UWR Rainwater Offset Unit Standard (UWR RoU Standard)

Project Concept Note & Monitoring Report (PCNMR)

Project Name: Water Credit Project by NSL Koppa Unit, Karnataka, India

UWR RoU Scope: 2 & 5
Monitoring Period: 01/01/2014 - 31/12/2024
Crediting Period[1]: 2014-2024
UNDP Human Development Indicator[2]: 0.644
NWS: 50 (India)[3]

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[1] Not applicable. RoUs can be claimed for the "Lifetime of the Project Activity as per UCR standard
[2] Value is applicable for India according to latest HDI 2023-24 https://hdr.undp.org/sites/default/files/2023-24_HDR/HDR23-24_Statistical_Annex_HDI_Table.xlsx.
This is below 0.9 as per requirement mentioned in methodology rainwater offset methodology standard version 7.0.
[3] All projects using this methodology are ideally below the NWS score of 60 and NWSI equal or lower than 2 (NWSI ≤ 2). As per UCR standard page 11 and NWS for India is below 50

A.1 Location of Project Activity

State	Karnataka
District	Mandya
Block Basin/Sub Basin/Watershed	Please refer to http://cgwb.gov.in/watershed/basinsindia.html
Lat. & Longitude	12^0 42' 24.84" and 12^0 41' 24.47" N latitudes and 76^0 58' 24.60" and 76^0 58' 51.13" E Longitudes
Area Extent	103 acres (41.68Ha)
No. of Villages/Towns	3; Chikkonahalli Village, Hurugalawadi Village and Koppa Village

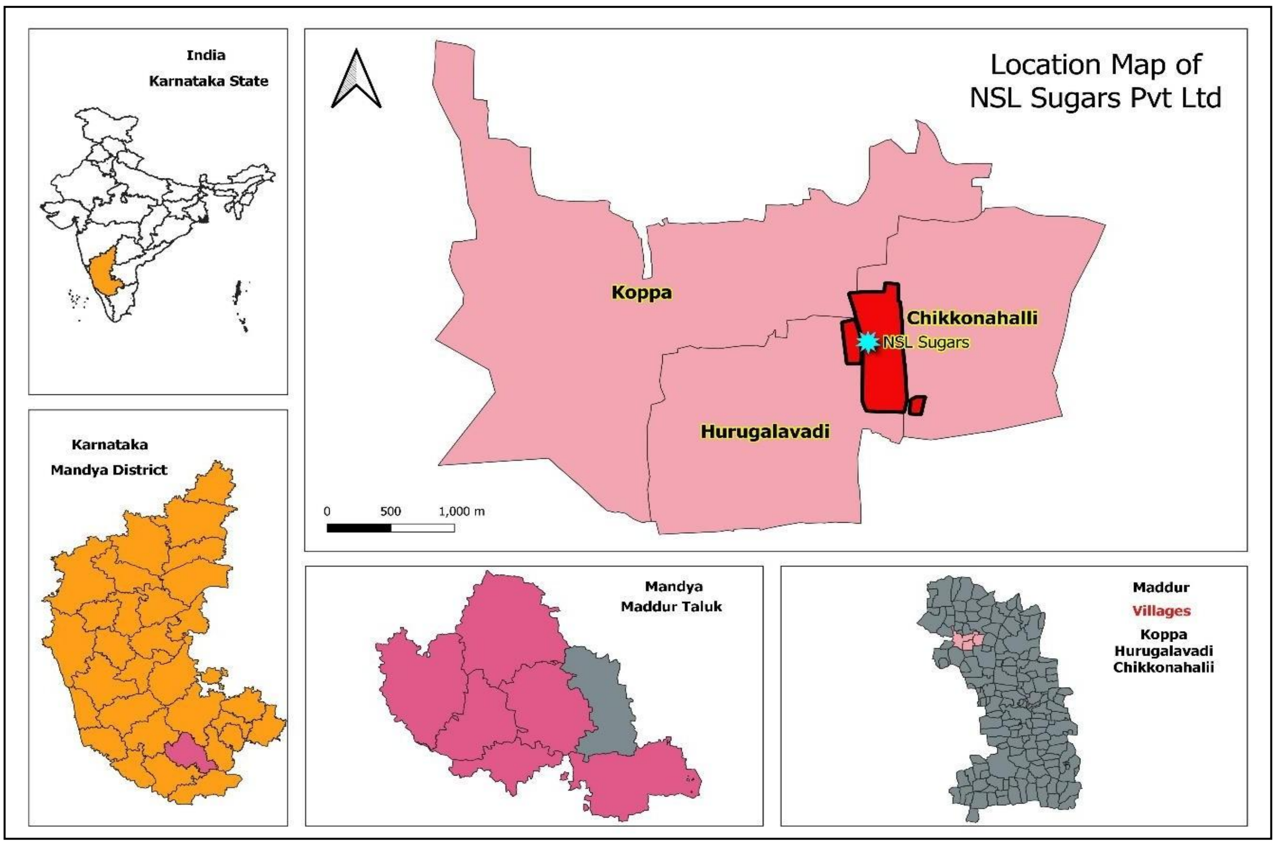

Figure 01: Location of NSL Sugars Ltd. in 3 Villages in Maddur Tehsil, Mandya District, Karnataka, India

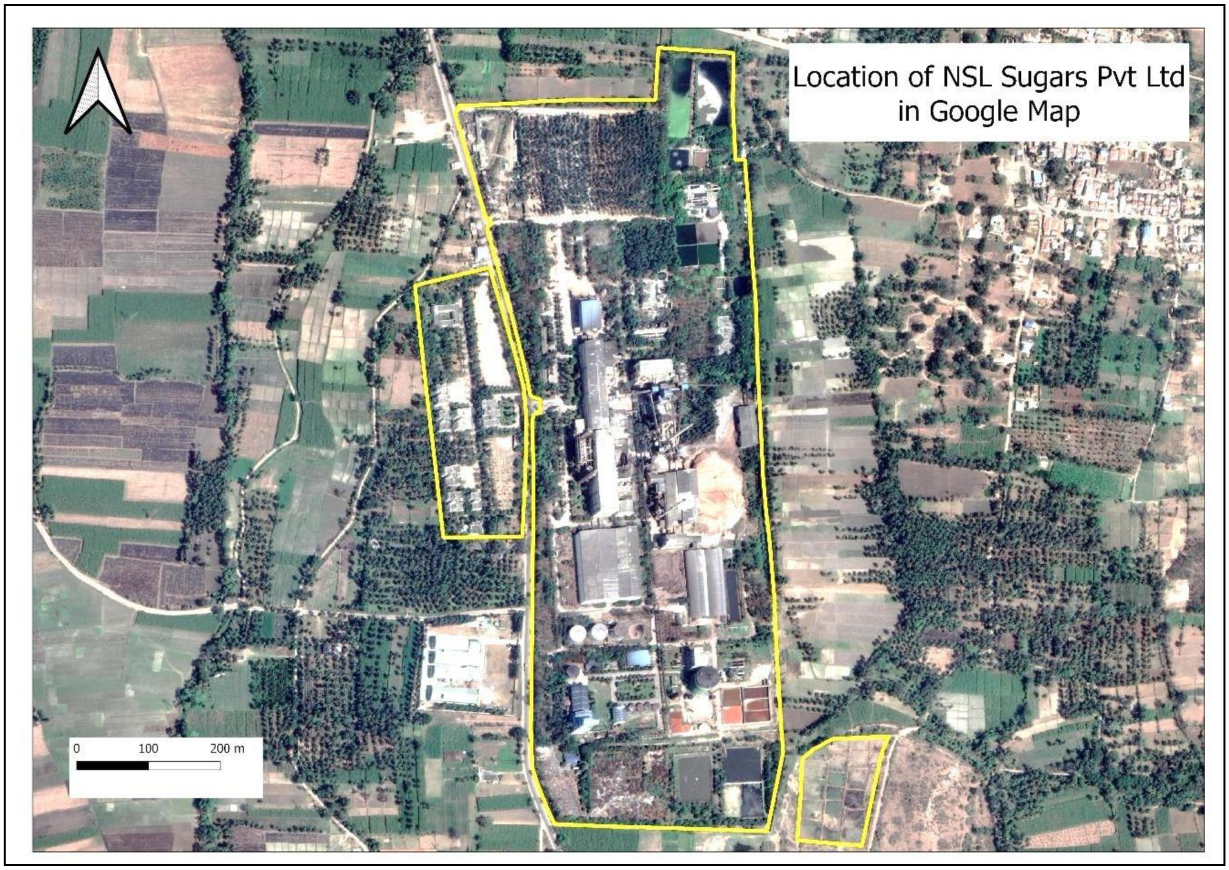

Figure 02: Aerial view of NSL Sugars Ltd. in Google Map

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

NSL (Nuziveedu Seeds Limited) group foundation was led by Sri Venkata Ramaiah in 1973, and built upon by his son Sri M Prabhakar Rao, who has been leading the company since 1982. The company has evolved over the years with core expertise in research, marketing and supply chain to emerge as the largest seed company in India. This particular project is part of NSL Sugar group, in Koppa Unit (also called as "NSL Sugar Koppa").

Name	Designation
Shri. M. Prabhakar Rao	Chairman of NSL Group
Shri Sithramachandra Roa	Sr. General manager & unit head of NSL Sugars Limited, Koppa

Roles and responsibilities are clearly documented here within the management plan including clear lines of accountability and reporting, which is presented below:-

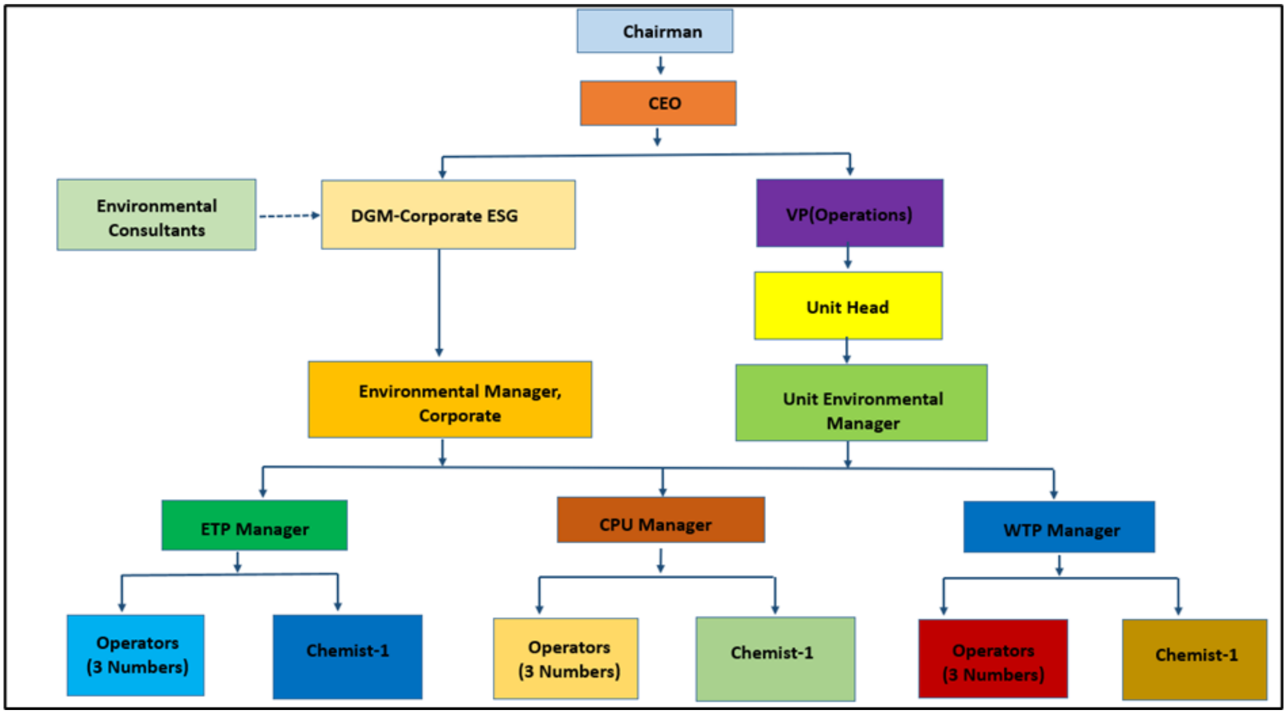

Figure 03: Environment Management Cell

Table 01: Roles & responsibilities of Environment Management Cell at NSL Plant

S. No.	Designation	Responsibility
1	Chairman	• Strategic Oversight • Board Leadership • Compliance and risk management
2	CEO	• Allocate adequate resources, including budgets and personnel, to implement and maintain environmental initiatives. • Invest in technologies and infrastructure that support sustainable practices
3	DGM- Corporate ESG	Interact with regulatory authorities, local communities, and other stakeholders to address environmental concerns and promote sustainability initiatives.
4	VP(Operation)	• Ensuring the alignment of environmental goals with operational objectives
5	Environmental Manager, Corporate	• Compliance Management • Environmental Monitoring and Reporting • Sustainability Initiatives • Training and Awareness • Incident management • Documentation and record keeping

6	Unit head	• Strategic Leadership • Compliance Oversight • Team management • Resource allocation • Policy Advocacy and Representation
7	Unit Environmental Manager	• Environmental Compliance • Develop strategies to mitigate adverse environmental impacts • Pollution Control • Resource management • Environmental Monitoring • Training and education
8	• ETP Manager	• Resource management • Pollution Control • Effluent quality Monitoring • Training and education • To verify the data entered in log book regarding treated and untreated effluent quality
	• ETP chemist	• Effluent Analysis and Monitoring • Treatment Process Optimization
	• ETP Operators	Operation and Maintenance of ETP
9	• CPU manager	• Pollution Control • To verify the data entered in log book regarding treated and untreated effluent quality • To verify the working efficiency of CPU
	• CPU Chemist	• Treated Effluent Analysis and Monitoring • Treatment Process Optimization
	• CPU operator	Operation and Maintenance of CPU
10	• WTP Manager	Water quality analysis
	• WTP operator	Operation and Maintenance of WTP
	• WTP Chemist	• Water quality Analysis and Monitoring • Treatment Process Optimization
11	APC operator	Operation and Maintenance ESP
12	Supervisors	Development and Maintenance of Greenbelt and other general EMP of the industry

The Project owner of NSL attest to the following:

(a) NSL Group owns the water user rights for the area within the project's boundary,

Government Order No: WRD 71 MMK 2023, Bangalore,
Dated: 15.03.2024

M/s NSL Sugars Ltd, Koppa, Maddur taluk, Mandya, had to use water for industrial purposes of 1600 megaliters (56.504 mcft per annum) of water from the river Shinsha near Koppa village, Maddur taluk, Mandya, for a period of 340 days to use available water during the rainy season. (from July to September) and to fill the storage system of the factory during the rainy season and to use it during the non-monsoon season, as per the conditions in the annexure, from February 28, 2022, to February 27,

2027, has been approved for renewal of the water license.

By order of and in the name
of the Governor of Karnataka

Sd/- (15.03.2024)

Manohara Y, Rotte)
Special Duty Officer
Water Resources Department

<u>Government order dated 15/03/2024 for renewal of water usage by NSL Koppa unit</u>

(b) NSL Group holds an uncontested legal land title for the project area within the project's boundary

ENVIRONMENTAL CLEARANCE

PARIVESH

(Pro-Active and Responsive Facilitation by Interactive, and Virtuous Environment Single-Window Hub)

Government of India
Ministry of Environment, Forest and Climate Change
(Impact Assessment Division)

To,

The Whole Time Director
M/S. NSL SUGARS LIMITED
Survey No. 60 to 62 , 88 to 98 and 100 to 105 of Chikkonahalli village of Thaggahalli gram panchayath and survey No. 55, 78 to 83 and 86 of Huragalwadi village of Koppa gram panchayat, Maddur taluk, Mandya district,,Mandya,Karnataka-571425

Subject: Grant of Environmental Clearance (EC) to the proposed Project Activity under the provision of EIA Notification 2006-regarding

Sir/Madam,

This is in reference to your application for Environmental Clearance (EC) in respect of project submitted to the Ministry vide proposal number IA/KA/IND2/242442/2021 dated 02 Feb 2022. The particulars of the environmental clearance granted to the project are as below.

1.	**EC Identification No.**	**EC22A022KA110935**
2.	**File No.**	J-11011/94/2015-IA-II(I)
3.	**Project Type**	Expansion7
4.	**Category**	A
5.	**Project/Activity including Schedule No.**	5(g) Distilleries
6.	**Name of Project**	Expansion of sugar plant and distillery to produce Ethanol under the EBP by M/s. NSL Sugars Limited
7.	**Name of Company/Organization**	M/S. NSL SUGARS LIMITED
8.	**Location of Project**	Karnataka
9.	**TOR Date**	N/A

The project details along with terms and conditions are appended herewith from page no 2 onwards.

Date: 14/03/2022

(e-signed)
A.K Pateshwary
Director
IA - (Industrial Projects - 2 sector)

Note: A valid environmental clearance shall be one that has EC identification number & E-Sign generated from PARIVESH.Please quote identification number in all future correspondence.

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8. The details of products and capacity are as under: -

Particular	Existing Capacity	Proposed expansion capacity	After expansion Total capacity
Sugar plant Expansion			
Sugar plant crushing capacity in TCD	5000	5000	10000
Co-generation in MW	26	-	26
Distillery Expansion			
Distillery Unit	60 KLPD RS/ENA/Ethanol using C Heavy molasses	Addition of new 100 KLPD distillery plant to produce; 100 KLPD Ethanol using C-heavy molasses Or 100 KLPD Ethanol using B-heavy molasses Or 140 KLPD Ethanol using Sugarcane syrup Or Grain based distillery to produce 60 KLPD Ethanol	•60 KLPD RS/ENA/Ethanol Or • 160 KLPD Ethanol Using C-Heavy molasses Or • 160 KLPD Ethanol using B-Heavy molasses Or • 200 KLPD Ethanol using Sugarcane Juice/syrup Or • 60 KLPD Ethanol using Grains
Distillery captive power plant in MW	2.1	0.9	3.0

EC Identification No. - EC22A022KA110935 File No. - J-11011/94/2015-IA-II(I) Date of Issue EC - 14/03/2022 Page 2 of 18

<u>Environmental clearance which clearly declares the land occupied and details of project implementation and capacity by the Koppa unit</u>

(c) NSL Group holds all necessary permits to implement the project or has applied for the same.- Yes, Unit possess all necessary documents like Environmental Clearance from MoEF&CC and **CFE** and **CFO** from State Pollution Control Board as attached below:

Consent For Establishment -Expand (CFE-EXP)

Consent No. CTE-331869 Valid upto: 13/03/2032

Karnataka State Pollution Control Board
Parisara Bhavana,No.49, Church Street,Bengaluru-560001
Tele : 080-25589112/3, 25581383
Fax:080-25586321
email id: ho@kspcb.gov.in

Industry Colour: RED Industry Scale: LARGE

(This document contains 8 pages including annexure & excluding additional conditions)

Consent Order No: CTE-331869 **PCB ID:** 10882 **Date:** 22/06/2022

To,

The Applicant,

N S L Sugars Ltd

Hurugalavadi & Chikkonahalli,
Koppa Hobli, Maddur Taluk,
Mandya

Sir,

Sub: Consent for Expansion of the unit in the Existing premises under the Water (Prevention & Control of Pollution) Act,1974 & the Air (Prevention & Control of Pollution) Act, 1981

Ref: 1.CFE expansion application submitted by the organization on 13/10/2020 at Regional Office KSPCB

2.Inspection of the project site by Regional Officer on 27/04/2022

3.Proceedings of the ECM date 18/05/2022 held on05/05/2022

With reference to the above, Karnataka State Pollution Control Board hereby accords **Consent for Expansion** of the unit in the existing premises under the Water (Prevention & Control of Pollution) Act, 1974 & the Air (Prevention & Control of Pollution) Act, 1981 at the location indicated below subject to the terms & conditions indicated in Schedule Annexed.

Location:

Name of the Industry:	N S L Sugars Ltd		
Address:	Sy. No. 60-62, 88 -98 & 100-105 Chikkonahalli Village, Sy. No. 55, 78-83 & 86, Hurugalavadi, Koppa Hobli, Maddur		
Industrial Area:	Not In I.A,		Hurugalavadi & Chikkonahalli,
Taluk:	Maddur,		District: Mandya

CONDITIONS:

1. The Consent for Expansion is granted considering the following activities:

Sr	Product Name	CFE Qty	CFO Qty	Applied Qty	Units	Existing/Proposed
1	distillery captive power of capacity from 2.1 mw to 3 mw	0.9000	0.000 - M.W	0.9000	M.W	Proposed
2	ethanol from sugarcane syrup/juice of capacity 200 klpd or	6000.0000	0.000 - KLT	6000.0000	KLT	Proposed
3	ethanol using b-heavy molasses of capacity 160 klpd OR	4800.0000	0.000 - KLT	4800.0000	KLT	Proposed
4	ethanol using c-heavy molasses of capacity 100 klpd or	3000.0000	0.000 - KLT	3000.0000	KLT	Proposed
5	ethanol using grains of capacity 60 klpd OR	1800.0000	0.000 - KLT	1800.0000	KLT	Proposed
6	sugarcane crushing of capacity from 5000 tcd to 10,000 tcd	5000.0000	0.000 - TCD	5000.0000	TCD	Proposed

2. This consent for establishment is valid up to 13/03/2032 from the date of issue.
3. The applicant shall not undertake further expansion/diversification without the prior consent of the Board.
4. The applicant shall obtain necessary license/clearance from other relevant statutory agencies as required under the law.

Consent for establishment by Karnataka State pollution control board for Koppa unit

Consent For Operation
(CFO-Air,Water)

Consent No. AW-328011
Valid upto: 30/06/2026

Karnataka State Pollution Control Board
Parisara Bhavana,No.49, Church
Street,Bengaluru-560001
Tele : 080-25589112/3, 25581383
Fax:080-25586321
email id: ho@kspcb.gov.in

Industry Colour: RED   Industry Scale: LARGE

(This document contains 7 pages including annexure & excluding additional conditions)

Combined Consent Order No. AW-328011   **PCB ID:** 10882   **Date:** 12/11/2021

Combined consent for discharge of effluents under the Water (Prevention and Control of Pollution) Act , 1974 and emission under the Air (Prevention and Control of Pollution)Act , 1981

Ref: 1. Application filed by the applicant/organization on 17/09/2021

2.Inspection of the Industry/organization/by RO, on 04/10/2021

3.Proceedings of the ECM dated 06/11/2021 ,held on 30/10/2021

Consent is hereby granted to the Occupier under Section 25(4) of the Water (Prevention & Control of Pollution) Act, 1974 (herein referred to as the Water Act) & Section 21 of Air (Prevention & Control of Pollution) Act, 1981, (herein referred to as the Air Act) and the Rules and Orders made there under and authorized the Occupier to operate /carryout industry/activity & to make discharge of the effluents & emissions confirming to the stipulated standards from the premises mentioned below and subject to the terms and conditions as detailed in the Schedule Annexed to this order.

Location:

Name of the Industry: N S L Sugars Ltd

Address: Sy. No. 60-62, 88 -98 & 100-105 Chikkonahalli Village, Sy. No. 55, 78-83 & 86, Hurugalavadi, Koppa Hobli, Maddur

Industrial Area: Not In I.A,   Hurugalavadi & Chikkonahalli,

Taluk: Maddur,   District: Mandya

CONDITIONS:

a) Discharge of effluents under the Water Act:

Sr	Water Code	WC(KLD)	WWG(KLD)	Remark
1	Boiler Feed	300.000	60.000	Freshwater 300 KLD (100 TPH boiler: Recycled to co-gen cooling tower)
2	Boiler Feed	60.000	15.000	Freshwater 60 KLD (25 TPH boiler - Recycled)
3	Boiler Feed	72.000	18.000	Proposed for installation of 30 TPH incineration Boiler The Boiler blow down is proposed to be collected in a tank & used for ash quenching/recycle to the Co-gen cooling tower make up.
4	Cooling Water	325.000	80.000	Fresh water 325 KLD (Distillery process: Recycled)
5	Cooling Water	380.000	100.000	Recycled 380 KLD (Sugar process: Recycle / on land for irrigation)
6	Cooling Water	515.000	150.000	Recycled 515 KLD (Cogen Cooling: Recycled to process)
7	Cooling Water	493.000	138.000	Freshwater 493 KLD (Cogen Cooling: Recycled to process)
8	D.M Water Plant	105.000	105.000	Freshwater 105 KLD (Backwash & Regen: On land for irrigation)
9	Domestic Purpose	95.000	76.000	Fresh water 95 KLD (Sugar, Cogen & Distillery: On land for gardening.)
10	Manufacturing Processes	650.000	375.000	Freshwater 650 KLD (Sugar process: Recycle / on land for irrigation)
11	Manufacturing Processes	480.000	480.000	Freshwater 480 KLD (Distillery process)
12	Others	130.000	130.000	Recycled water 130 KLD (Washing: On land for irrigation)
13	Others	0.000	80.000	Spent lees from Distillery plant : Recycled to process / On land for irrigation
14	Others	0.000	800.000	Excess hot water condensate from sugar plant / Recycled to process
15	Others	0.000	408.000	condensate from Distillery plant : Recycled to process / On land for irrigation

Consent for Operation by Karnataka State pollution control board for Koppa unit

d) Project implementation Cost:- the estimated project cost was referred as INR 17,58,69,743/-

A.2.1 Project RoU Scope

PROJECT NAME	Water Project by NSL Koppa Unit, Karnataka, India
UWR Scope:	Scope-2 & 5
Date PCNMR Prepared	Draft version : 15/01/2025 Version 01 (final) : 15/05/2025

A.3. Land use and Drainage Pattern

W.r.t. Scope-5

Not Applicable, since this project activity involves :

a) Treating and reusing wastewater from distillery and sugar plant
b) Reusing condensate water from operation.

It doesn't include or harm any land-use practices and Drainage system as it is an industrial process designed with technical requirements and following the specified norms of local pollution control board.

W.r.t. Scope-2

Land-use refers to the way in which the land has been used by humans and their habitat, usually with accent on the functional role of land for economic activities. It is the intended employment of management strategy placed on the land-cover type by human agents, and/or managers. Land-cover refers to the physical characteristics of earth's surface, captured in the distribution of vegetation, water, soil and other physical features of the land, including those created solely by human activities; for example - settlements. The land use and land cover are complex and largely continuous pattern and in order to understand its complexity, it is necessary to characterize them.

