet value. The TSS value at the influent level being less than that of the effluent level, indicates the addition of suspended solids inside the STPs. This needs to be verified by JUIDCO.

Audit also conducted the quality test of wastewater, at the inlets and outlets of two STPs (STP-1 and STP-2), through MECON Limited. The water samples were collected on 18 April 2022, by MECON Ltd. The test reports (02 May 2022), shown in **Table 4.10,** revealed the following:

Table 4.10: Test report of wastewater and treated water at two STPs

Location	Potential of Hydrogen (pH)	TSS	Biological Oxygen Demand (BOD)	Chemical Oxygen Demand (COD)	Faecal coliform
Units	-	mg/litre	mg/litre	mg/litre	MPN/100ml
Permissible limits	6.5-9.0	<50	<20	-	<1000
STP 1(inlet)	7.09	196	205	720	4000
STP 1 (outlet)	7.26	30	53	240	260
STP 2 (inlet)	6.85	154	243	1,040	4800
STP 2 (outlet)	7.34	120	97	960	550

The BOD level, at both the STPs, and TSS level at STP 2, was found higher than the permissible limits.

4.6.2.5 Non-functional Solar Lights around STPs

Sixty-four solar streetlights (eight for each STP), at a total cost of ₹ 99.45 lakh, were to be installed around the STPs, for area lighting. Of these, 15 lights were installed at other places, such as inlets, elevated pathways *etc*. Further, out of the 64 lights, only three solar lights were in working condition, while 61 solar lights that had been installed at a cost of ₹ 94.98 lakh, were non-functional, due to theft of batteries.

Recommendation 4: *The Department may survey and work out the quantity of: (i) sewage being discharged, from all the identified major and minor inlets (ii) sewage being passed into the sewerage network (iii) sewage getting into*

[38] *Based on phytorid design- TSS maximum level: between 20-30 mg/litre; test report: between 41 to 115 mg/litre*

the STPs and (iv) sewage flowing directly into the river, instead of being routed through the sewerage network. The Department may also examine the duration for which these STPs should be in operation, for ensuring the required filtration of the sewage.

4.6.3 Stormwater drainage

The stormwater drainage system was to be constructed, at a cost of ₹13.06 crore, on both sides of the river (10.4 km stretch), with a provision for silt trap and mechanical screens, for preventing solid waste and debris from getting into the river. Stormwater from drains was to be dispersed into the river, at 100 metres intervals, through dispersal outlets (a total of 208 outlets, of 10 metres length each, with a filtration chamber). A regime for cleaning the screens every day was also to be established.

Out of the 20.8 km stretch of the river (both sides), the stormwater drainage system was constructed in only 18.50 km, due to the existence of bridges. Audit conducted (March 2021 and October 2021) joint physical verifications to assess the functioning of these stormwater drains and noticed the following:

(i) The stormwater drain (250 metres) near *Muktidham* (between chainage 1845-1970 m) had been destroyed during a flood in July 2016 and had not been re-constructed till the conclusion of Audit (April 2022).

(ii) The stormwater drain between the Amaravati bridge and STP-5 was found filled with solid waste, sewage *etc*. and the outlets of these stormwater drains were found to be discharging sewage into the Harmu river, as shown in **Pictures 4.10 and 4.11**:

Picture 4.10: Outlet of storm water drain discharging sewage into the river

Picture 4.11: Stormwater drain filled with sewage

(iii) The stormwater drain between the Amaravati bridge and STP 6, along with its outlet, was not visible, as the entire stretch of this drain was covered by mud, deposits and silt. Thus, rainwater would be directly discharging into the Harmu river, carrying mud/silt, defeating the purpose of construction of the stormwater drain.

These were some of the sites visited by Audit in which the stormwater drains were found non-functional. The Department may carry out an extensive survey of the status of the entire stretch of the stormwater drains, to work out the modalities of making them functional.

