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NAGALAND POLLUTION CONTROL BOARD

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Editorial

Throughout history, civilizations have flourished along river banks as rivers provided a steady supply of drinking water and food, provided water for other domestic uses, made the land fertile for growing crops and for easy transportation, thus making it vital for survival. Early civilizations possessed and maintained power through control over access to water.

In the modern world, rivers are as important for the survival of humans and other species just as they were during the ancient times. Rivers are precious sources of drinking water for people around the world. They carry water and nutrients to surrounding areas and play a very important part in the water cycle acting as drainage channels for surface water. Rivers also provide excellent habitat for many organisms and facilitate the growth of various species of plants in its surrounding areas, resulting in vibrant bio-diverse ecosystems which are home to many species.

People depend on rivers for livelihood through fishing and agriculture. Thus maintenance of these resources has a direct impact on people's lives. Ever since the dawn of industrialization, rivers have been used as sources of power for running machinery. In addition, rivers also provide travel routes for exploration, commerce and recreation.

The Dhansiri river is one of the major rivers of Nagaland and while flowing as the boundary between Karbi Anglong and Nagaland, it flanks a large wilderness very rich in wildlife. On one side is the Dhansiri Reserved Forest and on the other Intangki National Park. There are numerous perennially waterlogged swampy regions locally known as bils associated with this river. Point and nonpoint sources of pollution along with anthropogenic pressures affect the lotic ecosystems of the town.

The water quality of the Dhansiri river has been threatened by activities which are mostly man-made. In the absence of a Sewage Treatment Facility, waste water from homes, offices, commercial establishments, small scale industries etc are discharged directly into the river degrading the water quality and posing as a threat to human health and the environment.

The Pollution Abatement of Rivers Dhansiri and Diphu (Chathe), two major rivers in Nagaland is a project approved and sanctioned by Ministry of Environment, Forests & Climate Change under National River Conservation Plan with 25.43 MLD capacity based on Waste Stabilization Pond Technology being carried out by the Public Health Engineering Department in the state through the construction of a Sewage Treatment Plant. In addition to other initiatives chalked out under the action plan for the Rejuvenation of the Dhansiri river, this project provides a ray of hope towards the improvement of the water quality in the Dhansiri river.

River Water Pollution:

Despite its importance for life, fresh water is an extremely rare resource on Earth. Although 71% of the Earth's surface is covered by water, less than 3 percent of the water found on Earth is fresh water, and the remaining 97 percent is salt water. Of freshwater, 69% resides in glaciers, 30% underground, and less than 1% is located in lakes, rivers, and swamps. Only 1% of the water on the Earth's surface is usable by humans, and 99% of the usable quantity is situated underground. This makes the conservation of freshwater resources like rivers even more important as this tiny amount has to provide the fresh water needed to support the Earth's population. Fresh water is thus a precious resource and the increasing pollution of our rivers and lakes is a cause for alarm.

River water has a wide variety of uses such as for drinking water, residential water supplies, agriculture (irrigation), generation of hydro-electricity, transportation and infrastructure, tourism, recreation and others. Rivers also provide habitats for a large number of aquatic plants, fishes, reptiles, birds and mammals. They also host many migratory and threatened species of birds, reptiles and fish, resulting in biodiversity rich ecosystems.

Increase in population, urbanization and industrialization is causing an ever increasing threat to the quality of water in our rivers, affecting ecosystems that thrive in and around rivers. Moving water dilutes and decomposes pollutants more rapidly than standing water, but many rivers and streams are significantly polluted all around the world. Most of the pollution in rivers is caused by the addition of organic material which is mainly sewage but can also include food waste or effluents from farms and agricultural activities. River pollution includes increasing sediment export, excess nutrients from fertilizer or urban runoff, sewage and septic inputs, dumping of waste like plastic, toxins from household cleaning products, pharmaceuticals and personal care products, synthetic chemicals, road salt, inorganic contaminants (e.g., heavy metals), and even heat via thermal pollution.

Effects of Water Pollution:

The severity of pollution in rivers varies from one region to another depending on the density of urban development, agricultural and industrial practices and the availability and efficiency of waste water treatment plants. The effects of pollution often depend on the context and material, but it can reduce ecosystem functioning, limit ecosystem services, reduce stream biodiversity, and impact human health.