Land use land cover of the of the study area is derived through interpretation of satellite remote sensing image in digital environment using remote and GIS software Erdas Imagine (version 8.5). Satellite Image of the study area downloaded from U.S. Geological Survey web site USGS Earth Explorer (www.earthexplorer.usgs.gov) and a land use map was prepared. The satellite remote sensing, with its synoptic view and repetitively, is very helpful in order to cover large areas within a short time to characterize land use & land cover qualitatively and quantitatively.

Results and Discussion

The date of acquisition of the satellite image for the study area is 14/02/2021 with the path and row of 144 and 51, respectively.

Drainage pattern of the study area was developed using Survey of India (SOI) toposheet of the numbers D43W13, D43W14, D43x01 and D43X02. Toposheets were downloaded from Online maps Portal of Survey of India website (https://onlinemaps.surveyofindia.gov.in/). The drainage pattern thus developed clearly showed that most of the drainage flows towards **south-eastern**.

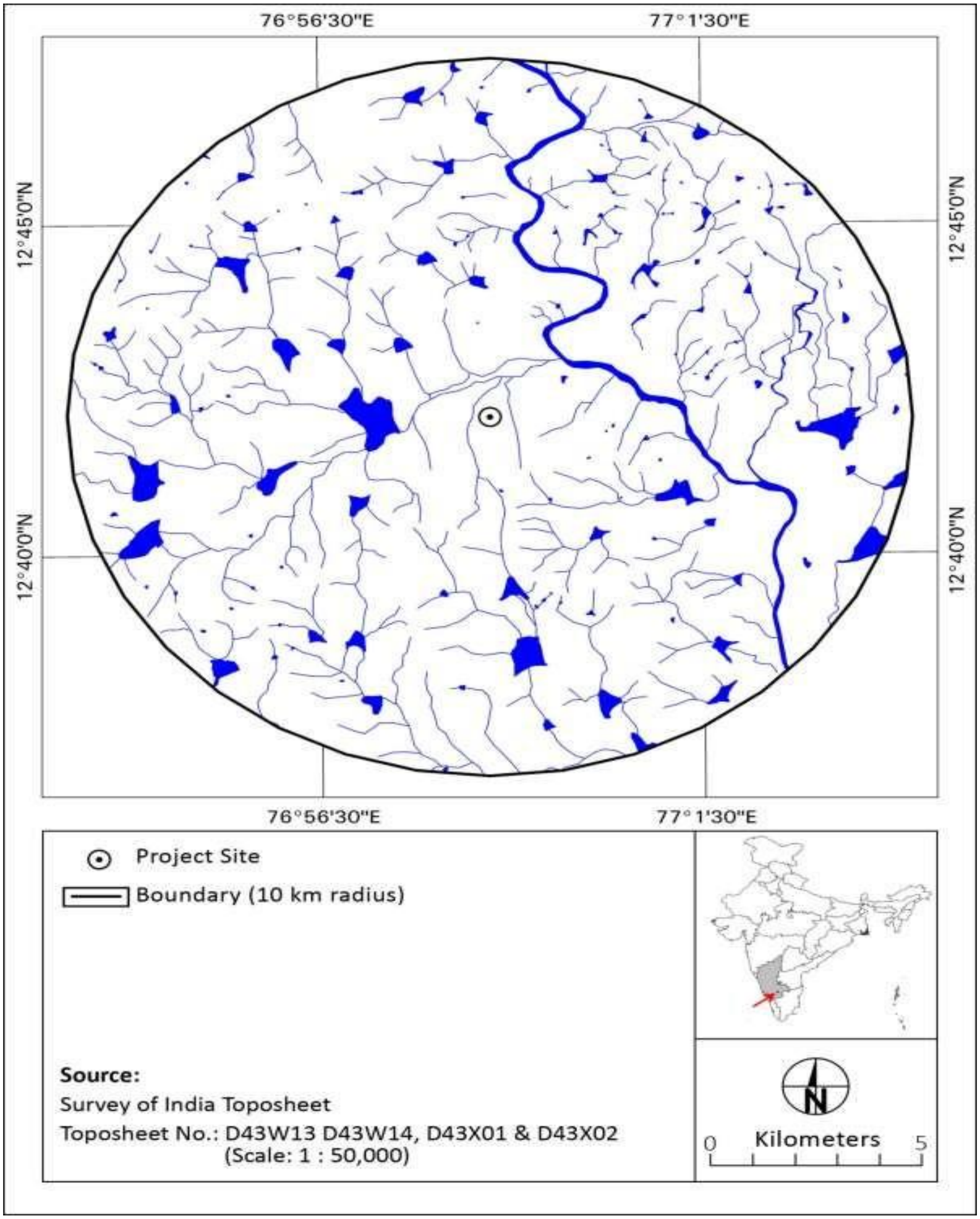

Figure 04: Drainage pattern of the project site in 10 km radius

The Digital Elevation Model (DEM) for the study area indicates that, the difference in the elevation of the study area is just 129 m above Mean Sea Level only (from 532 – 661 m, Fig. 3) indicating comparatively flat terrain.

Seven different land use / land cover classes have been identified in the study area and the image was classified accordingly. Table 02 shows the information about the extent of identified land use / land cover classes thus derived from the satellite image in the study area and represented below in Figure 05.

Table 02: Land use / land cover classes in 10 km area around the project site

S. No.	Land use / Land cover classes	Area (ha)	Area (%)
1	Forest	169.2675	0.54
2	Trees Outside Forest	2,238.93	7.15
3	Agriculture / Plantation	15,824.57	50.56
4	Open / Barren land	7,757.44	24.78
5	Built up	3,864.42	12.35
6	Wetland	834.84	2.67
7	Water body	609.53	1.95

There are **no reserved forests** in the study area. Vegetation of the study area is represented only by cultivated sparse trees (tree outside forests). Few third order drainage originate near the project site which joins Shimsha river which is 2.5 km away from the project site.

Since, the main river (Shimsha) is near to the project site, the possible impacts of the industry could be the wastes (both solid and liquid and organic as well as inorganic) generates in the premises of the industry if it goes into the drains and ultimately reaches the Shimsha river. Hence, care must be taken to ensure the zero-discharge system is in place and also measures need to be taken to avoid the escape any possible leakage of chemicals/waste to the stream and reaching the river.

The drainage head should be provided with small ponds so that leakages going into the drainage could be avoided. If these leakages going into the drain are not avoided, then agriculture in the study area may seriously affect due to the pollution of streams with organic and inorganic wastes from the industry.

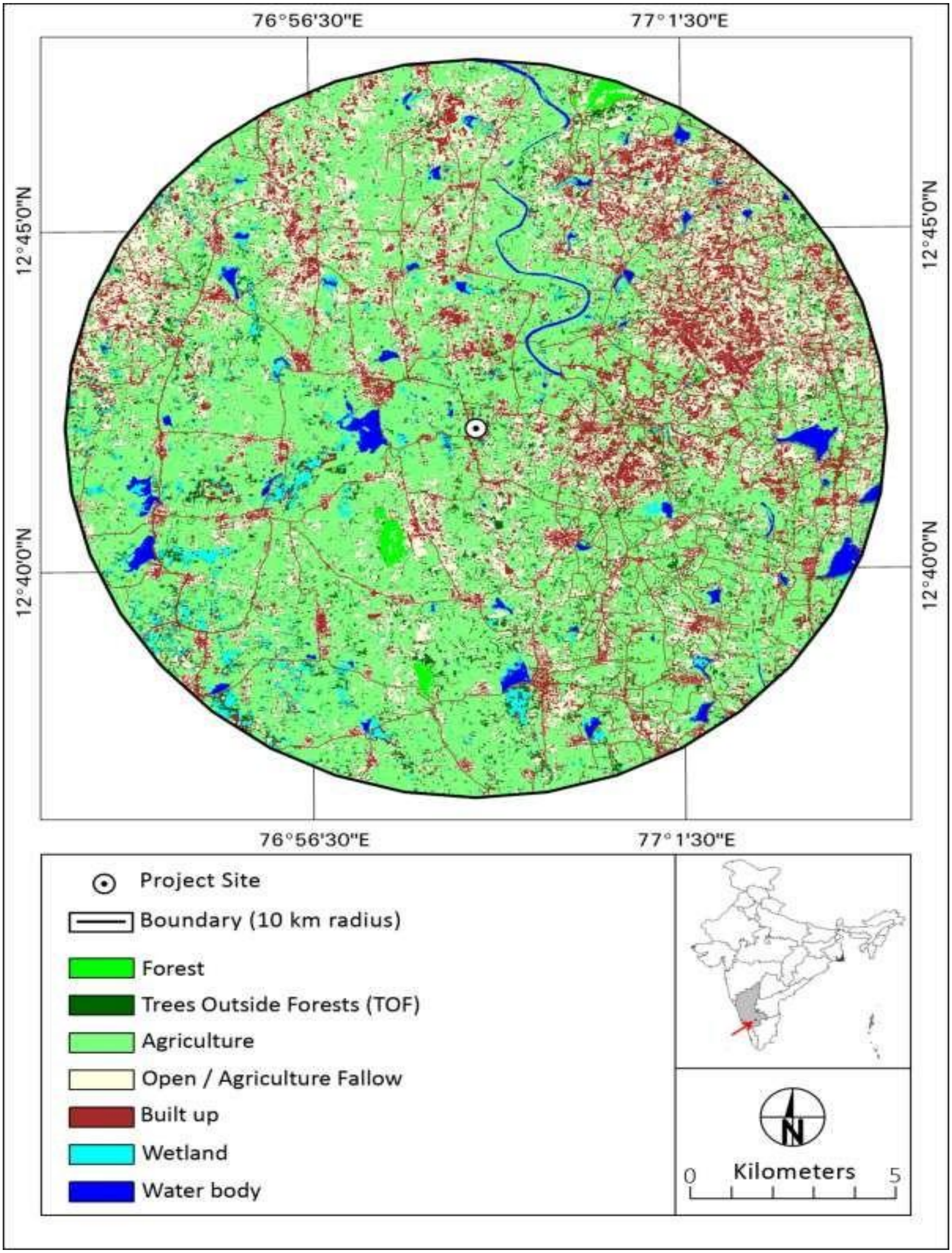

Figure 05: Land use / Land cover map of the project site in 10 km radius

A.4. Climate

For Scope-5

Not Applicable, since this project does not include any activity that is influenced by the climatic conditions of the area as it treats and reuses only the wastewater from the distillery and sugar plant without letting the water exposed to any climatic condition.

For Scope-2

Climate

The climate is a dominant factor in determining the relative abundance or scarcity of water in an area. The available secondary sources of information have been utilized for analyzing the climate characters of the study area. Climatologically the area experiences a **tropical sub-humid type of climate** with moderate summer and good seasonal rainfall. The southwest monsoon sets in the second week of June and lasts till September end. October and November receive rainfall from the NE monsoon. The Winter season with cool and fine weather prevails from December to February, followed by the summer season up to early June.

Based on the MERRA-2, the Temperature and Relative Humidity figures were obtained for the Plant location and presented below.

Period	2014	2015	2016	2017	2018	2019	2020	2021	Grand Total
Jan	20.86	22.25	22.02	21.99	20.21	23.83	22.06	20.81	**21.75**
Feb	22.72	22.68	22.08	22.39	21.35	22.49	22.20	22.07	**22.25**
Mar	25.17	24.14	24.77	24.19	23.46	26.00	24.61	23.27	**24.45**
Apr	27.15	26.93	28.57	27.28	27.02	29.48	28.55	27.27	**27.78**
May	30.09	27.44	31.68	29.85	29.61	30.08	28.71	28.44	**29.49**
Jun	26.95	25.97	27.89	27.09	26.43	28.12	28.70	26.05	**27.15**
Jul	25.35	24.52	24.33	24.70	24.18	26.13	24.87	24.12	**24.78**
Aug	23.74	24.94	24.01	24.87	24.18	24.73	23.62	23.67	**24.22**
Sep	23.34	24.93	24.26	24.21	24.01	23.67	23.76	23.84	**24.00**
Oct	23.54	24.86	24.25	23.48	24.93	23.59	22.89	23.75	**23.91**
Nov	22.88	24.26	24.87	22.74	23.63	23.06	22.79	23.41	**23.46**
Dec	21.46	21.96	24.63	21.75	23.46	22.53	21.85	21.85	**22.44**
Grand Total	**24.44**	**24.57**	**25.28**	**24.55**	**24.37**	**25.31**	**24.55**	**24.05**	**24.60**

Table 03: Average Monthly Temperatures of NSL Sugars Ltd.

During the winter season from December to February, low temperatures are recorded from a minimum of 20.21°C to a maximum of 23.83°C with an average of 21.72°C. The temperature begins to rise from March and go high during May with a minimum of 27.440C to a maximum of 29.66°C with an average of 29.99° C. Occasional Thunder storms with breeze bring welcome relief in afternoons. With the onset of the monsoon in early June, the average temperatures begin to drop and minimum being 22.91°C in September and the maximum being 28.12°C in June. However, the average temperatures of the area during the monsoon period vary from 23.92°C to 27.15°C.

Period	2014	2015	2016	2017	2018	2019	2020	2021	GrandTotal
Jan	62	64	70	53	75	53	75	77	**66.1**
Feb	51	49	53	48	58	40	49	69	**52.1**
Mar	42	36	40	33	43	42	39	48	**40.4**
Apr	34	41	38	42	39	31	38	34	**37.1**
May	36	55	36	42	44	38	45	47	**42.9**
Jun	64	68	58	65	68	59	55	69	**63.3**
Jul	72	73	73	70	73	67	71	75	**71.8**
Aug	76	69	74	68	73	69	79	79	**73.4**
Sep	78	69	72	75	71	75	79	76	**74.4**
Oct	78	70	68	82	68	79	82	77	**75.5**
Nov	79	66	57	84	69	84	82	83	**75.5**
Dec	70	81	43	82	63	82	82	87	**73.8**
Grand Total	**61.8**	**61.8**	**56.8**	**62.0**	**62.0**	**59.9**	**64.7**	**68.4**	**62.2**

Table 04: Average Monthly Relative Humidity of NSL Sugars Ltd.

Relative humidity, in general, is moderate to high throughout the year in the area. Humidity is found to be lowest during April, ranging from 31% to 41% with an average of 37.1%. Humidity starts rising in May being between 38% to 47% and continues rising and becoming appreciable up to December, varying between 58% to 82% with an average figure of 63.3% to 75.5%. Over all variation, during the year the humidity varies from a minimum of 37.1% to a maximum of 75.5% indicating that the humidity variations are appreciable.

A.5. Rainfall

For Scope-5

Not Applicable, since this project does not involve any usage of rainfall data.

For Scope-2

(a) Average annual: 864 mm

(b) No. of Rainy days: 75

(c) Temperature: The average temperatures of the area during the monsoon period vary from 23.92°C to 27.15°C.

The project activity area gets the benefit of both South West as well as North East monsoon rainfall. The NSL Plant is collecting the daily rainfall data from a **rain gauge station** established in their Plant premises in 2013 and continuing to monitor. The average rainfall data from 2014 to 2021 (8 Years) of the station is 880.9 mm with 75 average rainy days. The maximum rainfall of 1252.4 mm was received in 2021 and a minimum during the year 2016.

The monthly rainfall data of NSL Sugars from 2014 to 2021 is presented in Table 05 below:

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Rainfall in mm
2014	0	3.4	79	50	128.4	43.8	0	71.8	186.8	147.5	18	27	755.7
2015	0	0	17.6	82.8	112.2	85.4	39.2	131.8	186	100.6	184.4	6	946
2016	7.4	0	7	5.4	108.2	53	171	71	62	9.2	9.6	50	553.8
2017	7.2	0	11	73.8	159.4	37.2	23.6	213.5	356.8	179.6	42.2	11.1	1115.4
2018	0	0	15.4	38.8	222.2	83.6	0	24	244.4	140.4	0	8	776.8
2019	0	0	0	66.2	109.7	28.4	28.1	137.4	115.2	257.8	38	11.8	792.6
2020	0	0	47.4	60.8	139.6	98.6	57.6	76.4	164.6	146.8	54.4	8.4	854.6
2021	7	17.2	0	122.5	87.6	92	173	103.7	123.1	331.1	164.2	31	1252.4
Average Rainfall in mm	2.7	2.6	22.2	62.5	133.4	65.3	61.6	103.7	179.9	164.1	63.9	19.2	880.9

Table 05: Monthly Rainfall Data of NSL Sugars (2014 to 2021)

The monthly and yearly number of rainy days in which the rainfall received is presented in Table 06. The table reveals that the rainfall was received for a minimum day of 53 during the year 2018 and a maximum of 118 days in 2021. The average rainfall is moderate, it is spread over an average of 75 days which is very conducive for harvesting and utilizing the rain.

Period	2014	2015	2016	2017	2018	2019	2020	2021	Grand Total
Jan	0	0	1	1	0	0	0	2	**4**
Feb	2	0	0	0	0	0	0	4	**6**
Mar	4	3	2	2	3	0	3	0	**17**
Apr	5	10	3	7	5	4	7	7	**48**
May	13	11	7	11	14	9	11	11	**87**
Jun	4	7	11	7	6	3	6	14	**58**
Jul	0	5	15	6	0	5	12	16	**59**
Aug	12	10	7	17	3	13	7	14	**83**
Sep	12	9	10	14	13	8	9	12	**87**
Oct	15	4	2	12	8	18	8	21	**88**
Nov	1	19	1	3	0	3	5	16	**48**
Dec	2	2	4	1	1	2	3	1	**16**
Grand Total	**70**	**80**	**63**	**81**	**53**	**65**	**71**	**118**	75

Table 06: Monthly Rainfall Days of NSL Sugars (2014 to 2021)

In general, the rainfall for 8 years from 2014 to 2021 is showing a rising trend. The year 2017 and successive three years followed by 2021 being goodrainfall years, general rainfall is showing a rising trend.

A.6. Ground Water

For Scope-5

Not Applicable, since this scope of project does not include any activity that uses the ground water.

For Scope-2

The site under investigation is underlain by schistose rock formations. Weathering and fracturing of these rocks form the aquifer in the area. The weathered portion in schistose rocks is relatively less porous than other rock formations like Gneisses. As per the exploratory well drilling carried out by CGWB at Kokkera Bellur, Maddur, Kestur and B Hosur, to a depth of 140 to 200 m bgl which are nearby areas to the Plant, revealed that the average depth of weathering varies from 15.0 to 24.0 m bgl. Usually, in the case of consolidated rock formations, the subsoil zone passes into weathered strata, which, in turn, passes into un-weathered but fractured rock. The hydrogeological properties of the weathered strata are generally much better as compared to the parent rock due to higher porosity and permeability imparted by weathering. The nature of the soil, subsoil, weathered mantle and presence of hard pans or impermeable layers govern the process of recharge into the unconfined aquifer.

The saturation and movement of ground water within unconfined and all deeper semi-confined and confined aquifers are governed by the **Storativity and Hydraulic Conductivity** of the aquifer material.

There are two aquifer systems in the area.

- The First aquifer weathered aquifer down to a depth of 24 m bgl. The ground water in this zone occurs under phreatic conditions.
- The first aquifer is followed by the second aquifer constituting fracture zones from 30 mbgl to a maximum of 188 m bgl. The occurrence of ground water in this zone is generally found to be under semi-confined to confined conditions.

The transmissivity of the aquifer was found to be 2.28 m3/day to 195 m3/day with an average of 20 to 30 m^3/day. The storage co-efficient values of the granite gneiss and schist aquifers existing in the area varied from 6.98x10-4 to 2.42x10-4 indicating that the deeper aquifers are under confined condition. The aquifer parameters like transmissivity storage co-efficient and yield of the bore wells indicate that the area has poor to moderate yielding aquifer to a depth of 200 m bgl.

The average depth to ground water levels in the first aquifer, generally, in open wells during the pre-monsoon period is varying from 1.5 to 11.6 m bgl, whereas during the post-monsoon period it is ranging from 1.07 to 5.0m m bgl. Similarly in the second aquifer, i.e fractured aquifer, generally in bore wells, the average ground water levels remain at 5.51 m bgl during the pre-monsoon period and 4.66 mbgl during the post-monsoon period. In both the aquifers the general ground water levels are found to be moderately deep.

The yield of the bore wells ranged from a minimum of 0.046 lps to 4.3 lps, however, the overall average yields of the bore wells remained between 1.0 lps to 2.0 lps.

According to the data available from Ground Water Resources estimated by CGWB (Following GEC Methodology 2015) for the year 2020, the Annual Ground-Water Resources of the Maddur Taluk, in which the NSL Sugars is situated is 8154 Ham. The Total Ground Water Extraction for irrigation, domestic and other uses is 4493 Ham.

The net ground water available for future use is 3661 Ham. The Stage of Ground Water Extraction of the entire Maddur Taluk is 55% and classified as Safe Category indicating that there is a scope for further ground water extraction in the area. However, the mandatory guidelines like rainwater harvesting and artificial recharge issued by Karnataka Ground Water Authority need to be strictly implemented in the area, so that ground water sustainability is maintained.

There are **six bore wells** in the plant premises. The depth of the bore wells is varying from **60 to 70 m bgl.** The wells located at Dormitory and ETP are not being pumped, whereas the wells located at Coal, Bagasse, 9 acres area are being operated 2 to 3 hours in a day. The well located at R&D-3 is generally pumped for about 8 hours a day and a major part of the water requirements to the residential area is met through this bore well. These wells are moderate yielding with the discharges ranging from 1.0 to 2.5 lps (5 to 8 m3/hour). The overall ground water quality is good in the area.

The **Central Ground Water Board** is monitoring an observation well on regular basis to monitor the ground water levels and to assess the general ground water regime of the area. One such Monitoring well is located in **Koppa Village** which is very nearest to the present area under consideration. The data is available from **May 2000 to October 2020**. The shallowest ground water levels with an average of 1.5 m bgl were observed during November, the post-monsoon period after rainfall. Similarly, the average deep-water level of 2.70 m bgl was found to be during May in the summer period.

Overall, in Koppa station, the depth to water levels is relatively shallow, when compared to the surrounding areas. The long-term water level data indicates that the water levels are generally rising at the rate of 0.07 m/year which is very meagre over 10 years period. The hydrograph of the Koppa Ground Water Level Monitoring Station is Presented in Figure 06.

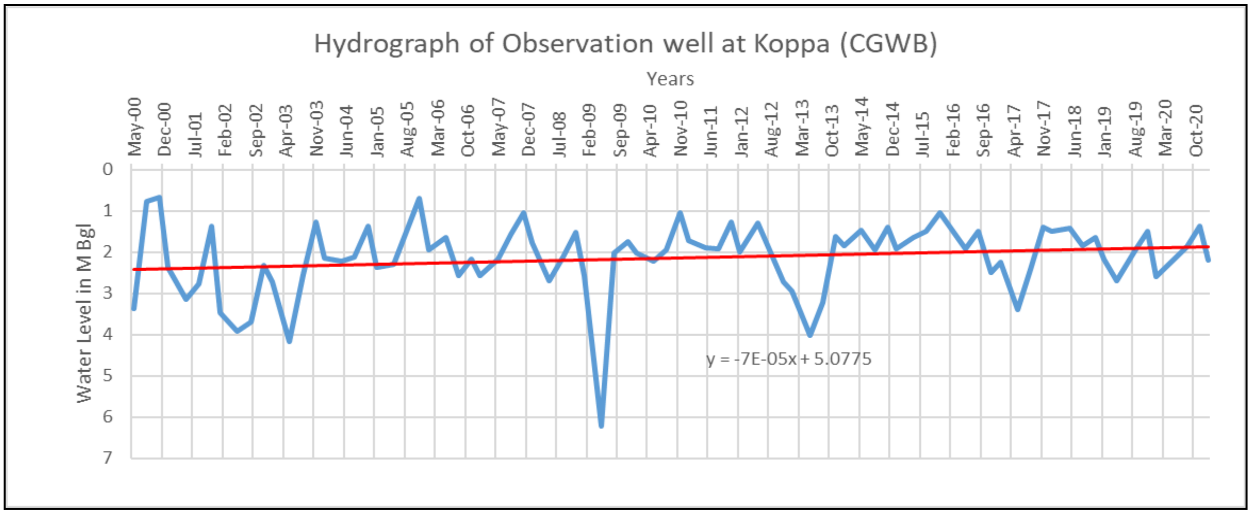

Figure 06: Hydrograph of Monitoring Well at Koppa Village

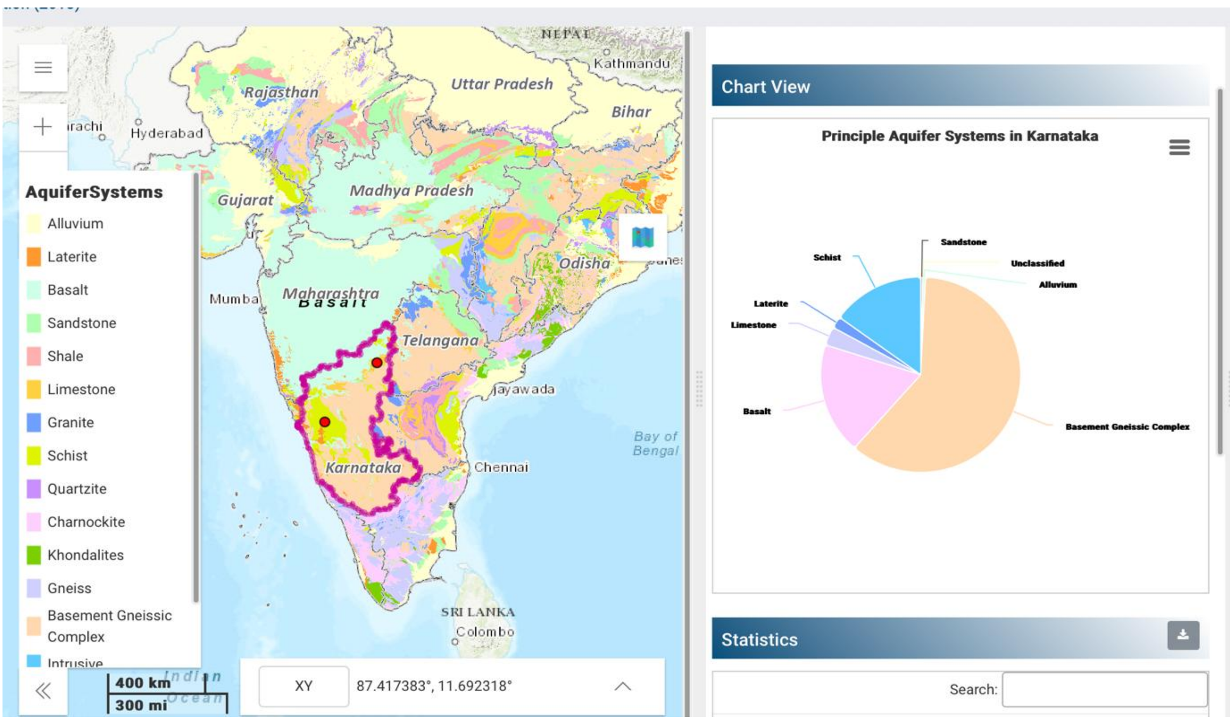

Figure 07: The Aquifer system available according to the India Water Resources Information System[4] in the plant site state- Karnataka

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[4] https://indiawris.gov.in/wris/#/Aquifer

Statistics

Search:

Principle Aquifer	Aquifer System	Aquifer Type	Thickness (m)	DTW (Decadal Avg.) (mgbl)
Alluvium	704.44	Unconfined	20-60	20-60
Basalt	34899.50	Unconfined	10-45	10-45
Basement Gneissic Complex	114967.88	Unconfined Semi-confined to Confine	Up to 60	Up to 60
Laterite	3627.27	Unconfined	5 -15	5 -15
Limestone	5873.49	Unconfined, Semi Confined to Confin	40-150	40-150
Sandstone	721.04	Unconfined	60-80	60-80
Schist	28464.07	Unconfined-Semi-confined	35	35
Unclassified	38.29			

Showing 6 to 8 of 8 entries Previous 1 2 Next

Figure 08: Showing the types of Aquifer system and their technical specification available according to the India Water Resources Information System in the plant site state- Karnataka

A.7. Alternate methods

For Scope-5

a) Common Practices for Wastewater Treatment in Sugar and Distillery Industries:
   - Anaerobic Digestion: Used to treat high-strength effluent like spent wash, reducing COD/BOD and generating biogas.
   - Multiple Effect Evaporation (MEE): Concentrates spent wash to reduce volume, preparing it for further treatment.
   - Bio-composting: Combines treated spent wash with press mud to produce organic fertilizer.
   - Zero Liquid Discharge (ZLD): Integrates MEE, crystallization, and reverse osmosis to recover water and prevent discharge.
   - Irrigation Use: Treated effluent is diluted and applied in agriculture under controlled conditions.
   - Incineration: Concentrated spent wash is burned for energy recovery in distillery operations.

b) Common Practices for Condensate water in Sugar and Distillery Industries:
   - It is generally used in the process back after treatment.
   - In some distilleries especially molasses-based units, condensate can be reused for diluting molasses in the fermentation section.

