INSTITUTE OF CHEMICAL TECHNOLOGY रसायन तंत्रज्ञान संस्था
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NAAC A++ CGPA 3.77

ICT/PSE/DVP/1838 01/08/2025

To,
Dr. Avinash Dhakne (IAS),
Member Secretary
Maharashtra Pollution Control Board
Kalpataru Point, Opp. PVR Cinema,
Sion Circle, Sion (E),
Mumbai - 400 022

Subject: Submission of Interim Report on "Study of environmental damage and adequacy of pollution control equipment for Jakraya sugar ltd., Gut No. 61/1/A, A/p- Watwate, Tal- Mohol, Dist- Solapur"

References: Work order no. BO/JD(APC)/TB/B-0288 dated 06/08/2024 issued by the MPCB.

Dear Sir,

With reference to the work order no. BO/JD(APC)/TB/B-0288 dated 06/08/2024 issued by the Maharashtra Pollution Control Board (MPCB) and subsequent to the order passed by the Hon'ble National Green Tribunal in OA No.198/2023, we are pleased to submit the interim report on the "Study of Environmental Damage and Adequacy of Pollution Control Equipment for Jakraya Sugar Ltd." The detailed interim report containing sampling data, photographic documentation, analytical results, observations, and preliminary recommendations is attached as ***Annexure I***.

This report encompasses the Phase I assessment conducted during the off season. The final report, incorporating findings from Phase II (during-season) and the complete restoration action plan, will be submitted.

Thank you for entrusting us with this crucial responsibility. We remain committed to contributing toward sustainable environmental management through scientific and transparent evaluations.

Warm regards,

Dr. Dipak V. Pinjari
Principal Investigator

Prof. A. B. Pandit
Vice Chancellor

VICE CHANCELLOR
Institute of Chemical Technology
(University under Section-3 of UGC ACT OF 1956)
N. P. Marg, Matunga, Mumbai - 400 019.

Enclosure: Annexure I

Annexure I

Report on environmental damage due to the Jakraya sugar ltd. Watwate, Tal- Mohol, Dist- Solapur.

1. Background: Jakraya Sugar Limited (JSL) is located at Watwate, Tal: Mohol, Dist.: Solapur, Maharashtra state. The Industrial site is towards South-West of Solapur, at about 35.2 Km from city. Existing cane crushing capacity of the sugar factory is about 4900 TCD and co-generation plant capacity is 11 MW& 30 KLPD Distillery. First crushing season for sugar factory and co-gen plant was done in year 2011. The Figure 1 (Google map) provides **a visual representation of the factory's position relative** to Jakraya city and nearby Bhima River. Furthermore, the Jakraya Sugar Ltd. (JSL) facility is surrounded by a natural brook, locally known as an Odha, which plays a crucial role in the region's hydrology. As depicted in Figure 2 (Google Map), this brook flows (shown with black dark line) adjacent to the factory premises and serves as a natural drainage channel for surface runoff. The Odha eventually merges into the Bhima River, a major water body that supports agriculture, drinking water supply, and aquatic biodiversity in the region.

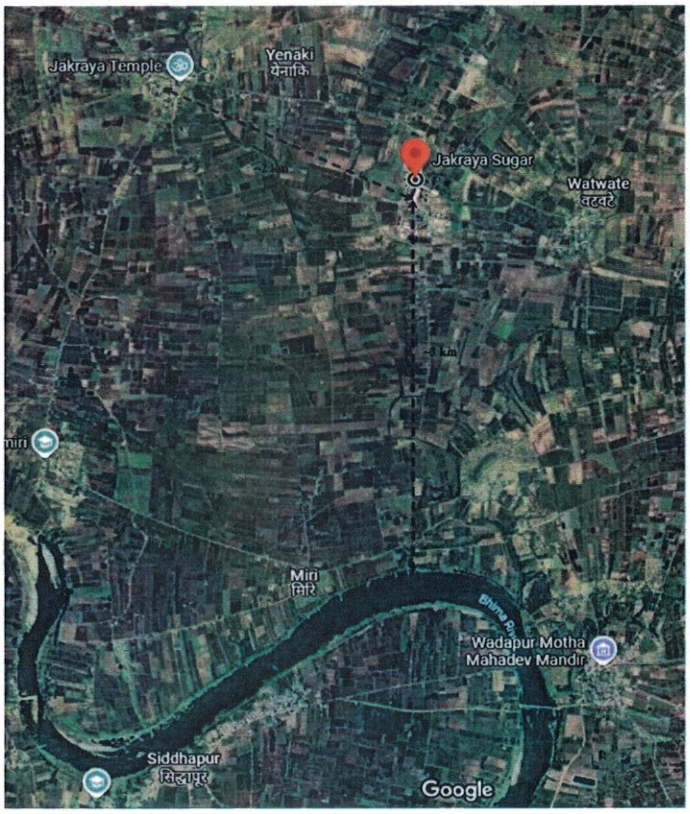


Figure 1. JSL position relative to Jakraya city and nearby Bhima River.

Figure 2. A brook flows, Odha, (shown with black dark line) adjacent to the factory premises.

Residents of Mohol Village, Solapur, have repeatedly voiced serious concerns regarding environmental pollution attributed to JSL, citing significant issues related to both water, solid, and air pollution. Complaints filed by local farmers and villagers highlighted the discharge of untreated effluent, including highly contaminated spent wash, which was allegedly being disposed of outside the factory premises via tankers, leading to groundwater contamination and adverse effects on nearby agricultural land. Additionally, air pollution emerged as a critical issue due to excessive emissions of smoke and fly ash from the factory's boiler stack, severely degrading local air quality and causing respiratory issues among residents, while also depositing pollutants onto farmland, affecting crop yields. The severity of these allegations led to the intervention of the National Green Tribunal (NGT), which, upon reviewing the complaints, directed a thorough environmental study to assess the extent of pollution caused by JSL. The NGT's orders emphasized the need for an in-depth evaluation of the environmental damage, focusing on the effectiveness and adequacy of the pollution control measures in place at the facility. As part of this directive, regulatory authorities, including the Maharashtra Pollution Control Board (MPCB), were instructed to investigate JSL's compliance with environmental norms and recommend corrective actions to mitigate further ecological harm.

2. MPCB order to Institute of Chemical Technology (ICT): Following the directive issued by the NGT, the MPCB engaged the ICT, Mumbai, to conduct an extensive environmental assessment of Jakraya Sugar Ltd. (JSL). The primary objective of ICT's study was to assess the environmental damage caused by JSL's operations. A critical component of this investigation involved conducting a detailed pollution load assessment to quantify the pollutants being generated by the facility and their potential effects on the surrounding environment. Furthermore, ICT was tasked with evaluating the effectiveness of JSL's existing air pollution control measures, particularly its wet scrubbers, bag filters, and boiler stack emissions control systems, to determine their compliance with environmental standards.