Waterborne pathogens in contaminated drinking water in the form of disease-causing bacteria, viruses, protozoa and helminths are major causes of illness and death around the world. Water pollution also has adverse impacts on aquatic life. Toxic chemicals and other waste like plastic are fatal to aquatic organisms when they are consumed as a result of obstruction in the digestive pathways leading to loss of appetite, starvation and choking while pollutants such as heavy metals like lead, cadmium, mercury etc continue to remain the body of these organisms ultimately reaching humans via the food chain. Higher than natural levels of nutrients also get concentrated in fresh water as a result of agricultural run-offs causing a rapid increase in the growth and accumulation of algae. As algal blooms grow, they deplete the oxygen in the water and block sunlight from reaching fishes and plants thus killing off aquatic life. Further, when the algae eventually dies off, the microbes which decompose the dead algae use up even more oxygen, which in turn causes more fish to die or leave the area. Other contaminants, such as herbicides and pesticides, can be toxic to the plants and animals found in rivers. Changes to water

quality can also impact animals in less obvious ways, such as affecting growth and reproduction, which can have long term effects on river health.

Dhansiri & Diphu (Chathe) River

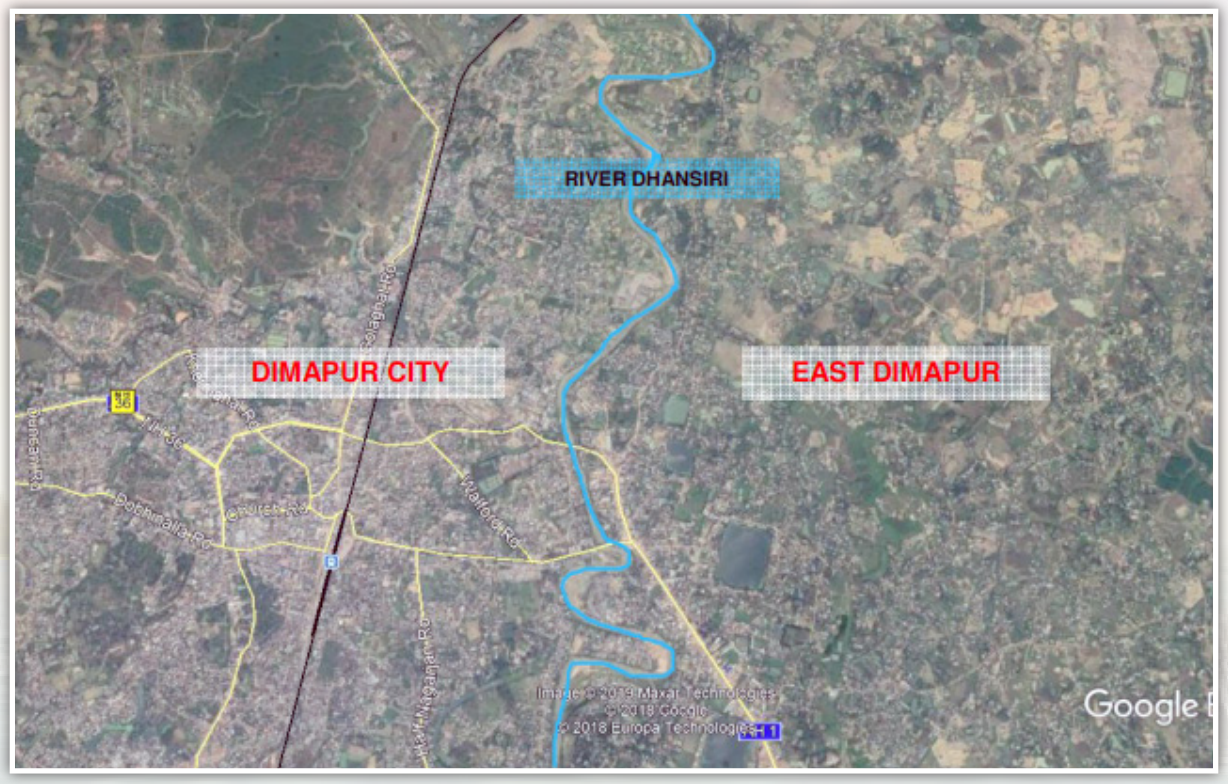
The River Dhansiri originates from the Laisang peak in Peren district and flows through a distance of 352 km (219 miles) from south to north before joining the Brahmaputra on its south bank. It has a total catchment area of 1,220 km² (470 sq miles). For the first 37 kms from the source, the river flows in a north-western direction where after turning to the north-east it flows for about 75.635 kms upto Dimapur, thereafter the direction of flow is generally northerly upto Golaghat, Assam. The river receives almost all the western and southern drainages of Nagaland.