These methods align with regulatory norms and support resource recovery and sustainability.

Industries face challenges such as high capital and operational costs, land scarcity for methods like bio-composting, and skilled workforce shortages. Managing spent wash with high COD/BOD, odor control, seasonal effluent variations, and strict regulatory compliance adds complexity. Additionally, handling byproducts and ensuring sustainable water reuse remain significant concerns. Hence implementing these methods in industry improves the water security.

For Scope-2

As per the study and data available of the NSL project it is clear that the project proponent is trying to collect and conserve the rainwater for reuse in the plant activity to avoid any runoff and wastage of water. The hydrological structures and conservation measures are developed in such a way that the runoff generated within the plant will be collected and stored to meet a part of the water requirement of the Plant.

As it was determined from each zone and land use hydrological characteristics, the runoff is the major component which is being affected by various factors. The following are the factors which are affecting different hydrological characteristics:

Storm Characteristics	Nature of Storm
	Seasonal Storms
	Intensity
	Duration
	Areal extent (Distribution)
	Antecedent Precipitation
	The direction of Storm Movement
Meteorological Characteristics	Temperature
	Humidity
	Wind velocity
	Pressure Variation
	Size
	Shape
	Slope (Average land slope & Stream slope)
	Altitude (Elevation)
Catchment Characteristics	Topography
	Geology
	Land use/vegetation
	Orientation
	Type of drainage network
	Proximity to Ocean and mountains
	Ranges
	Depressions
	Pits and Ponds
Storage Characteristics	Steams and channels
	Upstream tanks/ponds
	Flood plains and swamps
	Ground water storage in pervious deposits

Based on the above characteristics it is found that in general, low-intensity storms over longer spells contribute to the ground water storage and produces relative less runoff. On the other hand, high-intensity storm or smaller catchment areas increases the runoff since the losses like infiltration and evaporation are less. However, if there is a succession of storms the runoff will increase due to the initial wetness of the soil, and antecedent rainfall and most of the area is well developed into buildings for Plant activities and paved ones. As usual, the rain during the summer will produce less runoff and during the winter will produce more runoff.

The development of these catchment areas and measures to prevent run-off will save water and result is less runoff in the area.

A.8. Design Specifications

For Scope-5

a) The **Sugar Effluent Treatment Plant (ETP)** is designed to treat wastewater generated from sugar processing. The process involves multiple stages to progressively reduce contaminants such as Chemical Oxygen Demand (COD), Biological Oxygen Demand (BOD), oil & grease (O&G), and suspended solids. Below is a step-by-step overview of the treatment process:

   a) **Raw Sugar Effluent Collection Tank**
      - Wastewater from the sugar processing plant is collected in a **Raw Sugar Effluent Collection Tank**.
      - The effluent has a **pH of 5.50**, **COD of 6000 mg/L**, **BOD of 3000 mg/L**, and **oil & grease (O&G) of 50 mg/L**.

   b) **Pre-Treatment: Bar Screen Chamber & Oil & Grease Trap**
      - The effluent passes through a **Bar Screen Chamber** to remove large solid particles.
      - It then flows into an **Oil & Grease Trap**, where floating oils and grease are removed to ensure smoother downstream processing.

   c) **Equalization Tank**
      - The pre-treated wastewater enters the **Equalization Tank**, where fluctuations in effluent composition are stabilized.
      - The oil & grease content is reduced to **less than 10 mg/L**.

   d) **Neutralization Tank**
      - The effluent moves to the **Neutralization Tank**, where the pH is adjusted to **6.50** to prepare for biological treatment.

   e) **Biological Treatment: Bio-Digester & Aeration Tanks**
      - The wastewater enters the **Bio-Digester**, which reduces **COD (to 1800 mg/L)** and **BOD (to 600 mg/L)** under anaerobic conditions.
      - The effluent then flows into **Aeration Tanks**, where it undergoes aerobic treatment using **Microbial Mixed Liquor Suspended Solids (MLSS) at 3500 mg/L**, further reducing organic pollutants.

   f) **Buffer Tank**
      - The treated effluent is collected in a **Buffer Tank**, where the pH is stabilized at **7.00** before further clarification.

   g) **Clarification & Disinfection**
      - The effluent enters the **Clarifier**, where solid particles and biological sludge settle.
      - It then moves to the **Chlorine Contact Tank**, where chlorine is added for final disinfection.

h) **Polishing Pond**

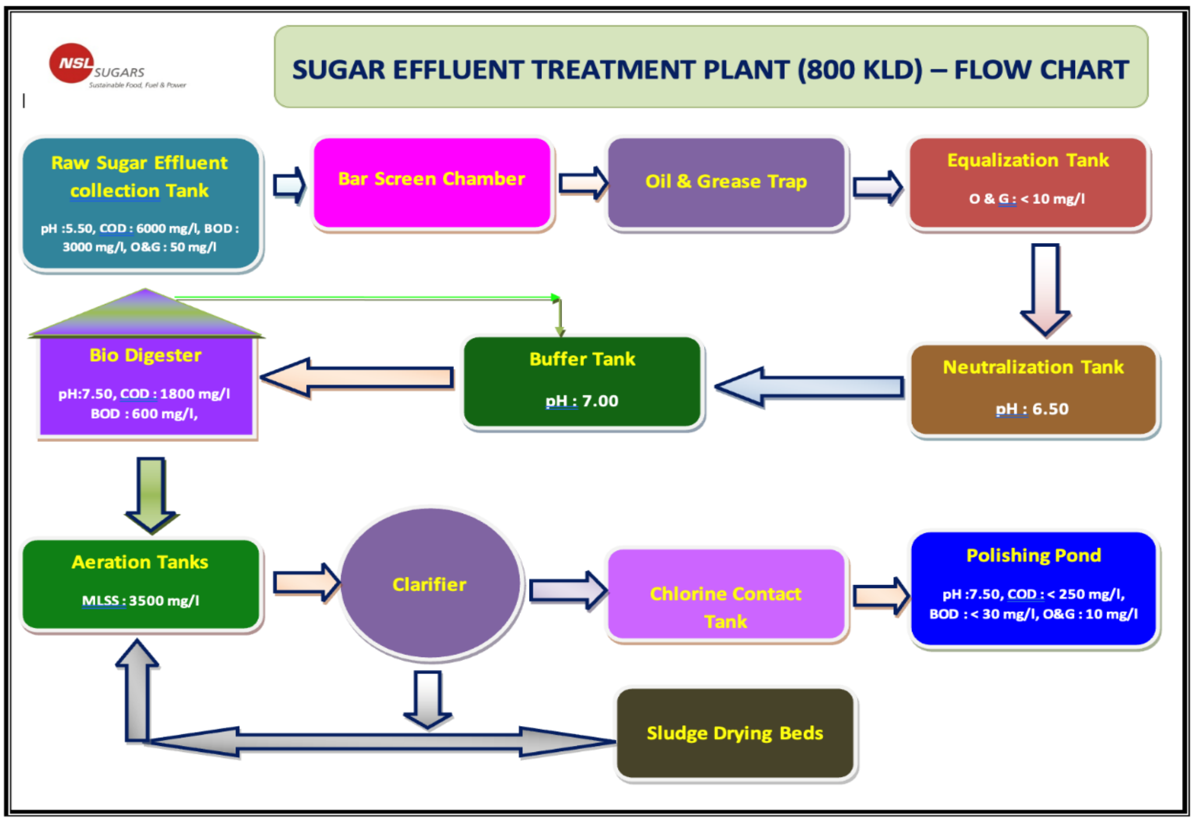
- The treated water flows into the **Polishing Pond**, where the final effluent quality meets discharge standards:
  - **pH: 7.50**
  - **COD: <250 mg/L**
  - **BOD: <30 mg/L**
  - **O&G: 10 mg/L**

i) **Sludge Management**

- The settled sludge from the clarifier is sent to **Sludge Drying Beds** for dewatering and disposal.

Final Effluent Quality & Compliance

The treated water from the polishing pond meets environmental discharge norms and can be safely released or reused for agricultural and gardening purposes.



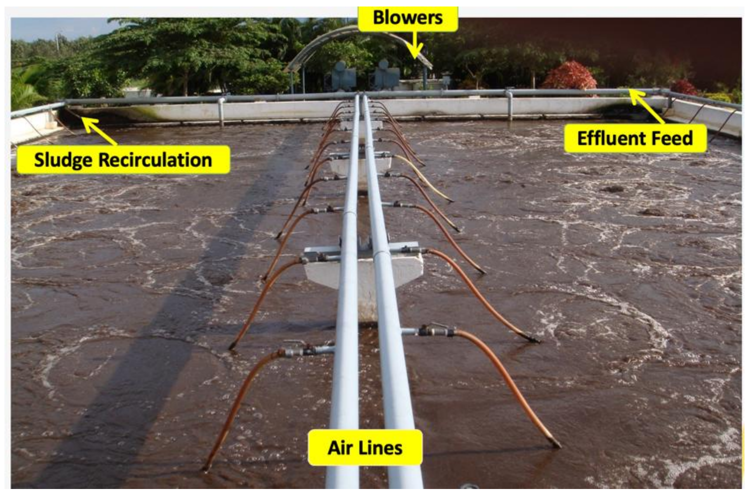
Raw Sugar Effluent collection Tank

pH :5.50, COD : 6000 mg/l, BOD : 3000 mg/l, O&G : 50 mg/l

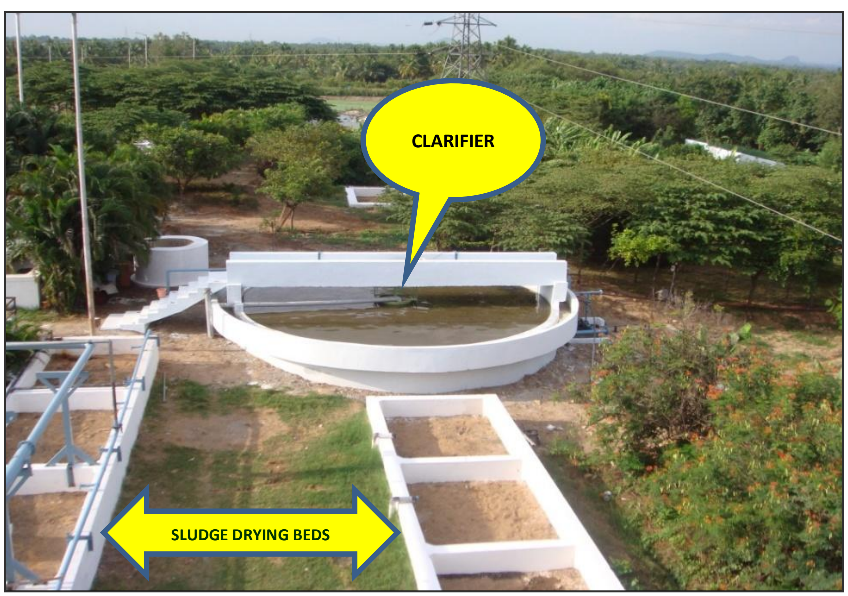
→ **Bar Screen Chamber** → **Oil & Grease Trap**

Equalization Tank → **Neutralization Tank** → **Buffer Tank**

Biodigester



Diffused Aeration Tank



Clarifier

Chlorine Contact Tank → Polishing Pond

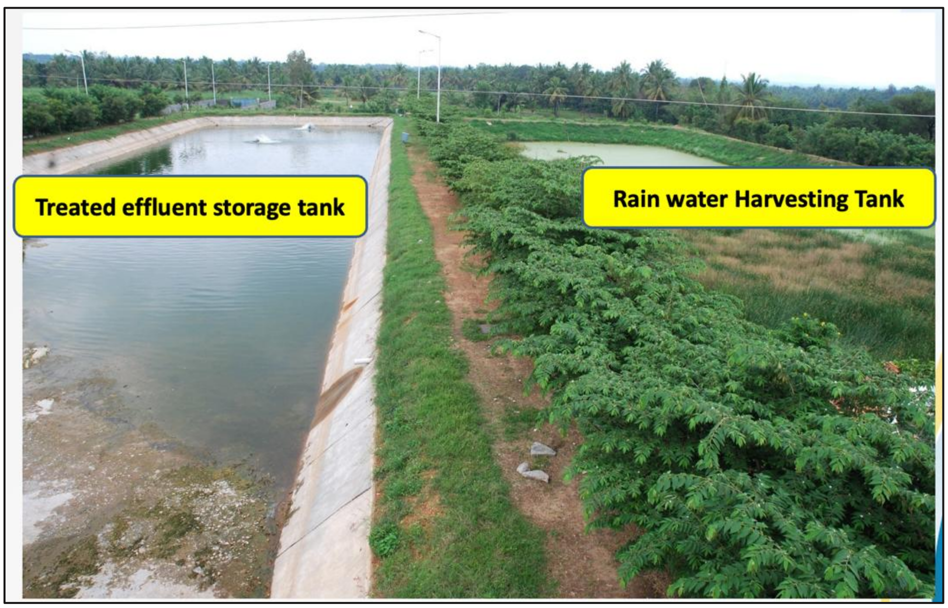
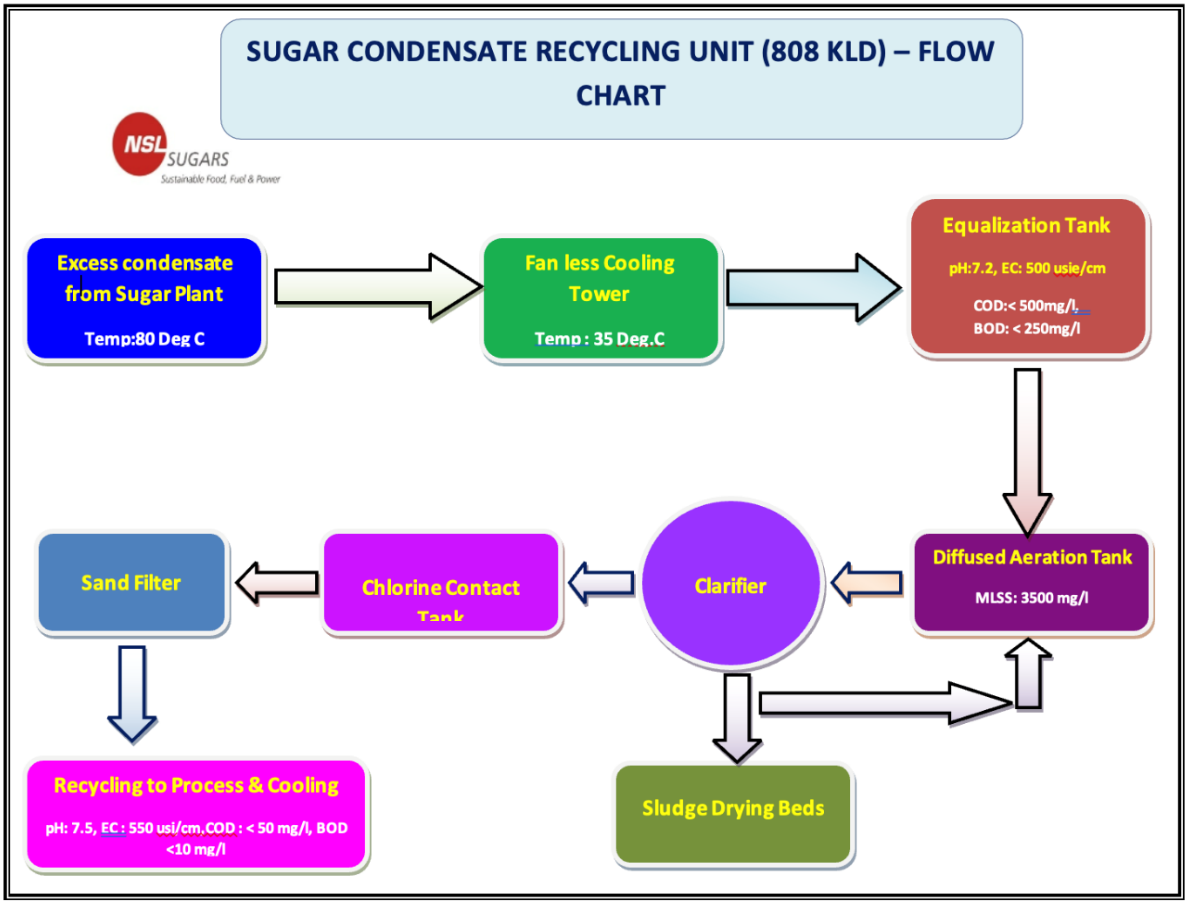
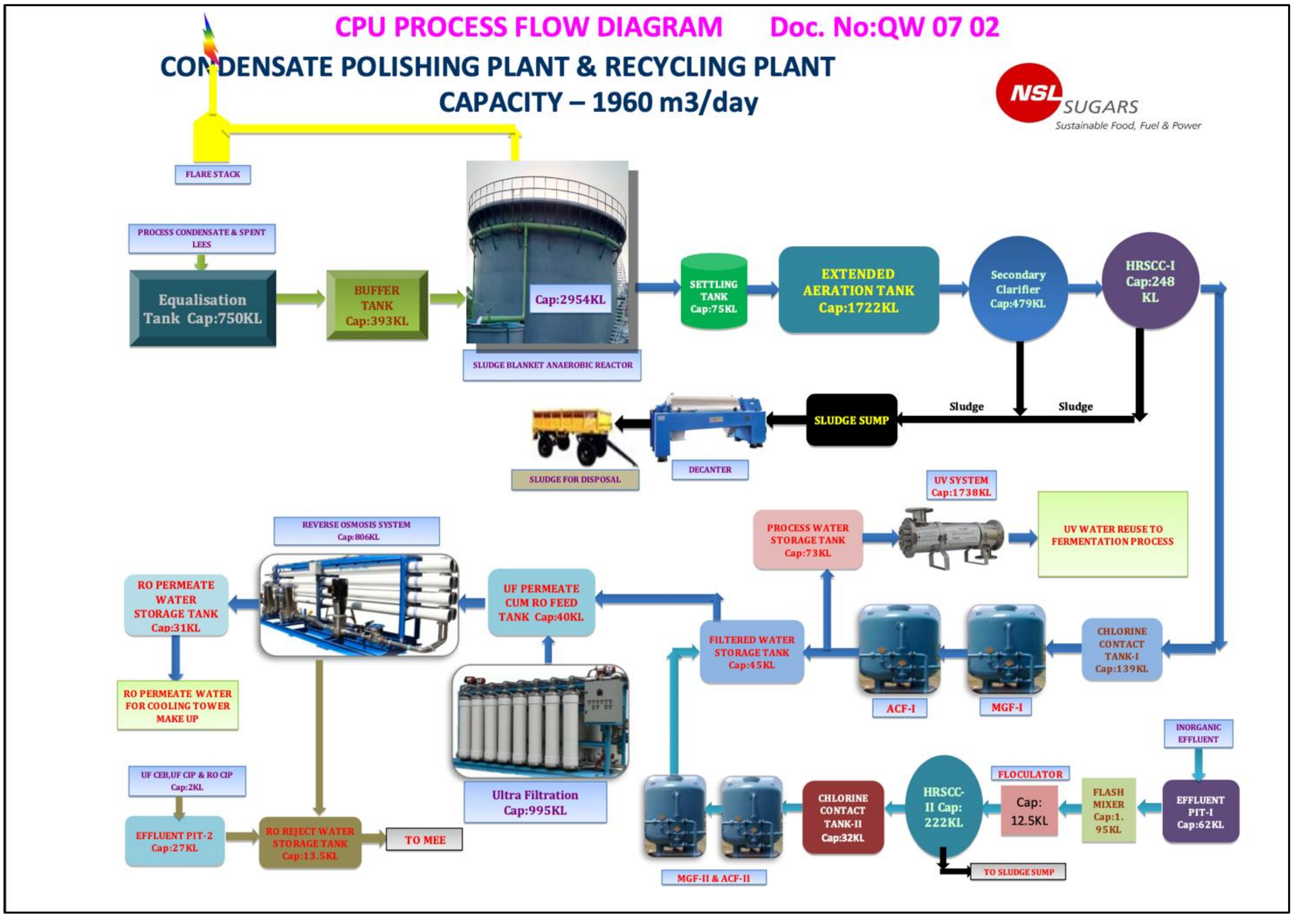


	Table 07 for the Equipment Specifications of the Sugar ETP	
Anaerobic System		
1.	**Inline Static Mixer before EQT**	
	Quantity	1 No
	MOC	SS 316/SS 304
2.	**Transfer Pump at EQT**	
	Quantity	2 nos. [1W + 1SB]
	Flow	Approx. 88 m^3/hr, 12-15 m head
	Type	Horizontal, centrifugal, non clog, gland pack
	MOC	SS 304 all
3.	**Air Blower for EQT**	
	Quantity	2 Nos. [1W + 1SB]
	Capacity	Approx 693 m3/hr
	Pressure	Approx 3500 mmWC
	Type	Root Type, Twin/Tri Lobe
	MOC	CI all
4.	**Air Grid at Equalization Tank**	
	Quantity	1 Lot
	Type	Coarse bubble (Sparger System Consisting of UPVC pipe with Holes).
	MOC Pipe	UPVC Sch 40 pipes (SS under water clamps and nut boltsin SS202/304)
5.	**Digester Feed Pump**	
	Quantity	2 nos. [1W + 1SB]
	Flow	Approx. 120 m^3/hr, 25 m head
	Type	Horizontal, centrifugal, non-clog, gland pack
	MOC	SS 304 all
6.	**Caustic Dosing System**	
	Dosing Tank	
	Quantity	1 No
	Type	Vertical, Cylindrical
	Volume	12500 Ltr
	MOC	MSEP
	Dosing Tank Mixer	
	Quantity	1 No
	Type	Fixed
	MOC	SS 316
	Dosing Tank Pump	
	Quantity	2 Nos [1W + 1SB]

b) For Condensate Plant the



<u>Picture showing the process flow of Sugar Condensate Recycling Unit</u>



Picture showing the process flow of Condensate polishing Unit and Recycling plant

Table 08 for the Equipment Specifications of Condensate polishing Unit and Recycling plant		
Anaerobic System		
1.	**Inline Static Mixer before EQT**	
	Quantity	1 No
	MOC	SS 316/SS 304
2.	**Transfer Pump at EQT**	
	Quantity	2 nos. [1W + 1SB]
	Flow	Approx. 88 m^3/hr, 12-15 m head
	Type	Horizontal, centrifugal, non-clog, gland pack
	MOC	SS 304 all
3.	**Air Blower for EQT**	
	Quantity	2 Nos. [1W + 1SB]
	Capacity	Approx693 m3/hr
	Pressure	Approx 3500 mmwc
	Type	Root Type, Twin/Tri Lobe
	MOC	CI all
	Air Grid at Equalization Tank	
	Quantity	1 Lot

4.	Type	Coarse bubble (Sparger System Consisting of UPVC pipe with Holes.
	MOC Pipe	UPVC Sch 40 pipes (SS under water clamps and nut boltsin SS202/304)
5.	**Digester Feed Pump**	
	Quantity	2 nos. [1W + 1SB]
	Flow	Approx. 120 m^3/hr, 25 m head
	Type	Horizontal, centrifugal, non-clog, gland pack
	MOC	SS 304 all
6.	**Caustic Dosing System**	
	Dosing Tank	
	Quantity	1 No
	Type	Vertical, Cylindrical
	Volume	12500 Ltr
	MOC	MSEP
	Dosing Tank Mixer	
	Quantity	1 No
	Type	Fixed
	MOC	SS 316
	Dosing Tank Pump	
	Quantity	2 Nos [1W + 1SB]
	Capacity (LPH)	960 LPH
	Head	4 Kg/cm2
	Type	Mechanical Diaphragm
	MOC	PP
7.	**Common Nutrient Dosing System (Urea & DAP)**	
	Dosing Tank	
	Quantity	1 No
	Type	Vertical, Cylindrical
	Volume	300 Ltr
	MOC	HDPE
	Dosing Tank Mixer	
	Quantity	1 No
	Type	Fixed
	MOC	MSEP
	Dosing Tank Pump	
	Quantity	1 No. [1W + 0SB]
	Capacity (LPH)	17.6 LPH
	Head	4 Kg/cm2
	Type	Electronic Diaphragm
	MOC	PP
Aerobic System		
	Air Blower for EAT	

