सी.एस.आई.आर. - राष्ट्रीय पर्यावरण अभियांत्रिकी अनुसंधान संस्थान
CSIR-National Environmental Engineering Research Institute
(वैज्ञानिक तथा औद्योगिक अनुसंधान परिषद / Council of Scientific & Industrial Research)
हैदराबाद क्षेत्रीय केंद्र / Hyderabad Zonal Centre
(वैज्ञानिक तथा औद्योगिक अनुसंधान विभाग, विज्ञान एवं प्रौद्योगिकी मंत्रालय, भारत सरकार के अंतर्गत स्वायत्त संगठन)
(Autonomous Organization under the Dept. of Scientific and Industrial Research, Ministry of Science & Technology, Govt. of India)

No. HZC/VB-Valley/2021/478
May 24th, 2021

To
The Executive Engineer
SWD, R.R. Nagara zone
Bruhat Bangalore Mahanagara Palike
9th floor, Jayanagara shopping Complex
4th Block, Jayanagara
Bangalore – 560011

Sub: Restoration and rejuvenation of Vrushabhavathi River Valley, Bengaluru – Submission of Interim Report – reg.

Ref: Work Order No.: EE/SWD/RR-Z/WO/20/2020-21 Dated 13.11.2020

Dear Sir,

With reference to the aforementioned subject, please find enclosed the interim report for the project entitled "**Restoration and rejuvenation of Vrushabhavathi River Valley, Bengaluru**" for your kind perusal.

Thanking you,

Yours faithfully,

(Encl: As Above)

(S Basha)
डॉ. शेक बाशा
Dr. Shaik Basha
वैज्ञानिक तथा प्रमुख / Scientist & Head
सीएसआईआर-नीरी क्षेत्रीय केंद्र
CSIR-NEERI Zonal Centre
तारनाका, हैदराबाद / Tarnaka, Hyderabad-7

आई.आई.सी.टी. परिसर, तारनाका, हैदराबाद - 500007, तेलंगाना राज्य, भारत IICT Campus, Tarnaka, Hyderabad-500007, Telangana State, INDIA
दूरभाष / Phone: +91-40-27160122, 27160441 टेलीफैक्स / Telefax: +91-40-27160639 ई-मेल / E-mail: hzl@neeri.res.in

सी.एस.आई.आर. - राष्ट्रीय पर्यावरण अभियांत्रिकी अनुसंधान संस्थान
CSIR-National Environmental Engineering Research Institute
(वैज्ञानिक तथा औद्योगिक अनुसंधान परिषद / Council of Scientific & Industrial Research)
हैदराबाद क्षेत्रीय केंद्र / Hyderabad Zonal Centre
(वैज्ञानिक तथा औद्योगिक अनुसंधान विभाग, विज्ञान एवं प्रौद्योगिकी मंत्रालय, भारत सरकार के अंतर्गत स्वायत्त संगठन)
(Autonomous Organization under the Dept. of Scientific and Industrial Research, Ministry of Science & Technology, Govt. of India)

INTERIM REPORT

RESTORATION AND REJUVENATION OF VRUSHABHAVATHI RIVER VALLEY, BENGALURU

Sponsor: Bruhat Bengaluru MahanagaraPalike (BBMP), Bengaluru

CSIR-NATIONAL ENVIRONMENTAL ENGINEERING RESEARCH INSTITUTE (NEERI)
HYDERABAD ZONAL CENTRE, HYDERABAD-500007

May 2021

डॉ. शेक बाशा
Dr. Shaik Basha
वैज्ञानिक तथा प्रमुख / Scientist & Head
सी.एस.आई.आर.-नीरी क्षेत्रीय केंद्र
CSIR-NEERI Zonal Centre

आई.आई.सी.टी. परिसर, तारनाका, हैदराबाद - 500007, तेलंगाना राज्य, भारत IICT Campus, Tarnaka, Hyderabad-500007, Telangana State, INDIA
दूरभाष / Phone: +91-40-27160122, 27160441 टेलीफैक्स / Telefax: +91-40-27160639 ई-मेल / E-mail: hzc@neeri.res.in
तारनाका, हैदराबाद / Tarnaka, Hyderabad-7

Project Personnel

CSIR-NEERI, Hyderabad Zonal Centre

Dr. T.V.B.P.S. Rama Krishna
Dr. Meganathan. P. R
Mr. S. Harirama Kumar
Mr. Shaik Fareed
Mr. P. Ramulu
Ms. Akanksha
Ms. Yeshwitha
Mr. Ibrahim Ali
Ms. Vincy
Mrs. Morami Kalita
Mrs. M. Sumathi
Mr. K. Yadagiri
Ms. P. Priyanka
Ms. K. Dhanasri
Ms. Yashaswitha
Ms. Anjani M
Mr. Vinay
Ms. Navyaka

Administrative Staff

Mr. T. Janaradhana Rao
Mr. P. Prasad
Mr. M. Vinaya Raju

CSIR-NEERI, Chennai Zonal Centre

Dr. G. Saravanan
Dr. T. Rajesh

Project Leader(s)

Dr. Shaik Basha
Ms. Ramya S

Project Coordinator

Dr. S. Chandrasekhar
Director, CSIR-NEERI, Nagpur

डॉ. शेक बाशा
Dr. Shaik Basha
वैज्ञानिक तथा प्रमुख / Scientist & Head
सीएसआईआर-नीरी क्षेत्रीय केंद्र
CSIR-NEERI Zonal Centre
तारनाका, हैदराबाद / Tarnaka, Hyderabad-7

ABBREVATIONS

APHA	American Public Health Association
BDL	Below Detection Limit
BIS	Bureau of Indian Standards
BOD	Biochemical Oxygen Demand
CFU	Colony Forming Unit
COD	Chemical Oxygen Demand
DO	Dissolved Oxygen
DPR	Detailed Project Report
EC	Electrical Conductivity
GIS	Geographical Information System
APPCB	Andhra Pradesh Pollution Control Board
MPN	Most Probable Number
Ppm	Parts Per Million
sq.km	Square Kilometer
STP	Sewage Treatment Plant
Sy.No.	Survey Number
TDS	Total Dissolved Solids
TSS	Total Suspended Solids
µg	Microgram
µS	Micro Siemens

डॉ. शेक बाशा
Dr. Shaik Basha
वैज्ञानिक तथा प्रमुख / Scientist & Head
सीएसआईआर-नीरी क्षेत्रीय केंद्र
CSIR-NEERI Zonal Centre
तारनाका, हैदराबाद / Tarnaka, Hyderabad-7

Chapter 1

Introduction

डॉ. शेक बाशा
Dr. Shaik Basha
वैज्ञानिक तथा प्रमुख / Scientist & Head
सीएसआईआर-नीरी क्षेत्रीय केंद्र
CSIR-NEERI Zonal Centre
तारनाका, हैदराबाद / Tarnaka, Hyderabad-7

1.0 Preamble

Bangalore, the 'Garden city' of India, dotted with numerous lakes in the absence of rivers close by. Kempe Gowda, the founder of Bangalore and his successors built more than hundred lakes and tanks in the city by damming the natural valley system with constructive bund. The city has undulating topography with three major valleys (Vrishabhavathi (VB) Valley, K&C Valley, Hebbal Valley) and minor valleys. Vrishabhavati, is a tributary of Arkavathi that originates in Bengaluru near the Bull Temple in Basavanagudi and flows through major areas like Guddadahalli, Bapujinagar, Rajarajeshwari Nagar, Kengeri before it meets Arkavathi near Kanakapura town. The River carries domestic sewage from Bengaluru city and industrial effluents from Peenya, Yeshwanthpura, Kumbalgodu, Bidadi and Harohalli Industrial areas. Vrishabhavathi Valley has a length of approximately 317 km with all the primary drains, secondary drains and tertiary drains leading to the Kaveri basin and has a catchment area of 169 km^2.

Vrishabhavati, is a tributary of Arkavathi that originates in Bengaluru near the Bull Temple in Basavanagudi and flows through major areas like Guddadahalli, Bapujinagar, Rajarajeshwari Nagar, Kengeri before it meets Arkavathi near Kanakapura town. The River carries domestic sewage from Bengaluru city and industrial effluents from Peenya, Yeshwanthpura, Kumbalgodu, Bidadi and Harohalli Industrial areas.

The Vrishabhavati catchment has about 70 lakes during the early 1970's which has now reduced to approx. 35 as on 2017. Most of the lakes have been filled and converted into residential/industrial areas, the streams/raj kaulveys are narrowed by dumping construction debris, solid wastes thereby increasing instances of floods, mortalities in monsoons. The valley has current treatment capability of 265 MLD (working) and 80 MLD (under construction) which is insufficient to treat the domestic waste.

A PIL has been filed vide no. W.P. No. 6961/2020 dated 12.10.2020 by Honourable High Court of Karnataka in respect of pollution caused to Vrishabhavathi River Valley in the jurisdiction of Bengaluru city. After hearing the PIL, Honourable High Court of Karnataka had given directions to appoint CSIR-National Environmental Engineering Research Institute (NEERI) to study the causes/reasons of pollution to Vrishabhavathi River Valley and methodology to be adopted for its protection, restoration and rejuvenation.

डॉ. शेक बाशा
Dr. Shaik Basha
वैज्ञानिक तथा प्रमुख / Scientist & Head
सीएसआईआर-नीरी क्षेत्रीय केंद्र
CSIR-NEERI Zonal Centre

1.1 Objectives

- To study the causes of pollution to Vrishabhavathi River Valley
- To ascertain the quantum of pollutants at various locations in the Vrishabhavathi River Valley
- To suggest the methodology for prevention of pollutants entering the Vrishabhavathi River Valley
- To suggest short term and long term measures for the protection, restoration and rejuvenation of Vrishabhavathi River Valley
- Any other technological interventions needed for the protection, restoration and rejuvenation of Vrishabhavathi River Valley

1.2 Scope of Work and Methodology

In accordance with the terms of reference for the study in consonance with the directions of Honourable High Court of Karnataka in its order W.P No. 6961/2020 dated 12.10.2020 are as follows. The study will be carried out as per the following scope of work:

- Reconnaissance of the VB River valley watershed
- Studies on the status of primary, secondary and tertiary drains in the valley will be conducted
- Delineation of the watershed on 1: 50,000 scale on survey of India toposheet on GIS platform
- Preparation of the thematic maps in GIS platform depicting the various drains and the lakes etc
- Collection of the secondary data viz., the quantities and the qualities of the effluents discharges by the respective industries to the drains etc
- To prepare the landuse/land cover maps and study the detection of the changes in landuse of the VB valley over time

डॉ. शेक बाशा
Dr. Shaik Basha
वैज्ञानिक तथा प्रमुख / Scientist & Head
सीएसआईआर-नीरी क्षेत्रीय केंद्र
CSIR-NEERI Zonal Centre
तारनाका, हैदराबाद / Tarnaka, Hyderabad-7

- Present status of lakes in the valley will be studied including primary data on the same will be generated. In addition, the information/data generated for the Bengaluru lakes project will also be utilized to ascertain the current status of the lakes in the VB valley.
- To study the status of sediments in the drains to understand the quantum of pollutants in the drain
- To ascertain the quantum of pollutants at various locations and the causes of pollution of VB River valley watershed
- Suitable methodology and approach for prevention of pollutants entering various drains in the Valley will be delineated
- Both short term and long-term measures for protection, restoration and rejuvenation of the VB River valley will be suggested.
- Various technological interventions such as STPs and biological treatment systems required for restoration of water quality of drains and lakes in the valley will studied and suitable cost effective systems will be proposed.

1.3 Layout of the report

The report is presented in the following structure:

Chapter 1: Introduction (this chapter)

Chapter 2: Description of Study Area

Chapter 3: VrIshabhavathi Valley: Present Status

Chapter 4: Short term and long term measures

डॉ. शेक बाशा
Dr. Shaik Basha
वैज्ञानिक तथा प्रमुख / Scientist & Head
सीएसआईआर-नीरी क्षेत्रीय केंद्र
CSIR-NEERI Zonal Centre
तारनाका, हैदराबाद / Tarnaka, Hyderabad-7

Chapter 2

Description of the study area

(Source: Central Groundwater Board (CGWB) Report)

डॉ. शेक बाशा
Dr. Shaik Basha
वैज्ञानिक तथा प्रमुख / Scientist & Head
सीएसआईआर-नीरी क्षेत्रीय केंद्र
CSIR-NEERI Zonal Centre
तारनाका, हैदराबाद / Tarnaka, Hyderabad-7

2.0 Introduction

The study area falls in the Survey of India Toposheet Nos.57G/8, 57G/12, 57H/5 and 57H/9 and lies in between the latitudes N 12° 50' 00" to N 13° 04' 00" and longitudes E 77° 26' 00" to E 77° 36' 00". The VrIshabhavathi Valley has been demarcated in the toposheets showing all the drains and the lakes. The location of the study area is shown in the Figure 2.1.

2.1 Climate and Rainfall

The rainfall in the area is mainly from pre-monsoon, South-west monsoon and North-East monsoon. Majority of the rainfall is contributed by SW Monsoon. The climatic conditions prevailing in the area are humid to semi-arid. The temperature on an average is 23.1˚C. The highest and lowest annual rainfall is1157mm and 890mm, respectively.