The Diphu (Chathe) River traverses its entire journey through the hills of Nagaland and outflows into the Dhansiri 9.6 km downstream of Dimapur. The length of the river is 48 km.

Map showing the Rivers Dhansiri & Diphu (Chathe) and the catchment areas.

MAJOR TOWNS AND INDUSTRIAL POCKETS IN THE CATCHMENT OF RIVER DHANSIRI

The major towns located on the catchment of River Dhansiri are Dimapur city and East Dimapur. However, the main pollution load comprises after crossing Dimapur city which has a total population of 1,22,834 (2011 census) consisting of 23 administrative wards with 35,000 households, whereas East Dimapur comprises a total population of 27,000.



Map showing Dimapur City & East Dimapur along the catchment of Dhansiri River.

There are no major industrial areas along the catchment of River Dhansiri, however, isolated industries are present in the catchment areas. The water polluting industry along the catchment of River Dhansiri is the M/s Modern Abattoir (Slaughter house) which has an ETP with a total capacity of 50 KLD and the Dimapur District Cooperative Milk Producers' Union Ltd. along the Diphu (Chathe) river which has an ETP with a total capacity of 10 KLD. There is no Common Effluent Treatment Plant (CEFT) in the state of Nagaland.

ETP at M/s Modern Abattoir (Slaughter house)

ETP at Dimapur District Cooperative Milk Producers' Union Ltd.

National Water Monitoring Programme along the Dhansiri River

To understand the value of water quality, and to more effectively manage and protect our water resources, it is critical to know the current status of water-quality conditions, and how and why those conditions have been changing over time. In order to assess the water quality in the state, the Nagaland Pollution Control Board in collaboration with the Central Pollution Control Board under the National Water Quality Monitoring Programme (NWMP) monitors 28 (twenty eight) stations in Nagaland. Four major rivers namely Dhansiri and Chathe at Dimapur, Dzu at Kohima and Milak at Mokokchung are monitored on monthly basis. Groundwater quality sources are monitored from 10 stations on half yearly basis.

The water quality of River Dhansiri and its tributaries is being monitored at six locations on monthly basis by the Nagaland Pollution Control Board under National Water Quality Monitoring Programme (NWMP). The main sources of pollution are sewage/municipal drainage from Dimapur city, improper disposal of solid waste into drains and industrial effluents from small scale industries. In the absence of a waste treatment facility, all sorts of waste and untreated sewage are released randomly into the Dhansiri River.

WATER QUALITY OF DHANSIRI RIVER :

Biochemical Oxygen Demand (BOD) is one of the most common measures of pollutant organic material in water. The BOD measures the oxygen consumed by microorganisms in the oxidation of organic matter under specified incubation period. The Station 1800, Naga Cemetery in Dimapur has reported the highest BOD level at 8.15 mg/l during the year 2019 whereas for designated best use, BOD should be below 3mg/l. The discharge of domestic wastewater/sewage mostly in untreated form and the municipal waste thrown directly into the water bodies/nullahs/drains have been identified as prime contributors for high level of BOD. The other reason for high BOD level may be due to increased run-off from urban and agricultural fields.

The Dissolved Oxygen (DO) is the amount of oxygen present in the water in the dissolved form. In the same nullah/drain at Naga Cemetery, Dimapur the DO level was found low on an average of 1.69 mg/l during the year 2019. As per designated best use, DO should be above 4mg/l. The comparison of annual average of DO and BOD in the upstream and downstream of River Dhansiri from 2016-19 and the water analysis data for all the stations along the river Dhansiri for the year 2019 is shown in the tables given below:

Sl. No	Year	Parameter	River Dhansiri	
			Upstream (Full Nagarjan 1796)	Downstream (Nagaland-Assam Border-1928)
1	2016	Dissolved Oxygen (mg/l)	4.26	3.38
		Biochemical Oxygen Demand (mg/l)	3.5	8
2	2017	Dissolved Oxygen (mg/l)	4.77	4.46
		Biochemical Oxygen Demand (mg/l)	3.39	5.15
3	2018	Dissolved Oxygen (mg/l)	5.83	5.66
		Biochemical Oxygen Demand (mg/l)	2.15	3.87
4	2019	Dissolved Oxygen (mg/l)	5.72	5.77
		Biochemical Oxygen Demand (mg/l)	1.76	3.21

Station Code	Location	District	Type	Latitude	Longitude	Monitoring Frequency
1796	Full Nagarjan	Dimapur	R	25^{0}53.21′	93^{0}44.15′	M
1797	Bridge near Purana Bazar	Dimapur	R	25^{0}54.77′	93^{0}44.58′	M
1798	Near Check Gate (Dimapur-Khatkhati Road)	Dimapur	R	25^{0}55.66′	93^{0}44.832′	M
1799	Town Boundary Bridge (Diphu Road)	Dimapur	R	25^{0}54.22′	93^{0}40.90′	M
1800	NutonBasti (Naga Cemetery)	Dimapur	R	25^{0}55.28′	93^{0}43.49′	M
1928	Nagaland-Assam Border	Dimapur	R	25^{0}557.11′	93^{0}45.46′	M

Water Analysis Report showing Average Value of different parameters during the year 2019 is given below:

Sl. No.	Parameters	Station Code					
		1796	1797	1798	1799	1800	1928
1	Dissolved Oxygen (mg/l)	5.72	5.73	5.74	5.58	1.69	5.77
2	pH	7.74	7.34	7.50	7.57	7.10	7.47
3	Conductivity (µS/cm)	171.8	222.9	188.1	170.8	272.1	196.3
4	BOD (mg/l)	1.76	2.29	2.49	1.92	8.15	3.21
5	Nitrate- Nitrogen (mg/l)	0.56	0.70	0.70	0.65	0.87	0.69
6	Turbidity (NTU)	44.0	39.1	38.0	67.5	15.8	43.3
7	Phenolphthalein Alkalinity (mg/l)	1.33	1.33	0.67	1.00	0.33	1.00
8	Total Alkalinity (mg/l)	104.3	121.5	100.2	116.5	145.9	99.8
9	Chloride (mg/l)	12.7	11.3	12.3	9.9	24.0	13.5
10	Chemical Oxygen Demand (mg/l)	61.8	44.5	35.6	29.8	64.7	45.9
11	Ammonia Nitrogen (mg/l)	0.20	1.08	0.38	0.18	2.74	0.69
12	Total Hardness (mg/l)	75.2	87.2	77.8	73.0	77.5	78.0
13	Calcium Hardness (mg/l)	37.7	40.5	38.3	38.7	44.5	38.8
14	Magnesium Hardness (mg/l)	9.7	11.3	9.6	8.4	8.0	9.5
15	Sulphate	23.13	21.87	23.07	23.60	11.93	21.40
16	Total Dissolved Solids (mg/l)	89.9	105.7	86.4	92.2	124.5	98.1
17	Total Suspended Solids(mg/l)	35.56	37.56	32.72	35.64	40.69	34.92
18	Phosphate (mg/l)	0.39	0.18	0.27	0.21	0.49	0.22
19	Boron (mg/l)	0.04	0.05	0.05	0.04	0.05	0.04
20	Potassium (mg/l)	4.16	5.01	4.76	4.73	7.75	4.59
21	Fluoride (mg/l)	0.09	0.08	0.19	0.16	0.09	0.23
22	Arsenic (mg/l)	0	0	0	0	0	0
23	Cadmium (mg/l)	0.02	0.02	0.02	0.04	0.01	0.02
24	Copper (mg/l)	0.25	0.17	0.19	0.27	0.08	0.19

Sl. No.	Parameters	Station Code					
		1796	1797	1798	1799	1800	1928
25	Lead (mg/l)	0.10	0.09	0.11	0.12	0.09	0.11
26	Chromium (mg/l)	0.015	0.015	0.02	0.025	0.02	0.02
27	Nickel	0.24	0.23	0.26	0.34	0.14	0.28
28	Zinc (mg/l)	0.42	1.18	0.90	0.15	0.26	1.04
29	Iron (mg/l)	0.69	0.52	0.58	2.96	1.32	0.71
30	Saprobic Score	-	-	-	-	-	3.4
31	Diversity Score	-	-	-	-	-	0.5
32	Water Quality	-	-	-	-	-	Moderate
33	Water Quality Class	-	-	-	-	-	C
34	Indicator Colour	-	-	-	-	-	Green