During the exit conference (August 2022), the Secretary of the Department accepted the audit findings and stated that appropriate action would be taken in keeping with the audit recommendations and through an impact study of the project by NEERI.

4.6.4 Solid Waste Management

In the approved DPR, provision was made for 40 community waste bins (₹ 10.14 lakh), two three-wheeler auto tippers (₹ 8 lakh) and four tricycles (₹ 0.82 lakh). During joint physical verification (October 2021) of different stretches of the Harmu river by Audit, with the engineers of JUIDCO, almost every stretch was found filled with solid waste. Dumping of solid waste was noticed on the way to and in the construction site of STP-3, near Radisson Blue Hotel. The engineers stated that the Ranchi Municipal Corporation (RMC) was using the place as a dumping yard for garbage. **Picture 4.12** shows the river and riverbank filled with solid waste.

Picture 4.12: Garbage dumped near STP-3

Further, Audit observed that no alternate arrangements had been made by JUIDCO, or by the Department, for the disposal of solid waste, which was found scattered at various places, in the absence of dedicated community waste bins. Further, most of the river stretches and its surrounding areas were so dirty (due to dumping yard of solid waste, operation of *khattals etc)* and it was unlikely that the proposal of keeping community bins, to collect waste, would serve the intended purpose.

During the exit conference (August 2022), the Secretary accepted the audit findings and stated that appropriate action would be taken, in keeping with the audit recommendations and through an impact study of the project by NEERI.

Recommendation 5: *Government may take steps to educate the urban population, living alongside the Harmu river, on the adverse effects of the unauthorised discharge of sewage into the river and explore the possibility of involving Residential Welfare Associations/Non-Government Organisations, for effective management of solid waste. The Department may also draw up a plan urgently, to resolve the problems arising due to improper management of solid waste, in and around the river, by involving RMC.*

4.6.5 Environmental Management Plan

As per the approved DPR, the contractor, as well as the site-in-charge, would be responsible for implementing all the mitigation measures, during the construction and operation phase. Such measures included testing the quality of air, stack emission, noise level, water and wastewater, during the construction and operation phase. Based on the quality test reports, the contractor had to prepare three Environment statements each, for the execution and the operation phase.

The Contractor got the water quality, air quality, stack emission, noise level *etc*. tested by Ultimate Envirolytical Solutions, Raipur, and submitted three statements pertaining to the execution phase (testing of samples done in May 2016, October 2016 and April 2017) and one relating to the operation phase (in June 2020), for which ₹ 22.81 lakh was paid, to the contractor ***(Appendix* 4.3)**. Scrutiny of these statements revealed the following.

(i) Different rates for the same tests

The rates for conducting the same tests for the construction phase were five times higher than that for the operation phase, while for preparation of environment statements, it was four times higher during the construction phase, as shown in **Table 4.11** and detailed in ***Appendix 4.3***.

Table 4.11: Comparison of rates between the construction and operation phases

Quality checks	Rates (₹) in the construction phase	Rates (₹) in the operation phase
Water and wastewater quality	2,500	500
Stack Emission	2,500	500
Noise Level	1,000	200
Air quality	7,500	1,500
Environment statement	8,000	2,000

This resulted in a higher payment of ₹ 18.23 lakh to the contractor, for conducting the tests and preparing the environment statements in the construction phase. The Project Manager, JUIDCO, stated during the discussion, that the rates were as per the sanctioned DPR. However, no rationale was provided for these significant differences.

(ii) Verification of stack emission

'Stack emission' refers to the gases released into the air, from boiler stacks, chimneys or DG set stacks *etc*., from various industries, after the incineration process.

Audit noticed that there was no stack emission from the STPs (based on environment-friendly technology), or any other components of the project. Further, no chimney-based industry-emitting stacks existed within the periphery of the Harmu river. However, payment of ₹ 12.50 lakh was made to the contractor for checking stack emission. This was irregular and was done without any survey in this regard. The Project Manager, JUIDCO, stated (April 2022) that the rates allowed were as per the sanctioned DPR.