2.2 Geology

The major geology of the area constitutes the Granites and Gneisses of peninsular gneissic group. Laterites of Tertiary age occur as isolated patches capping crystalline rocks in Bangalore north taluk and ground water occur in phreatic condition. Alluvium of limited thickness and aerial extent of 20 to 25m thick occur along the river courses possessing substantial ground water potential.

2.3 Soils

Red loamy and sandy soils generally occur on hilly to undulating land slope on granite and gneissic terrain. The soils are light textured and are highly leached in nature with good infiltration rate. It is mainly seen in the eastern and southern parts of Bangalore north and south taluks. Laterite soils occur on undulating terrain forming plain to gently sloping topography of peninsular gneissic region. It is mainly covered in Anekal taluk and western parts of Bangalore North and south taluks.

डा. शेक बाशा
Dr. Shaik Basha
वैज्ञानिक तथा प्रमुख / Scientist & Head
सीएसआईआर-नीरी क्षेत्रीय केंद्र
CSIR-NEERI Zonal Centre
तारनाका, हैदराबाद / Tarnaka, Hyderabad-7

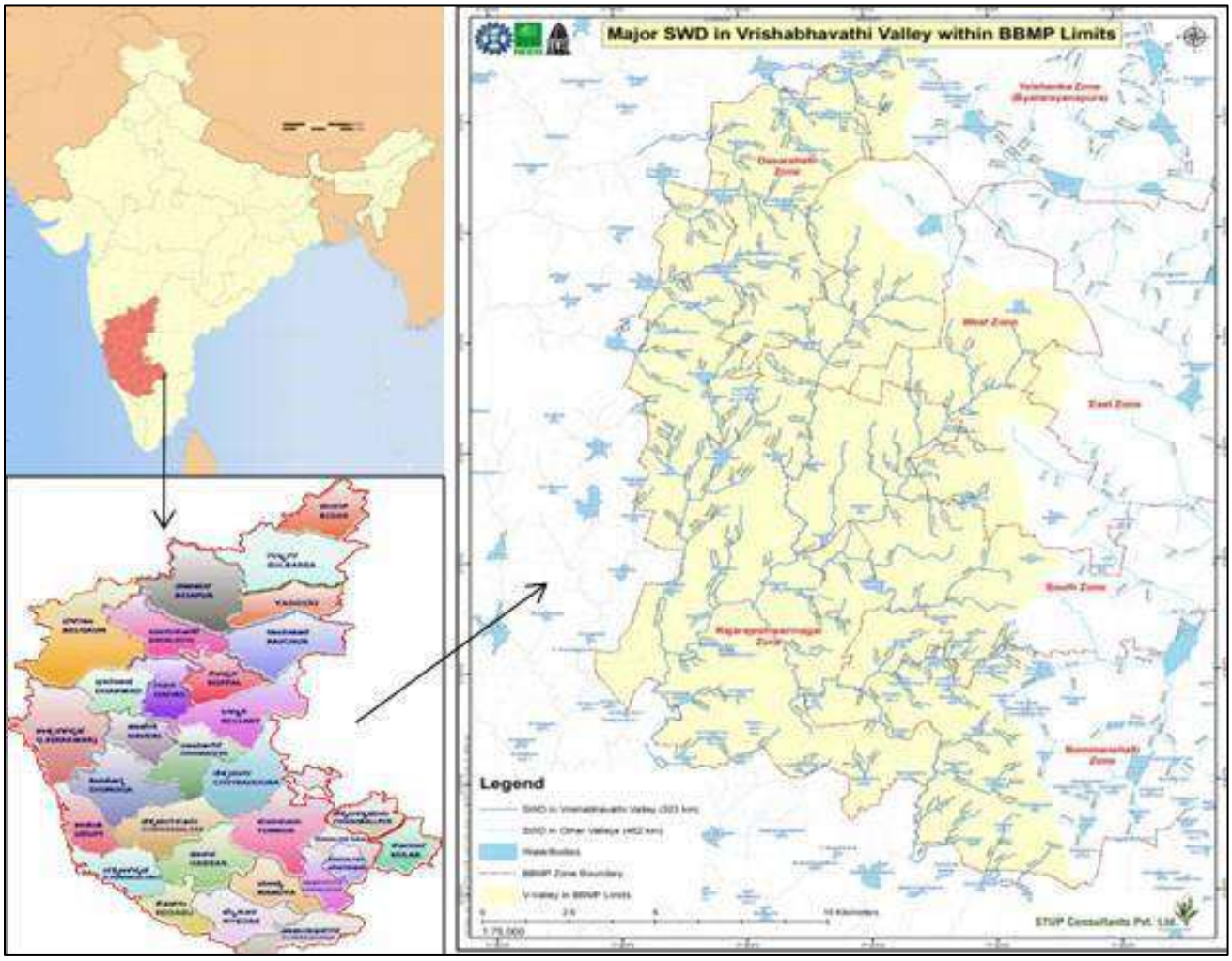


Fig. 2.1: Location of the study area

डॉ. शेक बाशा
Dr. Shaik Basha
वैज्ञानिक तथा प्रमुख / Scientist & Head
सीएसआईआर-नीरी क्षेत्रीय केंद्र
CSIR-NEERI Zonal Centre
तारनाका, हैदराबाद / Tarnaka, Hyderabad-7

सी.एस.आई.आर. - राष्ट्रीय पर्यावरण अभियांत्रिकी अनुसंधान संस्थान
CSIR-National Environmental Engineering Research Institute
(वैज्ञानिक तथा औद्योगिक अनुसंधान परिषद / Council of Scientific & Industrial Research)
हैदराबाद क्षेत्रीय केंद्र / Hyderabad Zonal Centre
(वैज्ञानिक तथा औद्योगिक अनुसंधान विभाग, विज्ञान एवं प्रौद्योगिकी मंत्रालय, भारत सरकार के अंतर्गत स्वायत्त संगठन)
(Autonomous Organization under the Dept. of Scientific and Industrial Research, Ministry of Science & Technology, Govt. of India)

Chapter 3

Vrishabhavathi Valley: Present Status

डॉ. शेक बाशा
Dr. Shaik Basha
वैज्ञानिक तथा प्रमुख / Scientist & Head
सीएसआईआर-नीरी क्षेत्रीय केंद्र
CSIR-NEERI Zonal Centre
तारनाका, हैदराबाद / Tarnaka, Hyderabad-7

3.0 Introduction

Vrishabhavathi Valley within the BBMP limits has a catchment area of ~170 sq.km, covering nearly 97 Wards of Bengaluru. Vrishabhavathi river catered domestic (drinking water, bathing, etc.) and agricultural needs of West Bengaluru before the industrial evolution in the city (mid of 1970's). The river had numerous interconnected lake systems such as Kempambudi Lake at Basavanagudi, Sankey Lake at Sadashivnagar, YediyurKere at Yediyuretc.

During 70's, the valley had nearly 71 lakes, which is now reduced to approximately 35 lakes in 2017. Anthropogenic activities particularly, indiscriminate disposal of untreated industrial effluents and sewage wastes, dumping of solid waste, dumping of construction and demolition wastes (building debris) have altered the physical and chemical integrity affecting the biological integrity, evident from the profuse growth of macrophytes weeds, exotic species of fish, etc.

Sewage generated in the catchment are either partially treated or untreated, evident form the prevailing water and sediment quality in the lakes of V. Valley. However, there are some efforts to treat sewage (but lacks option for removal of nutrients, which constitute the major problem of sewage) with 180 MLD (at Rajarajeshwari Nagar) and 75MLD (at Mylasandra) downstream of Vrishabhavathi Valley along the Mysore road. Two more treatment plants are being implemented at Kengeri (60 MLD) and Doddabele (20 MLD). Small treatment plans about 1 to 2 MLD scale are present at Uttaralli, Deepanjalinagar, Doraikere, Kempambudi lakes, respectively and 5 MLD plant at Mallathalli. Current treatment capacity is about 260 MLD whereas Sewage generated is about 431 MLD i.e., 54% of the sewage generated is treated when the plants are running at their full potential. Additional 80 MLD is under construction near Doddabele-Kengeri.

As per the directions of Honourable High Court of Karnataka, BBMP has entrusted the work of carrying out the study for the rejuvenation and restoration of the drains of Vrishabhavathi (VB) Valley to CSIR- National Environmental Engineering Research Institute (NEERI).

डॉ. शेक बाशा
Dr. Shaik Basha
वैज्ञानिक तथा प्रमुख / Scientist & Head
सीएसआईआर-नीरी क्षेत्रीय केंद्र
CSIR-NEERI Zonal Centre
तारनाका, हैदराबाद / Tarnaka, Hyderabad-7

3.1 Sewage status in Vrishabhavathi Valley

(Source: BMWSSB website)

The present supply of drinking water is Cauvery water for the Core & CMC areas is 1400 MLD. Around 400 MLD of water is being used from the bore wells in almost 110 villages. Hence, the total quantity of water being used in Bengaluru is 1800 MLD and accordingly the sewage generation is 1440 MLD. Furthermore, it is expected that the sewage generation by 2023 will be 1800 MLD. Out of the whole sewage being generated, 40% sewage is being generated in VB Valley and its minor Valley, 40% in K&C (Koramangala and Chalaghatta) and its minor Valley, and rest 20% in Hebbal and its minor Valley.

The present sewage flow in Vrishabhavathi Valley is 576 MLD and it is expected that the sewage will be 720 MLD by the year 2023. Many local industries dump their waste products directly into the river, which causes pollution and increases the stress on the river. The wastewater treatment plant capacity serving the area does not meet the demand, which further adds stress on the river.

3.2 Field Survey

CSIR-NEERI has carried out the reconnaissance survey of the VB Valley during the period November 24-25, 2020. The staffs of BBMP, KSPCB and BMWSSB were present along with the CSIR-NEERI officials during the site visit. The two major drains of VB valley are V100 and V200 (Figure 3.1).

V100 the major drain starts from Sankey Tank of Bengaluru and passes through the West Zone and South Zone of Bengaluru city within the BBMP limits. Various other secondary and tertiary drains meet the V100 drain along its path.

V200 the other major drain starts from Tumkur road and flows through the RajaRajeshwari Zone, Dasarahalli Zone of Bengaluru. Various other secondary and tertiary drains meet the V100 drain along its path. V100 and V200 finally meet each other opposite to the Bengaluru University and the combined drain carries the sewage combined with Industrial effluents and finally enters the Byramangala lake which is 20-25 km away from BBMP limits.

डॉ. शेक बाशा
Dr. Shaik Basha
वैज्ञानिक तथा प्रमुख / Scientist & Head
सीएसआईआर-नीरी क्षेत्रीय केंद्र
CSIR-NEERI Zonal Centre

It has been observed during the field survey that V200 drain present beside the Peenya Industrial area has illegal discharge of Industrial effluents by some of the Industries and domestic sewage. A clear demarcation of the industrial effluents and domestic sewage (Figure 3.3) has been observed during the site visit. The common observation at all the drains is the dumping of solid waste into the drain. Though the silt is being removed regularly, the dumping of solid waste into the drain has become a routine affair along all the drains of VB valley.

डॉ. शेक बाशा
Dr. Shaik Basha
वैज्ञानिक तथा प्रमुख / Scientist & Head
सीएसआईआर-नीरी क्षेत्रीय केंद्र
CSIR-NEERI Zonal Centre
तारनाका, हैदराबाद / Tarnaka, Hyderabad-7