3. ICT team and their capability: The ICT team, under the leadership of Vice Chancellor Professor Aniruddha Pandit, brings together a distinguished group of experts specializing in environmental impact assessment, pollution control, and sustainable industrial practices. Professor Pandit, a highly regarded authority in chemical engineering, serves as the chairman of Industry 3.0 organic chemical synthesis for the ministry of environment, forest, and climate change. His contributions to environmental policies, energy efficiency, and pollution mitigation strategies have played a pivotal role in shaping industrial regulations and sustainable manufacturing processes.

Dr. Dipak Pinjari, an expert in solid waste management, wastewater treatment, and mass and energy balance, has conducted extensive environmental audits across multiple industries. His research in advanced oxidation processes, hydrodynamic cavitation, and waste valorization has been instrumental in developing cost-effective pollution control solutions.

Dr. Ananda Jadhav, a specialist in mass and energy balance and techno-economic analysis, focuses on optimizing industrial operations for improved efficiency and regulatory compliance. His expertise lies in conducting audits, assessing industrial wastewater treatment systems, and formulating feasible solutions for pollution control.

Mr. Goswami, with over two decades of industrial experience, provides critical insights into on-site operations, regulatory compliance, and risk management. His hands-on experience in implementing pollution control measures and ensuring adherence to environmental norms strengthens the team's practical approach to problem-solving.

Together, the ICT team possesses a comprehensive skill set that includes pollution monitoring, waste management, resource efficiency, biodiversity conservation, and the development of sustainable industrial processes. Their multidisciplinary approach enables them to conduct in-depth environmental assessments.

4. ICT team visits to JSL site: The ICT team, was officially assigned the task of assessing environmental damage and evaluating the adequacy of pollution control equipment at JSL through a work order (BO/JD/APC/TB/B-0288) issued on 06/08/2024. The initial site visit was conducted on 12/08/2024 by Dr. Dipak V. Pinjari, accompanied by the Sub-Regional Officer (SRO) of Solapur. However, during this visit, the factory authorities were uncooperative and did not facilitate the investigation, as may be the communication gap. Recognizing this impediment, the MPCB issued an authority letter (BO/JD/APC/TB/B-0230) on 03/09/2024, granting ICT the necessary authorization to proceed with site inspections, environmental sampling, and data collection. A comprehensive site visit was subsequently conducted from 12/09/2024 to 13/09/2024 by a team comprising Dr. Dipak Pinjari, Dr. Ananda Jadhav, Abhijeet Goswami, Dr. Chandrakant Holkar, and Dr. Pranit Patil. During this visit, the team systematically collected water and solid samples from various locations both within and around the factory premises, examined manufacturing processes, scrutinized pollution control equipment for operational efficiency, and captured geo-tagged photographs with date and time stamps to document environmental conditions. Additionally, the ICT team reviewed factory records and requested critical environmental data from JSL to facilitate the assessment. In a formal meeting held on 13/09/2024, attended by Managing Director Sachin Jadhav and Dr. Dipak Pinjari, JSL agreed to provide the requested data, a commitment documented in the meeting minutes. However, despite this agreement, the necessary data was never furnished. To address this non-compliance, MPCB issued a notice (BO/JD(APC)/TB/B-0209) on 09/10/2024, summoning JSL representatives to appear at MPCB headquarters in Sion, Mumbai, on 17/10/2024. The higher management of JSL failed to attend this meeting, further delaying the assessment process. Subsequently, on 03/12/2024, JSL formally notified ICT (letter JSL/Reg/of 25/2024-25) that they had filed an appeal under Section 22 of the National Green Tribunal (NGT) Act, 2010, and had also approached the Supreme Court of India, where the case was registered on 01/12/2024 (Dairy No. 56113/2024). As a result of these legal proceedings, the environmental study has been put on hold pending a final ruling from the Supreme Court. Upon obtaining legal authorization from the Supreme Court, the Institute of Chemical Technology (ICT) recommenced its environmental assessment of JSL in accordance with regulatory directives and conducted a third site visit on 7th March 2025. During this visit, the ICT team, comprising Dr. Dipak Pinjari, Dr. Ananda Jadhav, Mr. Abhijeet Goswami, Dr. Chandrakant Holkar, and Dr. Pranit Patil, carried **out a thorough inspection of the facility's pollution control systems. The team collected additional water** and soil samples to reassess environmental conditions and verify compliance with regulatory standards. Geo-tagged photographs were taken to document any visible pollution sources.

5. Methodology: The ICT team employed a rigorous and structured methodology to comprehensively assess the environmental impact of JSL. This approach involved systematic sample collection, in-depth laboratory analysis, photographic documentation, and a detailed evaluation of pollution control equipment to determine their effectiveness in mitigating environmental damage.

5.1 Sample collection: To ensure a thorough environmental assessment, the team strategically collected water samples and solid samples from various locations within and around the JSL premises. The selection of sampling sites was based on proximity to effluent discharge points, groundwater sources, agricultural fields, and areas where previous environmental complaints had been raised. The water samples included surface water, groundwater, and effluent from different stages of wastewater treatment, while solid samples were taken from agricultural fields adjacent to the factory to analyse potential contamination from air and water pollutants.

Table 1 presents the exact latitude and longitude coordinates of each sampling site. Additionally, Figure 3 and Figure 4 [Google Map], respectively, illustrates the precise locations where water and solid samples were collected, highlighting the strategic points within and around the factory premises. These geographical details play a crucial role in correlating pollution levels with potential sources, evaluating the dispersion of contaminants, and understanding the environmental impact on nearby water bodies, soil, and air quality.

Table 1. Geographical coordinates and sampling details of water and solid samples collected from the Jakraya sugar ltd. site.

Sample notation	Type of sample	Location details		Date of sample collection
		Latitude	Longitude	
W1	West side discharge	17°34'31.5"N	75°38'28.5"E	07 March 2025
W2	CBG landfilling	17°34'13.1"N	75°39'02.4"E	07 March 2025
W3	Spent wash tank 2	17°34'07.9"N	75°38'51.2"E	07 March 2025
W4	ETP inlet	17°34'16.1"N	75°38'52.4"E	07 March 2025
W5	ETP outlet	17°34'14.8"N	75°38'53.8"E	07 March 2025
W6	Spent	17°34'07.8"N	75°38'51.1"E	07 March 2025
W7	East side dug well	17°34'09.8"N	75°39'08.5"E	07 March 2025
S1	CBG side discharge	17°34'13.1"N	75°39'02.4"E	07 March 2025
S2	South side soil sample	17°34'07.3"N	75°38'49.8"E	07 March 2025
S3	Spent wash tank 2	17°34'08.0"N	75°38'52.4"E	07 March 2025

* *W stands for water and S stands for solid.*

Furthermore, to ensure the authenticity and credibility of the sampling process, photographs were captured at each location during sample collection in the presence of authorized personnel from both

ICT and the concerned regulatory authorities. Figure 5 and 6, respectively, shows the geo-tagged photographs of water and solid sample collection carried out in the presence of authorized officials, depicting sampling locations, date, time.