(iii) Quality test of river water

Reports of the tests conducted by the contractor showed that the quality of river water had remained unchanged during the execution phase and the operation phase. Further, the overall quality of the river water was highly polluted, almost equivalent to the pollution levels of sewage water. Audit also conducted (18 April 2022) quality test of the water flowing in the Harmu river, through MECON Limited, at three locations. The test results (02 May 2022) are given in **Table 4.12**.

Table 4.12: Quality test results of the Harmu river water, conducted by MECON Limited

Location	Ph	TSS	BOD	COD	Faecal coliform
Units	**-**	**mg/litre**	**mg/litre**	**mg/litre**	**MPN/100ml**
Permissible limits (Drinking water)	6.5-8.5	-	2		-
Permissible/Desirable limits (Outdoor bathing)	6.5-8.5	-	3		500 Desirable
Harmu river (near overbridge)	7.15	728	480	2,240	2,300
Harmu river (near Muktidham)	7.20	498	240	1,120	3,600
Harmu river (near Amrawati bridge) Chutia	7.41	332	265	1,360	1,840

As per the criteria for the categorisation of river monitoring locations, issued (June 2019) by the Central Pollution Control Board, the water quality data is required to be analysed and the primary mean or average of BOD and faecal coliform (FC) need to be estimated. Based on the total score estimated for the parameters BOD (weightage 70 *per cent*) and FC (weightage 30 *per cent*), the monitoring location is categorised as a pollution location[39]. Audit analysis of the data (given in **Table 4.12** above) of water quality of the three locations of the Harmu river, showed a total score[40] of 81.20[41], implying that all the above

[39] ***Total score: 81-100****: critically polluted, 61-80: severally polluted, 41-60: moderately polluted, 21-60: less polluted and ≤ 20: good or fit for bathing.*

[40] *BOD value: score* ***(> 48: 100****, 24-48: 80, 12-24: 60, 6-12: 40, <6: 20, FC value: score (> 5 lakh: 100, 50,000 to 5 lakh: 80, 5,000 to 50,000: 60,* ***500 to 5,000: 40*** *and <500: 20)*

[41] *BOD (100*0.70)+ FC (40*0.30) = 81.20*

locations of the Harmu river were critically polluted monitoring stations. This indicated that the resources invested by the State Government, in implementing the project, had not been used effectively and efficiently.

As there was no improvement in the quality of water, even after the reported rejuvenation and conservation of the river, the fundamental objective of the project, to make the Harmu river a vibrant water asset, was not achieved.

The Department stated (July 2022) that: (i) the project was designed for limited capacity, but the flow of sewage was more than the capacity of the sewerage system of the Harmu river (ii) after the completion of the Sewerage and Drainage Project of Ranchi, the river water quality will certainly improve.

In the exit conference (August 2022), the Secretary of the Department accepted the audit observations and expressed concern that, even after the rejuvenation and conservation of the Harmu river, sewage water had been flowing into the river. The Secretary further stated that appropriate action will be taken, in keeping with the audit recommendations, and through an impact study of the project by NEERI.

4.6.6 Plantation

To improve the environmental condition of the city, a provision for the plantation of 4,160 coconut tree saplings (each six feet high) was made in the Agreement. The survival rate of the trees after five years was fixed as being not less than 95 *per cent*. The work of the plantation was to be completed in eight months from the date of commencement (October 2015) of the work, *i.e.,* by June 2016.

Scrutiny of the MB and other related records revealed that, initially, 360 coconut tree saplings were planted, during March 2016 (from chainage zero at Ganga Nagar, to chainage 1035 at Karam Chowk bridge). However, on the suggestions[42] (August 2016) of the Principal Scientist, Indian Council of Agricultural Research (ICAR), Palandu, Ranchi, and the Divisional Forest Officer, Ranchi, 4,304 plants of 12 species were considered (September 2016) for being planted in place of the remaining 3,800 coconut trees, within the same cost.