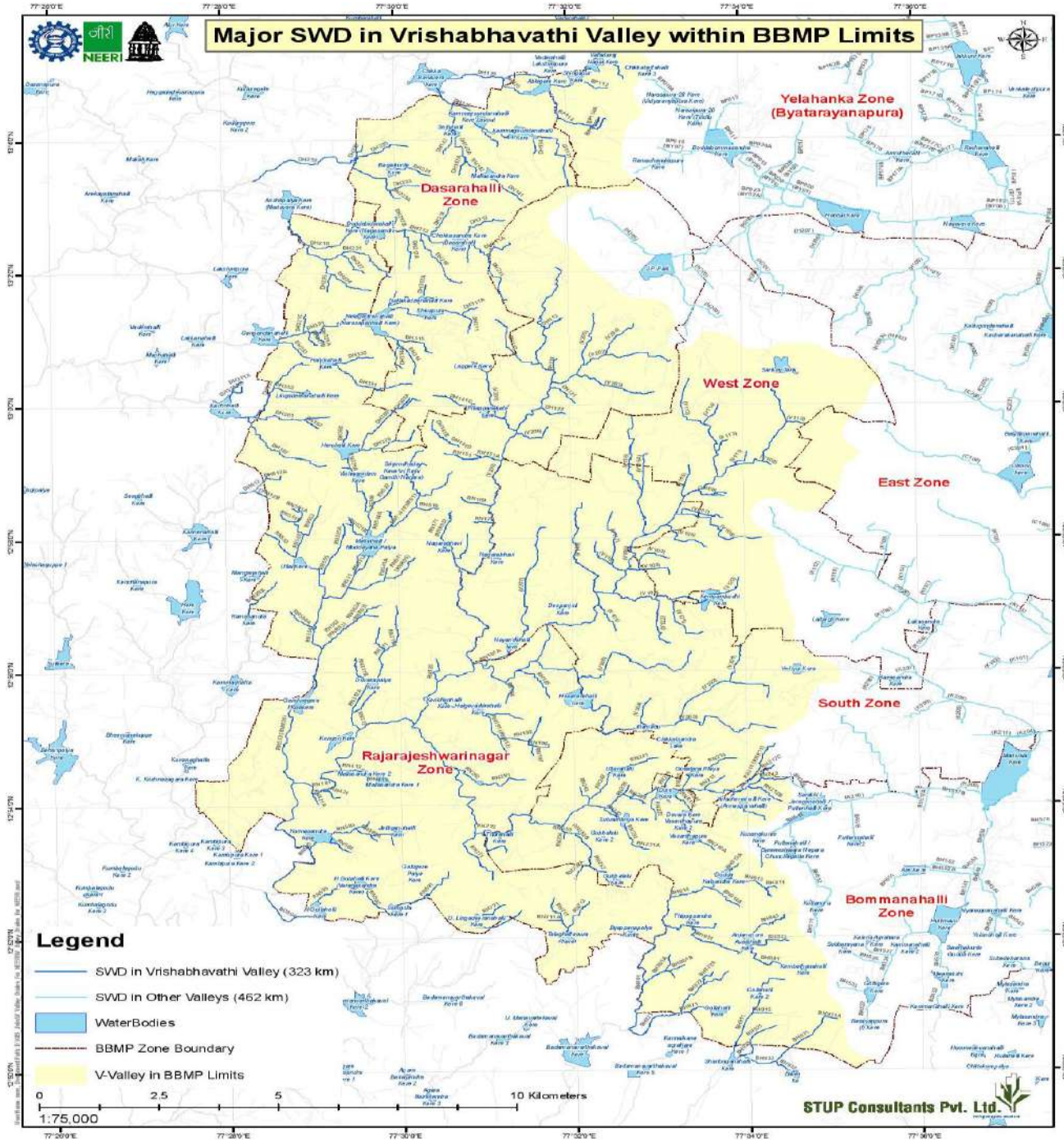


Figure 3.1: Vrishabhavathi valley Map showing the drains and lakes

डॉ. शेक बाशा
Dr. Shaik Basha
वैज्ञानिक तथा प्रमुख / Scientist & Head
सीएसआईआर-नीरी क्षेत्रीय केंद्र
CSIR-NEERI Zonal Centre

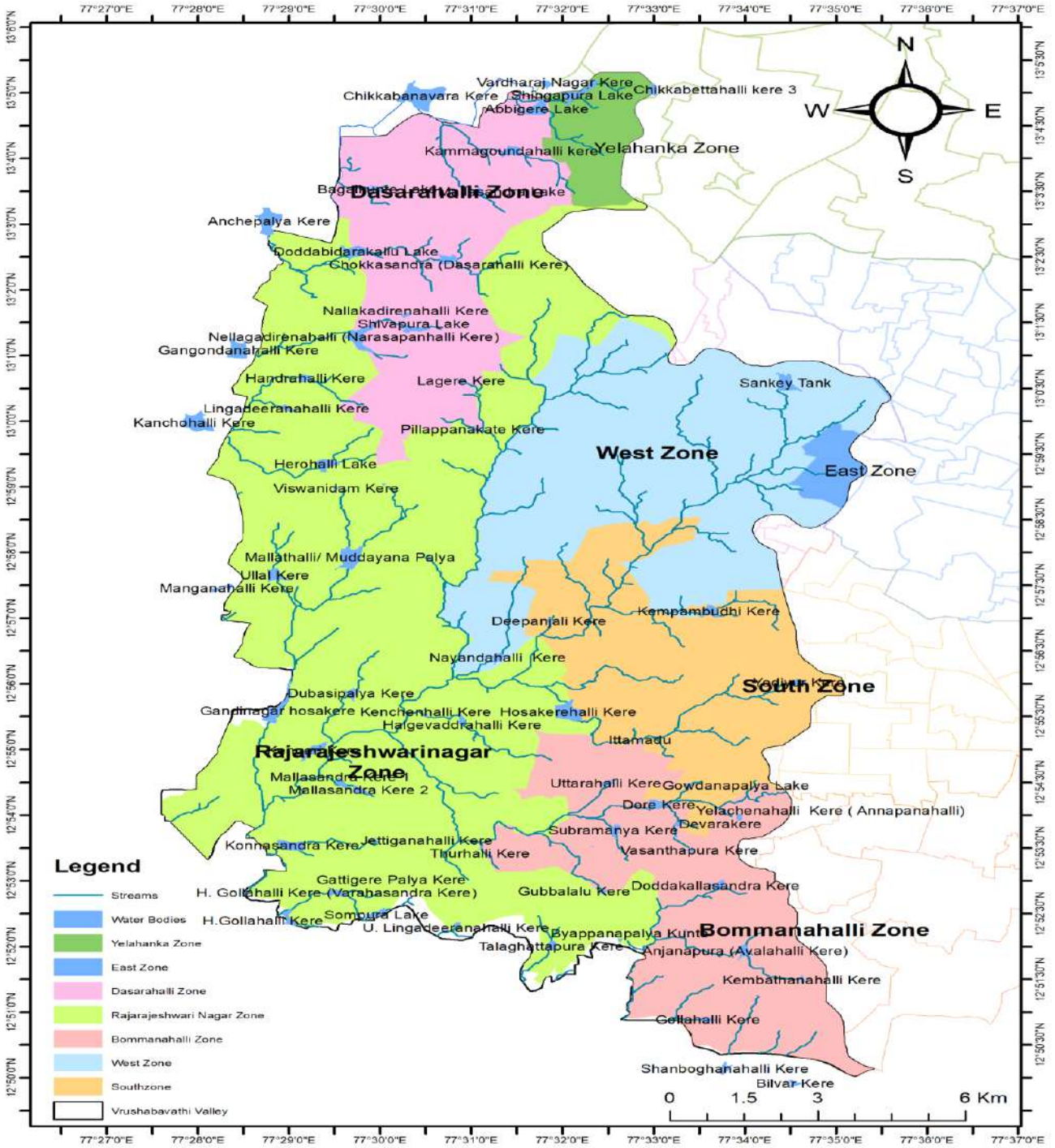


Fig. 3.2: Vrishabhavathi Valley map depicting all drains in each zone

डॉ. शेक बाशा
Dr. Shaik Basha
वैज्ञानिक तथा प्रमुख / Scientist & Head
सी.एस.आई.आर-नीरी क्षेत्रीय केंद्र
CSIR-NEERI Zonal Centre
तारनाका, हैदराबाद / Tarnaka, Hyderabad-7

Figure 3.3: V200 drain beside Peenya Industrial area showing the illegal discharge of Industrial effluents with sewage entering the drain

डॉ. शेक बाशा
Dr. Shaik Basha
वैज्ञानिक तथा प्रमुख / Scientist & Head
सीएसआईआर-नीरी क्षेत्रीय केंद्र
CSIR-NEERI Zonal Centre
तारनाका, हैदराबाद / Tarnaka, Hyderabad-7

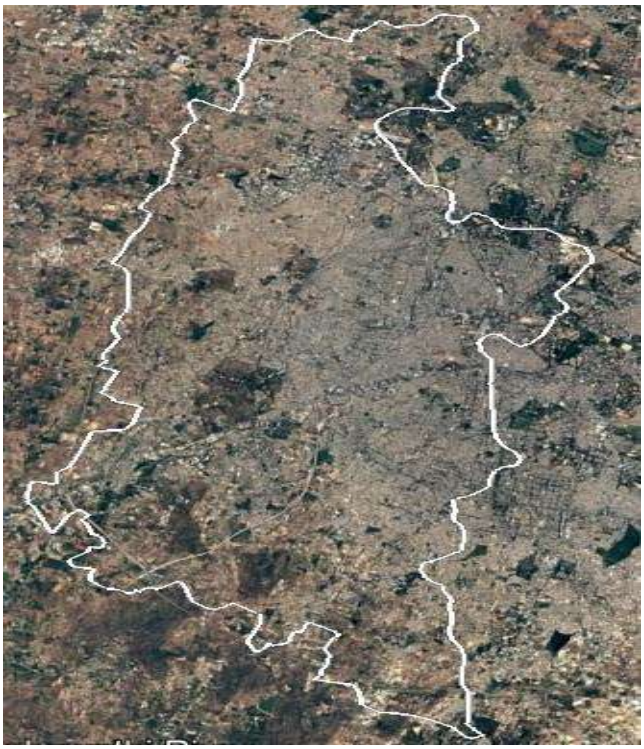
3.3 Historical data from google images about VB Valley

The google earth images reveal that since 1984, there was much greenery along the river and not much industrialisation was present. As the years pass by, the industrialisation and urbanisation increased as soon from the google images, which increased the disposal of industrial effluents and domestic sewage to the river.

Figure 3.4A: Status of the river in the year 1984

Figure 3.4 B: Status of the river in the year 1994

डॉ. शेक बाशा
Dr. Shaik Basha
वैज्ञानिक तथा प्रमुख / Scientist & Head
सी.एस.आई.आर-नीरी, क्षेत्रीय केंद्र
CSIR-NEERI Zonal Centre
तारनाका, हैदराबाद / Tarnaka, Hyderabad-7



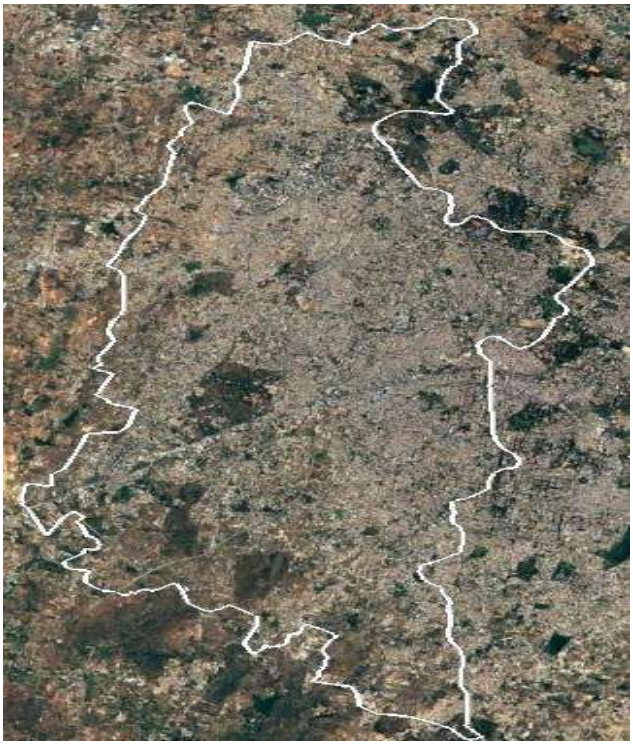


Figure 3.5 A&B: Status of the lake in the year 2014 & 2020

After the reconnaissance survey, the CSIR-NEERI team has undertaken the field survey for the collection of the samples of river/drain in each zone. Accordingly, a total of approximately 294 river/drain samples have been collected. At each drain, the status of the lake, flow of the lake, encroachment status etc has been noted down accordingly (format enclosed). A rigorous field survey had been undertaken for a period of 3 months and the sampling of river/drains and lakes has been undertaken. The samples have been collected from various locations along the V100 and V200 river/drains. It has been observed during the field visit that V100 and V200 meet in front of the Bengaluru University and from there the final stream leaves the BBMP limits and travels through the river stretch through the Kumbalgodu industrial area and finally enters Byramangala lake. The river/drains have been numbered as per the zone in which they are present. The length of each drain has also been sought from the BBMP and the same has been received and accordingly, the drain length is being done on GIS platform. The names of the river/drains are labelled as V, RH, BH etc. The zone maps are shown in the Figures 3.6 to 3.10.