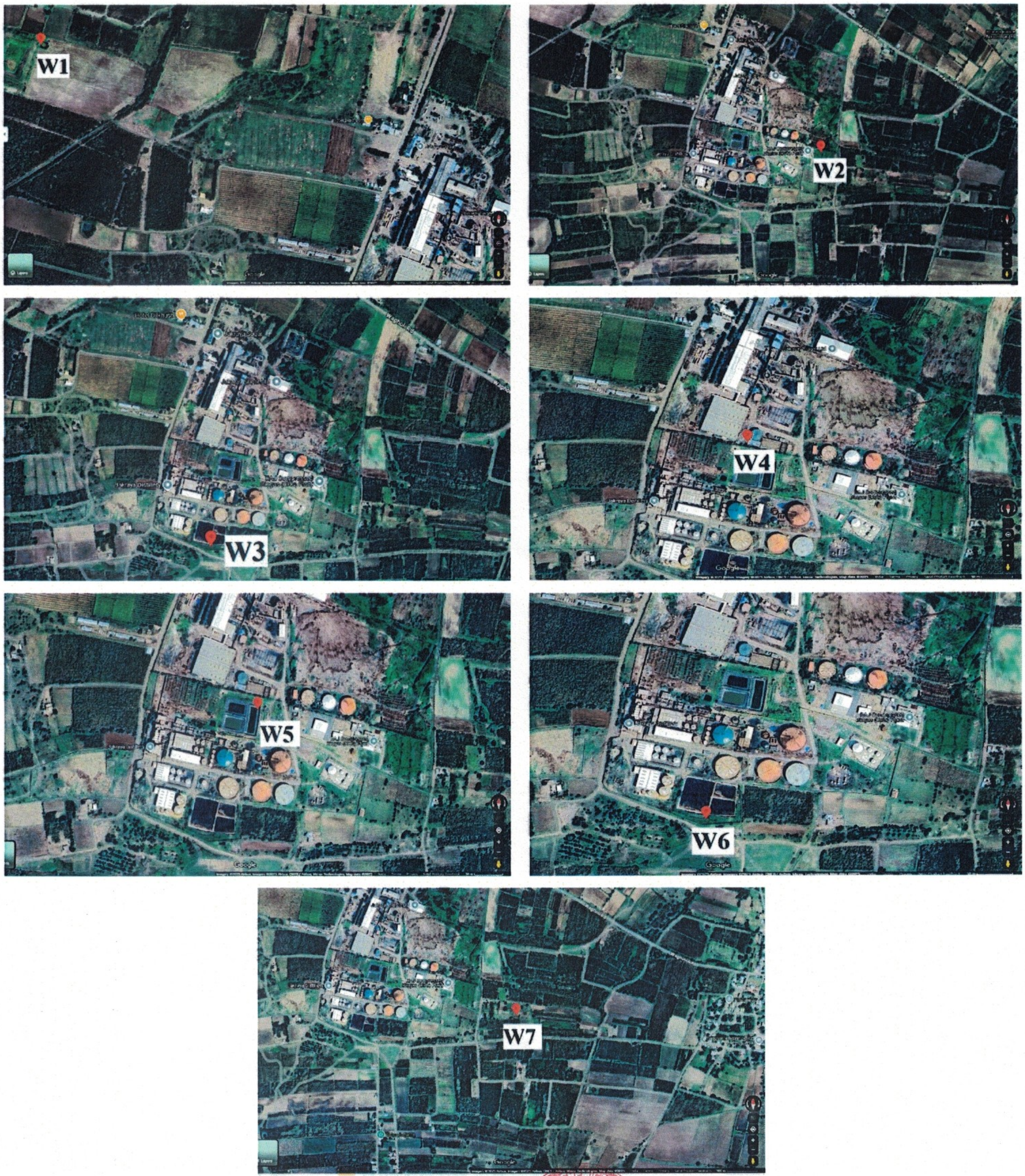


Figure 3. Geogrphical illustration of the precise locations where water samples were collected.