8.	Quantity	2 Nos. [1W + 1SB]
	Capacity	Approx 1270 m3/hr
	Pressure	Approx 5000 mmwc
	Type	Root Type, Twin/Tri Lobe
	MOC	CI all
9.	**Fine Bubble Diffusers in EAT**	
	Quantity	Approx 166 Nos.
	Type	Tubular with Retrievable arrangement
	Membrane	EPDM
10.	**Secondary Clarifier**	
	Quantity	1 No
	Diameter	Approx. 14.25 m
	Type	Centrally driven
	MOC of Mechanism	MSEP,
	Bridge	RCC , (By Client)
	RPH	2.5 – 3.0
11.	**Sludge Recirculation Pumps at Sec. Clarifier**	
	Quantity	2 nos. [1W + 1SB]
	Flow	Approx. 52 m^3/hr, 10 m head

	Type	Horizontal, centrifugal, non clog, gland pack
	MOC	CI all
12.	**Coagulant Dosing System-I**	
	Dosing Tank	
	Quantity	1 No
	Type	Vertical, Cylindrical
	Volume	750 Ltr
	MOC	HDPE
	Dosing Tank Mixer	
	Quantity	1 No
	Type	Fixed
	MOC	SS 304
	Dosing Pump	
	Quantity	1 No. [1W + 0SB]
	Capacity (LPH)	45 LPH
	Head	4 Kg/cm2
	Type	Mechanical Diaphragm
	MOC	PP
13.	**Poly Dosing System-I**	
	Dosing Tank	
	Quantity	1 No
	Type	Vertical, Cylindrical
	Volume	1500 Ltr
	MOC	HDPE
	Dosing Tank Mixer	
	Quantity	1 No
	Type	Fixed
	MOC	SS 304
	Dosing Pump	
	Quantity	1 No. [1W + 0SB]
	Capacity (LPH)	90 LPH
	Head (Kg/cm2)	4 Kg/cm2
	Type	Mechanical Diaphragm
	MOC	PP
14.	**AGS Mechanism -I(Tertiary Clarifier-I)**	
	Quantity	1 No
	Diameter	Approx. 9.0 m
	Type	Centrally driven
	MOC of Mechanism	MSEP,
	Bridge	RCC (By Client)
	RPH	2.6 – 3.0

15.	**Chlorine Dosing System**	
	Dosing Tank	
	Quantity	1 No
	Type	Vertical, Cylindrical
	Volume	Approx 300 ltr
	MOC	HDPE
	Dosing Pump	
	Quantity	1 No. [1W + 0SB]
	Capacity (LPH)	7.5 LPH
	Head (Kg/cm2)	4 Kg/cm2
	Type	Electronic Diaphragm
	MOC	PP
16.	**MGF-I Feed Pump cum Back wash**	
	Quantity	2 Nos [1W + 1SB]
	Flow	Approx 89 m3/hr
	Head	20 m
	Type	Horizontal, Centrifugal, Semi open Impeller, non-clog, gland pack
	Casing	CI
	Shaft	SS 304
	Impeller	SS 304
17.	**Multi Grade Filter-I**	
	Quantity	1 No.
	Capacity	Approx. 84 m3/hr
	Type	Cylindrical Vertical
	Diameter	Approx 3200 mm
	HOS	Approx 1500 mm
	MOC	MSEP
	Media	Graded Sand and pebbles
18.	**Activated Carbon Filter-I**	
	Quantity	1 No
	Capacity	Approx.84 m3/hr
	Type	Cylindrical Vertical
	Diameter	Approx 3200 mm
	HOS	Approx 1800 mm
	MOC	MSEP
	Media	Activated carbon (IV 900), Graded Sand and pebbles
19.	**Air Scoring Blower for MGF**	
	Quantity	2 Nos. [1W + 1SB]
	Capacity	Approx 300 m3/hr

	Pressure	Approx 5000 mmwc
	Type	Root Type, Twin/Tri Lobe
	MOC	CI all
Inorganic Effluent (Slope Cogen Power plant & Process Plant)		
20.	**Effluent Transfer Pump-I**	
	Quantity	2 Nos. [1W + 1SB]
	Flow	Approx 26 m3/hr
	Head	20 m
	Type	Horizontal, Centrifugal, on clog, gland pack
	MOC	SS 304
21.	**Flash Mixer-II**	
	Quantity	1 No
	MOC	SS 304
22.	**Flocculator**	
	Quantity	1 No
	MOC	SS 304
23.	**MGF-II Feed Pump cum Back wash**	
	Quantity	2 Nos [1W + 1SB]
	Flow	Approx 26 m3/hr
	Head	20 m
	Type	Horizontal, Centrifugal, Semi open Impeller, non-clog, gland pack
	MOC	
	Casing	CI
	Shaft	SS 304
	Impeller	SS 304
24.	**Multi Grade Filter-II**	
	Quantity	1 No.
	Capacity	Approx. 24 m3/hr
	Type	Cylindrical Vertical
	Diameter	Approx 1700 mm
	HOS	Approx 1500 mm
	MOC	MSEP
	Media	Graded Sand and pebbles
25.	**Activated Carbon Filter-I**	
	Quantity	1 No
	Capacity	Approx.24 m3/hr
	Type	Cylindrical Vertical
	Diameter	Approx 1700 mm
	HOS	Approx 1800 mm
	MOC	MSEP

	Media	Activated carbon (IV 900), Graded Sand and pebbles
26.	**Coagulant Dosing System-I**	
	Dosing Tank	
	Quantity	1 No
	Type	Vertical, Cylindrical
	Volume	200 Ltr
	MOC	HDPE
	Dosing Tank Mixer	
	Quantity	1 No
	Type	Fixed
	MOC	SS 304
	Dosing Pump	
	Quantity	1 No. [1W + 0SB]
	Capacity (LPH)	14 LPH
	Head	4 Kg/cm2
	Type	Mechanical Diaphragm
	MOC	PP
27.	**Poly Dosing System-I**	
	Dosing Tank	
	Quantity	1 No
	Type	Vertical, Cylindrical
	Volume	500 Ltr
	MOC	HDPE
	Dosing Tank Mixer	
	Quantity	1 No
	Type	Fixed
	MOC	SS 304
	Dosing Pump	
	Quantity	1 No. [1W + 0SB]
	Capacity (LPH)	27 LPH
	Head (Kg/cm2)	4 Kg/cm2
	Type	Mechanical Diaphragm
	MOC	PP
28.	**Chlorine Dosing System**	
	Dosing Tank	
	Quantity	1 No
	Type	Vertical, Cylindrical
	Volume	Approx 100 ltr
	MOC	HDPE
	Dosing Pump	
	Quantity	1 No. [1W + 0SB]

	Capacity (LPH)	3.0 LPH
	Head (Kg/cm2)	4 Kg/cm2
	Type	Electronic Diaphragm
	MOC	PP
UV System		
29.	**Ultra Violet System Feed Pumps**	
	Quantity	2 Nos [1W + 1SB]
	Flow	Approx 80 m3/hr
	Head	35 m
	Type	Horizontal, Centrifugal, Semi open Impeller, non clog, gland pack
	MOC	
	Casing	CI
	Shaft	SS 304
	Impeller	SS 304
30.	**Cartridge Filter**	
	Quantity	1 No
	Micron Size	5 Micron
	MOC	SS 304
31.	**UV System**	
	Quantity	1 No
	Flow	Approx 76 m3/hr
	Wavelength	254 nm
	UV transmission efficiency	85%
	MOC	SS 316
Ultra Filtration System		
32.	**UF Feed Pumps**	
	Quantity	2 Nos. [1W + 1SB]
	Flow	Approx 50 m3/hr
	Head	25 m
	Type	Horizontal, Centrifugal, Semi open Impeller, non-clog, gland pack
	MOC	
	Casing	CI
	Shaft	SS 304
	Impeller	SS 304
33.	**Basket Strainer**	
	Qty	1 No.
	Flow	Approx. 45 m3/hr
	MOC of housing	SS316
	Rating	100 micron

34.	**UF System**	
	Quantity	1
	Total Feed Flow	Approx. 995m3/day
	Gross Permeate Flow	895.5m3/day
	Recovery	Approx. 90 %
	No of Membrane required	Approx 10 Nos
	Header & Lateral on Skid	SS 304
	MOC of Skid	MSEP
35.	**UF Backwash Pump**	
	Quantity	2 Nos. (1W+1S)
	Flow	Approx. 145 m3/hr
	Head	25 m
	Type	Horizontal, centrifugal, mechanical seal
	MOC	
	Body	CI
	Shaft	SS 304
	Impeller	SS 304
36.	**Acid Dosing System**	
	Dosing Tank	
	Quantity	1 No
	Type	Vertical, Cylindrical
	Volume	200 Ltr
	MOC	FRP
	Dosing Pump	
	Quantity	1 No [1W + 0SB]
	Capacity (LPH)	210 LPH
	Head (Kg/cm2)	4 Kg/cm2
	Type	Mechanical Diaphragm
	MOC	PP
37.	**NaOH Dosing System**	
	Dosing Tank	
	Quantity	1 No
	Type	Vertical, Cylindrical
	Volume	200 Ltr
	MOC	HDPE
	Dosing Pump	
	Quantity	1 No [1W + 0SB]
	Capacity (LPH)	154LPH
	Head (Kg/cm2)	4 Kg/cm2
	Type	Mechanical Diaphragm
	MOC	PP

	Dosing Tank Mixer	
	Quantity	1 No
	Type	Fixed
	MOC	SS 304
38.	**NaOCl Dosing System**	
	Dosing Tank	
	Quantity	1 No
	Type	Vertical, Cylindrical
	Volume	200 Ltr
	MOC	HDPE
	Dosing Pump	
	Quantity	1 No [1W + 0SB]
	Capacity (LPH)	760 LPH
	Head (Kg/cm2)	4 Kg/cm2
	Type	Mechanical Diaphragm
	MOC	PP
Reverse Osmosis		
39.	**RO Feed Pump**	
	Quantity	2 Nos. (1W+1S)
	Flow	Approx.41 m^3/hr
	Head	25 m
	Type	Horizontal, centrifugal, mechanical seal
	MOC	SS 304 all
40.	**Hydrochloric Acid Dosing System**	
	Dosing Tank	
	Quantity	1 No
	Type	Vertical, Cylindrical
	Volume	300 Ltr
	MOC	FRP
	Auto Dosing Pump	
	Quantity	2 Nos (1W+1S)
	Type	Electronic Diaphragm
	Capacity	16 LPH
	Head	4 kg/cm2
	Material of construction	PP
41.	**Antioxidant (SMBS) Dosing System**	
	Dosing Tank	
	Quantity	1 No
	Type	Vertical, Cylindrical
	Volume	100 Ltr
	MOC	HDPE

	Dosing Pump	
	Quantity	2 Nos (1W+1S)
	Type	Electronic Diaphragm
	Capacity	4 LPH
	Head	4 kg/cm2
	Material of construction	PP
	Dosing Tank Mixer	
	Quantity	1 No
	Type	Fixed
	MOC	SS 304
42.	**Antiscalant Dosing System**	
	Dosing Tank	
	Quantity	1 No
	Type	Vertical, Cylindrical
	Volume	100 Ltr
	MOC	HDPE
	Dosing Pump	
	Quantity	2 Nos (1W+1S)
	Type	Electronic Diaphragm
	Capacity	4 LPH
	Head	4 kg/cm2
	Material of construction	PP
43.	**Micron Cartridge Filter**	
	Quantity	1 No.
	Flow	36.63 m3/hr
	Micron Rating	5 micron
	Cartridge MOC	PP
	Housing MOC	SS 316
44.	**RO High Pressure Pumps**	
	Quantity	2 Nos (1W+1S)
	Flow	41 m3/hr
	Pressure	9.8 bar
	Type	Vertical Multi Stage, mechanical seal
	MOC	SS316
45.	**RO Booster Pump-I**	
	Quantity	2 Nos. (1W+1S)
	Flow	18m3/hr
	Suction Pressure	9.44 bar
	Discharge Pressure	11.7 bar
	Differential Pressure	2.2 bar
	Type	Vertical Multi Stage

	MOC	SS316
46.	**RO Booster Pump-II**	
	Quantity	2 Nos (1W+1S)
	Flow	8.2m3/hr
	Suction Pressure	11.4 bar
	Discharge Pressure	14.2 bar
	Differential Pressure	2.8 bar
	Type	Vertical Multi Stage
	MOC	SS316
47.	**RO System**	
	Quantity	1 No,
	Flow	36.63 m3/hr
	Recovery	Approx. 86 %
	Permeate Flow	31.5 m3/hr
	No of Membrane	Approx 50 Nos
	No of pressure Vessel	10 Nos. 5 ELEMNET LONG
	MOC of Pressure Tube	FRP
	Pressure rating	300 PSI
	MOC of Skid	MSEP
Common CIP System for UF & RO		
48.	**CIP Tank**	
	Quantity	1 No (No stand by)
	Capacity	2000 Ltr
	MOC	HDPE
	Agitator	
	Quantity	1 No
	Type	Fixed
	MOC	SS 316
	CIP Pump	
	Quantity	01 No
	Flow	Approx. 42 m^3/hr
	Head	44 m
	Type	Horizontal, centrifugal, Mechanical Seal
	MOC	SS 316
	Micron cartridge Filter for CIP	
	Quantity	1 No.
	Flow	42 m3/hr
	Micron Rating	5 micron
	Cartridge MOC	PP
	Housing MOC	SS 316
Transfer Pumps		

49.	**RO Permeate Transfer Pump**	
	Quantity	2 Nos. (1W+1S)
	Flow	Approx.35 m^3/hr
	Head	35 m
	Type	Horizontal, centrifugal, Non Clog, Gland pack
	MOC	Body-CI, Internal- SS 304
50.	**RO Reject Transfer Pump**	
	Quantity	2 Nos (1W+1S)
	Flow	Approx. 6.0 m^3/hr
	Head	35 m
	Type	Horizontal, centrifugal, Non Clog, Gland pack
	MOC	SS 316 all
51.	**Effluent TransferPump-2**	
	Quantity	2 No (1W+1S)
	Flow	Approx.3 m3/hr
	Head	15 m
	Type	Horizontal, centrifugal, Non Clog, Gland pack
	MOC	SS 316 all
Sludge Management System		
52.	**Sludge Sump Mixer**	
	Quantity	1 No
	Type	Slow Speed, Fixed
	KW	2.2 KW
	MOC	MSEP
53.	**Sludge Feed Pump**	
	Quantity	2 Nos.[1W + 1SB]
	Flow (each)	Approx. 7 m3/hr
	Head	15 m
	Type	Horizontal, Centrifugal, non clog, gland pack
	MOC	CI/SS 304
54.	**Poly Dosing System**	
	Dosing Tank	
	Quantity	1 No
	Type	Vertical, Cylindrical
	Volume	Approx 10000 Ltr
	MOC	HDPE
	Dosing Tank Mixer	
	Quantity	1 No
	Type	Fixed
	MOC	SS 304
	Dosing Pump	

	Quantity	2 Nos. [1W + 1SB]
	Capacity (LPH)	540 LPH
	Head (Kg/cm2)	4 Kg/cm2
	Type	Mechanical Diaphragm
	MOC	PP
55.	**Centrifuge**	
	Quantity	1 No
	Flow	Approx. 6 m3/hr
	Type	Bowl type centrifuge
	MOC	Wetted part SS 304

For Scope-2

Plant Area Assessment for Rainwater Harvesting

The topography, climate, soil, land use and hydrogeological conditions are important factors controlling the suitability of an area for ground water recharge. The prevalent topography, soil and land use conditions determine the extent of infiltration, whereas the hydrogeological conditions govern the occurrence of potential aquifer systems and their suitability for artificial recharge. The Architectural map of NSL Sugars Pvt. Ltd. Is presented in Figure 09 below.

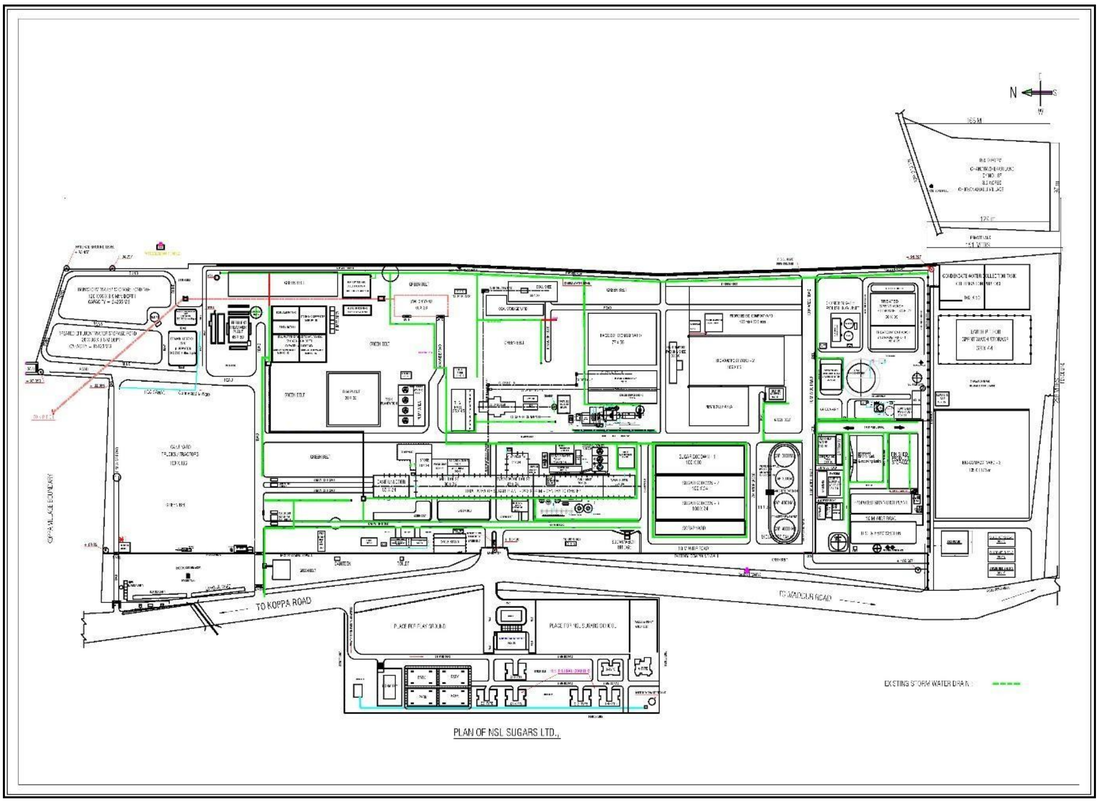


Figure 09: Architectural plan of NSL Sugars

Out of 100 acres (90 acres Plant area+10 acres Admin and Residential quarters area), an area of about 35 acres **(141640 m^2)** of the plant area has been considered separately and quantified for the rainwater potential due to the potential threat of contamination for the rainwater, especially the area around Bio-compost Yard and Distillery Unit in the south and south eastern part, similarly the area occupied by the large Treatment Effluent Storage Pond and Primary Aeration tanks. Thus around 55 acres of main Plant area and 10 acres of Admin and quarters area together 65 acres (263575 m^2) have been taken into consideration for rain water harvesting.

Topography of Plant Layout

The topography of the plant area is assessed and a contour map of 0.5 m interval is generated based on the topographic contour map provided by NSL Sugars Ltd. From the data provided, it is found that the topography is varying from a **higher altitude of 110 m in the southwest corner** to a lower altitude of **97 m in the northeast corner**. However, the general master slope of the plant is **towards the North** of the plant. Based on the altitude, slope, topography and to avoid the potential contamination areas, the Plant has been divided into 4 catchments and the Administrative Office area, including the Residential Quarters area as one catchment, together **five** catchments to plan different types of rainwater harvesting and recharge measures.

Based on the analysis of the catchment characteristics concerning its land use, topography, physiography, precipitation and climatic factors whenever the storm occurs, a portion of rainfall infiltrates into the ground, some portion evaporates and the rest flows as runoff through drains. Since the catchments possess the variable slope the flow over the land surface flows as a sheet of water (Overland flow) and joins to the drain. Thus the rain water over the land surface and under the land surface will create the Hydraulic gradient towards the drain.

On the other hand, because of this overland flow through different puddles, pits and pot holes joins in the low-lying areas are formed as depression areas. Such depression areas have been selected and utilized for water harvesting structures and recharge measures.

The C-1 is having the areal extent with (32 acres) comprises area of 130602 m^2 (32 acres) covering the east and SE parts of the Plant, C-2 in the west-central part of the Plant with 45364 m^2 (11.2 acres), C3 in north western part with 44459 m^2 (11.0 acres), C4 with an area of about 431450 m^2 (10.60 acres) in western part consisting of Admin building area and residential quarter's area and finally C-5 an area of about 141640 m^2 (35 acres) around Bio-compost Yard and Distillery Unit in the south and southern part of the Plant, similarly the area occupied by the large Treatment Effluent Storage Pond and Primary Aeration tanks.

The Catchment-1 to Catchment-5 as demarcated and mentioned above are shown in Google Map as in Figure 10 below:

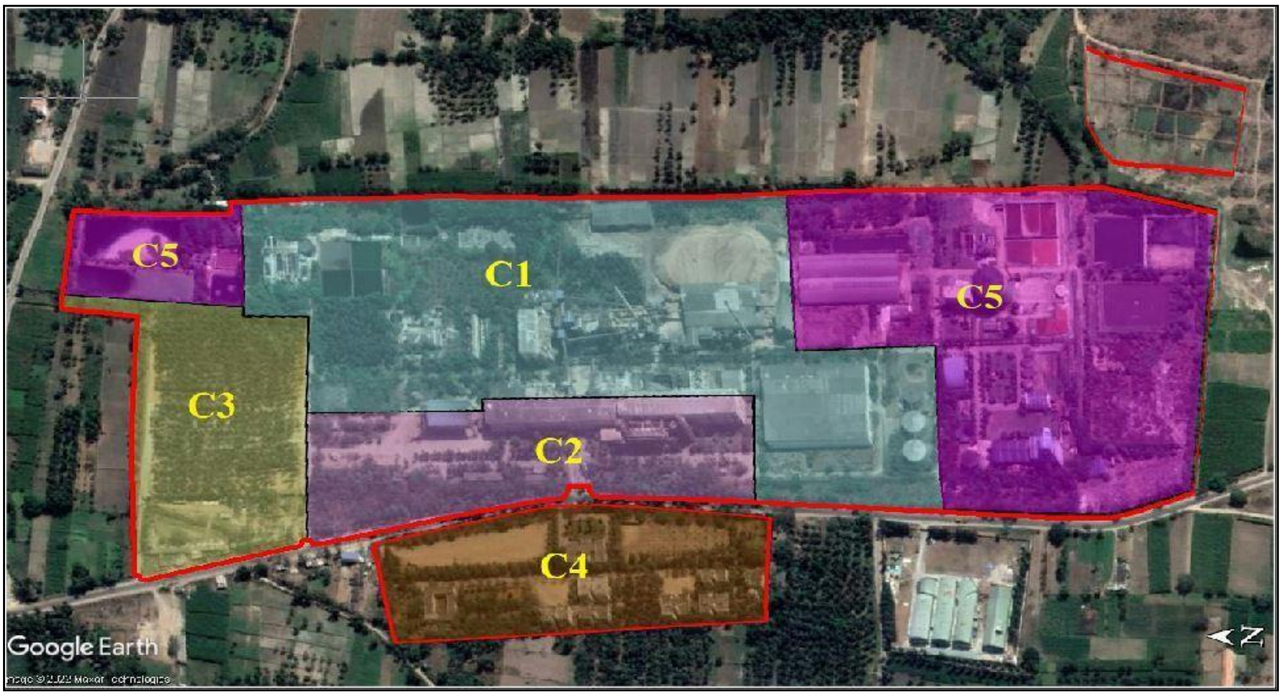


Figure 10: Contour Map with Catchments and Drains of NSL Sugars

The total area of all the five catchments together is 405215.56 m^2 (90+10 acres). Each structural component in the catchment is sub-divided into a different type of roofs like RCC, Asbestos/GI sheet, Cement concrete (CC) surfaces i.e. pavement area, green belt and open areas. The total available roof with GI/asbestos sheets is 92282.59 m^2, the Roads and Pavement area is 54360.78 m^2 and the open and Greenbelt/Open area is 258572.19 m^2 from five catchments in the plant area have been computed catchment-wise and are given in Figure 10 and Table 9 to Table 14.