Audit observed that a total of 4,624 saplings, valued at ₹ 94.49 lakh, were planted, against which payment of ₹ 49.77 lakh had been made to the contractor ***(Appendix* 4.4)**. Further payment of the balance amount was not made (March 2022). It was also noticed that the major plantation work (47 *per cent*) was carried out from August 2018 to October 2018, after the scheduled completion date (June 2016). However, the survival rates of trees/plants were not assessed by the contractor or JUIDCO, despite the fact that none of the coconut trees had survived. The Management, while

[42] *On grounds of non-suitability and non-sustainability of coconut trees, in and around the Harmu river*

confirming this, informed Audit that no inventory of existing plants was maintained, for the purpose of ascertaining their survival rates.

Audit analysed the plantation works near the Harmu river, during the last 12 years (October 2009 to June 2021), through satellite images of different stretches ***(Appendix 4.5)*** and noticed a gradual decline in the green cover, over the years, on the banks of the river. An instance of such deforestation, between Ganga Nagar (starting point of the urban stretch of the Harmu river) and Karamtoli chowk, in 2009, 2016 and 2021, is shown in **Picture 4.13** below.

Picture 4.13: Deforestation between Ganga Nagar and Karamtoli, during the rejuvenation of the Harmu river

Plantation in 2009

Very few trees were seen in 2016

Treeless stretch of the Harmu river in 2021

During the exit conference (August 2022), the Secretary of the Department accepted the audit findings and stated that appropriate action would be taken, in keeping with the audit recommendations and through an impact study of the project by NEERI.

4.6.7 Encroachment along the river course

Audit examined the satellite pictures (for the period between November 2004 and June 2021) of the different stretches of the river and observed substantial changes in the course of the river, such as reduction in the river width **(paragraph 4.5.4.3)**, change in the river course, encroachment of the river

front (**Picture 4.14**) and emergence of land due to change in the course of the river (**Picture 4.15**).

Picture 4.14: Satellite images of the river (Geographical co-ordinates: 23^{0}21'14.51''N and 85^0 19' 2.41'' E), showing encroachment of land (approximately 1,844 sq metres)

The meandering flow of the river, prior to its rejuvenation (date of image: 28 November 2004)	***The meandering portion was straightened after rejuvenation of the river (date of image: 3 June 2021)***

Picture 4.15: Satellite images of the river (Geographical co-ordinates: 23.3416 north and 85.34272 east), showing emergence of land (approximately 1487 metre sq), due to mechanical straightening of the meandering portion

Meandering flow, before rejuvenation of the river (date of image: 28 November 2004)	***The meandering portion was straightened during rejuvenation of the river (date of image: 3 June 2021)***

The changes in the river course resulted in encroachment of the riverfront and the land adjoining the river course. The land, which emerged as a result of changes in the river course, and is seen vacant in **Picture 4.14**, is not protected either by JUIDCO or by RMC and may get encroached.

Audit noticed that ₹ 75.41 lakh had been provided in the estimate/ agreement, for protecting the river boundary in the entire stretch, through 6,934 bollards (at every three metres) and hedges, in 18,720 metres. Against this, ₹ 33.76 lakh was paid to the contractor, for fixing all the 6,934 bollards and 1,400

metres of hedges. However, during joint physical verification (March 2021 and October 2021) at Ganga Nagar, Audit did not find bollards and hedges, except for a few bollards in some stretches of the river. The engineers who accompanied Audit during the site visit stated that all the bollards had been uprooted by local people. Thus, the river could not be fenced and protected from encroachments, as planned.

Audit noticed that 47 cases of encroachment (unauthorised construction near the Harmu river) had been filed in the month of July 2021, in the court of RMC. No action taken, if any, was reported by RMC and shared with Audit.