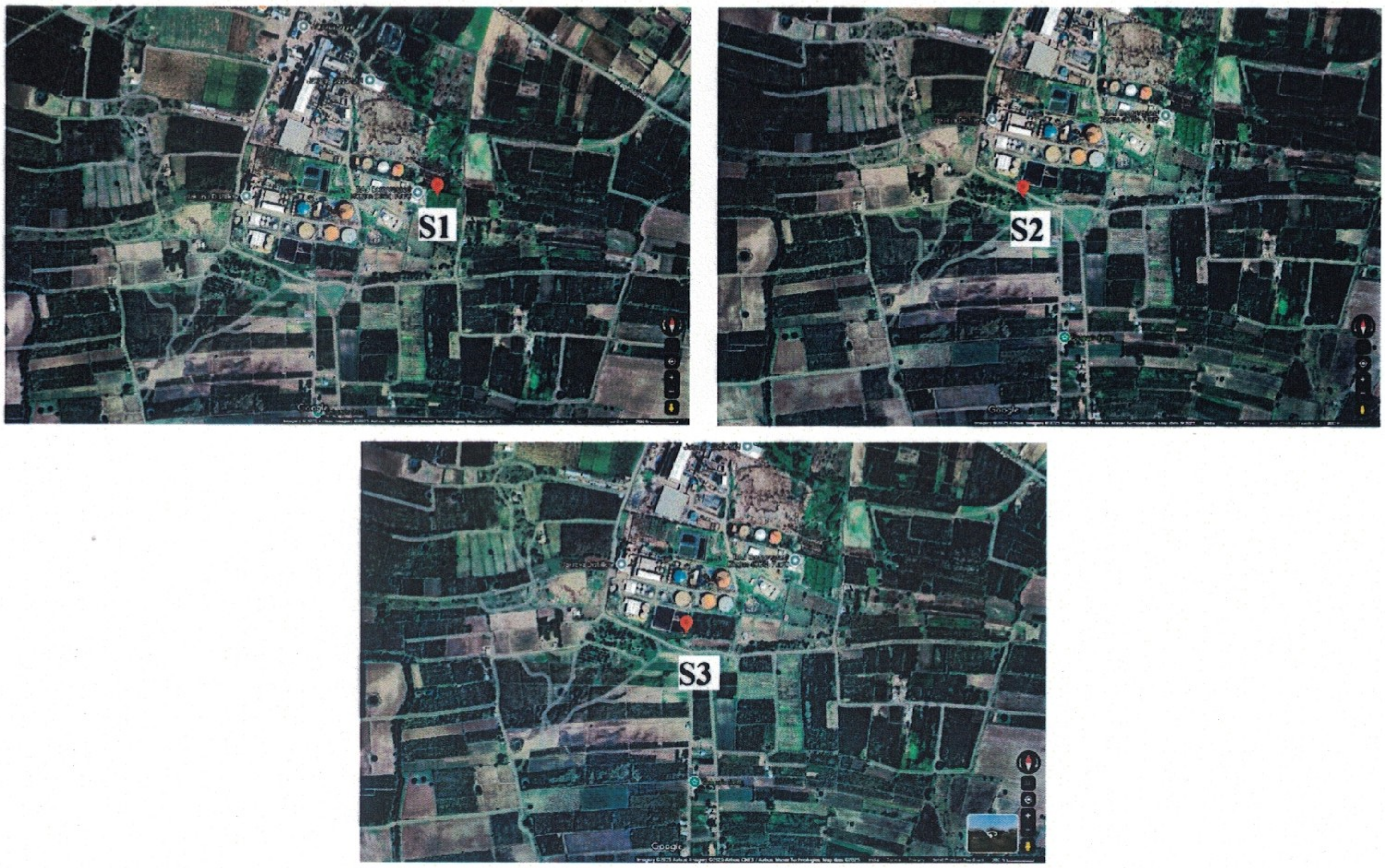


Figure 4. Geogrphical illustration of the precise locations where solid samples were collected.

5.2 Analytical parameters: Each collected sample underwent a detailed laboratory analysis based on standards to evaluate contamination levels and assess compliance with regulatory norms.

5.2.1 Water quality analysis: The seven water samples were subjected to an extensive range of physicochemical and biological tests to assess pollution levels:

i. **pH:** Determines the acidity or alkalinity of the water, indicating potential chemical contamination.

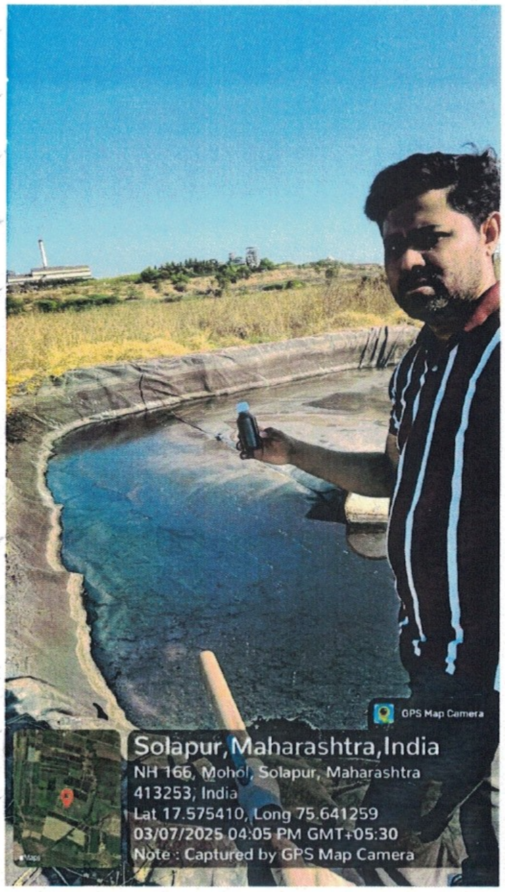
ii. **Total dissolved solids (TDS):** Measures the concentration of dissolved substances in water, signifying the presence of pollutants.

iii. **Suspended solids:** Evaluates particulate matter that can contribute to turbidity and affect aquatic life.

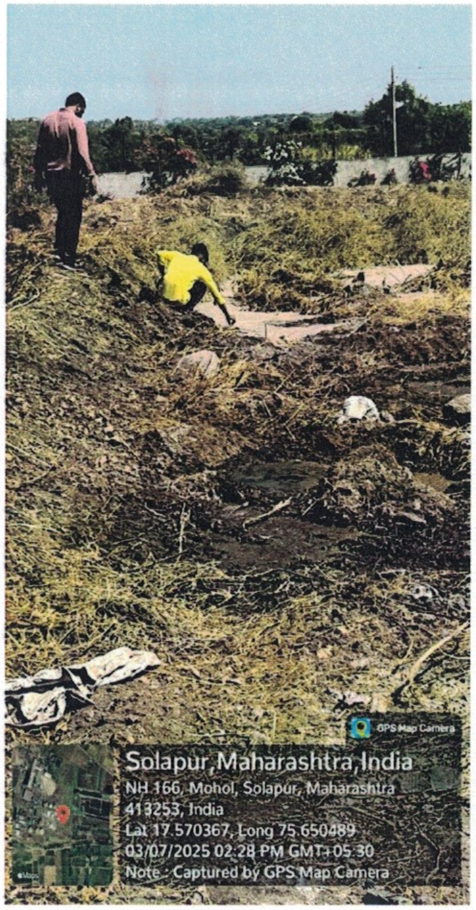
iv. **Turbidity:** Assesses the cloudiness of water, often influenced by industrial discharges.

v. **Total alkalinity:** Indicates the water's capacity to neutralize acids, affecting pH stability.

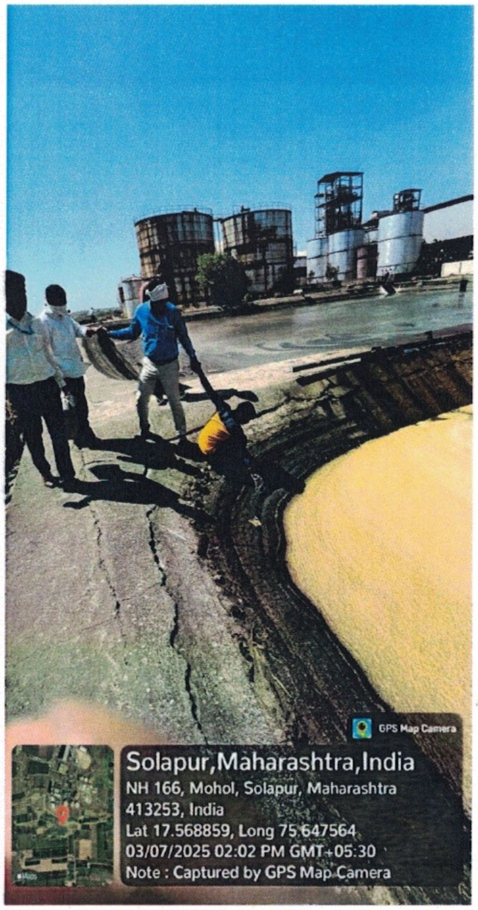
vi. **Chloride:** High chloride levels can indicate contamination from industrial effluents or improper wastewater discharge.