Suggested Criteria for Irrigation, Wildlife and Survival of Fish

Sl. No	Parameters	Class 'B' (Outdoor Bathing Criteria)	Class 'D' Water Quality Criteria- for Propagation of Wildlife & Fish	Class 'E' Water Quality Criteria for Irrigation
1	pH	6.5 to 8.5	6.5 to 8.5	6 to 8.5
2	Dissolved Oxygen (DO)	5 mg/l or more	≥ 4.0 mg/l	-
3	Sodium Absorption Ration	-	-	≤ 26
4	Boron	-	-	≤ 26
5	Free Ammonia	-	≤ 1.2 mg/l	-
6	Electrical Conductivity at 250C µmhos/cm	-	-	≤ 2250
7	BOD	3 mg/l	-	-
8	Faecal Coliform	500 MPN/100 ml	-	-

The polluted locations in a continuous sequence are defined as polluted river stretches and categorised in five priority classes based on BOD concentration exceeding to BOD levels >30 mg/l, BOD between 20 & 30 mg/l, BOD between 10&20mg/l, BOD between 6-10 mg/l and BOD between 3& 6 mg/l. Based on the water quality data for the year 2016, 2017 and 2018 which was submitted to the Central Pollution Control Board (CPCB), in Nagaland, River Dhansiri has been identified as polluted river stretches under Priority I based on high concentration of BOD, the details of which is given below in the Table below:

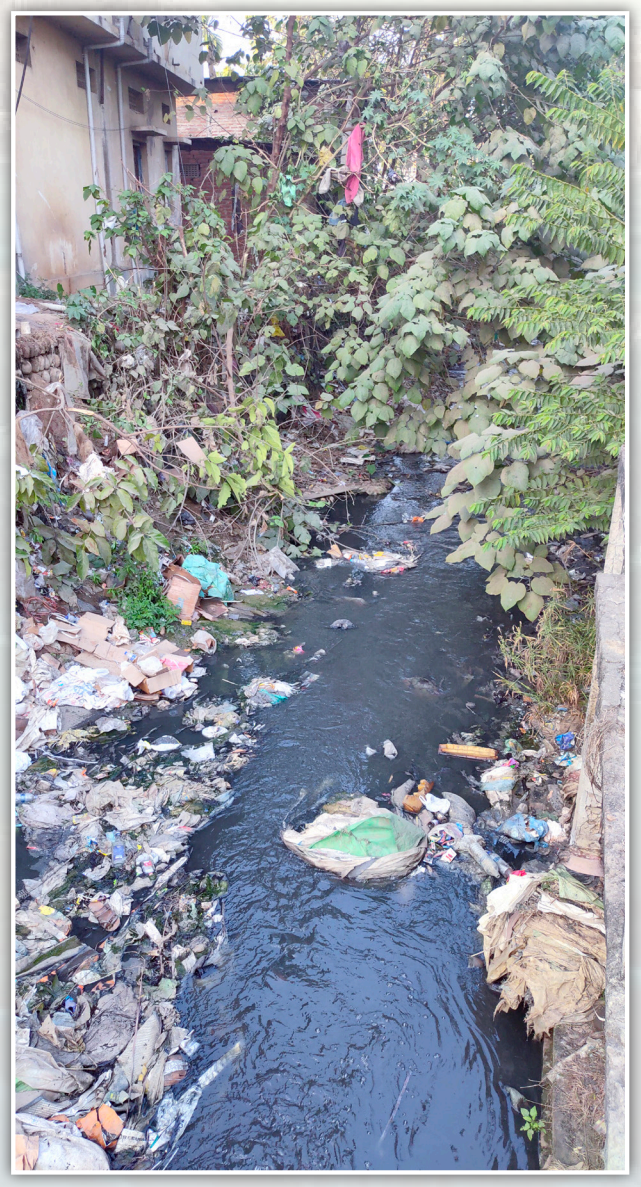
Name of the river/stream	Details	Identified polluted stretches	BOD range	Priority wise
Dhansiri	River Dhansiri originates from Laisang peak in Peren district and flows through Dimapur. It flows through a distance of 352 km from south to north before joining River Brahmaputra.	Polluted stretches are tributaries & drains of Dhansiri and downstream of Dimapur city.	30 mg/l	I