आई.आई.सी.टी. परिसर, तारनाका, हैदराबाद - 500007, तेलंगाना राज्य, भारत IICT Campus, Tarnaka, Hyderabad-500007, Telangana State, INDIA
दूरभाष / Phone: +91-40-27160122, 27160441 टेलीफैक्स / Telefax: +91-40-27160639 ई-मेल / E-mail: hzl@neeri.res.in
डॉ. शेक बाशा
Dr. Shaik Basha
वैज्ञानिक तथा प्रमुख / Scientist & Head
सीएसआईआर-नीरी, क्षेत्रीय केंद्र

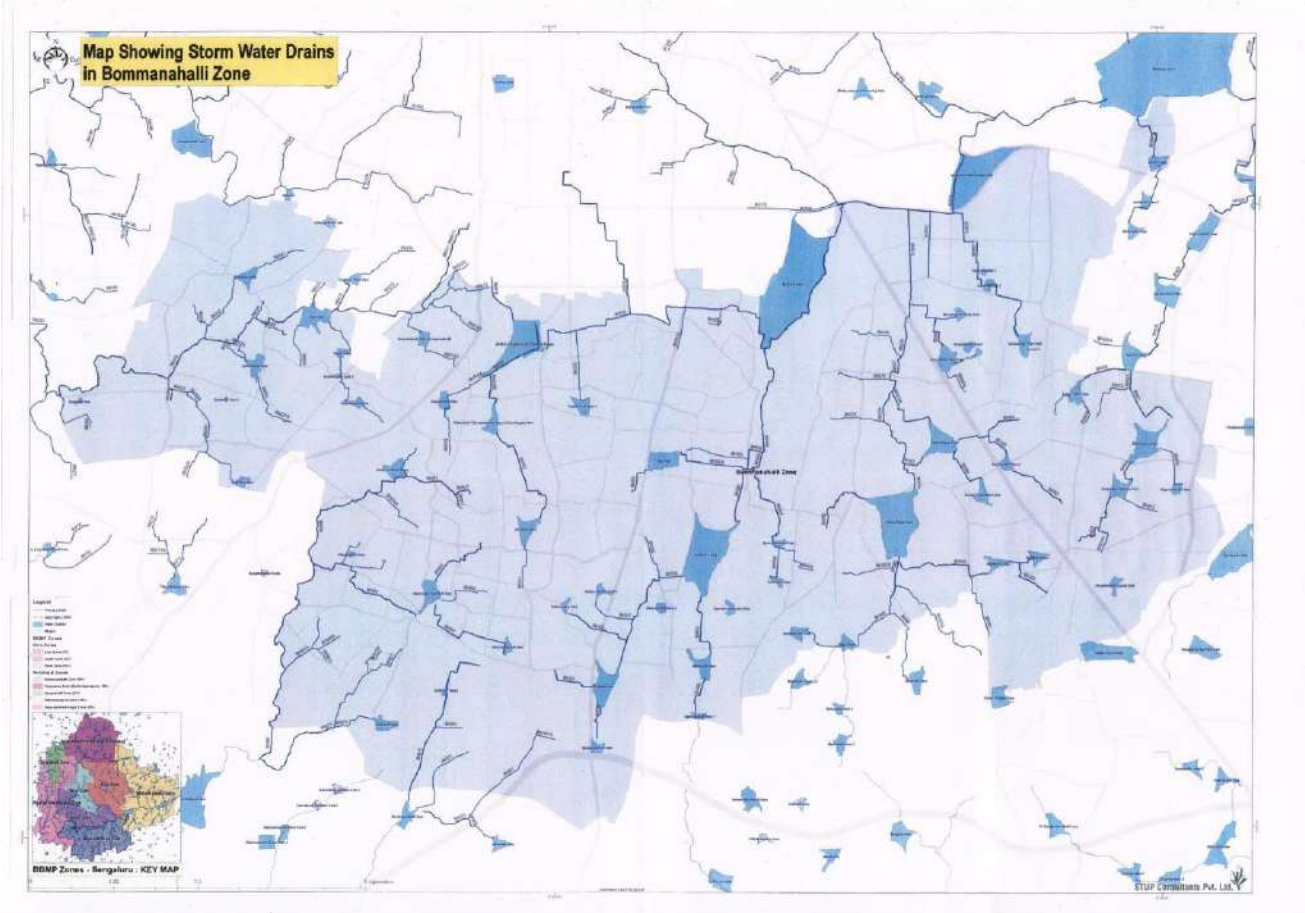


Figure 3.6: Storm water drains in Bommanahalli Zone

डॉ. शेक बाशा
Dr. Shaik Basha
वैज्ञानिक तथा प्रमुख / Scientist & Head
सीएसआईआर-नीरी क्षेत्रीय केंद्र
CSIR-NEERI Zonal Centre
तारनाका, हैदराबाद / Tarnaka, Hyderabad-7

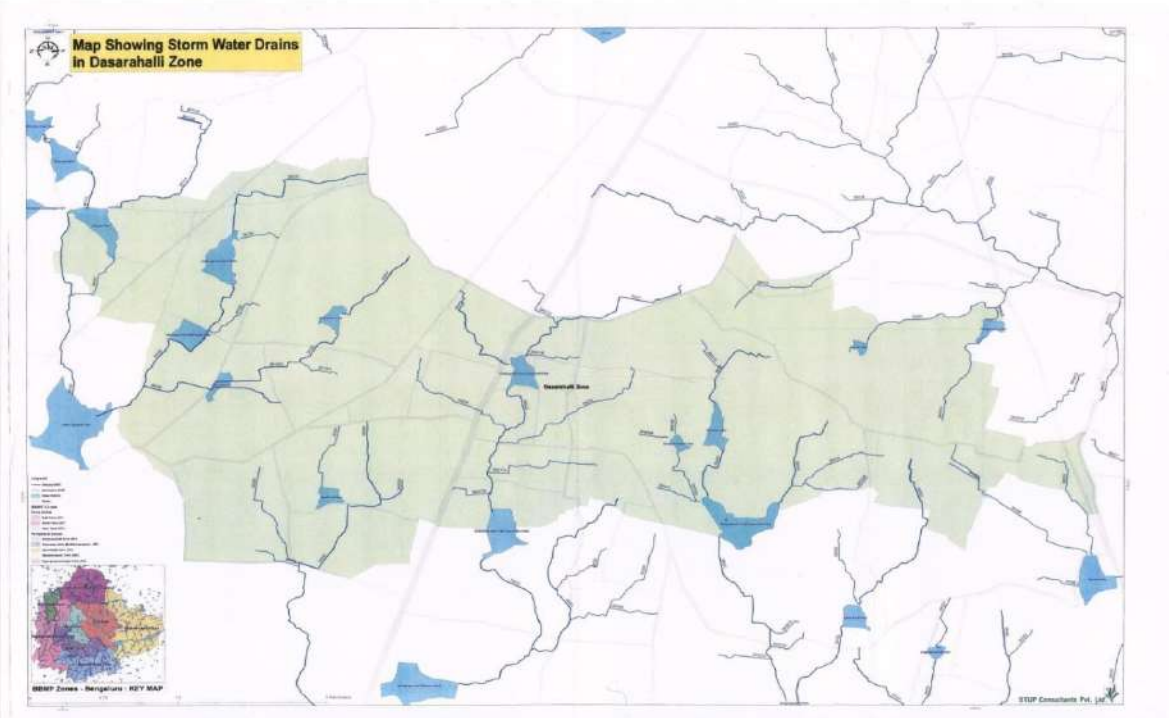


Figure 3.7: Storm water drains in Dasarahalli Zone

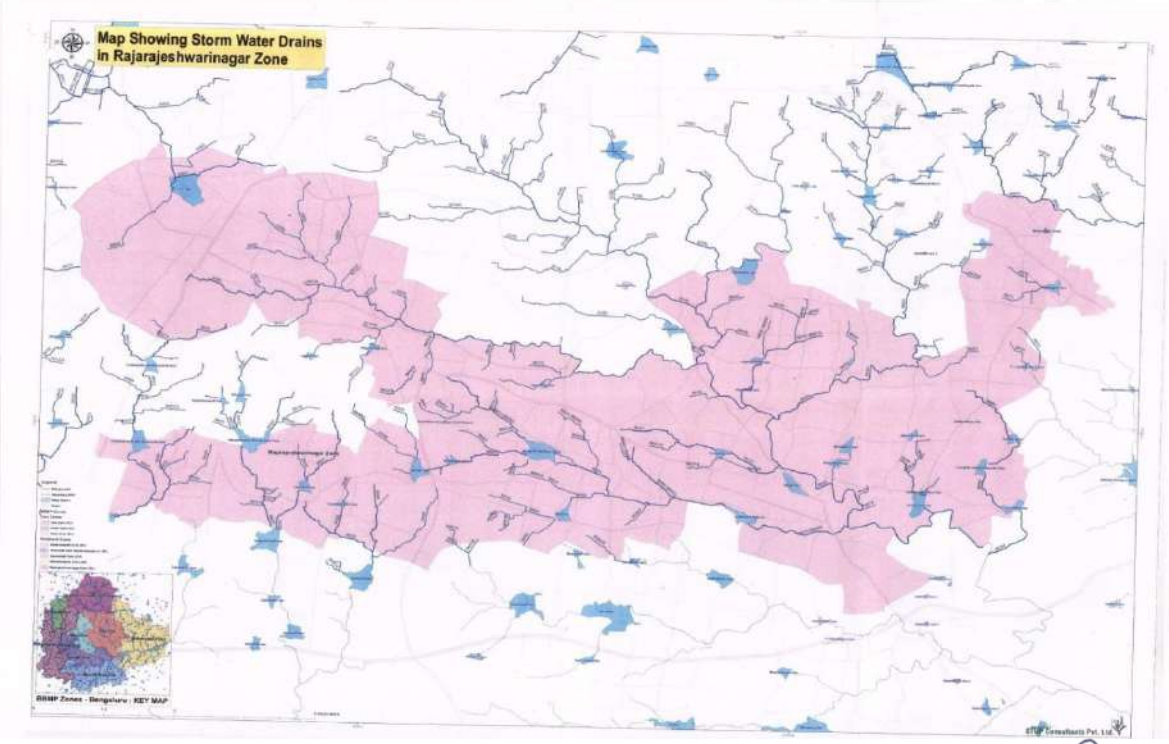


Figure 3.8: Storm water drains in Rajarajeshwari Zone

डॉ. शेक बाशा
Dr. Shaik Basha
वैज्ञानिक तथा प्रमुख / Scientist & Head
सीएसआईआर-नीरी क्षेत्रीय केंद्र
CSIR-NEERI Zonal Centre