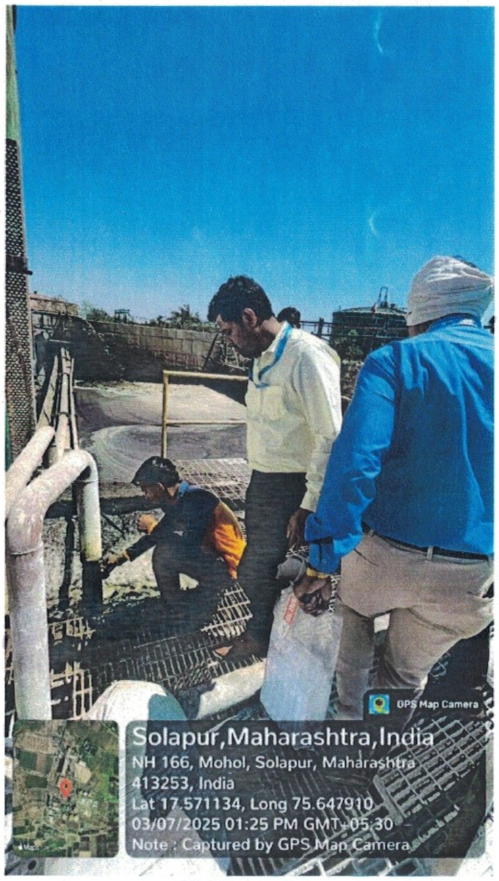
W1 Sampling



W2 Sampling

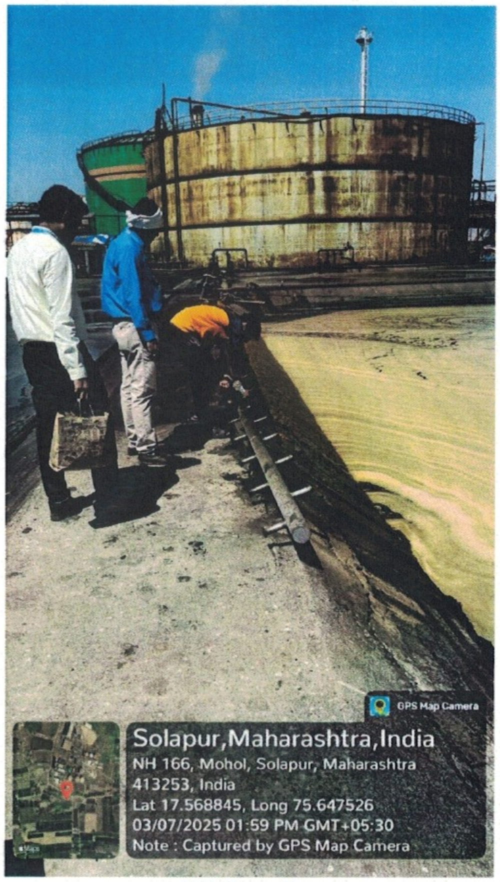


W3 Sampling

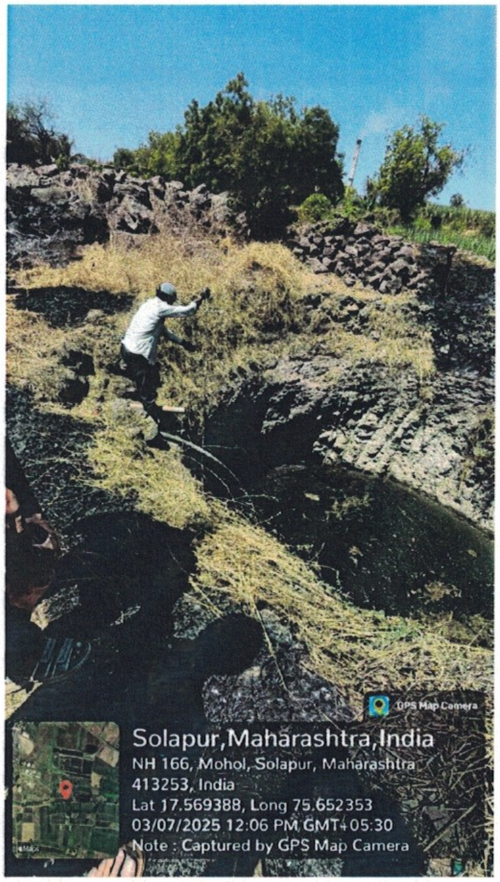


W4 Sampling

W5 Sampling



W6 Sampling



W7 Sampling

Figure 5. Geo-tagged photographs of water sample collection carried out in the presence of authorized officials, depicting sampling locations, date, time, and procedural integrity.

vii. **Biological oxygen demand (BOD):** Measures the amount of oxygen required by microorganisms to decompose organic matter, providing an indicator of organic pollution levels.

viii. **Chemical oxygen demand (COD):** Determines the amount of oxygen required to oxidize organic and inorganic substances, indicating the overall pollutant load.

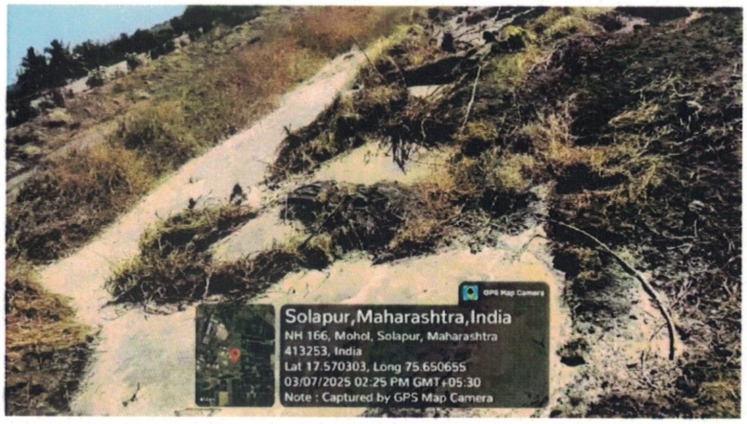
ix. **Hardness (Calcium, Magnesium, total):** Evaluates the concentration of calcium and magnesium ions, affecting water quality and usability.

x. **Nitrate nitrogen:** High levels suggest potential agricultural runoff or industrial contamination.