During the exit conference (August 2022), the Secretary of the Department accepted the audit findings and stated that appropriate action would be taken, in keeping with the audit recommendations and through an impact study of the project by NEERI.

Recommendation 6: *Government may, in coordination with RMC, take necessary action to identify and remove all encroachments on the river banks and its tributaries and maintain the stipulated buffer zone. For this purpose, periodical inspection of the river sites and tributaries and proper surveillance mechanisms, preferably in coordination with the Command, Control and Communication Centre (C4) at Smart city Ranchi, may be established.*

4.6.8 Electric connections

As per the DPR, 15 low-cost sanitation (LCS) toilet blocks (revised from 33 to 15), with the provision of high-yield tube wells, a transformer for each block and High Tension Service (10 km), were to be constructed on the banks of the river. Audit examination revealed the following:

4.6.8.1 Inconsistent maximum demand of electricity for STP

According to the Jharkhand State Electricity Regulatory Commission, if the electric power demand is above 100 KVA, the consumer has to sign a contract with the Electricity Department, under High Tension Service (HTS). In the case of HTS, billing is done for the energy charge (based on the actual consumption recorded) and as well as demand charge (the maximum demand recorded during the month, or 75 *per cent* of the contract demand, whichever is higher). A penalty is also applicable for exceeding the contract demand.

JUIDCO had taken two HTS connections from JBVNL for the operation of STPs and LCS toilets. Scrutiny of the available electricity bills (nine months[43]) of the Harmu sub-division revealed inconsistencies in recording measurement of the maximum demand. It was noticed that the maximum demand ranged between four and eight KVA for six months, 20 to 60 KVA for two months and was abnormally high at 240 KVA in October 2021. The wide variations in maximum demand indicated the possibility of inconsistent operation of the

[43] *August 2020, May- July 2021, September 2021: 4KVA, April 2021: 8 KVA, August 2021: 20 KVA, March 2021:60 KVA and October 2021: 240 KVA*

STPs and LCS under this sub-division. These variations were not reconciled with JBVNL.

The Department accepted the facts and stated (July 2022) that reconciliation with JBVNL would be done, to resolve the issue of wide variations in the maximum demand.

4.6.8.2 Avoidable payment of delayed payment surcharge

As per instructions of the Jharkhand State Electricity Regulatory Commission, the due date for making payment of energy charges or other charges was 21 days after the issue date of the bill, failing which, the consumer was liable to pay a delayed payment surcharge (DPS).

Audit noticed that DPS of ₹ 17.66 lakh (21 *per cent* of the total bill amount of ₹ 84.71 lakh) was paid to JBVNL, along with payment of the electricity bill for the month of August 2020 (for the period from September 2018 to August 2020, for both connections), in February 2021. The payment of DPS was avoidable, had the energy charges been cleared in time.

The bill also included a fixed charge of ₹ 21.00 lakh, in place of the leviable amount of ₹ 27,562.50, for a second connection (from the Doranda sub-division). The bill was paid by JUIDCO without any reconciliation. JUIDCO stated that the amount charged in excess was being adjusted against future energy charges.

The Department stated (July 2022) that the delay was due to non-acknowledgement of payment responsibility by RMC. It was further stated that timely payment of energy charges would be ensured henceforth.

4.7 Operation and maintenance

As per clause 55 of the Agreement, the time of completion of the project was 30 months, including three months for the trial run and commissioning period. After the trial run period and successful commissioning of the project, the contractor was to carry out operation and maintenance (O & M) for five years. The entire project was to be handed over to the Department thereafter. An amount of ₹ 7.54 crore was provided in the DPR, for the O & M of the project.

Audit observed that, out of various project components, the commissioning certificate had been issued (24 April 2018) only for the seven STPs. In this regard, the following were noticed:

(i) As recorded in the MB, the project work had been completed on 30 October 2018, and the O&M reportedly (as mentioned in the MB) began on 1 November 2018. However, the contractor was paid ₹ 1.80 crore, for O & M services, for the period from November 2019 to February 2021.