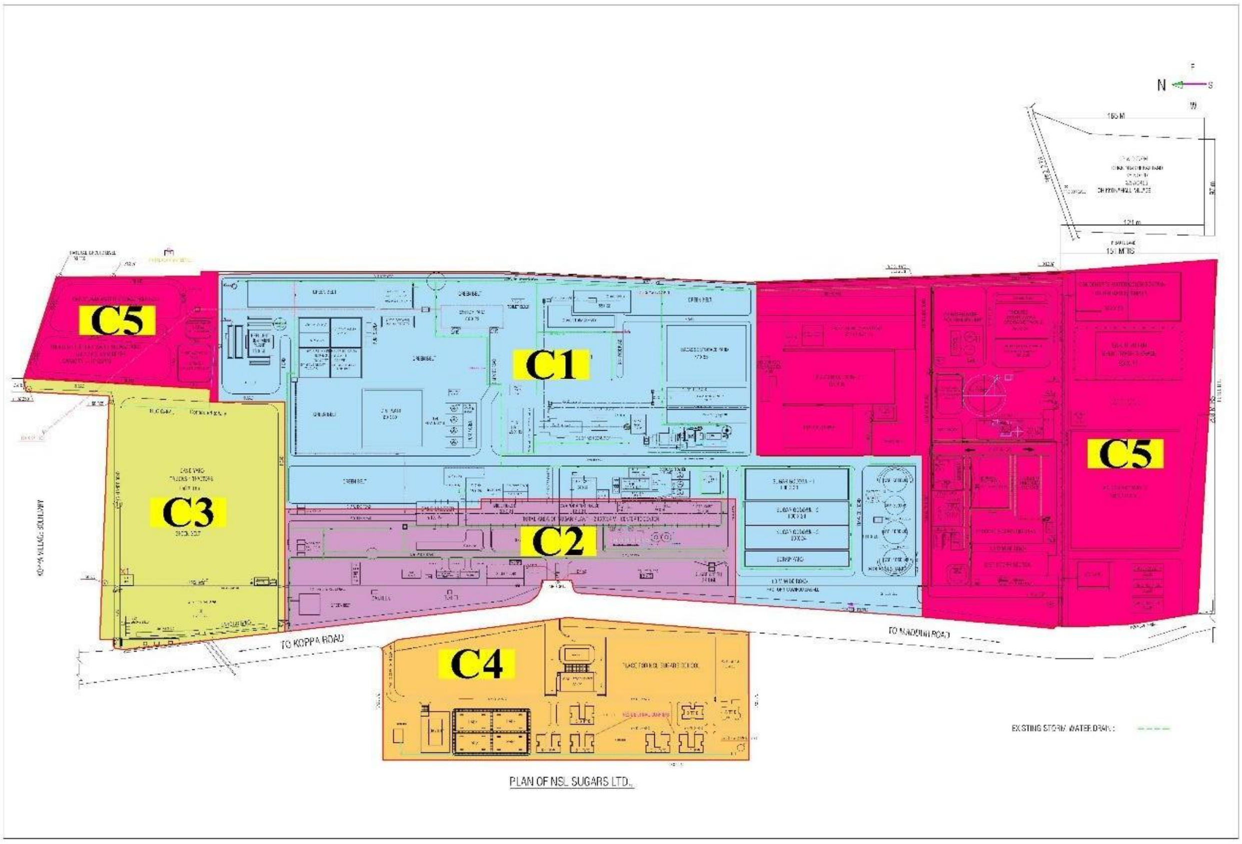


Figure 11: Zonal Layout of NSL Sugars

Table 09: Details of the Catchment -1 land use Surfaces in NSL Sugars

S.No.	Description	Area in m^2
Built Up		
1	Sugar Godown 1	3000.00
2	Sugar Godown 2	2400.00
3	Sugar Godown 3	2400.00
4	Scrap Yard	2000.00
5	Molases Tanks	3885.00
6	Gunny Bag Godown	396.00
7	cooling tower (sugar)	457.60
8	Jet cooling tower	85.25
9	pump house	360.00
10	service water tank	343.75
11	Jet type cooling tower	200.00
12	Clarification	576.00
13	sulphur station	144.00
14	Sulphurgodown	96.00
15	Store	432.00
16	Workshop	324.00

17	MCC ROOM	216.00
18	PCC ROOM (Sugar)	216.00
19	Transformer area	360.00
20	DM Plant	3600.00
21	cooling tower (co-gen)	1350.00
22	MCC ROOM	90.00
23	switch yard	1380.00
24	toilet block	65.00
25	coal shed	1100.00
26	coal yard	1210.00
27	TG Hall & control room	1125.00
28	Bagasse storage shed 1	1694.00
29	Bagasse storage shed 2	1155.00
30	Bagasse storage yard	14520.00
31	Boiler	902.00
32	ESP OLD	120.00
33	ESP NEW	120.00
34	Chimney	10.00
35	Shed	36.00
36	DGset room	154.00
37	Neutralization Pond	300.00
38	Rain water collection pond	1100.00
39	factory seepage collection tank	720.00
40	Rain water collection pond	3844.00
41	Effluent Treatment Plant	2250.00
Sub Total		54736.60
Road		
42	Road	
S.No.	**Description**	**Area in m^2**
Sub Total		17467.90
Green Belt / Open		
43	Green belt / Open	
Sub Total		58398.00

Total		**130602**

Table 10: Details of the Catchment- 2 land use Surfaces in NSL Sugars

S.No.	**Description**	**Area in m^2**
Built Up		
1	Mill House	2160
2	Cane Preparatory Devices	1440
3	Cane Weigh Bridge	35

4	Cane Weigh Bridge (Cart)	17.86
5	Shed	153
6	Civil Office	2250
7	Poly House SugarCane Seeds	176
8	Dispensary	153
9	Canteen	323
10	Employees dress changing shed	77
11	Security office & time office	44
12	Cycle stand	323
13	Evaporator house	1008
14	Engineering office & sugar lab	216
15	Sugar house	864
16	Pan section	1872
17	Centrifugal station	1872
18	Toilet Block	65
	Sub Total	13048.86
	Road	
19	Road	
	Sub Total	6191.96
	Green Belt / Open	
20	Green Belt / Open	
	Sub Total	26123.48

Total	**45,364**

Table 11: Details of the Catchment 3 land use Surfaces in NSL Sugars

S. No.	Description	Area in m^2
1	Built Up	1082.99
2	Paved	4989.40
3	Open / Green	38386.39
Total		**44,459**

Table 12: Details of the Catchment- 4 land use Surfaces in NSL Sugars

S. No.	Description	Area in m^2
	Built-Up	
1	A Type Quarters	440
2	B Type Quarters	352
3	C1 Type Quarters	500
4	C2 Type Quarters	500
5	C3 Type Quarters	500
6	D1 Type Quarters	405
7	D2 Type Quarters	405
8	Dormitory Building	1400
9	Administrative Office Building	700
Sub Total		5202
	Road	
10	Road	
Sub Total		5940.5172
	Green Belt / Open	
11	Open / Green	
Sub Total		32623.799

Total	**43,765**

Table 13: Details of the Catchment- 5 land use Surfaces in NSL Sugars

S. No.	Description	Area in m^2
Built UP		
1	Bio compost yard-1	2904
2	Bio compost yard-2	5830
3	Sulphur Godown-2	192
4	Bio compost packing shed	360
5	Treated spent wash tank-1	1250
6	Treated spent wash tank-2	1750
7	Bio-digester tank	804
8	Evaporation Drying	572
9	Raw wash tank	450
10	Buffer tank	157
11	Dist & Ferm section	1540
12	Molasses Tank	254
13	Toilet	9
14	Fern Cooling Tower	39
15	Dust cooling tower	70
16	Main pcc	80
17	Workshop	48
18	Finished product storage	1920
19	soft water	200
20	clarified water	400
Sub Total		**18828.68**
Road		
21	Road (Sulphur Godown)	336
22	Road (Baggase Yard)	1116
23	Road	3600
24	Road	14719
Sub Total		**19771.00**
Green Belt / Open		
25	Leachate tank	144
26	Black yard	120
Sl No	**Description**	**Area in m^2**

27	Spent wash storage	2772
28	Collection tank	2500
29	Condensate water for Irrigation purpose	2500
30	Rainstorm water storage pond no 1	6930
31	Treated Effluent water storage pond	4320
32	Primary Aeration tank	896
33	Secondary Diffused Aeration Tank	391
34	Green Belt/ Open	82468
Sub Total		**103040.51**

Table 14: Consolidated Details of the catchment-wise land use Surfaces in NSL Sugars

Land Use		Roofs	Roads	Earth	Catchment Wise Total Area
		RCC, Asbestos / G.I Sheet	**CC / BT**	**Green Belt /Open**	
Catchment	**C1**	54736.60	17467.90	58398.00	130602.50
	C2	13048.86	6191.96	26123.48	45364.30
	C3	1082.99	4989.40	38386.39	44458.79
	C4	4585.46	5940.52	32623.80	43149.77
	C5	18828.68	19771.00	103040.51	141640.19
Total Area		**92282.59**	**54360.78**	**258572.19**	**405215.56**

1. **Assessment of the Existing Strom water drains**
Well-designed storm water systems are existing in the plant premises to make way for the runoff created due to rainfall, especially in Plant area. All the drains have been assessed based on the topography data provided by NSL Sugars and from the existing storm water drains, for which the carrying capacity of storm water generated in the plant premises is also analyzed. In general, found that all the existing storm water drains have appropriate slopes for carrying runoff generated to the average rainfall of the area.

The existing layout of the storm water drains in the premises is shown in Figure 12 with the direction of flow. It is also observed that some of the drains are being used for both the purpose of storm water and the processed waste water of various processes and which are not having enough storm water carrying capacity.

Separate arrangements for the waste water is considered so that there is no interference between storm water and processes water drains. The separation of storm water from processed water drains is of utmost importance to avoid contamination of the storm water. Based on the observations majority of storm water drains are well laid and for further connection to the rainwater collection tanks, new drains are proposed (in Magenta colour), to properly divert the storm water to the proposed rain water harvesting structures. The drains (in Magenta colour), are to be executed in continuation to the existing and corresponding storm water drains/suitable pipes to their volumetric dimensions and appropriate slope for easy carrying of storm water.

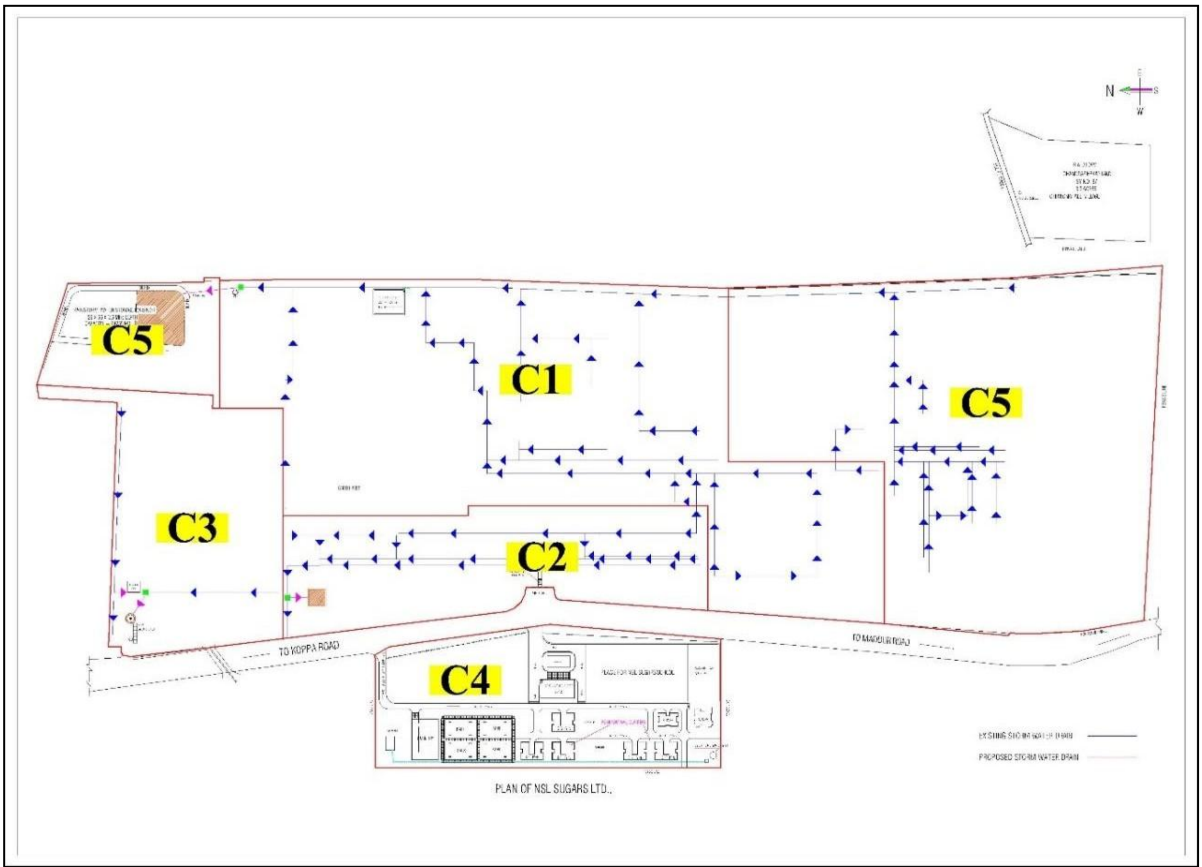


Figure 12: Existing and Proposed Storm Water Drains in NSL Sugars

2. **Assessment of Existing Rain Water Collection Tank**

In the northeastern part of the Plant, there is one existing RCC tank which is being used to store and drain the processed water during the normal course of time. During the rainy season, the same tank is also used to drain out the stormwater. The dimensions of the Tank are 30 m x 24 m x 2.5 m with a storage capacity of 1800 KL. The whole of the storm water that is generated from roofs, pavements and greenbelt/open areas in Catchment-1 is flowing through these storm water drains, otherwise, it is going as an overland flow and reaches the Rain water Harvesting Pond located northeastern part of the Plant. Sometimes when there is an excess overland flow, it also creates temporary and local inundation in the plant area. The existing storm water pond is quite insufficient to accommodate the minimal rainfall-runoff generated in the C-1 of the Plant area. The Plant Authorities have expressed to spare this tank, exclusively for rain water harvesting purposes. However, this tank is insufficient to store the rainwater harvesting potential generated in the C-1 catchment, but can be used to harvest partially storage the rainwater.

The location of the Tank is shown in Figure 13.

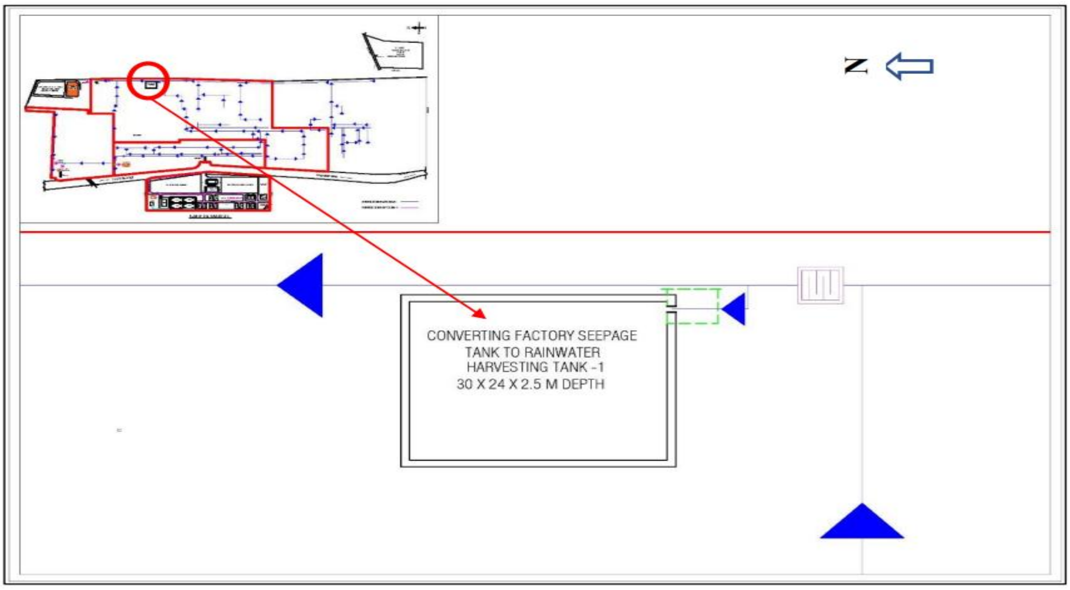


Figure 13: Existing Rain Water Harvesting Tank -1 in of NSL Sugars

Similarly, there is one unlined pond existing in the northeastern corner of the plant with the dimensions of 106m x 55m x 3.5m. Part of the tank with dimensions of 15m x 55m x 3.5m has been considered to convert into a rain water harvesting pond to accommodate the excess storm water that flows from the RCC tank as shown in Figure 13. Therefore, it is suggested to convert the existing unlined pond into rain water harvesting pond with a bund in the northern part as shown in Figure 14 to accommodate with above said dimensions and harvest the entire rainwater that falls in the Catchment-1.

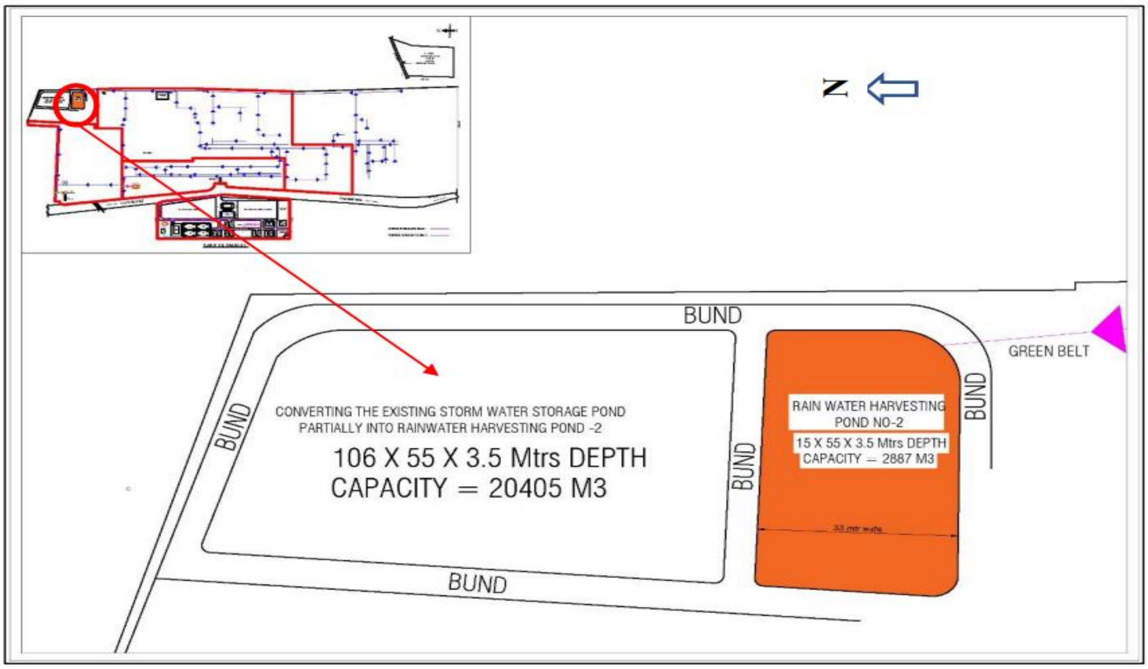


Figure 14: Existing Rain Water Harvesting pond-2 in NSL Sugars

3. **Stormwater Management**

Based on the hydrological assessments over the plant area, there is a potential scope to harvest surface water runoff with various hydrogeological and engineering measures for the conservation and recharge of rainwater. As the project site has been divided into different land uses viz., Roof areas, Paved areas, and Greenbelt/open areas, the analysis of these land use have been taken into consideration for this hydrological aspect. **Overall, this analysis is made to plan for water harvesting structures focusing more on storing the rainwater harvested and less on recharge measures.** The number of structures and their volumetric dimensions are decided based on the available peak hourly runoff and analysis of daily rainfall intensity.

The location of the Rainwater water harvesting structures is shown in Figure 15

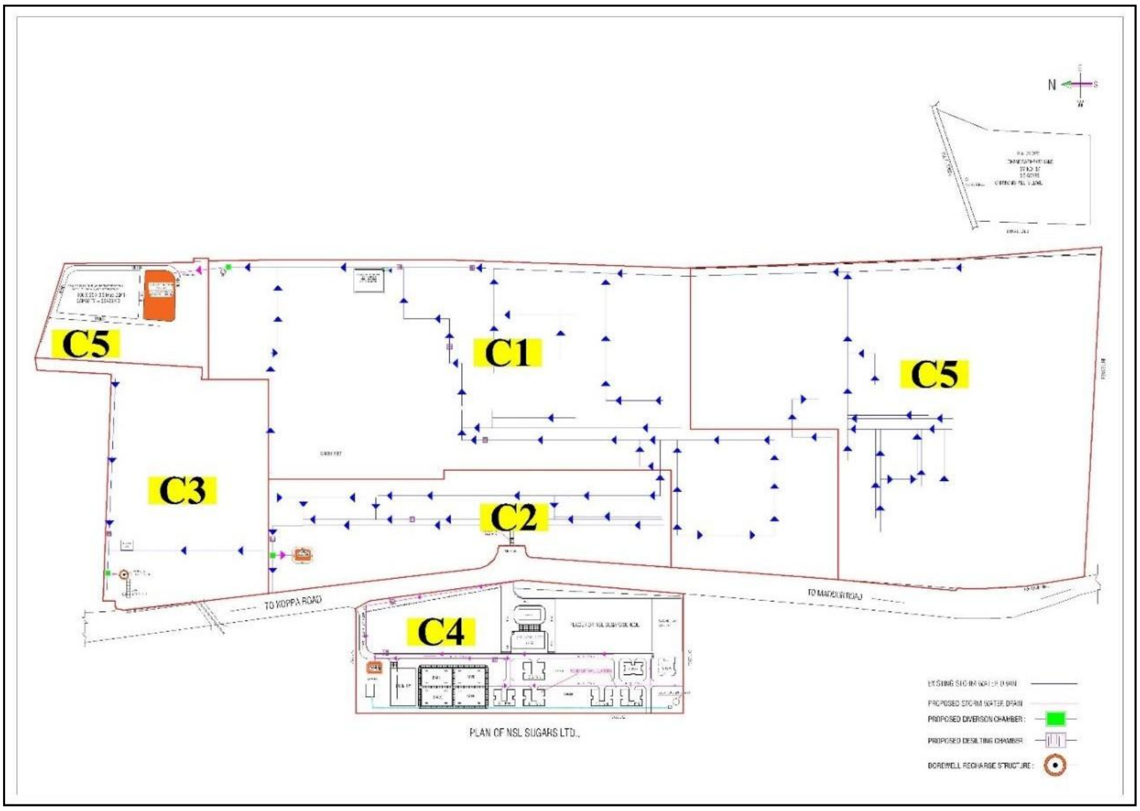


Figure 15: Rain Water Harvesting Structures at NSL Sugars

Catchment C-1: Based on the topography, the slope of the Plant area, existing alignment of the stormwater drains, suitability of the existing ponds and RCC tanks and availability of the and potential of stormwater in each of the catchments, it is proposed to use the existing RCC Tank with the dimensions of **30m x 24m x 2.5m** as a rainwater collection tank in the eastern part of the Plant area in C-1. However, this tank is insufficient to accommodate the rainwater harvesting potential, alone in this tank. In continuation of this tank, it has been suggested to convert and modify the part of the existing huge unlined pond, in the south part, into the rainwater harvesting pond with dimensions of **15m x 55m x 3.5m** in such a way that the both, RCC Tank and the modified pond together can store and accommodate with the Peak Rate of Runoff (PRR) of 34 mm/hr to store at least for two days of successive rains to an extent of **4687 KL.** After the construction of the pond, all four sides and the bottom of the pond should be covered continuously with HDPE Geomembrane Polythene sheet without any break to avoidleakages into the ground. Catchment C-1is the biggest catchment, area-wise, covering more than 32 acres of Plant area and also generates more than 60% of rainwater harvesting potential.

Catchment C-2: Besides, The C-2 is located in the western part of the green belt and can generate about 670 KL of runoff potential. As per the catchment and runoff potential generated,it is proposed to construct a rainwater harvesting pond with the dimensions of 16m x 14m x 3m to store the entire potential. All sides of the pond as suggested above to cover with an HDPEGeomembrane sheet.

Catchment C-3: Catchment C-3 is located in the NW corner of the Plant area draining the cane yard and surrounding areas. The C-3 is capable of producing around 370 KL of runoff from its catchment area. There is a bore well located in the NW corner which is a production well for supplying the groundwater to the Residential, Administrative and other buildings located in this area. Since it is a production well, is essential to maintain its sustainability for acontinuous supply of water by a recharge structure. it is suggested to recharge the production bore well, by constructing a 1.5 m wide Circular Recharge Pit with 2.5m depth and 2m radial distance from the bore well. This recharge pit should be backfilled with 40mm Kankar up to 1.0m depth from the bottom of the pit, followed by 20mm kankar 0.50 m thickness i.e up to 1.5 m and 0.5m thickness of coarse sand. Thus about 2.0 m of the circular pit should be filled with filter material and the remaining 0.5m should be left as a freeboard for standing water. Aparapet wall is also to be constructed from 0.30m above ground level to 1.20m below ground level to avoid the collapse of the pit as well as to avoid the overland flow or any other unwantedmaterial entering the recharge pit. Asso an out let provision should be made to let out the excess flow, if any.

Catchment C-4: The administrative and **Residential** building area has been consideredcatchment-4 which is a separate piece of land opposite the main Plant, in the western part, on either side of the road. This catchment is likely to generate 458 KL of rainwater harvesting potential. In this catchment, it is suggested to construct a rainwater storage pond with the dimensions of 12m x 15m x 2.5m which will collect 450 KL of rainwater. After the constructionof the pond, all four sides and the bottom of the pond should be covered continuously with HDPE Geomembrane Polythene sheet without any break to avoid leakages into the ground. However, in this part of the area, there are no well-defined drains to channel the rainwater. It is suggested to construct the drains following the slopes as shown on the map.

In entire catchments covering an area of about 100 acres of area, considered for rainwater harvesting potential is **96887KL**, from all the four catchments excluding the potential contaminating area. However, the harvesting structures have been designed only for Peak Rateof Runoff (PRR) of 34mm rainfall in which, rain falling on 96% rainy day is accommodated inthe harvesting structures. The rainfall events of the remaining 4% of rainy days are rare and unusual.

Table No. 15: Details of the Rain Water Harvesting Structures

S. No	Descriptio n	No's	Lengt hin m	Width inm	Depth inm
CATCHMENT 1					
1	Stormwater Drains (HDPE PIPE6" INCH DIA)		70.00	-	-
2	Existing RWH RCC Tank 1		-	-	-
3	Modification of Existing RWH Pond 2		15.58	55.5 8	3.50
4	Desilting Chambers	4	2.50	1.50	1.25
5	Diversion Chambers	1	2.50	1.50	1.25
CATCHMENT 2					
1	Stormwater Drains (HDPE PIPE6" INCH DIA)		20.00	-	-
2	RWH Pond 3		16.58	14.5 8	3.00
3	Desilting Chambers	2	2.50	1.50	1.25
4	Diversion Chambers	1	2.50	1.50	1.25
CATCHMENT 3					
1	Stormwater Drains (HDPE PIPE6" INCH DIA)		25.00	-	-
2	Stormwater Drains (RCC)		30.00	0.80	1.00
3	Recharge Well (Circular Structure)	1	-	1.50	2.50
4	Desilting Chambers	1	2.50	1.50	1.25
5	Diversion Chambers	1	2.50	1.50	1.25
CATCHMENT 4					
1	Stormwater Drains (RCC)		880.0 0	0.80	1.00
2	RWH Pond 4		15.58	12.5 8	3.00
3	Desilting Chambers	3	2.50	1.50	1.25

1. **Design Consideration of Rainwater Harvesting & Recharge Measures**

   The design considerations are made in the planning and design of rainwater harvesting for storage and recharge based on the plant layout, contour map, stormwater system, catchment areas, soil conditions, hydrology and hydrogeological behavior of the area. This entire work is carried out in detail during hydrogeological and engineering studies to know the characteristics and parameters for the actual assessment of rainwater conservation and recharge. At the same time, a study was also focused on the location of the rainwater harvesting for storage and aquifer recharge measures.