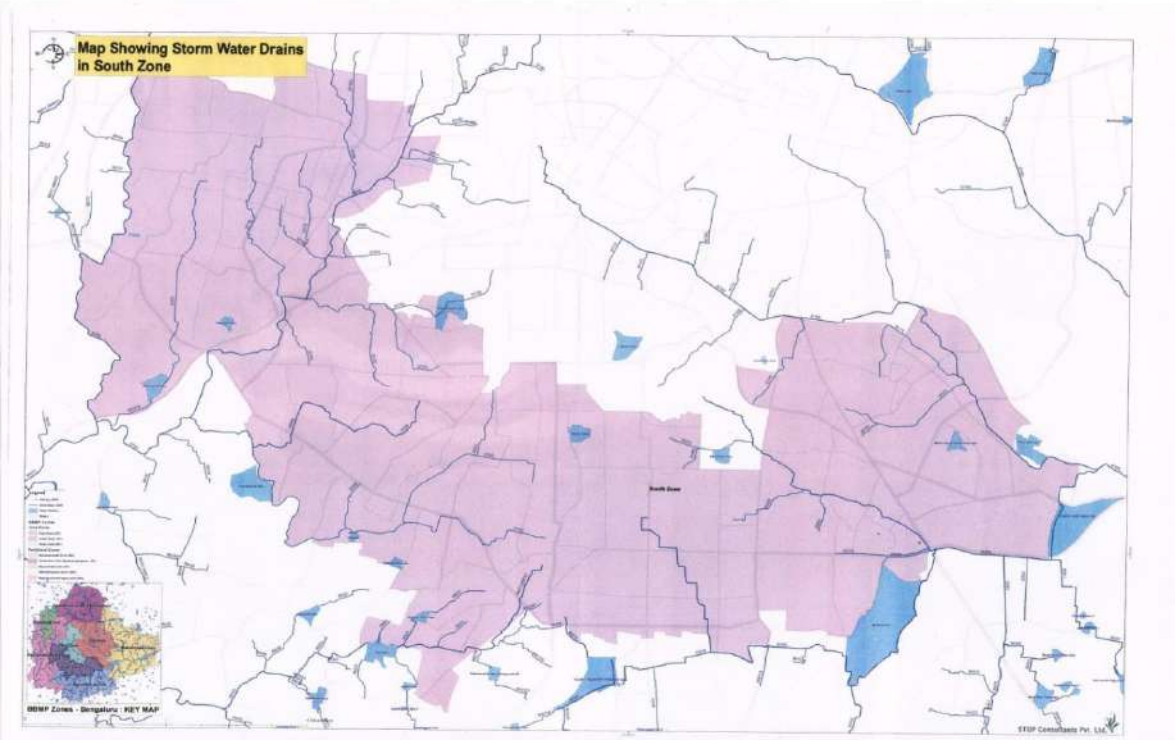


Figure 3.9: Storm water drains in South Zone

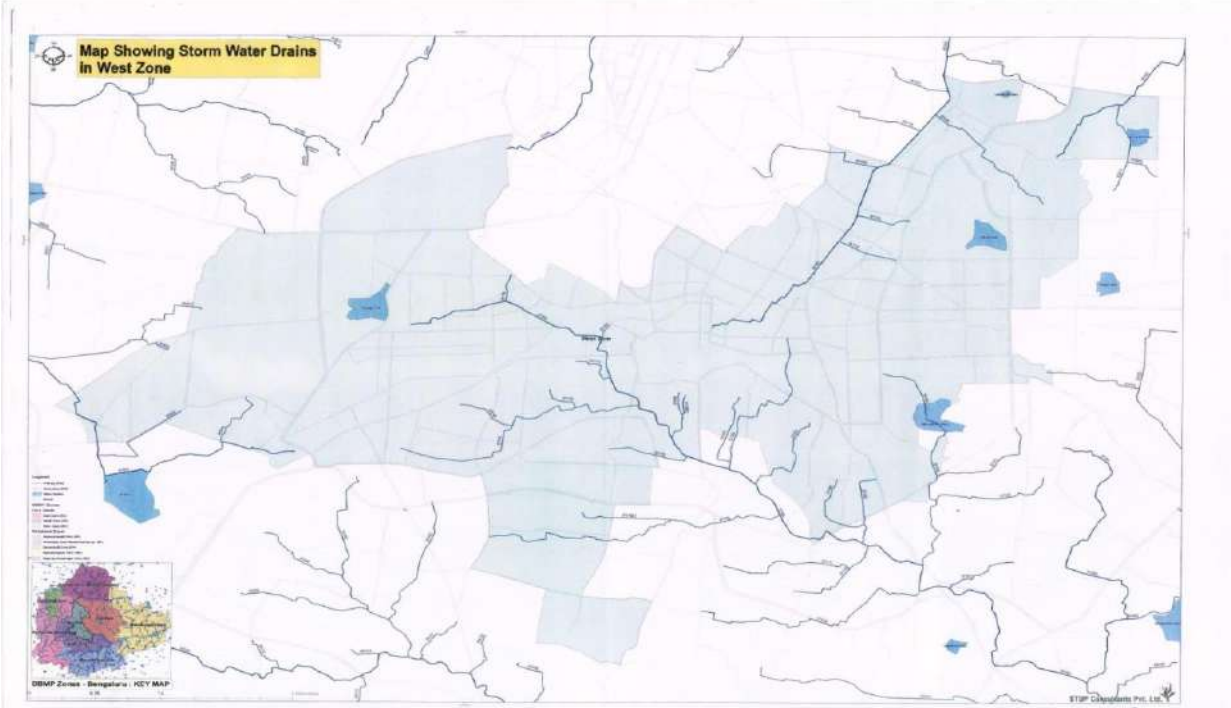


Figure 3.10: Storm water drains in West Zone

डॉ. शेक बाशा
Dr. Shaik Basha
वैज्ञानिक तथा प्रमुख / Scientist & Head
सी.एस.आई.आर-नीरी क्षेत्रीय केंद्र
CSIR-NEERI Zonal Centre

3.4 Thematic Maps

The thematic maps have been prepared in GIS platform viz., the flow map, LULC map. The digital elevation model of the VB Valley is represented in Figure 3.11. The digital elevation model indicates that the elevation varies from 674 to 895. The flow direction map has been delineated in GIS using the DEM map. The flow direction map depicting the streams is shown in Figure 3.12.

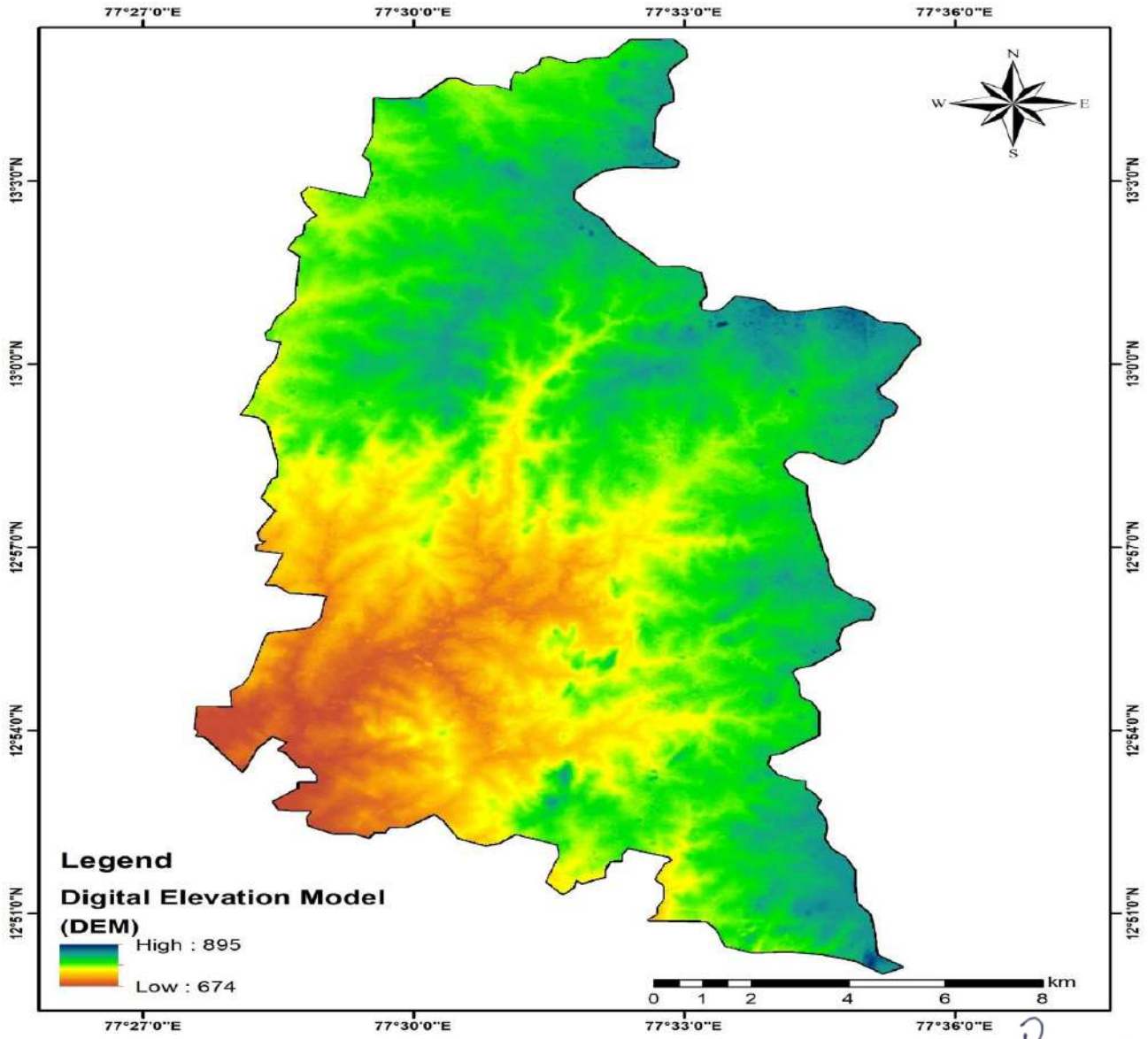


Figure 3.11: Digital Elevation Model of VB Valley

डॉ. शेक बाशा
Dr. Shaik Basha
वैज्ञानिक तथा प्रमुख / Scientist & Head
सीएसआईआर-नीरी क्षेत्रीय केंद्र

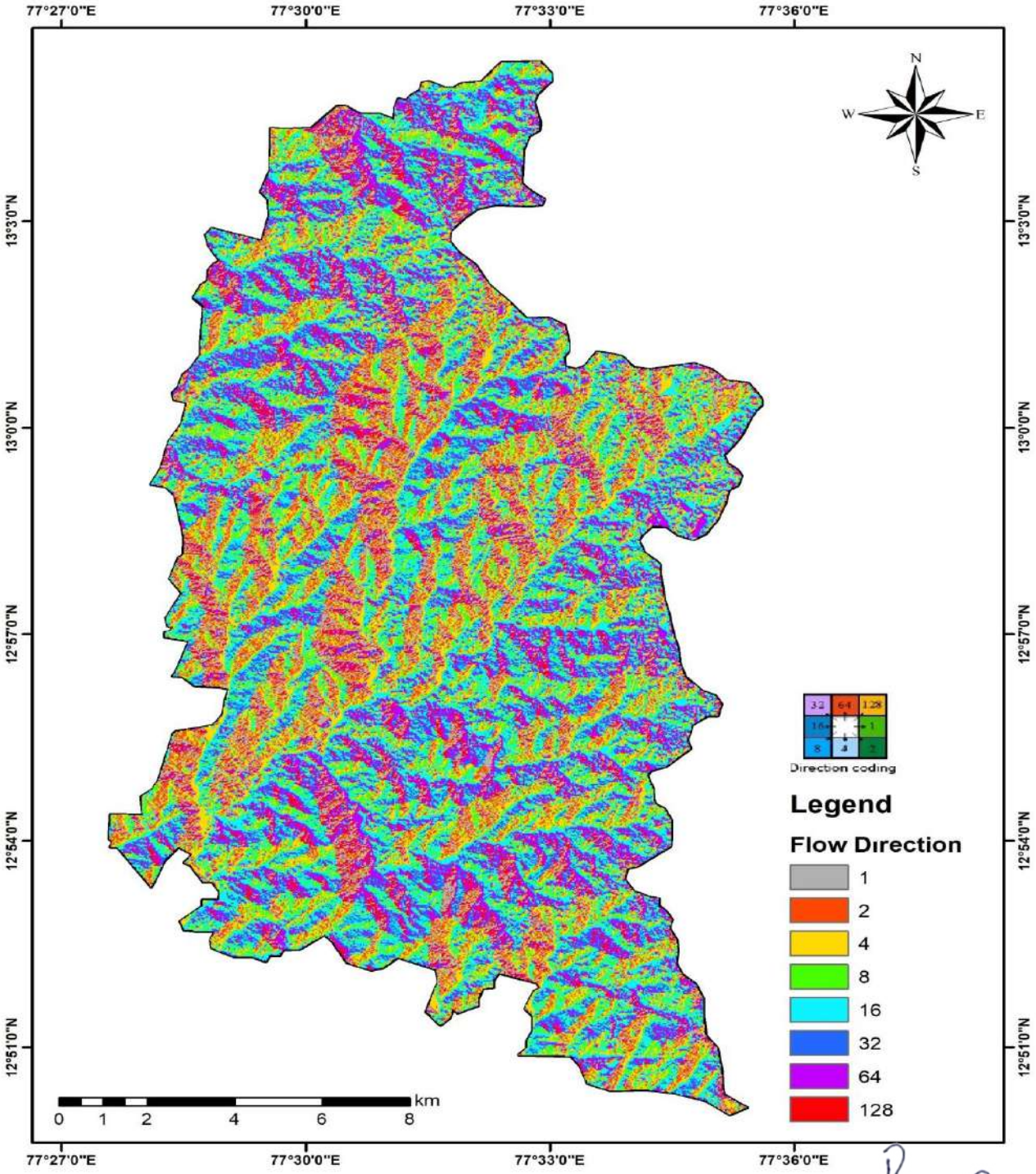


Figure 3.12: Flow Direction Map of VB Valley

डॉ. शेक बाशा
Dr. Shaik Basha
वैज्ञानिक तथा प्रमुख / Scientist & Head
सीएसआईआर-नीरी क्षेत्रीय केंद्र
CSIR-NEERI Zonal Centre

LULC pattern of the VB Valley:

The LULC maps of the VB Valley have been shown during the period 2005-2006 (Figure 3.13); 2011-2012 (Figure 3.14); 2015-2016 (Figure 3.15). It has been observed that the built up has kept on increasing since 2005 to 2016 and till date and this was also evident from the google images.

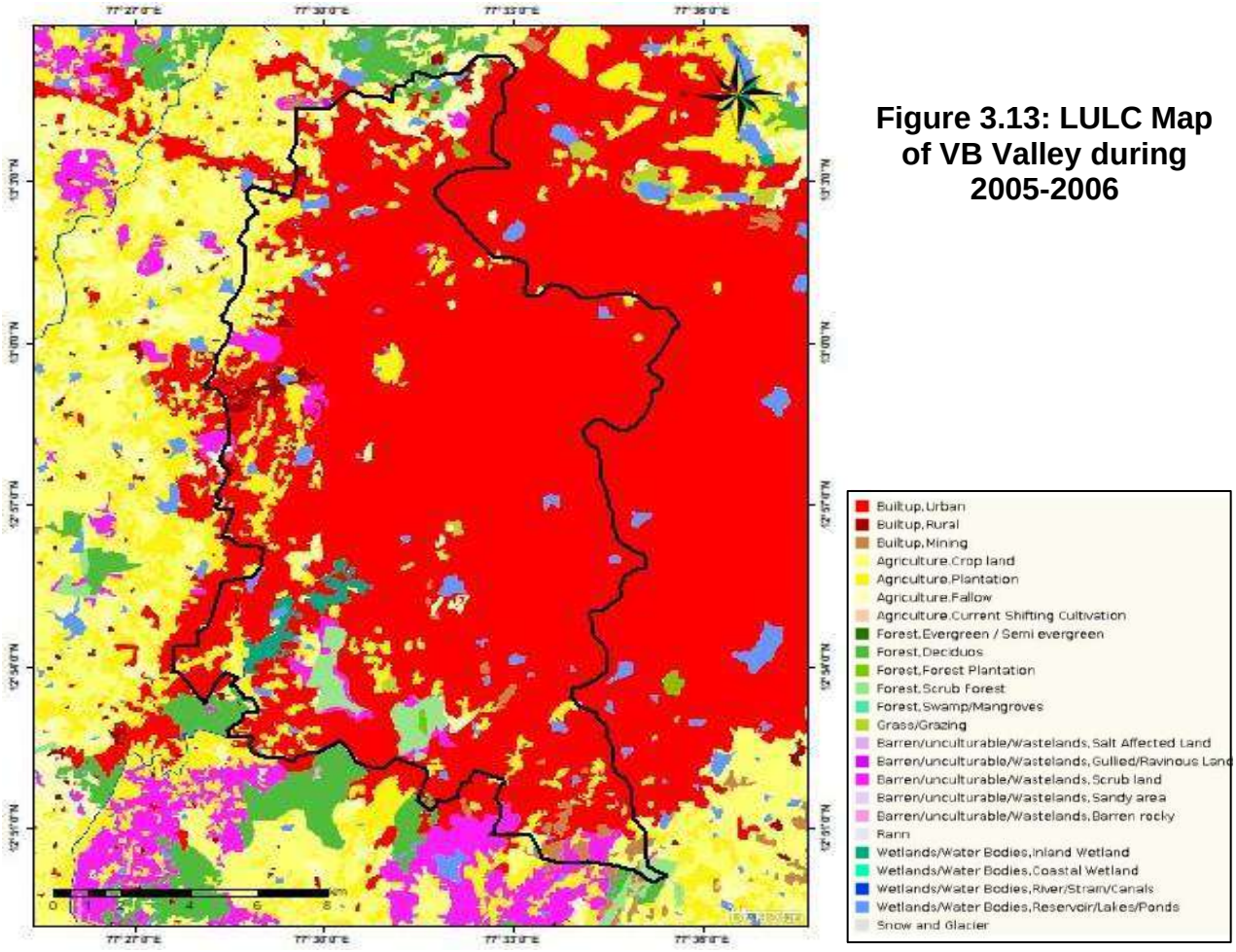


Figure 3.13: LULC Map of VB Valley during 2005-2006

डॉ. शेक बाशा
Dr. Shaik Basha
वैज्ञानिक तथा प्रमुख / Scientist & Head
सीएसआईआर-नीरी क्षेत्रीय केंद्र
CSIR-NEERI Zonal Centre
तारनाका, हैदराबाद / Tarnaka, Hyderabad-7