There is no underground planned sewerage system in Dimapur and similar situation exist in other towns of the state, thus sewage management is being done with natural slope in open drain system leading to valleys. Means of night soil disposal is mostly through septic tanks, two pit privies. There are 3 major drains contributing to the pollution load in the River Dhansiri which finally merges into River Dhansiri, the details are mentioned in the table given below.

Details of the major drains contributing to river Dhansiri

Sl. No	Details of Drain and Code	Latitude	Longitude	Altitude	Location
1	Hospital Nullah (HN)	25˚54.763'N	093˚44.584'E	126 m	Near Purana bazaar bridge
2	Lengri Nullah (LN)	25˚55.922'N	093˚44.359'E	126 m	Below bridge, near slaughter house
3	Sugarmill Nullah (SGN)	25˚55.194'N	093˚45.036'E	133 m	Near Darogajan gate

Hospital Nullah (upstream)



Lengri Nullah

Analysis reports of different parameters for the three major drains.

Sl. No	Parameter	Hospital Nullah	Lengri Nullah	Sugarmill Nullah
1	Depth	23	28	27
2	Colour	Clear	Clear	Clear
3	Odour	Unpleasant	Septic	Unpleasant
4	Velocity (m/s)	0.3	0.28	0.32
5	Water Temperature (°C)	29.6	26.8	25.4
6	Air Temperature(°C)	25.7	25	25.9
7	Dissolved Oxygen (mg/l)	4	0.8	3.04
8	pH	7.3	6.9	7.1
9	Conductivity (µS/cm)	325	559	344
10	Biochemical Oxygen Demand (mg/l)	6.4	8.28	5.02
11	Nitrate-Nitrogen (mg/l)	0.7	0.8	0.7
12	Turbidity (NTU)	46	15.65	9.63
13	Phenolphthalein Alkalinity (mg/l)	0	0	0
14	Total Alkalinity (mg/l)	238	384	232
15	Chemical Oxygen Demand	92	63	89
16	Ammonia-Nitrogen (mg/l)	3.2	3.23	1.97
17	Total Hardness (mg/l)	84	88	108
18	Calcium Hardness (mg/l)	40	70	72
19	Magnesium Hardness (mg/l)	10.37	4.39	8.78
20	Total Dissolved Solids (ppm)	143	258	163
21	Total Suspended Solids (mg/l)	0.26	0.18	0.12
22	Phosphate (mg/l)	0.48	1.5	0.47
23	Boron (mg/l)	0.06	0.08	0.07
24	Potassium (mg/l)	7.6	11.7	17.1
25	Fluoride (mg/l)	0.07	0.08	0.06

The discharge from the 3 major drains of River Dhansiri is given below:

Sl. No	Drains	Discharge	
		Peak Discharge	Lean Discharge
1	Hospital Nullah (HN)	0.035	0.02
2	Lengri Nullah (LN)	0.089	0.06
3	Sugarmill Nullah (SGN)	0.05	0.025

Waste Water Treatment and its importance:

In simple words, wastewater is any form of water that has been contaminated by a commercial or domestic process. Waste water or sewage contains waste water from kitchens, toilets, sinks, showers, washing machines and industrial processes and can be a mixture of faeces, food particles, toilet paper, grease, oil, soap, salts, metals, detergents, sand and grit. Discharging of these contents directly into natural water bodies can be detrimental to aquatic life, human health and the environment. Therefore it is important to treat waste water before it is discharged into natural water bodies like ponds, lakes, rivers etc.