2. **Optimum Utilization of the Rainwater**

   The hydrogeological and geophysical studies carried out in and around Plant premises show that the geological formation (granite gneisses and schists) is highly weathered and fractured till conducive for storage as well as recharge to groundwater. A major part of the runoff generated is considered for storage to utilize for various needs. However, one circular recharge pit is suggested to augment the existing and production bore well as desired by the Authorities. It is considered to store in one existing RCC tank, and suitably modification into one storage pond for C-1, Likewise one open pond with HDPE Liner in C-2, a Circular Recharge pit around the existing bore well in C-3 and again an open pond with HDPE Liner in C-4 is suggested to construct in suitable locations for optimal conservation and utilization of storm water runoff generated in the Plant premises. To make harvested water silt free and to reduce the velocity of the flow in the drains at each structure, Gutters, Desilting Chambers and Diversion chambers have been suggested. The details of the number and type of harvesting and associated structures like desilting chambers, diversion chambers and additional drains to construct are presented in Figure 15.

3. **Desilting Chamber**

   The proposed recharge measures are planned with gutters and de-silting chambers to reduce the entering of silt materials into structures. Since the stormwater is likely to contain dust and silt materials gathered from the roofs and paved areas, it is essential to remove them to the maximum extent to avoid the possibility of silting drains, and channels and lastly the recharge structure proper. The desilting chambers also help to reduce the turbidity in the stormwater. De-silting chambers, locating before the main recharge structure will not clog the filter media and maintain the efficiency of the main recharge structure proposed around the bore well.

   The desilting chamber and gutters together will facilitate to entry silt free water into rainwater harvesting structures like storage tanks or ponds. The design of the Gutter and desilting chamber is given in Figure 16. As per the quantity of silt load carried by the stormwater, desilting chambers are suggested in required locations where the possibility of more silt generation, to send silt-free water into recharge structures. The volumetric dimensions and different structural components such as the gutters involved are given in the drawing.

   Gutters need to be executed before the main drain which leads into the desilting chamber and ultimately into the harvesting structure. All together 8 desilting chambers have been suggested to make silt-free runoff water to harvest.

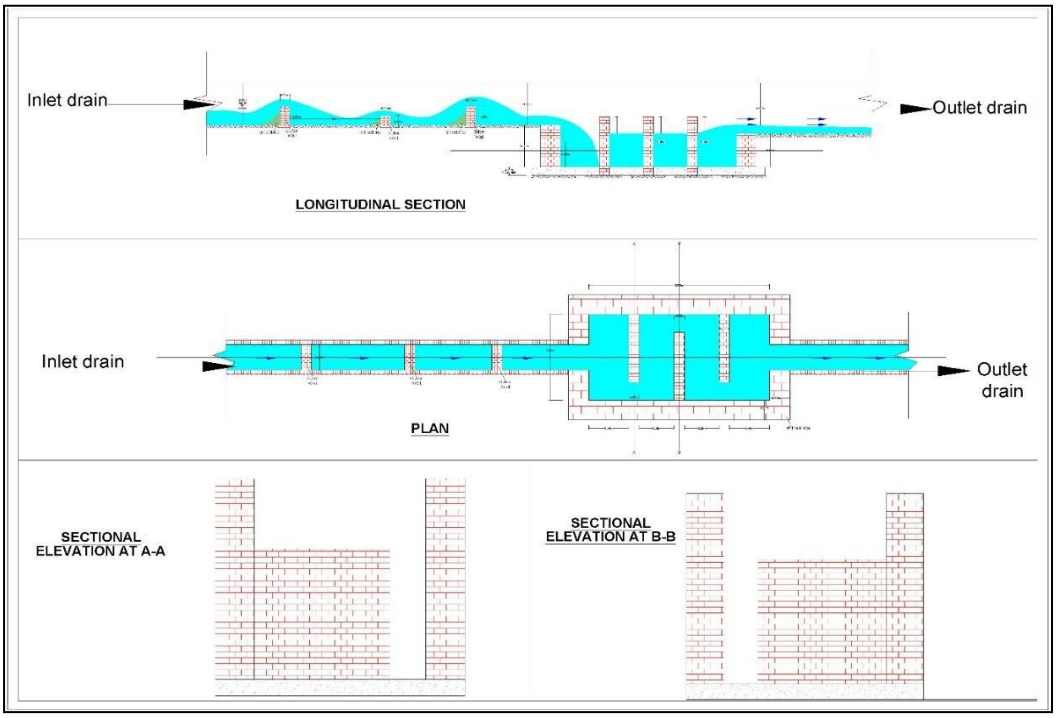


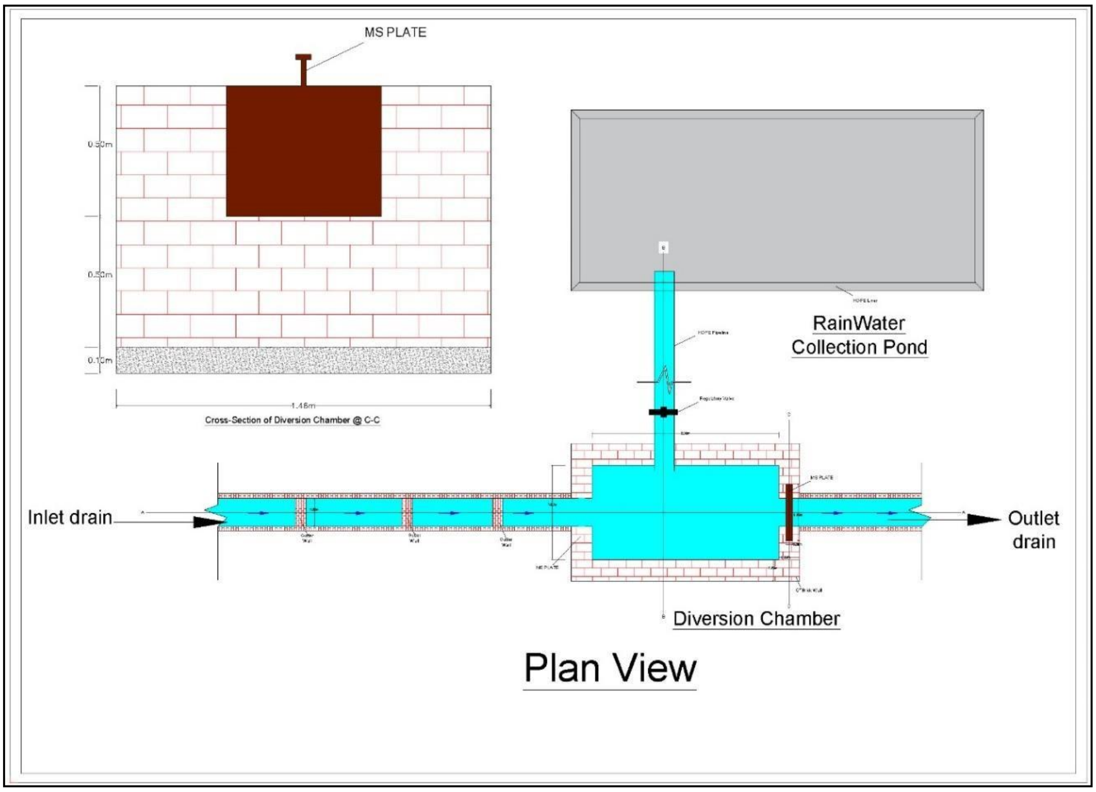
Figure 16: Plan and Sectional view of De-silting Chamber and Gutters

4. **Diversion Chamber**

A vital part of any Rain Harvesting system is the "First Flush" diversion drain/channel to capture and isolate the most contaminated rainwater from roof and ground surface in special diversion chambers. This first flush water can automatically be released into wastewater drains or ETP for any other deemed fit to use. The First Flush diversion protects rainwater quality by minimizing the volume of suspended and dissolved fine particles and turbidity of water that gathered during the non-monsoon period over the roofs and on the ground that end up in the water being harvested. This is something like a pre-storage treatment to clean the rainwater runoff as much as possible before it enters the storage tank/recharge pit.

This helps to reduce organic matter collecting in the tank, and reduces the amount of treatment needed after storage. This first flush of water has been found to contain the most amount of dust, silt and dry leaves from the roof as well as ground surfaces.

To divert the first flush, (i.e. initial rainwater runoff generated is generally loaded with most contaminants from the entire Plant area to let off into wastewater channels), a chamber needs to be constructed in such a way that the runoff generated during the initial one or two showers of rain to let off and divert into waste drains by stopping the rainwater going into the rainwater harvesting pond/structure by arranging stoppage M S plate. After the first flush is once or twice done, the M S Plate is to be arranged against the waste water drain letting the water into the harvesting structure. Three such diversion structures have been suitably identified to divert the first flush rainwater. The plan view and cross-section of the diversion channel along with gutter walls are shown in Figure 17.



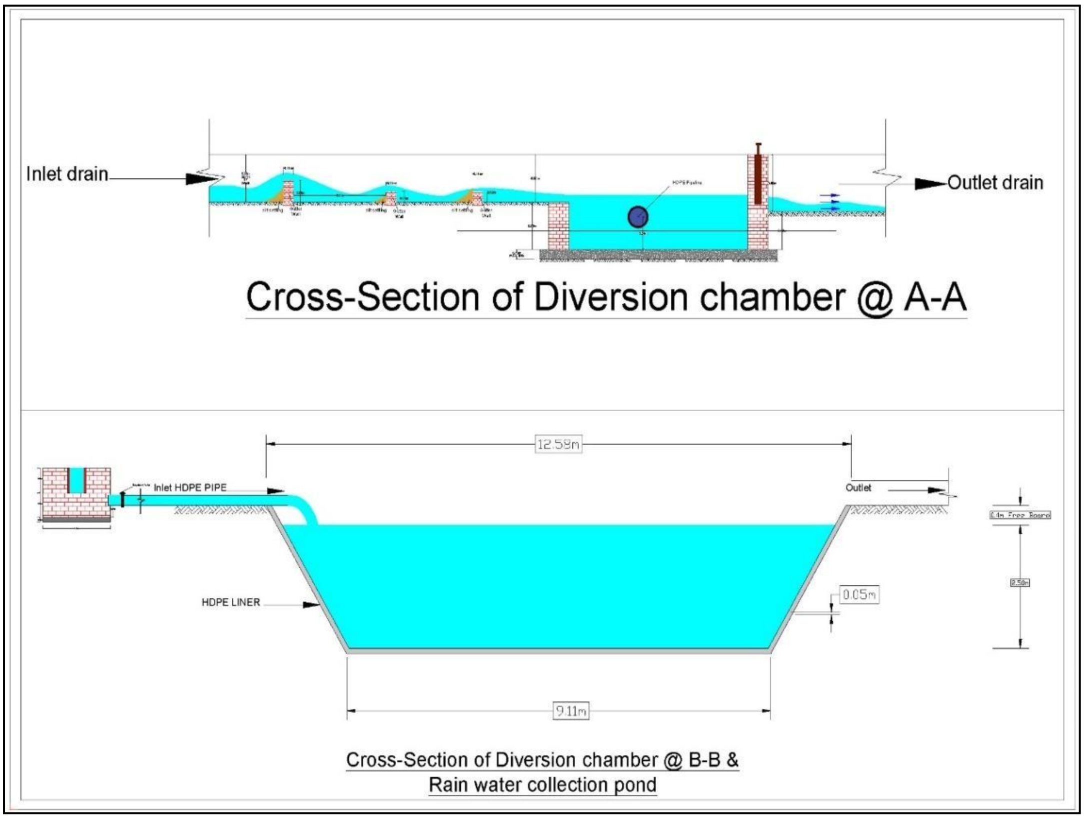


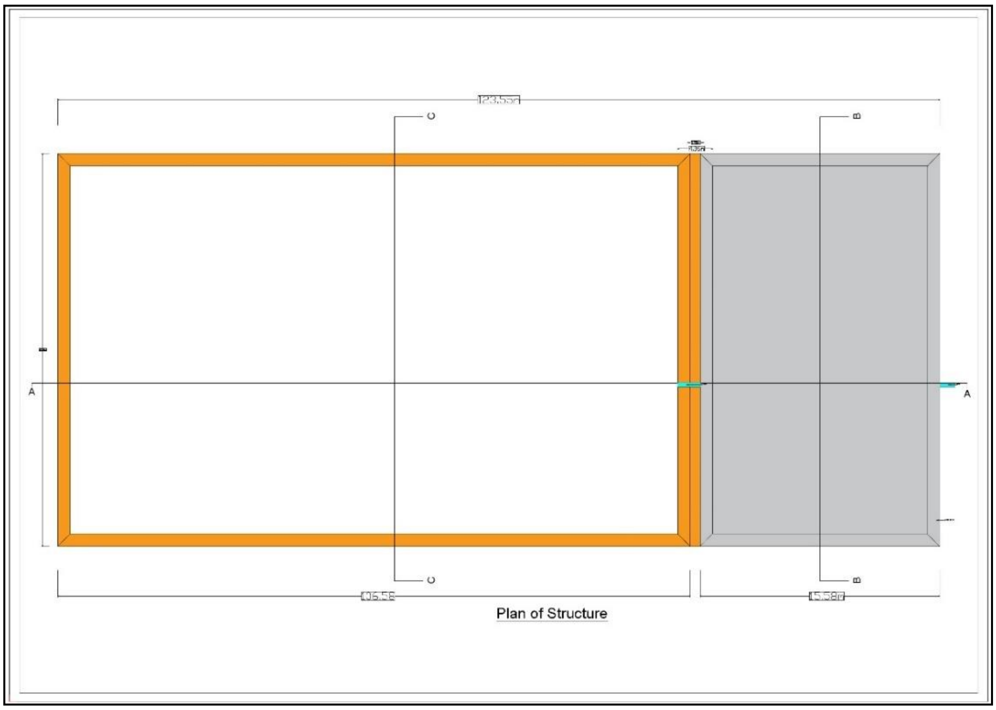
Figure 17: Plan and Sectional view of Diversion Chamber and Gutters

5. **Rainwater Harvesting Tank and Pond C-1**

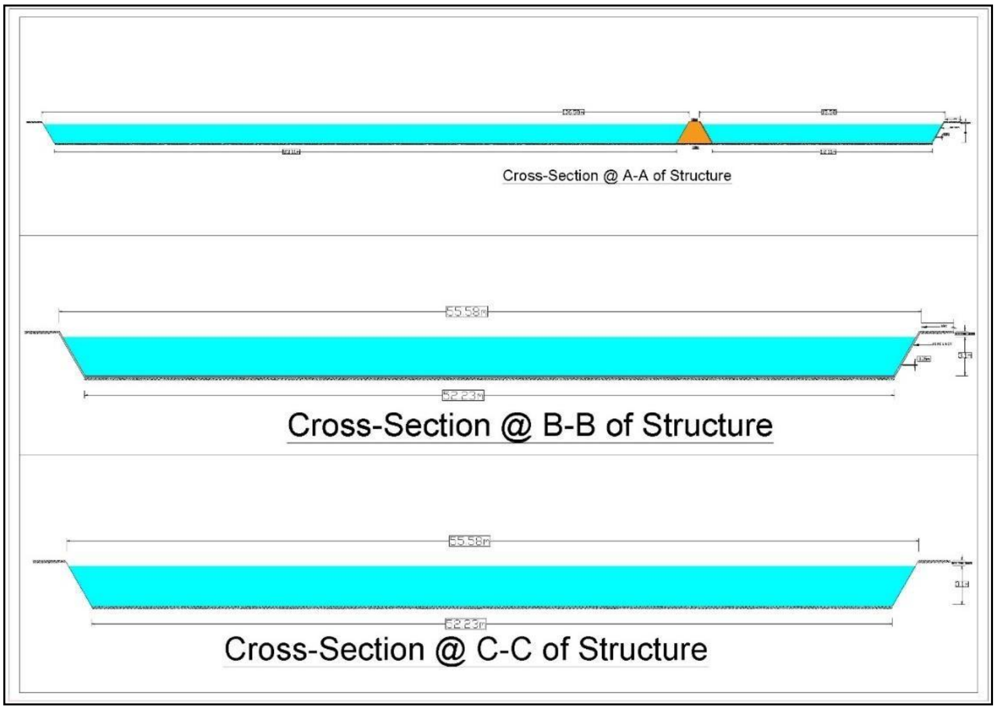
There is one RCC tank existing in the eastern part of the Plant with dimensions of 30m x 24m x 2.5m which can accommodate the rainwater runoff to the tune of 1800 KL. However, it is not sufficient to accommodate the entire runoff generated to the tune of 2315 KL in the C-1 for a rainfall intensity of 34mm/hr. In view of excess runoff, it is suggested to divert the excess runoff water into the open pond located further north of the RCC Tank. This open existing pond with dimensions of 106m X 55m X 3.5m is too large to convert into a rainwater harvesting pond. Hence it is suggested to convert the existing pond into a harvesting pond with the dimensions of 15m x 55m x 3.5m by creating an additional bund in the northern part. The pond can store to the tune of 2887 KL runoff water. The RCC tank together with the converted pond can store up to 4687 KL of water harvested. The two harvesting structures together in the C-1 catchment can store successive rainfall incidences of two days with rainfall intensity of 34mm/hr.

The pond is to be laid all through its surface area with HDPE Liner to avoid the loss of water due to percolation into the ground. Besides, in C-1 depending upon the requirement, 4 desilting chambers and one diversion chamber are also recommended to get silt-free and contamination-free rainwater if any. The location, Plan and cross-sectional view are presented in Figure 18 a, b, c.

(a)



(b)

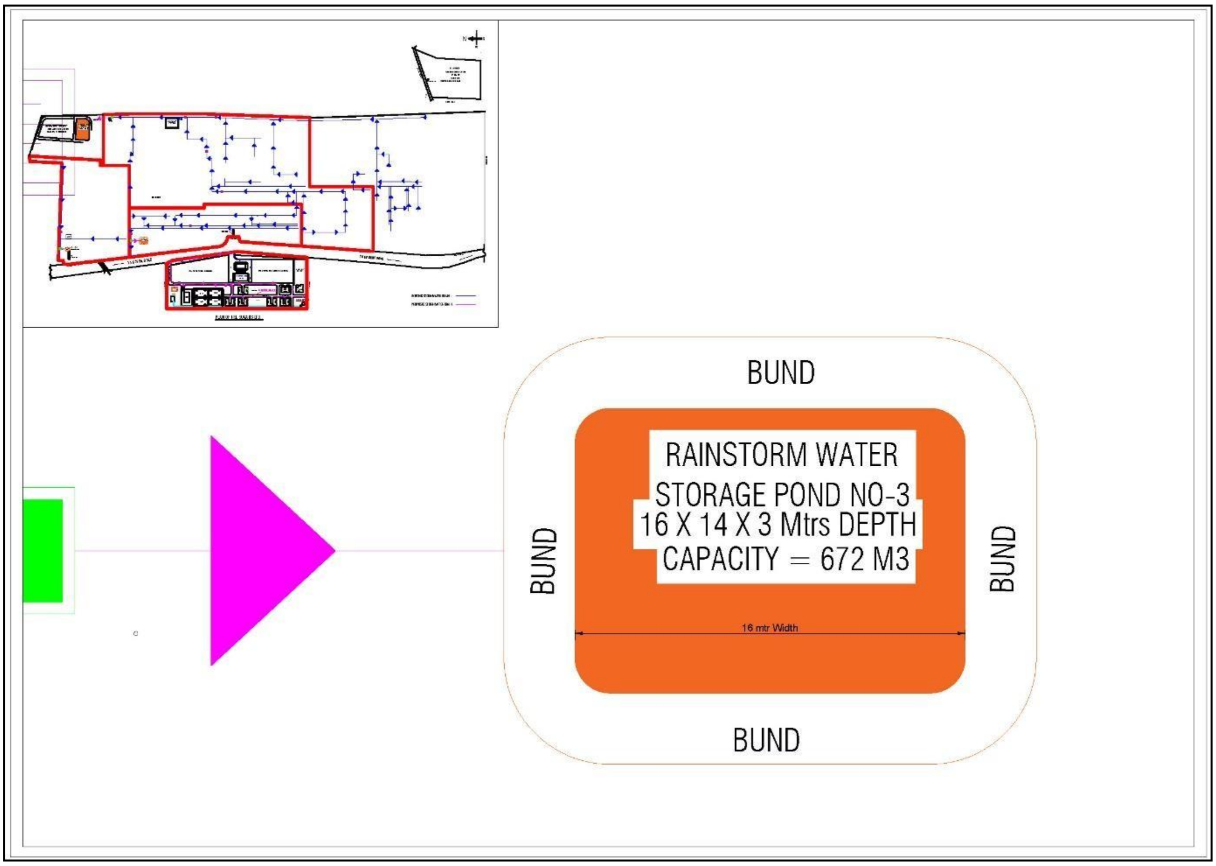


(c)

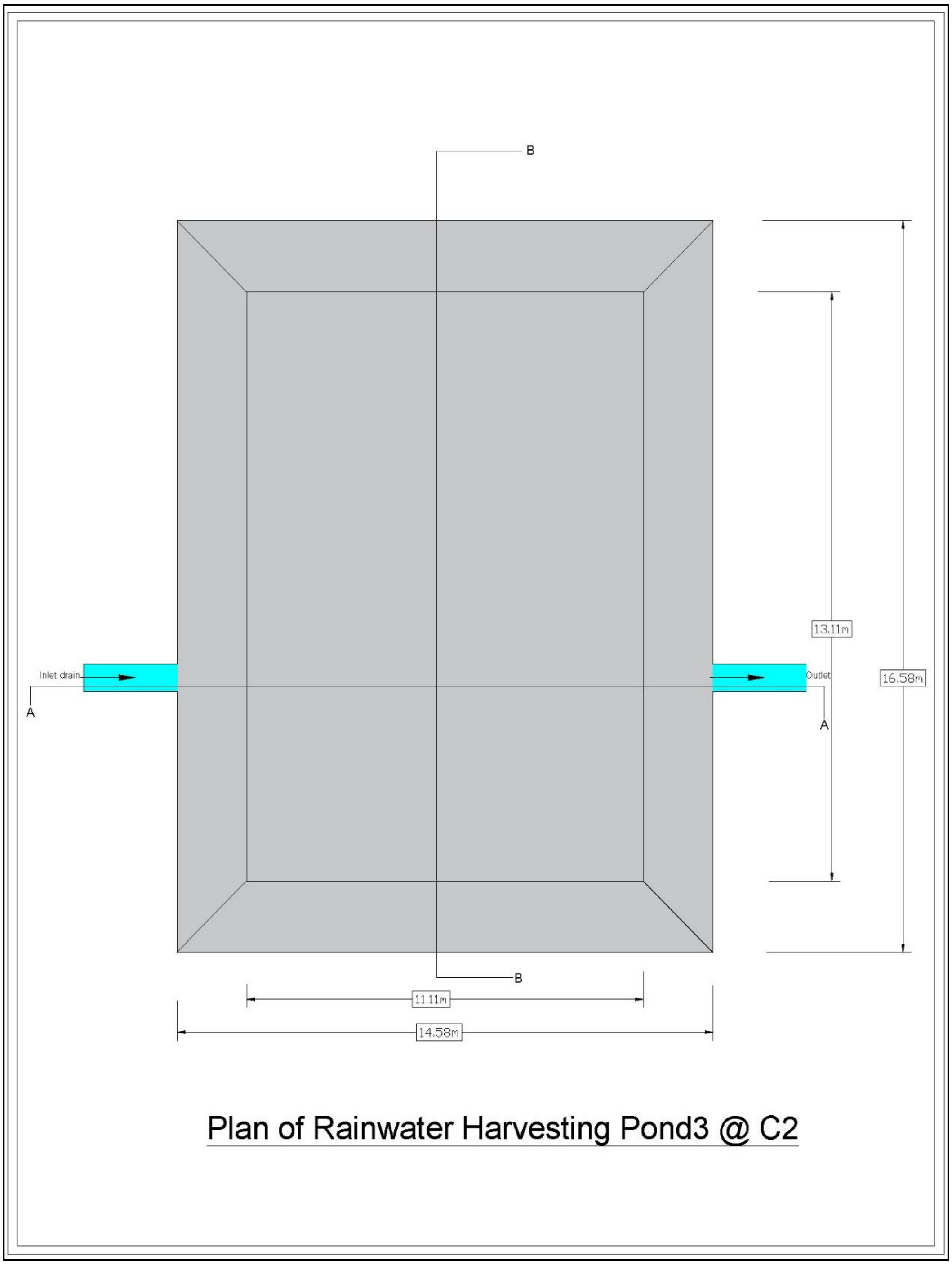
Figure 18: Location, Plan & Cross-Sectional (a, b, c) View of Proposed Rain WaterHarvesting Pond-2 in C-1 (converting the existing pond)

6. Rainwater Harvesting Pond in C-2

Catchment C-2 is located in the western part of the Plant which is capable of generating 669 Kl of runoff rainfall for a rainfall intensity of 35mm/hr. To harvest and store the runoff it is recommended to construct a Rain Water Harvesting (RWH) pond with the dimensions of 16m x 14m x 3m in the SW part of C-1 in the green belt area. This catchment can generate a total rainwater harvesting potential of 17010 KL/year. It is also recommended to lay all through its surface area with HDPE Liner to avoid the loss of water due to percolation into the ground. In C-2, depending upon the requirement, 2 desilting chambers and one diversion chamber are also recommended to get silt-free and contamination-free rainwater, if any. The location, plan view Plan and Cros sectional View of the structure are presented in Figure 19 a, b, c respectively.