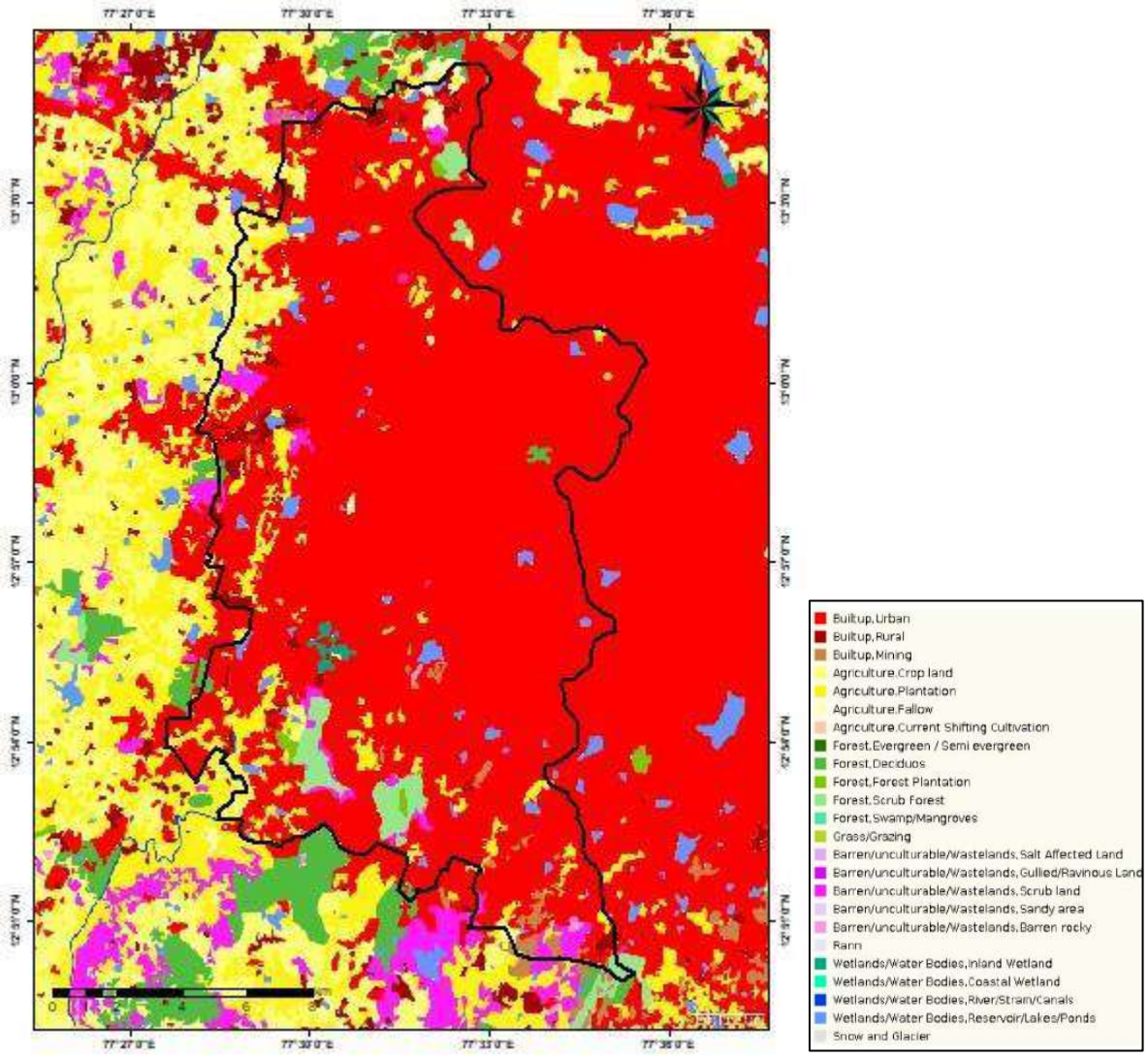


Figure 3.14: LULC Map of VB Valley during 2011-2012

डॉ. शेक बाशा
Dr. Shaik Basha
वैज्ञानिक तथा प्रमुख / Scientist & Head
सीएसआईआर-नीरी क्षेत्रीय केंद्र
CSIR-NEERI Zonal Centre
तारनाका, हैदराबाद / Tarnaka, Hyderabad-7

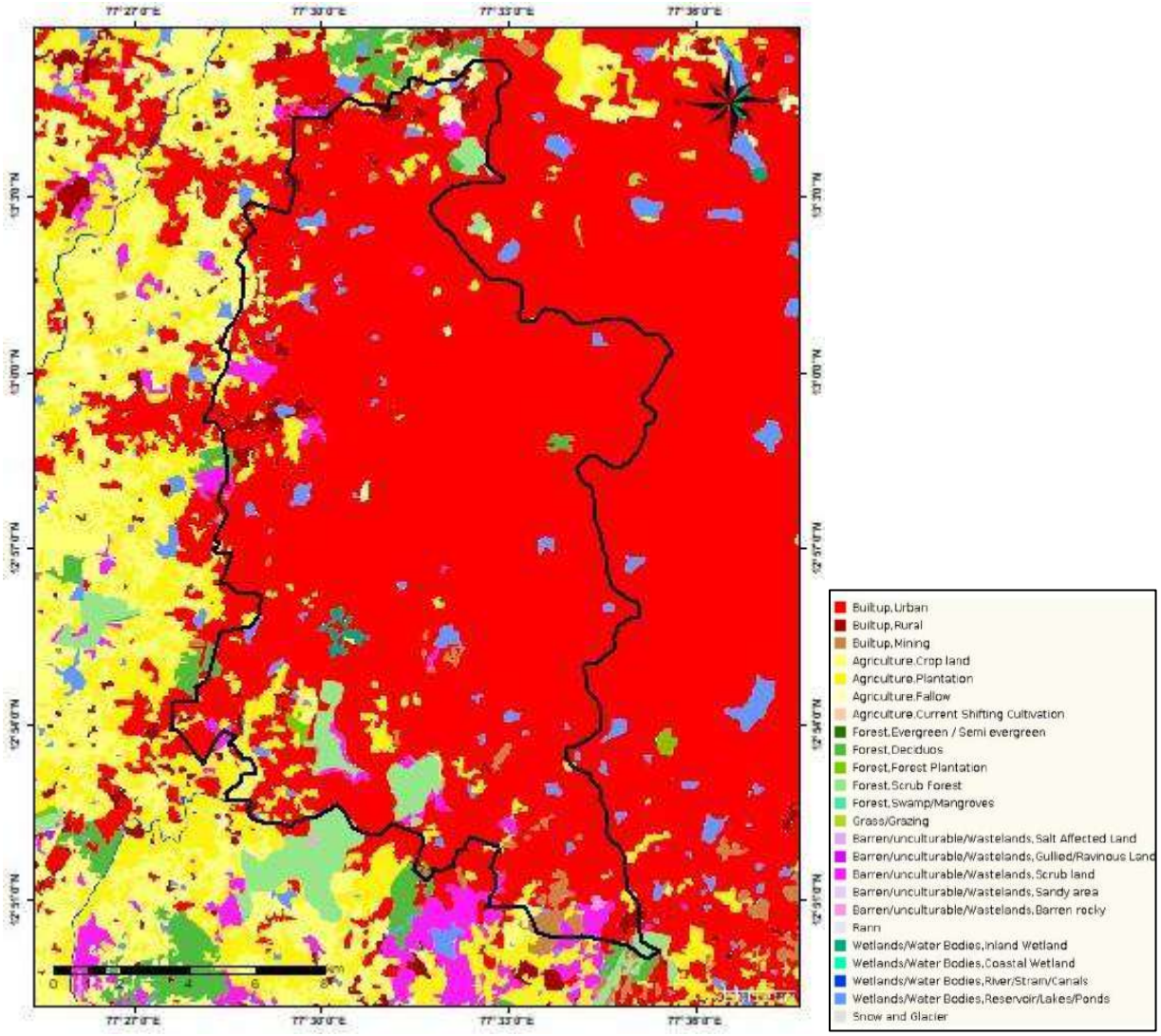


Figure 3.15: LULC Map of VB Valley during 2015-2016

डॉ. शेक बाशा
Dr. Shaik Basha
वैज्ञानिक तथा प्रमुख / Scientist & Head
सीएसआईआर-नीरी क्षेत्रीय केंद्र
CSIR-NEERI Zonal Centre
तारनाका, हैदराबाद / Tarnaka, Hyderabad-7

3.5 Field Observations

The following are the field observations by the field team during the sample collection (photographs attached as list of plates):

1. **Along the drains with V code:**

- Locations of V code lies in the main city encompassing areas of KSR Bangalore City railway stations and navigated to Mysuru Road, Malleshwaram, Sankey Tank
- Metro stations can be seen in these areas
- Solid waste dumping was most common in all the drains.
- Maximum number of slums were found in these areas
- Renovation of drain walls were observed at some places which had either diverted the flow of the drain or stopped. One case was observed near a drain of Attigupe Metro Station.
- Presence of industrial area adjacent to the Main valley was observed. These were mainly metal finishing, dye, fabric etc.
- Froth on water and coloured froth was observed in this zone
- Local people involvement was observed in few places. They were curious to know about the condition and development of these drains. No big nuisance was observed that could stop the sampling process.
- Encroachments found at some places
- Most of the drains were fenced by BBMP

2. **Along the drains with codes RN (Rajarajeshwar Nagara Zone)**

- This area is yet to be developed. There are less number of houses and apartments due to which the flow of wastewater is very less compared to other zones. Drains at many places were found dry in this zone.
- There were scenarios of dumping solid waste in open.
- Industrial development was less, however, BWSSB sewage treatment plant exists in this zone. On interaction, the BWSSB engineer stated that water turns red to pink at night. This case was for the main valley (Vrishabhavathi river). The reason might be due to the cleaning activities of industries which leads to discharge as an effluent.

डॉ. शेक बाशा
Dr. Shaik Basha
वैज्ञानिक तथा प्रमुख / Scientist & Head
सी एस आई आर-नीरी क्षेत्रीय केंद्र

3. Along the drains with codes DH (Dasarahalli Zone)

- Perhaps the most disturbed area of Bangalore in terms of environmental parameters, Dasarahalli tops the list.
- All types of industries can be found here.
- Water quality was found very poor
- The smell was very bad of some areas of this zone
- Frequent deposition of solid waste and incineration of solid waste in a residential area was caught red handed. When asked about the permission, the labour said it is BBMP who gave orders to burn.
- Maintenance of the area is very poor
- Maximum numbers of encroachment were found in this zone
- Drains were partially fenced

Based on the field observations during the sample collection, the preliminary short term and long term measures have been suggested in the next chapter.