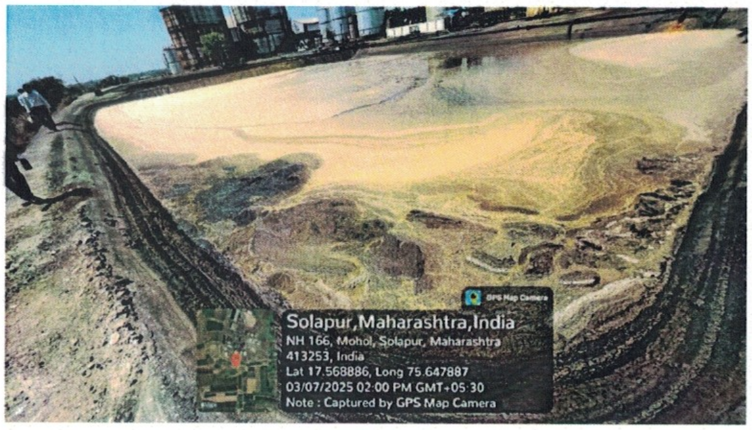
xi. **Sulphate:** Excessive sulphate concentrations can indicate pollution from industrial activities.

xii. **Oil & grease:** Detects contamination from petroleum-based products and industrial discharge.

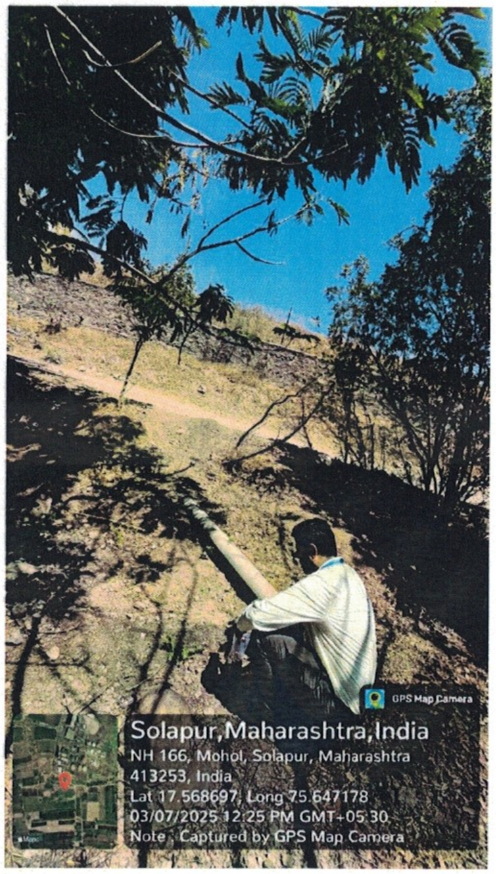
The results of these tests provide critical insights into the extent of water pollution, potential sources of contamination, and whether effluent treatment processes at JSL are functioning effectively.



S1 Sampling



S3 Sampling



S2 Sampling

Figure 6. Geo-tagged photographs of solid sample collection carried out in the presence of authorized officials, depicting sampling locations, date, time, and procedural integrity.

5.2.2 Solid quality analysis: The three solid samples were analyzed for key parameters to assess soil health, contamination levels, and the impact of industrial emissions:

i. **pH:** Determines soil acidity or alkalinity, which affects plant growth and nutrient availability.

ii. **Electric charge (conductivity):** Indicates the presence of dissolved salts and potential soil salinity issues.

iii. **Organic content:** Measures the presence of decomposed plant and microbial material, essential for soil fertility.

iv. **Nitrogen (N), Phosphorus (P), Potassium (K):** These are essential macronutrients that influence soil productivity and agricultural viability.

v. **Calcium carbonate ($CaCO_3$):** Evaluates the presence of lime in soil, which can impact soil buffering capacity.

vi. **Calcium (Ca), Magnesium (Mg), Sodium (Na): Determines the soil's cationic balance,** influencing nutrient absorption.

vii. **Heavy metals (Cadmium, Chromium, Copper, Lead, Nickel, Zinc):** Assesses contamination from industrial emissions or wastewater disposal, which could pose risks to crops, groundwater, and human health.

5.2.3 Air quality analysis: Due to the extreme weather conditions we could not collected the air samples.

5.3 Photographic documentation: To support the environmental assessment and provide concrete evidence, the ICT team captured geo-tagged images with date and time stamps at all key locations, including effluent discharge points, pollution control equipment, and areas of visible contamination such as wastewater seepage zones and affected agricultural fields. These images serve as critical documentation for regulatory authorities and legal proceedings, ensuring that pollution sources are accurately recorded.

5.4 Equipment Inspection and Evaluation: The effectiveness of JSL's pollution control measures was assessed through a comprehensive inspection of its equipment, focusing on design, operational efficiency, and maintenance protocols. Key areas of evaluation included:

i. **Effluent treatment plant (ETP) & sewage treatment plant (STP):** The team examined treatment efficiency, chemical dosing, sludge management practices, and compliance with discharge norms.

ii. **Boiler stack and air pollution control systems:** The emission control systems, including scrubbers, bag filters, and chimneys, were inspected to verify their functionality and effectiveness in reducing air pollutants.

iii. **Spent wash management:** The team assessed whether the factory was properly handling and treating spent wash or resorting to illegal disposal methods.

iv. **Hazardous waste storage and handling:** ICT experts checked storage facilities and handling practices for hazardous waste, ensuring compliance with safety and environmental regulations.

6. Results and observations:

6.1. Water sample analysis and environmental implications: The ICT team collected and analyzed seven water samples from strategically chosen locations within and around the Jakraya Sugar Ltd. premises. The measured parameters, along with their respective units and concentrations, are presented in Table 2. The results provide insight into the environmental degradation resulting from the industrial activities at the facility.

The results may indicate potential trends of contamination and possible inefficiencies in the pollution control systems. The samples collected from spent wash tank 2 (W3) and spent (W6) were found to be heavily polluted, with extremely high concentrations of TDS, BOD, COD, and turbidity. These values appear to exceed permissible limits, suggesting that the spent wash might be a high-strength effluent with potentially harmful characteristics. Continued land application may result in progressive soil quality deterioration, contamination of local groundwater resources, and significant ecological harm. Additionally, the water sample from the east side dug well (W7) shows signs of contamination, which might be linked to leachate from the CBG landfilling site (W2). The chloride content, total hardness, and nitrate nitrogen levels in this well may render it less suitable for drinking or agricultural use, pending further confirmation. This isolated sample also points toward a broader issue of regional groundwater pollution that could be affecting all nearby wells.