(ii) The completion period of the project included three months trial run and commissioning period. But the O&M was reportedly taken up from the

next day of completion of the work *i.e.* from 1 November 2018. Thus, the period of trial run was not clear.

(iii) Scrutiny of DPR revealed that ₹ 7.54 crore had been earmarked for five O&M activities: ₹ 2.47 crore for manpower, ₹ 0.59 crore for the bioremediation process, ₹ 2.95 crore for phytorid technology, ₹ 1.21 crore for purchase of equipment and ₹ 32 lakh for transportation and fuel charges.

Audit noticed that, instead of taking measurements for each activity, JUIDCO had fixed[44] the O & M cost for each month at ₹ 13.96 lakh and payments were made accordingly. The Management of JUIDCO (May 2022) stated that the payment had been made as per the O & M Manual. However, the said manual was not furnished to Audit. Hence, activity-wise O&M could not be examined.

(iv) In the seven STPs (total capacity 10 MLD), ₹ 6 lakh per year was allocated for the daily operation of sewage lifting pumps. Against this, JUIDCO incurred electric charges, at the rate of around ₹ 33 lakh per year, for operation[45] of sewage lifting pumps of the STPs, operation of 15 tube wells and lighting of 15 LCS toilet blocks. The high energy charges were on account of high fixed (energy) charges, which were not required, as phytorid technology, used in the STPs involves minimum consumption of electricity.

(v) The accumulation of solid waste, non-improvement in river water quality and deficiencies in the functioning of the STPs showed that O & M activities need to be extensively reviewed.

The Department (July 2022), while agreeing to the audit findings, assured that the five years O & M service, provided by the contractor, as per the O & M manual, would be accounted for. Further, the Department would explore the possibility of migrating to LT connection, from HT connection, in consultation with JBVNL.

In the exit conference (August 2022), the Secretary of the Department accepted the audit findings and stated that appropriate action would be taken, in keeping with the audit recommendations.

Recommendation 7: *The Department may ascertain the exact date of commencement of O & M, so that the five-year period can be reckoned. The exact period of trial run, commissioning and operation, may be confirmed and fixed. The Department may immediately switch over to LT electric connection, to make O & M viable and also explore the possibility of levying user charges against property connections.*

4.8 Execution of Phase II of the Project

JUIDCO executed (February 2016) an agreement with M/s IK Worldwide, for the preparation of DPR and PMC services, for Phase II of the project. The

[44] *Fixed per month cost of O & M activities (` 8.38 crore /60 months= ` 13.96 lakh)*
[45] *Payment of ₹ 80.57 lakh, for period November 2018-August 2020 (22 months), was made to JBVNL for the purpose.*

DPR was to be finalised within 12 weeks (by May 2016) from the date of agreement. Initially, Phase II was exclusively planned for the rejuvenation and conservation of the Harmu river in the rural stretch, but the scope was gradually increased between April 2017 and March 2019, with the inclusion of rectification work in the urban stretch. The scope of work in the urban stretch included the construction of standalone STPs, management of solid waste, tilting gates etc.

Audit observed from records that the said DPR had not been finalised, even after a lapse of more than five years (April 2022), due to frequent revisions in the scope of work. Against the total payable consultancy fee (for preparing the DPR) of ₹ 1.60 crore, ₹ 48 lakh had been paid (October 2016) to the consultant, for submitting a Feasibility Report.

During joint physical verification (March 2021) of the rural stretch, Audit noticed several *pucca* houses and *khattals,* in and around the river stream. The drains opening from these houses/*khattals* were found to be discharging untreated sewage and solid waste directly into the river.