डॉ. शेक बाशा
Dr. Shaik Basha
वैज्ञानिक तथा प्रमुख / Scientist & Head
सीएसआईआर-नीरी क्षेत्रीय केंद्र
CSIR-NEERI Zonal Centre
तारनाका, हैदराबाद / Tarnaka, Hyderabad-7

सी.एस.आई.आर. - राष्ट्रीय पर्यावरण अभियांत्रिकी अनुसंधान संस्थान
CSIR-National Environmental Engineering Research Institute
(वैज्ञानिक तथा औद्योगिक अनुसंधान परिषद / Council of Scientific & Industrial Research)
हैदराबाद क्षेत्रीय केंद्र / Hyderabad Zonal Centre
(वैज्ञानिक तथा औद्योगिक अनुसंधान विभाग, विज्ञान एवं प्रौद्योगिकी मंत्रालय, भारत सरकार के अंतर्गत स्वायत्त संगठन)
(Autonomous Organization under the Dept. of Scientific and Industrial Research, Ministry of Science & Technology, Govt. of India)

Chapter 4

Short term and Long term measures

डॉ. शेक बाशा
Dr. Shaik Basha
वैज्ञानिक तथा प्रमुख / Scientist & Head
सी एस आई आर-नीरी क्षेत्रीय केंद्र
CSIR-NEERI Zonal Centre
तारनाका, हैदराबाद / Tarnaka, Hyderabad-7

4.0 Background

Rejuvenation is a widely adopted term used for different methods adopted for the revival of a polluted area. It involves various procedures for the improvement of lake water quality, its area, and to recharge the ground water to fight with drought. It involves the improvement of the water quality to bring the water quality to irrigation standards. The main reasons neededfor rejuvenationare:

- Revival of a river helps in downpour water reap and broaden water security during non-blustery seasons
- The beds of riverthroughout the timeframe stores soil wealthy in supplement and humus because of the decay of natural issue, fishes and other water life forms. Such soils, having high water maintenance limit, whenever utilized as top soil helps ranchers additionally by lessening cost of manures.
- Social attachment
- Increase in Industrialisation and urbanisation
- Illegal dumping of solid waste, plastic waste etc on the banks of the river and into the river
- Illegal encroachment of the river banks

Vrishabhavathi Valley requires immediate restoration as there have been illegal discharges of effluents including domestic sewage to the whole course of the river from the starting point until it reaches Byramangala lake, which has deteriorated the river water quality and the existing lakes quality. Over a period of time, this may also affect the groundwater quality in the whole of Bengaluru area as the river water interacts with the sediment which recharges the groundwater.

डॉ. शेक बाशा
Dr. Shaik Basha
वैज्ञानिक तथा प्रमुख / Scientist & Head
सीएसआईआर-नीरी क्षेत्रीय केंद्र
CSIR-NEERI Zonal Centre
तारनाका, हैदराबाद / Tarnaka, Hyderabad-7

This chapter delineates the short term and longterm measures which needs to be immediately implemented so to ensure no further deterioration. The field survey undertaken for short term and long term measures for Vrishabhavathi Valley was narrowed down the following aspects:

- Discharge of effluents to the drains that enter each of the lake
- Mixing of storm water drain with the domestic sewage and industrial effluents
- Unhygienic activities like defecation in the drains and dumping of solid wastes, has led to the pollution and loss of eco-system of the area around the river and the lakes in the valley
- The groundwater quality of the area will be affected in the future years if the lakes in the valley is not rejuvenated
- The outlet of each lake pollutes the lake in the downstream and the lake water is being used by farmers for irrigation purposes

4.1 Short term and Long term measures:

Based on the field survey, collection of the drain and lake samples, the following short term and long term measures have been suggested:

4.1.1 Short term Measures:

Following short term measures should be undertaken:

- Check the authorized/Unauthorized developments around the lakes
- Prevention of pollution from point and non-point sources from entering the drains
- Regularly monitor the quality of wastewater coming to the drain and lake water.
- Silt accumulated in the drains must be removed on regular basis.
- Improvements to storm water drains
- Fencing along the stretch of the river to avoid solid waste dumping
- A toll free number to be made so that if any illegal dumping is being done, the concerned officer may immediately be noticed so that strict compliance can be taken

डॉ. शेक बाशा
Dr. Shaik Basha
वैज्ञानिक तथा प्रमुख / Scientist & Head
सीएसआईआर-नीरी क्षेत्रीय केंद्र

- A mobile based app may be developed to ensure that no illegal construction or industries dispose their effluents to the drain. If any such thing is done, a complaint may be done in the application which has to be rectified/looked into within 24 hrs
- A fine may be levied to such persons engaged in such activities as per the Water Act 1974
- In case of industrial area, all the industries to contribute and set up a common CETP plant in the area and only after proper treatment, the treated water may be left to the drains after complying to the norms
- To minimize frothing, a ban on use of phosphates in the manufacture of detergents should be done
- Regular removal of silt in the lakes to avoid eutrophication
- Plant native species of macrophytes in open spaces of lake catchment area;
- Restrictions on the diversion of lake for any other purposes
- Ban on illegal constructional activities in the valley
- Protect open spaces like lakes, parks etc
- Hoardings etc to be put up at frequent intervals along the periphery of the river
- Promoting public education programs regarding proper use and disposal of agricultural hazardous waste materials and regular monitoring of lake, which are rudimentary.
- Issuing notice to the industries by KSPCB which are illegally discharging the effluents to the river. Implementation of 'polluter pays' principle as per Water Act 1974;
- Check the operation and maintenance of STPs, CETPs existing near the river and lakes by BMWSSB
- Quantification of flow of sewage in each zone by BMWSSB
- Improving sanitation and health conditions, co-ordination with the stakeholders for cleaning and preventing vandalism.

डॉ. शेक बाशा
Dr. Shaik Basha
वैज्ञानिक तथा प्रमुख / Scientist & Head
सी.एस.आई.आर.-नीरी क्षेत्रीय केंद्र
CSIR-NEERI Zonal Centre
तारनाका, हैदराबाद / Tarnaka, Hyderabad-7

4.1.2 Long term Measures:

In order to implement long term measures for restoration and conservation of lakes and River, it is essential that accurate and complete information of the core and buffer areas is collected. It is very important to adopt a watershed approach, which includes the addressing of the needs / problems of both Buffer area and the Core area holistically. Demarcating of these two areas was done with the use of maps/GIS. The delineation of the zones will be a prerequisite for regulating developmental activities in various parts of the catchment areas to maintain its ecological character.

Survey of the whole stretch of the river: The whole stretchof the river should be surveyed freshly by the Revenue Department to check for the illegal constructions and encroachments on the banks of the river from the Bengaluru urban area until the BBMP limits. The survey should include the complete details of the illegal encroachments, buffer area to be maintained, storm water drain, agricultural runoff, actual boundaries of all the lakes, survey number of villages etc. A buffer zone of 30 m for the lake and 15 m for the drains should be demarcated in the survey map to avoid any future encroachments. The map should also delineate the FTL boundary of the lake. The map should be available for the common public.

Fencing along the periphery of the river: Once the boundary of the river is delineated, the fencing should be done to avoid any encroachment of the river and illegal dumping into the lake. Maintaining a distance of 1 m or so, a fence should be made at least 6ft height so that people are not able to throw the garbage. In the 1 m space, perennial plants like crocuses, tulips, irises and delphiniums etc., can be planted as they have strong and woody tissues which last through bad weather and which do not have to be renewed each year. They will also increase the scenic beauty of the river and brings in fresh air. This will add to the ambient cooling and enhances the ambience and beauty of the river.

डॉ. शेक बाशा
Dr. Shaik Basha
वैज्ञानिक तथा प्रमुख / Scientist & Head
सीएसआईआर-नीरी क्षेत्रीय केंद्र
CSIR-NEERI Zonal Centre
तारनाका, हैदराबाद / Tarnaka, Hyderabad-7

Pollution impediment: Wastewater including industrial effluent and domestic sewage, solid and semi solid wastes entering in to the river from external sources must be stopped before any restoration work is implemented. More garbage bins should be made available for safe disposal of solid wastes.

It has been identified that both industrial effluent and domestic sewage are contributing to the pollution load in the river. Stringent actions should be taken against violating industry by KSPCB as per provisions under Water (Prevention and Control of Pollution) Act, 1974 as well as Environment (Protection) Act, 1986. Also, fine or Environmental Compensation may be levied on the violators for improper disposal of industrial effluent or wastes into drain.

A detailed gap analysis has to be made with respect to domestic sewage and waste management with a projection of at least 15 to 20 years, existing infrastructure for management of sewage and waste management in the catchment area of the river.

With respect to industrial pollution in Vrishabhavathi Valley, there are about 145 industries, out of which 29 are under Red category, 43 are in Orange and 72 are in green category. These industries generate effluent of 8.23 MLD and hazardous waste of 2680.152 TPA. About 31 industries have their own ETP and 14 industries are connected to CETP (Dossier of Overall Karnataka and 17 PRS, Jan 2021). It has been observed during the field survey that many industries are releasing their effluents in to the Vrishabhavathi river. Therefore, it is proposed that each industrial zone in the valley should have a separate CETP based on the quantities generated by the industrial cluster. Only the treated effluent after meeting the specified norms should be allowed to release in to the River. However, CETPs should explore the possibility of reusing the treated effluent.

डॉ. शेक बाशा
Dr. Shaik Basha
वैज्ञानिक तथा प्रमुख / Scientist & Head
सी एस आई आर-नीरी क्षेत्रीय केंद्र
CSIR-NEERI Zonal Centre
तारनाका, हैदराबाद / Tarnaka, Hyderabad-7

Dredging and de-silting: Removing the unwanted silt upto a depth of 1.5 m to maintain the depth. Dredging of the sediments in the riverhelps to improve the soil permeability, water holding capacity and groundwater recharge.The sediments contain a mixture of clay, silt, sand and stones.Depending on the characteristics, such sediments may be used as manure (complying to the manure quality prescribed under Solid Waste Management Rules, 2016 as amended from time to time or disposed of in accordance with the relevant provisions notified under Environment (Protection) Act, 1986.

De-weeding: Removing of the weeds regularly either manually or by machines. De-weeding methods includemanual or physical control measures such as non-chemical and non-motorized measures may be adopted for removal of weeds (manual harvesting) using hand pulling, rakes, cutters, benthic barriers, drawdown, aeration, shading and weed rollers as these measures are typically very low, however, such measures are labor intensive and are therefore better suited to small, less established weed populations.

Construction of silt traps/screens at inlet points: Silt Traps/ Screen are proposed to be constructed across the existing inlets. Silt traps are to be constructed to stop the entry of floating debris and fresh sediments/silt into the drain.

Strom Water Drain: Diversion of the sewage from the existing storm water drain and construction of separate RCC structure for the sewage need to done. Construction of RCC structure does not allow the groundwater contamination to take place.Lake drainage basin is the starting point for planning and management actions for sustainable lake use. A long-term, preventive approach for preventing the causes of degradation is essential.

Feasibility of in-situ treatment of treated sewage within drainage channels and prior to the inflow into the water bodies should be explored. In this regard, *insitu* drain treatment system of NEERI can be installed along the drain which treats the incoming sewage along its path to the river so that treated water enters the drain. Diversion of the effluent carrying drains to CETP and to stop their entry to the lake or river.

डॉ. शेक बाशा
Dr. Shaik Basha
वैज्ञानिक तथा प्रमुख / Scientist & Head

Stabilization of earthen bunds and the drainage channels: Stabilization of earthen embankments, shore line protection with vegetative or rock riprap to avoid soil erosion and the inflow drainage channels with the stone revetment or pitching should be done to prevent rapid seepage or leakages. The inflow drainage channel should be provided with suitable silt barriers or sediment traps or sediment detention basins at suitable intervals for control of silt especially during monsoon. Also, at the outfall of drainage channel, suitable strains or traps should be provided to control inflow of all the floating materials and periodic removal of floating materials should be ensured.

Removal of encroachments and blockades: The State Revenue Government should maintain records pertaining to the boundaries of river and lakes and necessary steps should be taken and ensured removal of all encroachments in the water body spread area/water body boundary as and when required. Removal of encroachments in the drainage channel should be carried out periodically to facilitates enhancement in aeration naturally in the water body. Grant of any consent for establishment of any industry/project in the catchment areashould be avoided by KSPCB.

Communication Education and public awareness: With the restoration of the river, it is imperative to bring in awareness about the importance of the water body to the mankind, amongst the public. The necessity of maintenance, from the human onslaught and destruction, of this restored water body area. Imparting education to children, about the ecology and environment of a river or lake system is important. Conduct Community education and participation, on various environmental aspects, to support and safeguard the water body.

डॉ. शेक बाशा
Dr. Shaik Basha
वैज्ञानिक तथा प्रमुख / Scientist & Head
सीएसआईआर-नीरी क्षेत्रीय केंद्र
CSIR-NEERI Zonal Centre
तारनाका, हैदराबाद / Tarnaka, Hyderabad-7

4.2 Concluding Remarks

The Vrishabhavathi river originates in Bengaluru and flows south–southwest for about 52 km before joining the Arkavathi river, which is a tributary of River Cauvery. It has two origins- one originating from the Peenya industrial suburbs and the other from Gavipuram in Guttahalli. Both the streams join together near Nayandahalli, flows as a single stream from there and ultimately joins the River Arkavathi. More than one third of Bengaluru city is located within the Vrishabhavathi catchment area. The current estimated generation of sewage from the city is 1440MLD, a third of which (~530 MLD) then drains into the Vrishabhavathi. Presently, Vrishabhavathi valley has sewage treatment capacity of 180 MLD (installed capacity) and construction of another 150MLD STP is in progress, which is expected to be completed in March 2021. With this, the total installed capacity will be 330 MLD. Still, there is a gap of 200 MLD (530-330), which need to be addressed immediately. Therefore, the entire sewage generated will be treated and the treated water after meeting the specified norms, may be released in to Vrishabhavathi.