The water quality from west side discharge (W1), ETP inlet (W4), and ETP outlet (W5) suggests ongoing contamination and possible limitations in the current performance of the effluent treatment plant (ETP). While some reduction in pollutant concentration is observed between inlet and outlet, the final treated water still contains exceedingly high levels of BOD and COD. The inadequately treated water ultimately drains into the Odha, a natural brook that merges into the Bhima River, which might present risks to aquatic life and downstream users if sustained over time. Furthermore, the CBG landfilling site (W2) exhibits high TDS, sulphate, and chloride concentrations, suggesting poor leachate containment and resulting in localized groundwater pollution. Another observation is the notable variation in pH across sampling sites, with values ranging from as low as 3.67 in W6 to 8.23 in W2. Such fluctuations indicate strong acidic or alkaline conditions that disrupt soil chemistry and microbial life. Elevated turbidity and suspended solids across most samples further confirm a high concentration of undissolved pollutants, which can obstruct sunlight penetration in water bodies and suffocate aquatic ecosystems. The consistent presence of oil and grease in several samples, including W3 and W6, highlights inadequate industrial housekeeping practices. These substances are known to form surface films that limit oxygen exchange in water bodies and contribute to long-term ecological degradation.

Table 2. Physicochemical characteristics of water samples collected from various locations at Jakraya sugar ltd.

Sample/Parameters	Unit	W1	W2	W3	W4	W5	W6	W7
pH	-	5.79	8.23	4.04	7.42	8.21	3.67	7.10
Total dissolved solids (TDS)	mg/L	8941.18	52285.71	150000	7454.55	106.8	77028.57	107.20
Suspended solids (SS)	mg/L	358.82	BLQ	2644.44	1309.09	5120	2076.19	BLQ
Turbidity	NTU	1923.53	348.00	7066.67	509.09	524	6057.14	42.67
Total alkalinity	mg/L	2692.94	9529.71	BLQ	3250.18	3400.8	BLQ	872.00
Chloride	mg/L	1088.24	2614.29	9138.22	1523.27	1696	6070.29	1603.60
Biochemical oxygen demand (BOD)	mg/L	658.24	365.14	4130.44	1052.36	4336	3283.62	63.20
Chemical oxygen demand (COD)	mg/L	1339.41	1301.14	12911.11	3919.27	15362	9638.10	212.40
Hardness (Calcium)	mg/L	1468.24	460.57	3063.33	526.91	488.4	2920.95	1874.40
Hardness (Magnesium)	mg/L	235.29	252.00	1643.33	298.91	360.4	975.62	529.20
Hardness (total)	mg/L	4768.24	37181.71	14459.56	2594.18	69.17	11364.57	6874.00
Nitrate nitrogen	mg/L	341.76	3019.43	9888.89	295.64	276	7009.52	70.80
Sulphate	mg/L	663.53	12397.71	6567.11	1586.55	11623.2	5550.67	1970.00
Oil and grease	mg/L	129.41	160.00	155.56	BLQ	152	133.33	BLQ

BLQ: Below limit of quantification.

6.2 Solid sample analysis and environmental implications: In addition to water sampling, three solid samples (details are given in Table 1) were collected from different locations within the Jakraya Sugar Ltd. premises and analyzed for their metal, oxide content and other important parameters to evaluate the potential contamination of soil and solid waste streams. The results may revealed substantial presence of oxides of various metals, results are shown in Table 3, which provide insights into the environmental risks associated with particulate matter, ash, or solid residues being generated and potentially dispersed from the site.

Sample S1 (CBG side discharge) showed a relatively high sulphate content (85.656%), which might be attributed to combustion processes or possibly suboptimal handling of spent wash solids. These sulfur levels may suggest a possibility of acidic leachate generation if exposed to water, which might affect soil pH and potentially impact crop productivity. In S2 (south side soil sample), the oxide profile was more balanced but still showed considerable presence of sulfur (40.546%) and calcium (39.959%), along with notable levels of silicon (12.648%) and potassium (4.052%). This composition indicates mixed origin, possibly ash residue from bagasse combustion or landfill waste, which if not properly managed, can leach alkaline and toxic compounds into the soil and groundwater.

Sample S3 (spent wash tank 2), collected from a likely ash-rich zone, exhibited elevated calcium content (35.24%) and relatively lower sulfur (32.83%) and silicon (13.75%), along with elevated iron (9.346%) and aluminium (2.810%). These elements may be consistent with typical fly ash or combustion residues matter from boilers and furnaces. The detection of trace metals like copper, manganese, and zinc across all samples, though in trace amounts, raises concerns about the accumulation of heavy metals in the environment over time. Such contamination can lead to toxicity in soil, affect microbial activity, and eventually bioaccumulate in crops, posing a risk to human and animal health.

***Table 3.** Concentration of heavy metals in solid samples collected from various locations within and around Jakraya sugar ltd.*

S1 sample/ Elements	Oxide content (%)	S2 sample/ Elements	Oxide content (%)	S3 sample/ Elements	Oxide content (%)
S	85.656.	S	40.546.	Ca	35.237
Si	5.356.	Ca	39.959.	S	32.827
Ca	3.924.	Si	12.648.	Si	13.750
Fe	2.443.	K	4.052.	Fe	9.346
Al	1.943.	CI	1.267.	K	3.574
K	0.323.	Fe	1.208.	Al	2.810
Ti	0.283.	Ti	0.177.	Cl	1.506
Mn	0.038.	Mn	0.064.	Ti	0.742
Cu	0.029.	Cu	0.055.	Mn	0.140
Zn	0.005.	Br	0.024.	Zn	0.068

Due to unexpected biological contamination, only one solid sample, collected from the CBG side discharge location, could be successfully analyzed for the detail parameters as listed in ***section 5.2.2 solid quality analysis***. Despite being stored as per standard preservation protocols, the remaining two samples exhibited substantial fungal growth, which rendered them unsuitable for accurate laboratory analysis. This indicates a high organic and moisture content in the waste, making it prone to rapid microbial activity and degradation. As presented in Table 4, the findings clearly reflect inadequate segregation, improper storage, and unscientific disposal practices of solid waste at the site.

Table 4. Physicochemical characteristics of solid sample collected from CBG side discharge location at Jakraya sugar ltd.