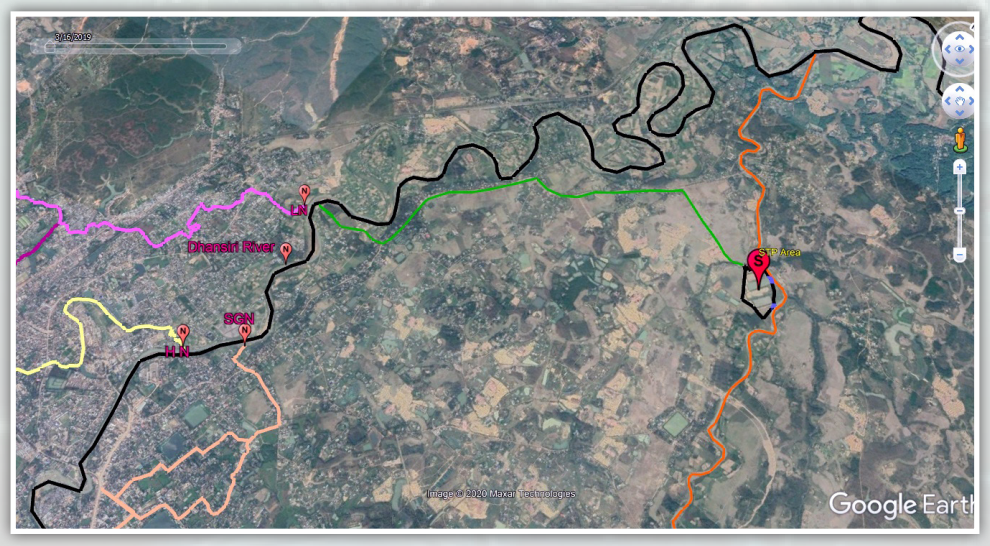
The process of removing contaminants from waste water or sewage and convert it into an effluent that can be returned to the water cycle with minimal impact on the environment or reused for various other purposes is called waste water treatment or sewage treatment. The treatment process takes place in a Waste Water Treatment Plant (WWTP), also referred to as a Water Resource Recovery Facility (WRRF) or a Sewage Treatment Plant (STP) in the case of domestic wastewater. Pollutants in wastewater are removed, converted or broken down during the treatment process. A by-product of sewage treatment is a semi-solid waste or slurry, called sewage sludge which has to undergo further treatment before being suitable for disposal or application to land.

POLLUTION ABATEMENT OF RIVERS DHANSIRI AND DIPHU (CHATHE)

The major town attributing to River Dhansiri are Dimapur town and East Dimapur which are the main contributors of pollution load. Dimapur town has a total population of about 1,22,834 (2011 census) and the population is expected to grow 2,71,350 by 2035, whereas, East Dimapur has a population of 27,000 which is expected to grow by 59,644. Main source of water supply for this two towns are groundwater supply i.e. ring wells and bore wells. Considering, water supply is consumed at 135 LPCD, the sewage flow is considered as 80% of the net water supplied to the consumer which accounts to waste water generation of 16.19 MLD.

Presently, there are no STPs in Dimapur city, however, a project "Pollution abatement of rivers Diphu & Dhansiri" was approved and sanctioned by Ministry of Environment, Forests & Climate Change under National River Conservation Plan with 25.43 MLD capacity based on Waste Stabilization Pond Technology which will be implemented and 44% of the physical work is completed by the Public Health Engineering Department. Presently, the total sewage generation consisting of both Dimapur town and East Dimapur is about 16.19 MLD.

MAP SHOWING DHANSIRI RIVER AND ITS TRIBUTARY (DIPHU RIVER) ,MAJOR DRAINS (POLLUTING SOURCE) AND LOCATION OF SEWAGE TREATMENT PLANT OF ONGOING SEWERAGE SCHEME



LEGEND

- Dhansiri River
- Diphu River
- Hospital Nalla
- Lengri Nalla
- Main Sewer line to STP

HN : Hospital Nalla
SGN : Sugar Mill Nall
LN : Lengri Nalla
STP : Sewage Treatment Plant

Concept and Design:

The main objective of the project of Pollution Abatement of Rivers Dhansiri and Diphu (Chathe) being taken up by the Public Health Engineering Department of Nagaland is interception, diversion and treatment of waste water flowing into the river so as to prevent and control organic pollution loadings on Rivers Dhansiri and Diphu.