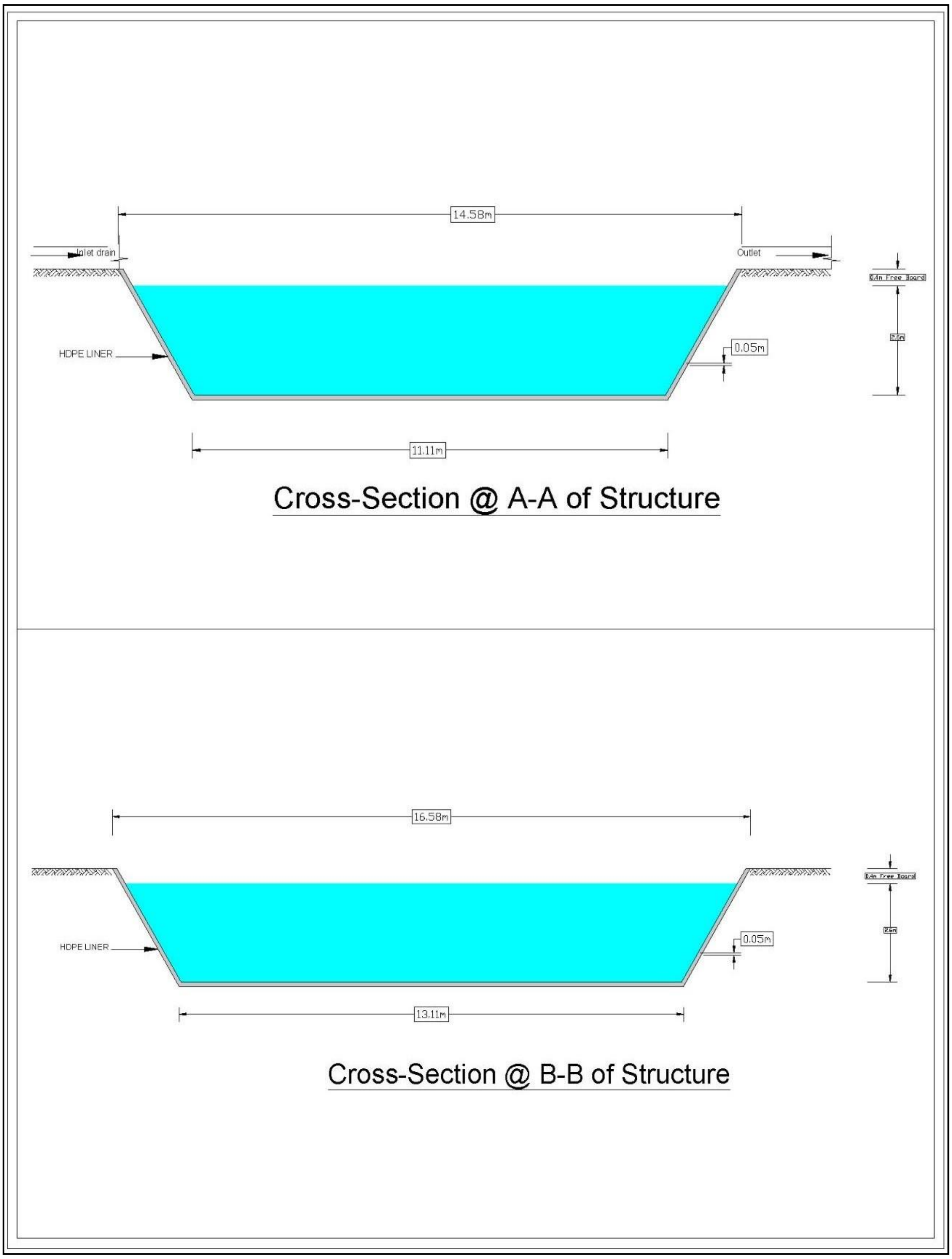

BUND
RAINSTORM WATER
STORAGE POND NO-3
16 X 14 X 3 Mtrs DEPTH
CAPACITY = 672 M3
BUND
BUND
16 mtr Width
BUND

(a)



B
13.11m
16.58m
Inlet drain
Outlet
A
A
B
11.11m
14.58m
Plan of Rainwater Harvesting Pond3 @ C2

(b)



(c)

Figure 19: Location, Plan & Cross-sectional View (a, b, c) of Proposed Rain Water Harvesting Pond-3 in C-2

7. **Circular Recharge Pit with Sand Filtration Unit in C-3**
   Catchment C-3 is located in the NW part of the Plant draining the cane yard and its surrounding areas. This catchment produces around 370 KL of runoff rainfall for a rainfall intensity of 35mm/hr. There is a bore well located in the NW corner which is a production well for supplying

the groundwater to the Residential, Administrative and other buildings. Since it is a production well, it is essential to maintain its sustainability for a continuous supply of water by a recharge structure. To recharge the production bore well, it is suggested to construct a 1.5 m wide Circular Recharge Pit with 2.5m depth and 2m radial distance from the bore well with “Sand Filtration”.

Sand filtration is the methodology adopted in recharge structure by arranging various filter media materials in the form of different layers from the bottom, at a varying depth such as 40 mm gravel/metal with 1.00 m thickness, followed by 20mm gravel/metal with 0.50 m thick and finally with coarse sand of 0.50 m thick followed by the thin layer of the geotextile membrane to entrapping of silt and other foreign materials to recharge silt free water into the aquifer. The filtering material is laid in the following manner with the progressively smaller sizes towards the top and bigger sizes towards the bottom.

Geotextiles membranes are permeable fabrics which, when used in association with soil (sand), can separate, filter, reinforce, protect, or drain. Typically made from polypropylene or polyester, geotextile fabrics come in three basic forms: woven (resembling mail bag sacking), needle punched (resembling felt), or heat bonded (resembling ironed felt). The filtration through the Geotextile Membrane is inserted on top of the sand layer which is a few millimetres in thickness. This layer provides effective purification, the underlying sand providing some biological treatment. As water passes through the membrane the silt and other foreign materials trapped on Geotextile Membrane can be easily removed and cleaned. Whenever silt or any other material is trapped on this membrane, it needs to be removed and cleaned. The same is to be placed back on the sand surface as usual and it is important for cleaning of the geotextile membrane for every couple of rains based on their intensity and silt settling. It is much more important to arrange a geotextile membrane on the top layer of sand in the recharge structure so that the quality of the production bore well water does not affect.
A parapet wall is also to be constructed from 0.30m above ground level to 1.20m below ground level to avoid the collapse of the pit as well as to avoid the overland flow or any other unwanted material entering the recharge pit.

Depending upon the catchment size, 1 desilting chamber and 1 diversion chamber have been suggested to get silt-free and contamination-free rainwater, if any. The location, plan view Plan and Cross-sectional View of the structure are presented in Figure 20.

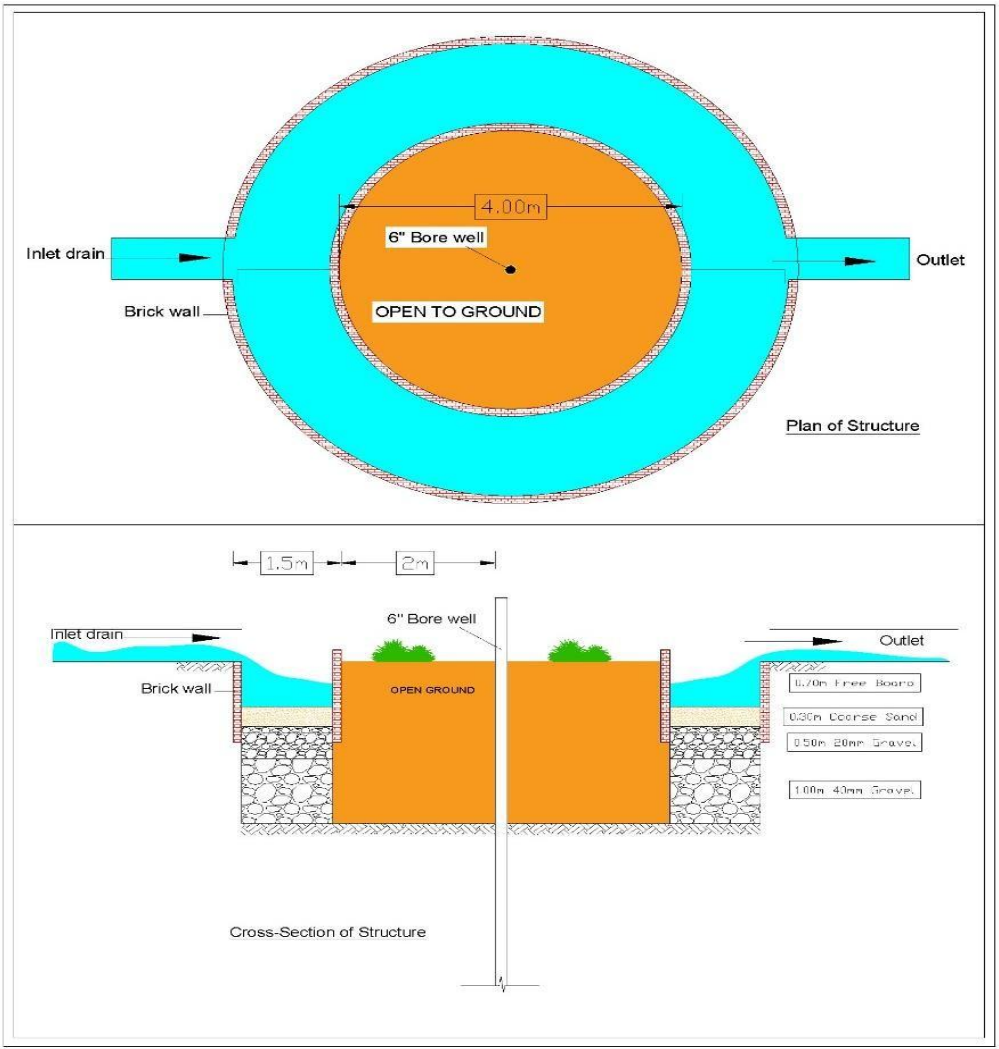
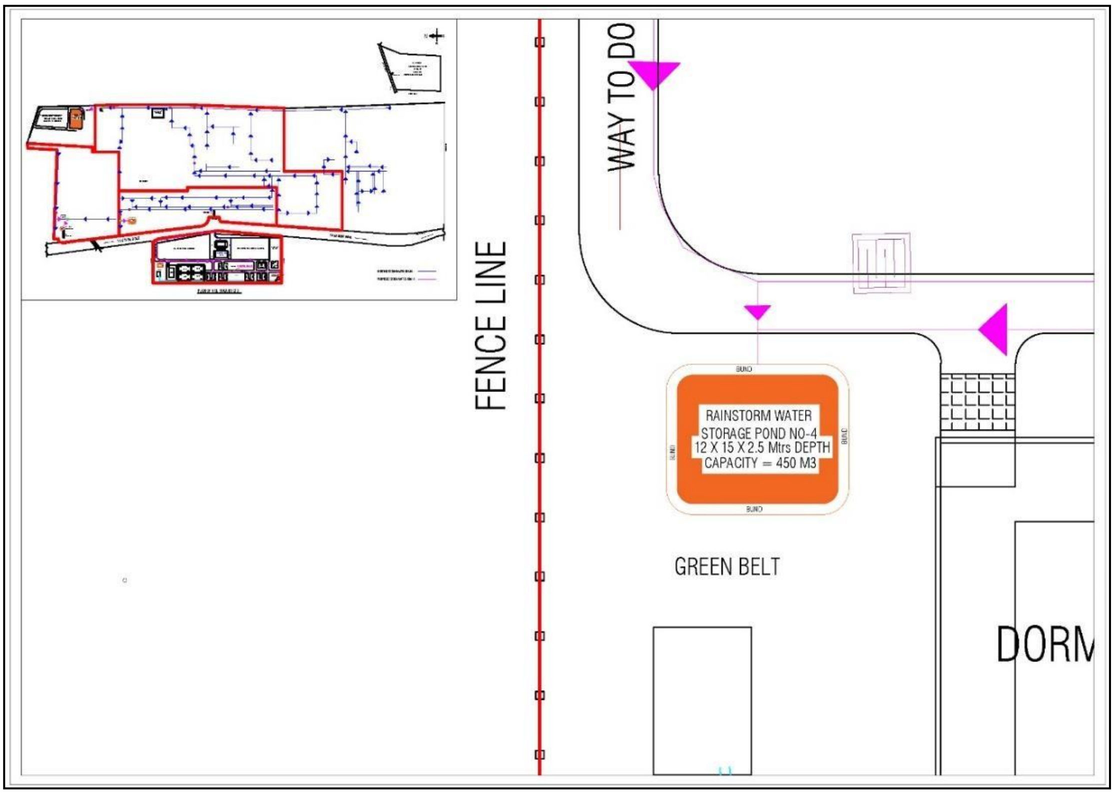


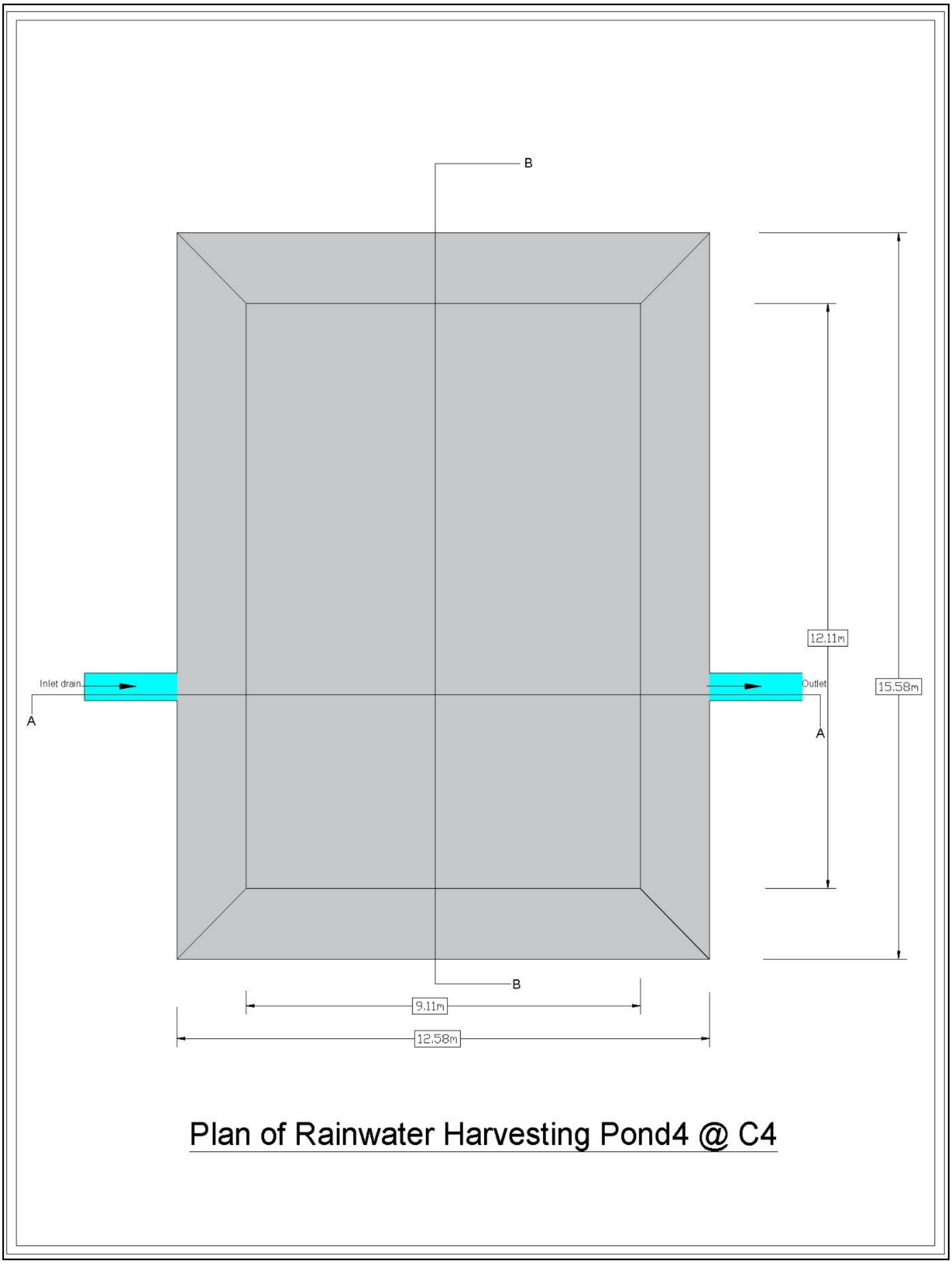
Figure 20: Circular Recharge Pit Surrounding the Existing Bore well in C-3

8. **Rainwater Harvesting Pond in C-4**
   Catchment C-4 is located in the western part of the Plant consisting of the Admin building and Residential quarters which is capable of generating 458 KL of runoff rainwater for a rainfall intensity of 35mm/hr. To harvest and store the runoff it is recommended to construct an RWH pond with the dimensions of 12m x 15m x 2.5 m in the NW part of C-4 in the green belt area. This catchment can generate a total rainwater harvesting potential of 11636 KL/year, mostly from roofs of the quarters, guest houses and dormitory areas. The rainwater harvesting potential generated in the C-4 is supposed to be the best quality of water with negligible silt load. Therefore, no diversion chamber is recommended and as such, there is no scope to divert the "First Flush" to lead the initial rainwater to any other channels through the diversion chamber. It is also recommended to lay all through its surface area with HDPE Liner to avoid the loss of water due to percolation into the ground. In C-4. Depending upon the requirement, 3 desilting chambers are recommended to get silt-free and contamination-free rainwater. The location, plan view Plan and Cros sectional View of the structure are presented in Figure 21 a, b and c respectively.

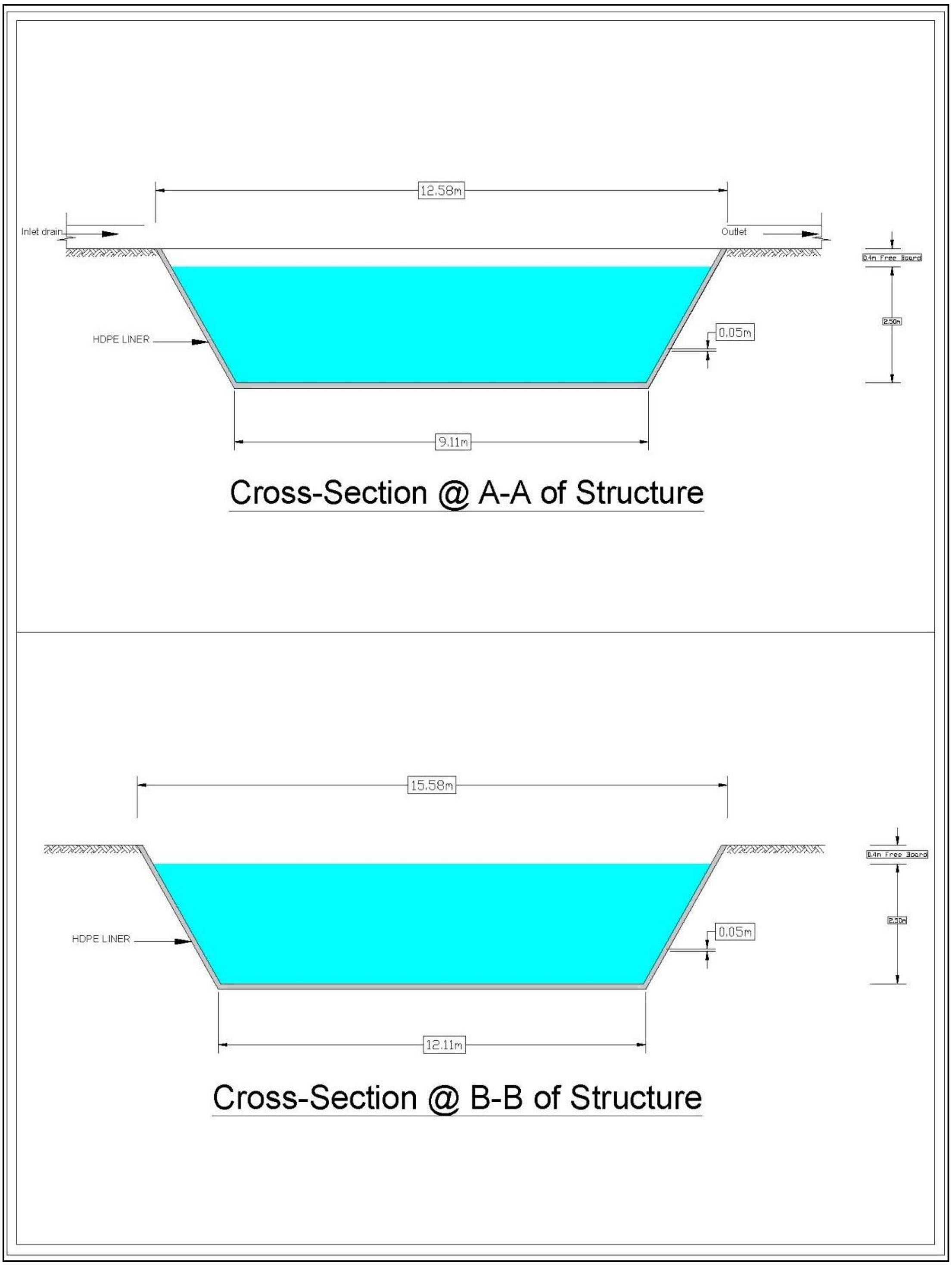


FENCE LINE
WAY TO DO
RAINSTORM WATER
STORAGE POND NO-4
12 X 15 X 2.5 Mtrs DEPTH
CAPACITY = 450 M3
GREEN BELT
DORM

(a)


B
12.11m
15.58m
Inlet drain
Outlet
A
A
B
9.11m
12.58m
Plan of Rainwater Harvesting Pond4 @ C4

(b)



(c)

Figure 21: Location, Plan & Cross-Sectional View of Proposed Rain Water Harvesting Pond-4 in C-4

9. Maintenance And Management Measures of Proposed Rainwater Harvesting Structures

The maintenance of rainwater harvesting structures is as important as the construction. Periodic maintenance of rainwater harvesting structures is essential because of silting, chemical precipitation and accumulation of organic matter hence the success of artificial recharge schemes and related developmental activities primarily depend on periodic maintenance. To ensure maintenance and management of the proposed structures, the following suggestions should be strictly adhered to increase the effectiveness, efficiency and life of the structure.

- As these are all permanent structures, there will not be any shortcomings, except watch and ward. Therefore, Scheduled visits to the structures by an assigned person should be there for any defectiveness and shortcomings to attend immediately.
- The structures that are proposed should be used for the purpose that is meant and should not be used for any other purpose.
- Cleaning and removal of the silt, suspended particles organic matter from the water body before the onset of monsoon every year.
- All the structures should have outlets to flow the excess water out in case of heavy and unusual rainfalls as the structures are designed for maximum hourly intensity of 3.4 cm/hour or 34mm/hour.
- All the structures should be protected by arranging fences around them and covering with appropriate material to avoid any untoward incidents and accidents.
- Frequent disinfection should be done with chlorine to reduce biological activity and near the walls of the recharge structures.
- Care should be taken such that the silt or suspended particles load should not increase in the structures.
- If any damage (either it is minor or major) immediate action needs to be taken to renovate and improve the performance of the structure.
- The water in the existing bore should be collected at least twice a year during pre- and post-monsoon periods to see the changes in the chemical quality of groundwater.
- Overall, the entire structure and its allied components should be taken care of

A.9. Implementation Benefits to Water Security

For Scope-5

a. Implementation of an Effluent Treatment Plant (ETP) in sugar and distillery industries ensures compliance with environmental regulations by reducing COD, BOD, and other pollutants in wastewater. It enables resource recovery through biogas generation, water reuse, and bio-compost production, enhancing sustainability. The ETP minimizes environmental impact by controlling odor, reducing groundwater contamination, and mitigating air pollution. Advanced technologies like ZLD prevent liquid effluent discharge, aligning with strict regulatory norms. Additionally, treated water can be reused for irrigation or industrial processes, reducing water consumption. ETP implementation supports the industry's eco-friendly image, improves operational efficiency, and promotes a circular economy while protecting local ecosystems.

b. The implementation and reuse of hot condensate water in a sugar distillery plant enhances water security by reducing dependency on freshwater sources. It promotes water reuse, lowers operational costs, and ensures a more sustainable and resilient water management system. This also supports regulatory compliance and environmental conservation goals.

For Scope-2

Based on the On-site investigations conducted in an entire plant to know and assess the different types of catchments, existing within the plant and structural units to manage the rain water harvesting potential from each catchment area i.e., Hard surface (Paved Area) and soft surface (Non-Paved Area). It is observed that the entire plant area (90+10 acres) had been divided with different catchments depending upon the slope of the Plant area viz., Cement Concrete (CC) roads, buildings with RCC roofs and asbestos/iron (GI) sheets, open area/greenbelt etc. However, as there is a tremendous scope to harvest the rainwater/runoff from both hard surfaces and soft surfaces, it can appropriately be collected for utilization or can be recharged to an underground aquifer.

The Catchment Area 5 has not been considered due to the potential threat of contamination for the rainwater, However, the rainwater potential has been computed for the catchment 5 in order to collect it in appropriate area, treat it and use accordingly, if required in future.

A9.1 Objectives vs Outcomes

For Scope-5

a) This project activity scope involves treating and reusing wastewater from distillery and sugar plant which would otherwise be thrown in the water bodies without treatment breaching the laws hence the project follows the following:

- Reduce the COD, BOD, and other pollutants in wastewater, which ensures compliance with environmental regulations and protects local water bodies.

- Treat high-strength effluents like distillery spent wash, which lowers the environmental impact and reduces the risk of contamination.
- Recycle treated water for reuse in the plant or agriculture, which reduces water consumption and promotes sustainable water management.
- Minimize sludge generation and enhance solid waste management, which reduces disposal costs and supports eco-friendly waste handling.
- Improve the quality of effluent before discharge, which helps maintain ecosystem balance and prevents pollution of surrounding areas.
- Reduce Odor and improve air quality in the plant area, which creates a healthier working environment and minimizes nuisance to nearby communities.

b) This project activity scope also involves use of hot condensate water in a sugar distillery plant which would otherwise be thrown in the water bodies hence the project follows the following:
   - To reduce freshwater consumption by reusing process water and achieve significant reduction in freshwater intake by reusing hot condensate.
   - To improve overall energy efficiency in operations as hot condensate reduces the need for heating process water.
   - To enhance sustainability performance and meet regulatory compliance which contributes to improved water use efficiency and met regulatory sustainability standards.
   - To minimize wastewater generation and reduce environmental impact as it reduces overall effluent discharge by reusing process water.

For Scope-2

Water is every essential element that supports life. Hence, this project activity aims to conserve water and reuse by using the modern and traditional methods.

The project activity is implemented to store and reuse the rainwater from the 5 catchment areas identified in the project site as per the topology and other physical features. This will ensure that the nearby areas have less storm runoff and less runoff will lead to clean water bodies present nearby.
The impact assessment or objectives of this RWH scheme can generally be enumerated as follows:

- Conserve surplus monsoon runoff and utilize it for groundwater recharge, which prevents the loss of runoff to the sea and enhances groundwater reserves.
- Arrest the decline in groundwater levels through recharge, which stabilizes water table levels and reduces energy costs for water extraction.
- Ensure sustainability of recharge wells during lean months, which provides consistent water availability in dry periods.
- Make domestic wells sustainable and reduce tanker dependency, which improves water security and makes communities tanker-free.
- Increase soil moisture to boost vegetation cover, which enhances green cover and agricultural productivity in recharge zones.
- Improve groundwater quality through dilution, which reduces pollutant concentrations, ensuring better water quality.
- Enhance ecological balance and reduce soil erosion, which promotes biodiversity, improves fauna and flora, and attracts migratory birds.

- Strengthen catchment area management, which positively impacts groundwater levels and visibly improves the ecological health of the project site.