Sample/Parameters	Unit	S1	Sample/Parameters	Unit	S1
pH	-	6.43	Magnesium	%	0.49
Conductivity	S/m	3.09	Sodium	%	0.51
TOC	%	6.25	Potassium	%	0.33
Lead	mg/kg	BLQ	Phosphorus	%	0.12
Nickel	mg/kg	15.64	**Zinc**	mg/kg	35.48
Chromium	mg/kg	36.58	**Calcium**	%	2.37
Copper	%	124.31			

The pH level of 6.43 indicates slightly acidic soil, which can affect nutrient availability. Electrical conductivity measured at 3.09 S/m suggests high salinity, which can severely restrict plant growth and microbial activity. The Total Organic Carbon (TOC) content at 6.25% appears elevated, potentially due to accumulation of decomposing organic waste or high-strength effluents.

Heavy metal analysis revealed elevated concentrations of Nickel (15.64 mg/kg) and Chromium (36.58 mg/kg), both of which are known to be toxic to soil microorganisms and plant roots when present in excessive amounts. Although Lead was below quantification limits, the presence of Copper (124.31 mg/kg) is significantly high and can contribute to phytotoxicity, especially in long-term exposure. Zinc (35.48 mg/kg), while an essential micronutrient, is also on the higher side and could become toxic with continuous accumulation.

The presence of major nutrients such as Calcium (2.37%), Magnesium (0.49%), Sodium (0.51%), Potassium (0.33%), and Phosphorus (0.12%) reflects chemical imbalances likely stemming from irregular and unscientific application of spent wash and solid waste as fertilizers. The excessive sodium and conductivity levels further hint at long-term risks of soil salinization, which can reduce agricultural productivity and soil permeability.

These findings confirm that the application of industrial by-products and discharge practices at Jakraya Sugar Ltd. have begun to alter soil chemistry in a manner that may be detrimental to crop growth, soil health, and groundwater recharge potential. Immediate remediation and regulation of waste application are necessary to prevent irreversible damage.

6.3 Photographs: During the site inspection, the Institute of Chemical Technology (ICT) team captured geo-tagged, date- and time-stamped photographs that may serve as visual indicators of possible environmental concerns in and around the Jakraya Sugar Ltd. premises. These images, documented in the presence of authorized personnel, are intended to supplement the overall environmental assessment and support the field observations noted during the site visits.

6.3.1. Fly ash pollution: Photographs, as shown in Figure 7, appear to indicate the presence of fly ash deposits on surrounding vegetation, residential rooftops, and open areas adjacent to the facility. This observation might suggest that the efficiency of mechanical ash collectors or wet scrubbers could be reviewed. These components are generally considered essential in controlling particulate emissions, and any deviation from optimal performance may lead to localized air quality concerns. The settled ash, if persistent, may also have implications for respiratory comfort and ambient dust levels affecting nearby residents and workers.

Figure 7. Photographs show the fly ash deposit on rooftop of nearby residence and on foliage of surrounding trees.

6.3.2 Wastewater discharge into fields and natural drain: Visual documentation obtained during the site inspection (as illustrated in Figure 8) appears to depict the discharge of wastewater from the facility into adjacent agricultural fields and a nearby natural brook (Odha), which traverses the local terrain and eventually connects to the Bhima River. The photographs show pipeline outlets extending from the plant toward this natural drainage system, which may suggest the need for further evaluation of discharge pathways and compliance mechanisms. The observed coloration and Odor of the effluent, along with the visibly saturated condition of the land, could be indicative of untreated or partially treated wastewater, including spent wash and other industrial streams, potentially influencing surface and groundwater quality. Further confirmatory sampling and assessment may be necessary to understand the extent and impact, if any.

Figure 8: Flooded agricultural field with wastewater discharge and wastewater pipeline from factory discharging into natural drain (Odha).

6.3.3 Concealed trucks transporting spent wash: During the site visit, eight trucks were observed and photographed within the facility premises (as shown in Figure 9). These vehicles appeared to be associated with the transportation of spent wash, a high-strength organic liquid by-product generated during molasses fermentation and distillation processes. It was understood that this material may have been intended for use on nearby agricultural land, potentially as a nutrient supplement. However, it remains unclear whether the spent wash underwent adequate pre-treatment or whether the practice was aligned with regulatory approvals. While spent wash can contain trace nutrients, its typically high levels of BOD, COD, total solids, and other constituents suggest that direct application without appropriate treatment and controls might affect soil structure, microbial ecosystems, and potentially contribute to groundwater quality concerns over time. These observations may warrant further review and monitoring.

Figure 9. Photograph shows trucks within premises are used for delivering the sold spent wash to the farmer's agricultural land.

6.3.4 Contaminated open dug well: During the site visit, a local open dug well was observed near areas where wastewater had reportedly been discharged onto land surfaces (see Figure 10). The photograph depicts blackish water, a surface film, and a distinct odor, which may suggest the possible infiltration of contaminants into the groundwater system. Given the proximity of the well to potential discharge points, it could be considered vulnerable to environmental influence. The observed water quality characteristics might limit its suitability for domestic or agricultural use and may warrant further investigation, especially since many rural communities rely on such sources for daily needs. These findings may point to the need for additional monitoring and evaluation to assess potential impacts on groundwater quality in the surrounding area.

Figure 10. The photograph shows discharge of wastewater on the open field, which results in the percolation of wastewater into the open dug well.

7. Conclusion: The environmental assessment conducted by the Institute of Chemical Technology (ICT), comprising field visits, environmental sampling, laboratory analyses, and photographic documentation, suggests that certain operations at Jakraya Sugar Ltd. may be contributing to localized environmental impacts. The water quality data indicates that some samples, particularly those from spent wash locations and groundwater sources near landfilling areas, exhibited elevated levels of parameters such as TDS, BOD, COD, and turbidity. These findings might be indicative of limitations in the current effluent treatment system and could pose potential risks to public health and environmental quality if left unaddressed. Instances of untreated or partially treated wastewater possibly entering natural drainage pathways such as the Odha, which ultimately connects to the Bhima River, may require closer monitoring to assess long-term implications.

Similarly, analyses of solid and soil samples revealed comparatively high concentrations of sulfur compounds, heavy metals, and nutrients. These results may suggest the need for more systematic solid waste management practices and a scientific review of the use of industrial by-products on agricultural land. Notably, one soil sample exhibited elevated electrical conductivity and metal content, which might point toward potential risks of soil salinization and long-term accumulation effects, including impacts on groundwater recharge areas.

Taken together, the findings may reflect areas where existing waste management and pollution control strategies could be strengthened. ICT respectfully recommends that the Maharashtra Pollution Control Board (MPCB) consider facilitating enhanced oversight, encouraging data sharing and cooperative engagement from the industry, and exploring the preparation of a time-bound action plan to improve **environmental compliance and remediation measures. These findings are submitted for MPCB's further** review and consideration for appropriate regulatory or advisory follow-up, including submission to the **Hon'ble National Green Tribunal, if required.**