Thus, the inordinate delay of around six years, in finalising the DPR led to non-rectification of the identified problems in the project work of Phase I, which was declared complete, without addressing the identified issues. Further, Phase II of the work could not be taken up, as the DPR was not prepared and the expenditure of ₹ 48 lakh on the consultancy services was unfruitful.

4.9 Monitoring and Inspection

The Department had set up (October 2014) a State Level Monitoring Committee (SLMC), for monitoring and ensuring the timely completion of the project. The Committee was to be chaired by the Development Commissioner, Jharkhand, and supported by seven members[46].

However, minutes of meetings, instructions given to JUIDCO or inspections undertaken by the Committee, were not found on record. The Project Manager, JUIDCO, stated, during the discussion (December 2021), that JUIDCO had not received any instructions from SLMC. Audit examination of records in JUIDCO revealed that four inspections had been undertaken by NEERI; CE WRD; BIT, Sindri and BIT Mesra. Their observations/ recommendations are shown in **Table 4.13**.

[46] *Secretary-UD & HD, Jharkhand, Secretary-Water resources Department, Chief Conservator of Forest, Head of Civil Engineering Department, IIT Mumbai, Head of Civil Engineering Department, BIT Mesra, representative of Director, NEERI and Chief Engineer, Technical cell, UD & HD, Jharkhand.*

Table 4.13: Details of inspections of the Harmu river

Institution/ Authority	Date of Inspection	Observations and Recommendations
Scientist-in-charge, NEERI	3 September 2016	Identification of 70 (14 major and 56 minor) nallas, discharging wastewater into the Harmu river. Bioremediation treatment of 14 major nallas and *in situ* bioremediation treatment of *Tapovan* stretch (approximately 2 km stretch unconnected to the sewerage network) required.
Director, NEERI, Nagpur	20 April 2017	One STP required before *Muktidham,* as the size of the Muktidham STP (STP 1) was insufficient to handle the load of incoming sewage from three nallas across the bridge.
Four member Committee headed by Engineer-in-Chief, WRD with representatives of BIT, Mesra, BIT, Sindri and NEERI, Nagpur	8 July 2019	Works carried out in Phase I failed to achieve goals, even after completion of project and unable to produce visible results. Detailed study of the Harmu river catchment area is required, for sustainable river water system, with special emphasis on reviving the origin of the river. Assessment and analysis of rainfall data for the last 66 years in the river basin is required to be done. New estimates must be obtained for stormwater and sewage quantities, considering the present and future growth of population in the Harmu river basin. Only minimal quantities of wastewater are being collected and treated with the existing STPs in the Harmu river project. There are many major drains which are discharging raw wastewater into the river and have been spoiling the project objectives. All these issues have to be taken into consideration for further work, as early as possible, to accomplish the goal of clean water in the Harmu river.
Chief Engineer, WRD	6 September 2019	Monitoring of solid waste thrown by locals in the river by installing CCTV cameras and creation of a dedicated solid waste management team.

In addition to the above observations/recommendations, Audit also observed the absence of a real-time surveillance mechanism of the river basin, by integrating it with the surveillance set-up of the Command, Control and Communication Centre (C4) in the Smart City. It was noticed that the Department had not taken the required remedial measures, on the advice of the above institutions/authorities. Further, the Department had also not complied with the deficiencies pointed out by NRCD, GoI, in the project proposal.

Audit noticed that a work order (March 2021) was issued to the Director, NEERI (at a cost of ₹ 21.78 lakh), for conducting a study on the technical and ecological impact of 'Rejuvenation and conservation of Harmu river', on the existing environmental condition of Ranchi city, besides an analysis of the project. However, NEERI expressed its inability (July 2021) to conduct such a study. The Department did not get the study and project analysis done by any other institution. Thus, the inspections done and professional inputs given for urgent revival measures of the project were not acted upon.

During the exit conference (August 2022), the Secretary of the Department accepted the audit findings and stated that appropriate action would be taken, in keeping with the audit recommendations and through an impact study of the project by NEERI.