So far, the excavation and construction of the treatment plant has been completed and the main sewer pipeline has been laid. The interception and diversion works are in progress and the project is expected to be completed by next year i.e.2021

Laying of the main sewer trunk

Waste stabilization ponds are large man-made basins in which sewage water can be treated by naturally occurring processes and the influence of micro-organisms to an effluent of relatively high quality and apt for reuse in agriculture (e.g. irrigation) or aquaculture.Waste stabilization ponds are ponds designed and built for waste water treatment to reduce the organic content and remove pathogens from waste water. Waste water enters on one side of the waste stabilization pond and exits on the other side as "effluent", after spending several days in the pond, during which treatment processes take place. Waste stabilization ponds are efficient in their primary objective of removing organic matter and pathogenic organisms. These ponds are simple to design, build, operate and maintain, which is very important in remote areas and in developing countries where sophisticated equipment and highly skilled labour is not easily available.

The system may consist of a single pond or several ponds in a series, each pond playing a different role in the removal of pollutants. After treatment, the effluent may be returned to surface water or reused as irrigation water (or reclaimed water) if the effluent meets the required effluent standards (e.g. sufficiently low levels of pathogens).

Under the project carried out by the Public Health Engineering Department of Nagaland, the Sewage Treatment Plant consists of a series of Waste Stabilization Ponds and occupies a total area of 22.5 hectares. The configuration of the Waste Stabilization Ponds consists of an anaerobic pond followed by two facultative ponds followed by two maturation ponds. Part of the suspended solids from the waste water settles in the anaerobic pond and some of the dissolved organic matter is removed by anaerobic bacteria. The anaerobic pond is designed to be deeper than the facultative and maturation ponds with a depth of 5 meters so that anaerobic bacteria can efficiently digest the waste. Anaerobic ponds contain anaerobic organisms which are able to break down complex organic waste into basic compounds that are less harmful to the environment. Anaerobic ponds also allow solids to settle down at the bottom as sludge. This settling removes a portion of the particulate organic material.

Anaerobic Pond

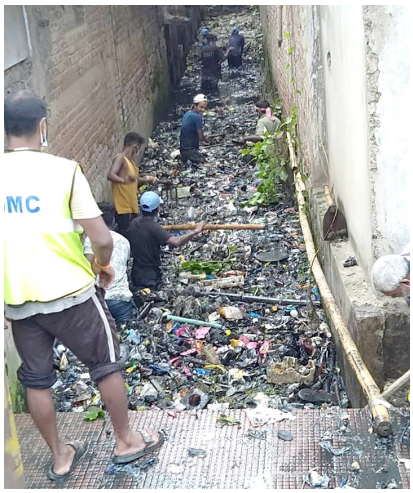
During the second stage in the facultative pond both aerobic and anaerobic bacteria are present and most of the remaining contaminants are removed after which the treated water reaches the maturation ponds. The facultative ponds have a depth of 2-2.5 metres and the detention time for the water is 7 days. The maturation ponds contains aerobic bacteria and are shallow with a depth of 1 meters and in this stage, the water has a detention time of 10 days.

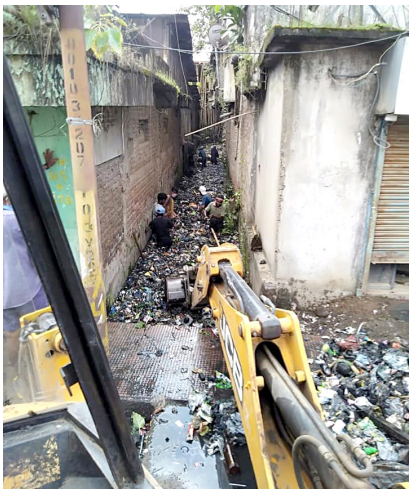
Facultative Pond

Maturation Pond

Cleaning of Drains in Dimapur Area – Dimapur Municipal Council Sanitation team

Dumping waste into drains has become a menace as wastes like plastic bags, bottles, foodwaste etc clogs the drains, pose as an eyesore, cause waste water to over flow into the roads during the rainy season and becomes a breeding ground for disease causing agents. There is a need for the public to cooperate with authorities and have a sense of responsibility towards keeping the environment clean. The Sanitation Team of the Dimapur Municipal Council, under the guidance of the DMC Administrator Shri. Albert Ezung cleaned the clogged drains along GS Road Dimapur on 30th September 2020 wherein the Administrator also appealed to the public not to throw garbage into the drains.





Cleaning of Drains by the Dimapur Municipal Council Sanitation Team

All queries and feedback regarding this newsletter can be sent to:
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