It was observed during the field survey that the entire river stretches including various drains were filled with all types of solid waste including plastic waste. It is like that any waste that is too inconvenient to be thrown anywhere else finds its way into the Vrishabhavathi river banks. Even, the issue of garbage burning persists at many locations due to poor infrastructure and waste management in the city. BBMP should take a serious note on the solid waste management aspect and adopt various measures to address this issue. Apart from separate vehicles for segregated waste collection, there should also be a secondary waste collection method like public dustbins in every ward across the city. Installation of composters across the wards could help in processing wet waste, leaving with the collection of only dry waste. Installation of composters will resolve the issue of wet waste at the source itself.

In order to rejuvenate Vrushabhavathi River, the two main issues like disposal of effluents (both domestic and industrial wastewater) and solid waste are to be addressed on priority basis. The detailed rejuvenation plan shall be given in the final report, which will be submitted in due course of time.

आई.आई.सी.टी. परिसर, तारनाका, हैदराबाद - 500007, तेलंगाना राज्य, भारत IICT Campus, Tarnaka, Hyderabad-500007, Telangana State, INDIA
दूरभाष / Phone: +91-40-27160122, 27160441 टेलीफैक्स / Telefax: +91-40-27160639 ई-मेल / E-mail: hzl@neeri.res.in
डॉ. शेख बाशा
Dr. Shaik Basha
वैज्ञानिक तथा प्रमुख / Scientist & Head

Annexure – I

Format for collection of data

Vrushabhavathi Valley – Field Document

Date:

S.No.	Details	Description
1.	Sample Code of the drain	
2.	Zone in which the drain falls	
3.	Latitude/Longitude	
4.	Elevation (in m)	
5.	Flow of the drain	a. Distance: ; Time: b. Distance: ; Time: c. Distance: ; Time: d. Distance: ; Time:
6.	Type of surrounding area (buildings, roads, schools, temple etc)	
7.	Name of the area	
8.	Encroachment status of the drain	
9.	Solid waste dumping in the drain (yes/no)	
10.	Nature of discharge to drain (Domestic sewage/effluent/anything else)	
11.	Length of the drain	
12.	Type of drain (primary, secondary, tertiary)	
13.	Photographs taken (Yes/No)	

डॉ. शेक बाशा
Dr. Shaik Basha
वैज्ञानिक तथा प्रमुख / Scientist & Head
सीएसआइआर-नीरी क्षेत्रीय केंद्र
CSIR-NEERI Zonal Centre

सी.एस.आई.आर. - राष्ट्रीय पर्यावरण अभियांत्रिकी अनुसंधान संस्थान
CSIR-National Environmental Engineering Research Institute
(वैज्ञानिक तथा औद्योगिक अनुसंधान परिषद / Council of Scientific & Industrial Research)
हैदराबाद क्षेत्रीय केंद्र / Hyderabad Zonal Centre
(वैज्ञानिक तथा औद्योगिक अनुसंधान विभाग, विज्ञान एवं प्रौद्योगिकी मंत्रालय, भारत सरकार के अंतर्गत स्वायत्त संगठन)
(Autonomous Organization under the Dept. of Scientific and Industrial Research, Ministry of Science & Technology, Govt. of India)

Dasarahalli Zone (DH)

List of Plates

आई.आई.सी.टी. परिसर, तारनाका, हैदराबाद - 500007, तेलंगाना राज्य, भारत IICT Campus, Tarnaka, Hyderabad-500007, Telangana State, INDIA
दूरभाष / Phone: +91-40-27160122, 27160441 टेलीफैक्स / Telefax: +91-40-27160639 ई-मेल / E-mail: hzl@neeri.res.in

डॉ. शेक बाशा
Dr. Shaik Basha
वैज्ञानिक तथा प्रमुख / Scientist & Head
सी.एस.आई.आर-नीरी क्षेत्रीय केंद्र

सी.एस.आई.आर. - राष्ट्रीय पर्यावरण अभियांत्रिकी अनुसंधान संस्थान
CSIR-National Environmental Engineering Research Institute
(वैज्ञानिक तथा औद्योगिक अनुसंधान परिषद / Council of Scientific & Industrial Research)
हैदराबाद क्षेत्रीय केंद्र / Hyderabad Zonal Centre
(वैज्ञानिक तथा औद्योगिक अनुसंधान विभाग, विज्ञान एवं प्रौद्योगिकी मंत्रालय, भारत सरकार के अंतर्गत स्वायत्त संगठन)
(Autonomous Organization under the Dept. of Scientific and Industrial Research, Ministry of Science & Technology, Govt. of India)

डॉ. शेक बाशा
Dr. Shaik Basha
वैज्ञानिक तथा प्रमुख / Scientist & Head
सी.एस.आई.आर-नीरी क्षेत्रीय केंद्र
CSIR-NEERI Zonal Centre

आई.आई.सी.टी. परिसर, तारनाका, हैदराबाद - 500007, तेलंगाना राज्य, भारत IICT Campus, Tarnaka, Hyderabad - 500 007, Telangana State, INDIA
दूरभाष / Phone: +91-40-27160122, 27160441 टेलीफैक्स / Telefax: +91-40-27160639 ई-मेल / E-mail: hzl@neeri.res.in

सी.एस.आई.आर. - राष्ट्रीय पर्यावरण अभियांत्रिकी अनुसंधान संस्थान
CSIR-National Environmental Engineering Research Institute
(वैज्ञानिक तथा औद्योगिक अनुसंधान परिषद / Council of Scientific & Industrial Research)
हैदराबाद क्षेत्रीय केंद्र / Hyderabad Zonal Centre
(वैज्ञानिक तथा औद्योगिक अनुसंधान विभाग, विज्ञान एवं प्रौद्योगिकी मंत्रालय, भारत सरकार के अंतर्गत स्वायत्त संगठन)
(Autonomous Organization under the Dept. of Scientific and Industrial Research, Ministry of Science & Technology, Govt. of India)

डॉ. शेक बाशा
Dr. Shaik Basha
वैज्ञानिक तथा प्रमुख / Scientist & Head
सीएसआईआर-नीरी क्षेत्रीय केंद्र
CSIR-NEERI Zonal Centre
तारनाका, हैदराबाद / Tarnaka, Hyderabad-7

सी.एस.आई.आर. - राष्ट्रीय पर्यावरण अभियांत्रिकी अनुसंधान संस्थान
CSIR-National Environmental Engineering Research Institute
(वैज्ञानिक तथा औद्योगिक अनुसंधान परिषद / Council of Scientific & Industrial Research)
हैदराबाद क्षेत्रीय केंद्र / Hyderabad Zonal Centre
(वैज्ञानिक तथा औद्योगिक अनुसंधान विभाग, विज्ञान एवं प्रौद्योगिकी मंत्रालय, भारत सरकार के अंतर्गत स्वायत्त संगठन)
(Autonomous Organization under the Dept. of Scientific and Industrial Research, Ministry of Science & Technology, Govt. of India)

डॉ. शेक बाशा
Dr. Shaik Basha
वैज्ञानिक तथा प्रमुख / Scientist & Head
सीएसआइआर-नीरी क्षेत्रीय केंद्र
CSIR-NEERI Zonal Centre

आई.आई.सी.टी. परिसर, तारनाका, हैदराबाद - 500007, तेलंगाना राज्य, भारत IICT Campus, Tarnaka, Hyderabad-500007, Telangana State, INDIA
दूरभाष / Phone: +91-40-27160122, 27160441 टेलीफैक्स / Telefax: +91-40-27160639 ई-मेल / E-mail: hzl@neeri.res.in

सी.एस.आई.आर. - राष्ट्रीय पर्यावरण अभियांत्रिकी अनुसंधान संस्थान
CSIR-National Environmental Engineering Research Institute
(वैज्ञानिक तथा औद्योगिक अनुसंधान परिषद / Council of Scientific & Industrial Research)
हैदराबाद क्षेत्रीय केंद्र / Hyderabad Zonal Centre
(वैज्ञानिक तथा औद्योगिक अनुसंधान विभाग, विज्ञान एवं प्रौद्योगिकी मंत्रालय, भारत सरकार के अंतर्गत स्वायत्त संगठन)
(Autonomous Organization under the Dept. of Scientific and Industrial Research, Ministry of Science & Technology, Govt. of India)

डॉ. शेक बाशा
Dr. Shaik Basha
वैज्ञानिक तथा प्रमुख / Scientist & Head
सीएसआईआर-नीरी क्षेत्रीय केंद्र
CSIR-NEERI Zonal Centre
तारनाका, हैदराबाद / Tarnaka, Hyderabad-7

सी.एस.आई.आर. - राष्ट्रीय पर्यावरण अभियांत्रिकी अनुसंधान संस्थान
CSIR-National Environmental Engineering Research Institute
(वैज्ञानिक तथा औद्योगिक अनुसंधान परिषद / Council of Scientific & Industrial Research)
हैदराबाद क्षेत्रीय केंद्र / Hyderabad Zonal Centre
(वैज्ञानिक तथा औद्योगिक अनुसंधान विभाग, विज्ञान एवं प्रौद्योगिकी मंत्रालय, भारत सरकार के अंतर्गत स्वायत्त संगठन)
(Autonomous Organization under the Dept. of Scientific and Industrial Research, Ministry of Science & Technology, Govt. of India)

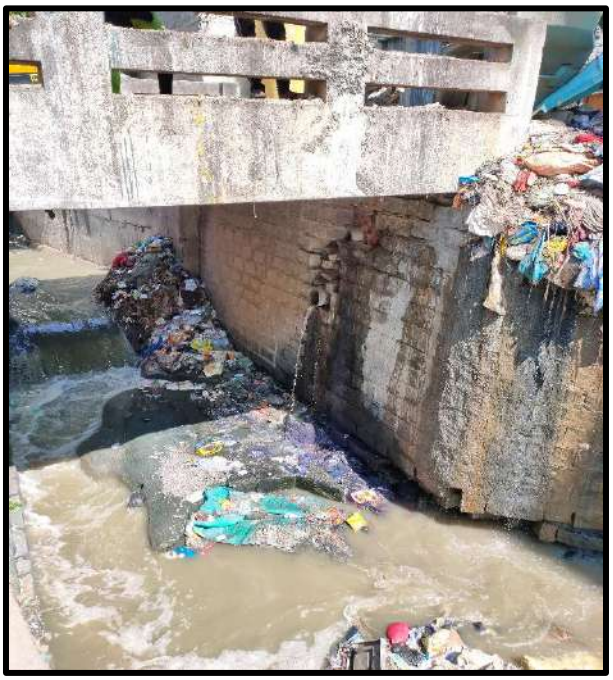
Vrishabhavathi Valley Zone






डॉ. शेक बाशा
Dr. Shaik Basha
वैज्ञानिक तथा प्रमुख / Scientist & Head
सीएसआईआर-नीरी क्षेत्रीय केंद्र
CSIR-NEERI Zonal Centre

सी.एस.आई.आर. - राष्ट्रीय पर्यावरण अभियांत्रिकी अनुसंधान संस्थान
CSIR-National Environmental Engineering Research Institute
(वैज्ञानिक तथा औद्योगिक अनुसंधान परिषद / Council of Scientific & Industrial Research)
हैदराबाद क्षेत्रीय केंद्र / Hyderabad Zonal Centre
(वैज्ञानिक तथा औद्योगिक अनुसंधान विभाग, विज्ञान एवं प्रौद्योगिकी मंत्रालय, भारत सरकार के अंतर्गत स्वायत्त संगठन)
(Autonomous Organization under the Dept. of Scientific and Industrial Research, Ministry of Science & Technology, Govt. of India)



डॉ. शेक बाशा
Dr. Shaik Basha
वैज्ञानिक तथा प्रमुख / Scientist & Head
सीएसआईआर-नीरी क्षेत्रीय केंद्र
CSIR-NEERI Zonal Centre
तारनाका, हैदराबाद / Tarnaka, Hyderabad-7

सी.एस.आई.आर. - राष्ट्रीय पर्यावरण अभियांत्रिकी अनुसंधान संस्थान
CSIR-National Environmental Engineering Research Institute
(वैज्ञानिक तथा औद्योगिक अनुसंधान परिषद / Council of Scientific & Industrial Research)
हैदराबाद क्षेत्रीय केंद्र / Hyderabad Zonal Centre
(वैज्ञानिक तथा औद्योगिक अनुसंधान विभाग, विज्ञान एवं प्रौद्योगिकी मंत्रालय, भारत सरकार के अंतर्गत स्वायत्त संगठन)
(Autonomous Organization under the Dept. of Scientific and Industrial Research, Ministry of Science & Technology, Govt. of India)

Bomanahalli Zone (BH)

आई.आई.सी.टी. परिसर, तारनाका, हैदराबाद - 500007, तेलंगाना राज्य, भारत IICT Campus, Tarnaka, Hyderabad-500007, Telangana State, INDIA
दूरभाष / Phone: +91-40-27160122, 27160441 टेलीफैक्स / Telefax: +91-40-27160639 ई-मेल / E-mail: hzl@neeri.res.in
डॉ. शैक बाशा
Dr. Shaik Basha
वैज्ञानिक तथा प्रमुख / Scientist & Head