A9.2 Interventions by Project Owner / Proponent / Seller

For Scope-5

Interventions by Project Owner for ETP plant:

1. **Installation of Advanced Treatment Systems:** Project owners invest in technologies like anaerobic digestion, multiple effect evaporation (MEE), and reverse osmosis (RO) to ensure effective treatment of high-strength effluents like distillery spent wash.
2. **Regular Monitoring and Maintenance:** Ensuring continuous monitoring of wastewater quality, system performance, and compliance with environmental standards through automated systems and regular inspections.
3. **Upgradation of ETP Capacity:** Expanding or upgrading the ETP facility to handle variations in wastewater volumes, especially during peak production seasons, to prevent overloading.
4. **Resource Recovery:** Implementing systems to recover biogas, treated water, or compost from the effluent treatment process, which adds value and reduces overall operational costs.
5. **Training and Skill Development**: Conducting regular training sessions for staff to ensure efficient operation and maintenance of the ETP, improving both performance and compliance with regulations.
6. **Compliance with Regulatory Standards**: Regularly updating the ETP to comply with evolving environmental regulations and local pollution control board requirements, ensuring sustainable operations.
7. **Public Awareness and Engagement:** Collaborating with local communities to raise awareness about the importance of ETP and its benefits for environmental protection and public health.
8. **Optimization of Chemical Usage:** Implementing strategies to optimize the use of chemicals in the treatment process, reducing operational costs and minimizing chemical waste.
9. **Zero Liquid Discharge (ZLD) Implementation:** Working towards a ZLD approach to ensure that no wastewater is discharged into the environment, promoting water reuse and reducing environmental impact.

Interventions by Project Owner for Use of Condensate water in plant:

1. **Infrastructure Upgrade:** Installed piping and storage systems to collect and transport hot condensate from process areas.
2. **Heat Recovery Systems:** Integrated heat exchangers to utilize thermal energy from hot condensate in preheating operations.
3. **Water Reuse Integration:** Modified existing processes to allow direct reuse of hot condensate as boiler feed water or for cleaning.
4. **Monitoring Systems:** Implemented flow meters and temperature sensors to monitor condensate recovery and reuse efficiency.
5. **Training & SOPs:** Conducted staff training and developed standard operating procedures for effective condensate management.
6. **Sustainability Alignment:** Ensured alignment of interventions with corporate water conservation and sustainability goals

For Scope-2

NSL Group identified huge potential and decided to take up the rainwater harvesting in project as discussed in above sections to conserve and store the rainwater and avoid the storm runoff.

1. **Installation of RWH Structures:** Project owners establish dedicated rainwater harvesting systems, such as recharge wells, ponds, and surface collection tanks, to capture and store rainwater during the monsoon season.
2. **Catchment Area Development:** They improve and maintain catchment areas, including roofs, paved surfaces, and surrounding land, to maximize rainwater collection potential.
3. **Filtration and Pre-treatment Systems:** Installing filtration units and first flush diverters to ensure clean and safe water storage, preventing contamination from debris or pollutants.
4. **Groundwater Recharge:** Implementing systems like recharge wells or pits to direct harvested rainwater into the ground, replenishing local aquifers and improving groundwater levels.
5. **Water Quality Monitoring:** Regular testing of stored rainwater to ensure its quality is suitable for reuse in plant operations or irrigation, meeting health and environmental standards.
6. **Reuse of Harvested Rainwater:** The harvested water is utilized for various plant needs, such as cooling systems, irrigation, cleaning, or non-potable uses, reducing dependence on external water sources.
7. **Integration with ETP:** Linking rainwater harvesting systems with the Effluent Treatment Plant (ETP) to recycle treated water back into the plant, optimizing water usage and reducing fresh water consumption.
8. **Awareness and Training:** Educating staff on the importance and proper maintenance of the RWH system, ensuring its long-term functionality and efficiency.
9. **Monitoring and Optimization:** Using digital tools and sensors to monitor rainfall patterns, water levels, and system efficiency, enabling timely interventions and optimization of water collection.
10. **Sustainability Initiatives:** Aligning the rainwater harvesting strategy with broader sustainability goals, such as reducing the plant's water footprint, conserving local water resources, and supporting the community's water needs.

These interventions help to conserve water, reduce dependency on external sources, and promote sustainable water management within the sugar and distillery industry.

A.10. Feasibility Evaluation

For Scope-5

The installed ETP and condensate water recovery system by the project proponent are robust and effectively handle variations in wastewater effluent. Prior to project implementation, a feasibility study was conducted in accordance with Karnataka State Pollution Control Board guidelines.

For Scope-2

The rainwater harvesting system installed by the project proponent is robust and capable of managing heavy rainfall events. The catchment areas are well-graded to ensure efficient runoff collection, and the storage infrastructure is of high quality.

A.11. Ecological Aspects :

For Scope-5

This project demonstrably achieves sustainable management and efficient utilization of India's natural resources. The project proponent (PP) had the option to install borewells, potentially depleting local groundwater reserves. Alternatively, they could have continued relying on existing, potentially potable, water resources registered with the Universal Water Registry. Recognizing the environmental impact, the PP commendably opted for a more sustainable approach.

They chose to treat and reuse the effluent generated by the Effluent Treatment Plant (ETP) and condensate water, resulting in significant water savings for the tannery operations, measured in millions of liters. This project encourages the industrial sector, particularly large-scale leather processing facilities, to adopt similar sustainable practices regarding their captive water needs and overall groundwater management.

The ETP effectively treats the distillery effluent, and the use of impervious machinery within the ETP area further safeguards against potential leakage and contamination of surrounding soil.

For Scope-2

The rainwater harvesting model is an environmentally sustainable practice that involves collecting and storing rainwater for various uses, reducing dependence on groundwater and surface water sources. It has significant ecological benefits, including water conservation, groundwater recharge, and ecosystem preservation. The key ecological aspects of RWH are discussed below:

- Helps replenish groundwater by directing excess rainwater into aquifers, reducing overdependence on borewells and natural groundwater sources.
- Helps to mitigate declining groundwater levels in certain areas and supports sustainable water availability.
- RWH reduces surface runoff, which can cause soil erosion and sedimentation in rivers and lakes.
- Prevents pollutants from roads, industries, and agricultural fields from washing into rivers and lakes, improving overall water quality.
- Helps to preserve aquatic ecosystems and supports biodiversity.
- Integrating RWH in city designs helps create green, water-sensitive urban environments with minimal ecological disruption.

A.12. Recharge Aspects:

For Scope-5

Not Applicable, since this aspect does not lead to any recharging and storing facility for a long time for the water recycled.

For Scope-2

For the rainwater harvesting systems (RWH) indirectly contribute to recharging the bore wells within the project area and reduce the storm water flow in the area. Soak pits near the catchment zones effectively filter the rainwater runoff before it enters the recharge areas. Consequently, the bore wells in the region are filled with water during the non-monsoon season, indicating successful groundwater recharge. Plans have been proposed to reduce any mixing of storm water and rainwater conserved and saved to ensure good quality of water.

A.12.1 Solving for Recharge

For Scope-5

Water Budget Component	Typical Estimated Uncertainty (%)	Description
Surface Inflow	NA	The total quantity of treated ETP wastewater is measured via flow meters and recorded daily
Precipitation	NA	Not available
Surface Outflow	NA	Not available
Evapotranspiration	NA	Not available
Change in Storage	NA	Not available
Deep Percolation	NA	Not available

For Scope-2

Recharge = Rainfall + Surface Inflow – Evapotranspiration – Surface Outflow – Change in Storage

Evapotranspiration & Other Data: https://datameet-pune.github.io/open-water-data/docs/open-water-data-paper.pdf (or available under Documents Section- Water Data Guide)

Water Budget Component	Typical Estimated Uncertainty (%)	Description
Surface Inflow	1-12%	Typical range of accuracy from meters to minimum delivery accuracy requirements of delivery and diversion measurement devices.
Precipitation	2-20%	Typical range of accuracy from field-level rain gauges to extrapolation of local weather station data
Surface Outflow	1-20%	Typical range of accuracy from meters to estimated outflow relationships
Evapotranspiration	20.00%	Clemmens and Burt, 1997; typical accuracy based on free water surface evaporation coefficient.
Change in Storage	15-25%	Estimated accuracy of change in storage calculation based on field scale water budget calibration to observed water levels.

Deep Percolation	5-30%	Typical range of calculated accuracy from field-scale water budget results (fields ranging from 56 to 125 acres)

A.13. Quantification Tools

The following tools are recommended to be used to estimate the quantity of RoUs in the absence of tamperproof flow meters or systems that accurately quantify the volume in litres or m^3 of water being harvested or conserved by the project activity.

For Scope-5

The baseline scenario is the situation where, unutilized water is not conserved/treated/recycled and water is extracted from multiple bore wells within the project boundary which would have depleted the local groundwater resources (aquifers), in the absence of the project activity, the water for distillery process, gardening and other plant facilities usage would have been extracted from the ground water which have been avoided with the ETP implementation and reuse of condensate water installed within the project boundary.

Hence, the quantity of RoUs is estimated as: *"the net quantity of treated wastewater that is gainfully used post treatment."*

Option -2 as per Rainwater Offset Standard version 6.1 is used and stated as:

Harvested/Recycled unutilized water or Volume of sea water utilized (m3) = Quantity of treated or recycled water in liters treated or harvested or volume of the artificial holding tank ($1m^3$ = 1000 liters).

The net quantity of treated water used is measured via flow meters installed at the site. For conservative estimates, the operational days have been assumed to be 330 days per year.

Further, as per *Rainwater Offset Standard version 6.1* a Conservative Approach: *The UWR RoU Verifier is recommended to apply a* ***10-50%*** *uncertainty factor related to degree of uncertainty to the final quantity of RoUs calculated for vintage years 2014-2021. However, a more conservative approach to uncertainty may be selected by the RoU Verifier as per its discretion. 10% uncertainty factor has been applied for conservative purposes.*

The Uncertainty factor of 10% is applied for the entire 10 year Monitoring period from 01/01/2014 to 31/12/2024.

The sugar and distillery ETP data for the volume of water treated and ROUs generated[5] in represented in the Table below:

[5] For the calculations, please refer ER Sheet

Year	Volume of water treated in m3 for Distillery	Volume of water treated in m3 for Sugar plant	Volume of Treated Hot condensate generation in m3 from Sugaxr Plant
2014	80358	101268	151980
2015	89689	120562	118550
2016	62032	100125	113380
2017	32529	76441	83890
2018	22072	68772	139830
2019	15368	97632	96810
2020	23319	87598	132620
2021	36695	82513	43790
2022	60346	90192	94670
2023	65745	90360	170220
2024	8565		140441
Total	496719	915463	1286181
Total ROUs	**2,698,363**		
Final ROUs after uncertainty factor of 10%	**2,428,526.57**		

For Scope-2

The baseline scenario is the situation where, unutilized water is not harvested into a well/aquifer/sub-surface structure/above-ground storage tank/collection chamber, in the absence of the project activity, the water for gardening and other plant facilities usage would have been extracted from the ground water which have been avoided with the rainwater harvesting method installed within the project boundary.

Hence, the quantity of RoUs is estimated as: *"the net quantity of rainwater harvested that is gainfully used in some other plant activity"*

Option -1 as per Rainwater Offset Standard version 6.1 is used and stated as:

Harvested/Recycled unutilized water or Volume of water utilized (m3) = Area of Catchment/Roof/Collection Zone (m2) X Amount of rainfall (mm) X Runoff coefficient

Water Harvesting Potential

Water harvesting potential of any catchment area is to be calculated under this methodology for each given year that the RoU is being claimed. The total amount of water that is received from rainfall over an area is called the rainwater legacy of that area. The amount that can be effectively harvested is called the water harvesting potential.

Scope-2

Assessment of Annual Rainwater Harvesting Potential (ARHP)

- Availability of source water is one of the basic prerequisites for taking up any rainwater harvesting and aquifer recharge scheme.
- The source of water available for aquifer recharge in the present case is only the rainfall-runoff which otherwise goes waste into local drains.
- A realistic assessment and quantification of the source water will help in designing the storage and recharge capacity of the RWH structures.
- The estimation of rainfall-runoff is made to quantify the water available for recharge, after all, losses.
- This estimated runoff will be used for the assessment of the size of the recharge structures.
- Though there are various methods to estimate the runoff, rational method is generally used as it is one of the most common and popularly used for small areas.
- The rational method is the sensible approach to determining the yield of a catchment by assuming the runoff coefficient.
- The **runoff coefficient** for various surfaces as per CGWA.
- Hence, based on each land use, its areas have been determined along with the corresponding runoff coefficient.
- The runoff coefficients established by CGWB[6], based on the field experiments are being used for the computation of rain water harvesting potential as listed in Table No. 16.
- Knowing the areas, runoff coefficient and average annual rainfall, the runoff from each land use has been determined. In this manner, all the land use, and open areas have been considered and cumulative runoff has been determined.
- The run-off coefficients for a different surface type are given in Table No. 16.

Table No. 16: Details of Runoff Coefficient (CGWA) and in line with the recommended Runoff Coefficient (K) by UWR

S.No.	Particulars	Runoff Coefficient as per land use
1	Roof Top of building /Shed	0.85
2	Road/Paved area	0.65
3	Open Land	0.20
4	Green Belt	0.15

[6] http://cgwa-noc.gov.in/LandingPage/index.htm

The following is the rational formula adopted to determine the yield of the catchment by considering the above runoff coefficient:

$$Quantity\ of\ Runoff = CAP\ in\ Cu.m$$

Where:

C = Runoff Coefficient (%)

A = Area of catchment (in Sq.mts)

P = Precipitation (in m)

Based on the above method and using the land use pattern, estimated the Annual Rain Water Harvesting Potential (ARHP) for roof areas, Paved & Non-Paved and greenbelt/open areas. In this calculation of ARHP, the Average Annual Rainfall considered is **864 mm (0.864 m).** The table indicates that there is a tremendous scope to harvest the rain water to the tune of **115,865.9 m^3** within plant premises (Table 5-2), however only **80,834.2 m^3 of quantity is considered** for rain water harvesting plan from the **Catchments 1 to 4** due to the threat of potential contamination of rainwater in Catchment 5.

The formula for calculation for harvesting potential or volume of water received or runoff produced or harvesting capacity is given as:-

Harvesting potential or Volume of water utilized (m3) = Area of Catchment/Roof/Collection Zone (m2) X Amount of rainfall (m) X Runoff coefficient .

Table No. 17: Details of Annual Rain Water Harvesting Potential

S.No.	Catchment No.	Type of Surface	Area Type	Available Area in Sq.mt	Average Annual Rainfall	Annual Quantity of runoff Generated
		Landuse		A	P	KL
1	C1	Roofs	G.I Sheet/RCC	54736.60	0.864	30740.1
2		Roads	C.C/BT	17467.90	0.864	9810.0
3		Earth	Green belt/open	58398.00	0.864	7568.4
		Total ARHP - C1		**130602.50**		**48118.4**
4	C2	Roofs	G.I Sheet/RCC	13048.86	0.864	7328.2
5		Roads	C.C/BT	6191.96	0.864	3477.4
6		Earth	Green belt/open	26123.48	0.864	3385.6

		Total ARHP - C2		**45364.30**		**14191.2**
7	**C3**	**Roofs**	**G.I Sheet/RCC**	**1082.99**	0.864	608.2
8		**Roads**	**C.C/BT**	**4989.40**	0.864	2802.0
9		**Earth**	**Green belt/open**	**38386.39**	0.864	4974.9
		Total ARHP - C3		**44458.79**		**8385.1**
10	**C4**	**Roofs**	**G.I Sheet/RCC**	**4585.46**	0.864	2575.2
11		**Roads**	**C.C/BT**	**5940.52**	0.864	3336.2
12		**Earth**	**Green belt/open**	**32623.80**	0.864	4228.0
		Total ARHP - C4		**43150**		**10139.4**
13	**C5**	**Roofs**	**G.I Sheet/RCC**	**18828.68**	0.864	10574.2
14		**Roads**	**C.C/BT**	**19771.00**	0.864	11103.4
15		**Earth**	**Green belt/open**	**103040.51**	0.864	13354.1
		Total ARHP - C5		**141640**		**35031.6**
Grand Total including the C5 area				**405,216**		**115,865.9**
Grand Total without including the C5 area				**263,576**		**80,834.2**

It is seen from the table that the highest rain water potential is generated from the C-1 to the tune of 48118.4 KL/year, similarly lowest of 8385.1 KL/year from C-3. In the entire Plant, except the C-5 tune of 35031.6 KL/year (Biocompost yard, Treated Effluent and Aeration Tank areas), the total Rain Water Harvesting Potential (RWHP) generated from the four Catchment areas (C1, C2, C3 & C4) would be around **80,834.2 KL/year** which is equivalent to the **134 days** water requirement of the Plant @ **600m^3/day**.

2. Estimation of Peak Runoff Rate

Rainfall analysis is one of the important factors to determine the intensity, duration and frequency of runoff in the project area so that the design of the harvesting structures and drains are determined for the safe carrying of storm water. The analysis of the intensity duration of rainfall over the year in the area has been carried out to arrive at an estimate of Intensity-Duration for given frequencies to establish typical storm profiles as per the rational method, the rainfall intensity has been calculated as below:

Where:

Rainfall Intensity (I) = KTra / (Tc+b)n

I = Rainfall intensity in cm/hr

Tr = Recurrence interval in years

Tc = Time of Concentration in min ($Tc = 0.01947\ (L)^{0.77}\ (S)^{-0.385}$,

Where,

'L'maximum length of travel of water (m),

S slope of the drainage basin

K, a, b & n = Constants as per the Manual on Artificial Recharge of groundwater by CGWB.

$I = 6.31 \times 25^{(0.153)} / (Tc + 0.50)^{(0.95)}$

$Tc = 0.01947\ 0.01947\ (L)^{0.77}\ (S)^{-0.385}$,

$Tc = 0.01947\ 0.01947\ (796)^{0.77}\ (1.63)^{-0.385}$,

Therefore Tc = 2.76 minutes

And, I = 3.359 cm/hr = 33.59 mm /hr (Say 34mm/hour)

In the above calculations, to estimate the rainfall intensity with a duration of 1 hour in the plant area, 25-year return period is considered as per the rational method. For the present area, one hour of the intensity of rainfall is coming to 33.59 mm/hour or 3.359 cm/hour, which is the most reasonable figure to adopt for computation of maximum generation of run-off potential per hour and design of harvesting and recharging structures.

The details of various components involved in peak hourly rainfall computations are given in Table No. 18 below:

Table No. 18: Components involved in the computation of peak hourly rainfall

Description	Details	
Maximum Length of Travel of water in Catchment in (m)	L	796
Slope of the Drainage Catchment in (%)	H	1.63
Time of Concentration – (Minutes)	Tc	2.76
Constants concerning the Southern Zone	K	6.31
	a	0.153
	b	0.5
	n	0.95
Recurrence Interval - Years	Tr	25
Rainfall Intensity for years recurrence interval	cm/hr	3.359
	mm/hr	33.59
Remarks	**Say mm/hr**	**34**

The number of rainy days of NSL Sugars rain gauge station, for the period of 2014 to 2021 have been collected and analyzed for different rainfall intensity like for less than 10 mm, 10 to 20 mm, 20 to 30 mm, 30 to 40 mm etc. up to more than 100 mm and number of days for each class. It is observed that during the period from 2014 to 2021 the rainfall events were found to be occurring for 623 days in 9 years. Out of these, 396 days received less than 10 mm rainfall, 101 days between 10 to 20mm, 52 days between 20 and 30mm, and 37 days between 30 and 40mm. 16 days between 40 to 50mm, 7 days between 50 and 60mm, 7 days between 60 and 70 mm, 8 days between 70 and 80mm, 2 days between 80 and 100 mm and there were no day’s rainfall events more than 100mm rainfall. It is also found that an average of 94% of days have received less than 40 mm rainfall in 9 years (Table 5-4). With this, a maximum of 40 mm is an appreciable rainfall for calculating the peak runoff potential for the area.

A comparison of computations done by the Rainfall Intensity method and a maximum number of days receiving rainfall intensity is 3.4 cm/hour or 34.0 mm/hour are comparable. Since both the figures are similar, the figure arrived by Rainfall Intensity i.e. 3.4 cm/hour is considered for designing the rainwater harvesting structures.

Table No. 19: Intensity of Rainfall vs No of Days of NSL Sugars (2014 to 2021)

Period	2014	2015	2016	2017	2018	2019	2020	2021	Avg No. of days	Max days	Min days
<10 mm	48	50	49	49	35	40	41	82	**49**	**51**	**35**
10-20 mm	11	10	8	12	8	9	16	16	**11**	**16**	**8**
20-30 mm	4	6	1	7	2	12	7	8	**6**	**12**	**1**
30-40mm	4	7	2	8	3	2	2	5	**4**	**8**	**0**
40-50mm	2	0	1	2	2	1	3	3	**2**	**3**	**0**
50-60mm	0	0	1	0	1	0	2	2	**1**	**2**	**0**
60-70mm	1	2	1	0	0	1	0	1	**1**	**2**	**0**
70-80mm	0	1	0	1	2	0	0	1	**1**	**2**	**0**
80-100mm	0	0	0	2	0	0	0	0	**0**	**2**	**0**
>100mm	0	0	0	0	0	0	0	0	**0**	**0**	**0**
Grand Total	**70**	**76**	**63**	**81**	**53**	**65**	**71**	**118**	**74**		

Based on the peak hourly rainfall of 3.4 cm/hour (0.034 m/hour) and areas of different structures like roof areas, paved areas, greenbelt/open areas and an average rainfall of 0.864 m/year, the peak rate of runoff/hour is calculated and presented Table No. 20 for each catchment area of C1 to C5. The table shows runoff generated for peak hourly rainfall is as high as 2315 m^3/hour in catchment C1, 669 m^3/hour in catchment C2, 370 m^3/hour in catchment C3, 458 m^3/hour in catchment C4 and 1594.18 m^3/hour in catchment C5. Accordingly, the dimensions of the harvesting structures and recharge pond has been designed to accommodate and recharge the maximum storm water generated on Plant premises.

Table No. 20: Details Catchment wise of Peak Rate of Runoff in NSL Sugars

S. No.	Catchment No.	Type of Surface	Area Type	Gross Available Area in Sq.mt	1 hour Intensity of Rainfall (from 09 Year)	Peak rate of runoff
		Landuse		A	mm/hr	Cu.m/hr
1	C1	Roofs	G.I Sheet/RCC	54736.60	34	1581.89
2		Roads	C.C/BT	17467.90	34	386.04
3		Earth	Green belt/open	58398.00	34	347.47
		Total ARHP - C1		130602.50		2315.40
4	C2	Roofs	G.I Sheet/RCC	13048.86	34	377.11
5		Roads	C.C/BT	6191.96	34	136.84
6		Earth	Green belt/open	26123.48	34	155.43
		Total ARHP - C2		45364.30		669.39
7	C3	Roofs	G.I Sheet/RCC	1082.99	34	31.30
8		Roads	C.C/BT	4989.40	34	110.27
9		Earth	Green belt/open	38386.39	34	228.40
		Total ARHP - C3		44458.79		369.96
10	C4	Roofs	G.I Sheet/RCC	4585.46	34	132.52
11		Roads	C.C/BT	5940.52	34	131.29
12		Earth	Green belt/open	32623.80	34	194.11
		Total ARHP - C4		43149.77		457.92
13	C5	Roofs	G.I Sheet/RCC	18828.68	34	544.15
14		Roads	C.C/BT	19771.00	34	436.94
15		Earth	Green belt/open	103040.51	34	613.09
		Total ARHP - C5		141640.19		1594.18

Catchment-wise consolidated figures, Annual Rain Water Harvesting Potential (ARHP), and Peak Rate of Runoff (PRR) have been given in Table No. 21.

Thus, out of 100 acres of Plant premises comprised of five catchments, the Annual Rain Water Potential would be around 4949 KL from the Plant area and 458 KL from the Admin and Residential Areas. The peak hourly rainfall intensity of the entire study area is 5407 KL, however ignoring the C-5 area, as mentioned earlier, the peak hourly rainfall intensity would be around 3813 KL .

Therefore, the harvesting structures designed should be able to accommodate 3813 KL of rainwater that falls on the premises on 94% of rainy days that occur in a year. The remaining 6% days though rarely occur as unexpected rainfall events, which are negligible, will go as free flow out of the premises.

Table No. 21: Consolidated Annual Rain Water Harvesting Potential (ARHP) and Peak Rate of Runoff (PRR) Details for each Catchment area

Catchments	Area in Sq.mt	ARHP in KL	PRR in KL
Total ARHP - C1	130602	48118	2315
Total ARHP - C2	45364	14191	669
Total ARHP - C3	44459	8385	370
Sub Total	**220426**	**70694**	**3355**
Total ARHP - C4	43150	10139	458
Sub Total	**43150**	**10139**	**458**
Total ARHP - C5	141640	35032	1594
Sub Total	**141640**	**35032**	**1594**
Grand Total	**405216**	**115866**	**5407**

Quantification

The formula for calculation for harvesting potential or volume of water received or runoff produced or harvesting capacity is given as:-

Harvesting potential or Volume of water utilized (m3) = Area of Catchment/Roof/Collection Zone (m2) X Amount of rainfall (m) X Runoff coefficient .

Year	Value of water consumption to be used for calculation In KL or in m3 (ROUs)
2014	787760
2015	515480
2016	598770
2017	223515
2018	241900
2019	295950
2020	413077
2021	306180
2022	371625
2023	427453
2024	24479
ROUs	**4,206,189**
Final ROUs after applying Uncertainty of 10% considered from 2014 to 2024	**37,85,570.10**

Total RoUs Generated from the unit (for both the scopes)	**7,371,660**
Annual average RoUs Generated from the unit (across both the scopes)	**737,166**

A.14. UWR Rainwater Offset Do No Net Harm Principles

Scope-5

The project activity accomplishes the following:

- Implementation of project activity prevents the release of wastewater directly into nearby river Shimsha which is the crucial step towards greener economy.
- The project activity does not harm any person or environment and it helps in improving the water quality of the area.
- The byproducts are also used as fertilizers by the farmers in nearby areas.
- This creates awareness among the employees and local people to practice such things on their level.

Scope-2

The project activity accomplishes the following:

- Increases the sustainable water yield in areas where over development has depleted the aquifer and water level in surrounding areas.
- The 5 catchments areas are built to collect the rainwater from going into storm drains or sewers and utilise in the facility for different purposes in future.
- This creates awareness among the employees and local people to practice such things on their level

A.15. Scaling Projects-Lessons Learned-Restarting Projects

Scope-5

No Scope of extension observed as of now, by PP.

Scope-2

No Scope of extension observed as of now, except the functioning of catchment-5 proposed by PP.

